IFERP®
connecting engineers... developing research

ICSTM

2nd INTERNATIONAL CONFERENCE ON SCIENCE TECHNOLOGY AND MANAGEMENT

VIRTUAL CONFERENCE

ICSTM-22

24th - 25th February 2022 Bangkok

Organized By

Institute For Engineering Research and Publication (IFERP)

ISBN : 978-93-92105-49-4

IFERP®
connecting engineers... developing research

ICSTM - 2022

2nd International Conference on

Science Technology and Management

Bangkok

24th – 25th February, 2022

Organized By

Institute For Engineering Research and Publication (IFERP)

www.iferp.in

Publisher: IFERP Explore

Editorial:

We cordially invite you to attend the **2nd International Conference on Science Technology and Management (ICSTM -22)** on **24th–25th February, 2022**.The main objective of **ICSTM -22** is to provide a platform for researchers, students, academicians as well as industrial professionals from all over the world to present their research results and development activities in Science Technology and Management. This conference will provide opportunities for the delegates to exchange new ideas and experience face to face, to establish business or research relationship and to find global partners for future collaboration.

These proceedings collect the up-to-date, comprehensive and worldwide state-of-art knowledge on cutting edge development of academia as well as industries. All accepted papers were subjected to strict peer-reviewing by a panel of expert referees. The papers have been selected for these proceedings because of their quality and the relevance to the conference. We hope these proceedings will not only provide the readers a broad overview of the latest research results but also will provide the readers a valuable summary and reference in these fields.

The conference is supported by many universities, research institutes and colleges. Many professors played an important role in the successful holding of the conference, so we would like to take this opportunity to express our sincere gratitude and highest respects to them. They have worked very hard in reviewing papers and making valuable suggestions for the authors to improve their work. We also would like to express our gratitude to the external reviewers, for providing extra help in there view process, and to the authors for contributing their research result to the conference.

Since December 2021, the Organizing Committees have received more than 80 manuscript papers, and the papers cover all the aspects in Science Technology and Management. Finally, after review, about 22 papers were included to the proceedings of **ICSTM -22**.

We would like to extend our appreciation to all participants in the conference for their great contribution to the success of **ICSTM-22** We would like to thank the keynote and individual speakers and all participating authors for their hard work and time. We also sincerely appreciate the work by the technical program committee and all reviewers, whose contributions made this conference possible. We would like to extend our thanks to all the referees for their constructive comments on all papers; especially, we would like to thank to organizing committee for their hard work.

Acknowledgement

IFERP is hosting the **2nd International Conference on Science Technology and Management - 2022** this year in the month of February. The main objective of **Science Technology and Management** is to grant the amazing opportunity to learn about ground breaking developments in modern industry, talk through difficult workplace scenarios with peers who experience the same pain points and experience enormous growth and development as a professional. There will be no shortage of continuous networking opportunities and informational sessions. The session will serve as an excellent opportunity to soak up information from widely respected experts. Connecting with fellow professionals and sharing the success stories of your firm is an excellent way to build relations and be known as a thoughtful leader.

I express my gratitude to all my colleagues, staffs, professors, reviewers and members of organizing committee for their hearty and dedicated support to make this conference successful.

Rudra Bhanu Satpathy
Chief Executive Officer
Institute for Engineering Research and Publication (IFERP)

(+91) 44 - 4958 9038
info@iferp.in
www.iferp.in
Rais Tower, 2054/B, 2nd Floor, 'L' West Block, 2nd Ave, Anna Nagar, Chennai, Tamil Nadu 600040, India

2nd International Conference on

Science Technology and Management

(ICSTM- 2022)

Bangkok

24th – 25th February, 2022

Keynote Speakers

Prof. Mudawi Mukhtar Elmusharaf
Professor,
The National Ribat University,
Khartoum, Sudan

Message

It is my honor and pleasure to welcome all the participants to **the 2nd International Conference on Science Technology and Management (ICSTM-22)** scheduled to take place on the **24th & 25th of February 2022 in Bangkok, Thailand** organized by **Institute For Engineering Research and Publication (IFERP).**

This two-day conference is expected to become one of the most important International events to bring out the latest trends in Multidisciplinary research and offer participants to interact with industry experts on the recent challenges in scientific research.

We hope that the **2nd International Conference on Science Technology and Management (ICSTM-22)** will provide you with state-of-the art and the opportunity to discuss various scientific issues and challenges with multidisciplinary aspects.

Welcome and greetings extend to those from different countries and nationalities who will attend this important scientific event.

Looking forward to seeing you in this important event.

Dr. Chanthiran Veerasamy
Group CEO
Nexus Ace Sdn Bhd, Malaysia.
HR Ace Solutions, Malaysia.

Message

It is a great honor for me to deliver, on behalf of Nexus Ace Sdn Bhd, a keynote speaker at this conference. I would like to first congratulate the **Institute for Engineering Research and Publication (IFERP)** in particular its organizing committee for the excellent arrangements for this **2nd International Conference on Science Technology and Management (ICSTM-22)** despite the current challenges which is scheduled to take place on the **24th and 25th of February, 2022** in the Stunning city of **Bangkok** organized by **Institute for Engineering Research and Publication (IFERP)**.

According to McKinsey talent experts Bryan Hancock and Bill Schaninger, COVID-19 added a new set of employee demands, such as juggling work and children at a period when school doors close abruptly, and dealing with the 24/7 aspect of working from home. These obligations also create additional challenges for CEOs and other leaders as they try to help overloaded workforces. This has profoundly shaken all organizations, creating a complex and challenging environment especially for managers and human resource management (HRM) practitioners who must devise innovative solutions to ensure the continuity of their businesses and assist their employees in dealing with this extraordinary crisis. I will be sharing more of these dynamic issues in the current working environment and how huge and small companies are changing their workflow process and adopting remote work strategies to maintain their competitiveness in the business fraternity.

Thank you very much for your kind attention and I hope the **2nd International Conference on Science Technology and Management (ICSTM-22)** will be a great success. Thank you.

ICSTM - 2022

2nd International Conference on
Science Technology and Management

Bangkok | 24th- 25th February, 2022

Organizing Committee

CONFERENCE CHAIRS

Dr. Lampong Klomkul Acting Director for Research, Information and Academic Services Division, ASEAN Studies Centre, MahaChulalongkornRajavidyalaya University, Bangkok, Thailand	**Dr shielilo R. Amihan** Cluster Dean Social Sciences and Humanities University of Perpetual Help System DALTA Calamba, Philippines

CONFERENCE CO-CHAIRS

John Edgar Sualog Anthony Dean College of Computer Studies Mindoro State University Oriental Mindoro, Philippines	**Dr. Chonlatee Photong** Associate Professor Faculty of Engineering Mahasarakham University MahaSarakham, Thailand
Dr Mohd Ramzi Bin Mohd Hussain Associate Professor Department of Landscape Architecture International Islamic University Malaysia (IIUM) Kuala Lumpur, Malaysia	**Dr. Sanya Kenaphoom** Associate Professor Faculty of Political Science and Public Administration, Rajabhat Mahasarakham University MahaSarakham, Thailand.

ORGANIZING SECRETARY

Dr.Fathmath Muna Director General Government of Maldives (civil service sector) Maldives Media Council, Maldives	**Dr Renjith V Ravi** HOD & Associate Professor Department of Electronics and Communication Engineering MEA Engineering College Kerala. India.
Dr.P.Selvaraj Professor Department of Electrical and Electronics Engineering S.V.Engineering College Andhra Pradesh, (INDIA)	**Hadi Erfani** Scientist Department of Chemical Engineering Islamic Azad University Iran
Dr. Osman Adiguzel Professor Department of Physics Firat University Elazig, Turkey	**Dr.Parames Chutima** Professor Department of Industrial Engineering Chulalongkorn University Bangkok 10330, Thailand.
Sumit Kumar Maitra Lecturer Electrical & Computer Engineering Wachemo University Hossana Ethiopia	

PROGRAM CHAIR

Paquito G. Fernando Jr Program Chairperson BS Computer Engineering, Mindoro State University-Bongabong Campus, Oriental Mindoro, Philippines	**Dr. Subarna Shakya** Professor Department of Electronics and Computer engineering Tribhuvan University Pulchowk Campus, Nepal

ORGANIZING COMMITTEE

CONTENTS

SR.NO	TITLES AND AUTHORS	PAGE NO
1.	Top Technological Trends in Fintech and Their Impact on the Financial Sector ➢ ***Prof. Dr. Yoser Gadhoum***	1
2.	Implementation of Factor Analysis in Education Industry ➢ ***Ritu Bhasin*** ➢ ***Vamsikrishna A***	10
3.	Slot Loaded Microstrip Triangular Patch Antenna for dual frequency applications in L and S band ➢ ***Manik Chandra Borah*** ➢ ***Parimita Saikia*** ➢ ***Anup Kr Bordoloi*** ➢ ***Bhairab Sarma***	14
4.	ASEAN and APEC Perspectives of Philippine ICT Roadmaps ➢ ***Ravenal A. De Jesus***	19
5.	Financial Literacy Web-based Learning Application Tool for Students of Higher Education Institutions ➢ ***Virgie Liza S. Mamauag*** ➢ ***Maricris M. Usita***	28
6.	The Effects of Muddy Terrain on Lower Extremity Loading During the Paddy Planting Activity ➢ ***Agung Kristanto*** ➢ ***Farid Ma'ruf*** ➢ ***Choirul Bariyah***	35
7.	Developing University Course Scheduling Model using Genetic Algorithm ➢ ***Hayati Mukti Asih*** ➢ ***Akhsanul Maulana,*** ➢ ***Raden Achmad Chairdino Leuveano***	42
8.	Graduates Employability Analysis using Classification Model: A Data Mining Approach ➢ ***Maricris M. Usita***	48
9.	Challenges and its ways to Cope up with New Digital Techniques in this Digital Supply Chain Management Era ➢ ***Ankita Maiti*** ➢ ***Rupesh Khare***	55
10.	SVM Hyperplane Misclassification Control by Finding Optimum Cost of Misclassification with Boundary Value Analysis Technique ➢ ***Kumar Gaurav Kapoor*** ➢ ***Avadhesh Kumar***	60
11.	Medical Images Augmentation via GAN Image patches segmentation using Yolo with Neural Style ➢ ***Kumar Gaurav Kapoor*** ➢ ***Avadhesh Kumar***	65

CONTENTS

SR.NO	TITLES AND AUTHORS	PAGE NO
12.	Development of Cost Planning Standards for Design Development, Sitework, and Structure for Stadium Area Works on Integrated Contracts for Main Stadium Building Based on Indonesian Minister of Public Works Regulation Number 22 of 2018 to Improve Cost Accuracy ➢ ***Siburian, Jonathan Hasian*** ➢ ***Latief, Yusuf***	68
13.	Land use and Climate Change Impact Assessment of Hydrological Characteristics of Addalam Watershed using Soil and Water Assessment Tool (SWAT) ➢ ***Sean L. Agbanlog***	76
14.	Yield Performance of Hybrid Glutinous Corn as Influenced by Third Generation Nutrition Bio-Fertilizer ➢ ***CIPRIANO M. TICMAN JR*** ➢ ***MARCIAL M. TICMAN***	83
15.	Growth and Yield Performance of Transplanted Sweet Corn Applied with Organic–Based Foliar Fertilizer ➢ ***ISAIAS C. DELA PENA***	90
16.	Increasing Success Rates of Capital Expenditure Procurement Process by Machine Learning Algorithms Development in Owner Estimate (OE) Price Analysis ➢ ***N H A Amiri*** ➢ ***M A Berawi*** ➢ ***M Sari***	95
17.	An Exploratory Research on Service Quality of the Urban Public Transport Companies and Sustainable City Logistics ➢ ***Kavita Sharma*** ➢ ***Sachin Sharma***	103
18.	Impact of Organizational Culture on Organizational Citizenship Behavior in IT Sector of India: An Exploratory Study using PLS-SEM ➢ ***Dr. Bhanupriya Khatri*** ➢ ***Dr. Harshita Shrimali*** ➢ ***Shaina Arora***	114
19.	The Impact of Human Resource Management Practices on Employee Retention ➢ ***Lwin, N.N***	127
20.	Employees Job Satisfaction and Retention at Workplace ➢ ***Htun, W.T***	131
21.	Integration of Technology Continuance Theory towards LMS acceptance after COVID 19 among Business Administration, Marketing, and Social Sciences Instructor ➢ ***Filipinas L. Bognot*** ➢ ***Adegbite Ganiu Adewale*** ➢ ***Solomon Ayodele Oluyinka***	135

CONTENTS

SR.NO	TITLES AND AUTHORS	PAGE NO
22.	Development Of Cost Planning Standard For Mechanical And Miscellaneous Work On Stadium Field Of Play Works In Integrated Contracts Of State Building Design Based On Indonesian Minister Of Public Works Regulation No 22 Of 2018 To Improve Cost Accuracy ➢ ***Pardamean, Yosua Manaek*** ➢ ***Latief, Yusuf***	146
23.	Swarm Intelligence Based Maze Solver ➢ ***Digya Acharya*** ➢ ***Pranish Bhagat*** ➢ ***Pratik Bhandari*** ➢ ***Sijan Bhattarai,*** ➢ ***Dinesh Baniya Kshatri***	152
24.	The Pattern of Principal Instructional Leadership at Indonesian Senior High Schools ➢ ***Rahayu, S*** ➢ ***Usman,H.*** ➢ ***Wibawa, S***	158
25.	Understanding the Importance of Project Planning and Scheduling in Indian Construction Projects ➢ ***Sagar Gaur***	166
26.	Strengthening Farmers' Social Capital to Build the Sustainable Agriculture in Tidal Swamplands, South Sumatra, Indonesia ➢ ***Bunaiyah Honorita*** ➢ ***Muhammad Yazid*** ➢ ***Riswani***	173
27.	Analysis of the Sustainability of Oil Palm Farming on Plasma Farmers in Sungai Lilin District Musi Banyuasin Regency South Sumatra Province Indonesia ➢ ***Destiya Rospiani*** ➢ ***Lifianthi*** ➢ ***Dwi Wulan Sari***	179
28.	Artificial Intelligence Trends and Ethics: Issues and Alternatives for Investors ➢ ***Prof. Dr. Yoser Gadhoum***	186
29.	The Impacts of the Covid-19 Pandemic on Developing Countries versus Developed Countries ➢ ***Prof. Dr. Yoser Gadhoum***	193
30.	A Pragmatic Strategy Approach to Optimize Performance of Parent Company and Its Business Entities through Policy Alignment ➢ ***Subramaniam Anbanathan*** ➢ ***Ernie Tisnawati Sule*** ➢ ***Nury Effendi*** ➢ ***Aldrin Herwany***	206

CONTENTS

SR.NO	TITLES AND AUTHORS	PAGE NO
31.	Quality Concerns in Higher Education with Reference to State Private Universities in Rajasthan, India ➢ ***J. Ernest Samuel Ratnakumar***	216

ICSTM -22

2nd International Conference on Science Technology and Management

Bangkok

24th – 25th February, 2022

PAPERS

ICSTM-22

Organized by

Institute For Engineering Research and Publication

Top Technological Trends in Fintech and Their Impact on the Financial Sector

Prof. Dr. Yoser Gadhoum
Institute of Strategic Studies on Governance, Former Dean of Research and Graduate Studies1, Prince Mohamad Bin Fahd University (PMU), KSA

Abstract
Fintech describes the technologies that seek to enhance and automate the delivery of financial services in the finance industry. At its core, fintech is used to help the financial sector better manage its financial procedures and operations by leveraging the specialized algorithms and software used in smartphones and computers. With the constant rise in technological innovations every year, the fintech industry has become the fastest-growing industry in the world. During the coronavirus in 2020, the digital transformation went to new heights as people shifted towards easier options that meet their financial needs. Fintech apps have helped improve customers' access to financial services at their comfort, but their demand is not yet over and continues to increase, further welcoming new technology trends that help to shape the industry. With many people moving towards digital solutions to manage their financial needs, stiff competition among financial institutions is expected to increase. Furthermore, banks and other financial institutions are adopting new ways to improve their banking experience. As a result, they have had to jump on the latest fintech trend to help them sustain a competitive advantage. The paper addresses major fintech trends, including Artificial Intelligence, blockchain, and partnerships, their benefits, and their impact on the finance industry.

Keywords
Fintech, Artificial Intelligence, Blockchain, Biometrics, Crypto market, Voice Banking

INTRODUCTION

Money has always been people's major priority, and since it is an important medium of exchange, individuals always have been skeptical about trusting others (banks) to provide safety for their money. Currently, almost two billion people worldwide do not have access to a bank account (Thinks Mobility 2021). However, financial services in 2020 were characterized by a sudden acceleration in "digital engagement" and digitization influenced by the effects of the coronavirus pandemic (Rowe 2021). Exchanges halted their trading floors and relied on remote trading to meet government movement restrictions and work from home measures. Personal trading apps recorded high transaction volumes, mobile banking transactions increased, and call center employees kept clients' support active by working from their homes, as directed by various governments worldwide. It was clear that financial institutions were required to modernize their architecture and systems to satisfy the rising consumer demands and increase data volume. Even when the financial sector was able to withstand the "digital tsunami" and continue with its operations, it became apparent that the "winds of change" were not temporary (Rowe 2021). Financial institutions have started thinking strategically about their technological situation and inquiring whether the tools they used previously are the most effective ones to implement going forward. Majority of the companies in the banking and finance industry have already spent most of their times digitizing core services and products to future proof their firms by improving their digital presence. This paper will analyze the technological trends that are likely to dominate the fintech industry as well as their impacts.

1. Artificial intelligence

In 2016, "AlphaGo," a machine, defeated Lee Sedol, the 18-time (eighteen-time) global champion at the game of Go. Since then, artificial intelligence (AI) technologies have progressed more, and their transformative nature has been witnessed across various industries (Biswas et al 2021.). Artificial intelligence is defined as an intelligent system developed to use and assess data and involve the performance of specific tasks minus the need for programming (Mhlanga 2020). AI-powered machines play a key role in targeted marketing, designing clothing lines, and surpassing experienced physicians in cancer detection. McKinsey estimates that AI technologies have the potential of delivering up to $1 trillion in extra value every year (Biswas et al.2021). However, many banking institutions have found it difficult to scale AI technologies across their operations because of fragmented data sets, unclear strategies for AI, outdated operating models, and investment-starved technology cores. To compete successfully and prosper following the coronavirus pandemic, incumbent banks now need to adopt AI technologies as the basis for unique customer experiences and new value propositions. The technologies can result in higher automation in the banking system, improving human decision-making capabilities in terms of accuracy and speed. Figure 1 displays some of the ways banking institutions are using AI to improve their operations.

Artificial intelligence technologies can aid to increase revenues through improved personalization of customer services. Combining relevant information such as customer's financial status, consumption preferences, behavior patterns, and financial status, AI can help realize the accurate position of client's needs, develop customer portraits, and predict customer needs (Li et al. 2021). AI will help decrease costs through competencies generated by automation, decrease error rates, and uncover new unrealized opportunities. More broadly, disruptive artificial intelligence technologies can significantly enhance the bank's ability to attain important outcomes: unique omnichannel experiences, at-scale personalization, rapid innovation cycles, and higher profits (Biswas et al 2021.). Financial institutions that fail to implement AI technology to their core operations and strategy will risk losing their competitive advantage and lose customers to the competition.

According to a report by Gartner, in 2019, 40% of major companies were expected to adopt AI technologies by 2020, and more than half of the companies that had implemented the AI solutions would double them by 2020 (Gartner 2021). While the coronavirus pandemic impacted these estimations, it is clear that Artificial Intelligence is now an important "player" in the finance industry. Already, AI is being used by some companies in the finance industry, and the technology has transformed the industry in the following ways:

1.1 Personalized banking

Many people believe that the banking industry was falling behind other industries when it came to customer service and satisfaction. The days of "face-to-face transactions" are long gone, as customers are relying on digital platforms for banks on customer support, and the banking industry is finally catching up. Chatbots and live chat technologies have become the primary contact point for clients seeking customer support (NEC 2021). Advanced chatbots integrated with "deep learning" abilities have enabled them to learn and improve customer service through customer conversations. One bank in Singapore, OCBC, partnered with Google to launch the first-ever AI-powered voice banking could converse with customers on a number of banking services, including calculating mortgage loans, foreign exchange rates, and unit trust prices (Nikolova 2018). Furthermore, many banks have been able to provide personalized financial guidance through mobile apps. These AI-powered applications can help manage expenses, spending behavior and income, and financial strategies and propositions. Mobile banking applications can also remind customers to conveniently pay bills, complete transactions, and interrelate with their respective financial institutions.

1.2 Fraud prevention

Digital transactions have increased significantly in recent years, necessitating appropriate fraud detection tools to safeguard sensitive financial data. According to a report by IBM 2021, 72% of influential business leaders believe that fraud has been a major concern for the 12 months. Artificial intelligence can be used to examine a huge number of transactions to uncover fraud trends that can be used to detect fraud in real-time. When fraud is detected, AI models are then used to flag or reject transactions for further investigation. Improved fraud detection and prevention offers an opportunity for financial service institutions providing virtual payment options and credits cards to use Artificial Intelligence-powered algorithms to detect stolen cards activities (Lappetito 2021).

1.3 Reliable risk management

AI plays an important role in managing risk efficiently. Its algorithms can be used in risk assessments to examine a case history and determine any probable issues. This involves adopting "machine learning" to develop models that allow financial professionals to follow certain tendencies and notice potential risks (NEC 2021). Risk assessment in accounting is a complex issue that, even with experts, manual errors are still prone to happen. Strict protocols usually govern financial institutions, and guaranteeing compliance when dealing with securities, debt, and insurance can be difficult. In such instances, AI can be employed to improve risk assessments by introducing "systemized" models that decrease manual error (Figure 1).

Fig 1: Banks using AI to improve operations (Biswas et al.)

2. BlockChain

Blockchain is a concept that has garnered significant attraction in "financial technology" (fintech 2021). This concept combines various computer technologies, including point-to-point transmission, distributed data storage, encryption algorithms, and consensus mechanisms (Guo and Liang 2016). Blockchain technology has also been described as a "disruptive innovation" that resulted from the advancement in the internet. However, since blockchain has been a breakthrough in information transmission and data storage, it is expected to transform the current economy and finance operating models, resulting in new technological innovations in the fintech industry (Guo and Liang 2016). Blockchain attracts attention, since it is a core technology for cryptocurrencies such as bitcoin and is perceived as the new basis for transactions in the world. It is an uninterrupted account database that is distributed and unchangeable (Chang et al. 2020). The most important advantage of blockchain is a "decentralized system" with a long security chain that cannot be altered or broken. Therefore, the blockchain provides the following benefits: removing third parties who facilitate transactions, reducing trading costs, and decreasing transaction time. Given the promise of such technology,

many financial institutions are investing in blockchain solutions because they have a huge opportunity to disintermediate key services that financial institutions provide, including facilitating payments and loans and credit.

2.1 Facilitating payments

Blockchain technology guarantees to facilitate fast and low-cost global payment process services through its secure distributed ledgers that eliminate intermediaries (Faden 2021). Sending a global payment through normal banking methods is often a sophisticated and expensive process involving many third parties. For instance, if Firm 1 in France wants to pay Firm 2 in the United States, Firm 1 asks its France bank to send an overseas payment. The France bank allies with a correspondent bank in the USA to facilitate the payment, and then the money is transferred to Firm 2's bank account. Every step in this process necessitates time and more money to be completed, establishing a frustrating and overpriced bottleneck. Blockchain solves this problem by restructuring the process of sending money and storing each transaction in a safe "distributed ledger". When a transaction is logged, the recipient immediately gets access to the money without delays and fines. In addition, once payment is made, it cannot be altered in the distributed ledger or reversed, fostering a sense of security and accountability. The best examples of blockchain technologies are cryptocurrencies such as ether and bitcoin, developed on public blockchains where anybody can send and receive money. These public blockchains eliminate the need for third parties such as banks to verify transactions and provide the customer with cheap and fast borderless payments (CB Insights 2021). For instance, Bitpesa is a company in East Africa that uses blockchain technology to facilitate payments in Uganda, Nigeria, and Kenya, eliminating more than 90% of transfer fees in East Africa.

2.2 Loans and credits

Blockchain technology plays an important role in assessing credit risk in customers (borrowers) (Kumar 2021). When customers fill out an application for a loan at a bank, the bank has to assess the risk that the customer would not payback. They accomplish this by assessing factors such as the "credit score, homeownership status, and debt-to-income ratio" (Kumar 2021). Based on this information, lending institutions risk a default into interest and fees collected on loans. This system is harsh to customers, as it can have "material error" in people's credit scores affect their ability to apply for loans. Therefore, blockchain technology could provide a cheap and efficient way of making personal loans easy to access. Through a decentralized ledger, banks could easily provide and approve loans depending on a global score. One company that uses blockchain technology to provide loans and credit is SALT Lending. It provides a platform where its users can request a loan by using cryptocurrency or a digital asset as collateral (Frankfield). Loans are approved depending on the collateral's value and not the customer's credit score. As seen in Figure 2, the Bloom protocol based on blockchain technology issues a credit card and loans depending on a track record of "successful identity attestation" without the need for third parties (CB Insights 2021).

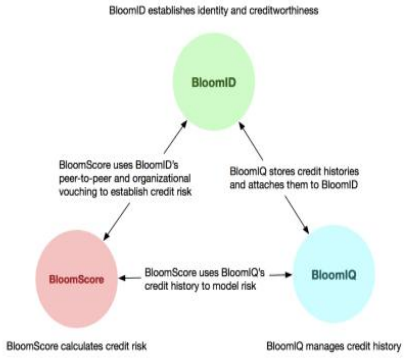


Fig 2: Bloom Protocol (CB Insights)

3. Bank and fintech collaboration is becoming mainstream

The relationship between banks and fintech has evolved for several years, with the recent focus being on partnerships and collaboration (Fintech Talents 2021). Although partnerships between banks and fintech have not been easy, many have learned from previous experiences and positioned themselves to collaborate and partner. During the coronavirus pandemic, almost every industry had to pivot in different ways so as to adapt to the challenges brought by the pandemic. Financial institutions were most affected by people shopping, banking, and working from home because of social distancing. The global pandemic had increased the shift to digital payment and commerce, in some cases substituting the merchant and the retail experience altogether. This is because fintech businesses had to function and work in different stages of lockdown while meeting customers' financial needs. As a result, banks and fintech needed pivots (partnerships) to survive the tough economic situations during the coronavirus pandemic. A bank-fintech partnership is an arrangement whereby a fintech company provides loan servicing, administration, or other services to enable the bank to provide tech-enabled banking services and products (Holzel and Stern 2021).

Multiple global developments have created a clear need for forming partnerships (van der Kroft 2021). Fintech companies corporated with banks mainly because of the following reasons: (1) banks have a stable and well-defined customer base; (2) forming a partnership with a bank is a sign of credibility; (3) banks usually have bigger investment budgets that could be used in developing fintech services, and (4) banks tend to possess a lot of knowledge in areas such as regulatory and legal compliance that fintech companies can benefit from. On the other hand, the key driver for banks to partner with fintech companies are that customers are used to seamless digital experience and expect their banks to provide digital services. In addition, because of the emergence of one-stop shops, fintech firms have shifted from being single service providers to offer a broad range of services. The

benefits that have emerged from the partnerships between banks and Fintech include:

i. ***Building up a brand reputation:*** If either the bank or the Fintech Company has an excellent reputation, it is likely that the reputation can be passed down to the other partner when the two companies come together (Raspa 2021). For instance, if a bank is known to have excellent customer satisfaction, it is likely that these reputation would be passed down to its Fintech partner.

ii. ***Offering more features to clients:*** The partnership formed between a bank and a fintech company enables the bank to provide to its customers' important functions and features such as mobile check deposits and money management tools, which it could not provide,

iii. ***Increased ease-of-use:*** When a bank partners with a fintech firm, it benefits from the firm's technological prowess and starts providing consumers with programs that are easy to use.

iv. ***Broadened consumer base:*** Through a partnership, both a fintech company and the bank can access each other's existing user base, enabling them to expand their market shares to reach new customers.

v. ***Reduce costs:*** Banks will spend less when working with fintech companies and leveraging their technological capacities, unlike finding ways to enhance their services on their own.

vi. ***Ability to scale quickly:*** Partnerships formed between banks and fintech firms can easily be scaled depending on the consumer requirements. If the partnership is successful, the two companies can find more ways to add more features or services while improving their relationship.

4. Google Cloud for Financial Services

Like any sector, financial institutions face several challenges like managing risk, providing great customer experiences, and striving for profitability and growth (Shaukat 2021). However, they also struggle with changing market forces and regulations. As a result, a number of financial institutions have turned to the cloud for their services. Historically, financial institutions were reluctant to turn to the cloud because of compliance and security concerns. However, the coronavirus pandemic and changing consumer expectations forced the financial industry to rethink its business models. Currently, many financial services companies that were shy to move to "the cloud" have become "cloud champions" after realizing the prospects of cloud computing in terms of security and compliance, and scalability. Financial institutions worldwide are now choosing "Google Cloud Platform 2021" to manage their business operations, guaranteeing resilience and success in the post-pandemic world (Lehman 2021). The following are some of the ways Google cloud is transforming the financial sector.

4.1 Faster insights

Financial institutions handle and store a huge amount of data, including user data and other unstructured data collected from the internet (Lehman 2021). The major impact of the Google cloud platform in the financial industry is when companies can access the correct information whenever they need it and act intelligently on the information. Google cloud helps financial institutions safely retrieve and store their data that was previously scattered across various systems. This helps financial companies enhance their overall user experience and, at times, create new products quickly. Financial companies are looking for ways to decrease expenses and grow their revenue, and data could be a key ingredient to achieving this goal. As daily transactions keep rising, so does the volume of data. To implement new user experience innovations, financial institutions are required to store user data effectively. For instance, AXA Switzerland uses real-time Google Analytics to better insight into customer preferences to tailor their needs effectively.

4.2 Compliance and regulatory needs

Financial services focus on compliance and security, regulations, and risk and fraud detection since they are highly regulated. Google Cloud offers a secure foundation that financial institutions can verify as well as an independent control. The technology decreases data loss and security risks since it is developed on a complex zero-trust architecture (Google Cloud 2021). Furthermore, within the Google Cloud platform, more than 750 full-time security professionals work on the platform applying various security practices, ranging from audit trails to physical data access. These security features are needed to meet the best compliance and practice certificates audits that are important in the financial service, making "Google Cloud 2021" a secure platform.

4.3 Customer support services

In the financial sector, downtime can result in millions of dollars in losses, even if the downtime lasts for a minute. Google Cloud provides "Mission Critical Services," a unique consultative service for premium support customers who handle peak traffic loads. This service is a consultative offering that helps financial institutions solve any issue with their traffic as soon as possible to avoid any losses (Condon 2021).

5. Robotic process automation (RPA)

Robotic process automation (RPA) is used in the financial sector to automate the manual business functions in financial institutions to remain competitive in today's dynamic business environment. Retiwalla 2021 defines RPA in banking institutions as using Artificial Intelligence and robots to replace manual human functions in banking. The rise of cryptocurrency, digital banking solutions, and mobile payments forced major bank institutions to adopt new technologies so as to provide a better customer experience and sustain their competitive advantage. The financial sector jobs involve analyzing huge amounts of data, handling repetitive tasks, and ensuring compliance, making RPA and financial institutions a perfect match. Automation in financial institutions is when a company uses software to decrease or eradicate manual functions in financial-related processes such as payroll, journal entries, accounts reconciliation, and expense management.

A good example where RPA can be effective in finance and accounting is when filling property tax returns. Property tax returns involve hundreds or thousands of forms that would make them difficult to complete. However, through automation, filing for property tax returns would be much easier since the software is able to retrieve and fill relevant data. As a result, the bank is able to save time and costs by automating the process of filing returns. With several repetitive and mundane tasks solved through automation, RPA has a profound impact on the financial sector in allocating scarce resources efficiently, decreasing costs, improving customer experience, and transforming some banking processes (International Banker 2021). Some of the banking processes that RPA would transform in the financial sector include:

5.1 Mortgage lending

Currently, mortgage lending is a time-consuming one requiring the need for automation (Kaur 2021). Loan borrowers must send several documents electronically to the bank offices, which the lending department then verifies. The verification process involved several repetitive functions, such as assessing and confirming data accuracy from identity to assets. Through capabilities such as screen scraping rules application and optical character recognition, RPA is able to perform the review and verification process effectively. In addition, the RPA can alert borrowers on the state of their application process without the need to visit the bank offices frequently. RPA will enable the bank's lending team to focus on handling exceptions, especially when documents are forged or of poor quality. Human intervention is then used to provide the quality assurance needed to approve the whole process

5.2 Efficient allocation of resources

RPA and automation will change the financial industry by liberating the staff from complex and repetitive tasks so as to focus more on value-added tasks (Kosmopoulos 2021). Robotic process automation is a proven solution to help the financial industry perform repetitive tasks quickly and with higher performance output by decreasing human error. With more employees free from mundane tasks, the management could allocate more resources to other tasks that require employees to provide analytical insight to drive key business objectives.

5.3 *Automatic report generation*

The standard requirement for any bank when there is a form of any suspicious or fraudulent activities is to generate compliance reports, also known as suspicious activity reports, that have to be analyzed by the compliance officers (Kaur 2021). These reports are read and filled manually, and in the case of severe fraudulent activities, they can be extremely cumbersome and time-consuming to fill. However, when this process is automated, the entire process can be completed at ease, saving time and money.

5.4 Faster customer onboarding

One of RPA's main objectives across the financial industry is enhancing customer experience. Customer onboarding has always been a major challenge for companies in the financial sector. This has been attributed to compliance issues, inadequate resources, manual effort, and secure onboarding demanding significant time. For instance, in a recent study carried out by Deloitte, onboarding new customers in the banking industry takes between 20 to 90 days, causing $25,000 in losses because of delays (Deloitte 2021). Financial institutions can automate their functions with robots to address the loss of revenue and improve the client onboarding cycle. Common onboarding processes that RPA can automate include customer information verification, background checks, and contract management.

6. Biometric identification

The introduction of "biometric" identification has affected many businesses, including financial and banking services. The insurance, financial services, and banking world are built on complex state and federal laws and risk management. With security threats always evolving in this field, the use of biometrics is on the rise in the financial industry. It is estimated that the biometric market in the financial industry in the United States alone is at $999.3 million (Global Industry Analysis 2021). The coronavirus pandemic changed the normal daily lives of many people more than they could have imagined. Suddenly, customers could not be able to visit their bank branches, and some could not speak to representatives or open banks. The financial industry needed a "security solution" that could be deployed fast and remotely – authenticating people's identities from their homes so that they could proceed with their banking activities without risking their health from the coronavirus. Flexible facial recognition software that had the ability to function on a customer's device found its way to the financial industry (Huang 2021). Using highly tested Artificial Intelligence algorithms, facial recognition software has been demonstrated to be safer than passwords and cards that can be stolen or lost. Some forms of identification like passwords are easy to counterfeit, leading to the increase in identity theft experienced today.

6.1 Benefits of biometric identification

Biometric banking is all about establishing the balance between security and convenience. For banking at home, whether it is through the bank's website or phone, security questions and passwords are being replaced by biometric solutions such as "voice verification" (Grant 2021). Mobile banking tends to feel like an examination, especially when a customer is asked security questions that they have forgotten. Voice verification easily bypasses this problem and offers total guarantee to the bank representative that the person on the phone is precisely who he claims to be. Voice recognition allows the customer to make a quick call without any hindrance or delay from security questions. Unlike passwords that can be stolen and documents that can be counterfeited, a person's voice is unique and cannot be altered. Voice verification technologies are becoming

sophisticated and thus a great tool to use in security-conscious sectors such as finance.

Today's voice technologies are able to determine spoken words, tone, and cadence in a voice. When a customer calls the bank, voice biometric authentication can be deployed quickly rather than the customer having to answer many questions such as "What is your account number? When was your last deposit?" Since every person has distinct characteristics and behaviors associated with their speech, their voice can function as an audio fingerprint (Boukadakis 2020). Financial institutions can deploy an audio fingerprint to prove beyond any reasonable doubt that the person on the phone is who they say to be. By eradicating unnecessary interrogation, bank representatives can immediately provide assistance as they begin the call on a good note. For cashless transactions, "biometric technologies" imply replacing the customary PIN code with facial recognition technology (Grant 2021). One of the major concerns facing customers today is the thought that someone who knows their PIN code might steal their debit card and withdraw a significant amount of money from their account. New biometric technologies have introduced facial recognition technologies that require an iris scan before one completes a transaction.

6.2 The future of biometric identification

The risks of entering physical banks are still high for both employees and customers because of the ongoing coronavirus pandemic. While the health risks of entering financial institutions will end in the coming future, a new trend of "branchless banking" is taking hold. Clients have now developed a preference to manage their banking activities through websites and apps to decrease the rates of visiting physical banks (Phaneuf 2021). Therefore, the need for remote and secure authentication is definitely here to stay. In addition, legacy security processes that are often expensive have added more reasons for banking institutions to embrace biometric technologies. Some major banking institutions have reported spending about $500 million per year on customer due diligence and KYC processes, a figure that is expected to decrease as facial recognition technologies are expected to replace inefficient identification processes. (Thompson Reuters 2016). Consumers are eagerly waiting for the future where brokerage and opening a bank account do not require cumbersome identity checks and passwords that require special characters and alphabets. Financial institutions quickly adopt new and affordable security solutions, satisfy government legislation and satisfy customer needs (Huang 2021). Facial and voice recognition are entering the financial industry expected to check all these boxes.

7. Open banking

Open banking is a trend whereby customers allow third-party providers to access their financial information in the financial institutions to inform new services and products using technology known as "Application Programming Interfaces" (APIs), (Chuard 2021). Open banking has established an exciting scheme whereby all banking information from companies and customers is readily available for access to financial providers and potential lenders. The basic assumption of Open Banking is that information and data held by financial institutions such as banks belong to the client and not the institution. If a client wants to use his information and data to gain better financial services and products, it is within their rights to use their data as per their wish (Ndinga2021). Information such as credit scores, financial transactions, bank statements, and income are made available through APIs that bypass customary financial networks. For consumers and financial providers, open banking provides many benefits, including request to pay, faster payments, fast-tracking mortgages, savings, and new opportunities for merchants.

7.1 Request to pay

One of the major applications of open banking is the request to pay (RTP) function that allows customers to request payment from their bank accounts (Peplow 2021). Even though customers can make a real-time payment using mobile banking, "Request to Pay" is revolutionizing regular payments and invoicing, which is advantageous to self-employed business owners and merchants debtors get a notification of the amount they owe, whereas payees can tract their invoices and bills on the same device, providing them an efficient and straightforward way of reconciling their accounts.

7.2 *Faster payments*

The future of open banking lies in the ability to process and make payments faster (Tutors Lodge 2021). When a customer's financial information is readily available, it becomes easy for lenders and finance providers to process car finance or personal loans. This is because customers can not obscure their financial position or income since it is readily available from the bank. However, the only thing preventing this mode of payment from going mainstream is some clients' reluctance to share their financial information openly.

7.3 Fast-tracking mortgages

The use of "open banking" is an exciting prospect for home loans and mortgages (Tutors Lodge 2021). When a customer applies for a mortgage loan, they go through a cumbersome process as they are supposed to provide their bank statement and financial documents, making it a long and time-consuming process. Through open banking, lenders and financial providers will be able to access customer information at easer to determine whether they qualify for a loan or not.

7.4 Savings and new opportunities for merchants

Accelerating the adoption of open banking are the cost savings benefits it has for merchants. Open banking eradicates the risk of mishandling money, and the low transaction costs from online purchases have made open banking attractive to business owners. The coronavirus pandemic saw most people shift towards online shopping for retail purchases. As more customers prefer to shop online, open banking could make non-banking companies become major financial-service players. With digital adoption expanding, many e-commerce companies would accumulate

a significant lead in client attention. This would open the possibility that e-commerce giants would be the first companies to provide new financial services and products to their customer base, similar to what Google is doing with its "Plex product" (Asif et al.2021)

8. Personalization

Financial institutions have been targeting customers and tailoring services to them for years before the age of mass marketing (Brodski et al.2021). The banking business was highly personal as loans were processed through handshakes, and tellers knew almost every customer who came in. Today, advancements in technology have enabled credit unions and banks to recognize their customers' interests and preferences. Until recently, these capabilities have been important to help banks differentiate their services, gain a competitive advantage and build customer engagement. However, this advantage is now being eroded as financial institutions are being leapfrogged by technological companies and retailers that put personalization at the core of their business strategies to attain significant performance gains. Similar to how these technology companies have been able to craft recommendations, financial institutions will be able to employ analytics and data to anticipate customers' needs as well as establish relationships.

Personalizing in financial industries such as banking is about delivering a product or a service to customers based on their historical data and personal experiences (Marketing Evolution 2021). Personalized banking is a journey with the client in focus. Getting closer to clients means meeting them, understanding their goals, and offering advice. As financial institutions are entering the post-pandemic world, they are likely to face a dynamic consumer landscape. Consumer expectations have changed, and achieving personalization will become a major challenge for financial institutions in the coming years. Therefore, to stay competitive in the financial sector, firms need to personalize their services towards meeting the needs of the consumers. The needs of consumers do not mean selling a service to the consumer but providing one before the consumers know they need it.

Personalization can help in fraud detection, especially when customers are not aware (NCR 2021). For instance, if a customer withdraws the maximum amount from the ATM two days consecutively or transacts in a different location than they have never transacted before, a bank can assess their customer behavior and send an SMS notification in real-time to validate the transactions. As a result, a customer will feel like the bank knows them and protects their money through personalization. Aside from fraud detection, great personalization has the following benefits, according to Rausch 2021:

i. It aids to foster coherence across service and product groups (credit cards/savings accounts, personal/housing loans, etc.), offering a consistent experience.
ii. It allows progressive profiling of clients to enable targeted offerings.
iii. It improves the brand appeal
iv. It helps identify new solutions that drive incremental growth

SUMMARY AND CONCLUSION

The aim of this research paper was to determine the Fintech trends currently shaping the finance industry and their impact. Fintech describes the technologies that seek to enhance and automate the delivery of financial services in the finance industry. At its core, Fintech is used to help the financial sector better manage its financial processes and operations by leveraging the specialized algorithms and software used in smartphones and computers. Fintech mobile applications have helped improve customers' access to financial services at their comfort, but their demand is not yet over and continues to increase further, welcoming new technology trends that help to reshape the industry.

Since 2020, financial services were subject to an abrupt acceleration in digital engagement and digitization influenced. The post coronavirus pandemic has required the financial industry to accelerate the adoption of various technologies and trends that will either improve their customer experience (less cost, less transaction time, more diversified investments) or sustain their competitive advantage more volume of transactions, better reactivity, and higher economy of scope).

With many people moving towards digital money to manage their financial needs, stiff competition among financial institutions is expected to increase to be very high. Innovation in digital solutions and investor satisfaction are of a paramount challenge in the financial sector landscape. The trends discussed in the paper include Artificial Intelligence (AI), Blockchain, Bank and Fintech Collaboration, Robotic Process Automation, Open banking, Biometric Identification, and Personalization. These trends were assessed in detail, with several examples related to them being provided and their impacts were discussed. It is evident that in the future, we will have a higher and a less risker digital solutions among the crypto communities. Fintech companies are playing a key role in improving customer experience through automating more and more financial services. Investors are more and more digital money literate and their risk aversion to the new digital services would decrease.

REFERENCE

1. Asif, Chandana et al. "Financial Services Unchained: The Ongoing Rise of Open Financial Data". *Mckinsey*, 2021, https://www.mckinsey.com/industries/financial-services/our-insights/financial-services-unchained-the-ongoing-rise-of-open-financial-data. Accessed 26 Nov 2021.
2. Biswas, Suparna et al. "AI-Bank of the Future: Can Banks Meet the AI Challenge?". *Mckinsey*, 2020, https://www.mckinsey.com/industries/financial-services/our-insights/ai-bank-of-the-future-can-banks-meet-the-ai-challenge. Accessed 26 Nov 2021
3. Boukadakis, Michael. "Voice Biometrics Are Ready for Prime Time in Banking". *Finextra Research*, 2020,

https://www.finextra.com/blogposting/20329/voice-biometrics-are-ready-for-prime-time-in-banking. Accessed 26 Nov 2021
4. Brodski, Sonia et al. "What Does Personalization in Banking Really Mean?". *BCG Global*, 2021, https://www.bcg.com/publications/2019/what-does-personalization-banking-really-mean. Accessed 26 Nov 2021
5. CB Insights. "How Blockchain Could Disrupt Banking". *CB Insights Research*, 2021, https://www.cbinsights.com/research/blockchain-disrupting-banking/.
6. Chang, Victor et al. "How Blockchain Can Impact Financial Services–The Overview, Challenges and Recommendations From Expert Interviewees." *Technological Forecasting and Social Change*, vol. 158, 2020, p. 120166.
7. Chuard, Max. "What Open Banking Needs to Become the Future of Banking". *World Economic Forum*, 2021, https://www.weforum.org/agenda/2021/04/open-banking-future-of-finance/. Accessed 26 Nov 2021
8. Condon, Stephanie. "Google Cloud Launches Mission Critical Services for GCP". *Zdnet*, 2021, https://www.zdnet.com/article/google-cloud-launches-mission-critical-services-for-gcp/. Accessed 26 Nov 2021
9. Deloitte. "Automation in Onboarding and Ongoing Servicing of Commercial Banking Clients: Streamlining Processes and Costs With Robotic Process Automation (RPA) and Cognitive Technologies". *Www2.Deloitte.Com*, 2021, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/financial-services/us-cons-automation-in-on-boarding-and-ongoing-servicing-of-commercial-banking-clients.pdf. Accessed 26 Nov 2021
10. Faden, Mike. "Benefits of Blockchain: Faster Payment Processing". *Americanexpress.Com*, 2021, https://www.americanexpress.com/us/foreign-exchange/articles/blockchain-to-accelerate-payment-processing-services/. Accessed 26 Nov 2021
11. FinTech Talents. "New Trends for Bank and Fintech Partnerships". *Fintech Talents*, 2021, https://www.fintechtalents.com/new-trends-for-banks-and-fintechs/. Accessed 26 Nov 2021
12. Gartner. "Gartner Says 70% of Organizations Will Shift Their Focus From Big to Small and Wide Data By 2025". *Gartner*, 2021, https://www.gartner.com/en/newsroom/press-releases/2021-05-19-gartner-says-70-percent-of-organizations-will-shift-their-focus-from-big-to-small-and-wide-data-by-2025. Accessed 26 Nov 2021
13. Global Industry Analysis. "Biometrics for Banking and Financial Services - Market Study By Global Industry Analysts, Inc.". *Strategyr.Com*, 2021, https://www.strategyr.com/market-report-biometrics-for-banking-and-financial-services-forecasts-global-industry-analysts-inc.asp. Accessed 26 Nov 2021
14. Google Cloud. "Helping the Financial Services Industry Transform With Google Cloud". *Google Cloud Blog*. 2021, https://cloud.google.com/blog/topics/financial-services/helping-the-financial-services-industry-transform. Accessed 26 Nov 2021
15. Grant, Edward. "The Rise of Biometric Technology in Banking". *Finance Digest*, 2021, https://www.financedigest.com/the-rise-of-biometric-technology-in-banking.html. Accessed 26 Nov 2021
16. Guo, Ye, and Chen Liang. "Blockchain Application and Outlook in the Banking Industry." *Financial Innovation*, vol. 2, no. 1, 2016, pp. 1-12.
17. Holzel, Kimberly, and William Stern. "Why Bank-Fintech Partnerships Are Here to Stay". *Bankdirector*, 2021, https://www.bankdirector.com/issues/strategy/why-bank-fintech-partnerships-are-here-stay/. Accessed 26 Nov 2021
18. Huang, Jau. "The force of biometrics in post-pandemic financial services security". *Securitymagazine*, 2021, https://www.securitymagazine.com/articles/95020-the-force-of-biometrics-in-post-pandemic-financial-services-security. Accessed 26 Nov 2021
19. IBM. "AI Improves Fraud Detection, Prediction And Prevention". *IBM*, 2021, https://www.ibm.com/analytics/fraud-prediction. Accessed 26 Nov 2021
20. International Banker. "The Impact Of Robotic Process Automation On Financial Services". *International Banker*, 2021, https://internationalbanker.com/technology/the-impact-of-robotic-process-automation-on-financial-services/.
21. Kaur, Jagreet. "Robotic Process Automation for Financial Services and Solutions". *Xenonstack.Com*, 2021, https://www.xenonstack.com/blog/rpa-for-financial-services. Accessed 26 Nov 2021
22. Kosmopoulos, Chris. "5 Ways Automation and RPA Are Changing Financial Services". *Blueprintsys.Com*, 2020, https://www.blueprintsys.com/blog/rpa/5-ways-automation-and-rpa-are-changing-financial-services. Accessed 26 Nov 2021
23. Kumar, Amit. "Blockchain: How it Plays a Crucial Role in Assessment of Credit Risk in Borrowers?". *The Financial Express*, 2021, https://www.financialexpress.com/money/blockchain-how-it-plays-a-crucial-role-in-assessment-of-credit-risk-in-borrowers/2339726/. Accessed 26 Nov 2021
24. Lappetito, Carson. "Council Post: AI and ML Can Transform Financial Services, but Industry Must Solve Data Problem First". *Forbes*, 2021, https://www.forbes.com/sites/forbesfinancecouncil/2021/10/13/ai-and-ml-can-transform-financial-services-but-industry-must-solve-data-problem-first/?sh=7d984aeb6ea3. Accessed 26 Nov 2021
25. Lehman, Chris. "5 Reasons Why Financial Services Firms Should Choose Google Cloud Platform". *SADA | Cloud Technology Services | Google Cloud Premier Partner*, 2021, https://sada.com/insights/blog/5-reasons-why-financial-services-firms-should-choose-google-cloud-platform/. Accessed 26 Nov 2021
26. Li, Yuxin, et al. "Theory and Application of Artificial Intelligence in Financial Industry." *Data Science in Finance and Economics*, vol. 1, no. 2, 2021, pp. 96-116.
27. Marketing Evolution. "Personalization in Financial Services: Types and Examples". *Marketingevolution.Com*, 2021, https://www.marketingevolution.com/knowledge-center/3-examples-of-personalization-in-the-financial-services-industry. Accessed 26 Nov 2021
28. Mhlanga, David. "Industry 4.0 in Finance: The Impact of Artificial Intelligence (AI) on Digital Financial Inclusion." *International Journal of Financial Studies*, vol. 8, no. 3, 2020, p. 45.
29. NCR. "What Is Personalization in Banking?", *NCR*, 2021, https://www.ncr.com/blogs/banking/what-is-personalization-in-banking. Accessed 26 Nov 2021
30. Ndinga, Lawrence. "Open Banking and Financial Services Disruption". *Business Daily*, 2021, https://www.businessdailyafrica.com/bd/opinion-analysis/columnists/open-banking-financial-services-disruption-3604250. Accessed 26 Nov 2021
31. NEC. "How Artificial Intelligence (AI) Is Transforming the Financial Sector". *NEC*, 2021, https://www.nec.co.nz/market-leadership/publications-media/

how-artificial-intelligence-ai-is-transforming-the-financial-sector/. Accessed 26 Nov 2021
32. Nikolova, Maria. "OCBC LAUNCHES AI-POWERED VOICE BANKING SERVICES IN PARTNERSHIP WITH GOOGLE". *Financefeeds*, 2018, https://financefeeds.com/ocbc-launches-ai-powered-voice-banking-services-partnership-google/.
33. Peplow, Mike. "Open Banking Is Poised to Drive Innovation". *Fintechmagazine*, 2021, https://fintechmagazine.com/banking/open-banking-poised-drive-innovation. Accessed 26 Nov 2021
34. Phaneuf, Alicia. "State of Mobile Banking In 2021: Top Apps, Features, Statistics and Market Trends". *Business Insider*, 2021, https://www.businessinsider.com/mobile-banking-market-trends?r=US&IR=T. Accessed 26 Nov 2021
35. Raspa, Scott. "How Bank and Fintech Partnerships Are Redefining the Future of Banking". *Finextra Research*, 2020, https://www.finextra.com/blogposting/19308/how-bank-and-fintech-partnerships-are-redefining-the-future-of-banking. Accessed 26 Nov 2021
36. Rausch, Jodi. "Personalization in Financial Services: An Imperative to Stay Relevant". *PK*, 2021, https://pkglobal.com/blog/2021/02/personalization-financial-services/. Accessed 26 Nov 2021
37. Retiwalla, Raheel. "What Is Robotic Process Automation (RPA) in Banking?". *Productive/Edge*, 2020, https://www.productiveedge.com/2020/06/18/banking-robotic-process-automation-intelligent-automation/. Accessed 26 Nov 2021
38. Rowe, Ulku. "Google Cloud Brandvoice: 6 Trends That Will Shape The Financial Services Industry In 2021". *Forbes*, 2021, https://www.forbes.com/sites/googlecloud/2021/02/05/6-trends-that-will-shape-the-financial-services-industry-in-2021/?sh=4ea2bed442b6.
39. Shaukat, Tariq. "Banking on the Cloud: How Financial Services Organizations Are Embracing Cloud Technology". *Google*, 2018, https://blog.google/products/google-cloud/banking-on-the-cloud-how-financial-services-organizations-are-embracing-cloud-technology/. Accessed 26 Nov 2021
40. Thinks Mobility. "Financial Services: 7 Emerging Technology Trends That Will Accelerate Your Digital Transformation". *Tmob - Thinksmobility*, 2021, https://thinksmobility.com/insights/blog/digital-money/7-emerging-technology-trends-that-will-accelerate-your-digital-transformation/. Accessed 26 Nov 2021
41. Thompson Reuters. "Thomson Reuters 2016 Know Your Customer Surveys Reveal Escalating Costs and Complexity". *Thomsonreuters.Com*, 2016, https://www.thomsonreuters.com/en/press-releases/2016/may/thomson-reuters-2016-know-your-customer-surveys.html. Accessed 26 Nov 2021
42. Tutors Lodge. "Open Banking and the Future of Finance". *Bobsguide*, 2021, https://www.bobsguide.com/articles/open-banking-and-the-future-of-finance/. Accessed 26 Nov 2021
43. Van der Kroft, Jeroen. "Collaboration at the Core: Evolving Partnerships Between Banks and Fintechs". *EY*, 2021, https://www.ey.com/en_nl/banking-capital-markets-transformation-growth/collaboration-at-the-core-evolving-partnerships-between-banks-and-fintechs. Accessed 26 Nov 2021

Implementation of Factor Analysis in Education Industry

[1]Ritu Bhasin, [2]Vamsikrishna A
[1][2] Symbiosis Statistical Institute, ICC Trade Tower, Pune

Abstract
This research aims to examine the factors that affect the choice of a student opting for a new course. This research uses exploratory factor analysis in determining the factors that play a significant role in the study. The data was collected using a questionnaire and the reliability of the questionnaire was checked through reliability statistics. The results indicated that there are five factors that affect the choice of a student while choosing a new course, namely, course structure and diversity, affordability and credibility, Brand Value, Competition and the trend and interests. The total variance of these factors is 69.694 percent, with only a 30.306 percent loss of information, we may reduce the complexity of the data set by using these components, which accounts for 69.697 percent of the variability in the original 15 variables.

Keywords
Factor Analysis, Reliability, KMO Test, Bartlett's Test, Factor Loading, Education Management

1. INTRODUCTION

With the increase in competition in the field of education, many colleges in India are coming up with new courses. These educational institutes are catering to the needs of the students and shaping the new courses to attract the students. We can see a surge in the number of students opting for higher education. With this surge comes a higher demand for admissions to courses. Many students are enrolling themselves for courses that are new or have been begun in the past few years.

The authors of [1] (Kinanti, E.S., Ritchi, H. and Handoyo, S.) explained the determinants of service performance in higher education using exploratory factor analysis. The author Roberts, P emphasizes how academic perceptions play a key role in shaping the academic curriculum [2]. Paul M. Biner, Raymond S. Dean, and Anthony E. Mellinger emphasized student performance in a distance learning program [3]. Rummel, R.J. said that factor analysis can be used to examine a topic area, structure a domain, map foreign concepts, classify or reduce data, identify linkages, test hypotheses, formulate theories, control variables, or draw inferences.[4]. The authors of [5] (Ford, J.K., MacCallum, R.C. and Tait, M.) have highlighted the fact that although factor analysis is a strong tool, researchers still lack a systematic approach to apply it in empirical work.

Factor analysis is a tool that helps in converting a large dataset into a smaller one by identifying the factors that have a significant role in the study. The two types of factor analysis are Exploratory Factor Analysis, which is a tool intended to generate a new theory and Confirmatory Factor Analysis, a tool to test an existing theory [6] (Matsunaga, M.). It is used to assess multicollinearity and prove or disprove theories that are already existing [7] (Williams, B., Onsman, A. and Brown, T.). Factor analysis can be applied to various fields, including psychology, education, health sciences, data science. It is also used in assessing groundwater quality [8] (Liu, C.W., Lin, K.H. and Kuo, Y.M.).

The youth nowadays have been trying to break the stereotypes of securing admissions in courses which offer basic graduation / post-graduation in science, arts, commerce, law and engineering. The students have shifted their choice to choosing courses that are new. It can be due to multiple reasons, like high competition for existing courses, new courses provide a new field to explore, infrastructure is new, a good way to establish relations with the heads of the institute and many more. The main aim of this paper is to understand the primary factors that affect a student's decision, while choosing a new course, that has been started less than 5 years back, over an already existing course. The steps that can be taken by the colleges to incorporate these factors into the courses.

2 METHODOLOGY

We use factor analysis and specifically exploratory factor analysis with data reduction to identify structures from studies that have not been widely tested. The purpose of this study is to highlight the significant factors that affect the choice of a student for a new course.

2.1 Population

All the students who are currently enrolled in a course, be it Graduation or Post Graduation were eligible to participate in the survey designed. Those respondents whose course was new, i.e., had started less than 5 years back, were filtered out as that was the interest of our study. Snowball sampling was used to conduct the survey. The survey was conducted in august 2021.

2.2 Questionnaire

The author Zhang, C., Yang, L., Liu, S., Ma, S., Wang, Y., Cai, Z., Du, H., Li, R., Kang, L., Su, M. and Zhang, J. used a questionnaire to collect the demographic information and to measure the severity of insomnia, respondents were asked to mark on a 4-point Likert scale [9]. A questionnaire was designed to study the factors that affect the choice for a new course over an existing course. It was a validated 15-item self-administered questionnaire. The questionnaire ascertained the age of the respondents, the current course they were enrolled in, if their course has been started less than 5 years back. The identity of the respondent was kept anonymous.

The responses were collected on a 4-point Likert scale, ranging from 'Not at all important' to 'highly important'. The respondents were asked to assess the important factors while choosing to secure admission in a new course. The total responses received were 71. Amongst the responses, 25 responses were excluded from our analysis as they did not fulfil the criteria of study. Hence, the final response for our study is 46.

Fig 1: Methodology Flow Chart

3 RESULTS AND DISCUSSION

3.1 Reliability

Since the questionnaire is self-made, we need to check the reliability of the questionnaire. We evaluate Cronbach's alpha reliability statistics. If the reliability statistics > 0.7, it means we can proceed with the questionnaire, as they are reliable and usable.

Figure 2 shows the reliability statistics is 0.748 i.e. 74.8% , hence our questionnaire is reliable and usable. We can proceed with the analysis.

Reliability Statistics

Cronbach's Alpha	N of Items
.748	15

Fig 2: Reliability Statistics

3.2 KMO and Bartlett's Test

To begin with the exploratory factor analysis, adequacy data must be tested before. Kaiser-Meyer-Olkin (KMO) and Bartlett's test are terminologies in EFA that are used to measure the adequacy of sampling and measure the homogeneity of indicators as a condition of construct correlation. To conduct exploratory factor analysis, the KMO value must be greater than 0.5 and Bartlett's test must be less than 0.05.

The values in Figure 3 show that the KMO is 0.568 > 0.5. The results of the (KMO) and Bartlett tests are summarised in the above table. The KMO value is 0.568, and the Bartlett test is significant with p value = 0.000 < 0.5, according to the results. It suggests that the data sufficiency conditions for factor analysis have been met. KMO values that fall within the range suggest that the data is sufficient to conduct an Exploratory Factor Analysis. Hence Bartlett test shows a significant value. Therefore, the data is sufficient to carry out further analysis.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.568
Bartlett's Test of Sphericity	Approx. Chi-Square	239.277
	df	105
	Sig.	.000

Fig 3: KMO and Bartlett's Test

3.3 Total Variance Explained

After conducting the adequacy data test, the data was extracted to discover the component pattern matrix. The Principal Component Analysis (PCA) extraction method and the Kaiser Varimax Normalization rotation method were used. The EFA results show that there are five initial factors identified as service performance and 12 elements of factor.

The degree of variation associated with the factor is represented by the eigenvalue. As a result, only factors with an eigenvalue greater than 1.0 are taken into account. Only five factors with eigenvalues greater than one are represented in the table, with factor 1 accounting for 25.194 percent of the variation in the data, factor 2 for 15.455 percent, and so on. See Figure 5

The figure 4 shows the total variance explained explains approximately 70% of the variability in the original 15 variables, so we can use these components to minimise the complexity of the data set while only losing 30% of the information.

The rotation keeps the cumulative proportion of variance explained by the extracted components, but it now spreads the variation more evenly across the components. Because of the huge differences in individual totals, the rotated component matrix should be easier to understand than the unrotated matrix.

Total Variance Explained

Component	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.779	25.194	25.194	2.653	17.685	17.685
2	2.318	15.455	40.649	2.001	13.340	31.025
3	1.809	12.060	52.708	1.988	13.254	44.279
4	1.516	10.104	62.812	1.966	13.104	57.383
5	1.033	6.884	69.697	1.847	12.314	69.697

Extraction Method: Principal Component Analysis.

Fig 4: Total Variance Explained

3.4 Scree Plot

The scree plot is a graph that shows the Eigenvalues in relation to all of the elements. The graph can be used to determine how many factors to keep. The point of interest is where the curve starts to flatten. We check the component number against the eigenvalue 1.

In figure 5 we observe that the eigenvalue was 1 against the component number 5. Hence, we considered 5 factors in our study.

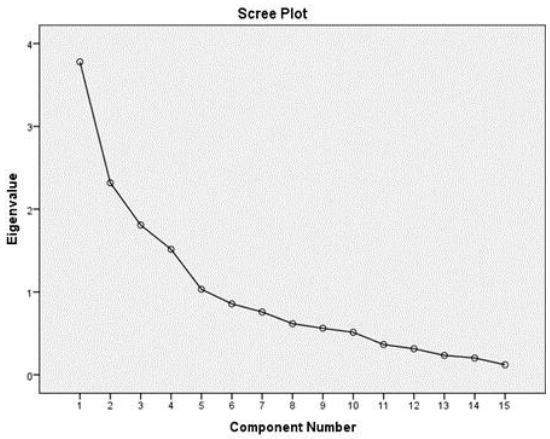


Fig 5: Scree Plot

3.5 Factor Loading

The factors in the component matrix are extracted. Once we decide how many factors to consider, we have to analyse whether a factor may be related to one or more variables in our data. The most common orthogonal rotation is varimax. The varimax rotated solution provides the simplest interpretation of the structure [10] (Pohlmann. J.T.). Rotation increases high item loadings while reducing low item loadings, resulting in a more comprehensible and streamlined solution. We have used varimax rotation in our analysis and get the rotated component matrix. For each of the five factors, the values which are greater than 0.5 are extracted. Those factors have a significant role in our analysis.

The figure 6.1 and 6.2 show the final variables under each factor and factor loading and factor name.

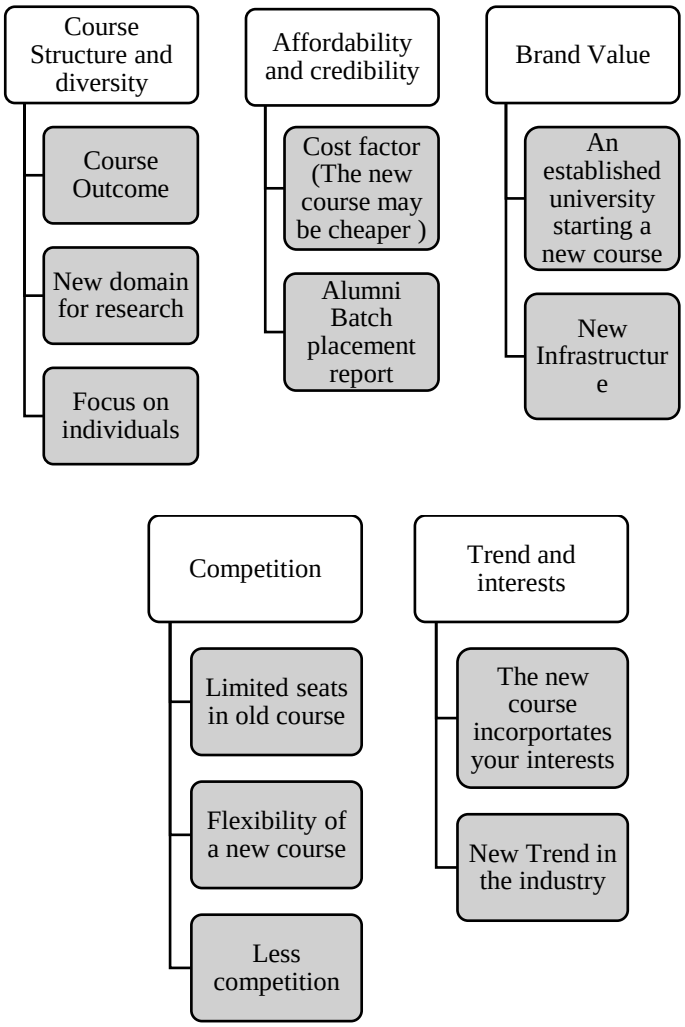


Fig 6: Key factors for choosing a new course

Factor 1 - Course structure and diversity: Factor 1 consists of 3 elements based on the course outcome, research opportunities and focus on individuals. This factor has a variance of 25.194%. It means that 25.194% of the factors in choosing a new course is determined by the course structure and diversity.

Factor 2 - Affordability and credibility: Factor 2 consists of 2 elements based on the cost factor and placement report. This factor has a variance of 15.455%. It means that 15.455% of the factors in choosing a new course is determined by the affordability and credibility

Factor 3 - Brand Value: Factor 3 consists of 2 elements based on the new infrastructure and an established university starting a new course. This factor has a variance of 12.060%. It means that 12.060% of the factors in choosing a new course is determined by the brand value of a college.

Factor 4 - Competition: Factor 4 consists of 3 elements based on the limited seats in an old course, flexibility and less competition. This factor has a variance of 10.104%. It means

that 10.104% of the factors in choosing a new course is determined by the competition.

Factor 5 - Trend and Interests: Factor 4 consists of 2 elements based on incorporating the individual interests and some new trend that has emerged in the market. This factor has a variance of 6.884%. It means that 6.884% of the factors in choosing a new course is determined by the interests of the individuals and trends in the market.

4 CONCLUSION

The results showed that course structure and diversity played a crucial role in determining what are the factors that are important while choosing a new course. The course outcome gives a student a clear idea of the topics that the course is going to cover, which plays a major role in choosing any course, be it new or old. The new course would also open new horizons of research for students and gives a lot to explore in that field. And being a new course, it would focus on each individual. Apart from course structure and diversity other factors also play a key role. The primary factors that affect the choice of a student while enrolling to a new course are course structure and diversity, affordability and credibility, brand value, competition and the trend and interests.

These results can be used in the education industry when making decisions about starting a new course as they are the main determining factors that a student looks for while enrolling to a newly started course.

The questionnaire was reliable and usable with reliability statistics as 0.784. The total variance of these factors is 69.697%, with only a 30.306% loss of information, we may reduce the complexity of the data set by using these components, which accounts for 69.694 % of the variability in the original 15 variables.

Out of the five factors extracted, factor 1 had 25.194% variance, factor 2 had 15.455% variance, factor 3 had 12.060% variance, factor 4 had 10.104% variance and factor 5 had 6.884% variance.

TABLE I. FACTOR LOADING

Factor Number	Factor Name	% Variance
Factor 1	Course Structure and Diversity	25.194%
Factor 2	Affordability and Credibility	15.455%
Factor 3	Brand Value	12.060%
Factor 4	Competition	10.104%
Factor 5	Trend and Interests	6.884%

REFERENCES

1. Kinanti, E.S., Ritchi, H. and Handoyo, S., 2020. Factor Analysis of Service Performance in Higher Education Institutions. *Journal of Accounting Auditing and Business-Vol*, *3*(1).
2. Roberts, P., 2015. Higher education curriculum orientations and the implications for institutional curriculum change. *Teaching in Higher Education*, *20*(5), pp.542-555.
3. Biner, P.M., Dean, R.S. and Mellinger, A.E., 1994. Factors underlying distance learner satisfaction with televised college-level courses. *American Journal of Distance Education*, *8*(1), pp.60-71.
4. Rummel, R.J., 1967. Understanding factor analysis. *Journal of conflict resolution*, *11*(4), pp.444-480.
5. Ford, J.K., MacCallum, R.C. and Tait, M., 1986. The application of exploratory factor analysis in applied psychology: A critical review and analysis. *Personnel psychology*, *39*(2), pp.291-314.
6. Matsunaga, M., 2010. How to Factor-Analyze Your Data Right: Do's, Don'ts, and How-To's. *International journal of psychological research*, *3*(1), pp.97-110.
7. Williams, B., Onsman, A. and Brown, T., 2010. Exploratory factor analysis: A five-step guide for novices. Australasian journal of paramedicine, 8(3).
8. Liu, C.W., Lin, K.H. and Kuo, Y.M., 2003. Application of factor analysis in the assessment of groundwater quality in a blackfoot disease area in Taiwan. *Science of the total environment*, *313*(1-3), pp.77-89.
9. Zhang, C., Yang, L., Liu, S., Ma, S., Wang, Y., Cai, Z., Du, H., Li, R., Kang, L., Su, M. and Zhang, J., 2020. Survey of insomnia and related social psychological factors among medical staff involved in the 2019 novel coronavirus disease outbreak. *Frontiers in psychiatry*, *11*, p.306.
10. Pohlmann, J.T., 2004. Use and interpretation of factor analysis in The Journal of Educational Research: 1992-2002. *the Journal of Educational research*, *98*(1), pp.14-23.

Slot Loaded Microstrip Triangular Patch Antenna for dual frequency applications in L and S band

[1] Manik Chandra Borah,[2]Parimita Saikia, [3]Anup Kr Bordoloi*,[4]Bhairab Sarma
[1][2] Research Scholar, University of Science & Technology, Meghalaya, India
[3]Assam down town University, Guwahati, Assam, India
[4]University of Science & Technology, Meghalaya, India

Abstract
Tuning of resonant frequency of microstrip patch antenna is an important aspect for practical applications within the application band. A simple dual frequency triangular patch antenna is designed which can be operated in L and S band. The antenna is initially designed for best performance in terms Return Loss values with optimized feed point location. The basic rectangular patch resonating within the band is further modified to triangular patch with insertion of slots, to investigate the shift in resonating frequency. Purpose of designing slot loaded antenna is to tune the antenna for single and/or dual frequency operation when required for various practical applications. Three triangular slots are inserted vertically across the radiating edge within the patch and one rectangular slit placed vertically 1mm distance from center towards another radiating edge.

Keywords
Dual frequency, L,S- band, Slot Loaded, Triangular patch.

1. INTRODUCTION

Microstrip patch antenna, highly used for communication purpose can provide wider bandwidth applicable in various frequency bands [2], [3], [7]. On the other hand, tuning resonant frequency of patch within the same band or other is an important design aspect [1], [4], [5] in terms of practical applications [6], [8]. In this report, path antenna has been fabricated on a copper clad FR4 substrate with a dielectric constant of 4.8 (ε_r) and substrate thickness of 1.5 mm (h). All the antennas designed in the present investigation are fed with coaxial probe feeding and simulations are carried out using CST microwave studio. Maximum Return Loss and VSWR for best matching with relocation of feed point for various structures at different frequencies has been investigated and results are analyzed. In conclusion, *the measured results indicate that the antenna resonates at two distinct frequencies, one is at 2.484 GHz and another is at 3.956 GHz with good return loss and the VSWR are within reasonable range, between 1.002 to 1.09*.

2. ANTENNA DESIGN

A simple rectangular microstrip patch antenna is designed using high frequency simulation software CST Microwave Studio which resonates at L and S- band. Dimension of the simple rectangular patch antenna has been put in Table 1 and Fig 2.shows the geometry of the simple patch.

Antenna parameters	Values in mm
Length of ground plane (Lg)	48 mm
Width of ground plane(Wg)	56 mm
Length of Rectangular Patch (Lp)	28 mm
Width of Rectangular Patch(Wp)	36 mm
Thickness of Substrate	1.5 mm
Dielectric constant of Substrate	4.8

Table1: Dimension of simple rectangular patch antenna

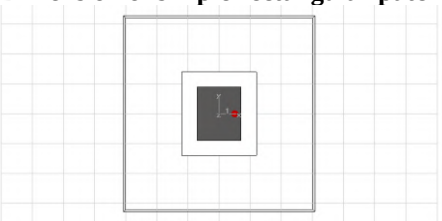


Fig 1: Simple Rectangular Patch Antenna

Feed point selection:
With the dimension summarized in Table1, feed point for best matching in terms of maximum Return Loss, value (S11 parameter) is investigated through repeated simulation. Feed point location from 0mm to 12mm with Return Loss (RL) value with frequency is plotted in Fig 2.

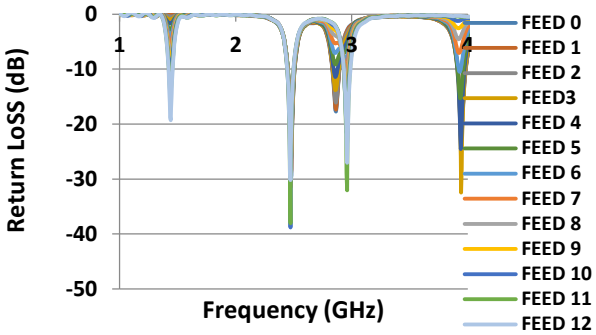


Fig: 2 Frequency (GHz) Vs, Return Loss (dB) of simple Rectangular Patch for different feeding points

From the above graph it has been observed that the RL is maximum (-38.822 dB) at the frequency 2.472 GHz and -32.472 dB at 3.948 GHz for the feeding point 10 mm and 3 mm along the X axis towards the radiating edges respectively. At the feeding point location 3mm, also shows the multi frequency responses within L, S band. For frequencies near 1.436 GHz, RL values below -20dB is observed and for another set of frequencies near 2.96GHz RL just above -30dB is observed. Further investigation is carried out for any shift of these frequencies by shaping the antenna into triangular shape without changing over all geometry of the antenna. Dimension of the modified antenna is summarized in Table2 and Fig 3 shows the geometry of the patch.

Table 2: Specification of Simple Triangular Patch Antenna

Antenna parameters	Values in mm
Length of ground plane (Lg)	48 mm
Width of ground plane(Wg)	56 mm
Length of Rectanguar Patch (Lp)	28 mm
Width of Rectanular Patch(Wp)	36 mm
Thickness of Substrate	1.5 mm
Dielectric constant of Substrate	4.8
(Co-Ordinates of the points of the triangle (in mm) of Triangular Patch	(14,18) (14,-18) (-14,0)

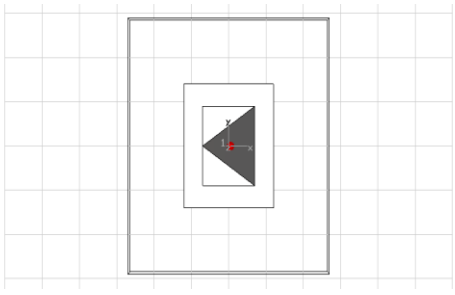


Fig 3: Simple Triangular Patch Antenna

Feed point relocation of the antenna is carried out (0mm to 11mm) with repeated iteration to obtained best matching in terms of maximum RL value (Fig 4) and values are put in Table3

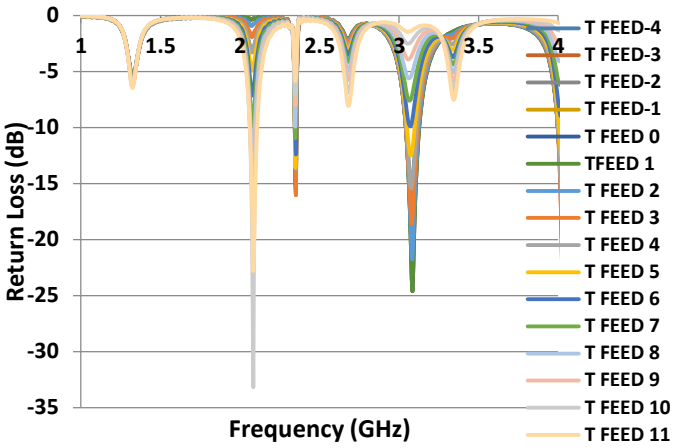


Fig 4: Frequency (GHz) versus Return Loss (dB) of the triangular patch antenna at different feeding points

Table 3: Frequency (GHz) versus RL (dB) of the triangular patch antenna at different feeding point locations.

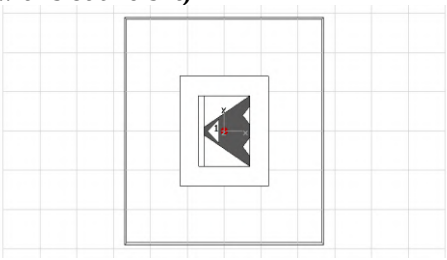
Feed point location (In mm)	Frequency (GHz)	Return Loss(dB)	Frequency (GHz)	Return Loss(dB)
FEED 0	2.352 ***3.084***	-15.904 ***-24.11***	***4.036***	***-22.39***
FEED 1	2.352 ***3.084***	-15.904 ***-24.611***	4.036	-22.391
FEED 2	2.352 3.08	-14.975 -21.639	4.032	-27.890
FEED 3	2.352 3.076	*-16.02* -18.775	***4.032***	***-30.633***
FEED 4	2.348 3.072	-13.375 -15.246	4.028	-18.515
FEED 5	2.348 3.068	-13.489 -12.287	4.02	-12.61
FEED 6	2.352 3.06	-12.48 -9.57	4.012 4.312	-8.794 -15.659
FEED 7	2.08 2.348	-9.94 -10.988	4.004 4.316	-5.96 -18.03
FEED 8	2.08 2.348	-13.722 -9.927	4.004 4.316	-4.09 -18.27
FEED 9	2.08 2.384	-19.777 -8.041	3.334 4.316	-3.63 -16.44
FEED 10	***2.084*** 2.348	***-33.189*** -7.082	3.34 4.312	-6.676 -13.236
FEED 11	2.084 2.348	-22.80 -5.857	3.344 4.3	-10.42 -7.5
FEED -1	2.352 ***3.084***	-15.904 ***-24.611***	4.036	-22.391
FEED-2	2.352 ***3.084***	-14.975 ***-21.789***	***4.036***	***28.116***
FEED -3	2.352 3.08	-16.025 -18.640	4.032	-30.634
FEED -4	2.352 3.072	-13.712 -15.246	4.028	-18.515

From the Table 4 it has been observed that change of RL values with slight shift of resonant frequencies for this modified antenna is observed as highlighted in Table 3.

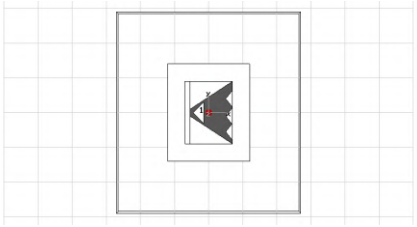
3. DESIGN OF SLOT LOADED TRIANGULAR PATCH ANTENNA

The simple triangular patch has been modified by introducing triangular slots and rectangular slit on it with simulations using CST microwave studio. The different structures has been shown below for various shape of slots and slit introduced on it for best result with different feeding point (structures 1 to structure 10) and the **structure 8** showed the best result i.e. maximum return loss (- 61.375 dB) at frequency 2.484 GH has been obtained.

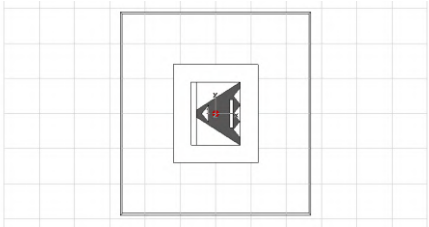
Few of the designed structures are shown below **(triangular antenna with slot and slit) -**



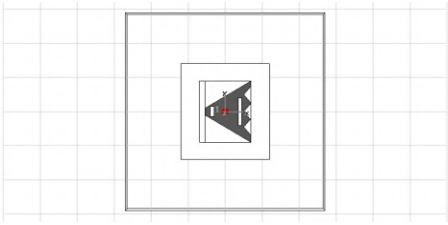
Structure: 1



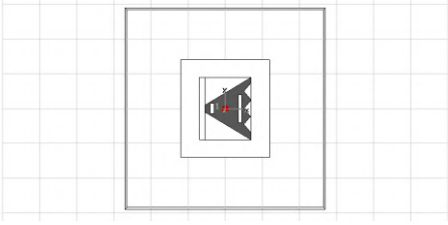
Structure: 2



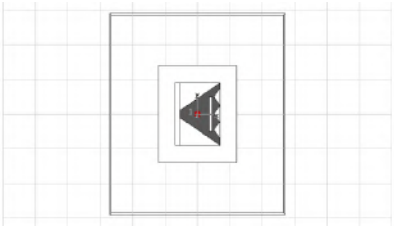
Structure: 3



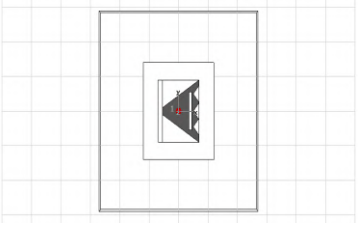
Structure: 4



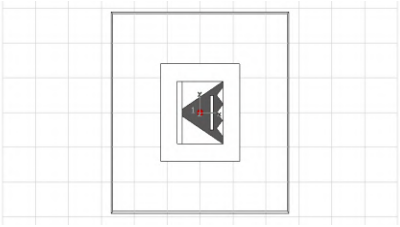
Structure: 5



Structure: 6



Structure: 7



Structure: 8

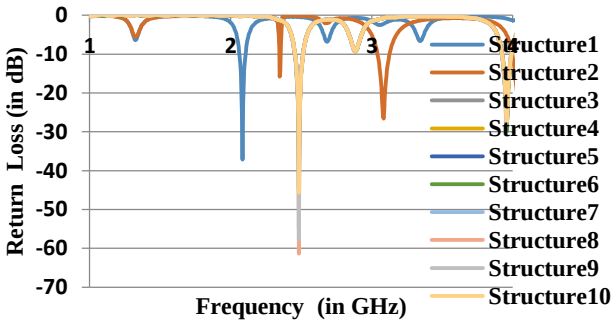


Fig. 5: Frequency (in GHz) Versus Return Loss (in dB) of different structures (1-8)

Table 5: Frequency (GH) Vs. Return Loss (dB) for different Structures

Structures	Frequency (GHz)	Return Loss (dB)	Frequency (GHz)	Return Loss (dB)
Structure 1	2.084 2.348	-37.124 -7.137	4.3	-12.621
Structure 2	2.348	-15.83	3.084 4.028	-26.593 -19.57
Structure 3	2.484	-43.942	3.956	-27.057
Structure 4	2.484	-36.392	3.96	-26.877
Structure 5	2.484	-45.01	3.956	-28.692
Structure 6	2.484	-35.929	3.956	-29.984
Structure 7	2.484	-54.955	3.956	-27.90
Structure 8	***2.484***	***-61.375***	***3.956***	***-27.392***
Structure 9	2.484	-57.777	3.956	-27.441
Structure 10	2.484	-45.729	3.956	-27.381

From the above Table 5, it is has been observed that for the structure 8, maximum RL value of -61.375 dB is found at the frequency 2.484 GHz., and another return loss is -27.392 dB at the higher frequency 3.956 GHz and also it is observed that it gives dual frequency responses. However, for structures 1 and 2 (without slit), antenna behaves as multifrequency antenna.

Geometrical dimension of the structure 8 is shown in Fig 6

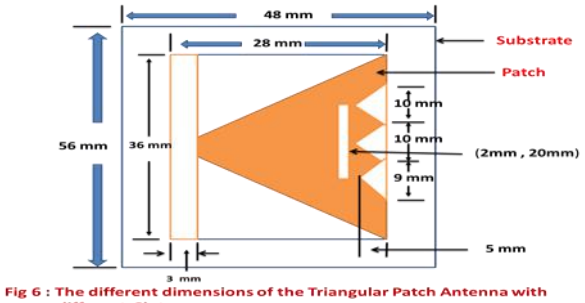


Fig 6 : The different dimensions of the Triangular Patch Antenna with different Slots .

To carry on further investigating, structure 8 with maximum RL value and behaving as dual frequency antenna, feed point relocations in step of 1 mm along the +ve and –ve X axis has been performed and the result are shown below in the Fig 7 and tabulated in Table 6.

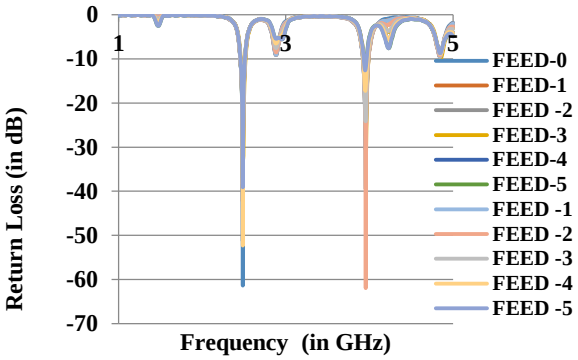


Fig: 7: Frequency (in GHz) vs. Return Loss of different feeding point of the antenna of structure 8(0 to 5mm, +ve, -ve X-axis)

Table 6: Frequency (GH) Vs. Return Loss (dB) for different feed point location

Feeding Point Location (in mm)	Frequency 1 (in GHz)	Return Loss (in dB)	Frequency 2 (in GHz)	Return Loss (in dB)
0	*2.484*	*-61.38*	*3.956*	*-27.392*
1	2.484	-42.29	3.956	-30.43
2	*2.848*	*-40.08*	*3.956*	*-39.46*
3	2.848	-38.35	3.951	-23.54
4	2.848	-51.62	3..92	-17.02
-2	*2.484*	*-38.99*	*3.956*	*-61.930*
-3	2.488	-32.78	3.952	-30.55
-4	2.484	-52.33	3.952	-17.227
-5	2.848	39.112	3.948	-12.60

From the above Table, 6 it has been observed that maximum Return Loss (RL) with dual frequency responses are found at frequency 2.484 GHz and 3.956 GHz for the three different individual feeding point locations are at 0 mm, 2mm , and at -2 mm along the X axis for the slot antenna structure 8. Also it is found that the VSWR for these frequencies are around 1. The value of VSWR at different frequencies and for the different feeding point locations are shown in the Table 7.

Table: 7: Frequency (GHz) Vs. Return Loss (dB) with their respective VSWR

Feeding Point Location (in mm)	Frequency1 (GHz)	RL 1 (dB)	VSWR1	Frequency2 (GHz)	RL2 (dB)	VSWR 2
-2	**2.484**	**-38.99**	**1.023**	**3.956**	**-61.93**	**1.002**
0	**2.484**	**-61.38**	**1.002**	**3.956**	**-27.392**	**1.09**
2	**2.484**	**-40.08**	**1.02**	**3.956**	**-39.46**	**1.002**

In the above Table 7, each individual feed point location and the Frequency (GHz) Vs. Return Loss (dB) with its respective VSWR for these frequencies are summarized. Plot between frequency vs. RL with its VSWR in each frequency is shown separately in Fig 8, Fig 9, Fig 10, Fig 11, Fig 11,Fig 12 and Fig 13 respectively.

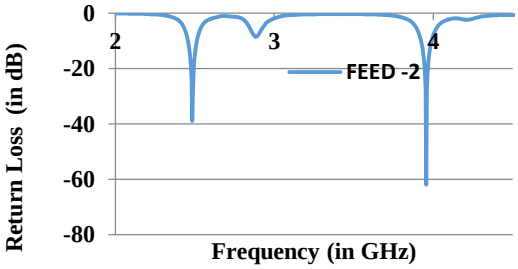


Fig: 8: Frequency (in GHz) vs. Return Loss at feed point -2mm

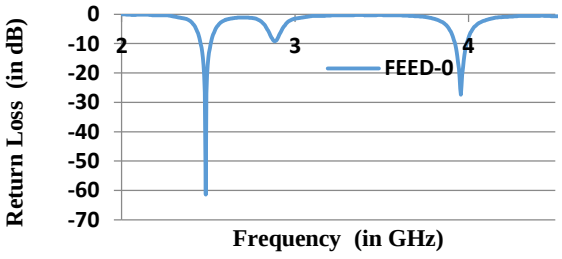


Fig: 9: Frequency (in GHz) vs. Return Loss at feed point 0mm

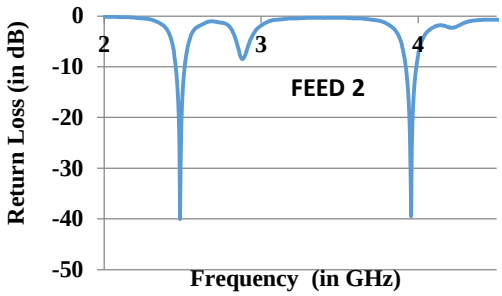


Fig 10: Frequency (in GHz) vs. Return Loss at feed point +2mm

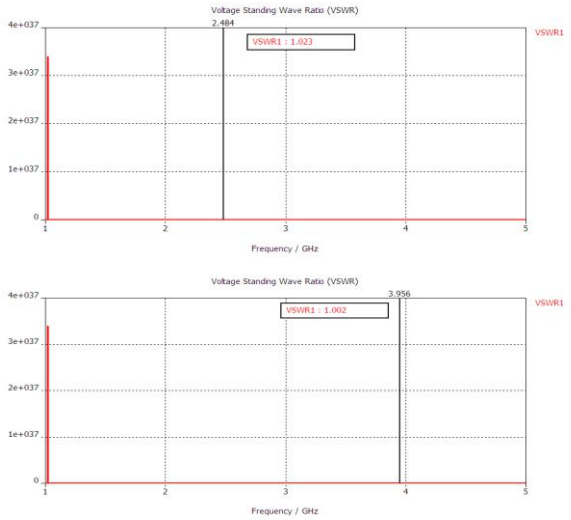


Fig 11: VSWR at frequency 2.484 GHz and 3.956 GHz for feeding point – 2mm along X axis

.

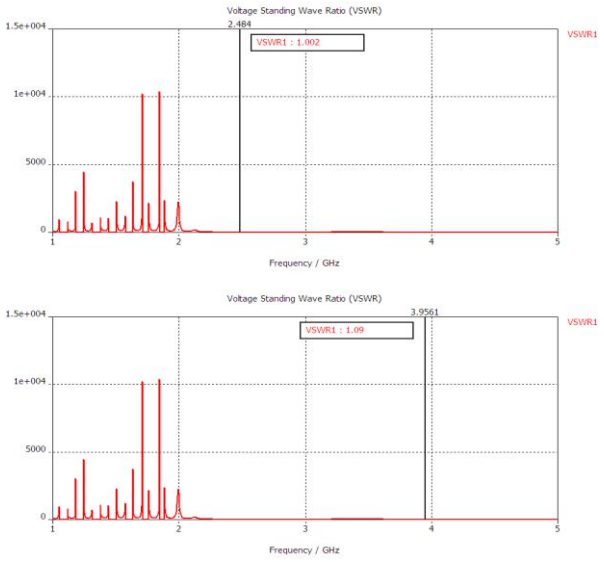


Fig12: VSWR at frequency 2.484 GHz and 3.956 GHz for feeding point at center (0,0)

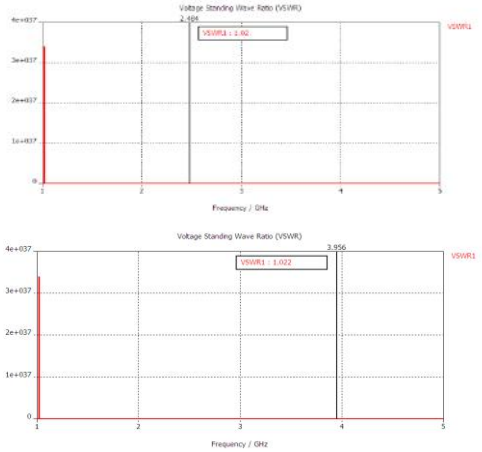


Fig 13: VSWR at frequency 2.484 GHz and 3.956 GHz for feeding point 2mm along X axis

From the investigation carried out, it is found that the proposed antenna responded the dual frequency responses with best Return Loss (RL) and acceptable VSWR at frequencies 2.484 GHz and 3.956 GHz for any one of the feeding point locations at -2 mm, at centre (0,0) and 2 mm along the X axis towards the radiating edge. Required frequency can be selected for applications in L and S band with the optimized feed point location which has been carried out in the work presented. The slot loaded antenna can act as potential candidate for applications in L and S band.

REFERENCES

1. Hang Wong, Kwok Kan So, Kwai Man Luk, Chi Hou Chan and Quan Xue, "New size reduction for patch antenna by parasitic shorting elements", *International Workshop on Antenna Technology* (IWAT), Page(s): 1-4 ,2010.
2. E. G. Korkontzila, D. B. Pappafilippo, D. P. Chrissoulids, "Miniaturization of microstrip patch antenna for wireless applications by use of multilayered electromagnetic band gap substrate," First European Conference on Antennas and Propagation, EuCAP, pp. 1-6, 2006.
3. Ji- Hyuk Kim, Hyeon Cheol Kim and Kukjin Chun, "A small size broadband MEMS antenna for 5 GHz WLAN applications," Journal of semiconductor technology and science, Vol. 5(3), pp. 204-209, 2005.
4. Michal Pokorny, Jiri Horak, and Zbynek Raida, "Planar tri-band antenna design," Radioengineering, Vol. 17, No.1, 2008.
5. Rahul Kumar Garg, Smrity Dwivedi, Raghuvir Tomar "A Wide Band, Highly-Efficient Circular Patch Antenna with Split Triangular-Shape Slit." 2018 8th International Conference on Communication Systems and Network Technologies.
6. Anup Kr. Bordoloi, Parimita Saikia, Pankaj Das, Apratim Borkataky "Triangular Cut Modified Rectangular Patch Antenna in S and C-band for Wireless Applications", International Journal for Research in Applied Science & Engineering Technology (IJRASET)
7. Keyoor Gosalia and Ganalika Lazzi "Reduced Size, Dual Polarised Microstrip Patch Antenna for Wireless Communications" JEEE transaction on antennas and propagation, Vol. 51, No.9, September 2003
8. Davor Bonefacic and Bojan Rapinnac, "Small H- shaped shorted patch antennas," Radioengineering, Vol. 17, No.2, pp. 77-82, 2008.

ASEAN and APEC Perspectives of Philippine ICT Roadmaps

Ravenal A. De Jesus
Department of Information and Communications Technology (Provincial / Section Head)

Abstract
This paper presented the synthesis of various perspectives involving the Information and Communications Technology (ICT) environment in the Philippines. These perspectives are referenced from Association of Southeast Asian Nations (ASEAN) and Asia – Pacific Economic Cooperation (APEC) where the Philippines is a Member State and Member Economy respectively. First, various engineering disciplines were delineated based from its respective statutes in order to determine the scopes of the same that cover ICT practices. Second, both ICT and allied engineering disciplines (particularly the Electronics Engineering) were elaborated and compared with international definitions. Third, the Philippine ICT Roadmaps were compared with the ASEAN Digital Masterplan 2025 and APEC Internet and Digital Economy Roadmap in order to analyze possible opportunities as well as areas for improvements. Fourth, various ICT programs and projects in the Philippines as well as selected ICT Policy Instruments were also presented and compared with its ASEAN/APEC counterparts. Fifth, the roles of Electronics Engineering (ECE) profession were presented especially its contribution to the ICT industries in the Philippines. Finally, conclusions and/or recommendations were indicated for future reference.

Keywords
gender and development (GAD), globalisation, information and communications technology (ICT), technology management (TM).

1. INTRODUCTION

The Philippines is a Member State of the Association of Southeast Asian Nations (ASEAN) and also a Member Economy of Asia – Pacific Economic Cooperation (APEC). Specifically, the Philippines is one of the founding Member States of ASEAN (i.e. Indonesia, Malaysia, the Philippines, Singapore and Thailand) and one of the first twelve Member Economies of APEC joined on November 1989 (i.e. Australia, Brunei Darussalam, Canada, Indonesia, Japan, Republic of Korea, Malaysia, New Zealand, the Philippines, Singapore, Thailand and United States).

Table 1ASEAN Member States [1]

Member State	Date of Accession
Indonesia	August 8, 1967
Malaysia	August 8, 1967
The Philippines	August 8, 1967
Singapore	August 8, 1967
Thailand	August 8, 1967
Brunei Darussalam	January 7, 1984
Viet Nam	July 28, 1995
Laos	July 23, 1997
Myanmar	July 23, 1997
Cambodia	April 30, 1999

Both ASEAN and APEC involve economic agenda toward prosperity while the former also include socio-cultural cooperation [2]. Moreover, these organizations exhibit challenges in various areas including the Information and Communications Technology (ICT). Furthermore, these challenges in ICT significantly increased during the Covid-19 Pandemic [3]. The Philippines was connected to the internet for the first time on March 1994 [4]. This event was cited as *history serves a reference for research and development as well as guide in formulation of policies* [3][5][6][7].

Table 2 APEC Member Economies [8]

Member Economy	Date of Accession
Australia	November 1989
Brunei Darussalam	November 1989
Canada	November 1989
Indonesia	November 1989
Japan	November 1989
Republic of Korea	November 1989
Malaysia	November 1989
Philippines	November 1989
Singapore	November 1989
Thailand	November 1989
The United States	November 1989
Chinese Taipei	November 1991
Hong Kong	November 1991
People's Republic of China	November 1991
Mexico	November 1993
Papua New Guinea	November 1993
Chile	November 1994
Peru	November 1998
Russia	November 1998
Viet Nam	November 1998

On the other hand, the Philippines being a member of both ASEAN and APEC had participated in Advanced Level

Engineering benchmarking schemes through its respective registries namely ASEAN Engineering Register, APEC Engineer Register, and ASEAN Chartered Professional Engineer Register [9][10][11]. While both ASEAN Engineering Register and ASEAN Chartered Professional Engineer Register have same Member States entered its respective mutual recognition, not all APEC Member Economies participated in APEC Engineer Registry. APEC Member economies who participated in APEC Engineer Registry are Australia, Canada, Chinese Taipei, Hong Kong, Indonesia, Japan, Korea, Malaysia New Zealand, Philippines, Russia, Singapore, United States, and Peru while Thailand and Papua New Guinea are Conditional and Provisional Members respectively [12]. Consequently, Science Advisory No. 2020-02 of the National Academy of Science and Technology states that the Philippines is still below the UNESCO benchmark for the number of Research Scientists and Engineers (RSEs) [13].

II. METHODS

Data from both local and international references were gathered in order to synthesize the same in order to arrive in the intended assessment of the Philippine ICT Roadmap in the perspectives of ASEAN and APEC.

A. Definitions of ICT

Information and Communications Technology (ICT) in the Philippines is defined by the Republic Act No. 9292 (RA 9292) also known as the "Electronics Engineering Law of 2004". The definition of ICT based from Article I, Section 3(g) of RA 9292 is the following [14]:

"*the acquisition, production, transformation, storage and transmission/reception of data and information by electronic means in forms such as vocal, pictorial, textual, numeric or the like; also refers to the theoretical and practical applications and processes utilizing such data and information*"

Years hence, another Philippine law was enacted named Republic Act No. 10844 (RA 10844) also known as the "Department of Information And Communications Technology Act of 2015". The definition of ICT based from Section 3(a) of RA 9292 is the following: [15]:

"*…the totality of electronic means to access, create, collect, store, process, receive, transmit, present and disseminate information:*"

Referring to the two definitions of ICT, RA 10844 adopted the definition of ICT from RA 9292 including provisions of positions requiring Professional Electronics Engineers (PECE) in spite of having a span of more than ten years. Moreover, the International Telecommunications Union (ITU) emphasized clearly the coverage of ICT in its document entitled "ITU Council Contribution to the 2016 United Nations High – Level Political Forum on Sustainable Development"[16]. Furthermore, the United Nations Educational, Scientific and Cultural Organization (UNESCO) defines ICT as [17]:

"*…diverse set of technological tools and resources used to transmit, store, create, share or exchange information. These technological tools and resources include computers, the Internet (websites, blogs and emails), live broadcasting technologies (radio, television and webcasting), recorded broadcasting technologies (podcasting, audio and video players, and storage devices) and telephony (fixed or mobile, satellite, visio/video-conferencing, etc.)*"

RA 10844 is also the law that created the Department of Information and Communications Technology (DICT) in 2016. DICT is the National Government Agency (NGA) that implements ICT programs, projects and services; formulate ICT policies; and foster strategic collaboration among ICT stakeholders. Table 3 summarizes references defining ICT.

Table 3 References Defining ICT

Reference	Category / Remarks
Philippine Republic Act No. 9292 (Electronics Engineering Law of 2004) [14]	Philippine Definition / Electronics Engineering (ECE) is a different discipline from Electrical Engineer (EE)
Philippine Republic Act No. 10844 (Department of Information And Communications Technology Act of 2015) [15]	Philippine Definition / The Department of Information and Communications Technology (DICT) was formed when the following agencies were abolished: • Information and Communications Technology Office (ICTO); • National Computer Center (NCC); • National Computer Institute (NCI); • Telecommunications Office (TELOF): • National Telecommunications Training Institute (NTTT) • All operating units of the Department of Transportation and Communications (DOTC) with functions and responsibilities dealing with communications Abolished agencies have its powers and functions, budget, records, properties, and personnel transferred to DICT
UNESCO Learning Portal [16]	International Definition
ITU Report [17]	International Definition

B. The Philippine Technological Council (PTC) and its Foreign Counterparts

The Philippine Technological Council (PTC) is non-stock and non-profit corporation incorporated under the Securities and Exchange Commission (SEC) that aims to foster engineering mobility of Filipino engineering practitioners

around the globe and encompasses thirteen (13) professional engineering organizations in the Philippines each representing specific engineering field of practice [18]. It is emphasized in this paper that the Philippine Government regulates engineering practices (except for Industrial Engineering) by virtue of respective statutes but the Accredited Professional Organizations (APOs) of respective engineering disciplines are actually non-profit corporation incorporated under the Securities and Exchange Commission (SEC).

Table 4 Accredited Professional Organizations (APOs) of Various Professional Engineering Disciplines in the Philippines Which Are Members of the Philippine Technological Council (PTC) [19][20]

Engineering Disciplines	Name of APO
Electronics Engineering (ECE)	Institute of Electronics Engineers of the Philippines (IECEP)
Geodetic Engineering (GE)	Geodetic Engineers of the Philippines (GEP)
Mechanical Engineer (ME)	Philippine Society of Mechanical Engineers (PSME)
Metallurgical Engineer	Society of Metallurgical Engineers of the Philippines (SMEP)
Mining Engineer	Philippine Society of Mining Engineers (PSEM)
Naval Architect / Marine Engineer (Marine Engineering is included in the Naval Architecture)	Society of Naval Architects and Marine Engineers (SONAME)
Sanitary Engineer	Philippine Society of Sanitary Engineers (PSSE)
Industrial Engineer (IE)	Philippine Institute of Industrial Engineers (PIIE)
Aeronautical Engineer	Society of Aerospace Engineers of the Philippines (SAEP)
Agricultural Engineer	Philippine Society of Agricultural Engineers (PSAE)
Civil Engineer (CE)	Philippine Institute of Civil Engineers (PICE)
Chemical Engineer (ChE)	Philippine Institute of Chemical Engineers (PIChE)
Electrical Engineer (EE)	Institute of Integrated Electrical Engineers (IIEE)

The engineering disciplines indicated in Table 4 are associated with its respective APOs. These APOs are members of the Philippine Technological Council (PTC). At the ASEAN level, PTC is a member of ASEAN Federation of Engineering Organisations (AFEO). Table 5 indicates the members of AFEO.

Table 5 Members of ASEAN Federation of Engineering Organisations (AFEO) [21]

ASEAN Engineering Organisation	Member State
Pertubuhan Ukur, Jurutera & Arkitek (PUJA)	Brunei Darussalam
Board of Engineers, Cambodia (BEC)	Kingdom of Cambodia
Persatuan Insinyur Indonesia (PII)	Republic of Indonesia
Laos Union of Scientist and Engineers Associations (LUSEA)	Laos People's Democratic Republic
The Institution of Engineers, Malaysia (IEM)	Malaysia
Federation of Myanmar Engineering Societies (Fed. MES)	Myanmar
Philippine Technological Council (PTC)	Philippines
The Institution of Engineers, Singapore (IES)	Singapore
The Engineering Institution of Thailand (EIT)	Thailand
Vietnam Union of Science & Technology Association (VUSTA)	Viet Nam

On the other hand, Table 6 indicates APEC Member Economies participating in the APEC Engineer Registry. Notice that among ASEAN, only Indonesia, Malaysia, Philippines, and Singapore fully participated APEC Engineer Registry.

Table 6 APEC Member Economies Having Full Rights of Participation in APEC Engineer Registry [12]

APEC Engineering Organisation	Member Economy
Persatuan Insinyur Indonesia (PII, 2001)	Indonesia
The Institution of Engineers, Malaysia (IEM, 2000)	Malaysia
Philippine Technological Council (PTC, 2003)	Philippines
The Institution of Engineers, Singapore (IES, 2005)	Singapore
Engineers Australia (EA, 2000)	Australia
Engineers Canada (EC, 2000)	Canada
Chinese Institute of Engineers (CIE, 2005)	Chinese Taipei
Hong Kong Institution of Engineers (HKIE, 2000)	Hong Kong China
Institution of Professional Engineers Japan (IPEJ, 2000)	Japan
Korean Professional Engineers Association (KPEA, 2000)	Korea
Engineering New Zealand (EngNZ, 2000)	New Zealand
Association for Engineering Education of Russia (AEER, 2010)	Russia

National Council of Examiners for Engineering and Surveying (NCEES, 2001)	United States
Peruvian Engineers Association / Colegio de Ingenioros del Peru (PEA/CIP, 2008)	Peru

C. The Electronics Engineering (ECE) Profession in the Philippines

The law governing the Electronics Engineering (ECE) Profession in the Philippines is Republic Act No. 9292 and this features *information and communications technology (ICT)* as one of its scope of practice.

Table 7 Engineering Disciplines Together With Its Respective Statute / Legal Basis

Engineering Disciplines	**Statute**
Electronics Engineering (ECE)	Republic Act No. 9292
Geodetic Engineering (GE)	Republic Act No. 8560
Mechanical Engineer (ME)	Republic Act No. 8495
Metallurgical Engineer	Republic Act No. 10688
Mining Engineer	Republic Act No. 4274 as amended by Republic Act. No. 5677
Naval Architect / Marine Engineer (Marine Engineering is included in the Naval Architecture)	Republic Act No. 4565
Sanitary Engineer	Republic Act No. 1364
Industrial Engineer (IE)	Non – Government Organisation but recognized by the Philippine Technological Council (PTC) and IEs are accepted in ASEAN Engineer Register (AER) and ASEAN Chartered Professional Engineer Registry (ACPER)
Aeronautical Engineer	Presidential Decree No. 1570
Agricultural Engineer	Republic Act No. 10915
Civil Engineer (CE)	Republic Act No. 544 as amended by Republic Act No. 1582
Chemical Engineer (ChE)	Republic Act No. 9297
Electrical Engineer (EE)	Republic Act No. 7920

Prior to the implementation of RA 9292, there was an old law named Republic Act No. 5734 known as the "Electronics and Communications Engineering Law of the Philippines". While both RA 5734 and RA 9292 uses the initials "ECE", the former refers to "Electronics and Communications Engineering" while the former refers to "Electronics Engineering". There are misconceptions that truncating the word "Communications" from "Electronics and Communications Engineering" that led to "Electronics Engineering" narrowed down the scope of practice of ECE. On the contrary, the Electronics Engineering (ECE) scope of practice pursuant to RA 9292 significantly broadened. As a matter of fact, prior to the implementation of RA 9292, the Board Examination subjects were only Mathematics (30%), Electronics Engineering (30%) and Communications Engineering+ (30%). Moreover, during the implementation of RA 9292, there are four subjects namely Mathematics (20%), General Engineering and Applied Sciences (20%), Electronics Engineering (30%), and Electronics Systems Technologies (30%). Furthermore, RA 5734 as compared with RA 9292, the latter had already repealed the former and RA 9292 actually has three levels of *Electronics Practitioners* namely: Professional Electronics Engineer (PECE), Electronics Engineer (ECE), and Electronics Technician (ECT).

Table 8 Comparisons of RA 5734 and RA 9292

	RA 5734	**RA 9292**
Name of Profession	Electronics and Communications Engineering (ECE)	Electronics Engineering (ECE)
Categories of Practice	One (Electronics and Communications Engineer or ECE)	Three (Professional Electronics Engineer or PECE, Electronics Engineer or ECE, and Electronics Technician or ECT)
Board Exam Scope (for ECE)	Mathematics, Electronics Engineering, and Communications Engineering	Mathematics, General Engineering and Applied Sciences, Electronics Engineering, Electronics Systems Technologies
Effectivity	Repealed by RA 9292	Still in effect

Electronics Engineering (ECE) is distinct from Electrical Engineering (EE) per regulation of the Professional Regulation Commission of the Philippines while both professions are recognized by the Philippine Technological Council (PTC) and accepted both in ASEAN and APEC Engineer Register.

D. The Department of Information and Communications Technology (DICT)[15][22]

The Department of Information and Communications Technology (DICT) is the National Government Agency (NGA) in the Philippines that executes ICT policies, plans

and agenda. It is also the NGA championing ICT drives and partnerships among stakeholders. DICT was created in 2016 when agencies such as Information and Communications Technology Office (ICTO), National Computer Center (NCC), National Computer Institute (NCI), Telecommunications Office (TELOF), National Telecommunications Training Institute (NTTT), and all operating units of the Department of Transportation and Communications (DOTC) with functions and responsibilities dealing with communications were abolished. These abolished agencies have its powers and functions, budget, records, properties, and personnel transferred to DICT. The names of these abolished agencies are reiterated in this paper in order to provide references to the ICT Roadmaps discussed (offices were reorganized together with the workforce in the organization). The scope and limitation discussed about DICT are its roles in perspectives of ASEAN and APEC. Specifically, one of the Mission of DICT is:

"Be the enabler, innovator, achiever and leader in pushing the country's development and transition towards a world-class digital economy."

It is clearly defined in its Mission that Philippine ICT Roadmap is gearing towards globalization. Referring to Fig. 1, Venn Diagram is used to represent the interrelationships of RA 9292, RA 10844, and International Benchmark (ASEAN/APEC). However, not all DICT programs and projects involve Electronics Engineering Profession. One example is the APEC Accountability Agent by the National Privacy Commission (NPC)[23]. Pursuant to RA 10844, NPC together with the National Telecommunications Commission (NTC), and Cybercrime Investigation and Coordinating Center (CICC) are attached agencies of DICT. Moreover, there are ECE practitioners employed in DICT but do not undergo ASEAN/APEC Benchmarking. Plantilla positions in DICT requiring ECE license are Engineers and IT Officers. Furthermore, there are ECE practitioners who undergone ASEAN/APEC Benchmark but neither employed or associated with ICT.

On the other hand, Section 10 of RA 10844 clearly states that at least one of the Assistant Secretaries shall be a licensed Professional Electronics Engineer (PECE). The Assistant Secretary is the third in-line of DICT hierarchy (Secretary being the highest position, followed by Undersecretary then by Assistant Secretary).

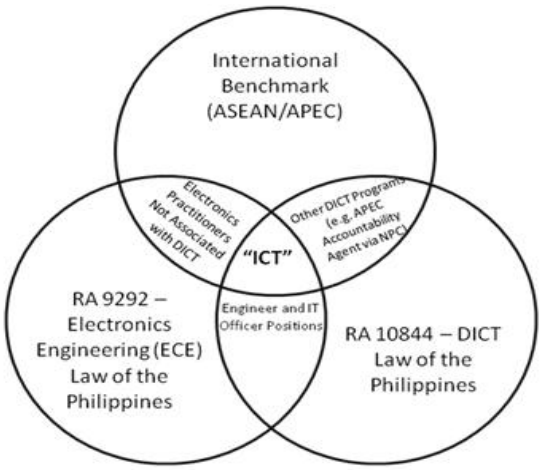


Fig. 1Venn Diagram Representation of Interrelationships of Philippine Electronics Engineering (ECE) Law, Philippine DICT Law and International Benchmark (ASEAN/APEC Engineer Registry)

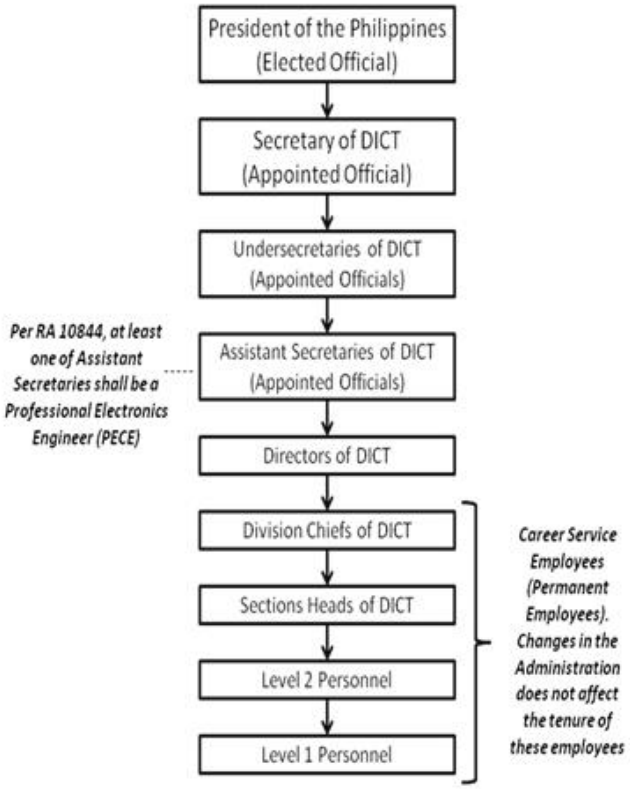


Fig. 2 DICT Hierarchy indicating the level of the Assistant Secretary (in which at least one of position shall be a Professional Electronics Engineer)

discussion

Referring to previous sections, Electronics Engineering (ECE) profession has vital roles in the ICT roadmap before, during and after Covid-19 pandemic as well as disaster risk reduction management [3][24][25].

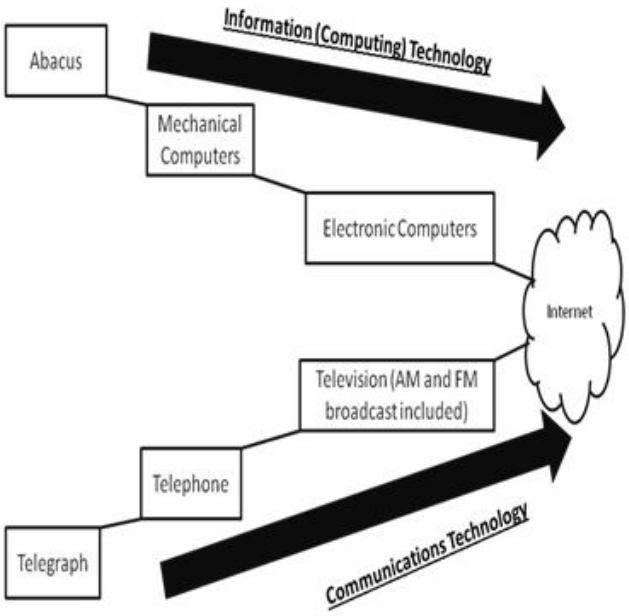


Fig. 3 "Digital Convergence" indicating the how information technology and communications technology converge each other with respect to time.

Likewise, government offices in-charge with Computers and Communications undergone convergence. This clearly indicated that ICT is neither limited with computer (information) technology alone nor communications technology alone. This convergence of government offices coincides with historical digital convergence as well as APEC and OECD studies [26].

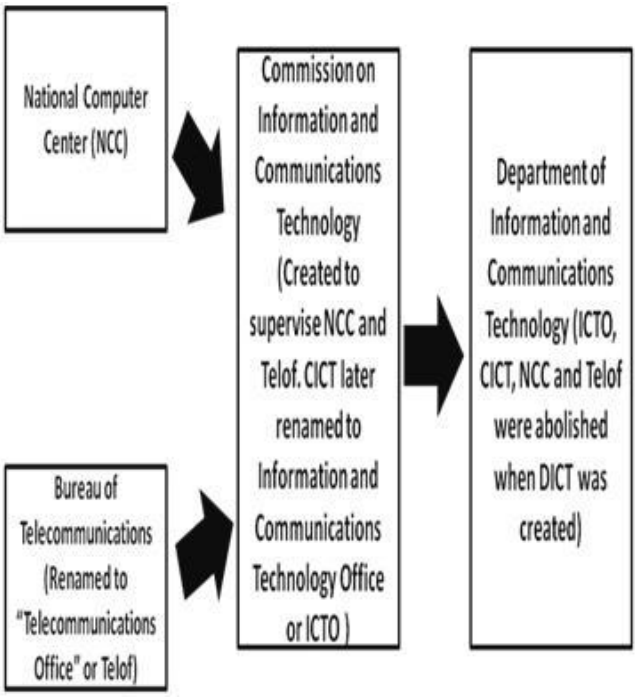


Fig. 4 Convergence of Philippine Government Offices In-Charge with Computers and Communications

Upon discussion of both ASEAN and APEC perspectives of ICT together with the roles of Electronics Engineering (ECE). Likewise, government offices in-charge with Computers and Communications undergone convergence. This clearly indicated that ICT is neither limited with computer (information) technology alone nor communications technology alone. This convergence of government offices coincides with historical digital convergence as well as APEC and OECD studies [26].

The 2006-2010 ICT Roadmap of the Philippines focused on Community e-Centers (CeCs) that aimed to reach out the marginalized sectors and other stakeholders down to grassroots levels while globalization was also pronounced [27]. Reaching out various sectors fulfills the Gender and Development (GAD) agenda. Empowering these sectors through digital literacy and capacity building enables them to be an economic contributor. This roadmap also aimed to create laws to strengthen ICT drives as well as updating old laws (including the abolition of NCC and Telof when DICT was created in 2016). However, there was no provision for Electronics Engineering profession despite of existence of RA 9292 and ASEAN / APEC Engineer Register. Moreover, there are many experienced Electronics Engineers in the old agency named Telecommunications Office (Telof) and considered permanent employees. Furthermore, even the National Broadband Plan was pronounced, the provision for backbone infrastructure was not included. In 2011, the Commission on Information and Communications Technology was renamed "Information and Communications Technology Office (ICTO)" Consequently, ICTO became an attached agency of the Department of Science and Technology (DOST). With ICTO being attached to DOST, research and development (R&D) agenda can be in future ICT roadmaps.

The 2011-2015 ICT Roadmap of the Philippines had included Institute of Electronics Engineers of the Philippines (IECEP) as one of its stakeholders [28]. In addition, the roles of Philippine ICT in ASEAN was pronounced and elaborated while APEC was also mentioned. Under this roadmap, CICT is now transforming into DICT in order to obtain its own statute/charter. On the other hand, when CICT became ICTO, another roadmap was created entitled "The Philippine Roadmap for Digital Startups, 2015 and Beyond". In this 2015 roadmap, engineering disciplines were now emphasized as these are essential in creating startups.

ICTO, CICT, NCC and Telof were abolished when DICT was created in 2016. However, the functions and personnel of these abolished agencies were just transferred to DICT. The Philippines finally launched the Strategic Engagement and Collaboration to Undertake a Reliable and Efficient Government Internet (SECURE GovNet) project on November 2017[29]. The author of this paper is the Focal Person of SECURE GovNet project and collaborated with expatriates as well as other government stakeholders. Once the infrastructure commenced operation, appropriate technology management is necessary. Moreover, *Technology Management (TM)* is one of the skills stipulated in the competency standards for ASEAN Engineers [30].

Table 9 Number of Registrants in the ASEAN Engineering Register per Country (subject to changes) [9]

Member States	Number of Registrants
Brunei	45
Cambodia	475
Indonesia	525
Laos	12
Malaysia	2182
Myanmar	362
Philippines	1214
Singapore	38
Thailand	39
Viet Nam	261

Referring to Table 9, if there are one thousand two hundred fourteen (1214) registered engineering practitioners from the Philippines and there are thirteen (13) engineering disciplines representing the Philippine Technological Council, there are only around ninety-three (93) Electronics Engineering practitioners with the assumption of equal distribution of disciplines in the roster. This date indicate that even Filipino ECEs are vital in ASEAN ICT perspectives, the number is smaller compared with Malaysia. However, relative other ASEAN Member States, Philippines ranked second highest in the number of registrants. On the other hand, Table 10 indicates the number of registrants in the APEC Engineer Registry per participating Member Economies.

Table 11 PTC Report on APEC Engineer Registry as of January 2020 (subject to changes) [20]

Member Economy	Number of Registrants
Indonesia	26
Malaysia	341
Philippines	133
Singapore	12
Australia	10000+
Canada	16
Chinese Taipei	80
Hong Kong China	54
Japan	2589
Korea	562
New Zealand	1472
Russia	30
United States	334
Thailand	244

CONCLUSION

The ICT Roadmaps of the Philippines continue to evolve in order to keep abreast with technological changes and disruptions. The are many laws in the Philippines pertaining with ICT which are aligned with ASEAN and APEC benchmarks while there are some laws needed to be updated. However, updating, amending, and / or repealing laws might be strenuous as this requires time, resources and efforts. In order to mitigate these issues, some non-government organizations spearhead engineering mobility (e.g. ASEAN Federation of Engineering Organisations and APEC – International Engineering Alliance). However, *engineering* is still a broad profession consisting of various disciplines in which ICT is under the scope of practice of Electronics Engineering (ECE). Moreover, ECE has still various scopes of practice aside from ICT. Furthermore this paper focused on ASEAN/APEC perspectives of Philippine ICT Roadmap in order to gauge the benchmark of engineering practices. ICT roadmaps of the Philippines also encompass the following but not limited to: *digital literacy*, *capacity building*, and *providing equitable access*. These functions of DICT are indeed associated with Electronics Engineering (ECE) profession. Specifically, the ICT sector not directly associated with ECE is called ICT-Enabled Sectors. Both ICT-Enabled Sectors and ICT Sectors were defined by RA 10844. Table 12 indicates some examples of both ICT Enabled Sectors and ICT Sectors.

Table 12 Examples of ICT Enabled Sectors and ICT Sectors

ICT Enabled Sectors	ICT Sectors
HR Tasks	Telecommunications
Finance	Broadcasting
Education Sectors *EXCEPT* to those having Technical Disciplines such as Engineering	Programming / Networking / Computer Hardware and Software

It was stated in this paper that Philippine ICT Roadmaps focus also community connectivity and digitalization. These ICT enabled skills help the participants to be globally competitive in their respective fields of expertise in the ICT Enabled Sectors. Table 13 indicates the number of people obtained ICT enabled skills upon completing DICT program named Rural Impact Sourcing (RIS, later rebranded to Digital Jobs). It is notable that in year 2020, online workers increased significantly due to *WFH* schemes implemented when pandemic struck (year 2020*). Moreover, data in Table 13 covers only Regions 3 and 4A of the Philippines [24].

Table 13 Number of DICT Trainees Who Obtained Online Jobs After Undergoing Digital Jobs Training Program

Year	Number of Trainees Who Obtained Online Jobs
2017	**40**
2018	**53**
2019	**51**
2020*	**91**

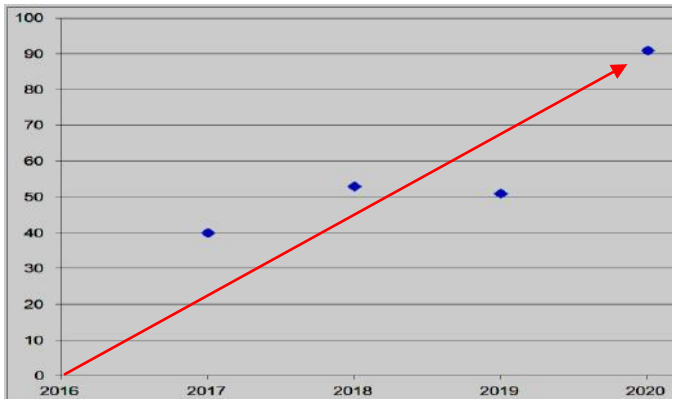


Fig. 5 Plot of Number of Trainees versus Year Time Lapse

The correlation coefficient is 0.876 which seemed a positive correlation of trainees who got online jobs (either *freelancing* or in *IT-BPM* companies) and the progression of year especially during the pandemic. The data for 2021 is not yet available as the training is still in progress. With this positive correlation, online workers both *ICT Sectors* and *ICT Enabled Sectors* may significantly increase. With this expansion, improvement of ICT infrastructures is necessary creating challenges and opportunities for the *electronics engineering* practitioners [24].

REFERENCES

[1] ASEAN Member States
URL: https://asean.org/about-asean/member-states/
Date Retrieved: December 15, 2021
[2] The ASEAN Charter, Article 1, Section 2
[3] R.A. De Jesus, "Challenges and Opportunities in the Field Of Information and Communications Technology (Ict) due to Covid-19 Pandemic and Migration Towards The New Normal", Turkish Journal of Computer and Mathematics Education, Vol.12 No. 11 (2021), 3406- 3422.

[4] R. Salac and Y. Kim "A Study on The Internet Connectivity in The Philippines", August 2016;1(1):67-88, http://dx.doi.org/10.20522/APJBR.2016.1.1.67
URL:https://www.koreascience.or.kr/article/JAKO201627037745764.pdf
Date Retrieved: December 15, 2021
[5] R.A. De Jesus, "Professional Engineering Practice: Engineering Science of Energy and Environment", p. 141 ISBN 978-971-0572-51-9, 2014
[6] R.A. De Jesus, "Professional Engineering Practice: ELECTROMAGNETICS: Engineering Outcomes Oriented", p. 10 ISBN 978-971-0572-54-0, 2015

[7] R.A. De Jesus, "Engineering Science of Energy and Environment (Electrical / Electronics Engineering Approach)", pp. 175 – 176 ISBN 978-971-95047-4-0, 2016
[8] About APEC
URL: https://www.apec.org/about-us/about-apec
Date Retrieved: December 15, 2021
[9] ASEAN Engineering Register
URL: https://aer.afeo.org/find-engineer/
Date Retrieved: January 1, 2021
[10] APEC Engineer Register – Philippines
URL:https://www.prc.gov.ph/sites/default/files/APEC%20REGISTER%20UPDATE%20as%20of%20March%202019.pdf
Date Retrieved: January 1, 2021
[11] ASEAN Chartered Professional Engineer Register
URL: http://acpecc.net/v2/search.php?query=acper
Date Retrieved: January 1, 2021
[12] APEC Agreement - Members
URL: https://www.ieagreements.org/agreements/apec/members/
Date Retrieved: December 15, 2021
[13] R. Vea, "The Elusive Critical Mass of Research Scientists and Engineers (RSEs)" Science Advisory No. 2020-02
URL:https://www.nast.ph/images/pdf%20files/Publications/ScienceAdvisory/SA20_02.pdf
Date Retrieved: December 15, 2021
[14] Philippine Republic Act No. 9292
[15] Philippine Republic Act No. 10844
[16] International Telecommunication Union (ITU): Document C16/INF/13, ―ITU Council Contribution to the 2016 United Nations High – Level Political Forum on Sustainable Development, pp. 1, 6, 7, 8
[17] Learning Portal: INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT)
URL:https://learningportal.iiep.unesco.org/en/glossary/information-and-communication-technologies-ict
Date Retrieved: December 15, 2021
[18] Philippine Technological Council: Who We Are
URL: https://ptc.org.ph/who-we-are/
Date Retrieved: December 15, 2021
[19] Philippine Technological Council: ASEAN Engineer Application Form
URL:https://ptc.org.ph/wp-content/uploads/2021/09/AER-Form-version-3.3.18.docx
Date Retrieved: December 15, 2021
[20] Philippine Technological Council: APEC Engineer Application Form
URL:
https://ptc.org.ph/wp-content/uploads/2016/06/APEC-Form-2016-April-2016.docx
Date Retrieved: December 15, 2021
[21] ASEAN Engineering Register: Secretariat
URL: https://aer.afeo.org/contact/
Date Retrieved: December 15, 2021
[22] DICT Information Booklet
URL:
https://dict.gov.ph/wp-content/uploads/2018/03/What-is-DICT.pdf
Date Retrieved: December 15, 2021
[23] Privacy Commission launches open call for accountability agent applicants for APEC cross-border privacy rules system
URL:https://www.privacy.gov.ph/2021/10/privacy-commission-launches-open-call-for-accountability-agent-applicants-for-apec-cross-border-privacy-rules-system/
Date Retrieved: October 15, 2021
[24] R.A. De Jesus, "ASSESSMENT OF TELECOMMUTING SCHEMES OF WORKING ENVIRONMENT IN THE PHILIPPINES BEFORE AND DURING COVID-19 PANDEMIC ", Institute of Electronics Engineers of the Philippines (IECEP), Electronics Engineering Conference 2021
[25] R.A. De Jesus, "Roles of Information and Communications Technology in Resilience Toward Sustainable Asia–Pacific Region", 37th Conference ofASEAN Federation of Engineering Organisations (CAFEO 37), Jakarta, Indonesia 2019
[26] S.H. Park and M. Pangestu, "THE NEW ECONOMY AND APEC CAPACITY BUILDING", p.1 , ANU Research Publications 2002
[27] "Philippine Strategic Roadmap for the Information and Communications Technology Sector", Commission on Information and Communications Technology 2006-2010

URL:https://dict.gov.ph/ictstatistics/wp-content/uploads/resources/Philippine-ICT-Roadmap-2006-2010.pdf
Date Retrieved: October 15, 2021
[28] "THE PHILIPPINE DIGITAL STRATEGY TRANFORMATION 2.0: DIGITALLY EMPOWERED NATION", Commission on Information and Communications Technology 2011-2015
URL:https://dict.gov.ph/wp-content/uploads/2014/06/philippine-digital-strategy-2011-2015.pdf
Date Retrieved: October 15, 2021
[29] PH launched ultra high-speed internet infrastructure project
URL:
https://pcoo.gov.ph/news_releases/ph-launched-ultra-high-speed-internet-infrastructure-project/
Date Retrieved: February 19, 2018
[30] GUIDE TO THE ASEAN ENGINEERS REGISTER
URL:
http://afeo.org/wp-content/uploads/2016/07/AER_Guide_to_the_AER.pdf, p 45
Date Retrieved: January 1, 2021

Financial Literacy Web-based Learning Application Tool for Students of Higher Education Institutions

[1]Virgie Liza S. Mamauag, [2]Maricris M. Usita
[1][2] Occidental Mindoro State College

Abstract
Online learning and knowledge sharing are now the trends in an educational setting. Educational online learning will fill the gap in getting the necessary knowledge about financial literacy. Students are encouraged to be financially literate to appreciate their purpose in life. The study focused on website development and evaluation for Higher Education Institutions' students to appreciate and internalize the value of financial literacy, including saving, spending, and investing. The experimental research was utilized and focused on the processes involved in developing the system. This study employed data analysis, online data gathering and used website validation, evaluation performance, and website deployment. A total of 145 respondents evaluated the web application. Results showed that all the pages passed the required tests. Further, the website's performance evaluation is based on the Website Evaluation Questionnaire (WEQ) criteria through randomly sampled respondents and obtained a numerical rating of 4.07, which exceeded expectations in descriptive terms. Therefore, the developed website could serve as a helpful tool in learning financial literacy.

Keywords
Information and communication technology, financial literacy, web-based, learning application, savings, proper spending, investing.

1. INTRODUCTION

Financial education remains a significant challenge in the global arena because financial crises affect the national economy. Moreover, global financial literacy confirmed poor economic behavior affects individuals and the global economy across developed and developing countries [1].

Financial literacy is essential because it influences people to save, borrow, invest, and manage their financial affairs. It helps to improve the quality of financial service and contribute to economic growth and development [2]. Financial education and behavioral intervention are crucial in shaping good money management skills [3]. Learning plays a vital role in establishing student financial literacy through teaching methods, media, and learning resources planned under a competency that provides skills in finance [4].

The State recognizes the country's growth and potential through financially literate people who make sound financial decisions, mobilize savings, and contribute ideas on improving economic and monetary policies and programs. Financial literacy plays a vital role in financial decision-making that helps financially literate people better plan retirement [5]. However, the Organization for Economic Co-operation and Development surveys, 30 countries' financial literacy levels are low in financial knowledge, financial attitude, and financial behavior [6]. The educational programs and testing tools are important to upgrade the financial market, learn to manage personal finances, and choose financial services effectively. People's lives experience financial loss due to extravagant spending and consumption, unwise use of money. Financial capability is related to their ability to manage money [7]. The Philippine government developed a control measure to optimize improving financial literacy. The RA No. 10922, an act, declares the State's policy to create national consciousness on economic and financial literacy by announcing the second week of November of every year as "Economic and Financial Literacy Week."

Students should be exposed to money and financial decision-making. The digital natives of today's generation and generation Z strive to be financially savvy. Understanding Generation Z financial literacy significantly influences their gender [8]. Digital financial literacy is emerging as a key enabler involving a set of knowledge, awareness, and abilities, including aspects of financial literacy and digital literacy [9]. Financial attitudes affect financial behavior and can mediate the influence of financial knowledge on financial behavior, which forms good intentions in the finances of individual behavior [10]. People must have the financial literacy to manage their personal finance well [2].

Students face a complicated financial decision in spending their money and allowances, especially today that online shopping is the trend, attracting people to increase more than usual. Students are advised to continue to improve their financial literacy to improve financial management that can lead to investment [11]. Financial literacy will make the

individual more selective in financial decision-making. There is a need and benefit of improving financial literacy to make individuals less financially fragile [12]. It positively influences savings decisions [13], and it is essential to understand the relationship between financial behavior and decision-making [14].

We can't blame our income for our financial problems because its primary cause is the absence of financial literacy, which causes issues in financial management such as financial planning and misuse of credit [15]. The limited knowledge about financial literacy may lead the students to become involved in financial problems during school life, which significantly affects their present and future family and professional life. The emergence of financial issues is not only due to a low level of income but can also come from a person's lack of knowledge in managing their finances [4]. Many people do not understand finance, so they cannot manage finances properly [16].

There is a need to improve students' financial skills because most parents suffer from economic challenges, loans, debt, and financial illiteracy. Because of that, financial education is one promising way to improve the financial capacity of students. Literacy helps an individual's knowledge and expertise towards finance and shapes a financial attitude towards money, behavior, financial planning, and ability to control their finances [17]. A financial literacy model is needed for financial education, and it is essential to understand the educational impact and barriers to effective financial choice [18]. The faculty has a role in providing proper skills and knowledge on managing students' financial resources effectively for financial security and developing supplementary materials for students to help them manage their finances. The paper provides information that financial literacy is the relevance of art-based instruction to social education and financial education affecting teachers [19].

Technological developments influence education, the development of online learning or e-learning has significant developments on financial management [20]. The development of web-based application play a vital role in providing financial knowledge that is interactive and flexible. The study aims to develop a web-based learning tool for students of Higher Education Institutions and improve the financial literacy of tertiary students, specifically those beneficiaries of the government allowance program. This application would be a great help for the students to be financially literate to help solve financial capability by using available technology. E-learning and financial literacy are currently running, and lifestyle significantly affects financial literacy [20]. The system will serve as a good platform for providing valuable and educational information to the students. The system can provide lessons, videos, webinars, and activities.

Furthermore, this study aims to provide a more profound understanding of money and its use in daily life. It includes how income and expenditure are managed and the ability to use the standard methods of exchanging and managing money. Lastly, financial literacy consists of understanding everyday situations that need to be understood, such as credit and appreciation of savings and borrowings and investing.

The study developed and evaluated the Financial Literacy Web-based Learning Application Tool for Students of Higher Education Institutions. Specifically, the study aims to achieve the following objectives:

1. Develop an appropriate Web-based Learning Application for Financial Literacy with informative digital materials, supplementary Learning Material, and open communication.
2. Test and improve the developed website based on Website Evaluation Questionnaire (WEQ) standards, and
3. Evaluate the performance of the developed Web-based Learning Application for Financial Literacy in terms of ease of use, hyperlinks, structure, relevance, comprehension, completeness, layout, and search option.

II. METHODS

System Architecture

The system's architectural design is shown in Figure 1, which describes the system's overall structure and how the significant components interact.

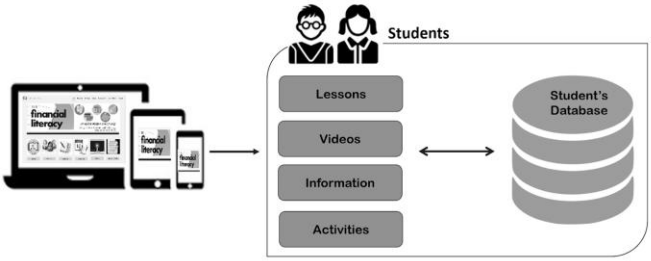


Fig. 1. The architecture of the Financial Literacy Web-based Learning Application Tool

In this system, the users are the students or Higher Education Institutions. The user submits information online, and then the system saves it on the database. Online login is needed to monitor the students using the system. The admin provides all the necessary resources for the user. The proposed system aims to identify the students' level of knowledge and provide better intervention. The researchers developed a web-based system that uses cloud computing. Various Google applications were utilized as a service provider and for the overall presentation of the system functions. Utilized the Google Chart to display the number of users while Google Calendar was for date and time. There are two primary users of the system. The regular users are the teachers who are responsible for the updating of lessons. Each teacher user has an account that the admin created. The admin and user have a separate system interface. Some of the functions in the user's pages are similar except for the admin, which holds complete access to the system's features.

The System Components

The system aims to provide helpful information and insights about financial literacy. These will guide them in seeking information about financial literacy, money, proper spending, savings, and investing. The web-based system uses cloud

computing, and Google applications were utilized as a service provider for the system. The use of a client and server framework holds the database and uses MySql as its server scripting language. The client is any computer that accesses the internet. The primary users of the system are the students and teachers who are authorized to use the system. The system requires them to input their information to the Sign-up page for monitoring purposes. The website has four major components, specifically, the "Lessons," the "Videos," the "Activities," and the "Information." The "Lessons" contains related information about financial literacy education, money, earning, proper spending, and investing. It is based on the available resources online.

The "Videos" are combinations of animations, motion graphic videos, screencast videos, and live-action screencasts. The "Activities" is the practice assessment for students to help them assess their capabilities and skills. The website can generate specific results provided the users choose from the given options, and the changes made by the user will only apply until the user logs out or closes the browser.

A financial literacy application is a web-based application accessible to students and faculty interested in learning and gaining knowledge about financial learning.

Project Development
The proponents deliver the project by the following standard development life cycle program. The study used the System Development Life Cycle model for project development. The process consists of the following steps: Analysis, Designing, Coding, Testing, and Implementation of the output project.

The analysis gathers needed data from students about saving money, spending their parents' allowances, and prioritizing spending their money. The accuracy of data and information for the system is necessary to meet the project set objectives. The proponents utilized interviews, surveys, and reading-related materials, the essential processes to gather crucial input requirements to gain the project set goals. The designing stage includes Context Diagram, and a storyboard is used as a guide in developing all the features required by the system. These served as the basis for the number of forms or windows that the plan contained. The coding involved designing and coding the website.

The proponents browse the internet, research-related information, and search for the codes and designs from the internet and libraries for the physical and logical structure. The Hypertext Preprocessor (PHP) is the scripting language used in coding the web-based application. During the development of the system (Development of a Web-based Application), the website undergoes a series of testing procedures and is evaluated by experts and end-users. An open-ended evaluation of the system was utilized and answered to get pertinent comments and recommendations for the study's success. Implementation is the step-by-step procedure for the deployment of the system.

The web-based application is used in website development based on the students' needs from Occidental Mindoro State College. The research employed the research designs in developing the Financial Literacy application. The experimental study focuses on the processes involved in developing the system to identify the appropriate and well-structured format suitable for end-users.

The researcher administered an assessment among faculty members, students, and Occidental Mindoro State College experts for the website's validation. Moreover, the website development's content and information were assessed through the validated survey questionnaire by peers and experts in the field. The application was evaluated by 145 students from Occidental Mindoro State College, AY 2021 – 2022. They were randomly selected using simple random sampling.

Research Design
The researcher used the descriptive method of research utilizing the developmental study. The descriptive developmental study was used to attain the desired evaluation of the developed Financial Literacy Web-based Learning Application Tool.

The study used the descriptive research method through the survey technique. It aims to describe the prevailing conditions of people, events, or phenomena. As a result, the Website Evaluation Questionnaire was adopted and used to assess Financial Literacy Web-based Learning Application Tool for Students.

Sources of Data
Questionnaires utilized were the Website Evaluation Questionnaire (WEQ) instrument, one of the websites' most popular evaluation tools. It was developed by the Human Factors Research Group (HFRG) in 1999 (Claridge and Kirakowski, 2011).

The study was developed Financial Literary Web-based Learning Application Tool. It was administered to Occidental Mindoro State College students and faculty during 2021 – 2022.

Statistical Treatment of Data
Mean was used to determine how the student-respondents evaluated the website using ease of use, hyperlinks, structure, relevance, comprehension, completeness, layout, and search option.

III. RESULT AND DISCUSSION

Project Description and Structure

The Web-based Financial Literacy Application created a useful online tool for students that consisted of different buttons, navigations, images, links, and text. In addition, the website aimed to update, evaluate the current and subsequent learning tools and environment for students through videos, lessons, activities and provide valuable and informative information through a webinar. The application was composed of a home page that can be viewed online using a different browser like Google Chrome, Bing, Mozilla

Firefox, Torch and Internet Browser, and the like. Besides, the application is compatible with a personal computer, laptop, and mobile phone.

Website Evaluation

Evaluated the website's performance for ease of use, hyperlinks, structure, relevance, comprehension, completeness, layout, and search option. There were 145 randomly selected students who evaluated the website. All the criteria provided were considered as an essential aspect of website development. Every component needs to work quickly and correctly.

The site worked as expected, including forms, site search, and hyperlinks. In addition, the negative statements were tabulated and converted into positive values to inverse the result for the tabulated data for more precise interpretation.

Table 1 shows the result of the website's appropriate placement, navigation, and environment manipulation. Ease of use represents the totality of the site in terms of its presentation, design, environmental manipulation, and information content. Two (2) items were evaluated as Extremely Useful. At the same time, the website's difficulty is moderately helpful (3.10), and the overall ease of use means 3.90, which shows that the respondents quickly find what they are searching for. Therefore, they appreciate the overall usefulness of the website.

Table 1. The ease of use of the Financial Literacy Web-based Learning Application Tool for Students of Higher Education Institutions.

Ease of Use	Mean	Descriptive Rating
I find this website easy to use.	4.30	Extremely Useful
I consider this website user-friendly.	4.30	Extremely Useful
I had difficulty using the website. *	3.10	Moderately Useful
Overall Mean	3.90	Very Useful

Table 2 shows the result of the evaluation of the website hyperlink. It gained a mean score of 4.15. Providing good quality information helps the user provide Very Satisfied results. Hyperlinks are essential to reference a document in another document. The website hyperlinks connect pages and other resource information such as images, videos, and buttons. In addition, hyperlinks help the user be interested in manipulating the sites.

Table 2. The Financial Literacy Web-based Learning Application Tool for Students of Higher Education Institutions are hyperlinks.

Hyperlinks	Mean	Descriptive Rating
1. The homepage directs me towards the information I need.	4.50	Extremely Satisfied
2. The homepage immediately points to the information I need.	4.40	Extremely Satisfied
3. It is unclear which hyperlink will lead to the information I am looking for.	3.50	Very Satisfied
4. Under the hyperlinks, I found the information I expected to find there.	4.20	Extremely Satisfied
Overall Mean	4.15	Very Satisfied

Table 3 presents the evaluation result concerning the website's structure. It shows that the information needed is easy to find, which obtained a mean score of 4.30 interpreted as Extremely Satisfied. The redirection of the website (4.10) and the structure of the website is clear (4.40) were also interpreted as Extremely Satisfied, while the website convenience helps find information easily (4.40) were interpreted as Extremely Satisfied. The overall mean of 4.30, which is extremely satisfactory, shows the structure is valuable from the homepage, category, tags, and pages interconnectivity.

Table 3. The Financial Literacy Web-based Learning Application Tool structure for Students of Higher Education Institutions.

Structure	Mean	Descriptive Rating
1. I know where to find the information I need on this website.	4.30	Extremely Satisfied
2. I was constantly being redirected to this website while I was looking for information.	4.10	Very Satisfied
3. I find the structure of this website clear.	4.50	Extremely Satisfied
4. The convenient setup of the website helps me find the information I am looking for.	4.20	Extremely Satisfied
Overall Mean	4.15	Very Satisfied

Table 4 revealed that the results for relevance are all Extremely Relevant and the overall mean score was 4.40. The result shows that the website performs well per the respondents' expectations. The website provides a good user experience that makes them accessible and navigates easily to needed information. In addition, the tools and content of the site meet the user's requirements, and the users considered the website as compact, coherent, sequential, and logical.

Table 4. The relevance of the Financial Literacy Web-based Learning Application Tool for Students of Higher Education Institutions.

Relevance	Mean	Descriptive Rating
1. I find the information on this website helpful.	4.50	Extremely Relevant
2. The information on this website is of little use to me	4.30	Extremely Relevant
3. This website offers information that I find useful	4.40	Extremely Relevant
Overall Mean	4.40	Extremely Relevant

Table 5 shows the comprehension performance of the website with an overall mean of 4.17 indicates that the website is easy to use and understand. The website obtained a very satisfactory rating because it is language and information they can easily trace the information they are looking for. In addition, the icons and links are well organized and easy to access.

Table 5. The comprehension of the Financial Literacy Web-based Learning Application Tool for Students of Higher Education Institutions.

Comprehension	Mean	Descriptive Rating
1. The language used in this website is clear to me.	4.60	Extremely Satisfied
2. I find the information on this website easy to understand.	4.50	Extremely Satisfied
3. I find many words on this website difficult to understand. *	3.40	Very Satisfied
Overall Mean	4.17	Very Satisfied

Table 6 shows the completeness performance of the website with an overall mean of 3.93 indicates that the website is complete. Thus, the website obtained a very satisfactory rating because it provides sufficient information on financial literacy.

Table 6. The completeness of the Financial Literacy Web-based Learning Application Tool for Students of Higher Education Institutions.

Completeness	Mean	Descriptive Rating
1. The website provides me with sufficient information.	4.50	Extremely Complete
2. I find the information on this website incomplete. *	3.20	Moderately Complete
3. I find the information on this website precise.	4.10	Very Complete
Overall Mean	3.93	Very Complete

Table 7 shows the layout performance of the website with an overall mean of 3.83, indicating that the website is appealing and looks attractive. The website obtained a Delighted result since the layout is simple, clean, and designed to draw attention to the user. In addition, the website is well presented, and its content is well organized, including the menu options and its elements. The design and links are well organized and easy to access.

Table 7. The layout of the Financial Literacy Web-based Learning Application Tool for Students of Higher Education Institutions.

Layout	Mean	Descriptive Rating
1. I think this website looks unattractive. *	3.00	Moderately Satisfied
2. I like the way this website looks.	4.23	Extremely Satisfied
3. I find the design of this website appealing.	4.20	Extremely Satisfied
Overall Mean	3.83	Very Satisfied

Table 8 shows the search option performance of the website with an overall mean of 4.07 indicates that the website is easy to navigate and manipulate. Thus, the website obtained a very satisfactory rating because it is helpful in the sense that even they utilized the site for the first time, they can easily trace the lessons they are looking for. In addition, the icons and links are well organized and easy to access.

Table 8. The Financial Literacy Web-based Learning Application Tool for Students of Higher Education Institutions is the search option.

Search Option	Mean	Descriptive Rating
1. This website's search option helps me find the correct information.	4.40	Extremely Satisfied
2. The search option on this website gives me valuable results.	4.40	Extremely Satisfied
3. The search option on this website gives me too many irrelevant results.*	3.40	Very Satisfied
Overall Mean	4.07	Very Satisfied

Table 9 shows the summary results for the Financial Literacy Web-based Learning Application tool for students. The respondents obtained exceeded expectations on the eight different criteria used in the evaluation of the site. The mean score of 3.90 for ease of use signified that the website was simple but attractive and had relevant information. The hyperlinks obtained a mean score of 4.15, which showed that the site was easy to navigate and manipulate. The respondents considered the site structure helpful with a mean of 4.30 due to the proper presentation of links, space, navigation, icons, and image locations.

The system's relevance achieved an overall mean of 4.40, which signified that the system performed the tasks required, provided comfort and convenience to the respondents.

Comprehension obtained an overall mean of 4.17. The result proves that the system used effective coding languages, which is essential and significant to attain the objectives of the site that provide a significant impact on the users. The result for the website's completeness is 3.93, while the layout is 3.83. The search option is 4.07, interpreted as exceeding expectations.

Summary of website performance evaluation results shows that relevance got the highest mean of 4.40 and was interpreted as greatly exceeding expectations and structure with a mean of 4.30. The rest of the criteria were all evaluated as exceeding expectations. Therefore, the system can be one of the tools that help students interact, communicate, share information and resources that lead to learning.

Table 9. Qualitative Interpretation of the Financial Literacy Web-based Learning Application Tool for Students of Higher Education Institutions.

Criteria	Mean	Descriptive Rating
Ease of Use	3.90	Exceeded Expectations
Hyperlinks	4.15	Exceeded Expectations
Structure	4.30	Greatly Exceeded Expectations
Relevance	4.40	Greatly Exceeded Expectations
Comprehension	4.17	Exceeded Expectations
Completeness	3.93	Exceeded Expectations
Layout	3.83	Exceeded Expectations
Search Option	4.07	Exceeded Expectations
Grand Mean	4.07	Exceeded Expectations

IV. CONCLUSION

Every year, the number of graduates produced by Higher Education Institutions (HEI) increases. The scenario is that the number matches job opportunities in the industry. The study provides valuable information about the graduate employment status, forecasting, visualization, and the exploration of classifiers algorithm to analyze the graduate employability in government, non-government organizations, self-employed, and unemployed.

In consideration of the objectives of the study and the results of testing and evaluation carried out, derived the following conclusions:

1. The Financial Literacy Web-based Learning Application Tool for students of HEIs was successfully designed. It has well-represented digital information; it can upload different files as supplementary learning material, and it can communicate easily through comment spaces and buttons.
2. The developed website is compliant with Website Evaluation Questionnaire (WEQ) standards in terms of attractiveness, controllability, efficiency, helpfulness, and learnability as validated by respondents in the test results, and
3. The respondents' evaluation of the website "Exceeded Expectations" proved that the website could be a valuable educational tool in financial literacy education and learning.

V.RECOMMENDATIONS

The utilization of the Financial Literacy Website was highly recommended to both the faculty and students of Occidental Mindoro State College. Likewise, the web application can also be disseminated through an extension program to provide additional knowledge and information to the Out-School Youth (OSY) and even to the Senior High School students in the whole province of Occidental Mindoro.

REFERENCES

1. L. Klapper and A. Lusardi, "Financial literacy and financial resilience: Evidence from around the world," *Finance. Manag.*, vol. 49, no. 3, pp. 589–614, 2020, doi: 10.1111/fima.12283.
2. C. B. P. Wewengkang, M. Mangantar, S. J. C. Wangke, and M. Program, "the Effect of Financial Technology Use and Financial Literacy Towards Financial Inclusion in Manado (Case Study: Feb Students in Sam Ratulangi University Manado)," *J. EMBA J. Ris. Ekon. Manajemen, Bisnis dan Akunt.*, vol. 9, no. 2, pp. 599–606, 2021, doi: 10.35794/emba.v9i2.33593.
3. F. S. Hamid and Y. J. Loke, "Financial literacy, money management skill, and credit card repayments," *Int. J. Consum. Stud.*, vol. 45, no. 2, pp. 235–247, 2021, doi: 10.1111/ijcs.12614.
4. A. F. Hayati and R. Syofyan, "Analysis of Student Digital Financial Literacy in the Era of Industrial Revolution 4 . 0," vol. 192, no. Piceeba, pp. 180–184, 2021.
5. T. Kawamura, T. Mori, T. Motonishi, and K. Ogawa, "Is Financial Literacy Dangerous? Financial Literacy, Behavioral Factors, and Financial Choices of Households," *J. Jpn. Int. Econ.*, vol. 60, no. 77, 2021, doi: 10.1016/j.jjie.2021.101131.
6. OECD, "International Survey of Adult Financial Literacy Competencies," *Oecd*, pp. 1–100, 2016, [Online]. Available: www.oecd.org/finance/OECD-INFE-International-Survey-of-Adult-Financial-Literacy-Competencies.pdf%0A.
7. K. De Beckker, K. De Witte, and G. Van Campenhout, "Identifying financially illiterate groups: An international comparison," *Int. J. Consum. Stud.*, vol. 43, no. 5, pp. 490–501, 2019, doi: 10.1111/ijcs.12534.
8. A. Rahmatia, S. Rahmah, and A. Khairunnisa, "Determinants of Understanding Generation Z Financial Literacy in the Vocational School Students of Kahayan Hilir," *J. Pendidik. Islam*, vol. 4, no. 2, pp. 315–327, 2021, [Online]. Available: http://jurnal.staiannawawi.com/index.php/At-Tarbiyat/article.
9. A. C. Lyons and J. Kass-Hanna, "A multidimensional approach to defining and measuring financial literacy in the digital age," *Routledge Handb. Financ. Lit.*, no. June, pp. 61–76, 2021, doi: 10.4324/9781003025221-7.
10. A. Çoşkun and N. Dalziel, "Mediation effect of financial attitude on financial knowledge and financial behavior," *Int. J. Res. Bus. Soc. Sci. (2147- 4478)*, vol. 9, no. 2, pp. 01–08, 2020, doi: 10.20525/ijrbs.v9i2.647.
11. L. P. Putri, I. Christiana, U. Kalsum, and M. Justianti, "The Influence of Financial Literacy on Investment Decisions During the Pandemic," *J. Int. Conf. Proc.*, vol. 4, no. 2, pp. 301–308, 2021.
12. R. Gupta, A. Hasler, A. Lusardi, and N. Oggero, "Financial fragility in the US: Evidence and

implications," *Glob. Financ. Lit. Excell. Cent.*, no. April, pp. 1–51, 2017, [Online]. Available: https://gflec.org/wp-content/uploads/2018/04/Financial-Fragility-Research-Paper-04-16-2018-Final.pdf?x38887.

13. S. Pangestu and E. B. Karnadi, "The effects of financial literacy and materialism on the savings decision of generation Z Indonesians," *Cogent Bus. Manag.*, vol. 7, no. 1, 2020, doi: 10.1080/23311975.2020.1743618.
14. A. C. Lyons and J. Kass-Hanna, "A methodological overview to defining and measuring 'digital' financial literacy," *Financ. Plan. Rev.*, vol. 4, no. 2, pp. 1–19, 2021, doi: 10.1002/cfp2.1113.
15. N. Sharma, "A Study of Financial Literacy Programs in India," vol. V, no. Iv, pp. 1–4.
16. K. Tanuwijaya and I. R. Setyawan, "Can financial literacy become an effective mediator for investment intention?," *Accounting*, vol. 7, no. 7, pp. 1591–1600, 2021, doi: 10.5267/j.ac.2021.5.011.
17. "Влияние Апоптотических Нейтрофилов На Продукцию Цитокинов И Простагландина E2 M1 Макрофагами Человека," *Иммунология*, vol. 38, no. 4, pp. 46–57, 2017.
18. S. J. Huston, "THE JOURNAL OF CONSUMER AFFAIRS Measuring Financial Literacy," 2010.
19. T. A. Lucey and M. B. Henning, "Toward critically compassionate financial literacy: How elementary preservice teachers view the standards," *Theory Res. Soc. Educ.*, vol. 49, no. 1, pp. 107–136, 2021, doi: 10.1080/00933104.2020.1859422.
20. M. Ferdy Firmansyah and H. Zulian Maulana, "Empirical Study of E-Learning on Financial Literacy and Lifestyle: A Millenial Urban Generations Cased Study," *Int. J. Eng. Sci. Inf. Technol.*, vol. 1, no. 3, pp. 75–81, 2021, doi: 10.52088/ijesty.v1i3.99.

The Effects of Muddy Terrain on Lower Extremity Loading During the Paddy Planting Activity

[1] Agung Kristanto, [2]Farid Ma'ruf, [3]Choirul Bariyah
[1][2][3] Industrial Engineering Department, Faculty of Industrial Technology, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

Abstract
In this research, 30 rice farmers were examined to investigate the effect of muddy terrain on lower extremity loadings during planting chores associated with rice production. A comparison was made against the force loadings on each lower extremity joint when rice cultivating on a flat, firm surface (rigid ground; "no-force") and muddy terrain (mud-force) using 3D Static Strength Prediction Program (3DSSPP). This research choses the toe-off stage of gait for the study since this is when a person raises their right foot off the work surface while planting. Each farmer's tensile viscosity force of mud was calculated individually. The study's findings indicate that muddy working surfaces place an increased load on lower extremity joints. The strain on all joints was found to be much greater in the mud-force condition than in the no-force condition ($p<0.05$). According to the descriptive data for the lower extremity joints, the tensile force of the right and left ankles rose by a ratio of 1.03 to 2.46 times. This study may result in reworking the work-rest schedule and designing an assistive device to decrease lower extremity harm caused by working in a muddy work environment.

Keywords
Biomechanical loads, Work environmental hazard, Musculoskeletal disorders, Muddy work environment, Lower extremity injury, Rice planting process

I. INTRODUCTION

Rice is the predominant carbohydrate source in the majority of Asian countries. Rice consumption is lower in countries outside of Asia, including the United States, Australia, and Europe, according to the International Rice Research Institute (IRRI). Indonesia will be the fourth largest milled rice producer in the world by 2021, according to Mundi Index [1]. The Indonesian Central Bureau of Statistics (BPS) reported that rice production increased by 0.08 percent from 2019 to 2020 [2]. Rice production and consumption are both predicted to increase in the future. As a result of this growth, the necessity for a safe and healthy working environment for rice farmers becomes critical in order to ensure labor availability.

Musculoskeletal disorders (MSDs) are prevalent among rice farmers and might manifest in any part of the body within a year [3]. Rice farmers are the four most frequent outpatients. Over 95% of rice farmers suffer from MSDs or accidents, and 95% have chronic pain. Lower extremity MSDs are prevalent among rice farmers. Previously, the prevalence of lower extremity musculoskeletal disorders (MSDs) was believed to reach between 10% and 41% [5]. Other rice growers experienced hip discomfort at a rate of 41%, knee pain at a rate of 35.44 percent, and ankle and foot pain at a rate of 10.3 percent [3]. Rice farmers had a higher prevalence of lower extremity MSDs than those in other manual jobs [6].

MSDs can be discovered at every stage of the rice cultivation process, from plowing to seeding, planting, and nursing. Rice planting has been shown to produce lower extremity pain and ergonomic problems [7]. The knee bends and the right arm is extended away from the body in an extreme forward bent and twisted position to plant rice sprouts below the knee. This pose is completed by holding a bundle of rice sprouts in the left hand. Lower extremity loading is increased as a result of an unpleasant position and excessive exertion [8-9]. As a result of exposure, this force produces tissue damage and inflammation. Prolonged exposure might result in pain, which can result in an decrease in productivity. Additionally, rice planting is typically carried out barefoot on muddy terrain. The viscosity of the mud increases the force loading on the lower extremity joints during the stepping phase due to the mud's density [12].

Mud requires a finite yield stress (i.e., the plot of shear stress versus shear strain does not intersect the origin) and is a non-Newtonian fluid in order to flow. When subjected to mild stress, it behaves like a solid, but when subjected to high stress, it behaves like a viscoplastic substance (Bingham plastic). When a farmer walks through mud, the farmer's lower extremity muscles must work harder due to the higher viscosity generated by their combined weight. The purpose of this study is to determine the effect of muddy ground on lower extremity loads associated with rice planting activity. The researchers compared the forces experienced by employees on a flat, solid surface to those encountered on a real work surface using force measurements at each lower extremity joint (muddy terrain).

II. MATERIAL AND METHODS

A. Participants

Thirty experienced rice farmers (male and female, aged 38 to 70) were chosen from a community of rice farmers in the Sewon subdistrict, Bantul District, Yogyakarta Province, Indonesia. Participation in this event needed at least one year of rice farming expertise. To be eligible for the trial,

individuals had to be free of lower extremity injuries or prior histories that would have impacted their alignment. Participants were not permitted to participate in the study if they had a prior medical history that could affect their lower extremity alignment.

B. Description of the activity

The figures 1 and 2 illustrate the instructions provided to participants to complete the simulated rice planting activity under two distinct conditions: without force and with mud-force (conducting task on muddy terrain). In this investigation, rice planting was conducted in an actual rice field. In both testing scenarios, farmers were asked to hold a rice sprout with an average weight force of 1.5 kg in the left hand and 0.15 kg in the right hand. A high-angle video camera was used to record every action throughout the planting performance simulation. Three perspectives of motion were filmed during the planting process (front, rear, and side). The sequence of the conditions was chosen at random at the commencement of the experiment. To simulate planting, the farmers were instructed by their instructors to use the right hand to force a tiny package of rice sprouts into the ground. Participants are instructed to take a step backward by raising and laying their right foot ere commencing the next row. Each participant was directed to take six steps backward and counterclockwise, then repeat six steps backward at a step length of 35 to 40 cm and a speed of 60 beats per minute. The metronome was utilized to regulate the speed of upper-body mobility and steps during planting chores. Each condition required a total of four replications. To avoid having to redo anything or making a mistake, participants first practiced the movement rate and stepped length. This study established a 5-minute interval between conditions on the advice of [13]. Five minutes of rest or relaxation time was proven to be useful in alleviating muscle fatigue in a study.

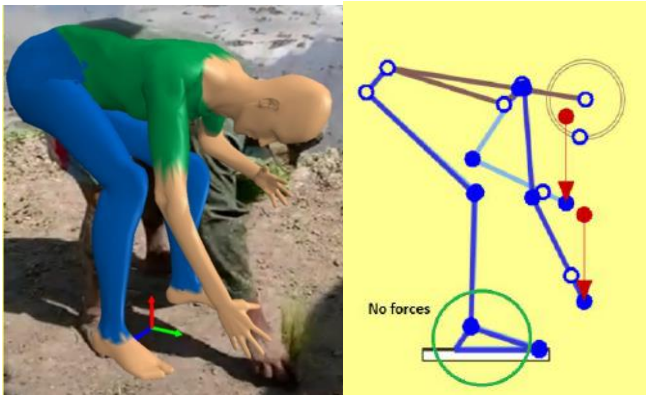


Figure 1. Simulated planting task performance without force condition (hard surface; without extra external force on feet)

The depth of the mud layer was based on the average immersion depth of farmer's legs in the mud, namely 20 cm regained from direct measurements in the field.

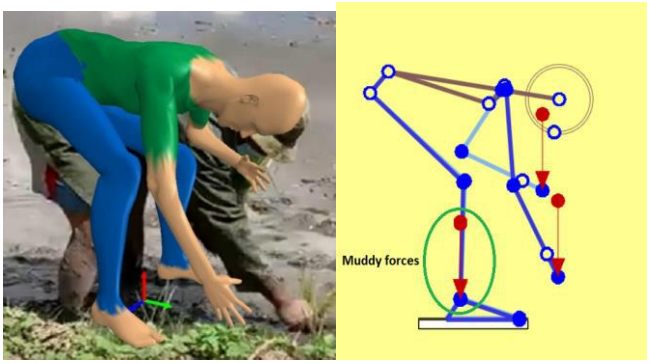


Figure 2. Simulated planting task performance with mud force (muddy terrain; including tensile viscous force on feet)

C. Mud viscous force calculation

Shear viscous force of mud were estimated with equation (1) as follows [14]:

$$F = \eta A \frac{v}{l} \quad (1)$$

$$A = 2\pi rh \quad (2)$$

Newton's shear viscous force, F, is used to determine the shear viscosity of mud. The average viscosity property of mud (η = 3598.07 Ns/m^2) was determined using the Rotational Rheometer Gemini 200Hr nano during laboratory testing of dynamic shear force on samples (taken from the rice field). To estimate one geometry of each farmer's lower legs, it was assumed that the lower extremities were cylindrical objects. Thus, using the equation (2), the area of the lower extremities impacted by viscous force (A, m^2) may be calculated. The velocity of a farmer's foot lifting out of mud is measured in meters per second using the Suunto 9 Black wrist band (Suunto Oy, Finland). While l denotes the width of the fluid in meters perpendicular to the velocity, m denotes the volume of the fluid in cubic meters (equivalent to the radius of lower extremity, r, in this state). r is the radius of the farmer's lower extremities, which is determined from their leg radius measurements. Additionally, h denotes the lower extremity height, which is the average height of the farmer's legs settling into the mud.

D. Force analysis on lower extremity joints

Compressive and tensile forces were estimated on the right and left hips, knees, and ankles utilizing the 3D Static Strength Prediction Program version 6.0.6. (3DSSPP; Center of Ergonomics, University of Michigan). The static position, which happens when lifting the foot off the planting area, was the subject of this study. Each farmer's demographic information was entered into the 3DSSPP software. For all farmers, a bundle of rice sprouts weighted 15 N on the left hand and 1.5 N on the right hand. The forces exerted on each lower extremity joint are depicted in figures 1 and 2 under the no-force and mud-force circumstances (with and without tensile viscous force acting on the feet, respectively). All

external inputs were calculated using only vertical force inputs.

E. Hypotheses

Based on literature reviews, this study predicted an increase in loading on lower extremity joints when farmers conduct rice planting in muddy terrain, compared with flat rigid terrain. The reviews showed that the lower extremity joints stand a high risk of injury when exposed to muddy terrain conditions.

F. Statistical analyses

The independent variable used to conduct this study is the working surface conditions for rice cultivation, namely (1) rigid (baseline) and (2) muddy terrains. Meanwhile the dependent variables, which are response measures retrieved from 3DSSPP software, include forces acting on the right and left hip, knee and ankle joints. This research used a paired t-test to contrast biomechanical force on the lower extremity of farmers when they performed the planting task on both surfaces. Furthermore, the Shapiro-Wilk test was used for the normal distribution confirmation test for mud viscous force on each the lower extremity of farmers since the data set in this study was smaller than 2000. The analyses used the SPSS version 26.0 software (IBM Corporation) on a significance level of α=0.05.

III. RESULTS

G.Participants

The demographic characteristics and descriptive statistics of the participants are shown in table 1, where eighty percent had a normal body mass index.

Table 1. The demographic characteristics and descriptive statistics for the participant (n = 30)

Characteristics	N (%)	Mean ± SD
Sex		
Male	11(36.67)	
Female	19(63.33)	
Age (years)		56.33 ± 8.87
Height (cm)		158.23 ± 6.97
Weight (kg)		54.58 ± 10.29
BMI (kg/m^2)		21.55 ± 3.77
Working experience (years)		21.93 ± 13.42

H.Determination of farmer lower limb geometry and mud shear force

The descriptive statistics for the determination of the right and left sides of farmers lower limb geometry and shear viscous force data are shown in the table 2.

Table 2. Descriptive statistics of determination of farmer lower limb geometry and shear viscous force data

	Male		Female		Total	
	Mean	SD	Mean	SD	Mean	SD
h (m)	0.21	0.02	0.20	0.01	0.20	0.02
v (m/s)	0.17	0.07	0.16	0.08	0.17	0.08
r (m)	0.03	0.01	0.04	0.01	0.03	0.01
A (m^2)	0.04	0.02	0.04	0.01	0.04	0.01
F (N)	416.54	170.44	356.50	170.30	378.52	172.79

The geometric data of lower extremity of the participants include height (h) and radius (r) of lower extremity, which ranges from 0.18 to 0.25 m and 0.01 to 0.05 m, respectively. The area of lower extremity (A) calculated for each participant resulted in values ranging from 0.01 to 0.06 m2. Meanwhile, the individual average speed of foot (v) captured based on video analysis ranged from 0.04 to 0.34 m/s. Based on equation (1), external shear viscous force acting on farmer lower extremity from walking on the mud (F) ranged from 103.62 to 769.28 N.

I. Biomechanical force analysis

Biomechanical force analysis was conducted to determine the effect of force acting on lower extremity joints of farmers during the planting stage of rice cultivation. This force was calculated on lower extremity using the 3DSSPP software based on factors of gender, height, weight, posture, and external force, such as hand loads and mud viscosity. The results of Paired T-Test of biomechanical force between muddy work surface condition and flat hard condition are shown in figure 3.

In this study, heavy weight led to increased leg immersing height (h) with a rise in the area of mud surface (A) and the viscous force acting on the leg (F). Correlation analyses were conducted to investigate the relationships among individual factors of weight, BMI, leg immersing height and area, foot lifting velocity, and biomechanical force on hip, knee, and ankle joints as shown in tables 3 to 8.

The body weight and BMI indicated a positive correlation between mud force and the right and left sides of participants hips and knees. Subsequently, the height indicated a positive correlation between mud force and left hip and left ankles of participants. Furthermore, the velocity of foot lifting out of mud indicated a positive correlation between mud force to ankle (both right and left side) of participants.

IV. DISCUSSION

Differences in individual characteristics and foot lifting speed were due to the mud force acting on lower extremity parts of the participants. Based on equation (2), farmers with greater height of the legs settling in the mud tend to experience a more significant contact area with increased viscosity force. Therefore, it is positively correlated to weight of the individual [15]. Furthermore, farmers with more weight are likely to immerse deeper into the mud terrain, compared with those with less weight. Farmers with the ability to lift their legs out of the mud terrain with higher speed, then leads to greater dragging force thereby leading to mud viscosity.

Biomechanical force analysis was conducted to determine the effect of force acting on lower extremity joints of farmer during the planting stage of rice cultivation. This force was calculated by 3DSSPP software based on various factors, such as gender, height, weight, posture, and external force.

The Paired T-Test results revealed significant force effects on hip, knee, and ankle of lower extremities due to muddy work surface conditions, which are significantly higher than the load from flat hard condition. The ratio of differences on right (2.46 times) and left (2.37 times) ankle joints was much higher than those on hip and knee joints at 1.04 and 1.03, respectively.

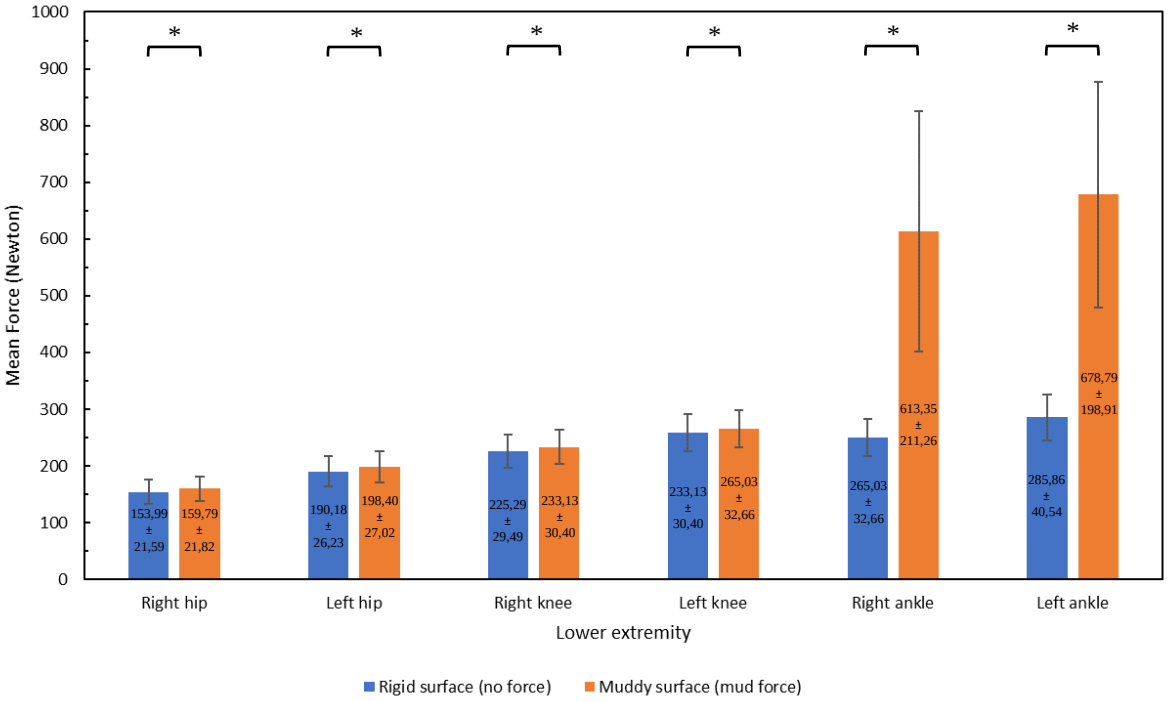


Figure 3. Comparison of biomechanical force on each lower extremity joint between no force and mud force condition (* indicated significant difference at p<0.05)

Table 3. Correlation analyses between force acting to right hip of subjects and demographic characteristics

	Height	Weight	BMI	h	v	A
Pearson correlation	0.289	0.466**	0.355	-0.284	0.142	-0.310
Sig.(2-tailed)	0.122	0.009	< 0.0001	0.128	0.454	0.096
N	30	30	30	30	30	30

Table 4. Correlation analyses between force acting to left hip of subjects and demographic characteristics

	Height	Weight	BMI	h	v	A
Pearson correlation	0.453*	0.790**	0.639**	0.142	-0.110	0.123
Sig.(2-tailed)	0.012	< 0.0001	< 0.0001	0.453	0.563	0.518
N	30	30	30	30	30	30

Table 5. Correlation analyses between force acting to right knee of subjects and demographic characteristics

	Height	Weight	BMI	h	V	A
Pearson correlation	0.338	0.721**	0.598**	-0.280	0.107	-0.310
Sig.(2-tailed)	0.067	< 0.0001	< 0.0001	0.134	0.575	0.096
N	30	30	30	30	30	30

Table 6. Correlation analyses between force acting to left knee of subjects and demographic characteristics

	Height	Weight	BMI	h	v	A
Pearson correlation	0.328	0.650**	0.551**	0.060	-0.067	0.063
Sig.(2-tailed)	0.077	< 0.0001	0.002	0.752	0.726	0.742
N	30	30	30	30	30	30

Table 7. Correlation analyses between force acting to right ankle of subjects and demographic characteristics

	Height	Weight	BMI	h	v	A
Pearson correlation	0.223	0.175	0.096	-0.042	0.868**	0.195
Sig.(2-tailed)	0.237	0.355	0.615	0.827	< 0.0001	0.303
N	30	30	30	30	30	30

Table 8. Correlation analyses between force acting to left ankle of subjects and demographic characteristics

	Height	Weight	BMI	h	v	A
Pearson correlation	0.518**	0.345	0.145	-0.011	0.784**	0.225
Sig.(2-tailed)	0.003	0.062	0.445	0.956	< 0.0001	0.232
N	30	30	30	30	30	30

* Indicated correlation is significant at the 0.05 level (2-tailed)
** Indicated correlation is significant at the 0.01 level (2-tailed)

Planting tasks were commonly carried out with bare feet on a slippery, muddy walking surface. This represents a challenge for controlling body alignment [16], and therefore, leads to an increased risk of leg injury [17-18]. The abnormal biomechanics of leg joints are due to adverse effects between ground reaction force and abnormal rotational alignment of the lower extremities. Such effects usually occurred on the weight-bearing surface during prolonged walking in the stance phase of gait [16][19-20]. Also, the muddy environment condition also increases the force acting on lower extremity joints due to viscous force [21].

Work related MSDs due to muscle and nervous tissue supported structure injury as well as excessive joint loading. Hip and knee osteoarthritis are identified to be common for lower extremity MSDs in rice farmers [22], and are associated with heavy labor osteoarthritis [23-24]. In line with preliminary studies, this study found that load on hip, knee, and ankle joints from muddy work surface condition was significantly higher than those from flat hard condition. Force exertion in planting tasks, due to mud viscosity in addition to heavy lifting, carrying, and prolonged standing while performing awkward postures, tends to overload muscles, tendons, ligaments and joints [25-26]. The joint, bone and cartilages can be injured due to increased shear, torsion and load on the joint. This was also in line with the physical examination study of [27], which indicated the structural origin of pain in rice farmers to be most prominent at knee (54.61%) and hip (22.18%) joints.

According to preliminary studies, dragging forces due to mud viscosity are also related to individual factors, such as weight and foot lifting velocity, which are correlated to biomechanical loads on lower extremity joints. Previous study on demographic risk factors of rice farming activity [7] found that individual factors of farmers BMI are associated with MSDs [5][18][28-29]. Furthermore, high BMI is related with lower extremity MSDs, particularly knee pain in overweight individual (BMI $\geq$ 25 kg/m2) [30-31]. Weight increase in individual would lead to upsurge in lower limb joint loadings, thereby resulting in leg injury. In this study, heavy weight led to increased leg immersing height (h), a rise in the associated mud surface area (A) and increase in viscous force acting on leg (F). Correlation analyses were conducted to investigate the relationships among individual factors of weight, BMI, leg immersing height and area, foot lifting velocity, and biomechanical force on hip, knee, and ankle joints, which are shown in tables 3 to 8. The relationships also supplement those in preliminary studies [7] indicating weight as one of the risk factors of lower extremity MSDs, which contribute to compression and tensile forces. These findings can function as an extra guideline for specific high-weight rice farmer populations when performing planting tasks in order to minimize risk of lower extremity injury. Furthermore, the positive relationship results between leg lifting velocity and force on lower extremity joints can be also used as a movement strategy guideline, specifically slower lifting velocity recommendation, to rice farmers in order to expose them to less viscous force while working on the muddy terrain. Previous studies also indicated slower motion requirements lead to lower risk exposure and decreased discomfort [8-9].

Therefore, by analyzing all results, it can be perceived that muddy work terrain posed risk to all lower extremity parts. The findings can act as supplementary support toward the high prevalence of lower extremity in farmers as indicated in preliminary studies [3][5][32-33]. Regarding specific lower extremity, this study found that the highest effects in terms of force, muscle activity and pain are found on farmers knees. According to knee alignment, a distribution of loading is generated from control alignment of hip, knee and ankle [34-35]. This is because planting tasks involve repetitive awkward postures performing in extreme environment, which might result in increasing risk factors for knee injury [18][36-37][38-39]. These exposures are associated with knee pain due to increased excessive load, which leads to fatigue and pain. Also, prolonged walking in slippery ground, repetitive lower limb motion and heavy weight carried out during this process represented a challenge for controlling the lower limbs. Hence, such body control difficulty leads to abnormal alignment and risk of injury, especially to lower legs and feet.

The findings of this study are in line with previous studies focusing on work injury for Thai rice farmers [27], showing that during planting, knee part endangered to the highest hazard in terms of pain perception, ergonomic risk, joint and muscle impairments, as well as structural malalignment. With additional impacts from planting activity on muddy terrain, farmers knees need to be emphasized for developing movement guideline, personal protective equipment or assistive device to prevent lower extremity injury during rice cultivation task performance. Subsequently, this research covered some limitations and assumptions, with the viscous force measured by calculating farmer leg and foot as a single-cylinder object. Further research needs to add more accurate farmer lower limb geometry.

V. CONCLUSION

The load on hip, knee, and ankle joints from muddy work surface is significantly higher than the flat hard condition. Furthermore, the biomechanical loads on lower extremity joints were related to individual factors, such as weight and foot lifting velocity. Specifically, farmers with more weight and those with the ability to lift their feet faster, contributed

to higher biomechanical force on joints. The results can perform as an extra guideline when performing planting tasks in order to minimize risk of lower extremity injury, especially in hip, knee, and ankle.

ACKNOWLEDGMENTS

Gratitudes are expressed to the Institute of Research and Community Service (LPPM) Universitas Ahmad Dahlan (Contract No. PD-380/SP3/LPPM-UAD/V/2021) for their financial assistance through a research grant. The opinions expressed in this research are those of the authors and do not necessarily reflect the views of LPPM.

REFERENCES

1. I. Mundi, "Milled Rice Production by Country in 1000 MT - Country Rankings." https://www.indexmundi.com/agriculture/?commodity=milled-rice&graph=production(accessed Feb. 25, 2021).
2. "Statistics Indonesia." https://www.bps.go.id/pressrelease/2021/03/01/1855/luas-panen-padi-pada-tahun-2020-mengalami-penurunan-dibandingkan-tahun-2019-sebesar-0-19-persen-dan-produksi-padi-pada-tahun-2020-mengalami-kenaikan-dibandingkan-tahun-2019-sebesar-0-08-persen.html (accessed Oct. 09, 2021).
3. R. Puntumetakul, W. Siritaratiwat, Y. Boonprakob, W. Eungpinichpong, and M. Puntumetakul, "Prevalence of musculoskeletal disorder in farmer: case study in Sila, Muang Khon Kaen, Khon Kaen Province," *J Med Tech Phys Ther*, vol. 23, no. 3, pp. 297–303, 2011.
4. M. S. Pengseesang, "Ergonomic problems and risk factors of farmers in Sriwichai Subdistrict WanonNiwat District of Sakon Nakon Province," Chiang Mai, 2009.
5. A. Osborne *et al.*, "Risk factors for musculoskeletal disorders among farm owners and farm workers: A systematic review," *American Journal of Industrial Medicine*, vol. 55, no. 4, pp. 376–389, 2012.
6. O. Saetan, J. Khiewyoo, C. Jones, and D. Ayuwat, "Musculoskeletal Disorders Among Northeastern Construction Workers with Temporary Migration," *Srinagarind Medical Journal*, vol. 22, no. 2, pp. 165–173, 2007.
7. U. Karukunchit, M. Swangnetr, and R. Puntumetakul, "Individual risk factors for foot and knee malalignment among rice farmers," presented at the Translational Research from Molecular Basis to Health Care, Khon Kaen, Thailand, 2014.
8. C. R. Reid, P. McCauley Bush, W. Karwowski, and S. K. Durrani, "Occupational postural activity and lower extremity discomfort: A review," *International Journal of Industrial Ergonomics*, vol. 40, no. 3, pp. 247–256, 2010.
9. N. Jaffar, A. H. Abdul-Tharim, I. F. Mohd-Kamar, and N. S. Lop, "A Literature Review of Ergonomics Risk Factors in Construction Industry," *Procedia Engineering*, vol. 20, pp. 89–97, 2011.
10. M. F. Barbe and A. E. Barr, "Inflammation and the pathophysiology of work-related musculoskeletal disorders," *Brain Behav Immun*, vol. 20, no. 5, pp. 423–429, 2006.
11. W. S. Marras, R. G. Cutlip, S. E. Burt, and T. R. Waters, "National occupational research agenda (NORA) future directions in occupational musculoskeletal disorder health research," *Applied Ergonomics*, vol. 40, no. 1, pp. 15–22, 2009.
12. C. Tropea, A. Yarin, and J. F. Foss, Eds., *Springer Handbook of Experimental Fluid Mechanics*. Berlin Heidelberg: Springer-Verlag, 2007.
13. A. Danielsson, C. Willén, and K. S. Sunnerhagen, "Measurement of energy cost by the physiological cost index in walking after stroke," *Arch Phys Med Rehabil*, vol. 88, no. 10, pp. 1298–1303, 2007.
14. K. Juntaracena and M. Swangnetr, "Effect of Muddy Work Terrain on Force of Rice Farmer Lower Extremity Joints During Rice Planting Process," presented at the The 4th IIAE International Conference on Industrial Application Engineering, Japan, 2016.
15. K. Juntaracena, "Effect of muddy work terrain on lower extremity loading during the planting stage of rice cultivation process," Thesis, Khon Kaen University, Khon Kaen Thailand, 2016.
16. R. A. Donatelli and M. J. Wooden, *Orthopaedic Physical Therapy*, 4th ed. Churchill Livingstone, 2009.
17. K. Messing, F. Tissot, and S. R. Stock, "Lower limb pain, standing, sitting and walking: the importance of freedom to adjust one's posture," presented at the the 16th Congress of the International Ergonomics Association, Netherlands, 2006.
18. S. Yu, M.-L. Lu, G. Gu, W. Zhou, L. He, and S. Wang, "Musculoskeletal symptoms and associated risk factors in a large sample of Chinese workers in Henan province of China," *Am J Ind Med*, vol. 55, no. 3, pp. 281–293, 2012.
19. A. Letafatkar, S. Zandi, M. Khodaei, and J. Belali, "Flat Foot Deformity, Q Angle and Knee Pain are Interrelated in Wrestlers," *Novel Physiotherapies*, vol. 3, 2013.
20. D. F. Murphy, D. a. J. Connolly, and B. D. Beynnon, "Risk factors for lower extremity injury: a review of the literature," *Br J Sports Med*, vol. 37, no. 1, pp. 13–29, 2003.
21. M. A. Horn, H. L. Drake, and A. Schramm, "Nitrous Oxide Reductase Genes (nosZ) of Denitrifying Microbial Populations in Soil and the Earthworm Gut Are Phylogenetically Similar," *Applied and Environmental Microbiology*, vol. 72, no. 2, pp. 1019–1026, 2006.
22. K. Walker-Bone and K. T. Palmer, "Musculoskeletal disorders in farmers and farm workers," *Occup Med (Lond)*, vol. 52, no. 8, pp. 441–450, 2002.
23. P. Baker, I. Reading, C. Cooper, and D. Coggon, "Knee disorders in the general population and their relation to occupation," *Occup Environ Med*, vol. 60, no. 10, pp. 794–797, 2003.
24. R. Juhakoski *et al.*, "Risk factors for the development of hip osteoarthritis: a population-based prospective study," *Rheumatology*, vol. 48, no. 1, pp. 83–87, 2009.

25. N. Jaffar, A. H. Abdul-Tharim, I. F. Mohd-Kamar, and N. S. Lop, "A Literature Review of Ergonomics Risk Factors in Construction Industry," *Procedia Engineering*, vol. 20, pp. 89–97, 2011.
26. K. Messing, F. Tissot, and S. Stock, "Distal Lower-Extremity Pain and Work Postures in the Quebec Population," *American Journal of Public Health*, vol. 98, no. 4, pp. 705–713, 2008.
27. U. Karukunchit, "Physical ergonomics risk factor analyses of lower extremity impairments in rice cultivation," Dissertation, Khon Kaen University, Khon Kaen, Thailand, 2015.
28. B. R. da Costa and E. R. Vieira, "Risk factors for work-related musculoskeletal disorders: a systematic review of recent longitudinal studies," *American Journal of Industrial Medicine*, vol. 53, no. 3, pp. 285–323, 2010.
29. H. Xiao, S. A. McCurdy, M. T. Stoecklin-Marois, C.-S. Li, and M. B. Schenker, "Agricultural work and chronic musculoskeletal pain among latino farm workers: The MICASA study," *American Journal of Industrial Medicine*, vol. 56, no. 2, pp. 216–225, 2013.
30. S. Holmberg, A. Thelin, E. Stiernstrom, and K. Svardsudd, "The impact of physical work exposure on musculoskeletal symptoms among farmers and rural non-farmers," *Ann Agric Environ Med*, vol. 10, no. 2, pp. 179–184, 2003.
31. M. Fransen, M. Agaliotis, L. Bridgett, and M. G. Mackey, "Hip and knee pain: Role of occupational factors," *Best Practice & Research Clinical Rheumatology*, vol. 25, no. 1, pp. 81–101, 2011.
32. J. Rosecrance, G. Rodgers, and L. Merlino, "Low back pain and musculoskeletal symptoms among Kansas farmers," *Am J Ind Med*, vol. 49, no. 7, pp. 547–556, 2006.
33. C. Kolstrup, M. Stål, S. Pinzke, and P. Lundqvist, "Ache, Pain, and Discomfort," *Journal of Agromedicine*, vol. 11, no. 2, pp. 45–55, 2006.
34. H. Daneshmandi, F. Saki, S. Shahheidari, and A. Khoori, "Lower extremity Malalignment and its linear relation with Q angle in female athletes," *Procedia - Social and Behavioral Sciences*, vol. 15, pp. 3349–3354, 2011.
35. A.-D. Nguyen and S. J. Shultz, "Identifying Relationships Among Lower Extremity Alignment Characteristics," *Journal of Athletic Training*, vol. 44, no. 5, pp. 511–518, 2009.
36. G. T. Jones, E. F. Harkness, E. S. Nahit, J. McBeth, A. J. Silman, and G. J. Macfarlane, "Predicting the onset of knee pain: results from a 2-year prospective study of new workers," *Ann Rheum Dis*, vol. 66, no. 3, pp. 400–406, 2007.
37. K. D. Allen *et al.*, "Associations of occupational tasks with knee and hip osteoarthritis: the Johnston County Osteoarthritis Project," *J Rheumatol*, vol. 37, no. 4, pp. 842–850, 2010.
38. J. C. D'Souza *et al.*, "Analysis of the third national health and nutrition examination survey (NHANES III) using expert ratings of job categories," *American Journal of Industrial Medicine*, vol. 51, no. 1, pp. 37–46, 2008.
39. [39] P. Baker, I. Reading, C. Cooper, and D. Coggon, "Knee disorders in the general population and their relation to occupation," *Occup Environ Med*, vol. 60, no. 10, pp. 794–797, 2003.

Developing University Course Scheduling Model using Genetic Algorithm

[1] Hayati Mukti Asih, [2] Akhsanul Maulana, [3] Raden Achmad Chairdino Leuveano
[1][2] Department of Industrial Engineering, Universitas Ahmad Dahlan, Indonesia, [3] Department of Mechanical and Material Engineering, Universiti Kebangsaan Malaysia, Malaysi

Abstract
University Course Scheduling (UCS) is a highly constrained real-world combinatorial optimization problem. Developing the UCS model means an optimal course by assigning lecturers, classrooms, and timeslots considering some constraints. This research is based on a case study on one of the universities in Indonesia. Currently, the staff are making the university course-scheduling model manually. It took more time, more human errors, and inefficiency. The main objective of this paper is to develop a UCS model using the genetic algorithm method. Experimental study shows that it can improve the current model by minimizing the number of clashes of classrooms and lecturers. For managerial insight, this research could help the staff conduct UCS in a university with minimum time and errors.

Keywords
University course scheduling; Genetic Algorithm; Combinatorial problem; Optimization

I. INTRODUCTION

The university course scheduling (UCS) problem is a combinatorial problem containing timetabling courses with several rooms, lecturers, and time slots. Two constraints that must be satisfied in timetabling problem is the hard and soft constraint. Hard constraints are the condition that must be met for the working timetable. On the other hand, soft constraints are condition that may not be fulfilled but affect the quality of the proposed solution [1]. Other applications for timetable problem is nursing scheduling in hospitals [2], air force academy [3], and military course scheduling [4]. Another application is in higher educational institutions. Two significant and complex problems are optimizing physical and human resources for examination and course scheduling task [5].

According to Babaei et al. [6], the objective of the timetable problem is to allocate the events (which include students, teachers, courses where resources involve the facilities and equipment of classroom) to timeslots and rooms by considering all constraints in problem are fulfilled. The complexity of the UCS model is on the constraints, such as instructors' dispositions, educational policies of the school, students' cohort, availability of teaching staff, and other physical resources [7]. These constraints may vary for each institution as it is based on their system characteristic, resources, and facilities.

A number of methods have been developed to solve UCS problem such as integer programming [8][9][10][11][12], mixed-integer programming [13], particle swarm optimization [7][14][15], genetic algorithm [15][16][17][18][19][20], ant colony optimization [21], hybrid algorithm [22], bee colony algorithm [23], simulated annealing [19], tabu search [5][24], memetic algorithm [25], GELS algorithm [26], graph coloring approach [27][28], case based reasoning [29].

This research is based on a case study in one of the universities in Indonesia. Currently, the staff are making the university course-scheduling model manually. It took more time, more human errors, and inefficiency. The main objective of this paper is to develop a UCS model using the genetic algorithm method. Experimental study shows that it can improve the current model by minimizing the number of clashes of classroom and lecturers

The rest of the paper is structured as follows: Section 2 describes the research method. It discusses the problem formulation and proposed UCS model. Then, Section 3 presents results and analysis. Finally, Section 4 provides some concluding remarks.

II. RESEARCH METHOD

This section discusses the problem formulation and the proposed model.

A. Problem Formulation

The university course scheduling (UCS) model is one of the essential things in the educational process. It consists of some main elements, and there are rooms, courses, lecturers, and timeslot. Each element has their own characteristic in developing the course scheduling model. The problem is based on a case study on a campus in one of the universities in Indonesia. Currently, the process scheduling was conducted manually. The current scheme of the process scheduling in this university is presented in Figure 1.

First of all, each study program in the university makes course scheduling. Then, the simeru department means the room management information system. This department has the responsibility to manage the course scheduling for all study programs. After that, each program will check the final course scheduling. The purpose is to make sure the entire course scheduling (which includes lecturers, days, and rooms) has been scheduled well. If the scheduling has some errors, the simeru department will do re-scheduling until all constraints are fulfilled. Next, the biskom department that

means the information system bureau. The responsibility of this department is to publish the final course scheduling to the room management website of the university.

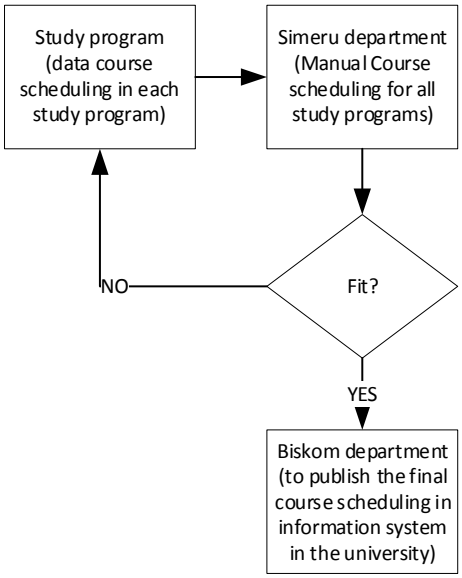


Figure 1. The current scheme of the scheduling process

However, the current scheme has some problems that often happen. First, the process scheduling is still conducted manually; therefore, it takes around a month to do it and often some errors. The re-scheduling must be performed frequently, especially on the process between the study program and simeru department. Another problem is there were two scheduling steps. The first one is in the study program, which is only scheduled within the study program's scope, then the second is in the simeru department, which will change the initial schedule to the university scope. It makes this scheme is inefficiency. In addition, the great variety of students number in each course and the capacity in classrooms makes the problem more complicated. The problem becomes challenging, as several lecturers cannot teach to classes upstairs because of pregnancy and old.

The characteristic and constraints that must be taken into account in university course scheduling for this research, such as:

1. A lecturer cannot teach two courses at the same time.
2. A classroom cannot contain two or more courses.
3. A lecturer can teach only a course at the same time.
4. The number of students must greater than the capacity of the classroom.
5. A student cannot attend two or more courses in the same day and session.
6. Particular lecturers cannot teach to the classes upstairs.

To solve those problems, the solution framework proposed in the study is presented in Figure 2.

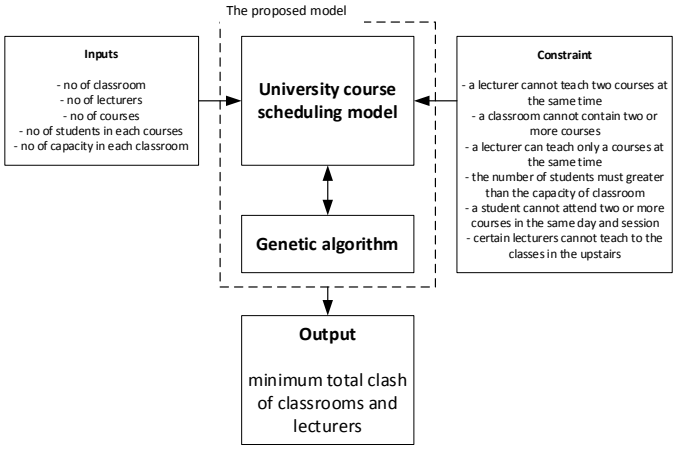


Figure 2. Solution framework

B. The Proposed Model

To solve the problems, this research has the objective to minimize total clash of rooms and lecturers. The proposed model is developing the university course-scheduling model through a genetic algorithm (GA). GA is a search heuristic that is according to natural evolution. This algorithm reflects the process of natural selection where the fittest individuals are selected for reproduction to produce offspring of the next generation [30].

This research employs Microsoft Excel. This software is compatible because industrial practitioners commonly use this software whose general purpose that can quickly solve distribution problems without learning new modeling or programming language, or buy expensive and specific tools, or Hire a specialist to do so. In contrast, previous researches employed modeling language (i.e.MATLAB, GAMS, AMPL), or programming language (i.e. Delphi, Java, C), or commercial solvers such as CPLEX, which makes the proposed solution difficult to be applied on the real industry. Moreover, to find the near or optimum solution of the UCS model, then the genetic Algorithm-based GeneHunter software is used. Therefore, both Microsoft Excel and GeneHunter are employed to conduct experiments to find the minimum clash of classrooms and lecturers.

To develop the GA method, there are the initial information required such as:

1. Population size (N): Sets of the chromosome are kept in each generation.
2. Crossover rate (Pc): The probability of crossover in the GA method.
3. Mutation rate (Pm): The probability of mutation in the GA method.

Generally, the steps of UCS model using GA method are as follows.

1. Initialization

The value of population (N) is firstly initialized by generating randomly. In the UCS model, the population consists of chromosomes that refer to the sequence of main components in UCS model, such as time, courses, lecturers, and classrooms (which is the gen in GA). In this case, the UCS model consists of 88 courses, 126 lecturers, and 33 classrooms. Therefore, the total number of chromosomes is

about 475 gens, consisting of various course scheduling. The detailed chromosome is presented in Figure 3.

Time		Courses			Lecturers		Classrooms	
A	B	C	D	E	F	G	H	I

*Note: A = start; B = end; C = name of courses; D = credits; E = number of students; F = name of lecturer 1; G = name of lecturer 2; H = name of classroom; I = capacity

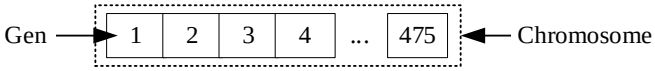


Figure 3. The chromosome in UCS model

2. Evaluating fitness function

The fitness function is referred to as the objective function, which minimizes the clash of classrooms and lecturers. It is calculated to evaluate the chromosome or solutions in the population. In this research, the expression of a fitness function of the UCS model is as follows.

$$Z(x) = \frac{1}{1 + (\sum_{i=1}^{n} X_n + \sum_{i=1}^{n} Y_n)} \qquad (1)$$

where,
n is total number of clash
X_n is clash of classroom i, i = 1, 2, … , n
Y_n is clash of lecturer j, j = 1, 2, … , n

3. Selecting the chromosome

In this selection step, the GA selects the parents for the next generation. It chooses N chromosome among parents and the offspring that has the best fitness value. There are some selection methods, like ranking, tournament, roulette wheel, and elitist, however, this research employ the elitist method to choose the best chromosome.

4. Performing crossover

Crossover is one of the essential phases in GA method. In this phase, two-parent chromosomes are paired to create offspring. It can be conducted by selecting a pair of chromosomes randomly from the generation with probability Pc. There are some different types of crossover operators, such as one-point, two-point, multiple-point, and uniform, however, this study employ one-point crossover to generate the offspring. The graphical representation of this crossover process is presented in Figure 4. The crossover process is to first choose a random crossover point and then cut the parents at that point, and finally, the offspring is created by exchanging the tails

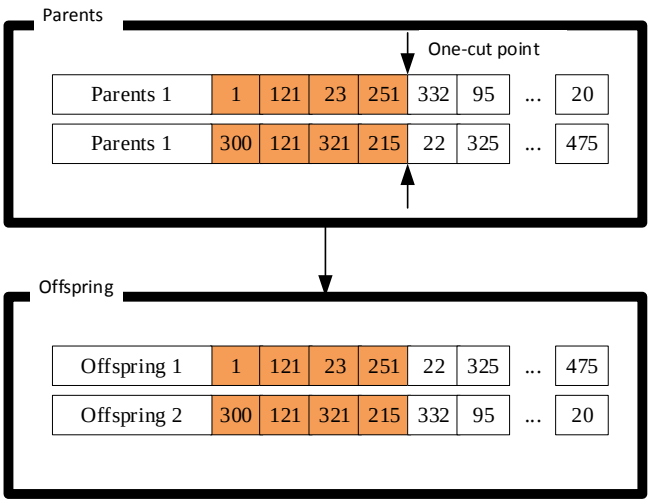


Figure 4. The graphical representation of crossover process

5. Performing mutation

This phase must be conducted because it maintains the genetic diversity from a generation of a population. It ensures a border search space to be searched by GA. The mutation process is presented in Figure 5.

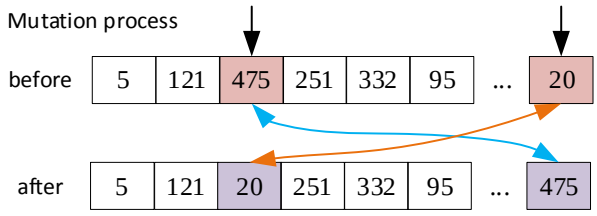


Figure 5. The mutation process

6. Termination of the GA process

Finally, the GA process is stopped for the searching process after a near or optimum solution has met the user's expectation. To stop the process of this GA method, this research employs some experiments to terminate the GA process, such as 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, and 10000 generations. Then, the best chromosome with minimum fitness is selected according to the solution that near or optimum in every experiment conducted.

III. RESULTS AND ANALYSIS

This section elaborates on the experimental results of the UCS model by evaluating its Performances. In developing the UCS model, this research employs Microsoft Excel software and Gene Hunter® Genetic Algorithm software. Microsoft Excel software is used for this research, as this software is easy to use and easy to be implemented. Figure 6 presents the university course model for odd semester year 2019/2020. This model is proposed to minimize the total number of clash lecturers and classrooms. It contains some main components in scheduling the course. There are time, course, lecturer, and classroom. The gen shows the sequence number of the schedule. It is generated randomly until near-optimal is achieved, which is presented in Figure 7. It is

the fitness function of this model that is referred as Equation 1.

University Course Model - Odd Semester Year 2019/2020

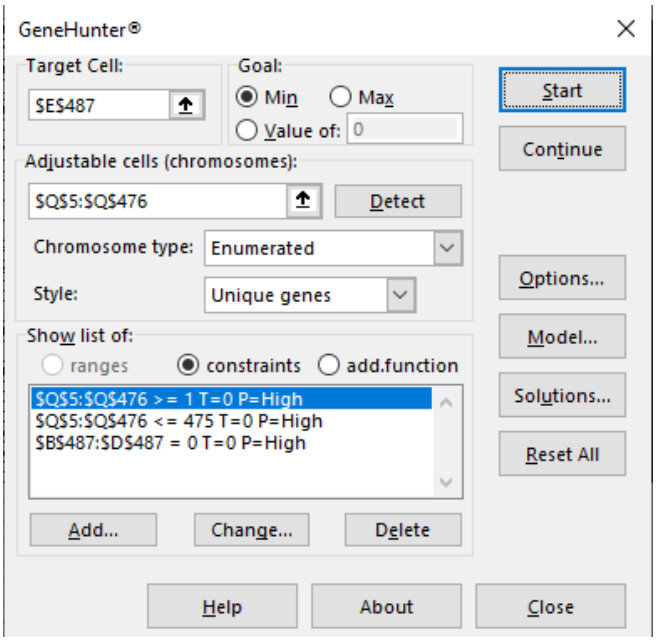
	Time		Course			Hour time		Lecturer and Classroom			
	Start	End	Day	Course code	Course name	Credit	LW	SEMESTER, FK, CLASS	Lecturer name 1	Lecturer name 2	Classroom	GEN
5	7:00	9:30		181220730	Descriptif Statistic	3	2:30	II,EA,E	NNA	WDP	1.1.304 A	1
6	7:00	9:30		181260311	Tax Practicum	1	2:30	VI,EA,D	OSS		1.1.305 A (Lab Komp)	2
7	7:00	9:30		181260630	Accounting Theory	3	2:30	VI,EA,E	AA		1.1.303	3
8	7:00	9:30		181261230	Islamic Finance	3	2:30	VI,EA,B	UYP	IS	1.2.402 ITC	4
9	7:00	9:30		181200300	Kemuhammadiyahan	0	2:30	II,EA,C	IH		1.1.324	5
10	7:00	9:30		181200300	Kemuhammadiyahan	0	2:30	II,EA,G	MIA		1.1.325	6
11	7:00	9:30		181200400	Da'wah Science	0	2:30	IV,EA,A	I		1.1.326	7
12	7:00	9:30		181200400	Da'wah Science	0	2:30	IV,EA,E	F		1.1.327	8
13	7:00	9:30		181260311	Tax Practicum	1	2:30	VI,EA,E	O		1.1.305 A (Lab Komp)	9
14	7:00	9:30		181270430	Thesis Proposal	2	2:30	VII,EA,I	UYP		PPA (Akuntansi)	10
15	7:00	9:30		181200300	Kemuhammadiyahan	0	2:30	II,EA,D	IH		1.2.123	11
16	7:00	9:30		181200400	Da'wah Science	0	2:30	IV,EA,B	I		1.2.124	12

Figure 6. University Course Model

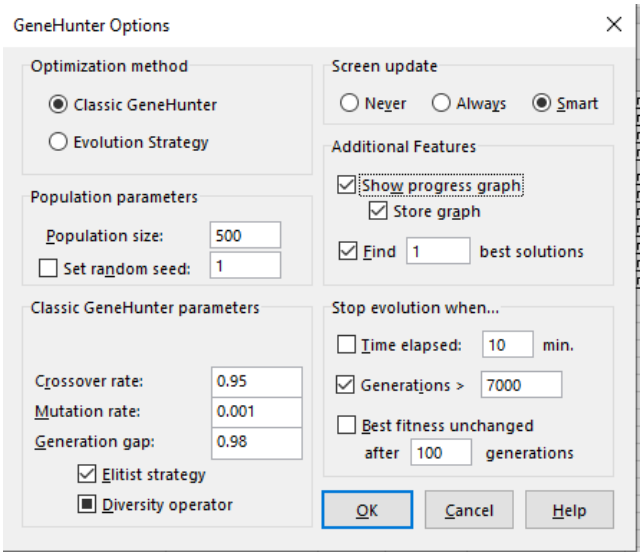
	Clash of lecturer 1	Clash of lecturer 2	Clash of classroom	
Monday	35	0	14	
Tuesday	46	1	26	
Wednesd	27	2	45	
Thursday	41	2	68	
Friday	39	0	30	
Saturday	43	0	27	
TOTAL	231	5	210	446
Fitness Function				0.0022371

Figure 7. The fitness function of UCS model

In developing the GA model, the GeneHunter® software is employed. It is an Excel Add-In that permits the user to run an optimization problem from Microsoft Excel software. Figure 8 shows the UCS model in GeneHunter® software. In this software, the target cell is the cell for the fitness function of the UCS model. The goal is to minimize the fitness function with the formula that is shown in Equation 1. Then, the adjustable cells is used to present the set of genes in the UCS model as stated in Figure 3. There are some constraints for these gens to ensure that the gens are not less than zero and not less than the total number of chromosomes that is 475. Some experiments were conducted on varying generations with a population of 500, a crossover rate of 0.95, and mutation rate of 0.001 (please refer to Table 1).



(a)



(b)

Figure 8. UCS model in GeneHunter® Software

Table 1. Experiments for optimizing UCS model using Genetic Algorithm

Experiment	Population	Crossover	Mutation	Generation
1	500	0.95	0.001	2000
2				3000
3				4000
4				5000
5				6000
6				7000
7				8000
8				9000
9				10000

After conducting some experiments with varying generations, the result shows that experiment 5 has a low total number of clashes with the minimum computational time, as presented in Table 2. This result provides better performance on the computational time of the current system, whereas previously is around five days to do a university course schedule. It means this research has 92% improvement from the current one with the minimum total number of clashes. In addition, this research also proposes a new scheduling process scheme, which makes the process more efficient, faster, and the minimum total number of the clash as shown in Figure 9.

Table 2. The results of experiments

Experi-ment	Gene-ration	Type of clash		Total number of clash	Fitness Func-tion	Compu-tational time (hour)
		Clash of lecturer	Clash of class-room			
1	2000	6	14	20	0.04762	6
2	3000	2	4	6	0.14286	8
3	4000	3	1	4	0.2	10
4	5000	2	1	3	0.25	12
5	6000	1	0	1	0.5	13
6	7000	1	0	1	0.5	14
7	8000	1	0	1	0.5	15
8	9000	0	1	1	0.5	16
9	10000	1	0	1	0.5	18

The study program presents the data of lecturers who will teach some courses and lecturers' constraints, which is as input for simeru department. Then, it will optimize the university course scheduling model for all study programs. Next, each study program will check whether the scheduling is fit or not. Finally, the biskom department will publish the final course scheduling in the university's information system to all lecturers and students can know the schedule of that semester. The advantage of this new scheduling scheme is that the university course scheduling is only conducted in Simeru department. It will save more time, more efficient, and minimize the clash of lecturers and classrooms.

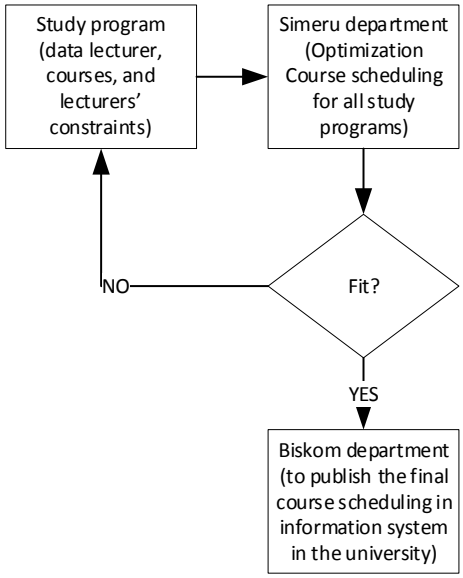


Figure 9. The proposed scheme of scheduling process

IV. CONCLUSION

This research is based on a case study on one university in Indonesia. Currently, the staff is manually making the university course-scheduling model. It took more time, more human errors, and inefficiency. The main objective of this paper is to develop a UCS model using the genetic algorithm method. Experimental study shows that it can improve the current model by minimizing the number of clashes of classrooms and lecturers. For further research, this research can be improved on other methods.

REFERENCES

1. P. Pongcharoen, W. Promtet, P. Yenradee, and C. Hicks, "Stochastic Optimisation Timetabling Tool for university course scheduling," *Int. J. Prod. Econ.*, vol. 112, no. 2, pp. 903–918, 2008.
2. Y. Wang, Y. Dai, X. Zhang, and A. Lei, "Research on the Nursing Scheduling Based on the optimization Algorithms," *Front. Educ. Res.*, vol. 3, no. 4, pp. 55–58, 2020.

3. G. Gonzalez, C. Richards, and A. Newman, "Optimal course scheduling for United States Air Force Academy cadets," *Interfaces (Providence).*, vol. 48, no. 3, pp. 217–234, 2018.
4. C. Eisler, P. Dobias, and M. J. Liu, "Optimizing Military Course Scheduling with Heterogeneous Resource Optimizing military course scheduling with heterogenous resource constraints and uncertain student demand," *Oper. Res. Manag. Sci. Lett.*, vol. 1, no. 1, pp. 28–33, 2018.
5. A. . Mushi, "Tabu search heuristic for university course timetabling problem," *African J. Sci. Technol.*, vol. 7, no. 1, pp. 34–40, 2010.
6. H. Babaei, J. Karimpour, and A. Hadidi, "A survey of approaches for university course timetabling problem," *Comput. Ind. Eng.*, vol. 86, pp. 43–59, 2015.
7. S. Imran Hossain, M. A. H. Akhand, M. I. R. Shuvo, N. Siddique, and H. Adeli, "Optimization of University Course Scheduling Problem using Particle Swarm Optimization with Selective Search," *Expert Syst. Appl.*, vol. 127, pp. 9–24, 2019.
8. M. A. Mohamad, Z. A. Putra, M. R. Bilad, N. Nordin, and M. D. H. Wirzal, "An Excel Based Tool Development for Scheduling Optimization," *ASEAN J. Sci. Eng. Educ.*, vol. 1, no. 1, pp. 7–14, 2021.
9. C. N. Rosyidi, E. Budiningsih, and W. A. Jauhari, "Scheduling of undergraduate thesis examination: a case study in Industrial Engineering Department of Universitas Sebelas Maret," *J. Ind. Eng. Int.*, vol. 15, no. 0123456789, pp. 209–221, 2019.
10. C. D. Palma and P. Bornhardt, "Considering section balance in an integer optimization model for the curriculum-based course timetabling problem," *Mathematics*, vol. 8, no. 10, pp. 1–12, 2020.
11. J. Samiuddin and M. A. Haq, "A novel two-stage optimization scheme for solving university class scheduling problem using binary integer linear programming," *Oper. Manag. Res.*, vol. 12, no. 3–4, pp. 173–181, 2019.
12. M. Pratiwi, C. N. Rosyidi, and Yuniaristanto, "An optimization model for course scheduling in Undergraduate Industrial Engineering Program of Universitas Sebelas Maret," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 1072, no. 1, p. 012008, 2021.
13. R. Huang, J. Huang, X. Wang, Y. Luo, and J. Yu, "Study of the Experimental Course Scheduling System Based on MIP Model," *Adv. Soc. Sci. Educ. Humanit. Res.*, vol. 371, pp. 21–26, 2020.
14. O. Abayomi-alli, A. Abayomi-alli, and S. Misra, "Automatic Examination Timetable Scheduling Using Particle Swarm Optimization and Local Search Algorithm," in *Data, Engineering and Applications*, no. April, Springer Singapore, 2019, pp. 119–130.
15. D. R. Ramdania, M. Irfan, F. Alfarisi, and D. Nuraiman, "Comparison of genetic algorithms and Particle Swarm Optimization (PSO) algorithms in course scheduling," *J. Phys. Conf. Ser.*, vol. 1402, no. 2, pp. 1–8, 2019.
16. H. Guo and J. Yan, "Research of university course scheduling system based on evolutionary algorithm," *Commun. Comput. Inf. Sci.*, vol. 225 CCIS, no. PART 2, pp. 171–177, 2011.
17. W. Wen-Jing, "Improved adaptive genetic algorithm for course scheduling in colleges and universities," *Int. J. Emerg. Technol. Learn.*, vol. 13, no. 6, pp. 29–42, 2018.
18. N. G. A. H. Saptarini, P. I. Ciptayani, and I. B. I. Purnama, "A custom-based crossover technique in genetic algorithm for course scheduling problem," *TEM J.*, vol. 9, no. 1, pp. 386–392, 2020.
19. S. Susan and A. Bhutani, "Data Mining with Association Rules for Scheduling Open Elective Courses Using Optimization Algorithms," *Adv. Intell. Syst. Comput.*, vol. 941, no. June, pp. 770–778, 2020.
20. X. Chen, X. G. Yue, R. Y. Man Li, A. Zhumadillayeva, and R. Liu, "Design and Application of an Improved Genetic Algorithm to a Class Scheduling System," *Int. J. Emerg. Technol. Learn.*, vol. 16, no. 1, pp. 44–59, 2020.
21. Al-Mahmud, "HIGHLY CONSTRAINED UNIVERSITY CLASS SCHEDULING USING ANT COLONY OPTIMIZATION," *Int. J. Comput. Sci. Inf. Technol.*, vol. 13, no. 1, pp. 21–32, 2021.
22. A. Gunawan, K. M. Ng, and K. L. Poh, "Solving the Teacher Assignment-Course Scheduling Problem by a Hybrid Algorithm," *Int. J. Comput. Information, Syst. Sci. Eng.*, vol. 1, no. 2, pp. 136–141, 2007.
23. M. C. Function, O. Using, A. Bee, and C. Algorithm, "Multi-Objective Cost Function Optimization Using Artificial Bee Colony Algorithm With Enhanced Local Search for Course Scheduling Problem," in *2018 International Conference on Artificial Intelligence and Data Processing (IDAP)*, 2018, pp. 1–6.
24. A. O. Sunday, I. E. Onwuka, and I. K. E., "A Tabu Search-based University Lectures Timetable Scheduling Model," *Int. J. Comput. Appl.*, vol. 181, no. 9, pp. 16–23, 2018.
25. S. Susan and A. Bhutani, "A novel memetic algorithm incorporating greedy stochastic local search mutation for course scheduling," in *Proceedings - 22nd IEEE International Conference on Computational Science and Engineering and 17th IEEE International Conference on Embedded and Ubiquitous Computing, CSE/EUC 2019*, 2019, no. August 2019, pp. 254–259.
26. M. N. Nategh, A. A. R. Hosseinabadi, and V. E. Balas, "University-timetabling problem and its solution using GELS algorithm : a case study," *Int. J. Adv. Intell. Paradig.*, vol. 11, no. 3/4, pp. 368–377, 2018.
27. V. Nandhini, "A Study on Course Timetable Scheduling and Exam Timetable Scheduling using Graph Coloring Approach," *Int. J. Res. Appl. Sci. Eng. Technol.*, vol. 7, no. 3, pp. 1999–2006, 2019.
28. N. Poddar and B. Mondal, "An Instruction on Course Timetable Scheduling Applying Graph Coloring Approach," *Int. J. Recent Sci. Res.*, vol. 9, no. 2(C), pp. 23939–23945, 2018.
29. S. Zhang and X. Wang, "Intelligent Course Scheduling System Based on Case-based Reasoning," *J. Phys. Conf. Ser.*, vol. 1920, no. 1, 2021.
30. H. Alghamdi, T. Alsubait, H. Alhakami, and A. Baz, "A Review of Optimization Algorithms for University Timetable Scheduling," *Eng. Technol. Appl. Sci. Res.*, vol. 10, no. 6, pp. 6410–6417, 2020.

Graduates Employability Analysis using Classification Model: A Data Mining Approach

Maricris M. Usita
Occidental Mindoro State College

Abstract
The employability of graduates serves as a measure of the success of every program offered within a Higher Education Institution. The employment assessment and evaluation of employment status allow improvement using data mining to analyze a vast amount of data in various areas. This study builds graduate's employment model using classification tasks in data mining, compares several data-mining approaches such as the Bayesian method and the Tree method with visualization, and explores the Association Rule using Apriori. The experiment used a classification task in Waikato Environment for Knowledge Analysis (WEKA) and compared the results of each algorithm, where several classification models were used. The experiment was conducted using accurate data sets from 1,489 graduate students for three years. The study provides valuable information about the graduate employment status, forecasting, visualization, and the exploration of classifiers algorithm to analyze the graduate employability in government, non-government organizations, self-employed, and unemployed. It is recommended to relate graduate employability to curriculum assessment and performance evaluation to identify measures and policies to improve students' performance.

Keywords
Bayesian method, Classification model, Data mining, Decision Tree.

I. INTRODUCTION

Higher Education Institutions produce an increasing number of graduates every year. The employability of its graduates is vital for all academic institutions. Graduate tracer studies are essential for enhancing study program effectiveness in contemporary higher education [1]. It is one of the most significant factors reflecting educational programs and academic institutions' significance and relevance. The quality of acquired results is an essential part of higher education quality. [2]. Universities promote initiatives to improve their overall quality by encouraging graduates to work in industries. [3]. It provides helpful information to evaluate higher education results to enhance the quality of higher education institutions [4]. The institution provided the needed skills and competencies of graduates in line with their professional practice, and they were highly employable in a wide range of industries [5].

The employment status of graduates varies depending on their programs and field of specialization. Because of educational changes and the rise of disruptive technology, the demand in the workplace is fast-changing, emphasizing the importance of employability skills and literacy that will assure career success and degree program relevancy. [6]. In addition, to improve the production of high-level human resources that can spearhead efforts to attain national development [7]. The employed graduates are regular/permanent, working in the Philippines, finding their first job within 1 to 6 months, earning P 10,000.00 to P 20,000.00. According to the survey, their initial job level position is either professional, technical, or supervisory. [8].

The college uses the alumni tracers studies to assess the relevance of the curricula, knowledge, skills, and work values acquired by the graduates relevant to their employment; identify the personal and professional characteristics, job placement, and school-related factors associated with their profession. In addition, it is used for quality assessment and tool for observation and formulation of feedback for professional development [9].

Hence, making career choices is complex since there are diverse factors affecting students' selection of programs when they enroll in higher education institutions [10]. Graduate tracer studies obtain intrinsic and extrinsic results and benefits if designed with rigor and inherent uniqueness. Tracer study methodologies provide simple and utilizable results that can consume appropriately at an individual and institutional level [11]. The conduct of a tracer study is a potent tool that documents the profile of graduates, which gives implications on the performance of graduates [12]. Therefore, it is vital to locate an excellent predictive model to determine the intervention suitable for particular graduate students to implement accurate predictions based on the identified problem.

The educational process has always been carried out based on development and market demands to meet standards [5]. Educational data is considered an indicator for predicting alumni students' employability status [13]. The conversion of raw data to create helpful information understood by different audiences is part of data mining. Educational data mining emerges as one tool to study academic data to identify patterns and help decision-making affecting education [14].

The application of data mining techniques improves the

performance of my organizational domains and the concept applied in the education sectors for their performance evaluation and improvement [15]. Data mining techniques are used to determine the factors affecting graduates' employability [16]. The application of data mining algorithms helps the computer sciences retrieve information from the data in the form of hidden patterns even if the information is not directly stored in the database [17].

Classification is one of the more helpful techniques in data mining to create classification models from an input data set. The decision tree and Naïve Bayes are part of the data classification [18].

The study explores the application of data mining to identify and improve the institution's services and enhance instruction. Analyzing patterns in large datasets can be efficiently analyzed with data mining techniques [15]. Employment prediction by the employability alignment of graduates is the primary goal of this paper. Significantly, the institution evaluates its performance in producing quality students. The paper helps the college have a data assessment of graduates to analyze and assess the program's outcome.

Likewise, gathering information about graduates is vital to assessing and improving institutional quality, monitoring employment outcomes, and enhancing the curriculum. Research studies used data mining techniques to extract rules and predict certain behaviors in several areas by identifying employees' performance as their productivity compared to their peers [19]. Therefore, applied classification techniques to search for graduate employability's essential element. The results were used to construct the graduate employability model and compare each model's accuracy under the Bayesian approach. Among the six different Bayesian methods, the results show that the AODEsr algorithm achieved the highest accuracy level of 98.3% [20].

The study reveals that work experience, occupation type, and times find work directly affect the employability of their graduates [19]. Every educational institution is mandated to trace its graduates to identify their current status, position, number of years in service, agency affiliation, etc. However, the Higher Education Institution (HEI) has no data analysis conducted to assess the current situation of their graduates within the industry. Therefore, there are no complete statistics on the profile of these graduates.

In addition, improving the quality of delivery is one of the biggest challenges of Educational institutions [21]. The employability of graduates is now an essential concern for students, both local and overseas. The research paper is intended to support the higher education institutions in preparing the graduates with sufficient skills to enter the job market.

Moreover, Occidental Mindoro State College is the home of the best graduates in the province. However, the graduates choose a course during their academic year but take a different path not aligned with the program they have studied for four years. Thus, there is a mismatch between their professional career and their course.

Graduate employment is one issue that needs to be given attention. A large number of graduates every year is accumulated; hence, obtaining their information on the whereabouts of the graduates can be a great help in the institution's strategic planning, particularly on the programs they offer. Furthermore, it is the institution's responsibility to craft students equipped on all aspects of their career growth and assist them in getting positions in their dream companies [21].

The paper provides necessary data on graduates' employability status, job environment, and the forecast on the job environment of the graduates. Furthermore, there were no further studies conducted on identifying what program within the college has a better performance based on the employment status of their graduates.

The researcher identified the fundamental causes of graduate employability using the Waikato Environment for Knowledge Analysis (WEKA) education domain. Specifically, this study aimed to: (1) determine the graduates' information in terms of gender and employment status; (2) Compare the employment trend per month; (3) Forecast the Graduate Employment Trends with seasonality and moving averages; (4) Visualize the Graduate Employment Trends; (5) Predict the Employment Rate using Classifiers and Trees Bayesian Network, and (6) Identify the Employment Pattern using Association Rule.

Conceptual Framework

The model is based on the concepts, theories, and findings of related literature, studies, and insights taken from them, as shown in Figure 1. The model combines the Cross-Industry Standard Process for Data Mining [22] and Knowledge Discovery Process [23]. Data mining is worthwhile. It has five steps: business understanding, data understanding, data preparation, modeling, evaluation and deployment, and data discovery processes such as data cleaning, data integration, data selection, data transformation, data mining, evaluation, and presentation.

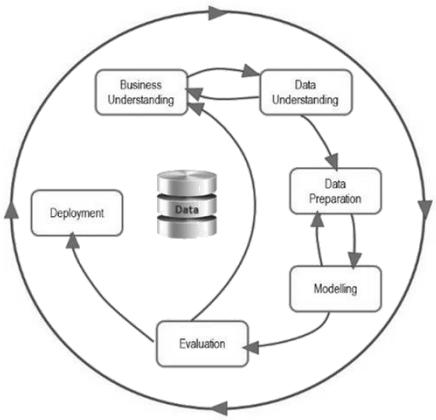


Fig. 1 Research Paradigm

II. METHODS

The model helps determine the potential attributes correlated significantly to graduates' target variables of employability. Figure 2 shows the Knowledge Discovery and

Data Mining Process Model that the researcher underwent to accomplish the paper.

.

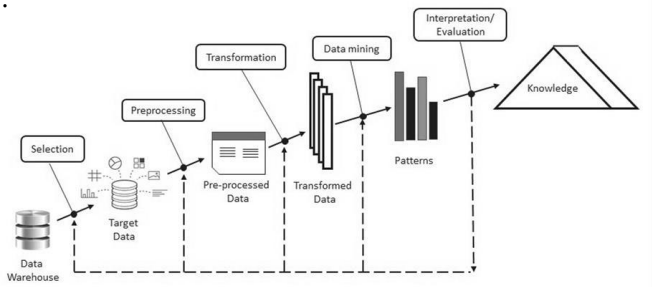


Fig. 2 Knowledge Discovery and Data Mining Process Model

Framework

According to Fayyad et al. (1996, the KD process) laid the foundation. Then, the KDD model was developed to support the complex and iterative knowledge generation process [24]. As shown in Figure 2, the KDD model comprises five steps from a data viewpoint: data selection and sampling, data processing, data transformation, data mining, and evaluation.

Data Selection

The data set needs to be analyzed from a large data store, and the selected data should be relevant to the knowledge discovery process.

Data Processing

The process involves dealing with noisy and missing data to ensure the correct input is used in the KDD process to generate valid output.

Data Transformation

The dimension reduction and transformation methods are used to identify functional attributes, which involves choosing the data mining task that matches the analysis goals, choosing an algorithm(s) and processes with corresponding parameters, and applying them to extract patterns from data.

Evaluation

The process interprets the mined patterns and extracts valuable knowledge to correct the subsequent iterations.

Instruments and Techniques

WEKA will be utilized for the classification and visualization of data sets.

Data Gathering Procedure

The study used standard google forms issued by the Monitoring and Evaluation unit of OMSC. It deployed the form to the students to gather information about their employment status from 2016 to 2018. Moreover, it also utilized secondary data available within the college.

Respondents of the Study

The graduate students under the College of Arts, Sciences, and Technology of Occidental Mindoro State College serve as the study's respondents. A total of 1,489 graduates from 2016 to 2018 thoroughly assessed graduates' employability situation.

III. RESULT AND DISCUSSION

The analytics solutions engaged for graduate tracer helps to understand fully the situation of graduates employed in different agencies, mainly if their work is related to the course they finished. Furthermore, this will predict if the graduates stay loyal to their companies.

Graduate Employed according to Gender and Employment Status.

Based on a percentage per Gender, for female graduates, 62% of which are employed, 31% are unemployed, and 7% are self-employed. On the other hand, 65% are used for male graduates, 27% are unemployed, and 8% are self-employed. Among 440 unemployed graduates, 323 are female, and 117 are male. In this illustration, male graduates have the lowest percentage of unemployed than female graduates, and it also comprises the highest employed rate than the female.

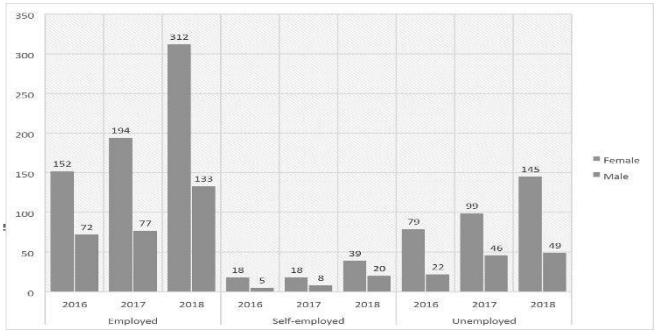


Fig 3. Graduate Employed from 2016 – 2018 according to Gender

Graduate Employment Trends per Month

Forecasting helps predict the future based on the available data incorporating appropriate processes, approaches, and models.

The OMSC Graduate Tracer forecasted the estimated number of employed, unemployed, and self-employed graduates. In addition, the graph contained data on the highest number of employed graduates during July within the period of 3 years because graduation takes place during April and graduates start to job hunt between May to June and most of the graduates get hired in July.

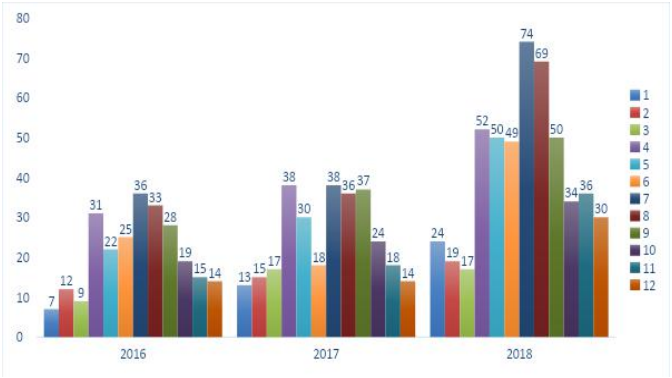


Fig. 4. Graduate Employment Trend per Month

Predicting Future Graduates Employment Trends

Forecasting helps predict the future based on the available data incorporating appropriate processes, approaches, and models. For example, the OMSC Graduate Tracer forecasted the estimated number of graduates employed in the next coming year.

Time-Series Forecasting with Seasonality

Graduate trends may also provide patterns on cyclical and seasonal variations. The graduate tracer was able to determine trends and monthly patterns on employment. To forecast next year's number of employed and unemployed graduates, the number of occurrences by month within the three years from 2016-2018. Table 2 shows the future trend of employed graduates for the year 2019. The results obtained data for Employed (359), Self-employed (43), Unemployed (170) with an average of 190.

Table 1. Trends and Yearly seasonal forecast

Employment Status	2016	2017	2018	2019 FORECAST	Yearly Average	Yearly Factor
Employed	224	272	445	359	313.67	7.58
Self-Employed	23	26	59	43	36.00	0.87
Unemployed	101	145	194	170	146.67	3.55
Average	116.00	147.67	232.67	190	165.44	4.00
Total	348	443	698			
Grand Total	1489					
Overall Average	41.36					
2019 Forecast	190					

Table 2 shows the data on monthly trends of Employed Graduate from 2016-2018 and the month of July obtained the highest number of employments such as 36, 38, and 74, respectively. The table also contains forecast data for 2019, and it shows that July obtained the highest with a value of 56. The data was also supported by a graph below.

Table 2. Trends and Monthly seasonal forecast

Month	2016	2017	2018	Monthly Average	Monthly Factor	2019 FORECAST
January	7	13	24	14.67	0.50	19
February	12	15	19	15.33	0.52	17
March	9	17	17	14.33	0.49	17
April	31	38	52	40.33	1.38	45
May	22	30	50	34.00	1.16	40
June	25	18	49	30.67	1.05	34
July	36	38	74	49.33	1.69	56
August	33	36	69	46.00	1.57	53
September	28	37	50	38.33	1.31	44
October	19	24	34	25.67	0.88	29
November	15	18	36	23.00	0.79	27
December	14	14	30	19.33	0.66	22
Average	20.92	24.83	42.00	29.25	1.00	33
Total	251	298	504			
Grand Total	1053					
Overall Average	29.25					
2019 Forecast	33					

The result of the abovementioned method is for forecasting for 2019 graduate employment rates as well as the monthly patterns are graphically presented in figure 5.

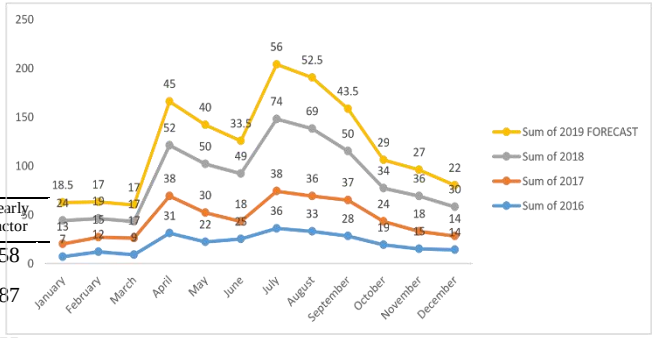


Fig. 5. Graduate Forecast for 2019, Trends, and Monthly Patterns

Forecasting using Moving Averages

The graph below shows the overall trends in a data set by calculating the moving average using a 2-period of data. The graduate employment forecasts presented cyclical and seasonal variations of the number of graduates employed.

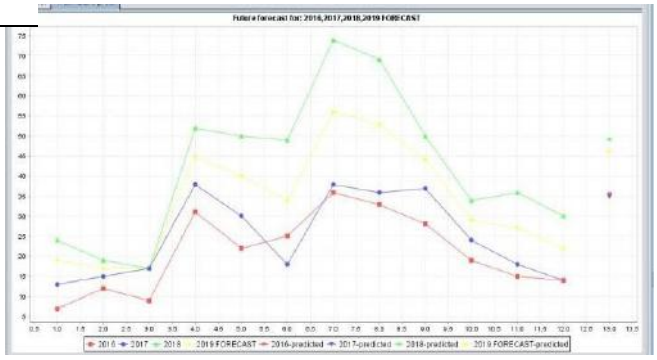


Fig. 6. Graduate Forecasts using 2 Point Moving Average

Visualization of Graduates Employment Trends

Figure 7 shows a visualization of the employment status of graduates with the program they finished and to their current employment. The results further explain that most IT graduates are unemployed while others are employed in non-government organizations.

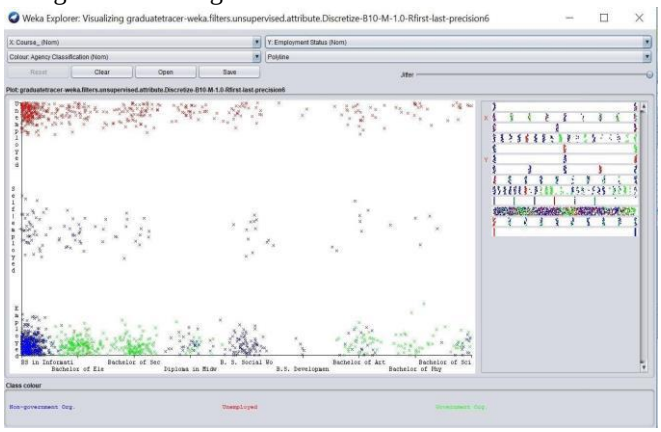


Fig. 7. Visualization of Employment Status with Program and the Agency of Graduates

Predicting Employment Rate using Classifiers and Trees
Bayesian Network

Bayesian Network

Bayesian Network is used to take an event that occurred and predict the likelihood that any of the several possible known causes was the contributing factor and model sequences of variables.

The program and specialization of graduates are related to their current job status. Using the Bayes Net Classifier in Weka, occupation can be classified as permanent, temporary, contractual, self-employed, and unemployed. Using the training set in Figure 8, the model correctly classified instances with a 73.6064% accuracy rate, with a mean absolute error of 0.1256. Therefore, this model is accurate enough to predict the employment rate.

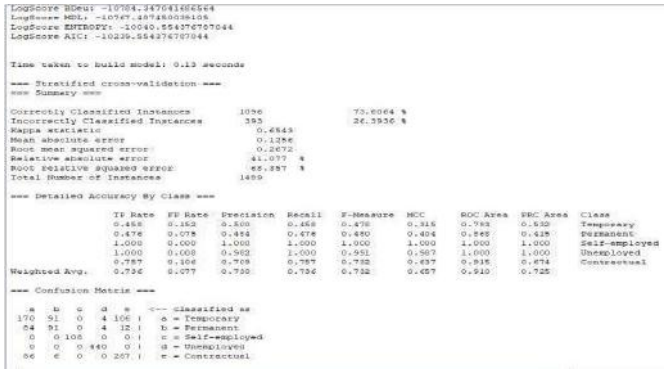


Fig. 8. Bayes Network Model (Bayes Net) to Classify Employment Status

Decision Tree

The decision tree serves as a decision support tool that models the possible consequences and event outcomes. Figure 9 shows the model correctly classified instances with an accuracy rate of 75.7555% with a mean absolute error of 0.1202. The J48 has been used to test the possibility of the employment rate.

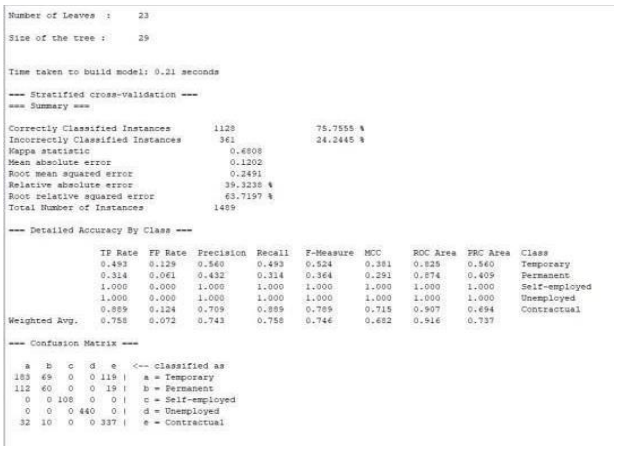


Fig. 9. Decision Tree Model (j48) Model to Classify Employment Status

Employment Pattern using Association Rule

Table 3 shows the comparison of two models used to determine which produces more accurate prediction based on the number of correctly classified values, incorrectly classified values, accuracy rate, and the mean absolute error. Based on the results, J48 obtained a high accuracy of 75.76% and a mean absolute error of .1202.

Table 3. Comparison of Bayes Net and J48 Model

Classifiers	Correctly Classified	Incorrectly Classified	Accuracy	Mean Absolute Error
Bayes Net	1096	393	73.61%	.1256
J48	1128	361	75.76%	.1202

Predictive Apriori Algorithm

This algorithm used more extensive support, traded with higher confidence, and calculated the expected accuracy in the Bayesian framework [25]. The results maximize the desired accuracy for future association rules data and generate association rules as the anticipated number of regulations by the user.

In this case, the Apriori algorithm has been tested to determine the patterns of employment rate. This algorithm generates frequent employment patterns by finding annotations that frequently occur. In addition, this method scans the dataset to collect all item sets that satisfy predefined minimum support. The best rule is shown in figure 10.

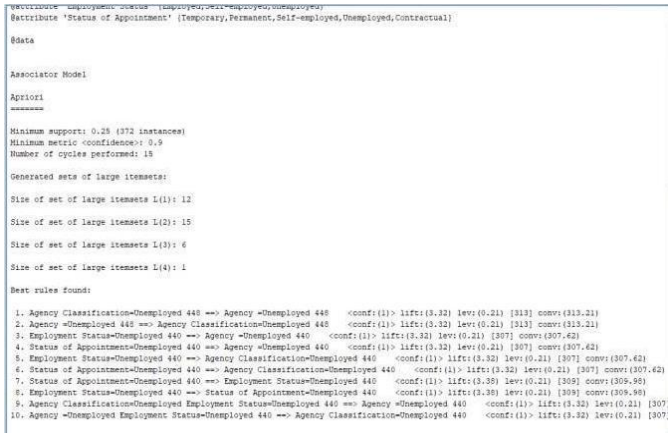


Fig. 10. Best Rules found using Predictive Apriori Algorithm

IV. CONCLUSION

Every year, the number of graduates produced by Higher Education Institutions (HEI) increases. The scenario is that the number matches job opportunities in the industry. The study provides valuable information about the graduate employment status, forecasting, visualization, and the exploration of classifiers algorithm to analyze the graduate employability in government, non-government organizations, self-employed, and unemployed.

V.RECOMMENDATIONS

The conduct of graduate tracer analysis on the different programs and relate the graduate employability to curriculum assessment and performance evaluation of graduates to identify measures and policies to improve student's performance.

REFERENCES

[1] H. P. Nudzor and F. Ansah, "Enhancing post-graduate programme effectiveness through tracer studies: the reflective accounts of a Ghanaian nation-wide graduate tracer study research team," Qual. High. Educ., vol. 26, no. 2, pp. 192–208, 2020, doi: 10.1080/13538322.2020.1763034.

[2] I. Djan and S. R. Adawiyyah, "A new decade for social changes," Tech. Soc. Sci. J., vol. 17, pp. 235–243, 2021.

[3] F. N. Romadlon and M. Arifin, "Improving Graduate Profiles Through Tracer Studies at University," KnE Soc. Sci., vol. 2021, pp. 34–44, 2021, doi: 10.18502/kss.v5i7.9317.

[4] S. Andari, A. C. Setiawan, and A. Rifqi, "Educational Management Graduates : A Tracer Study from Universitas Negeri Surabaya , Indonesia," vol. 2, no. 6, pp. 671–681, 2021.

[5] B. H. Et.al, "Tracer Study Analysis for the Reconstruction of the Mining Vocational Curriculum in the Era of Industrial Revolution 4.0," Turkish J. Comput. Math. Educ., vol. 12, no. 3, pp. 3013–3019, 2021, doi: 10.17762/turcomat.v12i3.1335.

[6] M. E. Caingcoy, "Scoping Review on Employability Skills of Teacher Education Graduates in the Philippines: A Framework for Curriculum Enhancement," Int. J. Educ. Lit. Stud., vol. 9, no. 4, p. 182, 2021, doi: 10.7575/aiac.ijels.v.9n.4p.182.

[7] E. Cagasan, B. Belonias, and M. E. Cuadra, "Graduate Students' Perceived Contribution of Scholarship Grants to Academic Success," Sci. Humanit. J., vol. 13, no. 1, pp. 99–113, 2019, doi: 10.47773/shj.1998.121.8.

[8] A. P. Dela Rosa and G. Galang, "Bachelor of Science in Information Technology at Bulacan State University: A Graduate Tracer Study," Int. J. English Lit. Soc. Sci., vol. 6, no. 3, pp. 265–272, 2021, doi: 10.22161/ijels.63.36.

[9] R. A. Steenbruggen, M. J. M. Maas, T. J. Hoogeboom, P. L. P. Brand, and P. J. van der Wees, "The application of the tracer method with peer observation and formative feedback for professional development in clinical practice: a scoping review," Perspect. Med. Educ., 2021, doi: 10.1007/s40037-021-00693-6.

[10] M. Tapfuma, O. Chikuta, F. N. Ncube, R. Baipai, P. Mazhande, and V. Basera, "Graduates' Perception of Tourism and Hospitality Degree Program Relevance To Career Attainment: a Case of Graduates From Three State Universities in Zimbabwe," J. Tour. Culin. Entrep., vol. 1, no. 2, pp. 190–207, 2021, doi: 10.37715/jtce.v1i2.2185.

[11] D. C. Bueno, T. R. Dumlao, M. H. Lopez, and J. G. Manago, "Tracing CCI education graduates: How well are we in developing professional teachers? Tracing CCI education graduates: How well are we in developing professional teachers? VP for Lifelong Learning and Students Welfare," CC J. A Multidiscip. Res. Rev., vol. 15, no. March, 2020, doi: 10.13140/RG.2.2.18081.35686.

[12] E. C. Deblois, "The Employment Profile of Graduates in a State University in Bicol Region, Philippines," J. Educ. Manag. Dev. Stud., vol. 1, no. 1, pp. 33–41, 2021, doi: 10.52631/jemds.v1i1.10.

[13] S. Khadragy and S. Abdallah, "Adaptive Network Based Fuzzy Inference System and the Future of Employability," Netw. Complex Syst., no. April, pp. 24–32, 2021, doi: 10.7176/ncs/12-04.

[14] K. C. Piad, M. Dumlao, M. A. Ballera, and S. C. Ambat, "Predicting IT employability using data mining techniques," 2016 3rd Int. Conf. Digit. Inf. Process. Data Mining, Wirel. Commun. DIPDMWC 2016, no. July, pp. 26–30, 2016, doi: 10.1109/DIPDMWC.2016.7529358.

[15] M. A. Job, "Data Mining Techniques Applying on Educational Dataset to Evaluate Learner Performance Using Cluster Analysis," Eur. J. Eng. Res. Sci., vol. 3, no. 11, pp. 25–31, 2018, doi: 10.24018/ejers.2018.3.11.966.

[16] Z. Othman, S. W. Shan, I. Yusoff, and C. P. Kee, "Classification techniques for predicting graduate employability," Int. J. Adv. Sci. Eng. Inf. Technol., vol. 8, no. 4–2, pp. 1712–1720, 2018, doi: 10.18517/ijaseit.8.4-2.6832.

[17] S. Hizam, "A Research Study by Delphi Technique in School Counseling," Test, vol. 82, no. 5607, pp. 5607–5615, 2020, doi: 10.5281/zenodo.4306058.

[18] S. F. S. Syeda Farha Shazmeen, "Performance Evaluation of Different Data Mining Classification Algorithm and Predictive Analysis," IOSR J. Comput. Eng., vol. 10, no. 6, pp. 1–6, 2013, doi: 10.9790/0661-1060106.

[19] O. M. Karatepe, O. Uludag, I. Menevis, L. Hadzimehmedagic, and L. Baddar, "The effects of selected individual characteristics on frontline employee performance and job satisfaction," Tour. Manag., vol. 27, no. 4, pp. 547–560, 2006, doi: 10.1016/j.tourman.2005.02.009.

[20] B. Jantawan and C. Tsai, "A Classification Model on Graduate Employability Using Bayesian Approaches: A Comparison," Int. J. Innov. Res. Comput. Commun. Eng. (An ISO Certif. Organ., vol. 3297, no. 6, pp. 4584–4588, 2007, [Online]. Available: www.ijircce.com.

[21] S. Thatavarti and K. Thammi Reddy, "Spice: A perspective approach for gap analysis to improve student performance index," Int. J. Appl. Eng. Res., vol. 12, no. 19, pp. 8651–8659, 2017.

[22] R. Wirth, "CRISP-DM : Towards a Standard Process Model for Data Mining," Proc. Fourth Int. Conf. Pract. Appl. Knowl. Discov. Data Min., no. 24959, pp. 29–39, 2000.
[23] K. J. Cios, R. W. Swiniarski, W. Pedrycz, and L. A. Kurgan, "The Knowledge Discovery Process," Data Min., pp. 9–24, 2007, doi: 10.1007/978-0-387-36795-8_2.
[24] P. Kurgan, L.A., Musilek, "A survey of Knowledge Discovery and Data Mining Process Models," Knowl. Eng. Rev., vol. 21, no. 1, pp. 1–24, 1996.
[25] T. Scheffer, "Finding association rules that trade support optimally against confidence," Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics), vol. 2168, pp. 424–435, 2001, doi: 10.1007/3-540-44794-6_35.

Challenges and its ways to Cope up with New Digital Techniques in this Digital Supply Chain Management Era

[1]Ankita Maiti, [2]Rupesh Khare
[1]Data Scientist, ABB, India [2]Global Head of Advance Artificial Intelligence, ABB, India

Abstract
This paper is an extension to the previous paper based on the digital supply chain framework and its importance , its need to digitalize various parts of the supply value chain. In this paper, we discuss about how to overcome the challenges of traditional supply chain such as Inventory management accuracy, warehouse efficiency, smarter planning, and risk management, on time delivery and high transparency between the tiers, also suggested various analytical strategies and application of Machine Learning technology with its pros and cons on overall framework.

Keywords
Artificial Intelligence, Machine Learning, Analytics, Digitalization, Supplier Chain Management

I. INTRODUCTION

The traditional way of supply chain has many existing challenges, including the lack of transparency and traceability, difficulty in managing risks and disruptions, and the need to build trust and faster production process. In the previous paper, we have discussed about the traditional supply chain flow and the areas in supplier chain which need to be enlightened for digital integration. Fig 1.1 (Appendix) shows the traditional supply chain process in an electrical equipment manufacturing company and its parts which could be digitalized. The paper also discussed about the digital supplier-manufacturer framework for integration with the detailed frameworks of Supplier chain processes from Supplier Selection to Negotiation and Evaluation digitally. Fig 1.2 depicts the final view of the supplier-manufacturer digital supply chain framework.

The four phases of the paper discussed about the digitalization in the supply chain, give a framework to digitalize those supplier's areas and associated benefits. As an extension to the same paper, we now talk about the other major areas of that needs to upgrade and its benefits to the supply chain framework In this paper, we would further highlight the various parts of the supply chain that need to be digitalized and answer various questions such as why digitalization is needed in the traditional supply chain, how can this be achieved, what are the various challenges in traditional SCM and how advanced analytics can be introduced in the supply chain to make the processes more efficient.

Application of Artificial Intelligence (AI) and other Machine Learning (ML) algorithms provides us various gain over the challenges that the SCM now faces with in the current digital world and technologies. Artificial Intelligence (AI) and other Machine Learning (ML) are already beginning to change the face of the supply chain industry. By culling out deep-rooted inefficiencies and uncertainties, Analytics drive

enterprise-wide visibility into all aspects of the supply chain and with granularity and methodologies that humans simply can't mimic at scale. Analytics in supply chains is helping to deliver the powerful

optimization capabilities required for more accurate capacity planning, improved productivity, high quality, lower costs, and greater output, all while fostering safer working conditions.

II. SCENE SETTING

This research study aims to look at various KPIs of interest in the entire value chain with focus on Customer-Manufacturer-Supplier ecosystem from a Digitalization perspective scenario creating a huge impact on Materials, Planning and process in the supply chain and suggesting preventive methods using AI and ML technologies.

2.1 To study the existing framework of supply chain

The traditional supply chain has many existing challenges, including the lack of transparency and traceability, difficulty in managing risks and disruptions. We also figured out various KPI's that caused adding on the various non-value-added services in the supply chain.

2.2 To study the need and difficulties confronted with and without digitalization in the supply chain

Digitalization enables industry to reach yet another level of accomplishment. Digitalization – i.e. the networking of people and things and the convergence of the real and virtual worlds that is enabled by information and communication technology (Kagermann, 2018), that digitalization triggers a radical transformation of the manufacturing environment. That is, with the emergence of the Internet of Things, we are now entering the era of the "fourth industrial revolution –

Industry 4.0" (ibid, 2017).

2.3 To study the various analytical strategies that can be applied to facilitate the interaction of SCM digitally

The current technology-based market is demanding and fast processing, with less human intervention and low error rates. So, with the help of Data Science and analytical techniques we are getting more data from more sources; it is the right data; and it is accurate.

2.4 To collect data and analysis based on the survey on supply chain digitalization integration

This part has been explained and surveyed in the next section of this paper. This gives out a very data specific outcome, of how is transformation from traditional to smart applications and technologies helped industries and companies form various threats and opened a way for new opportunities. Also, rectifying many existing limitations in their systems to ease the process flow and help industries evolve with the changing environment and technologies.

2.5 To understand how Integration of Analytics help in overcoming challenges based on empirical studies

Artificial Intelligence and Machine Learning (ML) are already beginning to change the face of the supply chain industry. By culling out deep-rooted inefficiencies and uncertainties, Artificial Intelligence and Machine Learning drive enterprise-wide visibility into all aspects of the supply chain and with granularity and methodologies that humans simply can't mimic at scale.

III. OBJECTIVE CONCEPTS AND INSIGHT

3.1: The whole focus of the previous paper was on analyzing the existing prior art and identifying digitalization opportunities and identification of value proposition in data exchange between manufacturer and suppliers which was purely case based approach from the company's perspective and studies.

Various non-value-added services or factors that influenced the data flow in the supply chain were-

1. No seamless data and information flow
2. No common platform for internal communication
3. Lack of transparency
4. Inappropriate hierarchy
5. Data duplicity or multiple copy of data
6. Reduce markdowns and stockouts
7. Human effort wastage

3.2: Traditionally, manufacturing organizations focus on producing and selling tangible products (Herterich, Uebernickel, and Brenner, 2019). In recent years, the manufacturing industry has been facing challenges such as constant need to expand into new markets and geographies, to capitalize on technology to affordably adapt new processes, to implement faster and more efficient ways of sharing fulfilment information, and furthermore to demonstrate compliance capabilities to win new businesses. Meanwhile, industry distribution faces challenges of increasing demand for just-in-time inventory, the need for up-to-date supply chain visibility, and service automation requirements from customers. **Digitalization** alludes to "the expanding infiltration of computerized advances in the public eye with the related changes in the association of people and their conduct" (Gimpel and Roglinger et al. 2019).

The digitalized "smart factories" are simultaneously vertically connected to the operational processes of individual factories while being horizontally linked to value networks that stretch across the entire globe, incorporating everything from ordering to delivery.

Forward-thinking companies are turning to integration to digital supply chain strategies harnessing the power innovations such as big data, the internet of things, artificial intelligence, machine learning and augmented reality. There can be various challenges both advantageous and disadvantageous faced in the process of transformation from traditional to digital supply chain management,

Challenges:

1. One of the major challenges in the digitalization of logistics is involvement of different stakeholders and communication among these stakeholders needs to be inclusive
2. Necessity of a platform where stakeholders can access common relevant information, dashboards that process and present this information empower decision-makers to pinpoint production bottlenecks, transform maintenance activities from reactive to preventative and predictive, identify parts redundancies and consolidate sources of supply.
3. Silo-based procurement, inventory, and maintenance processes create conflicts among departments whose performance is measured based on isolated factors such as work order completion, units produced, on-time delivery, or cost per piece. As a result, cooperation among various factions can be challenging.

3.3: Technology such as artificial intelligence, machine learning and cloud computing enable us to analyze and use that data in powerful new ways. Rather than using information to sound alarms when there are "exceptions" – problems or anomalies in the supply chain – we can use it to prevent them. Data becomes about managing the future, not the present.

3.4: Deep learning algorithms are appropriately named since their primary focus is on building systems that can learn from daily activity, mistakes, and solutions alike. In Inventory management, forecasts of future demands are generated to select an efficient inventory level, balancing inventory holding costs for excessive stocks with costs of lost sales-revenue through insufficient stock. Consequently, the precision of the forecasts directly determines the safety stocks kept, the inventory level and the inventory holding costs. Hence, forecasting methods with superior accuracy such as ANN may significantly reduce inventory holding costs. The ability to ingest mountains, and we mean terabyte

after terabyte of data and come up with real-time actionable insights is pattern recognition on a whole new scale. There are several practices to implement and rely on simulation modeling for strategic and operational decision making, including hiring simulation engineers, building internal simulation team, or contract consultants. These practices are different in terms of budget, time to implement, and returns.

There are various other technologies and techniques in the digital world that can be adapted in SCM. Few are namely: AI and ML, DNN & ANN, Stochastic simulations, Physarum model, Bayesian networks, Swarm intelligence, SVM, Internet of Things (IoT) and many more.

3.5: AI in supply chains is helping to deliver the powerful optimization capabilities required for more accurate capacity planning, improved productivity, high quality, lower costs, and greater output, all while fostering safer working conditions.

Studies suggest that AI and ML can deliver unprecedented value to supply chain and logistics operations. from cost savings through reduced operational redundancies and risk mitigation, to enhanced supply chain forecasting and speedy deliveries through more optimized routes to improved customer service. Some of the high impact areas in supply chain management include planning and scheduling, forecasting, spend analytics, logistics network optimization and more.

Integration of supply chain with smart analytics brings in various advantages in the supply chain from reduced labor, decrease utilities, increased productivity per hour, low percentage errors to increased profits for the organizations.

IV. DATA COLLECTION AND DATA ANALYSIS

As a part of research analysis, we analyzed our data and case studies over various companies in the supply chain market globally. The following results were analyzed and the main reasons behind these were followed up and depicted after the analysis process. The analysis was done in 3 stages:

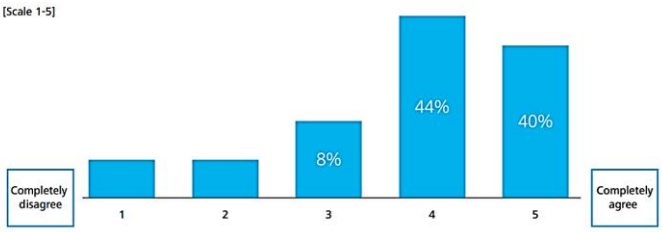
1. Data collection: from the various sources on internet, research thesis, old research papers and offline interviews
2. Data Analysis: done after the data collection using the analysis tools
3. Data Interpretation: based on the findings of the analysis, we concluded how much Digitalization is needful for the current market from small SC businesses to globally

4.1: Data Collection

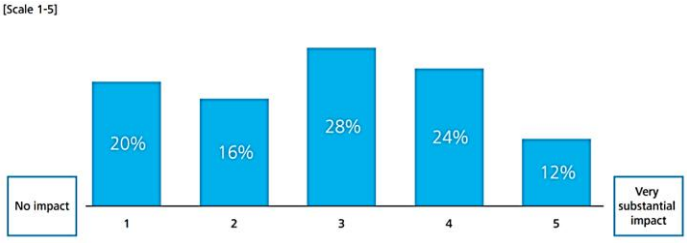
Based on survey done online (LinkedIn Voting, 2021), the digital transformation from traditional way to smart way has made good progress all over globally. The transformation not only influenced competitiveness in companies but also opened upon many new opportunities and risks, identifying future scopes and potentials for business and facilitate new manufacturing technologies.

We considered various factors in the transformation-

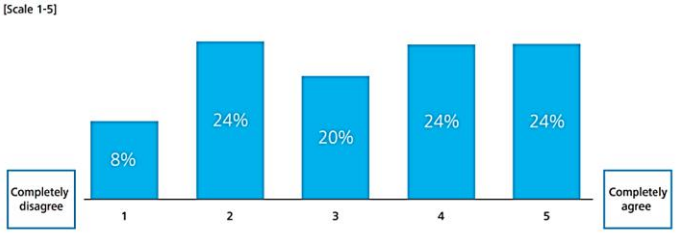
1. Digital transformation boosts the global competitiveness



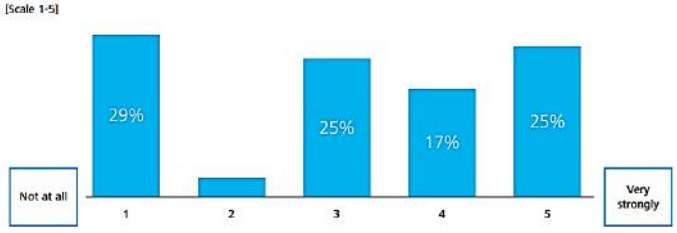
2. The company's feeling about the impact of digital transformation



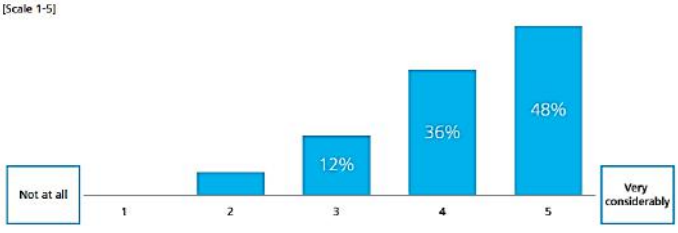
3. Digital transformation slowing down trend towards relocating production to low-wage countries



4. The company is already processing data through digital processes among all their stakeholders



5. Digitalization increasing cyber risk for manufacturing companies globally



4.2: Data Analysis and interpretation

After studying the collected data and understanding the graphs, we can conclude that Digitalization might have increased the chances of cybercrimes and invited with many new cyber thieving, but as they say, a coin has two faces, so with disadvantages comes the advantages on the other face,

where data processing and accessibility to them is now very easy and globally from anywhere in the world. The stakeholders have much appreciated with the transparency in the whole chain and there involvement throughout with hierarchical securities and authentications.

As the study depicts, digital transformation slowing down trend towards relocating production to low-wage countries, giving those countries in economic needs to grow and have decent knowledge of the global demands too. With reduced wage and high fruitful outputs and productions, the companies have now started to have a huge competitiveness globally. Increasing new paths to betterment.

V. ADVANTAGES & CONCLUSION

5.1: Benefits of AI in Supply Chain

5.1.1: Accurate Inventory Management: Accurate inventory management can ensure the right flow of items in and out of a warehouse. By and large, there are many stock related factors like request handling, picking and pressing, and this can turn out to be extremely tedious with a high propensity for blunder. Additionally, precise stock administration can help in forestalling overloading, lacking stock and startling stock-outs.

With their capacity to deal with mass information, analytical tools can end up being exceptionally successful in inventory administration. These keen frameworks can break down and decipher gigantic datasets rapidly, giving opportune direction on anticipating organic market. These AI systems with smart calculations can likewise foresee and find new customer propensities and conjecture occasional interest. This use of AI expects future client request patterns while limiting the expenses of overloading undesirable stock.

5.1.2: Warehouse Efficiency: An efficient warehouse is an integral part of the supply chain and automation can assist in the timely retrieval of an item from a warehouse and ensure a smooth journey to the customer. AI systems can also solve several warehouse issues, more quickly and accurately than a human can and simplify complex procedures and speed up work. Also, along with saving valuable time, AI-driven automation efforts can significantly reduce the need for, and cost of, warehouse staff.

5.1.3: Enhanced Safety: AI-based automated tools can ensure smarter planning and efficient warehouse management, which can enhance worker and material safety. Analytics can also analyze workplace safety data and inform manufacturers about any possible risks. It can record stocking parameters and update operations along with necessary feedback loops and proactive maintenance. This helps manufacturers react swiftly and decisively to keep warehouses secure and compliant with safety standards.

5.1.4: Reduced Operations Costs: This is a big benefit of AI systems for the supply chain. From customer service to the warehouse, automated intelligent operations can work error-free for a longer duration, reducing the number of errors and workplace incidents. Warehouse robots provide greater speed and accuracy achieving higher levels of productivity.

5.1.5: On-time Delivery: AI systems can help reduce dependency on manual efforts thus making the entire process faster, safer and smarter. This helps facilitate timely delivery to the customer as per the commitment. Automated systems accelerate traditional warehouse procedures, thus removing operational bottlenecks along the value chain with minimal effort to achieve delivery targets.

5.1.6: High transparency: By implementing Analytics in supply chain and logistics, supply chain managers can enhance their decision making by predicting building-up bottlenecks, unforeseen abnormalities, and solutions in order to streamline production scheduling that otherwise tends to be highly variable due to dependencies on manufacturing operations management. Furthermore, analytical techniques in supply chain also led to accurate predictions and quantification of expected outcomes across different stages of the schedule enable the scheduling of more optimal alternatives as and when such interruptions occur during execution. Having a cognitive AI-driven automated platform offers a single virtualized data layer to reveal the cause and effect, to eliminate bottleneck operations, and pick opportunities for improvement. All this using real-time data instead of redundant historical data.

5.1.7 Faster Decision Making: Faster decisions based on accurate representations of usage, costs, and historical performance. Elimination of effort duplication in which several departments input similar data for different purposes. By digitalizing and collecting data from across the enterprise, supply chain integration creates a single version of a company's performance – sales, efficiency, cost allocations, profit centers and more. Less downtime as machine learning and analytical forecasting helps coordinate maintenance and predict part failure.

VI. CONCLUSION

We can conclude that digitalization might have increased the chances of cybercrimes and invited with many new cyber thieving, but as they say, a coin has two faces, so with disadvantages comes the advantages on the other face, where data processing and accessibility to them is now very easy and globally from anywhere in the world. The stakeholders have much appreciated with the transparency in the whole chain and there involvement throughout with hierarchical securities and authentications. Furthermore, AI in supply chain also led to accurate predictions and quantification of expected outcomes across different stages of the schedule enable the scheduling of more optimal alternatives as and when such interruptions occur during execution. Having a cognitive AI-driven automated platform offers a single

virtualized data layer to reveal the cause and effect, to eliminate bottleneck operations, and pick opportunities for improvement. All this use real-time data instead of redundant historical data.

VII. LIMITATIONS AND FUTURE SCOPE

7.1: Challenges of AI in Supply Chain

7.1.1: System complexities: AI systems are usually cloud-based and require expansive bandwidth which is needed for powering the system. Sometimes, operators also need a specialized hardware to access these AI capabilities and the cost of this AI-specific hardware can involve a huge initial investment for many supply chains partners.

7.1.2: The scalability factor: Since Most AI and cloud-based systems are quite scalable, the challenge faced here is the level of initial start-up users/systems needed to be more impactful and effective. Since all AI systems are unique and different, this is something that supply chain partners will have to discuss in depth with their AI service providers.

7.1.3: The cost of training: Like any other new technology solution, training is another aspect which needs significant investment in terms of time and money. This can impact business efficiency as supply chain partners will need to work with the AI providers to create a training solution that is impactful yet affordable during the integration phase.

7.1.4: The operational costs involved: An AI-operated machine has an exceptional network of individual processors and each of these parts need maintenance and replacement from time-to-time. The challenge here is that due to the possible cost and energy involved, the operational investment could be quite high. Manufacturers would also need to replace these which can shoot up the cost of utility bills and could directly impact the overhead expenses of keeping them running.

7.2: Future Scope

For this system, we have focused only on AI and simple analytics technique to help overcome the limitations of traditional SCM based problems. This study could be furthermore divided and studied into sub parts on IoT applications, machine learning technologies, Advance Machine learning techniques, various stochastic algorithms, technology specific models and many more.

REFERENCES

1. Supply Chain General Paper:

1. Desai, D. and Makridis, C., 2020. Supply Chain Risks in Cybersecurity. *SSRN Electronic Journal*,.
2. *REST Journal on Emerging trends in Modelling and Manufacturing*, 2021. A CRITICAL ANALYSIS ON CYBER SECURITY IN LATEST TECHNOLOGIES. 7(2).
3. *Connections: The Quarterly Journal*, 2006. Emerging Technologies in the Context of "Security". 05(2), pp.121-153.
4. Cheung, K., Bell, M. and Bhattacharjya, J., 2021. Cybersecurity in logistics and supply chain management: An overview and future research directions. *Transportation Research Part E: Logistics and Transportation Review*, 146, p.102217.

2. AI and Supply Chain Paper:

5. Yan, W., He, J. and Trappey, A., 2019. Risk-aware supply chain intelligence: AI-enabled supply chain and logistics management considering risk mitigation. *Advanced Engineering Informatics*, 42, p.100976.
6. Chandraul, V. and Barode, S., 2018. Optimizing Demand and Forecasting in Supply Chain Management Using AI. *SMART MOVES JOURNAL IJOSCIENCE*, 4(12), p.9.
7. Toorajipour, R., Sohrabpour, V., Nazarpour, A., Oghazi, P. and Fischl, M., 2021. Artificial intelligence in supply chain management: A systematic literature review. *Journal of Business Research*, 122, pp.502-517.
8. Min, H., 2019. Artificial intelligence in supply chain management: theory and applications. *International Journal of Logistics Research and Applications*, 13(1), pp.13-39.
9. Helo, P. and Hao, Y., 2021. Artificial intelligence in operations management and supply chain management: an exploratory case study. *Production Planning & Control*, pp.1-18.
10. Fahle, S., Prinz, C. and Kuhlenkötter, B., 2020. Systematic review on machine learning (ML) methods for manufacturing processes – Identifying artificial intelligence (AI) methods for field application. *Procedia CIRP*, 93, pp.413-418.

SVM Hyperplane Misclassification Control by Finding Optimum Cost of Misclassification with Boundary Value Analysis Technique

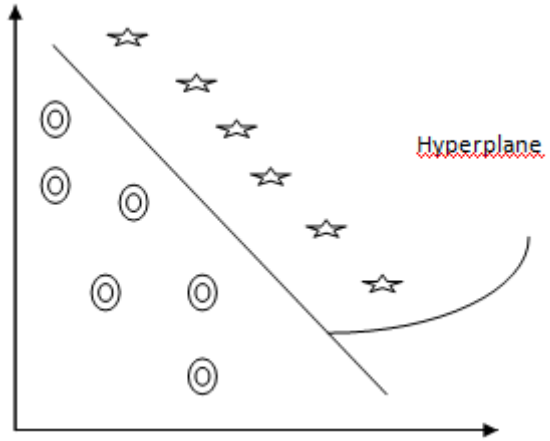
[1] Kumar Gaurav Kapoor, [2] Avadhesh Kumar
[1][2] Galgotias University, Greater Noida (U.P.),India

Abstract
In Health care domain roughly 80% of data in electronic medical records consists of physicians' unstructured notes. To unlock this important data we need a different approach than what we used to analyse structured data. That's one place where machine learning comes in and for this SVM (Support Vector Machine) is extensively used to identify the handwritten digits and words based on pixel given as features. SVM uses the concept of Hyper Planes which leads to a boundary which classifies the data set.
Key area of the Research paper is to get Optimum Hyper plane

Keywords
Support Vector Machine, Hyperplane, Slack Variable

I. INTRODUCTION

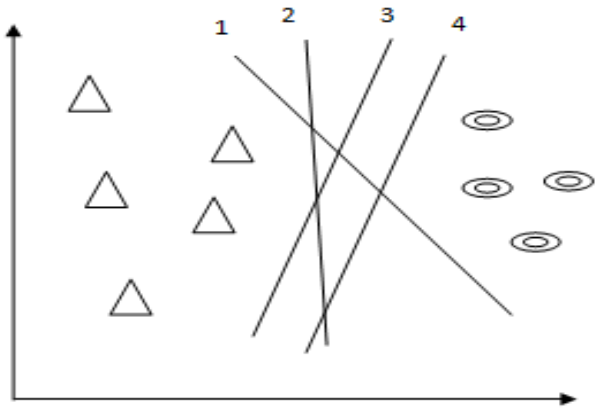
Support Vector Machine (SVM) is an advanced machine learning technique which has a unique way of solving complex problems such as image recognition, face detection, voice detection [1]. SVMs belong to the class of linear machine learning models. A line that is used to classify one class from another is called a hyperplane



Hyperplane

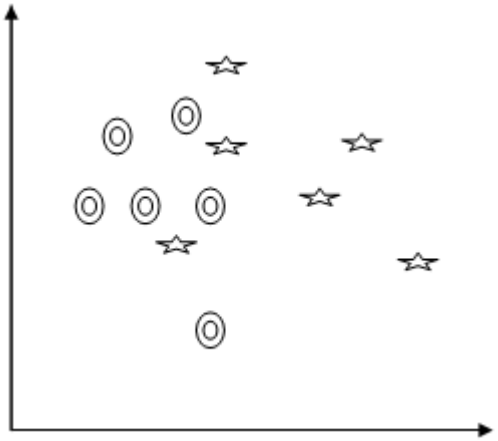
A positive value (blue points in the plot above) would mean that the set of values of the features is in one class; however, a negative value (red points in the plot above)would imply it belongs to the other class. A value of zero would imply that the point lies on the line (hyperplane).

However, there could be multiple lines (or hyperplanes in general) possible, which perfectly separate the two classes. How to get the optimum hyperplane.is the key challenge.



Choosing 1 or 2 or 3 or 4 is the biggest challenge in Hyperplane finding

Partially Intermingled data case create more confusion in finding hyper plane for example in below diagram.

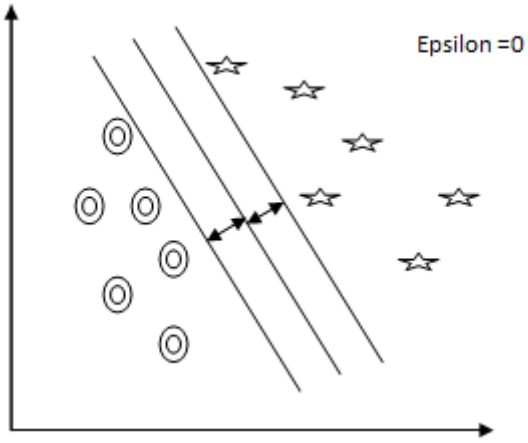


Partially Intermingled Data

It seems that the maximal margin line (hyperplane) is not even possible in this case. In this case, if want to create a linear hyperplane, we will inevitably need to misclassify a few data points. In other words, some points will need to fall on the wrong side of the hyperplane.

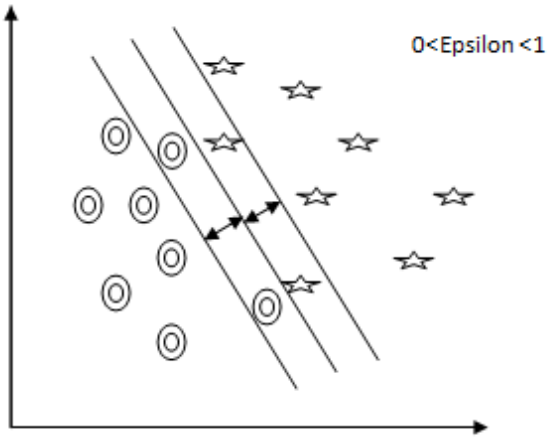
Slack variable: A slack variable is used to control misclassifications.It tellswhere an observation is located relative to the margin and hyperplane.

For points which are at safe distance from the hyperplane, the value of the slack variable is 0.



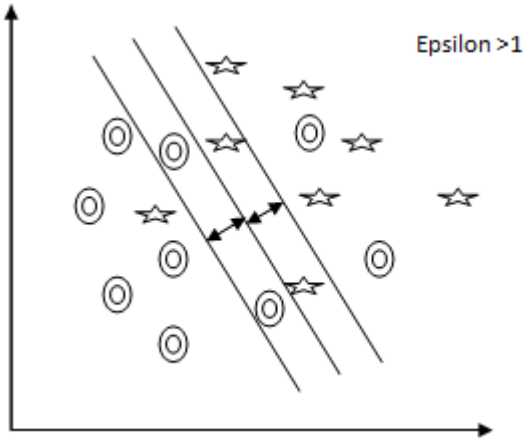
Slack Variable

On the other hand, if a data point is correctly classified but falls inside the margin (or violates the margin), then the value of its slack is between 0 and 1 [2, 3].



Epsilon value lies between 0 and 1

Finally, if a data point is incorrectly classified (i.e. it violates the hyperplane), the value of epsilon > 1.



Epsilon value> 1

Each data point has a slack value associated. The value of the slack lies between 0 and infinity . Lower values of slack are better than higher values.

The summation of all the epsilons of each data point is denoted by cost or 'C' [3]i.e.

$\sum \epsilon i \leq C$.

When C (summation of all the epsilons) is large, the slack variables can be large thus allowing a large number of data points to be misclassified or to violate the margin.

On the other hand, when C is small, it force the individual slack variables to be small, thus allowing many data points to fall on the wrong side of the margin or the hyperplane.

Finding optimum cost of misclassification is the main objective of the paper.

II. LITERATURE REVIEW

Health care industry is focusing on Digitization that leads to electronic health recording system. Today digitally means analysis of records which occurred due to use of sensors, remote monitoring, and apps to provide continuous data [4].

Now Health care industry started using Predictive analysis Predictive analysis Modelling uses machine learning algorithms, in which the machine learns from the data just like humans learn from their experiences. Machine learning can be used heavily in the industry. Let's go deeper into the types of models that come under machine learning[5].

Machine learning models can be classified into the followingthree types based on the task performed and the nature of the output:

1. Regression: The output variable to be predicted is a continuous variable, e.g. blood pressure of a patient
2. Classification: The output variable to be predicted is a

categorical variable, e.g. classifying patients with fever or not.

3. Clustering: No pre-defined notion of label allocated to groups/clusters formed, e.g. patient segmentation

Machine learning models classified into two broad categories as follows:[7, 8].

1. **Supervised Learning Methods**

- Past data with labels is used for building the model.
- Regression and classification algorithms fall under this category.
- The past data is divided into training and testing data sets for building the model.

2. **Unsupervised Learning Methods**[9]

- No pre-defined labels are assigned to past data
- Clustering algorithms fall under this category

Over fitting is a phenomenon where a model becomes too specific to the data it is trained on and fails to generalize to other unseen data points in the larger domain. A model that has become too specific to a training data set has actually 'learnt' not just the hidden patterns in the data but also the noise and the inconsistencies in the data. In a typical case of over fitting, the model performs very well on the training data but fails miserably on the test data.

A model should never be evaluated on data it has already seenb before. With that in mind there will either one of two cases –

1) The training data is abundant or
2) The training data is limited.

The first case is straightforward because it can use as many observations as like to both train and test the model. In the second case, however, it has to find some 'hack' so that the model can be evaluated on unseen data and at the same time doesn't eat up the data available for training. This hack, commonly used in statistics, is called cross-validation [4].

On dividing the available data into 75:25 or 70:30, themajority data is called the training set, the other part is called testing set [10].SVMs belong to the class of linear machine learning models which uses a linear function(i.e. of the form y = ax +b) to model the relationship between the input x and output y.

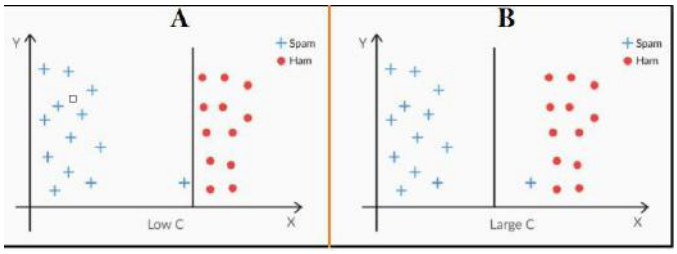
For example, in logistic regression, the log(odds) of an outcome (say, defaulting on a credit card) is linearly related to the attributes x1, x2, etc.

$$\log(\text{odds of default}) = \beta 0 + \beta 1 X1 + \beta 2 X2 + \ldots \beta n Xn$$

Similarly, SVMs are also linear models [11].SVMs need attributes in the numeric form. To summarize, SVMs are basically a linear models that takes numeric attributes. But if the attributes are non-numeric, then have to convert them to a numeric form in the data preparation stage [1].

III. PROBLEM STATEMENT

Support Vector Machine uses the concept of Hyperplanes which leads to a boundary which classifies the data set. Problem is how to get Optimum hyperplane with cost of misclassification so thus to perfectly separate classes [3].



Optimum Hyperplane

If C is large, the slack variables (epsilons(ϵ)) can be large, i.e. you allow a larger number of data points to be misclassified or violate the margin; and if C is small, you force the individual slack variables to be small, i.e. you do not allow many data points to fall on the wrong side of the margin or the hyperplane [4, 6, 12].

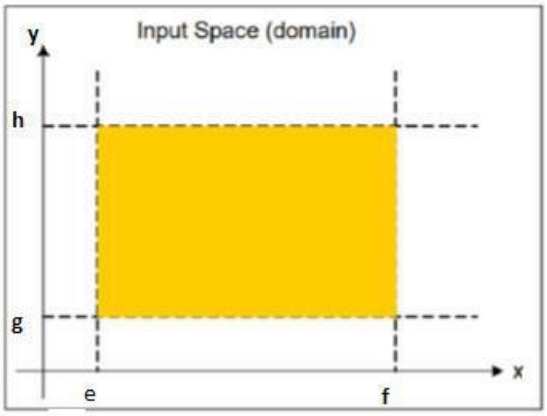
IV. PROPOSED SOLUTION

Application of BVA for finding Optimum Cost of Misclassification. Boundary Value Analysis (BVA) analysis the values which lies on the boundaries, values just above the boundary and just below the boundary [13].

Example: x and y

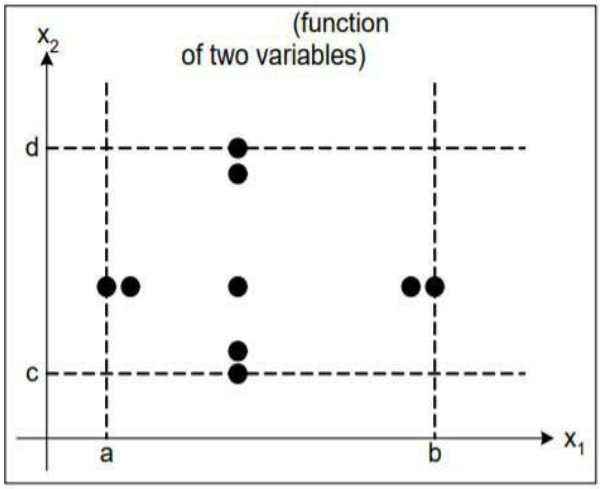
e <= x<= f
g <= y <=h

In this e and g are lower boundary f and h are upper boundary



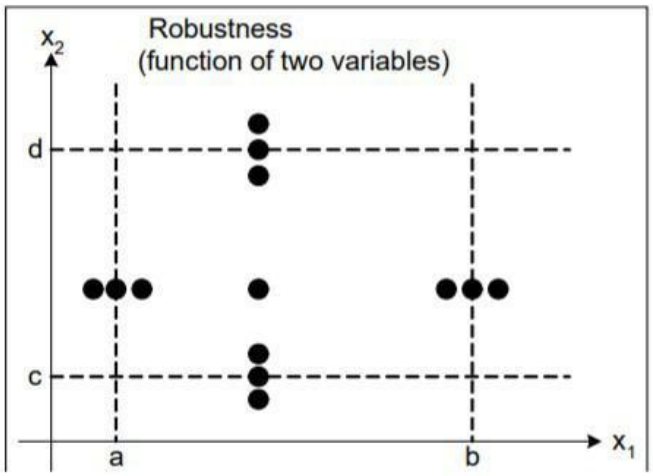
Boundary Value Analysis

- Min range---------- Minimum
- Min+ range ---------- - Just above Minimum
- Nom range ---------- Nominal
- Max range ---------- Maximum
- Max- range ---------- - Just below Maximum



Function of two variables

Formula for number of variables n f= 4n+1
Extension of Boundary Value Analysis: Robustness[14].



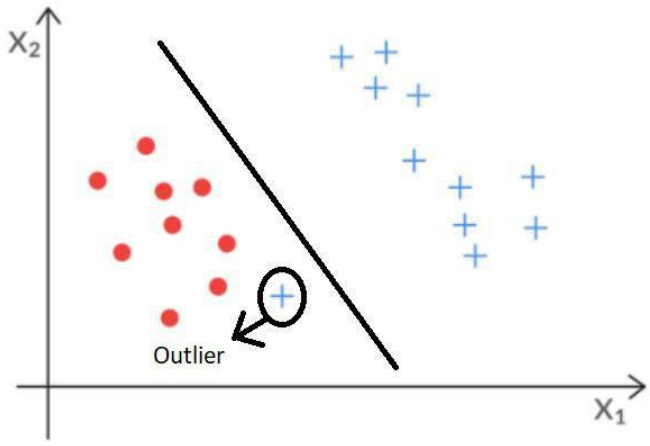
Robustness

In Robustness BVA we have two more addition to above Min– and Max+

- Min- range----------Just below Minimum
- Max+ range ---------- Just above Maximum

f = 6n + 1

On considering the range values of max and min with Extended BVA optimum cost of misclassification can be considered.



Depicts Outlier

Proposed Optimum Cost of Misclassification C:

Outlier (n) = 1

Apply Extended BVA

C= 6n + 1

C = 6 *1 + 1

C = 7

V. CONCLUSION

Proposed novel idea of applying Extended Boundary Value analysis helps in solving the problem of identifying Optimum Cost of misclassification (C) in Support Vector Machine

If C is high, a higher number of points are allowed to be misclassified or violate the margin. In this case the model is flexible, more generalizable and less likely to over fit. In other words it has high bias.

On the other hand if C is low, a lesser number of Points are allowed to be misclassified or violate the margin. In this case the model is less flexible, less generalizable and more likely to over fit. In other words it has a high variance.

REFERENCES

1. Decision support system based on the support vector machines and the adaptive support vector machines algorithm for solving chest disease diagnosis problems Amani Yahyaoui1, Nejat Yumuşak Biomedical Research 2018 , 29 (7): 1474-1480.
2. An Efficient Feature Selection Strategy Based on Multiple Support Vector Machine Technology with Gene Expression Data ,Ying Zhang,1 Qingchun Deng,2 Wenbin Liang,3 and Xianchun Zou BioMed Research International , 2018.
3. Data mining in healthcare–a review. Procedia,Computer Science , NeeshaJothi,WahidahHusain,etal., 72:306–313, 2015.
4. A survey on data mining approaches for healthcare. International Journal of Bio-Science and Bio-Technology, Divya Tomar and Sonali Agarwal ,5(5):241–266, 2013.
5. Greg JF. Household-contact investigation for detection of tuberculosis in Vietnam. N Engl J Med 2018; 378: 221-229.
6. Sentiment Analysis using SVM: A Systematic Literature Review , Munir Ahmad1, Shabib Aftab2, Muhammad Salman Bashir3, Noureen Hameed4 , IJACSA, Vol. 9, No. 2, 2018.
7. N. T. Liu and J. Salinas, "Machine learning in burn care and research: A systematic review of the literature," Burns, vol. 41, no. 8, pp. 1636–1641, 2015.
8. Maria Virvou, Efthimios Alepis, George A. Tsihrintzis, Lakhmi C. Jain:Machine Learning Paradigms-Advances in Learning Analytics Intelligent Systems Reference Library 158, Springer 2019, ISBN 978-3-030-13742-7.
9. Empirical Approach to Machine Learning. Studies in Computational Intelligence 800, Springer 2019, ISBN 978-3-030-02383-6.
10. Jun Jiang, Zhe Wen, Mingxin Zhao, Yifan Bie, Chen Li, Mingang Tan, Chaohai Zhang:Series Arc Detection and Complex Load Recognition Based on Principal Component Analysis and Support Vector Machine. IEEE Access 7: 47221-47229, 2019.
11. HushengGuo, Wenjian Wang:Granular support vector machine: a review. Artif. Intell. Rev. 51(1): 19-32 (2019).
12. Seokho Kang, Dongil Kim, Sungzoon Cho:Approximate training of one-class support vector machines using expected margin. Computers & Industrial Engineering 130: 772-778 (2019).
13. Tianyong Wu, Jian Zhang:Boundary value analysis in automatic white-box test generation. ISSRE 2015: 239-249.
14. Rolci Cipolatti, I-Shih Liu, Luiz A. Palermo, Mauro Antonio Rincon, Ricardo M. S. Rosa:A boundary value problem arising from nonlinear viscoelasticity: Mathematical analysis and numerical simulations. Applied Mathematics and Computation 335: 237-247 (2018).

Medical Images Augmentation via GAN Image patches segmentation using Yolo with Neural Style

[1] Kumar Gaurav Kapoor, [2] Avadhesh Kumar
[1][2] Galgotias University, Greater Noida (U.P.),India

Abstract
The problem that paper is solving relates to Low Model performance due To Fewer Images to train. Medical field is the area in which we encounter less amount of training data due to rare diseases like Lung Cancer, Histopathological Cancer, Covid 19 etc.
The problem with small datasets is that models trained with them suffer from the problem of over fitting.
Image Augmentation is another way we can reduce over fitting on models, where we increase the number of training images using information only in our training image.
Key area of the Research paper is to get Image Augmentation with GAN using YOLO and Neural Style.

Keywords
GAN , Image Augmentation ,YOLO ,Neural Style

I. INTRODUCTION

The paper will bolster Image Augmentation by introducing a novel technique where we are combining the power of YOLO algorithm for image patch creation. GAN to create new images with patches and Neural Style Transfer to further augment images based on different techniques of Neural Style Transfer like colour combinations, textures, intensities of various colours.

The invention will help in increasing the accuracy of Image augmentation by a significant level of 20 -30%.

GAN (Generative Adversarial Network): Set of generative models that are used to produce /generate new content.

YOLO (You only look once): Robust techniques of real time object detection in an Image.

Neural Style Transfer: The process of applying the style of an image to another content image.

Input Image + Style Image -> Output Image
(Styled Input)

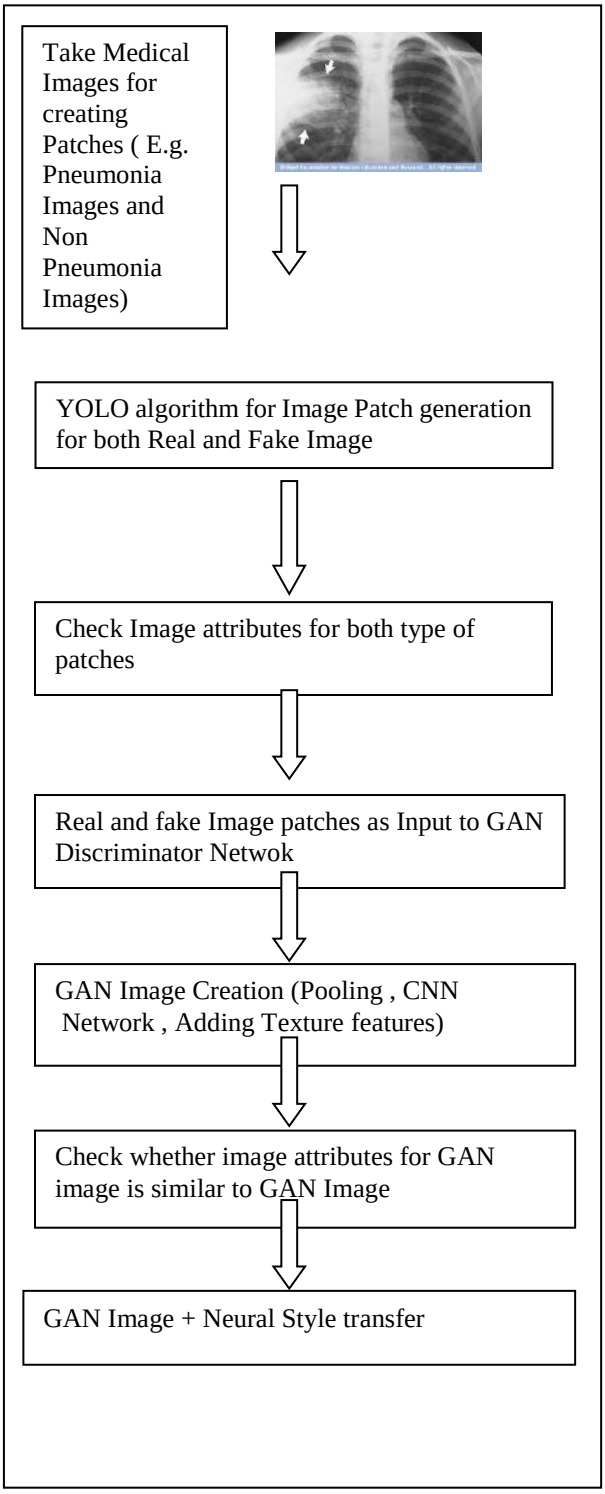
II. RELATED WORK

The process will start with the input of two types of images i.e Disease Image (Lung Image with Pneumonia) and Non Disease Image (Normal Lung Image) . In the next step YOLO algorithm will take both type of images as a input and produce patches for them . These patches will be treated as a input for GAN algorithm which will produce new images that are a combination of Normal and disease image.

The GAN algorithm compromises of two type networks i.e Generator and Discriminator network. Generator network process the patches to create new images whereas discriminator network validates whether the properties of generated images are same as real images or not .If yes then it passes the images as a final created image whereas in case if the attributes are not same , it will again back propagate the image to generative network for further processing.

The images generated by GAN algorithm will act as a input for Neural Style processing .

Neural Style processing based on the inputs provided for styling of the image , produces multiple images with the help of VGG -16 neural network.



III. Mathematical Representation

Universe: {Image 1, Image 2 , Image 3 ….Image N }

Let's suppose N= 100
Thus
Universe Count =100

GAN Output:

	Image					Output
S. No	Real ref patch with Nuclei from Image 1	Fake Patch From Image 2	Reference Patch from Image1	Reference Patch from Image1		GAN Image
1	1	1	1	1		✓
2	2	1	1	1		✓
3	3	1	1	1		✓
4	4	1	1	1….		✓
….						✓
M	M	1	1	1		✓

Number of patches with Nuclei from Image 1 : M
Let's suppose M =10
GAN Images count : M
Number of Images : N
Total GAN Images Count =GAN Images Count * Number of Images
= M*N
Let's suppose M =10
Number of Images = 100

Thus Total GAN Images Count = 100 *10=1000 GAN Images

Neural Style Image Output

	Image				
S.No	Patch from Image 1	Neural Style representation 1	Neural Style representation 2	Neural Style S	Neural Style Image
1	1	1	1	1	✓
2	2	1	1	1	✓
3	3	1	1	1	✓
4	4	1	1	1	✓
….	…	1	1	1	✓
M	M	1	1	1	✓

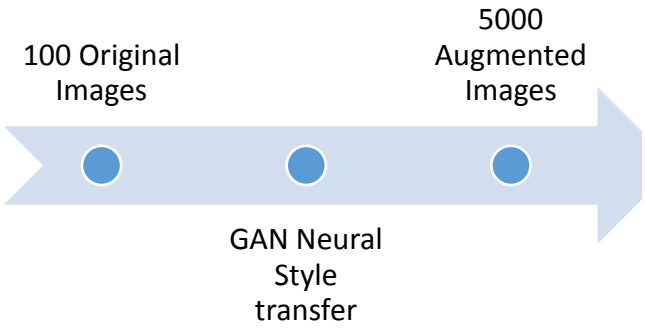
Number of patches from Image 1:R
Neural Style for a Patch : S
Neural Style Images for 1 Image : R * S
Total number of Neural Style Images : N*R*S
Let's suppose Number of patches from Image1:10

Neural Style for a Patch : 5
Neural Style Images for a Image : 10*5 :50
Total Number of Neural Style Image :50*100 : 5000
GAN with Neural Style

	GAN + Neural Style Image Transfer			Output
S.No	Image	GAN Image	Neural Style	GAN Neural Style Image
1	1	1	1	1+1
2			2	1+2
3			3	1+3
4			4	1+4
5			5	1+5
6		2	1	2+1
7			2	2+2
8			3	2+3
9			4	2+4
10			5	2+5

No. Of Images	No. Of GAN Images	No. Of Neural Styles corresponding to 1 GAN Image	Total
N	M	S	N*M*S

Number of Neural Styles corresponding to 1GAN Image : 5
Number of GAN Images from a Histopathologic Image :10
Number of Images : 100
Total Number of GAN Neural Style Image : 5*10*100 : 5000 Images



IV. CONCLUSION

Proposed novel idea of Medical Images Augmentation via GAN Image patches segmentation using Yolo with Neural Style leads to increase in the number of training images which helps machine learning models to overcome the problem of over fitting. Better accuracy is the key metrics for each model and this Image augmentation technique will help in it.

REFERENCES

1. Krizhevsky A, Sutskever I, Hinton GE. ImageNet classification with deep convolutional neural networks. Adv Neural Inf Process Syst. 2012;25:1106–14.
2. Karen S, Andrew Z. Very deep convolutional networks for large-scale image recognition. arXiv e-prints. 2014.
3. Data mining in healthcare–a review. Procedia,Computer Science , NeeshaJothi,WahidahHusain,etal., 72:306–313, 2015.
4. Kaiming H, Xiangyu Z, Shaoqing R, Jian S. Deep residual learning for image recognition. In: CVPR, 2016..
5. Gao H, Zhuang L, Laurens M, Kilian QW. Densely connected convolutional networks. arXiv preprint. 2016.
6. Sergey I, Christan S. Batch normalization: accelerating deep network training by reducing internal covariate shift. In: ICML; 2015.
7. Empirical Approach to Machine Learning. Studies in Computational Intelligence 800, Springer 2019, ISBN 978-3-030-02383-6.
8. Jun Jiang, Zhe Wen, Mingxin Zhao, Yifan Bie, Chen Li, Mingang Tan, Chaohai Zhang:Series Arc Detection and Complex Load Recognition Based on Principal Component Analysis and Support Vector Machine. IEEE Access 7: 47221-47229, 2019.
9. HushengGuo, Wenjian Wang:Granular support vector machine: a review. Artif. Intell. Rev. 51(1): 19-32 (2019).
10. Alex Krizhevsky, Ilya Sutskever, and Geoffrey E Hinton. 2012. ImageNet Classification with Deep Convolutional Neural Networks. In Advances in Neural Information Processing Systems 25, F. Pereira, C. J. C. Burges, L. Bottou, and K. Q. Weinberger (Eds.). Curran Associates, Inc., 1097--1105

Development of Cost Planning Standards for Design Development, Sitework, and Structure for Stadium Area Works on Integrated Contracts for Main Stadium Building Based on Indonesian Minister of Public Works Regulation Number 22 of 2018 to Improve Cost Accuracy

[1] Siburian, Jonathan Hasian, [2] Latief, Yusuf
[1]Student, [2] Supervisor

Abstract
Increasing development and future planning on the sports tourism in Indonesia, is not in line with the planning execution process, particularly on the construction plan application process in several big projects especially stadium construction. Ironically, stadium that can be classified as Bangunan Gedung Negara, should be one of the most important buildings which could be the main cantilever for all of the sports tourism activities and planning in Indonesia. This thing could be happened because there were not any policies has been made and issued by the Indonesian's government institutions, which contains standard and clauses of stadium construction in particular.Moreover, the complexity rate of stadium construction process is also requiring the most efficient and effective method, particularly in cost planning, thus the project delivery accomplishment process can be conducted with a high accuracy rate. This degree of accuracy became so important, because there is a probability of project cost differ from the planning could be happened. Furthermore, there is a likelihood of dispute occurrence as the impact of the inaccurate cost planning in the project beginning.Because of that, the design and build method could be one of the best choices, as long as can be implemented following the standards that have been tested against the cost planning accuracy rate. However, because this kind of method has not been contained in any existing national standards, thus a development against the existing policies and standards became so crucial, in order to assisting the national planning and development especially in the sports tourism area. Therefore, a development for the existing policies that is the closest-to-be the solution of the issues above, which is Permen No. 22 issued in 2018, need to be conducted as soon as possible.

Keywords
Cost Planning Standards, Main Stadium Building, Design and Build, Cost Accuracy.

I. INTRODUCTION

The concept of stadium development has developed rapidly, where stadium design must focus on the need for community-friendly structures that provide the maximum level of safety and comfort, as an architectural icon in the urban landscape that has a major impact on the surrounding community and its infrastructure, designed for the needs of the community, maximizing potential commercial operations, and incorporates the latest technological advances to offer the best facilities for the community (UEFA, 2011). The main stadium building itself is divided into 3 types, namely Type A (International), Type B (National), and the last is Type C. The differentiators for these 3 types are based on the capacity of the audience, the number of 100 m running tracks, and the 400m running tracks. The larger the scale of the Main Stadium Building type, the greater the capacity. Standardized work cost planning is very important for Stadium Main Building Works because it will produce a validated, universal, written, transparent, and agreed-upon cost planning standard for all parties. The standardized method of measuring the volume of work has the main objective of increasing the accuracy of the calculation of the volume of work. This can have an impact on reducing the difference in the calculation of results between the construction service provider appointed to carry out the Design and Build contract with the auditor/owner. In addition, another positive impact is that of course it can reduce the possibility of disputes and has an indirect impact on saving time, costs, and maintaining relations between stakeholders.

The construction of the main stadium and its complementary sports venues are often required to be completed in a relatively fast and limited time to meet the demands of the timeline of the event to be held. Efforts to reduce or control the time of building construction work can be done by choosing the right form of contract. Therefore, the

main stadium building is also included in the project criteria that can be carried out using an integrated design-build contract according to PUPR Ministerial Regulation Number 1/PRT/M/2020. According to the regulation, design and build integrated construction work is defined as all work related to the construction of a building or the construction of other physical forms, where the design work is integrated with the construction implementation. In stadium construction, Design and Build Integrated Contracts are often used as an effort to streamline time, by eliminating the bidding process for construction service providers and preparing planning documents because one party is directly appointed to design and build at the same time. There are fewer stakeholders involved so they don't have projects. In addition, the design-build contractor can create the building as long as it is in accordance with the contract value and the owner's specifications or criteria.

II. LITERATURE REVIEW

A. State Building

According to the Presidential Regulation of the Republic of Indonesia Number 73 of 2011 concerning the Construction of State Buildings, it is explained that a building is a building for service purposes which becomes state/regional property and is held with funding sources originating from APBN and/or APBD funds, or other acquisitions. legitimate. Building construction is the activity of constructing a state building which is carried out through the technical, implementation, and supervision stages, both construction of new buildings, building maintenance, as well as expansion of existing buildings, and/or continuation of building construction.

There are 3 stages of Construction of State Buildings, which consist of the preparation stage, the technical planning stage, and the construction implementation stage (Peraturan Menteri Pekerjaan Umum Nomor 22/PRT/M/2018 Article 3 concerning Technical Guidelines for the Construction of State Buildings). These stages should be carried out in accordance with the technical guidelines for the construction of state buildings in Permen PU No. 22 Tahun 2018 :

1.The implementation of the construction of state buildings includes the construction maintenance phase.

2.The implementation of construction is the implementation stage of constructing buildings, whether it is a new construction, partial or total renovation, expansion of existing buildings, continuation of maintenance (rehabilitation, renovation, restoration) carried by using construction service provider according to the requirement.

3.The implementation of construction is carried out based on the contract documents that have been signed by both parties.

B. Design and Build

Design and Build is a construction contract for work related to the construction of a building where the provider has one unit of responsibility for the design and implementation of construction (PUPR, 2020). Another definition of a design and build contract is a contract for all work related to the construction of a building or the manufacture of other physical forms, where the design work is integrated with the construction implementation (Ministerial Regulation of PUPR No.1 of 2020).

Design and build integrated construction works can increase innovation and accelerate the development of quality infrastructure. Design and Build is a construction contract for work related to the construction of a building where the provider has one unit of responsibility for the design and implementation of construction (PUPR, 2020). This Design and Build is different from the conventional method where the Service User does not need to prepare a Detail Engineering Design (DED), but only prepares a basic design.

C. Stadium main building

According to Minister of Youth and Sports Regulation No. 400 of 2013, a stadium is a piece of sports infrastructure that must be predominantly used for sporting activities/practices. The stadium is prioritized as a center for athletics and football. However, because the stadium is equipped with stands with sufficient seats for spectators and a reasonably wide arena, it can be used for a variety of non-sports activities, such as music concerts, religious activities, social activities, and other activities that involve visitors. In general, stadium work is separated into three parts: the main stadium building, field of play, and Stadium Area. The scope of work on the main stadium building zone includes:

a. Spectator Tribune Area
b.Athlete/Player Facilities
c. Activity Management Facility
d. Building Management Facility
e.Media Facilities
f.Commercial Area

D. Standard Cost

Standard cost is used for standard physical construction works such as architectural, structural, utility works which include plumbing work, lighting, installation, and finishing. The overhead cost of carrying out construction work, insurance, work safety, inflation, and taxes in accordance with the provisions of law and regulations are also included in the standard cost. The followings are indicators for the standard cost used in this study, there are 5 indicators as described in table 2.1 below.

Table Error! No text of specified style in document.**.1 Indicators and Variables of Standard Cost**

No	Variable	Indicator	Reference
1	Standard Cost	Work component	Jauzy A. (2012); BPSDM PUPR (2016); Kementerian PUPR (2017)
		Extensive standard	Jauzy A. (2012); BPSDM PUPR (2016); Kementerian PUPR (2017); Permen PU (2018)
		Number of	Jauzy A. (2012);

	floors	BPSDM PUPR (2016); Kementerian PUPR (2017)
	The highest unit price for state buildings	Jauzy A. (2012); BPSDM PUPR (2016); Kementerian PUPR (2017)
	Construction cost index	Hikmah J. dan Idris (2019)

E. Non-Standard Cost

Non-standard cost is the cost incurred for the implementation of non-standard construction such as: permits other than Izin Mendirikan Bangunan (IMB) and the installation of other utilities, land preparation, improvement of architectural and structural work, building special equipments for mechanical and electrical building works, and specifically for environmentally friendly buildings (Peraturan Presiden No. 73 Tahun 2011). The followings are indicators for non-standard cost variables used in this research, there are 4 indicators as described in table 2.2 below.

Table Error! No text of specified style in document..**2 Indicators and Variables of Non-Standard Cost**

No	Variable	Indicator	Reference
1	Non-Standard Cost	Volume details	Jauzy A. (2012); BPSDM PUPR (2016)
		Buildings and environment	Kementerian PUPR (2017)
		Significant function	Kementerian PUPR (2017); Permen PU (2018)
		Other works	Kementerian PUPR (2017)

F. The Relation of Standards Planning and Permen PU No. 22 Tahun 2018 to Improve Cost Accuracy

Based on the journal from (Muhammad T. Hatamleh, 2017) which examines the factors that affect the accuracy of project costs and added with an understanding of the rules and regulations related to the Integrated Design and Build contract of the State Building in Permen PU No. 22 Tahun 2018. Then the synthesis of research or the relation between variables is obtained as explained in table 2.4 below..

Table Error! No text of specified style in document..**4 Research Synthesis – Relation Between Variables**

No	Relation Between Variables	Reference
1	Standard Cost → Non-Standard Cost	Permen PU No. 22 (2018); Perpres No. 73 (2011)
2	Standard Cost → Cost Accuracy	Muhammad T. H (2017); Alfredo F. (2005); Mamik R. (2007); Pradana & Miftahul (2019)
3	Non-Standard Cost → Cost Accuracy	Muhammad T. H (2017); Alfredo F. (2005); Mamik R. (2007)

As seen from table 2.4, the development of standards planning for Design Development, Sitework, Structure Work on the stadium are works was designed on an Integrated Design and Build contract of the state building based on Permen PU No. 22 Tahun 2018 as an effort to improve cost accuracy..

G.Problem Statement

Variables and indicators that can improve cost accuracy are identified through this research. The research objectives in this study include how the relationship between cost accuracy and cost planning standards in the scope of Design Development, Sitework, and Structure work on the Main Stadium Building is based on the Minister of Public Works Regulation No. 22 of 2018. It is envisaged that via the development of this research, the integrated contract system for design and construction that is controlled in Minister of Public Works Regulation No. 1 of 2020 will be accepted and optimized, preventing disputes between the service provider and the owner..

III. METHOD

The research method is also the method used about the process that is passed in research and discussion of the concept of various methods, their strengths and weaknesses (Tamara, 2008). So it can be said that the research method is a strategy used to answer the formulation of the problem. The research method is carried out by identifying the stages in conducting research which will be explained further in the following subchapters. Chapter 3 will describe the research methodology consisting of research strategies, research processes consisting of research variables, research instruments, data collection processes, and data analysis methods. After all these processes have been carried out, the Planning and Development of Standards for Design Development Work, Sitework, and Structures for the Main Stadium Building Works is carried out on an Integrated Contract for the Design of State Buildings based on PUPR Ministerial Regulation No. 22 of 2018 based on PUPR Ministerial Regulation No. 22 of 2018 based on the results of the research question which contains the identification of the Planning Development Work, Sitework, and Structure Costs for the Main Stadium Area Building Work on the Integrated Contract for the Design of State Buildings Based on the PUPR Ministerial Regulation No. 22 of 2018 which can be used to increase cost accuracy.

H.Materials

To achieve the objectives of this research, research strategies are needed so that the research becomes easier, structured, neat, efficient, and effective. The definition of research strategy itself is one way to collect data consisting of object, subject, variable, and the problem that is being studied so that the data is will be directed at the goals to be achieved (Sukmadinata, 2005). The grouping of research strategies that have been presented above can be explained in table 3.1 below.

Table Error! No text of specified style in document..**1 Measurement Strategy**

Strategy	Form of Research Questions	Control of Events	Focus on Contemporary Events
Experiment	How, why	Yes	Yes
Survey	Who, what, where, how many, how big	No	Yes
Archive Analysis	Who, what, where, how many, how big	No	Yes / No
Historical	How, why	No	No
Case Study	How, why	No	Yes

How is the relation between cost accuracy and cost planning standards based on Permen PU No. 22 Tahun 2018 on the scope of Design Development Work, Sitework, and Structures Work in the main stadium area? With this, we will answer the questions using archive analysis, questionnaires, and Structural Equation Model (SEM).

I. Research Process

There are several stages in this research, all of which are combined from several elements from the data obtained from Research Question (RQ) and from the legal understanding of Permpen PU No. 22 Tahun 2018. The initial stage in this research is to identify the background of the problem that causes this research to be carried out, then the next stage is to formulate the problem statement in the Research Question (RQ) so that the objectives of this research can be achieved. Next, an analysis of previous literature is carried out which will be used as a support for the literature study that has been mentioned in Chapter 2. In the conduction of research, there must be a conceptual model in order to develop the system that will be produced, also to determine the research methodology used as a tool to find the final result of the research

J. Research Variable

The point of research variables is everything that is determined by the researcher to be studied and used to obtain information about it, then get a conclusion (Sugiyono, Metode Penelitian Kuantitatif, Kualitatif, dan R&D, 2009). The followings are the research variables from this study:

Table Error! No text of specified style in document..**2 Research Variables**

No	Problem Statement	Independent Variable (X)	Dependent Variable (Y)
1	Development of Cost Planning Standards for Design Development, Sitework, and Structure for Stadium Area Works in Stadium Area based on Permen PU No. 22 Tahun 2018 to improve cost accuracy	• Technical Specification Standard • Cost Percentage per Scope of Work • Standard / Non-standard Fee per Scope of Work • Cost per m2 • Cost per seat • Permen PU No 22 Tahun 2018	Improve cost accuracy

K. Procedures

The procedure used as research strategies that have been determined for this research is archive analysis, surveys in the form of questionnaires, and validation from experts. The questionnaire will be used as a research instrument in this study. Data collection for the Research Question (RQ) is divided into several stages. Before conducting a pilot survey for the first questionnaire, an analysis of the archive from previous literature studies was carried out as materials in order to create the questionnaires. The first stage of data collection was carried out to find out what elements of standard and non-standard costs could have an influence cost accuracy in the cost planning for integrated design and build contract in the scope of Design Development, Sitework, and Structure Work in the stadium area by validating the contents onstructs through interviews and discussions with experts..

L. Data Analysis

After the data has been collected, the next phase is to do data analysis. Data analysis is conducted to determine whether or not the independent variables could affect the dependent variables. The results obtained from the data analysis will be compared with the temporary associative causal research hypothesis. According to (Santoso, 2000) statistical science is useful for making decisions on certain problems. In addition, statistics can also be interpreted as activities carried out to collect data, summarize/present the data, analyze the data with certain methods, and interpret the result of the analysis. To ascertain the effect of planning standards on cost accuracy in state buildings, this research is extended by evaluating respondent questionnaire data using the SmartPLS tool after it has been analyzed using the SPSS tool.

M. Validity and Reliability

a) Validity Test Using SPSS

A study is included in the category of trustworthy and has good results when the instrument in the study is valid and reliable. The validity test will measure the accuracy of each research instrument. In this study, the product moment correlation test or Pearson correlation using SPSS will be used to measure the validity of an instrument. Firdaus (2009) states that Pearson Correlation will have a correlation coefficient value to measure the strength of a linear relationship between two variables (Wulandari, 2021). The

result of the Pearson correlation test is the Pearson correlation value "r". According to Sudhana (2005), a statement instrument will be declared valid if it has a Pearson correlation r value greater than the r value contained in the r distribution table (Wulandari, 2021). This study uses a sample of 74 people so that the value of r table as a guideline for measuring the validity of the data is 0.229 at a significant level of 5%.

Table 4.6 Result of The Pearson Correlation Analysis

Correlations		Total	Description
X1.1	Pearson Correlation	0.775**	Valid
	Sig. (2-tailed)	0.000	
X1.2	Pearson Correlation	0.816**	Valid
	Sig. (2-tailed)	0.000	
X1.3	Pearson Correlation	0.788**	Valid
	Sig. (2-tailed)	0.000	
X1.4	Pearson Correlation	0.798**	Valid
	Sig. (2-tailed)	0.000	
X1.5	Pearson Correlation	0.838**	Valid
	Sig. (2-tailed)	0.000	
X1.6	Pearson Correlation	0.874**	Valid
	Sig. (2-tailed)	0.000	
X2.1	Pearson Correlation	0.793**	Valid
	Sig. (2-tailed)	0.006	
X2.2	Pearson Correlation	0.769**	Valid
	Sig. (2-tailed)	0.000	
X2.3	Pearson Correlation	0.814**	Valid
	Sig. (2-tailed)	0.000	
X2.4	Pearson Correlation	0.781**	Valid
	Sig. (2-tailed)	0.000	
X3.1	Pearson Correlation	0.740**	Valid
	Sig. (2-tailed)	0.000	
X3.2	Pearson Correlation	0.832**	Valid
	Sig. (2-tailed)	0.000	
X3.3	Pearson Correlation	0.771**	Valid
	Sig. (2-tailed)	0.000	
X3.4	Pearson Correlation	0.721**	Valid
	Sig. (2-tailed)	0.000	
Y1.1	Pearson Correlation	0.768**	Valid
	Sig. (2-tailed)	0.000	
Y1.2	Pearson Correlation	0.839**	Valid
	Sig. (2-tailed)	0.000	
Y1.3	Pearson Correlation	0.805**	Valid
	Sig. (2-tailed)	0.000	
Y1.4	Pearson Correlation	0.797**	Valid
	Sig. (2-tailed)	0.000	
Y1.5	Pearson Correlation	0.762**	Valid
	Sig. (2-tailed)	0.000	

N. Reliability Test (Cronbach's Alpha) Using SPSS

Reliability test is conducted to measure whether a research result can be trusted or not. According to Singarimbun (1989), the reliability test aims to determine the level of consistency or reliability of measuring instruments in providing research results as indicated by the consistency and stability of respondents' answers to each question. The reliability test will be carried out with SPSS using the Cronbach's Alpha method with the following conditions (Wulandari, 2021):

- Cronbach's Alpha value > 0.6 → Reliable
- Cronbach's Alpha value < 0.6 → Unreliable

The results of the reliability test of 19 indicators are as follows:

Table 4.7 Results of Reliability Test

Reliability Statistics	
Cronbach's Alpha	N of Items
0.871	19

The results of the reliability test in Table 4.7 show that of the 19 indicators used in this study, the Cronbach alpha's value of 0.871 > 0.6 means that all indicators in this study are reliable and trustworthy. The reliability of each indicator can also be known through the value of Cronbach's Alpha if Item Deleted which is listed in the following table:

O. Data Adequacy Test Using SPSS

The data adequacy test in this study was conducted to determine that the amount of data used was sufficient to be used or not. The data adequacy test will be analyzed using the KMO & Bartlett's Test using SPSS with the following results:

Table 4.9 Calculation Result of KMO dan Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.844
Bartlett's Test of Sphericity	Approx. Chi-Square	795.777
	df	171
	Sig.	0.000

The results of the KMO & Bartlett's Test in Table 4.9 show that this study has a KMO value of 0.844 > 0.5, so it can be concluded that the research sample obtained is sufficient to be used. The value of Bartlett's Test of Sphericity has a significance value of 0.000 < 0.05, which means that there is a significant correlation between research variables so that it can be continued to the next stage of analysis.

IV. Result and Discussion

All the existing indicators (indicators after deletion) have a significant effect on the latent variable because each has a T-statistic value greater than 1.96 or a P-Value < 0.05. Furthermore, the following is a table of path coefficient result from bootstrapping to see the significance of the relation between variables.

Table 4.1 Path Coefficient Table, Result of Bootstrapping

Relation	**Original Sample (O)**	**T Statistics (|O/STDEV|)**	**P Values**	**Description**
Non-standard Cost -> Cost Accuracy	0.541	3.891	**0.000**	Significant Impact
Standard Cost -> Cost Accuracy	-0.197	3.014	**0.003**	Significant Impact
Other Cost -> Cost Accuracy	0.339	2.404	**0.017**	Significant Impact

The results of the Path Coefficient in Table 4.17 show the X1 variable. Standard Cost, X2. Non Standard Costs and X3. Other Costs have a significant effect on Y1. Cost Accuracy because the T-Statistic value > 1.96 or P-Value value < 0.05 Standard costs (0.541) and other costs (0.339) have a positive path coefficient value which means that standard costs and other costs have a positive and significant effect on increasing accuracy cost. Meanwhile, non-standard costs (-0.197) have a negative path coefficient value, which means that non-standard costs have a negative and significant effect on decreasing cost accuracy. Judging from the smallest p-value and the largest coefficient, the variables that have the most influence on cost accuracy are standard costs, other costs and the last is non-standard costs.

P. R Square

The value of R Square is the coefficient of determination which explains the further relationship between the independent variable and the dependent variable. The value of R Square ranges from 0 to 1. The value of R Square which is closer to 1 (one), the better.

Table 4.2 R Square Table, Result of Bootstrapping

	R Square	**R Square Adjusted**
Y1 - Akurasi Biaya	0.739	0.728

Table 4.18 shows that the R-square value of the cost accuracy variable is 0.739 which indicates that the cost estimation accuracy can be explained by standard costs, non-standard costs and other costs of 73.9% which are included in the moderate category. (Joe F Hair et al., 2011). While the remaining 26.1% can be explained by variables other than the variables used in this study.

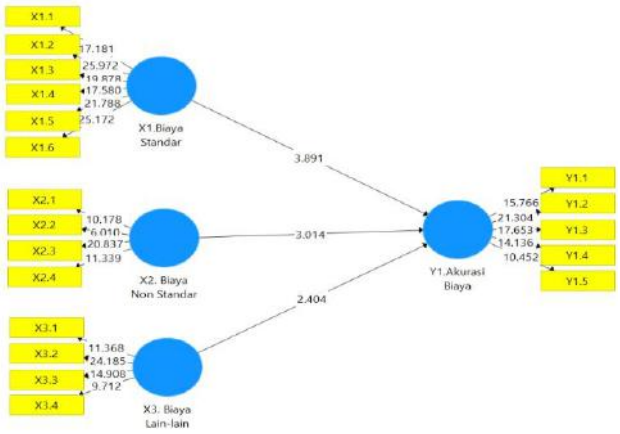
Q.Fit Model

The result of Fit Model can be seen in table 4.3 below:

Table 4.3 Result of Fit Model

	Saturated Model	**Estimated Model**
SRMR	0.075	0.075
d_ULS	1.064	1.064
d_G	0.647	0.647
Chi-Square	247.130	247.130
NFI	0.720	0.720

Table 4.19 shows that the model in this study is able to represent the actual situation in the field by 72%. The following is a model of the relationship between variables in the Inner Model which is described using the SmartPLS software, which can be seen as follows:



Picture 4.1 Structural Equation Modelling Overview on Inner Model

V. CONCLUSION

The mathematical model obtained from this research is y = 0.541x1 – 0.197x2 + 0.339x3 so that the cost accuracy will improve if the standard and other costs are increased, while non-standard cost must be reduced. This is also evident from the P-Value which shows that all the indicators are significant to cost accuracy.

VI. ACKNOWLEDGEMENT

I would like to give my thanks to Prof. Yusuf Latief as a supervisor on this research, to Mr. Anggoro Putro as a supervisor on this research, my wife, daughter, and my parents who never tire of giving great support and motivation to me and also to my colleagues in RQ-3 cost accuracy research. .

REFERENCES

1. Cakmak, P. I. (2016). Causes of disputes in the Turkish Construction industry: Case of public sector projects.
2. Ekhator, J. O. (2016). Investigating Causes of Disputes in Building Construction Projects in Nigeria.
3. Itani, H. (2018). Construction Contract Disputes-Reasons, Avoidance And Resolution. PUPR. (2018). Pelaksanaan Kontrak Terintegrasi Rancang dan Bangun (Design and Build). Jakarta.
4. Ruslan, R. (2003). Metode Penelitian PR dan Komunikasi. Jakarta: PT. Raja Grafika Persada.
5. Sakate, P., & Shawale, A. W. (2017). Analysis of Claims and Dispute in Construction Industry.
6. UEFA. (2011). UEFA Guide To Quality Stadiums. Nyon: Union of European Football Associations.
7. Wicaksono, R. G., Brita, A., Gawei, P., & Puspasari, V. H. (2019). Identifikasi Faktor- faktor yang Berpotensi Menjadi Penyebab Timbulnya Sengketa Pada Proyek Konstruksi di Kota Palangkaraya.
8. Willow, A. (2020). The Most Common Causes of Construction Disputes – And How to Deal With Them.
9. Yaroni, E. (2012). Evolution Of Stadium Design.
10. Younis, G., Wood, G., & Malak, M. A. (2008). Minimizing Construction Disputes: The relationship between risk allocation and behavioural attitudes.92
11. Yuliana, C. (2004). Faktor-Faktor Potensial Terjadinya Perselisihan Kontrak pada Proyek Gedung.
12. Adamu, I., Sidik, M.A., Ernest, O.T. (2017). Adopting Design and Build (D&B) as an Alternative Construction Procurement System to the Traditional Method in Ghana. International Journal of Construction Engineering and Management, Vol.6, No.4, pp. 148-159.
13. Alashwal, A.M. and Chew, M.Y. (2017). Simulation Techniques for Cost Management and Perfomance in Construction Project in Malaysia. Built Environment Project and Asset Management, Vol. 7, No. 5, pp. 534-545.
14. Arikunto, S. (2000). Prosedur Penelitian Suatu Pendekatan Praktek. Jakarta: Rineka Cipta. Bagus, J. (2010). Estimasi Biaya Konseptual Proyek Pembangunan Konstruksi Pabrik dengan
15. Metode Artifical Neural Network (ANN), Tesis, Program Studi Teknik Sipil Program Pascasarjana Bidang Ilmu Teknik, Universitas Indonesia, Depok, Indonesia.
16. Bakr, G.A (2019). Identifying Crucial Factors Affecting Accuracy of Cost Estimates at The Tendering Phase of Public Construction Projects in Jordan. International Journal of Civil Engineering and Technology (IJCIET), ISSN 0976-6308, Vol. 10, Issue, 01, pp. 1335-1348.
17. Barakchi, M., Torp, A., Belay, A.M. (2017). Cost Estimation Methods for Transport Infrastructure: A Systematic Literature Review. Procedia Engineering Vol. 196, pp. 270-277.
18. Basrowi dan Suwandi. (2012). Memahami Penelitian Kualitatif. Jakarta: Rineka Cipta. CA. Umar. A.A.A.F., Ronald, M., Simanjuntak, A. (2020). Analisis Risiko Metode
19. Konstruksi Design and Build Terhadap Waktu Pelaksanaan Proyek Pada Pembangunan Gedung PT ABC. Prosiding Seminar Nasional Teknik Sipil 2020, ISSN: 2459-9727, pp. 241-249.
20. Cheng, M.Y., Tsai, H.C., Sudjono, E. (2010). Conceptual cost estimates using evolutionary fuzzy hybrid neural network for projects in construction industry. Expert Systems with Applications, ISSN 4224-4234, Vol. 37, No.6.
21. Christian, Y., Harimurti., Wijatmiko, I. (2017). Pemodelan Peningkatan Akurasi Estimasi Biaya dengan Metode Structural Equation Modeling Partial Least Square pada Proyek Jalan Provinsi Kalimantan Tengah. Rekayasa Sipil, ISSN: 1978 – 5658, Vol 11, No. 2, pp. 91 – 101.
22. CNN Indonesia (2016), Kementerian PUPR Siapkan Skema Lelang Baru. Diakses pada 02 April 2021, dari https://www.cnnindonesia.com/ekonomi/20160829133500-92 - 154500/kebut-konstruksi-kementerian-pupr-siapkan-skema-lelang-baru.
23. Dandan, T.H., Sweis, G., Sukkari, L.S. (2019). Factors Affecting the Accuracy of Cost Estimate During Various Design Stages. Journal of Engineering, Design and Technology, Vol. 18, No. 4, pp. 787-819.
24. Design Build Institute of American (DBIA). (2018). Revisiting Project Delivery Perfomance 1998-2018.
25. Detik News (2020), BPK Temukan Kerugian Negara Rp. 6 T di 4 Proyek. Diakses pada 02 April 2021, dari https://news.detik.com/berita/d-4850409/bpk-temukan-kerugian- negara-rp-6-t-di-4-proyek-kpk-nanti-ditindaklanjuti/2
26. Faught, A. and Tran, D. (2015). Communication Issues in Design-Build Project Delivery Method. 5th International/ 11th Construction Specialty Conference, Vol. 241, pp. 1-9.
27. Favie, Ruben. (2010). Quality Monitoring in Infrastructural Design-Build Projects.
28. Department Architecture Building and Planning. University of Technology: The Netherlands. ISBN:978-90-6814-634-9.
29. Ghallab, A.H.O. and Hosain, M.S. (2020). Factors Affecting The Cost Accuracy of Construction Projects: Arab Contractors in Egypt. International Journal of Construction Project Management, ISSN: 1944-1436, Vol. 12, No. 12, pp. 175-211.
30. Gilson, N.K. and Vanreyk, A.J. (2016). Review of Cost Estimation Models. International Journal of Scientific Engineering and Research (IJSER), ISSN: 2347-3878, Vol. 4, Issue 3, pp. 42-44.
31. Hajar, I. (1996). Dasar-Dasar Metodologi Penelitian Kuantitatif Dalam Pendidikan. Jakarta.
32. PT. Raja Grafindo Persada.
33. Hatamleh, M.T., Hiyassat M., Sweis G.J., Sweis R.J. (2018). Factors Affecting the Accuracy of Cost Estimate: Case of

Jordan. Enggineering Construction and Architectural Management. Vol. 25, No. 1, pp. 113-131.
34. Hyung, W.G., Kim. S., Jo, J.K. (2019), Improved Similarity Measure in Case-Based Reasoning: A Case Study of Construction Cost Estimation. Engineering, Construction and Architectural Management. Vol. 27, No. 2, pp. 561-578.
35. Jumas, D., Rahim, F.A.M., Zainon, N., Utama, W.P. (2018). Improving Accuracy of Conceptual Cost Estimation Using MRA and ANFIS in Indonesia Building Projects, Built Environment Project and Asset Mangement, Vol. 8, No. 4, pp. 348-357.
36. Kwon, H, and Kang, C.W. (2019). Improving Project Budget Estimation Accuracy and Precision by Analyzing Reserves for Both Identified and Unidentified Risks. Project Management Journal. Vol. 50, No. 1, pp. 86-100.
37. Latief, Y., Wibowo, A., Wisnu, I. (2013). Preliminary Cost Estimation Using Regression Analysis Incorporated With Adaptive Neuro Fuzzy Inference System. International Journal of Technology (2013) 1: pp. 63-72.
38. Ling, F.Y.Y. and Leong, E.F.K. (2002). Performance of Design-Build Projects in Terms of Cost, Quality and Time: Views of Clients, Architects and Contractors in Singapore. The Australian Journal of Construction Economics and Building, Vol. 2, No. 1, pp. 37-46.
39. Ogunsanmi, O.E., Salako, O.A., Ajayi, O.M. (2011). Risk Classification Model for Design and Build Projects. Journal of Engineering, Project, and Production Management, Vol. 1, No. 1, pp. 46-60.
40. Omran, A. and Hooi, L.B. (2018). Determining the Critical Factors in Ensuring the Accuracy of Cost Estimate in Obtaining a Tender. Acta Technica Corviniensis – Bulletin of Engineering, ISSN: 2067-3809, Fascicule 3, pp. 23-26.
41. Park, J. and Kwak, Y.H. (2017). Design-Bid-Build (DBB) vs. Design-Build (DB) in the U.S. Public Transportation Projects: The Choice and Consequences. International Journal of Project Management, Vol 35, pp. 280-295.
42. Pekanbaru. Tribunnews (2018), Komplain Hasil Audit BPK. Diakses pada 02 April 2021, dari https://pekanbaru.tribunnews.com/2018/07/29/komplain-hasil-audit-bpk-rekanan-sebut-temuan-dilapangan-terlalu-dipaksakan
43. Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 12/PRT/M/2017 Tahun 2017 Tentang Standar dan Pedoman Pengadaan Pekerjaan Konstruksi Terintegrasi Rancang dan Bangun (Design and Build).
44. Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 19/PRT/M/2015 Tahun 2015 Tentang Standar dan Pedoman Pengadaan Pekerjaan Konstruksi Terintegrasi Rancang dan Bangun (Design and Build).
45. Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 22 Tahun 2018 Tentang Pembangunan Bangunan Gedung Negara.
46. Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 28 Tahun 2016 Tentang Pedoman Analisis Harga Satuan Pekerjaan Bidang Pekerjaan Umum.
47. Purwanto. (2010). Evaluasi Hasil Belajar. Yogyakarta: Pustaka Belajar.
48. Putro, A. and Latief, Y. (2020). Implementation of Design and Build Contract in Government Building Construction Project Practice. IOP Conference Series: Materials Science and Engineering.
49. PMBOK. (2017). Project Management Body Knowledge 6th Edition.
50. Seng, N.G.W. and Yusof, A.M. (2006). The Success Factors of Design and Build Procurement Method: A Literature Visit. Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference (APSEC 2006), 5-6 September 2006, Kuala Lumpur, Malaysia.
51. Sequeira, S. and Lopes, E. (2015). Simple Method Proposal for Cost Estimation from Work Breakdown Structure. Procedia Computer Science, Vol 64, pp. 537-544.
52. Sridarran, P., Keraminiyage, K., Herszon, L. (2017). Improving the Cost Estimates of Complex Projects in the Project-Based Industries. Built Environment Project and Asset Management, Vol. 7, No. 2, pp. 173-184.
53. Standar SK SNI T-25-1991-03: Tata Cara Perencanaan Teknik Bangunan Stadion. Standish Group International. (2015). Chaos Report 2015. www.standishgroup.com
54. Sugiyono. (2009). Metode Penelitian Kuantitatif, Kualitatif dan R&D, Bandung : Alfabeta.
55. Tarigan, A.M., Abdullah, A., Rani, H.A. (2018). Faktor-Faktor Risiko Design and Build yang Mempengaruhi Kesuksesan Proyek Rehabilitasi Total Gedung Pendidikan di Provinsi Daerah Khusus Ibukota Jakarta. Journal of Archive in Civil Engineering and Planning. E-ISSN: 2615-1340; P-ISSN:2620-7547, Vol.1, No. 2 pp. 156-165
56. Taurano, G.A. and Hardjomuljadi, S. (2013) Analisa Faktor Penyebab Klaim pada Proyek Konstruksi yang Menggunakan FIDIC Conditions of Contract for Plant and Design Build. Jurnal Konstruksia, Vol. 5, No. 1, pp. 14-25.
57. Tsai, T.C. and Yang, M.L. (2010). Risk Assessment of Design-Bid-Build and Desgin-Build Building Projects. Journal of the Operations Research Society of Japan, Vol. 53, No. 1, pp. 20-39.
58. Umar, A.A.A.F.CA., Ronald, M., Simanjuntak, A. (2020). Analisis Risiko Metode Konstruksi Design and Build Terhadap Waktu Pelaksanaan Proyek Pada Pembangunan Gedung PT ABC. Prosiding Seminar Nasional Teknik Sipil 2020, ISSN: 2459-9727, pp. 241- 249.
59. Young, B.E., Seidu, R.D., Ponsford,S., Robinson, H., Adamu.Z. (2021). Cost Changes in UK Design and Build Project. Journal of Emerging Trends in Economic and Management Sciences (JETEMS), ISSN: 2141-7024, Vol.12, No. 1, pp. 49-57.

Land use and Climate Change Impact Assessment of Hydrological Characteristics of Addalam Watershed using Soil and Water Assessment Tool (SWAT)

Sean L. Agbanlog

Abstract
Assessing the future environmental impact of climate change and land use change as it greatly affects the hydrologic processes and physical condition of the watershed is important as a mitigation and adaptation strategies to minimize risks and vulnerability of the watershed.
Prediction of the possible outcome of rainfall change in 2050 to the watershed was one important index that SWAT model has generated. The measures for the goodness-of-fit of model predictions used during the calibration and validation periods were the Coefficient of determination (R2) and the Nash Sutcliffe Simulation Efficiency (NSE), these numerical model performance measures the fraction of the variation in the measured data that is replicated in the simulated result of the model which was the basis of the acceptability of the model simulated values.
The SWAT model was parameterized and calibrated to simulate the hydrologic responses of the Addalam watershed to land use and climate changes using the A1B medium range climate scenario of PAGASA using the PRECIS (Providing Regional Climates for Impacts Studies, pronounced pray-sea) model. The A1B medium range climate scenario of PAGASA was used to capture the future impact of climate change and land use change. The seasonal temperature change and rainfall change in 2050 revealed a significant change in the annual water balance parameters of the watershed.
Application of the model on analysis of integrated climate and land use changes indicated the positive impact of scenario 3 (reforestation) reveals the reduction of surface runoff and sediment yield in 2050-time frame as compared to scenario 1 which represents 2050 climate and rainfall increase and scenario 2 (50% transformation of agricultural land to urbanization) of about 4.47% converting 50% of Agricultural land and 100% of grassland to forest area.
It was concluded that the increased surface runoff and sediment yield in 2050 time slices could trigger more landslide and erosion and flooding in low lying areas. And it will be recommended that adaptation strategies should be formulated to address these issues and associated impacts affecting development in the area. An advance planting dates of crops during dry months is one way of addressing farmers on the expected rainfall reducing the impact of water scarcity and hazards.

I. INTRODUCTION

The Addalam watershed of the Cagayan River Basin is home to the people of Quirino province and lower downstream is partly belongs to Isabela province. The Addalam river caters to the irrigation needs of ricelands in Cabarroguis, Aglipay and Saguday in Quirino, and nearby towns in Isabela. Didipio is a high-grade underground gold and copper mine located on the island of Luzon, where one of the gold mining company was operating. Oceana Gold Philippines Incorporation acquired Didipio, Nueva Vizcaya in 2006 through a merger with Climax Mining Ltd. and commenced commercial production as an open pit operation in 2013. In 2016, the mine transitioned from an open pit to underground operation, with production from the underground commencing in early 2017. This existence of mining company catches major concern in watershed management especially increasing of surface runoff and sediments.

Watershed Management is the process of implementing land use and water management practices to protect and improve quality of water and other natural resource within a watershed. It also defines the relationship between people, nature, land and water. Hence, balance between natural resources and the society should be achieved because people cannot be separated from nature. Quantitative prediction of land cover and climate change impacts on hydrologic processes is widely used to develop sound watershed management strategies. However, not much is yet understood about the hydrologic behavior of watersheds in the Philippines in response to land cover change and climate variability (Maria Graciela Anna S. Arceo et.al., 2018).

The increased agricultural land area, variability of rainfall and vegetation damage as influenced by Climate Change and changes in land use pattern can lead to the change in hydrological equilibrium in a watershed system. Climate change and other factors aggravates the unnatural hydrologic processes that contributes destructive phenomena such as droughts and floods. Flash floods causes severe natural disasters over the world generating property and infrastructures damages, poverty and loss of human life,

among others (J. Abellan, et.al., 2018).

Land use, land cover and climate change (CC) can significantly influence the hydrologic balance and biogeochemical processes of watershed systems. These changes can alter interception, evapotranspiration (ET), infiltration, soil moisture, water balance, and biogeochemical cycling of carbon, nitrogen, and other elements. Changes in climate and land cover increase surface runoff significantly by 2100 as well as stream discharge. Combined change in land cover and climate cause 10% increase in peak volume with 7% increase in precipitation and 75% increase in effective impervious area. Climate and land use changes can intensify the water cycle and introduce seasonal changes in watershed systems. Understanding dynamic changes in watershed systems is critical for mitigation and adaptation options. (A. Talib, et.al., 2017).

DISCUSSION OF RESULTS

Simulated Water Balance Components Production in Addalam Watershed.

Table 6 and 7 shows the annual and monthly components of water balance in the watershed including the amount of sediment or erosion rate and as graphically showed in Figure 12. As presented, average monthly hydrological processes peaks during rainy season in the watershed except for evapotranspiration which is largest during dry months. From the annual average rainfall from 1986 to 2016 computed at 2,137.9 mm, 3.05% were transformed in a form of runoff, 16.98% for shallow ground water recharge, smallest amount of 1.33% for deep aquifer recharge having its total aquifer recharge of 26.51% and gaining the Water yield (Streamflow) gained the highest amount of rainfall of 73.93% and 17.72% are being consumed to meet evapotranspiration demand. Evapotranspiration rate are highest during the months of February to June. Total sediment yield range was 7.024 ton/ha at 19.09% average monthly increase attributed to projected higher rainfall from July to December. The highest monthly value and rate is computed in the month of November at 2.11 tons/ha and 29.97% respectively.

Table 6. Annual Water Balance in Addalam Watershed.

PARAMETERS	AMOUNT (mm)	PERCENT OF RAINFALL
Rainfall	2137.9	
Surface Runoff	65.28	3.05
Shallow Groundwater Recharge	362.97	16.98
Deep Aquifer Recharge	28.34	1.33
Total Aquifer Recharge	566.85	26.51
Total Water Yield (Streamflow)	1580.59	73.93
Percolation	569.66	26.65
Potential Evapotranspiration	903.7	42.27
Evapotranspiration	378.8	17.72

Table 7. Average Monthly Parameter Values of Addalam Watershed.

MONTH	RAIN (mm)	SURF Q (mm)	LAT Q (mm)	WATERY IED (mm)	ET (mm)	SEDIMENT YIELD (T/Ha)	PET (mm)
JAN	71.86	1.75	36.09	85.09	19.19	0.23	45.18
FEB	55.36	0.15	27.09	47.58	18.64	0.03	63.88
MAR	57.18	0.11	26.19	36.5	23.75	0	69.43
APR	68.56	0.09	31.91	38.22	33.57	0	103.76
MAY	199.17	1.71	99.67	111.17	46.49	0.03	102.13
JUN	171.46	1.86	86.65	109.61	41.2	0.03	97.41
JUL	211.51	4.48	108.03	137.77	40.35	0.17	92.66
AUG	230.25	7.04	120.64	161	40	0.42	94.92
SEP	242.96	6.06	131.17	177.56	36.27	0.7	77.71
OCT	278.04	11.43	151.45	213.23	32.84	1.39	68.44
NOV	310.94	18.37	171.62	249.1	25.47	2.11	49.59
DEC	242.04	12.25	134.29	215	21.54	1.93	40.27
TOTAL	**2139.3**	**65.3**	**1124.8**	**1581.83**	**379.31**	**7.04**	**905.38**

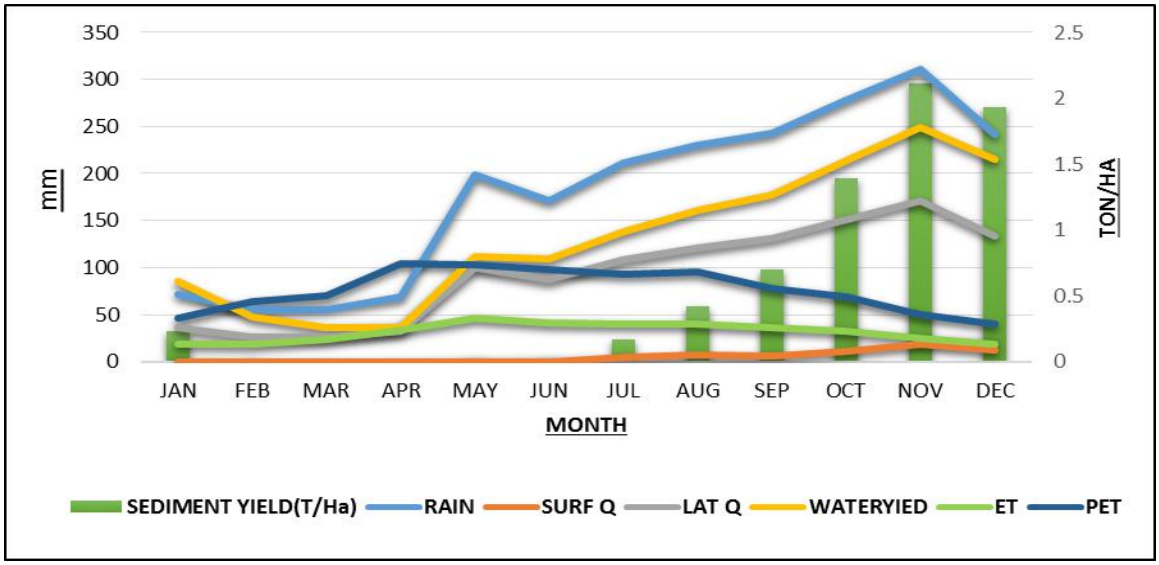


Figure 12. Average monthly values and sediment yield in tons/ha

Calibrated Values of SWAT Model Parameters for Addalam Watershed.

Table (8) below showed the calibrated parameters of the SWAT model for the Addalam watershed. These values were used for validation and later for application.

Table 8. Calibrated SWAT parameters for Addalam watershed.

Parameter	Description	Calibrated Value
SOL_AWC	Available soil water content	0.355
ESCO	Evaporation compensation factor	0.95
ALPHA_BF	ALPHA_BF	0.048
CN2	SCS curve number for soil moisture condition	35
USLE_P	USLE practice factor	1
GW_DELAY	Groundwater delay (days)	5000
GWQMN	Threshold depth of water in the shallow aquifer required	1000
GW_REVAP	Groundwater "revap" coefficient	0.1

The SWAT simulation reproduced the observed discharges and their variation in time but tended to overestimate the streamflow during dry periods. The overestimation may indicate that the model is nor entirely capturing the dynamics of the groundwater components or is not simulating adequately the evapotranspiration capacity of the vegetation. The in accuracy of the model performance during periods maybe also associated with the objective function (NSE) used to calibrate the model, which tends to rely more on model performance during flood events. In line with these results, SWAT has been shown to be weak when simulating low flows in other areas, thus calibration did not cover the most extreme rainfall events of the entire period, resulting in a poor performance during the validation (Zamora et.al., 2018).

In addition, event timing was simulated relatively accurately although a few hydrographs display a slight lag in the timing peaks. This lag tends to suggest that factors including the spatial variation and resolution of the precipitation product may impact the model performance in simulating peak timing and routing (Smith et.al., 2004). Some reasons also may indicate by unexpected storm events during dry season or absence of storm during expected wet seasons. One situation cited from the graph (Figure 15) was the occurrence of storm during the dry months of 2005.

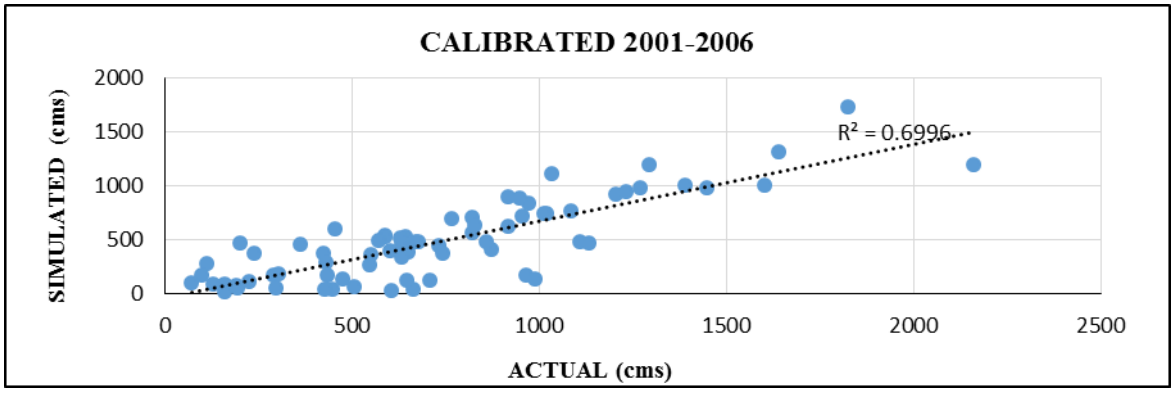


Figure 13. **Comparison of the monthly simulated and actual streamflow for the calibration period.**

The month of January to May 2005 showed a reverse result between the actual and calibrated streamflow indicating a sudden increase during the dry months of February to May which expectedly a decrease of water yield on that period. The increase of flow in that period showed that there was an entry of typhoons- *Auring* and *Bising* in the month of March 2005 showing an increase of water yield and caused an underestimated value of calibrated from the actual. Overall, the results, thus indicated that hydrologic processes in SWAT were modeled realistically and thus, can be extended to simulate other hydrologic process including various land use and climate change scenarios. The simulated streamflow in the gauging station were lumped into monthly totals and compared with the monthly measured streamflow.

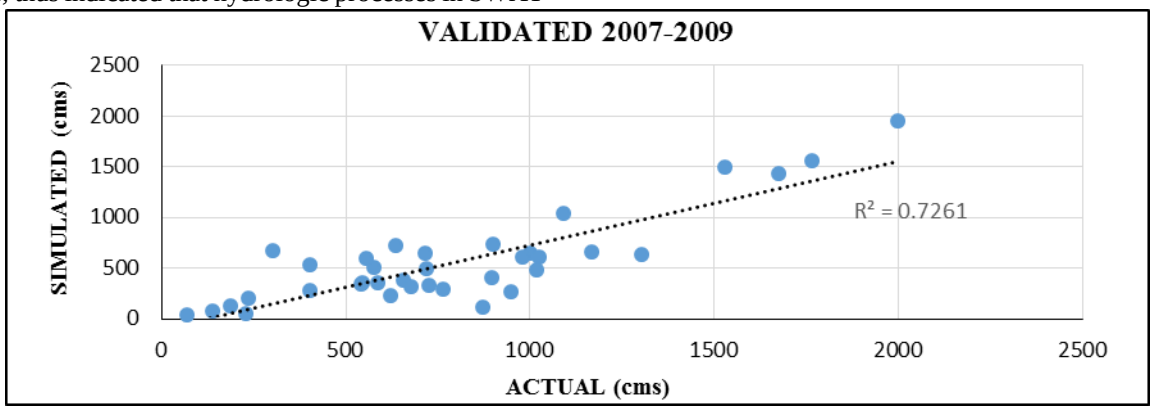


Figure 14. Comparison of the monthly simulated and actual streamflow for the validation period.

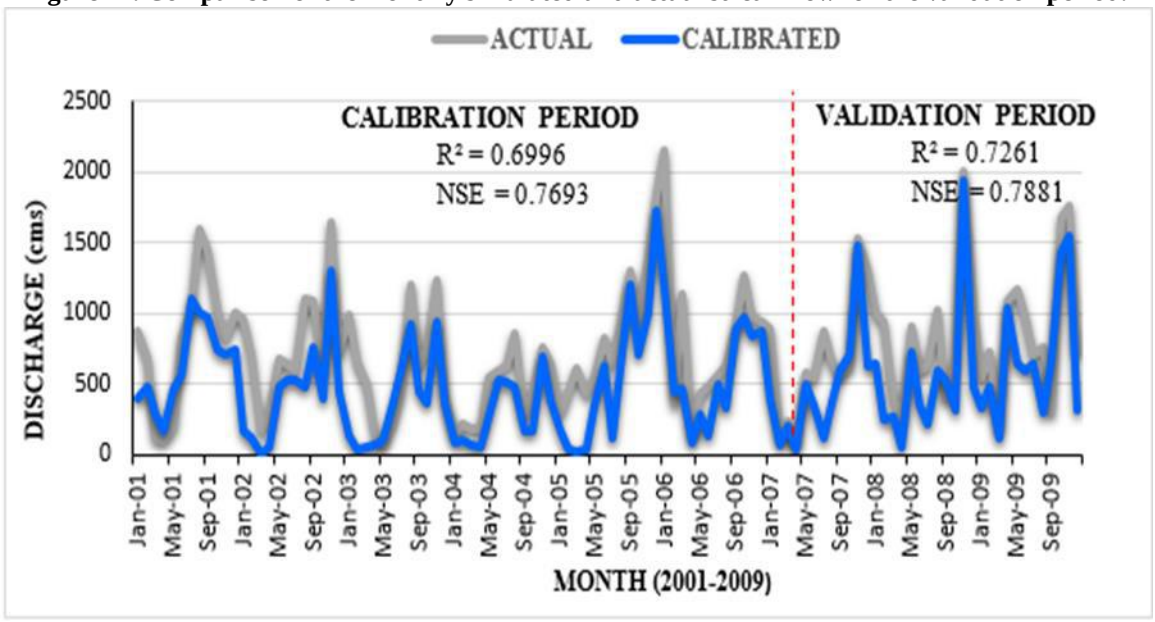


Figure 15. Monthly observed and simulated streamflow in the study area.

Results showed that the simulated and measured streamflow were matched well (Figure 15) with coefficient of determination, R^2 of 0.6996 in calibration period (Figure 13) and 0.7261 in validation period (Figure 14). The adequacy of

the SWAT model to simulate the streamflow was also indicated by the positive NSE value of 0.7693 under calibration period and 0.7881 under validation period. The adequacy of the model was further indicated by its clear response to extreme rainfall events resulting in high streamflow.

Simulation of Hydrologic Impacts of Land Use and Climatic Change Scenarios

The calibrated SWAT model was used in assessing the impact of increasing temperature and rainfall changes on the water balance of the watershed. The computed seasonal temperature and rainfall changes in 2050 under the A1B medium-range scenario were used to generate synthetic rainfall and temperature data for the period 2036-2065. The generated data were then used to run the calibrated SWAT model to simulate the water balance of watershed.

Results of the simulation showed that there would be likely increase in water yield, surface runoff and sediment yield (Table 9) in 2050 time slices as a result of the increase annual rainfall amount in the watershed. Water yield during the summer months of February to May would likely decreased as consequence of less rainfall during these period. Such decrease in the water yield of the watershed during the summer months may result to shortage of water supplies affecting rainfed crop production at the later part of dry cropping season.

On the other hand, the simulated surface runoff and sediment yield also showed that there would be likely increase of surface runoff and sediment yield in 2050 time slices which could trigger more landslide and erosion and flooding in low lying areas. Adaptation strategies should be formulated to address these issues and associated impacts affecting development in the area.

Table 9. Simulated monthly baseline and 2050 percent increase of surface runoff, water yield and Sediment Yield in Addalam watershed.

MONTH	Baseline			2050			% Increase		
	Surface Runoff, mm	Water Yield, mm	Sediment Yield, tons/ha	Surface Runoff, mms	Water Yield, mm	Sediment Yield, tons/ha	Surface Runoff, mm	Water Yield, mm	Sediment Yield, tons/ha
Jan	1.75	85.09	0.23	3.25	104.31	0.6	85.7	22.6	160.9
Feb	0.15	47.58	0.03	0.36	61.6	0.09	140.0	29.5	200.0
Mar	0.11	36.5	0	0	29.62	0	-100.0	-18.8	0.0
Apr	0.09	38.22	0	0	25.28	0	-100.0	-33.9	0.0
May	1.71	111.17	0.03	0.29	71.67	0	-83.0	-35.5	-100.0
Jun	1.86	109.61	0.03	2.78	110.29	0.05	49.5	0.6	66.7
Jul	4.48	137.77	0.17	5.98	146.57	0.33	33.5	6.4	94.1
Aug	7.04	161	0.42	9.01	174.13	0.7	28.0	8.2	66.7
Sep	6.06	177.56	0.7	6.23	181.73	0.86	2.8	2.3	22.9
Oct	11.43	213.23	1.39	11.82	216.5	1.59	3.4	1.5	14.4
Nov	18.37	249.1	2.11	18.93	253.44	2.41	3.0	1.7	14.2
Dec	12.25	215	1.93	23.07	260.53	4.12	88.3	21.2	113.5

Table 9 showed also a negative percentage increase of surface runoff, water yield and sediment yield in the period of March to May due to the projected Seasonal temperature increases and rainfall change in 2050 under the medium-range scenario (A1B) in the province of Isabela which showed a negative projection percentage increase of -29.2 % of rainfall and highest increased of temperature of about 2.1 ^{o}C indicating lower amount of surface runoff, water yield and sediment yield than the actual measured value.

Result highlights of simulation were shown in Figure 16 and Table 10 as follows:

1) Scenario 1: As shown in Figure 16, total increase in annual rainfall would be 3.04% or 64.9 mm resulting to increases in run-off and water yield at 25.2% and 3.36%, respectively; all other parameters increases against baseline like percolation increase of about 2.45%, evapotranspiration increase of 1.95% and 52.7% sediment yield expectedly as surface runoff increased.
2) Scenario 2: Simulation showed a 25.25% or 16.48 mm increase in runoff, 3.36 % or 53.13 mm increase in water yield, 6.52% increase in percolation and 0.25% decreased in evapotranspiration.
3) Scenario 3: Result reveals that this scenario condition will result to significant reduction of erosion in 2050 by 12.09% for the month of October against baseline, 4.47% against scenario1 and scenario 2 which is translated to 0.15 during the month of October and 0.46 tons per hectare during rainy months from July to December.

Table 10. Simulated annual water balance of the different scenarios in Addalam watershed.

Parameters	Baseline		Scenario 1		Scenario 2		Scenario 3	
	Amount (mm)	Percent of Rainfall	Amount (mm)	Percent of Rainfall	Amount (mm)	Percent of Rainfall	Amount (mm)	Percent of Rainfall
Rainfall	2137.9		2202.8		2202.8		2202.8	
Surface Runoff	65.28	3.05	81.73	3.71	81.76	3.71	81.71	3.71
Shallow Groundwater Recharge	362.97	16.98	372.22	16.9	372.16	16.89	371.8	16.88
Deep Aquifer Recharge	28.34	1.33	29.02	1.32	29.01	1.32	28.88	1.31
Total Aquifer Recharge	566.85	26.51	580.3	26.34	580.28	26.34	579.99	26.33
Total Water Yield (Streamflow)	1580.89	73.93	1634.07	74.18	1634.02	74.18	1633.92	74.17
Percolation	569.66	26.65	583.63	26.49	583.61	26.49	583.3	26.48
Potential Evapotranspiration	903.7	42.27	959.4	43.55	959.4	43.55	959.4	43.55
Evapotranspiration	378.8	17.72	386.2	17.53	386.2	17.53	386.3	17.54

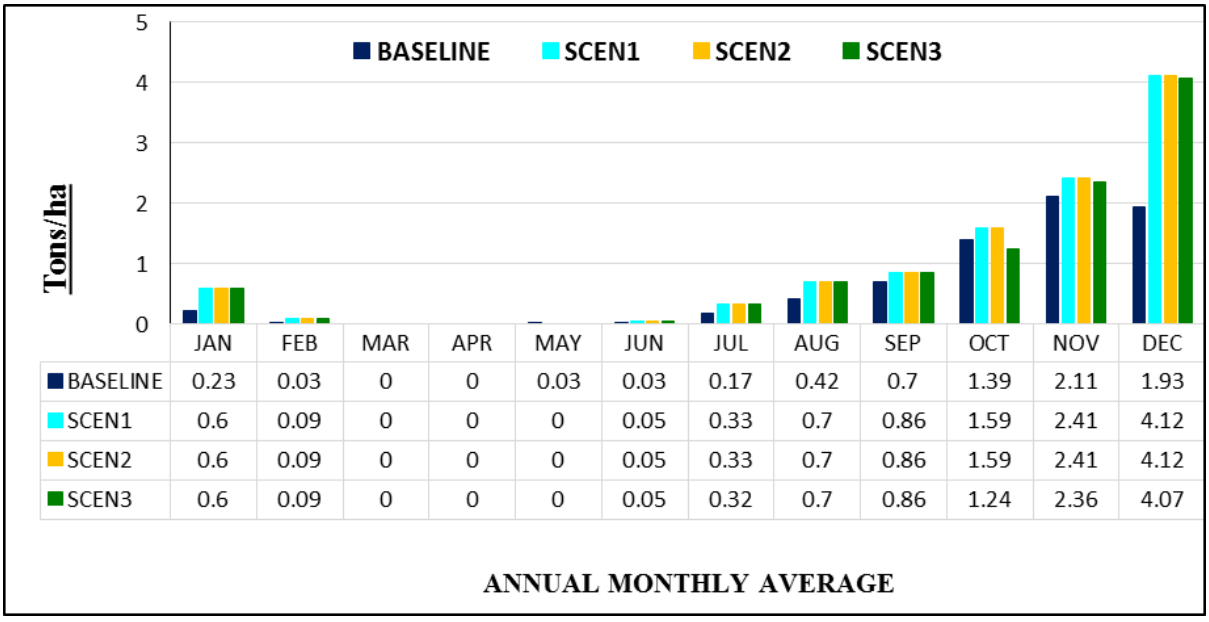


Figure 16. Simulated baseline sediment yield and across scenarios.

CONCLUSIONS

Based from the result of the analysis, the following conclusions were drawn;

1. Results show that the simulated and measured streamflow were matched well with coefficient of determination, R^2 of 0.6996 in calibration period and 0.7261 in validation period. The adequacy of the SWAT model to simulate the streamflow is also indicated by the positive Nash-Sutcliffe model Efficiency (NSE) value of 0.7693 under calibration period and 0.7881 under validation period which was greater than the threshold acceptable value of 0.50 and 0.60, respectively.
2. Water yield during the summer months of February to April would likely decreased as consequence of less rainfall during these period. Such decrease in the water yield of the watershed during the summer months may result to shortage of water supplies affecting rain fed crop production at the later part of dry cropping season.

   The positive impact of reforestation revealed the reduction of surface runoff and sediment yield in 2050-time frame as compared to scenario 1 and 2 which was reduced of about 4.47% by converting about 50% of Agricultural land and 100% of grassland to forest area.

Yield Performance of Hybrid Glutinous Corn as Influenced by Third Generation Nutrition Bio-Fertilizer

[1] CIPRIANO M. TICMAN JR, [2] MARCIAL M. TICMAN
[1] Isabela State University-Cauayan campus
[2] DENR- Cauayan City

Abstract
The study was conducted to determine the performance of two corn varieties and Third Generation Nutrition Bio-fertilizer interaction and to determine the return of investment of the different treatment combinations. The study was conducted at the experimental area of the Institute of Agricultural Technology, Isabela State University, Cauayan City Isabela. There were two factors used as treatments in the study. Main-plot (variety) using to corn varieties and sub-plot (fertilizer) F_1-Farmers practice (100 kg 14-14-14, 100 kg 16-20-0, & 100 kg urea ha^{-1}, F_2- 50 kg 14-14-14, 50 kg 16-20-0, & 50 kg urea ha^{-1}, +75 kg Aishawariya , 1000 ml New Suryamin, 500 ml Wonder , and 500 ml Megacal ha^{-1}, F_3- 70 kg 14-14-14, 70 kg 16-20-0, & 70 kg urea ha^{-1}, +37.5 kg Aishawariya , 500 ml New Suryamin, 250 ml Wonder , and 250 ml Megacal ha^{-1}, and F_4- 150 kg Aishawariya , 2000 ml New Suryamin, 1000 ml Wonder , and 1000 ml Megacal ha^{-1}). The experiment was laid out following the split plot design. The two corn varieties had insignificant differences on plant height. The ear height, ear weights with and without husk, ear length, ear diameter and corn ear yield per sampling area obtained from the two varieties were comparable with each other. The plants applied with 70 kg 14-14-14, 70 kg 16-20-0, & 70 kg Urea ha^{-1}, +37.5 kg Aishawariya, 500 ml New Suryamin, 250 ml Wonde , and 250 ml Megacal ha^{-1} produced the tallest plants , ear weights with and without husk, ear length and ear diameter. The different treatment combinations produed comparable heights at 30 days after planting but significant differences among the treatment combination were observed at 60 days after planting. The combined effect of 70 kg 14-14-14, 70 kg 16-20-0, & 70 kg Urea ha^{-1}, +37.5 kg Aishawariya, 500 ml New Suryamin, 250 ml Wonde , and 250 ml Megacal ha^{-1} is recommended for glutinous corn because it obtained the highest yield and return on investment.

Keywords: *"Glutinous corn, bio available, organic nutrients, optimum, Bio-fertilizer, Third generation nutrition technology"*

I. INTRODUCTION

Corn growers need to set a realistic corn yield goal in order to make sound decisions on hybrid, seeding rate, fertilizer application, and irrigation. The goal should be the most profitable yield that can be expected for a particular set of soil, climate, and management practices. The yield potential is the maximum production of a crop cultivar that can be achieved in a given environment. To achieve a yield potential, the crop must receive optimum levels of water and nutrients and be completely protected against weeds, pests, diseases and other factors that may reduce growth. Growth limiting factors such as water and nutrients determine the actual yield. Yield potential is reduced by insufficient nutrients, water supply, diseases, insects, weeds, lodging, or poor soil physical traits and quality. Maximum yields obtained in corn yield contest are reasonable estimates of yield potential because corn is grown in these plots at high density and nutrient supply and full weed and pest control.

The third generation nutrition technology or 3G includes bioavailable, organic nutrients which were chelated with gluconate, lactate, and amino acids which are almost 100 percent absorbed by plants. The 3G bioorganic nutritional products were produced through sophisticated fermentation biotechnology and tap innovative molecules. These substitute chemical fertilizers, bio-fertilizers, effective microorganism and other nutritional inputs needed by the plants to achieve their optimum growth. Studies of the 3G technology showed that there is no fixation of nutrients in the soil, hence leading to no soil or water pollution. Increased in microflora was also observed making the nutrients bioavailable providing balance distribution to plants.

The objective of the study was to evaluate the effect of Third Generation Nutrition Bio-fertilizer on two hybrid corn.

II. MATERIALS AND METHODS

Securing of Seeds

The seeds of hybrid glutinous corn (Klasika F_1 and Sweet Pearl varieties) were secured from an accredited seed dealer of East West Seed Company in the locality.

Location of the Experimental Area

The Experimental area was located at the experimental area of the Institute of Agricultural Technology, Isabela State University, Cauayan

Land Preparation, Laying-out the Experimental Area and Experimental Design

An experimental area of 381.88 square meters was cleared from grasses and stubbles to facilitate thorough land preparation. The area was plowed initially by tractor and left idles for two weeks for the weeds to decay. All un-decayed weeds were removed to facilitate thorough land preparation. An animal drawn plow was used for the final plowing and harrowing.

The prepared area was laid-out in three equal blocks, each block and had a dimension of 4.75 meters' x 23.5 meters spaced with one meter between blocks. Each block was further subdivided into eight plots measuring by 4.75 meters' x 2.5 meters, spaced with 50 centimeters between plots. The experimental treatments were randomly allocated following the randomization procedure for Split-Plot Design.

Experimental Treatments

There were two factors used in the experiment and they were as follows:

Main-Plot (Variety)

V_1 – Klasika F_1

V_2 – Sweet Pearl

Sub-Plot (Fertilizer)

F_1 – Farmer's Practice (100 kg Triple 14, 100 kg 16-20-0 kg & 100 kg Urea ha $^{-1}$)

F_2 – 50% Farmer's Practice + 50% RR Third Generation Nutrition Bio-fertilizer (50 kg Triple 14, 50 kg 16-20-0 & 50 kg Urea ha^{-1} + 75 kg Aishwariya, 1000 ml New Suryamin, 500 ml Wonder, and 500 ml Megacal ha^{-1})

F_3 – 70% Farmer's Practice + ^{1} + 30% RR Third Generation Nutrition Bio-fertilizer (70 kg Triple 14, 70 kg 16-20-0 & 70 kg Urea ha^{-1} 37.5 kg Aishwariya, 500 ml New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1})

F_4 – 100% RR Third Generation Nutrition Bio-fertilizer (150 kg Aishwariya, 2000 ml New Suryamin, 1000 ml Wonder, and 1000 ml Megacal ha^{-1})

Construction of Furrows and Application of Fertilizer

Furrows at a distance of 75 centimeters between furrows were established just before basal application and planting. The rate of inorganic fertilizer was based from the Farmer's Practice and the application of Third Generation Nutrition Bio-fertilizer was based from the protocol given by the Department of Agriculture – Bureau of Agricultural Research (DA-BAR), Quezon City. The fertilizer used applied per treatment is presented in Tables 1 and 2.

Planting and Replanting

Two seeds were planted per hill at a distance of 20 centimeters per hill. The seeds were covered with fine soil and foot pressed to have uniform germination.

Replanting was done five days after emergence.

Table 1. Kinds, Amount (kg) and Time of Application of Fertilizer per Hectare used in the Study.

TREATMENT	Basal	Top Dressing (30 DAP)	Application of 3G	
			15 DAP	30 DAP
T_1 – Farmer's Practice	100 kg T14 100 kg 16-20-0	100 kg Urea		
T_2 – 50% FP + 50% 3G	50 kg T14 50 kg 16-20-0 75 kg Aishwariya (3G)	50 kg Urea	1000 ml New Suryamin 500 ml Wonder 500 ml Megacal	1000 ml New Suryamin 500 ml Wonder 500 ml Megacal
T_3 – 70% FP + 30%3G	70 kg T14 70 kg 16-20-0 105 kg Aishwariya (3G)	70 kg Urea	600 ml New Suryamin 300 ml Wonder 300 ml Megacal	600 ml New Suryamin 300 ml Wonder 300 ml Megacal
T_4 – 100% 3G	150 kg Aishwariya (3G)		2000 ml New Suryamin 1000 ml Wonder 1000 ml Megacal	2000 ml New Suryamin 1000 ml Wonder 1000 ml Megacal

Table 2. Kinds, Amount (g) and Time of Application of Fertilizer per 11.88 m^2 used in the Study.

TREATMENT	Basal	Top Dressing (30 DAP)	Application of 3G	
			15 DAP	30 DAP
T_1 – Farmer's Practice	118.8 g T14 118.8 g 16-20-0	118.80 g Urea		
T_2 – 50% FP + 50% 3G	59.40 g T14 59.40 g 16-20-0 0.89.1 g Aishwariya (3G)	59.40 g Urea	1.13 ml New Suryamin 0.56 ml Wonder 0.56 ml Megacal	1.13 ml New Suryamin 0.56 ml Wonder 0.56 ml Megacal
T_3 – 70% FP + 30%3G	83.16 g T14 83.16 g 16-20-0 53.46 g Aishwariya (3G)	83.16 g Urea	0.79 ml New Suryamin 0.39 ml Wonder 0.39 ml Megacal	0.79 ml New Suryamin 0.39 ml Wonder 0.39 ml Megacal
T_4 – 100% 3G	1.78.20 g Aishwariya		2.25 ml New Suryamin 1.13 ml Wonder 1.13 ml Megacal	2.25 ml New Suryamin 1.13 ml Wonder 1.13 ml Megacal

Care and Management of the Crop

Cultivation and Weeding. Off-barring was done at 15 days after planting and hilling-up was done at 30 days after planting. Hand weeding was done to control weeds that were not controlled during cultivation.

Water Management. Irrigation was done as the need arose.

Crop Protection. The occurrence of insect pests and diseases was monitored to control severe infestation.

Harvesting

The corn ears were harvested when they reached soft dough stage. The ears of the sample plants were harvested one by one, placed in plastic sack, and properly labeled.

Data Gathering

1. Plant Height at 30 and 60 Days after Planting. The height of the ten randomly selected representative plants was measured from the base of the plants up to the tip of the meristem by using a meter stick at 30 days after planting while the plant height at 60 days after planting was measured up to the first node of the tassel.

2. Ear Height. Ear height was measured from the base of the plant to the node bearing the lowest ear.

3. Weight of Ear with and without Husk. The ten sample ears with husks was weighted after harvest. The husk was removed and weighted. The weight was divided by ten to obtain the weight per ear. The weight was determined using the digital weighing balance.

4.Lenght of Corn Ear. The ear lengths of the ear without husks from the ten representative plants was measured by using foot ruler from end to end of the ear.

5. Diameter of Ear. The sample ears that was used in determining the length of ear without husks was used to determine the diameter using the Vernier caliper.

6. Yield per Sampling Area. All harvested ears in each sampling area with husks was weighed and used as the basis for the computation of yield per hectare.

Statistical Analysis

All the data gathered were analyzed following the Analysis of Variance for the Split-Plot Design. The Least Significant Differences was used to compare means of the variety and fertilizer as single factor. The Duncan's Multiple Range Test (DMRT) was used for the comparison of means of the treatment combinations.

Cost and Return Analysis

The cost of production in terms of labor and farm inputs using the current price in the locality was considered in the determining the return of investment per treatment. The gross income was taken from the current price of fresh green glutinous corn in the market. The return of investment was obtained by dividing the net income over total cost of production multiplied by one hundred.

III. DISCUSSION OF RESULTS

Plant height.

The height of plants at 30 and 60 days after planting as affected by inorganic fertilizer and Third Generation Nutrition Fertilizer. No significant differences were found on the height of the two glutinous corn varieties at 30 days after planting with values of 122.33 centimeters for klasika (V_1) and 122.31 centimeters for sweet Pearl variety (V_2).

The fertilizer as a single factor significantly influenced the height of plants at 30 days after planting. The application of fertilizer at the rate of 50 kg of 14-14-14, 50 kg 16-20-0 & 50 kg 46-0-0 ha^{-1} + 75 kg Aishawariya, 1,000 ml of New Suryamin, 500 ml Wonder, and 500 ml Megacal ha^{-1} (F_2), 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} (F_3) and 150 kg Aishawariya, 2000 ml of New Suryamin, 1000 ml Wonder, and 1000 ml Megacal ha^{-1} (F_4) obtained comparable heights with means of 122.86, 123.72 and 122.74 centimeters, respectively. The shortest plants were observed by the application of 100 kg 14-14-14, 100 kg 16-20-0 & 100 kg 46-0-0 ha^{-1} with a mean of 119.97 centimeters.

Insignificant result was found the interaction of the different treatment combinations on the height of plants at 30 days after planting with means ranging from 119.95 to 123.82 centimeters.

Significant result was obtained on the height of plants at 60

days after planting. The plants applied with 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} (F_3) produced the tallest plants with a mean of 173.53 centimeters. It was followed by the plants applied with 50 kg of 14-14-14, 50 kg 16-20-0 & 50 kg 46-0-0 ha^{-1} + 75 kg Aishawariya, 1,000 ml of New Suryamin, 500 ml Wonder, and 500 ml Megacal ha^{-1} (F_2), and 150 kg Aishawariya, 2000 ml of New Suryamin, 1000 ml Wonder, and 1000 ml Megacal ha^{-1} (F_4) with a mean valu of 164.82 and 161.83 centimeters. The shortest plants were produced by the plants applied with 100 kg 14-14-14, 100 kg 16-20-0 & 100 kg 46-0-0 ha^{-1}(F_1) with a mean value of 159.12 centimeters. The significant result of the study was attributed by the fertilizer applied, i.e., the corn plant requires nitrogen and phosphorus soon after germination to initiate the growth of stems, leaves and ear structures (Jones, 2005).

Ear Height.

The ear height of glutinous corn as affected by the application of inorganic fertilizer plus Third Generation Nutrition Bio-fertilizer. The klasika F_1 (V_1) and Sweet pearl (V_2) glutinous corn varieties showed no significant differences on ear height.

The fertilizer as single factor significantly affects the ear height of the plants. The plants applied with 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} (F_3) had the tallest ear heights with a mean value of 90.25 centimeters. It was followed by plants applied with 50 kg of 14-14-14, 50 kg 16-20-0 & 50 kg 46-0-0 ha^{-1} + 75 kg Aishawariya, 1,000 ml of New Suryamin, 500 ml Wonder, and 500 ml Megacal ha^{-1} (F_2), with a mean value of 86.12 centimeters.

The ear heights of the plants showed no significant differences among the different treatment combinations with mean values ranging from 77.83 to 90.46 centimeters.

Weight of Ear with and without Husk.

Result showed that the variety as a single factor obtained insignificant result on the weight of ear with husk with mean values of 216.78 grams and 220 grams for the two varieties. The fertilizer as single factor influenced The fertilizer as a single factor influenced the weight of ear per plant. The plants fertilized with the rate of 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} (F_3) obtained the heaviest ear with a mean of value 245.22 grams. It was followed by the plants applied with 50 kg of 14-14-14, 50 kg 16-20-0 & 50 kg 46-0-0 ha^{-1} + 75 kg Aishawariya, 1,000 ml of New Suryamin, 500 ml Wonder, and 500 ml Megacal ha^{-1} (F_2), with a mean of 225.62 grams.

The lightest ear was obtained in plants fertilized using the Farmers practice at the rate of 100 kg 14-14-14, 100 kg 16-20-0 & 100 kg 46-0-0 ha^{-1}(F_1) and 150 kg Aishawariya, 2000 ml of New Suryamin, 1000 ml Wonder, and 1000 ml Megacal ha^{-1} (F_4) with a mean value of 202.45 and 200.28 grams. The significant result of the study was attributed by the fertilizer applied. Large yields and good quality are possible if the soil contains an abundance of readily available nutrients (Naeem *et al*.,2006; Dauda *et al*.,2008).

The fertilizer significantly affects the ear weights without husks wherein the plants applied with 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} (F_3) produced the heaviest ear without husk with a mean value 222.49 grams. It was followed by plants applied with 50 kg of 14-14-14, 50 kg 16-20-0 & 50 kg 46-0-0 ha^{-1} + 75 kg Aishawariya, 1,000 ml of New Suryamin, 500 ml Wonder, and 500 ml Megacal ha^{-1} (F_2), with a mean value 204 grams. The least in ear weight were obtained in plants fertilized using the farmers practice of 100 kg 14-14-14, 100 kg 16-20-0 & 100 kg 46-0-0 ha^{-1}(F_1) and 150 kg Aishawariya, 2000 ml of New Suryamin, 1000 ml Wonder, and 1000 ml Megacal ha^{-1} (F_4) with mean values of 188.20 and 186.85 grams. The result of the study conformed to the findings of Akinrinde *et al*., (2008) that may be attributed fertilizer applied .The third generation crop nutrition technology had the combining ability of pro organic raw materials and enzymes blended synergistically to provide adequate macronutrients , micronutrients and catalytic enzymes readily available for the microbes like rhizobium and azospirillum to convert nitrogenous materials to nitrate nitrogen that is needed for plant growth and development. The application of bioorganic fertilizer as in case of Third Generation Nutrition Biofertilizer affected the growth and development of the roots as cited by Levai *et al*., (2006).

The interaction of the two factors did not show significant effect on the weight of the ear without husk with mean values ranging from 183.43 to 223.03 grams. The result implied that the amount of fertilizer applied had the effect on the weight of corn ear.

Length and Diameter of Corn Ear

The ear length of the two varieties did not show any significant differences in ear lengths with mean values of 15.88 centimeters for Klasika F_1 (V_1) and 15.35 centimeters for the sweet pearl (V_2)

The fertilizer as a single factor showed significant result on the length of corn ear. The application of 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} (F_3) produced the longest ear with a mean of 17.03 centimeters. The plants applied with 50 kg of 14-14-14, 50 kg 16-20-0 & 50 kg 46-0-0 ha^{-1} + 75 kg Aishawariya, 1,000 ml of New Suryamin, 500 ml Wonder, and 500 ml Megacal ha^{-1} (F_2), Farmers practice with 100 kg 14-14-14, 100 kg 16-20-0 & 100 kg 46-0-0 ha^{-1}(F_1) and 150 kg Aishawariya, 2000 ml of New Suryamin, 1000 ml Wonder, and 1000 ml Megacal ha^{-1} (F_4) produced comparable ear length with mean values of 15.42, 14.96, and 15.07 centimeters. The result indicates that the Third Generation Nutrition Bio fertilizer enhanced the development of corn ear.

Non-significant result was observed on the ear lengths of the different treatment combinations with mean values

ranging from 14.67 to 17. 00 centimeters.

The corn ear diameter of the two varieties of corn obtained non-significant result with result with mean values of 4.12 and 4.20 centimeters. The fertilizer as single factor showed a significant effect of the corn ear diameter wherein the application of 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} (F_3) produced the biggest corn ear with a mean of 5 centimeters. It was followed by the plants applied with 50 kg of 14-14-14, 50 kg 16-20-0 & 50 kg 46-0-0 ha^{-1} + 75 kg Aishawariya, 1,000 ml of New Suryamin, 500 ml Wonder, and 500 ml Megacal ha^{-1} (F_2), with a mean of 4.75 centimeters. He application of 150 kg Aishawariya, 2000 ml of New Suryamin, 1000 ml Wonder, and 1000 ml Megacal ha^{-1} (F_4) produced 3.60 centimeters. The use of farmers practice with Farmers practice with 100 kg 14-14-14, 100 kg 16-20-0 & 100 kg 46-0-0 ha^{-1}(F_1) produced the smallest corn ear with a mean of 3.28 centimeters. The result was attributed by fertilizer.

No significant variations were observed in the treatment combinations on ear diameter with mean ranging from 3.23 to 5.00 centimeters.

Weight of Ear with and without Husk per sampling area.

Non-significant result was obtained on the weight of the ear with husk per sampling area on the variety as single factor.

The fertilizer as a single factor obtained significant result on the weight of corn ear with husk per sampling area. Consistently, the plants fertilized with 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} (F_3) obtained the heaviest ear with a mean of 2.45 kilograms. It was followed by the plants applied with 50 kg of 14-14-14, 50 kg 16-20-0 & 50 kg 46-0-0 ha^{-1} + 75 kg Aishawariya, 1,000 ml of New Suryamin, 500 ml Wonder, and 500 ml Megacal ha^{-1} (F_2) with a mean value of 2.26 kilograms. The least were observed from the plants fertilized using the farmers practice at the rates of 100 kg 14-14-14, 100 kg 16-20-0 & 100 kg 46-0-0 ha^{-1}(F_1) and 150 kg Aishawariya, 2000 ml of New Suryamin, 1000 ml Wonder, and 1000 ml Megacal ha^{-1} (F_4) with mean values of 2.00 and 2.03 kilograms.

No significant interactions were obtained on the weight of ear with husk per sampling area in the different treatment combinations with mean values ranging from 1.98 to 2.46 kilograms. The two corn varieties had comparable ear weights without husk per sampling area with means of 2.02 and 2.06 kilograms.

Likewise, the plants applied with fertilizer at the rate of 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} (F_3) produced the heaviest ear without husk per sampling area with a mean of 2.30 kilograms. It was followed by the plants applied with 50 kg of 14-14-14, 50 kg 16-20-0 & 50 kg 46-0-0 ha^{-1} + 75 kg Aishawariya, 1,000 ml of New Suryamin, 500 ml Wonder, and 500 ml Megacal ha^{-1} (F_2) with a mean of 2.11 kilograms. The lightest ear was obtained in plants fertilized with 100 kg 14-14-14, 100 kg 16-20-0 & 100 kg 46-0-0 ha^{-1}(F_1) and 150 kg Aishawariya, 2000 ml of New Suryamin, 1000 ml Wonder, and 1000 ml Megacal ha^{-1} (F_4) with mean values of 1.85 and 1.90 kilogram.

Insignificant result was obtained on the weight of corn ear without husk per sampling area from the different treatment combinations. The different treatment combinations produced comparable ear weights with mean values ranging from 1.83 to 2.31 kilograms.

IV. CONCLUSION AND RECOMMENDATION

The study was conducted to evaluate the effect of Third Generation Nutrition Bio- fertilizer on two hybrid corns.

Result showed that the two varieties showed no significant differences on plant height at 30 days after planting. The fertilizer influenced the height of plants at 60 days after planting wherein the application of 50 kg of 14-14-14, 50 kg 16-20-0 & 50 kg 46-0-0 ha^{-1} + 75 kg Aishawariya, 1,000 ml of New Suryamin, 500 ml Wonder, and 500 ml Megacal ha^{-1} produced the tallest plants. The treatment combinations obtained significant result on the height at 60 days after planting that the application of 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} in both varieties produced the tallest plants at 60 days after planting. The plants applied with 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} (F_3) had the tallest ear heights. The fertilizer as single factor influenced the weight of ear plant wherein the plants fertilized with 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal $ha^{-1.}$ The fertilizer significantly affects the ear weights without husks. The interaction of two factors did not show any significant effect on the weight of ear without husk. In terms of ear length of two corn varieties did not show any significant differences with each other. The fertilizer significantly affects corn ear diameter wherein the application 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal $ha^{-1.}$ No significant differences on the ear diameter among the treatment combinations. The fertilizer as a single factor obtained significant result on the weight of corn with husk per sampling area that the plants fertilized with 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} obtained the heaviest ear.

Based from the results of the study, Klasika F1 and Sweet Pearl varieties are recommended because they produced comparable green corn yield. The application of 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} is recommended as cultural production

modality for glutinous corn because it obtained the highest yield. Likewise, the combined effect of 70 kg of 14-14-14, 70 kg 16-20-0 & 70 kg 46-0-0 ha^{-1} + 37.5 kg Aishawariya, 500 ml of New Suryamin, 250 ml Wonder, and 250 ml Megacal ha^{-1} is recommended for green corn production using hybrid glutinous corn as also obtained the highest return on investment.

REFERENCES

1. Abduli MA, Amiri L, Madadian E, Gitipour S, Sedighian S (2013) Efficiency of vermicompost on quantitative and qualitative growth of tomato plants. Int J Environ Res 7(2):467–472
2. Alagöz Z, Yilmaz E (2009) Effects of different sources of organic matter on soil aggregate formation and stability: a laboratory study on a Lithic Rhodoxeralf from Turkey. Soil Tillage Res 103:419–424
3. Arif I, Batool M, Schenk PM. Plant microbiome engineering: expected benefits for improved crop growth and resilience. Trends Biotechnol. 2020;38:1385–96.
4. Atiyeh RM, Lee S, Edwards CA, Arancon NQ, Metzger JD (2002) The influence of humic acids derived from earthworms processed organic wastes on plant growth. Bioresour Technol 84:7–14. doi:10.1016/S0960-8524(02)00017-2
5. Backer RGM, Saeed W, Seguin P, Smith DL (2017) Root traits and nitrogen fertilizer recovery efficiency of corn grown in biochar-amended soil under greenhouse conditions. Plant Soil 415:1–13
6. Baghdadi A, Halim RA, Ghasemzadeh A, Ramlan MF, Sakimin SZ (2018) Impact of organic and inorganic fertilizers on the yield and quality of silage corn intercropped with soybean. PeerJ 6:e5280
7. Benton J, Jones J (2012) Inorganic chemical fertilizers and their properties in plant nutrition and soil fertility manual, 2nd edn. CRC Press, Boca Raton, pp 20–23
8. Berta G, Copetta A, Gamalero E, Bona E, Cesaro P, Scarafoni A, D'Agostino G. Maize development and grain quality are differentially affected by mycorrhizal fungi and a growth-promoting pseudomonad in the field. Mycorrhiza. 2014;24:161–70.
9. Canatoy RC (2018b) Effects of fertilization on the growth and yield of sweet corn under no tillage in Bukidnon, Philippines. Int J Sci Res Publ 8(7):443–450
10. Carlos GGR, Dendooven L, Antonio GMF (2008) Vermicomposting leachate (worm tea) as liquid fertilizer for maize (*Zea mays* L.) Forage production. Asian J Plant Sci 7(4):360–367. doi:10.3923/ajps.2008.360.367
11. Cassman KG, Gines GC, Dizon MA, Samson MI, Alcantara JM (1996) Nitrogen-use efficiency in tropical lowland rice systems: contributions from indigenous and applied nitrogen. Fields Crops Res 47:1–12
12. Chen G, Chen Y, Zhao GH, Cheng WD, Guo SW, Zhang HL, Shi WM (2015) Do high nitrogen use efficiency rice cultivars reduce nitrogen losses from paddy fields. Agri Ecosys Environ 209:26–33
13. Delgado A, Madrid A, Kassem S, Andreu L, del Campillo Md. Phosphorus fertilizer recovery from calcareous soils amended with humic and fulvic acids. Plant Soil. 2002;245:277–86.
14. Dhillon J, Torres G, Driver E, Figueiredo B, Raun WR (2017) World phosphorus use efficiency in cereal crops. Agron J 109:1670–1677
15. Dobbss LB, Canellas LP, Olivares FL, Aguiar NO, Peres LEP, Azevedo M, et al. Bioactivity of chemically transformed humic matter from vermicompost on plant root growth. J Agric Food Chem. 2010;58:3681–8.
16. Egrinya Eneji A, Islam R, An P, Amalu UC (2013) Nitrate retention and physiological adjustment of maize to soil amendment with superabsorbent polymers. J Clean Prod 52:474–480. https://doi.org/10.1016/j.jclepro.2013.02.027
17. Feil B, Thiraporn R, Sramp P (1992) Can maize cultivars with low mineral nutrient concentrations in the grain help to reduce the need of fertilizers in the third world countries? Plant Soil 146(1–2):295–299
18. Gaofei G, Zhaojun L, Fenliang F, Guixin C, Zhenan H, Yongchao L, Gaofei G, Zhaojun L, Fenliang F, Guixin C, Zhenan H, Yongchao L (2010) Soil biological activity and their seasonal variations in response to long-term application of organic and inorganic fertilizers. Plant Soil 326:31–44. https://doi.org/10.1007/s11104-009- 0186-8
19. Geng Y, Cao G, Wang L, Wang S (2019) Effects of equal chemical fertilizer substitutions with organic manure on yield, dry matter, and nitrogen uptake of spring maize and soil nitrogen distribution. PLoS ONE 14(7):e0219512
20. George TS, Hinsinger P, Turner BL. Phosphorus in soils and plants—facing phosphorus scarcity. Plant Soil. 2016;401:1–6
21. Ghorchiani M, Etesami H, Alikhani HA. Improvement of growth and yield of maize under water stress by co-inoculating an arbuscular mycorrhizal fungus and a plant growth promoting rhizobacterium together with phosphate fertilizers. Agr Ecosyst Environ. 2018;258:59–70.
22. Girma T, Beyene S, Biazin B (2017) Effect of organic and inorganic fertilizer application on soil phosphorous balance and phosphorous uptake and use efficiency of potato in Arbegona district. Southern Ethiopia J Fertil Pestic 8:185
23. Havlin JL (1999) Soil fertility and fertilizer: an introduction to nutrient management. Prentice Hall, Upper Saddle River, New Jersey.
24. Hunter MC, Smith RG, Schipanski ME, Atwood LW, Mortensen DA (2017) Agriculture in 2050: recalibrating targets for sustainable intensification. Bioscience 67(4):386–391
25. Jansa J, Forczek ST, Rozmoš M, Püschel D, Bukovská P, Hršelová H. Arbuscular mycorrhiza and soil organic nitrogen: network of players and interactions. Chem Biol Technol Agric. 2019;6(1):1–10.
26. Khan A, Lu G, Ayaz M, Zhang H, Wang R, Lv F, Yang X, Sun B, Zhang S (2018) Phosphorus efficiency, soil phosphorus dynamics and critical phosphorus level under long-term fertilization for single and double cropping systems. Agric Ecosyst Environ 256:1–11
27. King KW, Torbert HA. Nitrate and ammonium losses from surface-applied organic and inorganic fertilizers. J Agric Sci. 2007;145:385–93.
28. Leme Filho JF, Thomason WE, Evanylo GK, Zhang X, Strickland MS, Chim BK, Diatta AA. The synergistic effects of humic substances and biofertilizers on plant development and microbial activity: a review. Int J Plant Soil Sci. 2020;32:56–75.
29. Liang Q, Chen HQ, Gong YS, Fan MS, Yang HF, Lal R, Kuzyakov Y (2012) Effects of 15 years of manure and inorganic fertilizers on soil organic carbon fractions in a wheat-maize system in the North China Plain. Nutr Cycl Agroecosyst 92:21–33
30. Liu Z, Rong Q, Zhou W, Liang G (2017) Effects of inorganic and organic amendment on soil chemical properties,

enzyme activities, microbial community and soil quality in yellow clayey soil. PLoS ONE 12(3):e0172767

31. Neumann G, Römheld V. Rhizosphere chemistry in relation to plant nutrition. In: Marschner H, editor. Marschner's mineral nutrition for higher plants. Cambridge: Academic Press; 2012. p. 347–68.
32. Owen D, Williams AP, Griffith GW, Withers PJ. Use of commercial bio-inoculants to increase agricultural production through improved phosphorus acquisition. Appl Soil Ecol. 2015;86:41–54.
33. Piccolo A, Nardi S, Concheri G. Structural characteristics of humic substances as related to nitrate uptake and growth regulation in plant systems. Soil Biol Biochem. 1992;24:373–80.
34. Singh S, Kapoor KK. Effects of inoculation of phosphate-solubilizing microorganisms and an arbuscular mycorrhizal fungus on mungbean grown under natural soil conditions. Mycorrhiza. 1998;7:249–53.

Growth and Yield Performance of Transplanted Sweet Corn Applied with Organic–Based Foliar Fertilizer

ISAIAS C. DELA PENA
Isabela State University, Cauayan, Isabela

Abstract
A field study was carried out to determine the effect of inorganic fertilizer plus varying rates of organic-based foliar fertilizer on sweet corn from November 2018 to February 2019 at experimental area of the Isabela State University, Cauayan City, Isabela with 7 fertilizer treatments as follows: T1- Farmers Practice (8 bags ha $^{-1)}$, T2 - 120-7-0 kg NPK ha $^{-1}$ (RR), T3 - 120-7-0 + 0.5 Liter Foliar Fertilizer ha^{-1}, T4 - 120-7-0 + 1 Liter Foliar Fertilizer ha^{-1}, T5 - 120-7-0 + 1.5 Liter Foliar Fertilizer ha^{-1}, T6 - 120-7-0 + 2 Liter Foliar Fertilizer ha^{-1}, and T7 – 3 Liter Foliar Fertilizer ha^{-1} arranged in a Randomized Complete Block Design replicated three times.
Plant height at 30 and 60 days after transplanting, Ear height, ear length and diameter. Were significantly higher among fertilized with the combination of the recommended rate of inorganic fertilizer and organic-based foliar fertilizer. On the same manner, the weight of ear with and without husk per plant as well as six square meters sampling area out yielded the plants fertilized with foliar fertilizer alone. This is a strong manifestation that foliar fertilization of crops can complement soil fertilization.
Soil application method and foliar fertilization favorably produced the highest projected yield per hectare while farmer's practice of fertilization (8 bags per hectare) attained the highest return on investment.

I. INTRODUCTION

Corn Due to the extensive and improper use of chemical fertilizers and pesticides in the soil, the soil is degrading to an alarming level, causing an imbalance in the ecosystem and environmental pollution as well. The impact of increased fertilizer use on crop production has been large and important. It has been estimated that fertilizer use contributed to about 25% of the total increase in corn production in Asia. However, in recent years there has been serious concern about long-term adverse effect of continuous and indiscriminate use of inorganic fertilizers on deterioration of soil structure, soil health and environmental pollution. The declining yield for major food crops coupled with the declining soil fertility have raised much concerns about agriculture's ability to feed a world population that is expected to exceed 7.5 billion by the year 2020 (Scott et aI., 2000). In the Philippines, about 70% of the crop lands are degrading its quality and fertility for crop cultivation which cannot produce good and high quality crops and yield anymore. The crops lands in the Philippines are getting more and more acidic because of continuous cultivation and application of inorganic fertilizers and pesticides. The acidic and degrading states of the soil dramatically reduce the soil productivity and the yield. In order to obtain higher yields in corn, innovations that will warrant and assure higher yields and economic returns should be developed to ensure the sustainability of corn production and to encourage more farmers and entrepreneurs to venture into corn production. Thus, it is important that fertilizer management strategies should include those that will not only increase nutrient use efficiency but likewise improve soil health to sustain productivity.

Application of foliar fertilizer is an effective way of correcting soil nutrient deficiencies when plants are unable to absorb them directly from the soil (Liang and Silberbush, 2002). Foliar applied fertilizers provide a quicker response and are more effective for some nutrients than soil applied fertilizers (Jamal *et al*., 2006). Considering the benefits of foliar fertilization cited in the literature, there was the need to evaluate in field trials organic based foliar fertilizers in transplanted sweet corn.

The objective of the study is to determine the growth and yield performance of transplanted sweet corn with the application of organic-based foliar fertilizer.

II. REVIEW OF RELATED LITERATURE

The nature of the soil plays a very vital role in the availability of some micronutrients like Mn, Cu, Zn and Fe which are precipitated in insoluble forms in alkaline soils. However, farmers must be sure that their crops will not be damaged by the foliar fertilizers as some plants are intolerant to this treatment (Gooding and Davies, 1992). In young leaves the nutrient solution is absorbed through minute hairs (trichomes) on the leaf surface through the stomata, even though the latter is not the major pathway. Most of the absorption takes place by diffusion through the cuticle (Salisbury and Ross, 1992). This is in contrast to soil applied fertilizer which is usually in powder or granular form which

has to be dissolved by moisture from rainfall or irrigation to be available to plants via the roots. In other words, soil applied fertilizer has to dissolve into the soil solution to be available. When soil applied fertilizers are not readily available or insufficient, foliar feeding is usually practiced or used as supplement (Abbas and Ali, 2011). Chemical residues in the soil and its subsequent ground water pollution as a result of excessive use of fertilizers can be resolved by the use of small amounts of foliar applications to increase growth and yield in wheat (Sabir *et al*., 2002b).

The use of both foliar and soil application of NPK have been found to increase **grain yield** in maize (Ghaffari *et al*., 2011) and pods/plant, seeds/pod and seed weight in lentil (Hamayun *et al*., 2011). Silicon and boron foliar applications had also been used by Ahmed *et al*. (2008) on saline soils to hasten growth, yield and nutrient uptake in wheat. Sabir *et al*. (2002a) also used foliar application of nitrogen to increase vegetative and reproductive growth and development in barley. Afifi *et al*. (2011) used urea foliar application with the aim of minimizing soil applied fertilization of maize to reduce water pollution. Ben Dkhil *et al*. (2011) also found out that foliar potassium fertilization significantly increased vegetative growth of potato but not tuber numbers and yield.

Nitrogen is one of the macronutrients which is required in relatively high quantities for good vegetative and reproductive development in maize. It is a component of protein and **nucleic acids** and when it is inadequate, growth is reduced (Adediran and Banjoko, 1995). It forms part of many important compounds like chlorophyll and enzymes responsible for many physiological processes in the plant. Nitrogen serves as an intermediary in the utilization of phosphorus, potassium and other elements in plants (Brady and Weil, 2007). Phosphorus also has many vital functions in photosynthesis, utilization of both sugar and starches and in energy transfer processes. Young plants absorb phosphorus very rapidly, to provide rapid, extensive growth of roots. Onasanya *et al*. (2009) have stated that fruit ripening can be hastened by phosphorus when there is excessive application of nitrogen fertilizer in the soil. Potassium also acts as an activator of many enzymes in plant metabolism and provides the ionic background for the maintenance of the living entity of the plant cell (White and Collins, 1982).

III. METHODOLOGY

A field trial was conducted at the experimental area of the Institute of Agricultural Technology, Isabela State University, Cauayan City on November 2018 to January 2019. The **experimental design** was a randomized complete block with three replications. Pre-germinated seedlings of 5-7 day old were transplanted in a plot size of 7 rows, 5 m long with plant spacing of 75 x 50 cm. Different rates (0.5, 1.0, 1.5, 2.0 liters ha^{-1}) of organic foliar fertilizers (Vermitea and Masinag) were sprayed at 15 and 45 DAT alongside with the recommended inorganic fertilizer rate of 120-7-0 kg ha^{-1} were evaluated using transplanted sweet corn (Sweet Fortune F1).

Weeds on the plots were controlled when necessary throughout the experimental period. Soil samples were taken from each location at soil horizons of 0-30 cm depth for analysis. Soil chemical analyses indicated that soil is slightly acidic with pH of 6.10 and low in nitrogen (0.02-0.07%) and **organic matter** (2.48%). However, phosphorus level was high at (68.09 ppm) while potassium level was low (13.39 ppm).

Data on plant height, corn ear height, ear length, diameter and weight with and without husk were taken and **calculated**. All the data gathered were subjected to statistical analysis using the Statistical Tool for Agricultural Research (STAR) Package computer software. Where the ANOVA showed significant differences of variables between treatments, the Tukeys's Honest Significant Difference (HSD) was used to compare between treatment means.

IV. RESULTS

1. Plant Height at 30 and 60 Days after Transplanting**.** The plants applied with the recommended rate of inorganic as well as the inorganic and foliar fertilizer (T_1, T_6) produced the tallest plants with a comparable mean heights ranged from 141.59 to 150.93 centimeters. The shortest plants were produced from the plants with sole foliar fertilizer with a mean of 95.91 centimeters.

At 60 days after transplanting same trend of results where variation existed. The application of inorganic fertilizer and foliar fertilizer rates from 0.5 liter to 2 liters per hectare produced taller plants with a comparable means ranged from 246.80 to 254.43 centimeters. The shortest were observed from the plants with sole foliar fertilizer at the rate of 3 liters per hectare with a mean value of 204.17 centimeters which shows that the combination of nitrogen and potassium and increasing rate of foliar fertilizer was better than the foliar fertilizer alone.

The use of both foliar and soil application of NPK have been found to increase heights of the plants, which justified the claim of Abbas and Ali (2011) that when soil applied fertilizers are not readily available or insufficient, foliar feeding is usually practiced or used as supplement. Likewise, the significant increase in the plant heights of the plants applied with the recommended rate of inorganic and foliar fertilizer over the plants applied with sole foliar fertilizer, the result conformed the findings of Liang and Silberbush (2002) that foliar fertilizer may partially compensate for insufficient uptake by the roots of corn because the leaf area at the time of spraying might not be large enough to hold the liquid fertilizer in place to make it effective, hence smaller over the other treatments.

2. Ear Height**.** The ear height of the plants fertilized with

the recommended rate at 120-70-0 /ha as well as the plants with the same rate of inorganic fertilizer supplemented at 0.5 (T_3); 1.0 (T_4); 1.5 (T_5); and 2.0 liters (T_6) foliar fertilizer per hectare produced the tallest ear with comparable mean values of 99.60, 98.93, 101.23, 102.67, 96.43 and 103.27 centimeters, respectively. The plants without inorganic fertilizer but applied with 3 liters foliar fertilizer produced the shortest ear height with a mean of 79.43 centimeters.

The positive effect of inorganic, organic fertilizer and foliar as exhibited on the ear height of the plants showed that the nutrients derived from inorganic (vermicompost), foliar (Masinag) can be used as an additional fertilizer to enhance the growth of crops and increase nutrient availability. The beneficial response may be due to plant growth regulators or hormones produced by the high microbial activity in vermicompost (Chang, 2013).

3. Ear Length. The plants applied with inorganic fertilizer at the application rate of 8 bag per ha-1 (T_1) as well as the application of inorganic fertilizer at the recommended rate (T_2) and the plant applied the same rate supplemented with foliar fertilizer at 0.5 liter (T_3), 1.0 liters (T_4), 1.5 liters (T_5) and 2.0 liters (T_6) produced a comparable mean values of 21.53, 21.70, 22.16, 21.46, 21.76 and 21.95centimeters, respectively. On the other hand, plants applied with 3 liters foliar fertilizer alone produced the shortest ear with a mean value of 15.45 centimeters.

The increases in ear length as a result of increasing foliar fertilizer levels may be ascribed to the role of nitrogen from inorganic in improving growth and development of longer ears leading to increase synthesis of amino acids and their assimilation into grain protein (Okumura *et al*., 2011).

4. Ear Diameter. All the plants applied with sole inorganic fertilizer as well as the application of the same rate supplemented with foliar fertilizer produced significantly bigger ears with mean values of 4.90, 4.98, 4.92, 4.96 from treatment 1, 2, 3, 4, 5, and 6 respectively. The smallest ear was produced from the plants applied with pure foliar fertilizer at 3 liter per ha-1 (T_6) with a mean value of 3.99 centimeters.

Such difference is attributed to the fertilizers used in this study that when such are blended, these were dominated by potassium from foliar and nitrogen from inorganic tend to promote vegetative growth and fruit size and to encourage seed development. In the case of ear quality. It is the key to a better yield as influenced by good pollination that is essential for full kernel development (Williams and Williams, 2006). Moreover, this maybe also attributed from the organic fertilizer which plays a vital role to plant growth. It is involved in several key plant functions, including energy transfer, photosynthesis, and nutrient movement within the plants (Brady and Well, 2002).

5. Weight of Corn Ears with Husk. The plants applied with 8 bags of inorganic fertilizer (T_1) as well as the plants applied with the recommended rate of inorganic fertilizer (T_2) and the plants applied the same rate supplemented with foliar fertilizer at the rate of 0.5 litters (T_3), 1.0 litters (T_4) 1.5 litters (T_5) and 2.0 litters of foliar fertilizer (T_6) produced the heaviest ear which comparable mean values of 366.73, 411.87, 407.97, 395.57, 404.30 and 432.37grams, respectively. The lightest ear was produced from the plants applied with pure foliar fertilizer at 3 litters per hectare with a mean value of 155.10 grams.

The efficacy of inorganic fertilizer to increase crop growth and yield is well known since the nutrients are readily available for plant use. It shows that the combination of inorganic and foliar fertilizers significantly affected the weight compared to single application of inorganic fertilizer. It appears that the nutrients applied used in the corn is enough and appeared to be better when combined rather than foliar fertilizer alone. Moreover, the demand for some nutrients may be greater during the physiological growth and the combination of inorganic and foliar fertilizers have the capacity to supply the required nutrients and there was an available and abundant supply. This often occurs during the development of fruit or grain.

6. Weight of the ear without Husk (g). The integration of inorganic fertilizer to organic foliar fertilized differ significantly among treatments. Consistently, the plants applied with 8 bags inorganic fertilizer (T_1) the plants applied with the recommended rate at 120-7-0 kgs NPK per hectare (T2) as well as the plants applied the same rate of inorganic fertilizer supplemented with 0.5 liters (T_3), 10 liters (T_4), 1.5 liters (T_5) and 2 liters of foliar fertilizer (T_6) produced the heaviest ears inch a comparable mean values of 268.57, 293.40, 290.67, 285.37, 285.83, 302.90 grams, respectively. The plants applied 3 Liters Foliar Fertilizer ha^{-1} had produced the lightest ear without husk with a mean value of 111.63 grams.

The results herein is in contrast with the findings of Reickenberg and Pritts, (1996); Jamal *et al*., (2006) that foliar applied fertilizers provide a quicker response and are more effective for some nutrients than soil applied fertilizers. It has to consider that the nature of the soil plays a very vital role in the availability of some micronutrients like Mn, Cu, Zn and Fe which are precipitated in insoluble forms in alkaline soils. Basically, corn plant requires an adequate supply of nutrients particularly nitrogen, phosphorus and potassium for optimum growth and yield (Agba and Long, 2005). If the amount of nitrogen is deficient, it could exert a particularly marked effect on corn crop yield as the plant would remain small and rapidly turn yellow if sufficient nitrogen is not available for the construction of protein and chlorophyll (Kogbe and Adediran, 2003). This is traced in the plants applied with sole fertilizer alone.

7. Weight of ear per Sampling Area with Husk (kg/6 m^2). Consistently, the application of inorganic fertilizer at 8 bags per hectare (T_1) application of some recommended rate of inorganic fertilizer (T_2) as well as the same rate supplemented with foliar fertilizer at the rates of 0.5 liters (T_3), 1.0 liters (T_4), 1.5 liters (T_5) and 2.0 liters per hectare (T_6) produced the

heaviest ears per sampling area with a comparable mean values of12.30, 13.29, 13.41, 13.80 and 14.32 kilograms, respectively. The 3 liters foliar applied plants produced the lightest ears with a mean values of 5.96 kilograms.

Foliar fertilizer improves adhesion of the fertilizers to the leaf surface and release nutrients over a prolonged period of time. These can also improve the growth of plant foliage, roots, and yield. By increasing plant growth processes within the leaves, an increase in carbohydrates content of the leaves and stems occurs thus producing heavier seed weight (Chen, 2004).

8. Weight of Ear (w/o Husk) per Sampling Area (kg/6 m^2). In like manner, the effect of combining the recommended rate of inorganic fertilizer and foliar fertilizer tend to increase the weight of ears without husk per six square meters sampling area. The mean weights ranging between 8.62 kg to 9.96 kilograms (T_1 to T_6) showed the superiority of the plants applied with the complete nutrients. The plants applied with sole foliar fertilizer (T_7) had produced the lightest ear weight without husk with a mean value of 3.68 kilograms.

The results indicates that aside from the nitrogen and phosphorus from inorganic source, foliar nutrient applications quickly correct physiological disorders caused by nutrient deficiencies, as well as help to overcome various stress conditions (Kuepper, 2003). Proper nutrition is essential for satisfactory crop growth and production. Efficient application of the correct types and amounts of fertilizers for the supply of the nutrients is an important part of achieving profitable yields as in case of this study.

9. Computed Ear Yield per Hectare. In descending order, Treatment 6 (120-7-0 + 2 Liters Foliar Fert. ha^{-1}) produced the highest ear yield with 23.86 tons per hectare. This was followed by T_5 - (120-7-0 + 1.5 Liter Foliar Fert. ha^{-1}), T_4 - (120-7-0 + 1 Liter Foliar Fert. ha^{-1}), T_3 – (120-7-0 + 0.5 Liter Foliar Fert. ha^{-1}), T_2 – (120-7-0 kg NPK ha^{-1} (RR), and T_1 – (Farmers Practice (8 bags ha^{-1}) with corresponding grand means of 23.00 tons, 22.35, 22.08, 22.15 and 20.50 tons per hectare, respectively. On the other hand, the least was produced by Treatment 7 with 9.93 tons per hectare.

10. Projected Cost and Return Analysis. The plants fertilized using the farmer's practice attained the highest return with 996.25 percent. This was followed by the plants applied with 120-7-0 + 2 Liters Foliar (T_6) with 985.83 percent, Treatment 5 with 953.59 percent, Treatment 2 with 936.01 percent, T_4 with 930.90, and Treatment 7 with 527.10 percent, respectively.

V. CONCLUSION AND RECOMMENDATION

Field study was carried out to evaluate the effect of organic-based foliar fertilizers on the growth and yield performance of transplanted sweet corn at the experimental site of Isabela State University, Cauayan Campus, Cauayan City, Isabela laid out following the Randomized Complete Block Design with three replication. The results of the study were summarized as follows:

1. The heights of sweet corn at 30 and 60 days after transplanting applied with the recommended rate of inorganic with varying levels of organic-based foliar fertilizer were significantly different from those plants applied with sole foliar fertilizer.

2. Likewise, plants applied with such fertilizer combinations performed better in terms of ear heights, ear length and diameter over the plants applied with sole foliar fertilizer.

3. The ear yield of sweet corn with and without husk was increased by the application of the 120-7-0 kg NPK per hectare plus foliar fertilizer regardless of the levels similar to the farmers' practice.

4. The highest projected ear weight was obtained by Treatment 6 (120-7-0 + 2 Liters Foliar Fertilizer ha^{-1}) which was due to improvement in yield components.

5. Among the treatments, farmers 'practice recorded the highest return on investment with 996.25 percent**.**

The combination of the recommended rate of inorganic fertilizer and organic-based foliar fertilizer increased the growth and yield components of transplanted sweet corn. However, fertilization following the farmer's practice (4 bags urea and 4 bags 16-20-0 kg NPK per hectare out yielded all other treatments.

Based from the results of the study, the farmer's practice of applying 4 bags 16-20-0 kg NPK per hectare at basal and 4 bags urea at topdress is a good practice in transplanted sweet corn which attained higher yield and economical than the combination of inorganic and organic-based foliar fertilizers, hence it is recommended. Moreover, follow up study along this way is recommended for further verification.

Table 1. Growth and yield of transplanted corn applied with different rates of organic-based foliar fertilizers

TREATMENTS	30 DAT	60 DAT	Ear Diameter (cm)	Ear Length (cm)	Ear Weight (g)	Weight per sampling Area (kg/6 m^2)	Yield Per Hectare (tons)	ROI (%)
T_1 Farmers Practice	142.73a	242.70a	4.90a	21.53a	268.57a	8.62a	20.50	996.25
T_2 120-7-0 kg NPK ha^{-1}	149.18a	250.33a	4.94a	21.70a	293.40a	9.34a	22.15	936.01

T_3 0.5 L ha^{-1} Foliar Fertilizer	150.93a	246.80a	4.89a	22.16a	290.67a	9.22a	22.08	925.70
T_4 10 L ha^{-1} Foliar Fertilizer	141.59a	253.07a	4.92a	21.46a	285.37a	9.32a	22.35	930.90
T_5 1.5 L ha^{-1} Foliar Fertilizer	144.22a	249.27a	4.96a	21.76a	285.83a	9.64a	23.00	953.59
T_6 2.0 L ha^{-1} Foliar Fertilizer	145.26a	254.43a	4.96a	21.95a	302.90a	9.96a	23.86	985.83
T_7 3.0 L ha^{-1} Foliar Fertilizer	95.91b	204.17b	3.99b	15.45b	111.63b	3.68b	9.93	527.10
ANOVA	9.27**	7.97**	46.74 **	38.77**	50.42**	40.89**		
CV (%)	7.84	4.43	1.88	3.20	6.26	4.79		

Means with common letter are not significantly different with each other at 1% HSD

REFERENCES

1. Abbas, M.K. and A.S. Ali, 2011. Effect of foliar application of NPK on some growth characters of two cultivars of roselle (Hibiscus sabdariffa L.). Am. J. Plant Physiol., 6: 220-227.
2. Agba, T. S., Long, H. S. 2005. Nitrogen effects on maize foliage and grain yield. Nigerian Agricultural Journal. 2005; 3:74-80.
3. Kogbe, J, S., Adediran J. A. 2003 Influence of nitrogen, phosphorus and potassium application on the yield of maize in the Savana zone of Nigeria. African Journal of Biotechnology. 2003; 2 (10):345-349.
4. Ghaffari, A., A. Ali, M. Tahir, M. Waseem, M. Ayub, A. Iqbal and A.U. Mohsin, 2011. Influence of integrated nutrients on growth, yield and quality of maize (Zea mays L.). Am. J. Plant Sci., 2: 63-69.
5. Gooding, M.J. and W.P. Davies, 1992. Foliar urea fertilization of cereals: A review. Nutr. Cycl. Agroecosyst., 32: 209-222.
6. Hamayun, M., S.A. Khan, A.L. Khan, Z.K. Shinwari, N. Ahmad, Y.H. Kim and I.J. Lee, 2011. Effect of foliar and soil application of nitrogen, phosphorus and potassium on yield components of lentil. Pak. J. Bot., 43: 391-396.
7. Jamal, Z., M. Hamayun, N. Ahmad and M.F. Chaudhary, 2006. Effects of soil and foliar application of different concentrations of NPK and foliar application of (NH4)2 SO4 on different yield parameters in wheat. J. Agron., 5: 251-256.
8. Liang, F. and M. Silberbush, 2002. Response of maize to foliar vs. soil application of nitrogen-phosphorus-potassium fertilizers. J. Plant Nutr. 25: 2333-2342.
9. Okumura, R.S., H.W. Takahashi, D.G.C. dos Santos, A.K.S. da Silva Lobato and D.D.C. Mariano 2011. Influence of different nitrogen levels on growth and production parameters in maize plants. J. Food Agric. Environ., 9: 510-514.
10. Reickenberg, R.L. and M.P. Pritts, 1996. Dynamics of nutrient uptake from foliar fertilizers in red raspberry (Rubusidaeus L.). J. Am. Soc. Hort. Sci., 121: 158-163.
11. Sabir, S., J. Bakht, M. Shafi and W. Ali shah, 2002. Effect of foliar vs. broadcast application of different doses of nitrogen on wheat. Asian J. Plant Sci., 1: 300-303.
12. Salisbury, F.B. and W.C. Ross, 1992. Plant Physiology. 4th Edn, Wadsworth Publishing Co., Belmont, California, USA, Pages: 682.
13. Williams, G. and P. Williams. 2006. Foliar Sprays Need n't be Fancy, HortIdeas. March. P. 32.

Increasing Success Rates of Capital Expenditure Procurement Process by Machine Learning Algorithms Development in Owner Estimate (OE) Price Analysis

[1] N H A Amiri, [2]M A Berawi, [3]M Sari
[1][2][3] Civil Engineering, University of Indonesia

Abstract
The realization of capital expenditure budget is one of the key performance indicators. The largest portion is owned by procurement activities of goods / services. Owner Estimate (OE) is an estimate of price of goods / services that has taken into account all components of cost until it is ready to be used and utilized by users. OE is used to assess the fairness of the offer price of prospective providers of goods / services. OE preparation must be based on accountable methods and based on relevant, actual and reliable data. Machine learning is about designing algorithms that automatically extract valuable information from data. Machine learning uses linear regression to be one of the most widely used algorithms for performing price and sales prediction models. In this study, Machine learning are used to calculate owner estimate predictions in 2021 in the procurement of State-Owned Company Building Construction. From the results of the development obtained predictions with machine learning can be used in calculating the owner estimate price analysis for price predictions on the procurement of capital expenditures in building construction. Prediction results from machine learning have good fit accuracy so it can be concluded that predictions from machine learning can help budget planning and cost estimaties (Owner Estimate), which increase the project's success rate.

Keywords: *Capital Expenditure Procurement Process, Owner Estimate, Machine Learning, Root Mean Square Error (RMSE)*

I. INTRODUCTION

As in [1] If the procurement function fails to provide quality goods and services in a timely manner and at an economical price, the government's performance will clearly be disrupted. The largest portion of the capital expenditure budget is owned by goods/services procurement activities [2]. Owner Estimate (OE) is an estimate price of goods/services that has taken into account all cost components until they are ready to be used and utilized by users. The preparation of the OE must be based on an accountable method and based on relevant, actual and reliable data [3],[4].

Machine Learning is about designing algorithms that automatically extract valuable information from data [5] Machine Learning using linear regression is one of the most widely used algorithms to model price and sales predictions. Based on this, the author will conduct research on the Increasing Success Rates of Capital Expenditure Procurement Process by Machine Learning Algorithms Development in Owner Estimate (OE) Price Analysis, with the aim to be achieved is to identify variables in OE calculations for development in machine learning, develop machine learning algorithms in OE on the procurement of capital expenditures and analyze the increase in the accuracy of the calculation of OE in the development of machine learning on the procurement of capital expenditures.

II. THEORITICAL STUDY

A. PROCUREMENT OF GOODS AND SERVICES

Public procurement is an important government system for spending public money on the procurement of goods, works and services needed for public programs and projects [6]. Procurement planning includes identification of needs, determination of goods/services, methods, schedules, and budget for the procurement of goods/services. After the Technical specifications have been determined, the next step is to prepare an OE which will be used as a basis for assessing the reasonableness of the bid price from the prospective provider. OE is the result of calculating the entire volume of work multiplied by the unit price of work plus all taxes and profits. The calculation of the unit price of work is analyzed based on the coefficient of the work unit price analysis which is the calculation of the cost of labor, materials and equipment. In compiling the work unit price analysis, it requires the Basic Unit Price of labor, raw materials, processed materials and/or finished materials as well as equipment at the job site.

In carrying out construction work, changes to contracts are common. This can be caused by various factors that affect the implementation of the construction work itself. Contract amendments can be made by means of a Contract Addendum. Reference [7] show the indicators of project success can be

measured from the following four aspects: time of execution of work, quality of work results, cost of implementation, and work safety.

B. MACHINE LEARNING ON PROCUREMENT ANALYSIS

Machine Learning using linear regression is one of the most widely used algorithms to model price and sales predictions. Linear regression attempts to model relationships by fitting linear equations to experimental data [8]. Machine Learning using Jupyter Notebook extends the console-based approach to interactive computing in a qualitatively new direction, providing a web-based application suitable for capturing the entire computational process: develop, document, and execute code, and communicate the results.

C. ACCURACY USING ROOT MEAN SQUARED ERROR

Root Mean Square Error (RMSE) is one way to evaluate a linear regression model by measuring the level of accuracy of the estimated results of a model [9]. Mathematically, the formula is written as follows:

$$RMSE = \sqrt{\sum_{i=0}^{n}(y_i)^2/\mathrm{n}} = \left(\frac{\sum(y_i - \hat{y}_i)}{n}\right)^{1/2} (1)$$

RMSE = Root Mean Square Error value
y = observed value
$\hat{y}_i$ = predicted value
i = order of data in database
n = number of data

A low RMSE value indicates that the variation in the value produced by a forecast model is close to the variation in the observed value. The smaller the RMSE value, the closer the predicted and observed values are.

III. RESEARCH METHODS

Research Question can be analyzed based on the data obtained with the correct and directed process. After the data is collected then the data is analyzed using statistics. The results of the analysis will prove whether the hypothesis is proven or not [10], the following is a flow chart of the research to be carried out as in figure 1.

Secondary data obtained from case studies and observations then needs to be analyzed to identify data variables, form a database by calculating unit price analysis, forming machine learning models, and calculating the accuracy of predictive data from machine learning. The analysis methods carried out include:

1. Identification of Variables in Building Construction Procurement Data that experience addendum in State Owned Company;
2. The research was conducted at the Price Analysis of Owner Estimate in Building Construction in State Owned Company;
3. Calculation of *Basic Unit Price* in *Work Unit Price Analysis* using Journal of Building Materials Unit Price in 2017, 2018, 2019, 2020 [11]-[14];
4. Development of Machine Learning using Linear Regression Algorithms;
5. Machine Learning uses phyton-3;
6. Price Predictions from machine learning development for 2021;
7. Analysis of the accuracy of price prediction results from Machine Learning using Root Mean Squared Error (RMSE).

IV. DATA COLLECTION AND ANALYSIS

A. CASE STUDY AND ANALYSIS OF CAPITAL EXPENDITURE PROCUREMENT

To answer the formulation of the problem, the first researchers do is to collect secondary data on building procurement contracts in 2020 that experience price addendum on State-owned Company in 2021. (Table I)

Job items that experience a price addendum in Table I consist of several sub-works. The sub-work includes classified information, as it relates to the contents of agreements with third parties or implementing contractors on the State-owned Company Building Procurement.

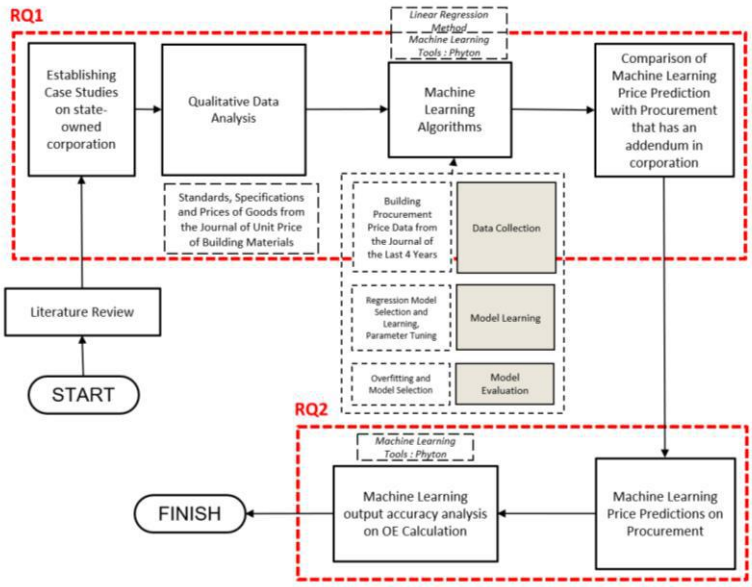


Figure 1. Research Flow

Table I. Addendum of Building Procurement on State-Owned Company

No	WORK DESCRIPTION	INITIAL CONTRACT (2020)	ADDENDUM CONTRACT (2021)
A	**ARCHITECTURAL WORK**		
I	**PREPARATORY WORK**		
II	**DEMOLITION WORK**		
	A. MAIN BUILDING		
	B. SUPPORTING BUILDINGS		
	C. OUTDOOR SPATIAL BUILDING		
III	**BRICK WALL WORK**		
	A. GROUND FLOOR MAIN BUILDING	*Rp217,784,355*	*Rp235.157.052*
	B. THE MAIN BUILDING UPSTAIRS		
	C. SUPPORTING BUILDINGS / FRONT FACILITIES		
	D. REAR SUPPORT BUILDING	*Rp22.452.987*	*Rp23.775.636*
	E. OUTDOOR LAYOUT		
IV	**WORK WALL PAIR GYPSUM TWO FACE + HOLLOW IRON FRAME**		
	A. GROUND FLOOR MAIN BUILDING	*Rp72,467,890*	*Rp76.291.285*
	B. THE MAIN BUILDING UPSTAIRS		
V	**FLOOR & WALL FINISHING WORK**		
	A. GROUND FLOOR MAIN BUILDING	*Rp417.195.402*	*Rp424.999.080*
	B. THE MAIN BUILDING UPSTAIRS		
	C. SUPPORTING BUILDINGS		
	D. OUTDOOR LAYOUT	*Rp161,522,782*	*Rp164,468,465*
	E. REAR & SIDE OUTDOOR LAYOUT	*Rp213.592.071*	*Rp219,999,833*

Source: Historical data on State-Owned Company

Table II. (III.A) Work Of Brick Wall – Ground Floor Main Building

TYPE OF WORK	VOLUME	UNIT
Ordinary Brick Wall Couple's Work 1/2 Stone	606,192	m2
Trasram Brick Wall Couple's Work 1/2 Stone	48,477	m2
Fireplace + Plaster Work	105,47	m2
Ordinary Stucco Work	1193,73	m2

Watertight Plastering Work	91,61	m2
Skoneng Door & Window Work	254,8	m¹

Table III. (III.D) Work Of Brick Wall – Rear Supporting Building

TYPE OF WORK	VOLUME	UNIT
Ordinary Brick Wall Couple's Work 1/2 Stone	41,937	m2
Trasram Brick Wall Couple's Work 1/2 Stone	11,809	m2
Ordinary Stucco Work	101,58	m2
Watertight Plastering Work	22,636	m2
Skoneng Door & Window Work	13,15	m¹

Table IV. (IV.A) Work Of Gypsum Partition Wall – Ground Floor Main Building

TYPE OF WORK	VOLUME	UNIT
Gypsum Partition Wall Couple Work, Two Faces	180,887	m2
Hollow Iron Partition Frame Work	180,887	m2

Table V. (V.A). Floor & Wall Finishing Work - Ground Floor Main Building

TYPE OF WORK	VOLUME	UNIT
Granite Tile Floor Work	505,783	m²
Rough Motif Ceramic Floor Work	62,18	m²
Granite Tile Wall Work	151,074	m²
Floor Plint Work	11,625	m¹
Plint Work Granite Tile Floor	302,222	m¹

Table VI. (V.D) Floor & Wall Finishing Work - Outdoor Layout

TYPE OF WORK	VOLUME	UNIT
Granite Floor Work	65	m²
Ground Work	91,74	m³
Paving Floor Work	323	m²
Curb DKI Installation	60,44	m¹
Curb Work and Installation	50	m¹

Table VII. (V.E) Floor Finishing Work & Wall - Rear Outdoor Layout &Aside

TYPE OF WORK	VOLUME	UNIT
Paving Floor Work	424	m²
Curb DKI Installation	174	m¹
Ground Work	41,6	m³

Table VIII. Work Price Unit Calculation Table 2017-2020

No.	Work Description	2017	2018	2019	2020
1	Ordinary Brick Wall Couple's Work 1/2 Stone	Rp143,267	Rp168.120	Rp167.500	Rp258.617
2	Fireplace + Plaster Work	Rp89.203	Rp95,846	Rp102.611	Rp114.264
3	Skoneng Door & Window Work	Rp89.210	Rp92.832	Rp95.433	Rp102.066
4	Trasram Brick Wall Couple's Work 1/2 Stone	Rp147,296	Rp173,688	Rp175.226	Rp267.098
5	Watertight Plastering Work	Rp91,502	Rp98.977	Rp106.906	Rp119.003
6	Gypsum Partition Wall Couple Work, Two Faces	Rp67.291	Rp73,846	Rp75,677	Rp81,516
7	Hollow Iron Partition Frame Work	Rp276.947	Rp289.716	Rp344.553	Rp316.192
8	Paving Floor Work	Rp277.757	Rp284.903	Rp286.189	Rp312.413
9	Curb DKI Installation	Rp177.926	Rp174.829	Rp179,294	Rp192.864
10	Ground Work	Rp81.205	Rp84.601	Rp86.118	Rp97.388
11	Granite Floor Work	Rp528,756	Rp542.437	Rp579.463	Rp604.012
12	Curb Work and Installation	Rp182,674	Rp179,394	Rp184.772	Rp197,886
1	Granite Tile Polish Floor Work	Rp634,796	Rp610.153	Rp641.140	Rp713.869

3					
1	Rough Motif Ceramic Floor Work	Rp323.607	Rp353,887	Rp372.718	Rp541.244
4					
1	Granite Tile Wall Work	Rp289.909	Rp305.012	Rp308,779	Rp386.913
5					
1	Floor Plint Work	Rp87.370	Rp81,593	Rp79.519	Rp82.974
6					

Source: Author (2021)

To calculate OE, it requires volume information and Unit Price of Work (Table II to Table VII). With the items listed in the tables, we have 16 (sixteen) kind of work according to Table VII.

After obtaining the description of *Work Price Unit*, then the calculation is analyzed based on the coefficient of *Unit Price Analysis* for 2017 to 2020. In preparing Unit Price Analysis requires a *Standard Price* of work, raw materials, processed materials and / or finished materials and equipment at the job site. Standard Price was taken from the *Journal of Construction and Interior Building Materials Unit Price from 2017 to 2020*.

B. CALCULATION OF UNIT PRICE ANALYSIS FOR MACHINE LEARNING DATABASE.

The next step to establishing a Machine Learning database, we calculates *Unit Price Analysis* for 16 (sixteen) *Work Price Unit* items obtained from the State-owned Company Building Procurement Case. From the *Unit Price Analysis* Calculation mentioned above, it then produces *Work Price Unit* from 2017 to 2020 for Building Construction Work that undergoes a price addendum on State-Owned Company contained in Table VIII. The *Work Price Unit* calculation in the table above will then be used as a database for the development of Machine Learning.

V. V. DISCUSSION

A. IDENTIFYING VARIABLES

From the Calculation of *Work Price Unit* in 2017-2020 then formed data that classifies *Work Price Unit* as Figure 2. Based on the figure, taken Year as Input Variable (x) written as YEAR, and Job Price as Response Variable (y) written as PEKERJAAN1 to PEKERJAAN16 (WORK1 to WORK16). Where in a linear regression model, the value to be predicted is the value of the response variable (y) bound to the input variable (x). According to [15], linear regression is a statistical method used to form a model of relationships between bound variables (dependent; response; Y) with one or more free variables (independent, predictor, X).

TAHUN	PEKERJAAN1	PEKERJAAN2	PEKERJAAN3	PEKERJAAN4	PEKERJAAN5	PEKERJAAN6	PEKERJAAN7	PEKERJAAN8
2017	143267	89203	89210	147296	91502	305467	315657	67291
2018	168120	95846	92832	173688	98977	503984	526543	73846
2019	167500	102611	95433	175226	106906	530449	556742	75677
2020	258617	114264	102066	267098	119003	537990	94327	81516

Figure 2. Database Format in Excel

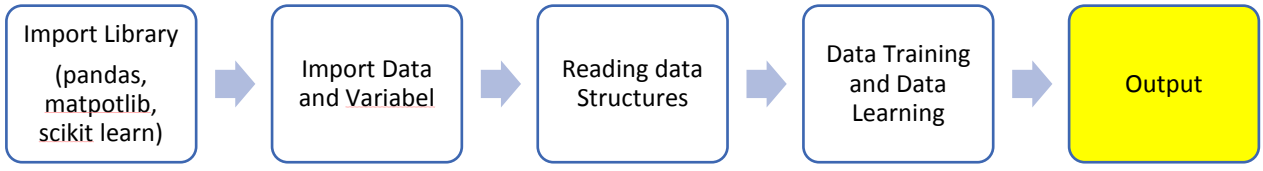


Figure 3. Machine Learning Development Process

B. MACHINE LEARNING DEVELOPMENT

The development of the Linear Regression Machine Learning Model is done with the Jupyter Notebook tool, which is a web-based application that can use a variety of library functions using Phyton-3.

The Development Stage starts from the conversion of data into Comma Separated Values (csv), Supervised Learning Process in Jupyter Notebook, Then import library on Machine Learning. The libraries used are pandas that serve to create data structures and data manipulation, matpotlib libraries that function to perform mathematical functions, and

sckit-learn library libraries that function to run machine learning models, build data training and data learning, up to issue output price predictions for types of work in building procurement in State-Owned Company.

C. MACHINE LEARNING PREDICITIONS RESULTS

In this Machine Learning model, data is split into 20: 80 to become data training and data learning, and then sample training data is taken randomly every time Machine Learning is running. After running as many as 10 times per item, the following Machine Learning Prediction Results after passing the process of data training, data testing, and passing the average distribution of predictions as seen in Table IX.

D. ANALYSIS OF OWNER ESTIMATE PERCENTAGE

The Price Database and Price Prediction Results are previously multiplied by the volume of buildings construction in case studies in State-Owned Company, then the Percentage Price Increase is calculated from 2020 to 2021 (Table X to Table XV)

To measure and compare the accuracy value of machine learning prediction results, the percentage price increase from 2020 to 2021 for prediction data and case studies needs to be calculated as seen in Table XVI.

Because sub-works data on State-Owned Company is classified, the percentage increase in sub works item price is assumed to be equivalent or equal to the percentage increase of it's Work Price Unit.

E. MACHINE LEARNING ACCURACY ANALYSIS

From the Percentage Comparison of Price Increases in predictions for 2020 to 2021, the data will be compared to the percentage price increase on OE data from State-Owned Company to calculate its RMSE Score using (1).

TYPE OF WORK	RMSE	SCORE
III.A BRICK WALLS WORK - GROUND FLOOR	0,020907570	Good Fit
III.D BRICK WALLS WORK – REAR SUPPORTING BUILDINGS	0,019759200	Good Fit
IV.A BRICK WALLS WORK - OUTDOOR LAYOUT	0,031128803	Good Fit
V.A. FINISHING FLOOR & WALL WORK - MAIN BUILDING GROUND FLOOR	0,036831897	Good Fit
V.D. FLOOR & WALL FINISHING WORK - OUTDOOR LAYOUT	0,014214358	Good Fit
V.E FLOOR FINISHING WORK & WALL - REAR OUTDOOR LAYOUT &ASIDE	0,014699887	Good Fit

Each project depends on cost or budget. Many researchers rate cost as a very important success criteria, where cost budget planning and proper cost estimation have been mentioned as success factors [16].

From the data on the RMSE Table, predictions from Machine Learning all have good fit criteria, and a high level of accuracy. So it can be concluded that Predictions from Machine Learning can help budget planning and cost estimation, which increases the success rates of procurements.

Table IX. Results of Machine Learning Predictions

No.	Job Description	2017	2018	2019	2020	*2021 (Prediction)*
1	Ordinary Brick Wall Couple's Work 1/2 Stone	Rp143,267	Rp168.120	Rp167.500	Rp258.617	*Rp279.655*
2	Fireplace + Plaster Work	Rp89.203	Rp95,846	Rp102.611	Rp114.264	*Rp121,671*
3	Skoneng Door & Window Work	Rp89.210	Rp92.832	Rp95.433	Rp102.066	*Rp105.594*
4	Trasram Brick Wall Couple's Work 1/2 Stone	Rp147,296	Rp173,688	Rp175.226	Rp267.098	*Rp289.905*
5	Watertight Plastering Work	Rp91,502	Rp98.977	Rp106.906	Rp119.003	*Rp127.317*
6	Gypsum Partition Wall Couple Work, Two Faces	Rp67.291	Rp73,846	Rp75,677	Rp81,516	*Rp85.280*
7	Hollow Iron Partition Frame Work	Rp276.947	Rp289.716	Rp344.533	Rp316.192	*Rp346.637*
8	Paving Floor Work	Rp277.757	Rp284.903	Rp286.189	Rp312.413	*Rp319.320*
9	Curb DKI Installation	Rp177.926	Rp174.829	Rp179,294	Rp192.864	*Rp195.119*
10	Ground Work	Rp81.205	Rp84.601	Rp86.118	Rp97.388	*Rp101,000*
11	Granite Floor Work	Rp528,756	Rp542.437	Rp579.463	Rp604.012	*Rp629.365*
12	Curb Work and Installation	Rp182,674	Rp179,394	Rp184.772	Rp197,886	*Rp200.349*
13	Granite Tile Polish Floor Work	Rp634,796	Rp610.153	Rp641.140	Rp713.869	*Rp724.991*
14	Rough Motif Ceramic Floor Work	Rp323.607	Rp353,887	Rp372.718	Rp541.244	*Rp565,799*
15	Granite Tile Wall Work	Rp289.909	Rp305.012	Rp308,779	Rp386.913	*Rp396,347*

16	Floor Plint Work	Rp87.370	Rp81,593	Rp79.519	Rp82.974	*Rp79.970*

Table X Price Predictions 2021 Machine Learning Work Of Brick Wall Pair - Ground Floor

TYPE OF WORK	VOL	SAT	2020	*Prediction 2021*	%
Ordinary Brick Wall Couple's Work 1/2 Stone	606,192	m^2	Rp156,771,556	*Rp169.524.321*	*8,1%*
Trasram Brick Wall Couple's Work 1/2 Stone	48,477	m^3	Rp12.948.110	*Rp14.053.725*	*8,5%*
Fireplace + Plaster Work	105,47	m^2	Rp12.051.424	*Rp12,832,588*	*6,5%*
Ordinary Stucco Work	1193,73	m^1	Rp136.400.365	*Rp145.241.726*	*6,5%*
Watertight Plastering Work	91,61	m^1	Rp10,901,865	*Rp11,663,465*	*7,0%*
Skoneng Door & Window Work	254,8	m^1	Rp26.006.417	*Rp26.905.351*	*3,5%*
TOTAL			**Rp355.079.737**	***Rp380.221.175***	***7,1%***

Table XI Price Predictions 2021 Machine Learning Work Of Brick Wall Pair – Rear Supporting Building

TYPE OF WORK	VOL	SAT	2020	*Prediction 2021*	%
Ordinary Brick Wall Couple's Work 1/2 Stone	41,937	m^2	Rp10.845.621	*Rp11,727,871*	*8,1%*
Trasram Brick Wall Couple's Work 1/2 Stone	11,809	m^3	Rp3,154,160	*Rp3,423,488*	*8,5%*
Ordinary Stucco Work	101,58	m^2	Rp11,606,937	*Rp12,359,289*	*6,5%*
Watertight Plastering Work	22,636	m^1	Rp2,693,752	*Rp2,881,936*	*7,0%*
Skoneng Door & Window Work	13,15	m^1	Rp1,342,168	*Rp1,388,561*	*3,5%*
TOTAL			**Rp29,642,638**	***Rp31,781,146***	***7,2%***

Table XII Price Predictions 2021 Machine Learning Work Pairs Gypsum Partition Wall – Ground Floor Main Building

TYPE OF WORK	VOL	SAT	2020	*Prediction 2021*	%
Gypsum Partition Wall Couple Work, Two Faces	180,887	m^2	Rp14.745.185	*Rp15.425.953*	*4,6%*
Hollow Iron Partition Frame Work	180,887	m^3	Rp57.195.022	*Rp62.702.127*	*9,6%*
TOTAL		m^2	**Rp71.940.207**	***Rp78.128.080***	***8,6%***

Table XIII Price Predictions 2021 Machine Learning Work Finishing Floors & Walls - Ground Floor Main Buildings

TYPE OF WORK	VOL	SAT	2020	*Prediction 2021*	%
Granite Tile Floor Work	505,783	m^2	Rp361.062.804	*Rp366,687,870*	*1,6%*
Rough Motif Ceramic Floor Work	62,18	m^3	Rp33.654.552	*Rp35.181.382*	*4,5%*
Granite Tile Wall Work	151,074	m^2	Rp58.452.495	*Rp59.877.727*	*2,4%*
Floor Plint Work	11,625	m^1	Rp964,573	*Rp929,651*	*-3,6%*
Plint Work Granite Tile Floor	302,222	m^1	Rp25.076.568	*Rp24.168.693*	*-3,6%*
TOTAL			**Rp479.210.992**	***Rp486.845.323***	***1,6%***

Table XIV Price Prediction 2021 Machine Learning Floor & Wall Finishing Work - Outdoor Layout

TYPE OF WORK	VOL	SAT	2020	*Prediction 2021*	%
Grilled Granite Floor Work	65	m^2	Rp39.260.780	*Rp40.908.725*	*4,2%*
Ground Work	91,74	m^3	Rp8,934,375	*Rp9,265,740*	*3,7%*
Paving Floor Work	323	m^2	Rp100.909.399	*Rp103.140.360*	*2,2%*
Curb DKI Installation	60,44	m^1	Rp11,656,700	*Rp11,792,962*	*1,2%*
Curb Work and Installation	50	m^1	Rp9,894,300	*Rp10.017.450*	*1,2%*
TOTAL			**Rp170,655,554**	***Rp175.125.237***	***2,6%***

Table XV Price Prediction 2021 Machine Learning Floor & Wall Finishing Work - Rear and Side Outdoor Layout

TYPE OF WORK	VOL	SAT	2020	*Prediction 2021*	%
Paving Floor Work	424	m^2	Rp132.463.112	*Rp135,391,680*	*2,2%*
Curb DKI Installation	174	m^1	Rp33.558.336	*Rp33.950.619*	*1,2%*
Ground Work	41,6	m^3	Rp4,051,341	*Rp4,201,600*	*3,7%*
TOTAL			**Rp170.072.789**	***Rp173,543,899***	***2,0%***

Table XVI Percentage Increase in Company Employment Addendum X Price From 2020 – 2021

No	TYPE OF WORK	*PERCENTAGE PRICE INCREASE*	INITIAL CONTRACT	ADDENDUM
3a	III.A BRICK WALLS WORK - GROUND FLOOR	*7.98%*	Rp217,784,355	Rp235.157.052
3d	III.D BRICK WALLS WORK – REAR SUPPORTING BUILDINGS	*5.89%*	Rp22.452.987	Rp23.775.636
4a	IV.A BRICK WALLS WORK - OUTDOOR LAYOUT	*5.28%*	Rp72,467,890	Rp76.291.285
5a	V.A. FINISHING FLOOR & WALL WORK - MAIN BUILDING GROUND FLOOR	*1.87%*	Rp417.195.402	Rp424.999.080
5d	V.D. FLOOR & WALL FINISHING WORK - OUTDOOR LAYOUT	*1.82%*	Rp161,522,782	Rp164,468,465
5e	V.E FLOOR FINISHING WORK & WALL - REAR OUTDOOR LAYOUT &ASIDE	*3.00%*	Rp213.592.071	Rp219,999,833

VI. CONCLUSIONS

Based on the results of the study, it can be concluded as follows:

1. In the Calculation of Owner Estimate (OE) there are variables X (YEAR) and Variable Y (PRICE) that can be developed in Machine Learning.

2. Calculations and predictions of OE can be developed in Machine Learning. Prediction with Machine Learning can be used in OE calculations for price predictions on capital expenditure procurement, namely building construction.

3. Prediction results from Machine Learning have good fit criteria, and a high level of accuracy. So it can be concluded that Predictions from Machine Learning can help budget planning and cost estimation, which increases the success factor of the project.

In the next study, the authors hope that the development of machine learning can identify more variables, study various cases of causes of price addendum due to external factors. We also hope a feedback from this study so that the results of the study can be further developed and refined for materials to both practically and academically.

REFERENCES

1. Komakech R.A (2016). Public Procurement in Developing Countries: Objectives, Principles and Required Professional Skills. Kumi University, Uganda. ISSN 2224-5731 (Paper) ISSN 2225-0972 (Online) Vol.6, No.8, 2016.
2. Sandhy H. (2018). Analisis Faktor-Faktor Penyebab Gagal Lelang dan Putus Kontrak Pengadaan Barang/Jasa Studi Kasus pada Pemerintah Kota Yogyakarta. Tesis. Fakultas Ekonomika dan Bisnis. Jurusan Akuntansi. Universitas Gadjah Mada. Yogyakarta. Indonesia
3. Lembaga Kebijakan Pengadaan Barang/Jasa Pemerintah. Buku Informasi – 6 Pelatihan Pengadaan Barang/Jasa Tingkat Dasar. Persiapan Pengadaan Barang/Jasa Pemerintah. Deputi Bidang Pengembangan Dan Pembinaan Sumber Daya Manusia Pusat Pendidikan Dan Pelatihan Kompetensi, Jakarta. 2018.
4. Lembaga Kebijakan Pengadaan Barang/Jasa Pemerintah. Buku Informasi – 5 Pelatihan Pengadaan Barang/Jasa Tingkat Dasar. Perencanaan Pengadaan Barang/Jasa Pemerintah. Deputi Bidang Pengembangan Dan Pembinaan Sumber Daya Manusia Pusat Pendidikan Dan Pelatihan Kompetensi, Jakarta. 2018.
5. Deisenroth M.P, Faisal A. A, Ong C.S. (2021). Mathematics for Machine Learning. Published by Cambridge University Press. https://mml-book.com.
6. Khan N. (2018). Public Procurement Fundamentals. Lessons from and for the Field. British Library Cataloguing in Publication Data ISBN:978-1-78754-605-9.
7. M Aprilia S, (2021). Analisis Faktor Utama Keberhasilan Proyek Konstruksi Pada Proyek Pembangunan Rumah Sakit Regina Maris Kota Medan. Skripsi Program Studi Teknik Sipil Fakultas Teknik Universitas Muhammadiyah Sumatera Utara tahun 2021.
8. Raditya D, Erlin N.P, Amanda F.S, Hanafiah N. (2021). Predicting Sneaker Resale Prices using Machine Learning. Bina Nusantara University, Indonesia. Procedia Computer Science 179 (2021) 533-540.
9. Dulakshi S, Kumari K. (2021). Root Mean Square Error or mean absolute error? Use their ratio as well. University of Peradeniya, Sri Lanka. Information Sciences 585 (2022) 609-620.
10. Sugiyono,2008. Metode Penelitian Kuantitatif, Kualitatif dan R&D. Alfabeta. Bandung.
11. Harga Satuan Bahan Bangunan Konstruksi dan Interior. Journal Of Building Construction, Interior & Material Prices. Pandu Bangun Persada Nusantara. 2017. Edisi 36 ISSN.0853-4829.
12. Harga Satuan Bahan Bangunan Konstruksi dan Interior. Journal Of Building Construction, Interior & Material Prices. Pandu Bangun Persada Nusantara. 2018. Edisi 37 ISSN.0853-4829.
13. Harga Satuan Bahan Bangunan Konstruksi dan Interior. Journal Of Building Construction, Interior & Material Prices. Pandu Bangun Persada Nusantara. 2019. Edisi 38 ISSN.0853-4829.
14. Harga Satuan Bahan Bangunan Konstruksi dan Interior. Journal Of Building Construction, Interior & Material Prices. Pandu Bangun Persada Nusantara. 2020. Edisi 39 ISSN.0853-4829.
15. Deny K. (2008). Linear Regression. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org
16. Olomolaiye, P. O., Proverbs, D. G., Ahadzie, D. K., Ahadzie, D., Proverbs, D., & Olomolaiye, P. (2008). Critical success criteria for mass house building projects in developing countries. International Journal of Project Management, 26(6), 675-687.

An Exploratory Research on Service Quality of the Urban Public Transport Companies and Sustainable City Logistics

[1] Kavita Sharma, [2] Sachin Sharma
[1] University School of Business, Chandigarh University, Mohali, Punjab, India
[2] School of Management Studies, CT University, Ludhiana, Punjab, India

Abstract
Purpose:
The aim of this article is to provide an assessment of the results of primary research conducted on the quality of service provided by urban public transportation companies and sustainable city logistics in India.
Methodology:
The paper is primary in research. Primarily, survey with a representative sample of 277 respondents were conducted for the purpose of gathering information for the main study. To examine the data, a variety of statistical approaches, namely,descriptive statistics, Exploratory Factor Analysis and Confirmatory Factor Analysis applied.
Findings:
According to the findings of this study, respondents are more satisfied with the level of service quality provided by urban public transportation companies, whereas specific service quality characteristics are also seen differently by different employees of the companies related to sustainable logistics. According to the study, customers-orientation and environmental monitoring have significant influence on urban public transportation companies. According to the existing study, public transportation providers should take into account the needs of various passenger while determining fares.
Originality:
The existing research will provide wide scope to the researchers and practitioners to carry out a comprehensive analysis on sustainable logistics withurban and rural public transport for future research.

Keywords: environmental monitoring, influence, public urban transport, service quality, sustainable city logistics

I. INTRODUCTION

This century has also seen a dramatic shift in mobility needs due to the changing corporate environment and population development. As a result, individuals were no longer able to go outside of their towns and cities, but were instead restricted to their own urban areas, However, the continents' frameworks were shifted and intercontinental overlap developed as a result of mobility. Passenger and freight transit performance is steadily improving. Cities and urban agglomerations face increasing demand on their transportation infrastructure and logistics. These developments are equally crucial for the twenty-first century, a time in which current information and communication technologies are likewise undergoing a fundamental evolution, shifts in consumer buying habits and shifting mobility requirements. As the number of people driving their own cars increases in cities and urban agglomerations, driving speeds drop, public transportation services become more irregular, and passengers experience frustrating waits(Stopka, Bartuska and Kampf, 2015). Numerous academic papers have shown the environmental, economic, and social consequences of globalisation, urbanisation, and excessive individual automobile use in metropolitan areas(Haghshenas and Vaziri, 2012). Road infrastructure safety, air pollution, traffic noise, and global warming are just some of the issues that arise as more people drive their own cars; It takes a significant amount of money and time to build new road infrastructure and the accompanying transportation equipment; Parked vehicles are a hindrance to those on foot, on bicycles, and in wheelchairs(Stopka, Bartuska and Kampf, 2015). One of the study outlined the interplay between business, the environment, and humankind as the primary obstacles to fast global urbanisation(Riffat, Powell and Aydin, 2016). While economic effect is important, Birkin and Polesie stressed the need of adopting methods and behaviours that are social and environmental resilient(Bartelmus, 2010). City and global environments face the biggest challenges today not just in decreasing greenhouse gas emissions and pollution but also in enhancing the quality of life for residents(Vardoulakis and Kinney, 2019). Urban sprawl and the decentralisation of communities are both exacerbated by traffic, but the promotion of environmentally friendly forms of transportation is essential, because city people have the option of using one of these environmentally friendly forms of transportation(Stopka, Bartuska and Kampf, 2015). With

regard to sustainable city logistics, this article focuses on the quality of service provided by the city's public transportation providers in the specified urban area. Its purpose is to assess the level of service provided by the metropolitan public transportation firms in this area, and to highlight certain shortcomings in this area from the standpoint of sustainable city logistics. The following is the structure of the paper: Section 1 includes the introduction to the issue and justifications for the research effort given in this study are included inside section. Section 2 provides an overview of the theoretical foundations in the fields of city logistics challenges and public transportation services, respectively. Section 3 explains the procedures that were employed in the research study for data collecting and data analysis, as well as the results of the research. The findings and conclusions of the study are presented in Section 4. Section 5 examines the findings and offers a comparison between the findings and previous study in the field (i.e., existing literature). As a conclusion, the article offers suggestions for potential applications in sustainable urban logistics.

II. Review of Literature

Limited resources and inadequate infrastructural capacity must be addressed by cities, which must create solutions(Peter and Swilling, 2012). Kauf(2016) utilises the phrase "sustainable city logistics" to refer to the area of city logistics that is critical to long-term urban sustainability(Kauf, 2016). Achieving sustainable urban transportation is seen as a precondition for implementing the notion of sustainable city logistics by the majority of authors(Cheba and Saniuk, 2016). According to some researchers, optimising intra-city transportation may help to thelong-term sustainability and profitability while also relieving infrastructure congestion and reducing emissions and noise(Viu-Roig and Alvarez-Palau, 2020). Many fields of study are now looking at how to best implement sustainable city logistics. The utilisation of new sources of information to provide sustainable transportation networks in cities and urban agglomerations presents new problems and possibilities for city logistics(Ogryzek, Kmiec and Klimach, 2020). The use of big data for in-depth research to plan and optimise sustainable city logistics is also promoted by other sources(Bibri, 2019). Other authors stress the importance of decision support systems and tools in addressing city logistics problems since without them, it is hard to come up with an ideal solution(Yigitcanlar *et al.*, 2019) ; (Toli and Murtagh, 2020). Logistics in the city are becoming more difficult as a result of urbanisation and e-commerce(Schöder, Ding and Campos, 2016). There are several issues facing city logistics today, including e-commerce and its impact on the transportation network in and around agglomerations(Bosona, 2020). The purpose of city planners is to establish the optimum grading system for sustainable city development(Al-Zoabi and Jarrar, 2016). In cities, public areas and social connections are intertwined and mutually dependent. City settings influence social activity because of this connection(Latham and Layton, 2019). Development nations place a high value on urban planning and water quality preservation since both are essential to a country's long-term social and economic progress(Cosgrove and Loucks, 2015). Sustainable city logistics has been the subject of several studies, with a wide range of possible solutions. a greater use of low-energy and low-emission vehicles for last-mile delivery(Mucowska, 2021); Given the overall performance obtained by all modes of transportation, a greater proportion of co-modal travel(Naumov *et al.*, 2020); roadways, city centres, or particular zones may be charged based on their usage; the improvement of transportation infrastructure and the reduction of emissions from automobiles(Guo *et al.*, 2020); Traveling in a more environmentally friendly manner. According toStopka, et.al., (2015), limits on the use of automobiles and favourable conditions for the use of ecologically friendly forms of transportation should be addressed,in order to make urban public transportation and cycling and pedestrian traffic more competitive and favoured over private automobile transportation, and because of the tremendous dissemination of these solutions. For individuals, walking and cycling are essential components of sustainable and resilient communities and towns(Tight, 2016). As a result, metropolitan public transportation networks and services play a critical role in promoting sustainable growth in our communities and sustainable logistical systems(Mosaberpanah and Khales, 2013). Several management methods may be used by public transportation firms in order to enhance their environmental performance. An intriguing solution is one that allows for the formation of new partnerships and value network reconfigurations capable of enhancing efficiency. In order to deliver greater service and efficiency, public transportation services address sustainable challenges to combining environmental "eco-efficiency" and social sustainability by including all stakeholders. Encourage clients to use public transportation by highlighting the benefits of doing so in terms of the environment(Lopez, Ruiz-Benítez and Vargas-Machuca, 2019). Improving public transportation's quality and responsiveness to customer needs is one answer, but only if the whole transportation system as a whole is improved. Public transportation networks in the agglomeration context may be considered as a dynamic system, according to many research(Fang and Yu, 2017). However, the real issue is overcoming the habit of driving one's own automobile, and one approach is to use public transit or car-sharing services instead(Alyavina, Nikitas and Tchouamou Njoya, 2020). However, the real issue is overcoming the habit of driving one's own automobile, and one approach is to use public transit or car-sharing services instead(White, Habib and Hardisty, 2019). Providing high-quality public transportation services is critical to the success of sustainable city logistics, which is why this topic is often debated(White, Habib and Hardisty, 2019). There are two dimensions to service quality, according to Parasuraman and co-workers [51]. Service quality may be defined as the gap between the customer's

expectations and their perceptions that happens throughout the service process, which is part of the exchange and long-term sustainable service business model(Enquist, Edvardsson and Petros Sebhatu, 2007). However, this does not indicate that a service provider must satisfy the client's demands; rather, it means that the customer's expectation is something the customer wants to be supplied by the service provider in a long-term way(Angelova and Zekiri, 2011). An intangible collection of criteria may be used to determine the quality of public transportation services for passenger transportation(Güner, 2018); (Riffat, Powell and Aydin, 2016).

Research shows that passengers value overall time, comfort and cleanliness, accessibility of the service and information, service organisation and safety, conductors' behaviour and expenses, i.e., the fee, more than any other quality factor, according to passengers' perceptions of service quality(Shen *et al.*, 2016).

III. Research Gap

After thorough assessment of prior studies on Urban public transportation it was found that there is no study that aims and measure "Service quality of the urban public transport companies and sustainable city logistics." Therefore, existing research made an effort to fill the gap and conduct an analysis of service quality of the urban public transport companies and sustainable city logistics and extracted variables based on prior studies for existing research, namely, service quality, Accessibility, Information sharing, timely delivery, customer-orientation, safety,environmental monitoring adapted from 54,56.

Research questions

- What are the factors influencing the quality of service of the urban public transport companies to ensure sustainable city logistics?
- What are the results of the evaluation of the quality of service of the selected factors in urban transport companies and sustainable city logistics?
- Which factors were considered the most important and least important in urban transportation firms and sustainable city logistics?

IV. Objectives of the study

- To identify the factors influencing the Service quality of the urban public transport companies.
- To assess the relationship of identified factors of urban public transport companies with sustainable city logistics.
- To proposed a conceptual framework to indicate the relationship of urban public transport companies and sustainable city logistics.

Hypothesis of the study

- H01: There is no relationship among factors of service quality of urban public transport companies with sustainable city logistics.

Ha1: There is relationship among factors of service quality of urban public transport companies with sustainable city logistics.

- H02: There is no relationship among factors of accessibility of urban public transport companies with sustainable city logistics.

Ha2: There is relationship among factors of accessibility of urban public transport companies with sustainable city logistics.

- H03: There is no relationship among factors of information control of urban public transport companies with sustainable city logistics.

Ha3: There is relationship among factors of information control of urban public transport companies with sustainable city logistics.

- H04: There is no relationship among factors of customer-orientation of urban public transport companies with sustainable city logistics.

Ha4: There is relationship among factors of customer-orientation of urban public transport companies with sustainable city logistics.

- H05: There is no relationship among factors of environmental monitoring of urban public transport companies with sustainable city logistics.

Ha5: There is relationship among factors of environmental monitoring of urban public transport companies with sustainable city logistics.

V. Research Methodology

The present study carried out using exploratory analysis, which practices three rounds of internal screening conducted by the researchers in the current study. Firstly, the most critical articles on recent developments of Service quality of the urban public transport companies and sustainable city logistics were selected. The researchers created a flowchart (mentioned in Figure 1) to show their procedures for selecting papers. Second, A survey performed among the employees as respondents of 277 of urban transport companies' logistics department to facilitate the identification of important factors concerning to Service quality of the urban public transport companies and sustainable city logistics. Finally, after assessing both the outcome of former rounds, the conceptual framework for the existing research developed (Fig 2).

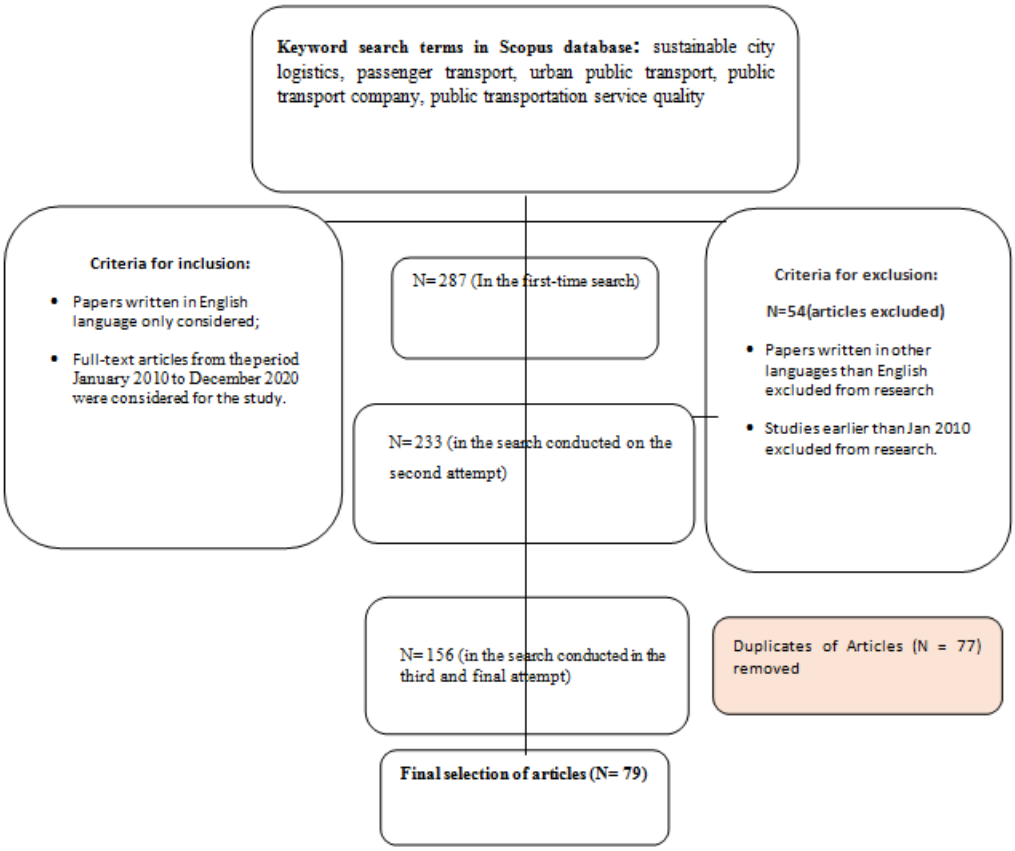


Figure 1: Flowchart Presentation of Selection of Research Articles

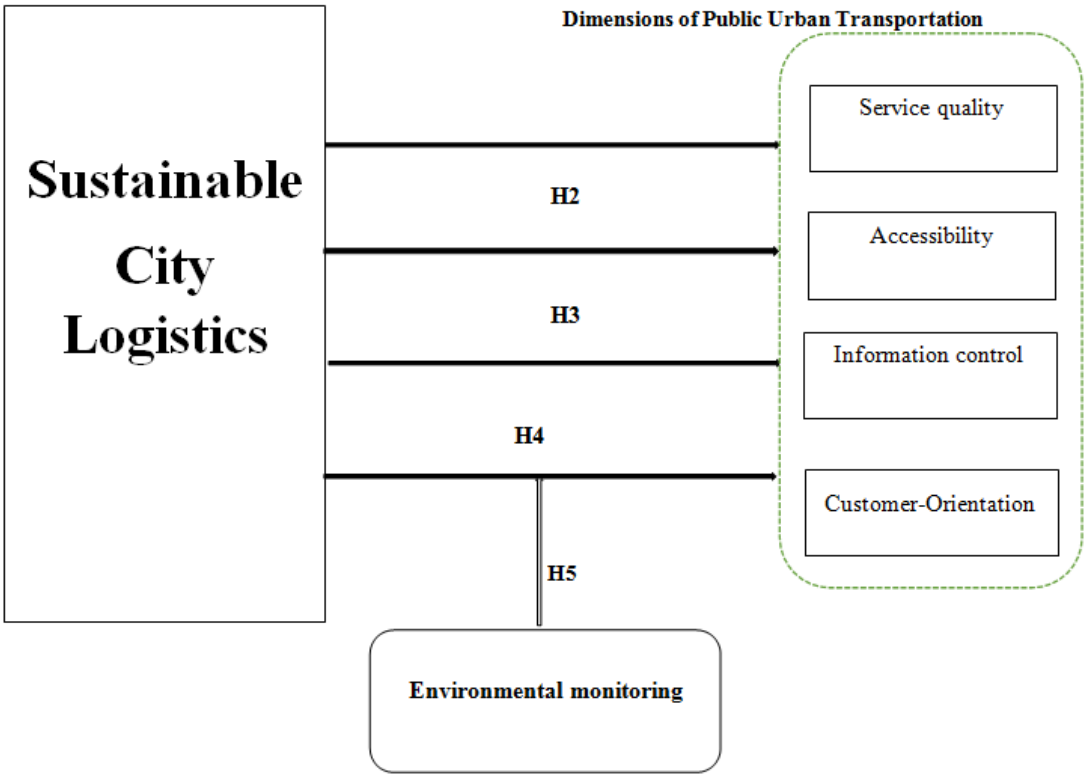


Figure 2: Conceptual Framework of Impact of Public

Result and Discussion

Table 1: Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
.896	18

Table 1,documented a study and stated the assessment of reliability statistics of the study and found that the estimated value of Cronbach Alpha is .896 (N=18), which is greater than the acceptable threshold limitof .60. Therefore, the reliability statistics documented the presence of internal consistency among the variables and thereby led to perform further comprehensive quantitative analysis.

Table 2: Descriptive Statistics

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Reliability	277	1	5	4.34	.642
Consistency	277	1	5	4.36	.664
Timely Delivery	277	1	5	4.34	.723
Dependability	277	1	5	4.41	.668
Responsiveness	277	1	5	4.18	.767
Material Handling	277	1	5	4.39	.630
Inventory Management	277	1	5	4.22	.765
Packaging and distribution	277	1	5	4.27	.720
Availability of accurate data	277	\ 1	5	4.40	.661
Integrity of information	277	1	5	4.36	.654
Confidentiality	277	1	5	4.29	.683
Non-Repudiation	277	1	5	4.19	.709
Customer satisfaction	277	1	5	4.13	.867
Customer retention	277	1	5	4.01	.927
Toxic waste	277	1	5	3.78	1.094
Air quality	277	1	5	4.13	.851
Energy use	277	1	5	4.02	.911
Water scarcity	277	1	5	3.82	1.060
Valid N (listwise)	277				

Table 2,documented a study and stated the assessment of descriptive statistics and identified that “Dependability”

(Mean= 4.41 and Standard Deviation=.668) considered to be the most important Urban transport goods that influence sustainable logistics followed by "Availability of accurate data" (Mean= 4.40 and Standard Deviation=.661). The factor "Toxic waste" considered to be the least important factors perceived by employees of logistics department. Therefore, the descriptive statistics made an important observation that Urban transport goods factors dependability and availability of accurate data are the two prime determinants influencing sustainablelogistics.

Table 3: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.815
Bartlett's Test of Sphericity	Approx. Chi-Square	3048.450
	Df	153
	Sig.	.000

Table 3, depicted the component analysis that was shown to be legitimate by demonstrating its validity using the results of the KMO and the Bartlett test of sphericity. The Kaiser-Meyer-Olkin (KMO) test, which employs two observed variables to analyse a third seen variable, may be used to determine if a sample size is enough.An overall sample size of 277 participants was used in the study, which was large enough that statistical analysis can be performed, however, the results of the Bartlett test of sphericity are also available, and they were determined to be statistically significant.The employment of KMO test statistics serves the aim of assessing a broad range of values, from 0 to 1. The KMO test produces a result with an accuracy of more than 0.50 (n=.815 in the case of present KMO output), and as the value increases, the results improve. Statistical analysis revealed that the sample size was sufficient and that the variables exhibited a significant relationship, which allowed for the construction of the factors to be determined.

Table 4: Principal Component Analysis

Total Variance Explained						
	Initial Eigenvalues			**Extraction Sums of Squared Loadings**		
Components	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
Reliability	6.819	37.881	37.881	6.819	37.881	37.881
Consistency	2.082	11.564	49.445	2.082	11.564	49.445
Timely Delivery	1.397	7.758	57.204	1.397	7.758	57.204
Dependability	1.181	6.561	63.765	1.181	6.561	63.765
Responsiveness	1.029	5.716	69.481	1.029	5.716	73.29
Material Handling	.740	4.111	73.593			
Inventory Management	.720	4.003	77.595			
Packaging and distribution	.657	3.652	81.248			
Availability of accurate data	.598	3.322	84.570			
Integrity of information	.531	2.949	87.519			
Confidentiality	.504	2.797	90.317			
Non-Repudiation	.457	2.541	92.858			
Customer satisfaction	.392	2.177	95.035			
Customer retention	.340	1.886	96.921			
Toxic waste	.278	1.544	98.465			
Air quality	.161	.895	99.360			

Energy use	.064	.354	99.714			
Water scarcity	.052	.286	100.000			
Extraction Method: Principal Component Analysis.						

Table 4, shows the factors and their factor loadings determined using a procedure known as factor analysis. It was possible to explain the greatest amount of variance in the data by using PCA to extract 18 components and rotating the data using the varimax method. The five factors accounted for 73.29% of the total variance. This data reduction technique resulted in the loss of a significant quantity of information, lowering the variance to 26.71 percent.26.71 percent of the variability was accounted for by the first component "Reliability," and 37.881 percent by the second component "Consistency," as determined by Eigenvalue analysis. "Timely Delivery" (6.561) and "Responsiveness" (5.716) together accounted for 11.564% and 7.758% of the total variance. More than 73.29% of the variance was explained by this combination of 18 variables, above the 60% criteria for significance.

Table 5: Exploratory Factor Analysis

Component Matrix[a]					
Dimensions of Urban Transport Logistics	**Component**				
	Service Quality	**Accessibility**	**Information Control**	**Customer-Orientation**	**Environmental monitoring**
Reliability	.642				
Consistency	.639				
Timely Delivery	.583				
Dependability	.629				
Responsiveness	.610				
Material Handling		.669			
Inventory Management		.633			
Packaging and distribution		.622			
Availability of accurate data			.637		
Integrity of information			.666		
Confidentiality			.677		
Non-Repudiation			.654		
Customer satisfaction				.570	
Customer retention				.572	
Toxic waste					.542
Air quality					.585
Energy use					.566
Water scarcity					.454
Extraction Method: Principal Component Analysis.					
a. 5 components extracted.					

From table 5,It may be concluded that the logical and effective reduction of 18 variables to five components was achieved. There are numerous factors that determine sustainable logistics, and the five basic aspects give a fair explanation for their effects on Urban transportation products. These data have been suppressed because loadings of variables below 0.4 were judged insignificant by the authors.

Results showed that "Service Quality" was influenced by five distinct elements. When applied to the sample population, factor loading was.639 at the highest and.583 at the lowest. Accessibility was influenced by three criteria, all of which had varying degrees of significance. There were two factor loadings (the first and final values) set at.669 (Maximum loading) and.622 (Minimum loading), respectively. The "Information Control" category has four variables with observed values of.677 (Maximum loading) and.637 (Control information) (Minimum loading). The "Customer-Orientation" component was set to a maximum loading of.572 and a minimum loading of.570 (Minimum loading). The fifth component was made up of four variables with loadings between.454 and.585 (maximum loading) (Minimum loading).

Confirmatory Factor Analysis (CFA)

In the next step, it is critical to identify whether or not factors are related to their variables. In the confirmatory procedure, the accuracy of the measurement items is first assessed, and then the measurement model is calculated. To illustrate the relationship between the observed variables in a measurement model, a construct is used. Using PLS, it is possible to examine all associations in the model at once since there are so many variables involved.

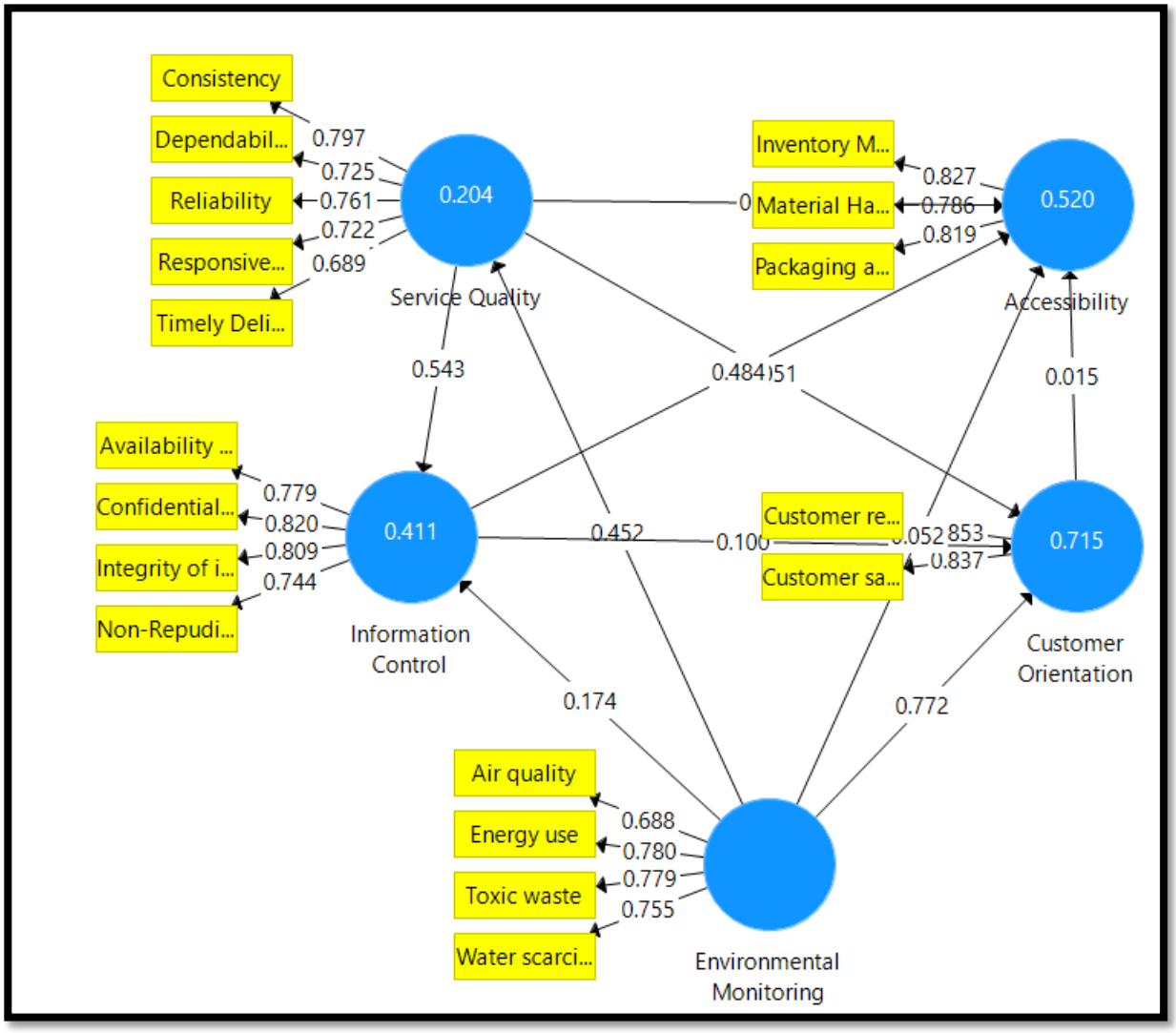


Figure 2: Partial Least Square

Table 6: Confirmatory Factor Analysis

Component Matrix[a]					
Dimensions of Urban Transport Logistics	**Component**				
	Service Quality	**Accessibility**	**InformationControl**	**Customer-Orientation**	**Environmental monitoring**
Reliability	**0.761**				

Consistency	**0.797**				
Timely Delivery					
Dependability	**0.725**				
Responsiveness	**0.722**				
Material Handling		**0.827**			
Inventory Management		**0.795**			
Packaging and distribution		**0.810**			
Availability of accurate data			**0.777**		
Integrity of information			**0.809**		
Confidentiality			**0.820**		
Non-Repudiation			**0.747**		
Customer satisfaction				**0.845**	
Customer retention				**0.844**	
Toxic waste					**0.748**
Air quality					**0.705**
Energy use					**0.801**
Water scarcity					**0.724**
Extraction Method: Principal Component Analysis.					
a. 5 components extracted.					

Table 6, In order to better understand the structure of the measurement model, please see Table 3. Similar findings were found in the Factor Loading Analysis (EFA). Factor loadings bigger than those authorised in exploratory factor analysis are allowed in confirmatory factor analysis. Over 0.7 is the loading (except one). In general, model fit is considered satisfactory if the loadings are over 0.7, which is the threshold for acceptable model fit. Convergent validity was high when the factor loadings were greater than 0.70. It is allowed to use other goodness parameters as long as the measurement model converges.

Table 7:Reliability and convergent validity statistics of measurement model

	Cronbach's Alpha	**Composite Reliability**	**Average Variance Extracted (AVE)**
Accessibility	**0.739**	**0.852**	**0.657**
Customer-orientation	**0.598**	**0.833**	**0.713**
Environmental Monitoring	**0.753**	**0.833**	**0.555**
Information Control	**0.797**	**0.868**	**0.622**
Service quality	**0.792**	**0.858**	**0.547**

In table 7, Confirming the model's dependability and validity is critical once the preceding step has been completed. Cronbach's alpha is a metric for evaluating the consistency of a set of variables. It is assumed that the statements being administered all evaluate the same construct (i.e., the construct is unidimensional) and that observations are independent of each other when giving the Cronbach test. Using Cronbach's alpha, we may observe some interesting results in Table 4. Cronbach's alpha values ranged from.797 to.739, which is a very good result, even if we exclude the importance of customer-oriented variables (0.598).

Composite reliability is an additional, improved metric for assessing trustworthiness (CR). Factor score-based estimates

are better than Cronbach alpha in terms of construct estimation, according to this study There is a range of acceptable CR values between.7 and 1. Construct CR should be more than 0.7 for the best results. According to table 4, the CR values of all four structures are more than or equal to 0.7. The CR for composite dependability was as low as 0.833 at the time.

Table 8: Descriptive Statistics

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Service Quality	277	1	5	4.19	.709
Accessibility	277	1	5	3.78	1.094
Information Control	277	1	5	4.01	.927
Customer-orientation	277	1	5	4.13	.867
Environmental Monitoring	277	1	5	4.13	.851
Valid N (listwise)	277				

Table 8,documented a study and stated the assessment of newly formed variables descriptive statistics and identified that "Service Quality" (Mean= 4.19 and Standard Deviation=.709) considered to be the most important Urban transport goods that influence sustainable logistics followed by "Customer-orientation" (Mean= 4.13 and Standard Deviation=.867) and "Environmental Monitoring" (Mean= 4.13 and Standard Deviation=.851). The factor "Accessibility" considered to be the least important factors perceived by employees of logistics department. Therefore, the descriptive statistics made an important observation that Urban transport goods factors Service Quality and Customer-orientation are the two prime determinants influencing sustainable logistics.

Hypothesis Testing

After applying Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) the findings of the study stated that there exist strong association among the factors of Service quality of the urban public transport companies with sustainable city logistics as KMO bartlett test value (.815) which is also close to 1 and also significant at .000. Also, in EFA cumulative value of total variance explained value is 73.29% which is greater than the acceptable thresholdlimit of 70%. Moreover, the assessment of CFA, value depicted that newly formed constructs Cronbach alpha value is greater than .60 and also in case of composite reliability is greater than .70. Therefore, null hypothesis (H01, H02, H03, H04 and H05) is rejected and alternative hypothesis (Ha1, Ha2, Ha3, Ha4 and Ha5 is accepted.

VI. Conclusion

Cities need innovative, long-term logistical solutions to meet the demands of the on-demand economy in the realm of public transport. These solutions must be environmentally friendly. Service Quality is a possible strategy for ensuring the long-term viability of urban public transportation systems. Using data from India's public urban transportation system, this research examines the economic and environmental consequences of a service-based sustainable logistics system. In order to better understand the perceptions of personnel in the logistics department, a survey is conducted first. Researchers then used Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) to determine the influence and relationship among variables and also thereby try to identify existence of reduction of variables and formation of new constructs for the study, the revenues for public urban transportation firms, and the investment and management expenses for the public urban transportation companies' platform. The research also included an environmental evaluation, which concluded that establishing environmental monitoring has a significant impact on the long-term viability of public urban transportation businesses. The elements of Service Quality and Customer-Orientation, in addition, have a substantial impact on the long-term viability of public urban transportation organisations. More extensive environmental evaluations employing micro-simulation modelling, both accounting for actual traffic circumstances and the availability of commercial bays and comparing conventional vs public transportation-based crowdshipping will be the subject of future research endeavours; (ii) an in-depth examination of both technical needs (for example, the placement and size of parcel lockers) and the necessary cooperation between shippers, logistics operators, and different transportation platform providers; and (iii) a complete investigation of the whole spectrum of key components (e.g., economic, legal, social, and psychological difficulties) that may obstruct the adoption of a successful business mode, conducted via a multidisciplinary method.

References

1. Al-Zoabi, A. Y. and Jarrar, O. M. (2016) 'A sustainable city paradigm: criteria and indicators of efficiency', *The Sustainable City XI*, 1(Sc), pp. 143–159. doi: 10.2495/sc160131.
2. Alyavina, E., Nikitas, A. and Tchouamou Njoya, E. (2020) 'Mobility as a service and sustainable travel behaviour: A thematic analysis study', *Transportation Research Part F: Traffic Psychology and Behaviour*. The Authors, 73, pp. 362–381. doi: 10.1016/j.trf.2020.07.004.
3. Angelova, B. and Zekiri, J. (2011) 'Measuring Customer Satisfaction with Service Quality Using American Customer Satisfaction Model (ACSI Model)', *International Journal of Academic Research in Business and Social Sciences*, 1(3), p. 27. doi: 10.6007/ijarbss.v1i2.35.
4. Bartelmus, P. (2010) 'Use and usefulness of sustainability economics', *Ecological Economics*. Elsevier B.V., 69(11), pp.

2053–2055. doi: 10.1016/j.ecolecon.2010.06.019.
5. Bibri, S. E. (2019) 'On the sustainability of smart and smarter cities in the era of big data: an interdisciplinary and transdisciplinary literature review', *Journal of Big Data*. Springer International Publishing, 6(1). doi: 10.1186/s40537-019-0182-7.
6. Bosona, T. (2020) 'Urban freight last mile logistics—challenges and opportunities to improve sustainability: A literature review', *Sustainability (Switzerland)*, 12(21), pp. 1–20. doi: 10.3390/su12218769.
7. Cheba, K. and Saniuk, S. (2016) 'Sustainable Urban Transport - The Concept of Measurement in the Field of City Logistics', *Transportation Research Procedia*. The Author(s), 16(March), pp. 35–45. doi: 10.1016/j.trpro.2016.11.005.
8. Cosgrove, W. J. and Loucks, D. P. (2015) 'Cosgrove şi Loucks2015-Water_Resources_Research.pdf', *AGU Publications*, 51(2), pp. 4823–4839. doi: 10.1002/2014WR016869.Received.
9. Enquist, B., Edvardsson, B. and Petros Sebhatu, S. (2007) 'Values-based service quality for sustainable business', *Managing Service Quality*, 17(4), pp. 385–403. doi: 10.1108/09604520710760535.
10. Fang, C. and Yu, D. (2017) 'Urban agglomeration: An evolving concept of an emerging phenomenon', *Landscape and Urban Planning*. Elsevier B.V., 162, pp. 126–136. doi: 10.1016/j.landurbplan.2017.02.014.
11. Güner, S. (2018) 'Measuring the quality of public transportation systems and ranking the bus transit routes using multi-criteria decision making techniques', *Case Studies on Transport Policy*, 6(2), pp. 214–224. doi: 10.1016/j.cstp.2018.05.005.
12. Guo, Y. *et al.* (2020) 'The impact of urban transportation infrastructure on air quality', *Sustainability (Switzerland)*, 12(14), pp. 1–23. doi: 10.3390/su12145626.
13. Haghshenas, H. and Vaziri, M. (2012) 'Urban sustainable transportation indicators for global comparison', *Ecological Indicators*. Elsevier Ltd, 15(1), pp. 115–121. doi: 10.1016/j.ecolind.2011.09.010.
14. Kauf, S. (2016) 'City logistics - A Strategic Element of Sustainable Urban Development', *Transportation Research Procedia*. Elsevier B.V., 16(March), pp. 158–164. doi: 10.1016/j.trpro.2016.11.016.
15. Latham, A. and Layton, J. (2019) 'Social infrastructure and the public life of cities: Studying urban sociality and public spaces', *Geography Compass*, 13(7), pp. 1–15. doi: 10.1111/gec3.12444.
16. Lopez, C., Ruiz-Benítez, R. and Vargas-Machuca, C. (2019) 'On the environmental and social sustainability of technological innovations in Urban bus transport: The EU case', *Sustainability (Switzerland)*, 11(5), pp. 1–22. doi: 10.3390/su11051413.
17. Mosaberpanah, M. A. and Khales, S. D. (2013) 'The role of transportation in sustainable development', *ICSDEC 2012: Developing the Frontier of Sustainable Design, Engineering, and Construction - Proceedings of the 2012 International Conference on Sustainable Design and Construction*, (September), pp. 441–448. doi: 10.1061/9780784412688.053.
18. Mucowska, M. (2021) 'Trends of environmentally sustainable solutions of urban last-mile deliveries on the e-commerce market—a literature review', *Sustainability (Switzerland)*, 13(11). doi: 10.3390/su13115894.
19. Naumov, V. *et al.* (2020) 'Optimizing resources of multimodal transport terminal for material flow service', *Sustainability (Switzerland)*, 12(16), pp. 1–13. doi: 10.3390/su12166545.
20. Ogryzek, M., Kmiec, D. A. and Klimach, A. (2020) 'Sustainable Transport An Efficient Transportation Network—Case Study.pdf', *Sustainability*, pp. 1–14.
21. Peter, C. and Swilling, M. (2012) *Sustainable , Resource Efficient Cities – M aking it Happen !*
22. Riffat, S., Powell, R. and Aydin, D. (2016) 'Future cities and environmental sustainability', *Future Cities and Environment*. Future Cities and Environment, 2(0), p. 1. doi: 10.1186/s40984-016-0014-2.
23. Schöder, D., Ding, F. and Campos, J. K. (2016) 'The Impact of E-Commerce Development on Urban Logistics Sustainability', *Open Journal of Social Sciences*, 04(03), pp. 1–6. doi: 10.4236/jss.2016.43001.
24. Shen, X. *et al.* (2016) 'Analysis of bus passenger comfort perception based on passenger load factor and in-vehicle time', *SpringerPlus*. Springer International Publishing, 5(1), pp. 1–10. doi: 10.1186/s40064-016-1694-7.
25. Stopka, O., Bartuska, L. and Kampf, R. (2015) 'Integrirani prijevozni sustavi – Procjena putnika', *Nase More*, 62(3), pp. 153–157. doi: 10.17818/NM/2015/SI12.
26. Tight, M. (2016) 'Sustainable urban transport - The role of walking and cycling', *Proceedings of the Institution of Civil Engineers: Engineering Sustainability*, 169(3), pp. 87–91. doi: 10.1680/jensu.15.00065.
27. Toli, A. M. and Murtagh, N. (2020) 'The Concept of Sustainability in Smart City Definitions', *Frontiers in Built Environment*, 6(June), pp. 1–10. doi: 10.3389/fbuil.2020.00077.
28. Vardoulakis, S. and Kinney, P. (2019) 'Grand Challenges in Sustainable Cities and Health', *Frontiers in Sustainable Cities*, 1(December), pp. 1–5. doi: 10.3389/frsc.2019.00007.
29. Viu-Roig, M. and Alvarez-Palau, E. J. (2020) 'The impact of E-Commerce-related last-mile logistics on cities: A systematic literature review', *Sustainability (Switzerland)*, 12(16). doi: 10.3390/su12166492.
30. White, K., Habib, R. and Hardisty, D. J. (2019) 'How to SHIFT consumer behaviors to be more sustainable: A literature review and guiding framework', *Journal of Marketing*, 83(3), pp. 22–49. doi: 10.1177/0022242919825649.
31. Yigitcanlar, T. *et al.* (2019) 'Can cities become smart without being sustainable? A systematic review of the literature', *Sustainable Cities and Society*. Elsevier B.V., 45, pp. 348–365. doi: 10.1016/j.scs.2018.11.033.

Impact of Organizational Culture on Organizational Citizenship Behavior in IT Sector of India: An Exploratory Study using PLS-SEM

[1] Dr. Bhanupriya Khatri, [2]Dr. Harshita Shrimali, [3]Shaina Arora
[1] Associate Professor, University School of Business, Chandigarh University, Mohali (India)
[2] Professor & HOD, Department of MBA, Geetanjali Institute of Technical Studies, Udaipur, India
[3] Assistant Professor, UITHM, Chandigarh University, Mohali, India

Abstract
IT Sector is serving as the financial backbone of the country, the employees are anticipated to be extremely competent, operative, and creative. Definitive Culture and Organizational Citizenship Behaviour (OCB) are the parts of various leveled advancements and improvements that have gained the uncommonly considered supervisors, subject matter experts, and researchers. Organizational Culture is a significant benefit when it derives fascinating talent and outstripping the competition. Every establishment's culture is different, so it's imperative to hold what makes the organization exclusive. Culture is most huge when trying to achieve association-wide change and Organizational citizenship conduct is a conduct that is utilized to characterize all the hopeful and useful representative exercises and practices that aren't a part of their endorsed set of working responsibilities. The ultimate goal of this analysis quest was to evaluate the effect of working culture on OCB. PLS-Sem was applied to see the outcomes and it showed that there was a gainful result of work culture on OCB of IT specialists.

Keywords: Organizational Citizenship Behavior, Work culture, IT Sector

I. INTRODUCTION

This Only gratified and fulfilled employees will participate in the active working of the association(Chiboiwa et al., 2011). Hierarchical culture is the person and conduct of the association. It is the collection of ethics, prospects, and plays out that control and evaluate the exercises surprisingly of the association. Batman and Organ in the year 1983 coined the term OCB for the primary time and they reflect on it as valuable behavior which hasn't been stated in the job description but the workforces obvious them while gratifying their responsibilities and obligations to aid others. It stands for behaviors that are not a fragment of the recognized necessities of the work but supports the efficiency of effort and voluntary work. Organ's (1988) idea of OCB deals with five behavior categories – all essential for productive establishments and enhancing the effectiveness of the organizations. It has experienced understated definitional reconsiderations since the term was devised in the late 1980s, but the construct relics the identical at its fundamental. OCB is a rationally contemporary organization impression that has activated approximately for three decades. The academic paradigm of Organizational Citizenship Behavior was innovated by Dennis Organ and Ann Smith (Smith et al., 1983). "Organizations need and prerequisite workforces who will put efforts that are not present in any job description. Indication denotes that those establishments that have such workforces outclass those that don't (Podsakoff et al., 2009).

II. Review of Literature

The organizational culture is its nature, charisma and overall behavior. Organizational culture is also described by(Needle, 2004) as the behavior or interface of persons within an association. Organizational culture incorporates four significant develops: overseeing change, accomplishing objectives, organizing cooperation, and building a solid culture. Independently, the designs are upheld or frustrated by the ethics and rules that are gathered by the foundation's partners. These standards and perspectives are strong powers for hierarchical development or let-down.

(Anning-Dorson, 2021) [i] studied how imaginative hierarchical culture and inventive drive produce market versatility for little and medium undertakings (SMEs) in the help region to work on their force. Both moderate culture and association are viewed as firm-level assets arranged for impacting the adaptability of the firm amidst market disturbance. The appraisal battles that SME association firms should involve their internal assets for develop their adaptability limit which is more basic, remarkable, superior and not substitutable. The disclosures suggest that anyway moderate culture and authority might impact a help association's power, It is more possible to consolidate these enterprise-level resources, allowing the market to be more flexible to its effects.

As per the research by (Bogoviz et al., 2019), the accentuation on their work is to pick the association between

different evened out culture and focal characteristics of the planned exertion of dynamic in current business structures and to pick the headings of the heads of certified culture subject to the set standards of dynamic. Thusly, the relationship between authoritative culture and focal points of the pattern of dynamic in current business structures as shown by the norms of the level of incorporation of laborers in powerful is settled.

1 (Zeb et al., 2021), investigated of systems that allow invention seems to be of interest to both professionals and scholars because innovation is the essential input to organizational longevity Thus, there is a developing interest in directing extra investigation into the variables that impact creativity. The revelations showed that the fighting regard structure (CVF) model of legitimate culture might raise inventiveness that implies the headway of PEPCO, which justified limit for everyone relying upon the characteristics made by the lifestyle of the affiliation.

(Olafsen et al., 2021) recommended that future organizations need to zero in on their capacity to adjust to be supportable, and that implies that manageability as an authoritative issue will get more accentuation. Change programs, of course, a significant part of the delayed bomb in view of a shortfall of staff responsibility. The target of this investigation is to see what various leveled culture and individuals arranged for change mean for various types of progress liability. The revelations suggest such advancement obligation didn't differentiate across versatile and stable definitive social orders. This could propose that the force of an affiliation's lifestyle, rather than its insightful, is fundamental for change liability.

(Solomon & Brown, 2020) concluded that organizational culture assumes a significant part in affecting worker consistency with data security approaches. Making a subculture of data security can help with working with consistency. The principle force for this paper is to perceive open entryways for the joining effect of media and data security culture on capable data security consistency. This examination similarly means to clarify the impact of veritable culture on the data security culture.

(Gautam & Basnet, 2021), The reason for this investigation is to analyze the intervening impact of inspiration to move preparing in the middle of five elements of hierarchical culture and preparing move. The results show that motivation to move to get ready generally mediates the association between the four parts of definitive culture and setting up the move. Further, the results moreover show the association among trust and planning move is totally interceded by the motivation to move to get ready.

(V. T. Nguyen et al., 2019), researched the association between hierarchical culture agent definitive obligation and specialist advancement in the Vietnamese IT industry. The results suggest that for the most part authoritative culture and hierarchical obligation are unequivocally and by and large related to agent headway. A more fundamental look uncovers that from authoritative culture's assessments that is mission, versatility and achievement are results in explicitly and all things considered connected with worker headway.

The motivation behind the research study of (Aboramadan et al., 2019) inspected the connections between organizational culture, advancement and banks' presentation in Palestine. The discoveries of the examination show that organizational culture and promoting advancement emphatically affect banks' exhibition. Additionally, it was discovered that advertising execution part of the way intervenes the connection between authoritative culture and banks' presentation

2 (Park & Doo, 2020), The justification for the evaluation is to research the vital institutions amongst authoritative subculture, HR practices, and lady overseers` revolutionary duty and career pleasure in South Korea. The disclosures exhibited that hierarchical subculture actually impacted HR practices and in a roundabout way affected paintings pleasure and valid liability.

3 (Azila-Gbettor et al., 2021) was studied on direct citizenship (OCB) rights as an intervening variable between respect for instrumental work and different enforcement of justice; and the difference in attendance rates between household heads and non-family supervisors for models attending family dormitories. Respect for work clearly impacts OCB and moderate family housing performance. OCB intervenes the connection between regard for work and moderate execution.

(Ashfaq & Hamid, 2020) studied the effect of personal relationship (PO) on job responsibility (WE). The article also investigates the relationship between WE, Citizen Direct Affiliate Individual (OCBI) and Citizen Alliance Primary Affiliate (OCBO). On the balance side, the WE-mediating effect of WE were separately assessed between the matched PO and the OCBI/OCBO.

Drawing on the "substitute for authority" hypothesis, the examination by (Aslam et al., 2021) researches the intervening job of workers between administrative help and representative's authoritative citizenship conduct for the climate. It additionally elucidates the part of natural administration rehearses, an alternative for administrative help in this relationship. The discoveries uncover that administrative help upgrades representative perspectives towards supportive of ecological conduct, which thusly builds workers' propensity to include in organization citizenship conduct for the climate.

The research study by (Suharnomo & Hashim, 2019) plans to look at the impact of occupation inspiration and commitment on OCB of Indonesian and Malaysian representatives. Genuine and public social orders are presented as specialists and OCB as a go-between to examine their affiliations concerning work execution. The outcomes

show that work obligation and occupation inspiration unequivocally sway OCB in Indonesia yet not Malaysia.

The purpose of the research study by (Qi & Armstrong, 2019) is to perceive how mental style assortment influences intra-bunch debate and individual-level authoritative citizenship exercises. The profession of exchange between forerunners and intermediaries is also explored. The results provide general support for our studied relationship between mental stylistic diversity and internal relationship struggle.

The research of (Singh et al., 2020) plans to quantify OCB among staff individuals in the quick purchaser merchandise (FMCG) business, where a superior presentation work framework (HPWS) has been embraced, to all the more likely comprehend worker usefulness.The outcomes show that HPWS impacts OCB. The vast majority of the components of HPWS and OCB were discovered to be emphatically related. The discoveries additionally refute the work interaction hypothesis concerning the investigation.

The goal of the study by (Kissi et al., 2019) was to decide the cooperation between authoritative citizenship conduct, work over-burden and worker efficiency in the Ghanaian development industry, to recognize the slender line among both embracing OCB and overlooking work over-burden to further develop representative execution. The review demonstrated that OCBs decidedly influence worker execution in the development business.

According to (Garg, 2019), Albeit elite execution work rehearses (HPWPs) are considered to have a solid impact over authoritative execution, analysts are not consistent with regards to the specific system through which the effect of HPWS rises above to hierarchical execution. The motivation behind this paper is to investigate two illustrative hypotheses (work attributes hypothesis and mental effect hypothesis) of HRM and inspect their conceivable intercession impact on the connection among HPWPs and hierarchical execution.

Table 1: Insights for Organizational Culture and its influence onOCB

Author/Title/year	Objectives	Findings	Limitations
The influence of organizational culture on corporate accountants' ethical judgement and ethical intention in Vietnam (L. A. Nguyen et al., 2021)	The knowledge this inspects the effect of organizational culture on the moral judgment and moral expectation of corporate bookkeepers in Vietnam.	The findings suggest that social gathering (organized as a family) wins and influences accountants' moral judgment and ethical views. Respondents in subculture study conditions and represent much more morally separate conditions in theocratic and market social orders, but not in inviting cultures. Agents who stress the adhocracy and market social orders show a more relaxed demeanor towards subtle conditions in any case respondents in the chain of significance culture (rule facilitated) show the most raised moral attitude.	The code of ethics, its substance and the way in which it is translated and applied may fluctuate between callings, affiliations or societies.
Organizational culture, leadership behavior and job satisfaction in the Vietnam context (Tran, 2021)	The motivation for this article is to challenge the impact of different types of level cultures on associate leadership and career achievement. The cultural	Chain of command culture adversely associated with relationship-situated initiative conduct. Adhocracy culture emphatically influenced work fulfillment. Group and market societies inconsequential	The outcomes of the study may assist leaders and superiors in selecting an appropriate organizational culture that would actually reduce unhappiness.

	hypothesis is limited to four credits, explicitly, tribe, attraction, composition, and market.	anticipated authority style and occupation fulfillment.	
Let's get everyone involved! The effects of transformational leadership and organizational culture on organizational excellence (Lasrado & Kassem, 2020)	The research study set a powerful connection between groundbreaking administration, organizational culture, and hierarchical greatness to foster a superior comprehension of the easygoing linkages between these three regions.	The vital finding in this investigation recommends that making the association culture gives the comprehensive cooperation and all-encompassing commitment from representatives, which thus prompts hierarchical greatness.	The research focuses on a certain style of leadership, but it can be applied to other styles of leadership as well as different places. The findings of the study build on prior research that revealed that authority was important at first, but that doing so would alter as the culture evolved.
Cultural Encounters: A practice-driven Institutional Approach to the Study of Organizational Culture (Wang & Lounsbury, 2021)	The assessment is performed rather than communicating the honor of planning and the point of view of institutional explanations to integrate the usefulness of preparedness motivated by institutional strategy to face the assessment. cultural values actually bring society back.	Through evaluating seven scenes that we define as "social experiences", the creators track that the combination of silos and the general combination of thoughts increases a sense of temporary relaxation. Time and individuals in complicit relationships sharing common geographic socialization criteria will not have a doubt regarding disposition.	We want to motivate future analysts to research how cultural perspectives and practices penetrate associations in an assortment of ways, both clear and clandestine.
The impacts of corporate social responsibility on	The reason for the review was to perceive how	The outcomes showed that CSR positively affects	In light of social personality

organization citizenship behavior and task performance in hospitality: A sequential mediation model (He et al., 2019)	corporate social obligation (CSR) influences representative hierarchical citizenship conduct (OCB) and work commitment in the neighborliness business. The accessible review centers around the large-scale ramifications of CSR on hierarchical execution.	social character, which thusly impacts worker OCB and subsequently tasks execution. Social personality and OCB play consecutive intercession parts among CSR and errand execution. Moreover, there is a turned around U-shape association among OCB and task execution.	hypothesis, this study shows how and why CSR influences worker OCB and occupation execution. Specifically, there is a successive intervention linkage among CSR and assignment execution. As indicated by the review, neighborliness associations that training
Conservative culture, innovative culture, and innovative performance: a multi-group analysis of the moderating role of the job type (Al-Khatib et al., 2021)	The motivation driving the investigation study was to perceive the impact of various leveled cultural environmrnt by its two assessments (imaginative real culture and moderate culture) on inventive execution.	The results of this assessment show that the inventive authoritative culture will work on imaginative execution and that a conservative culture diminishes progression openings. Additionally, innovative hierarchical culture progresses creative execution for all laborers paying little brain to who stands firm on administrative circumstances.	This cross-sectional study captures a snapshot in time, a methodological restriction that limits the generalizability of the findings.
Organizational culture and project management methodology: research in the financial industry (Piwowar-Sulej,	Progressive cultural surroundings impacts different exercises in affiliations, including project	Project administrators discover organizational culture more significant than target project	Other sectors and organizational culture typologies should be investigated in future research.

2021)	the leaders (PM). The evaluation hopes to respond to the going with examination questions: R Q1: what importance is credited to various leveled culture stood apart from the true endeavor qualities while picking the overwhelming PM structure in affiliations? RQ2: What sort of authentic culture is valued for helpful execution of different PM systems? RQ3: what kind (wanting to be any) of relationship exists between the inescapable kind of different evened out culture in affiliations and the pervasive PM technique?	attributes while picking the prevailing PM system in an association. Though authentic assessment uncovered a tremendous association between the leaned toward kind of definitive culture and PM methodology, there is no gigantic association between the current sort of various leveled culture and the PM theory which wins in the association.	
Employer brand experience and organizational citizenship behavior: mediating role of employee engagement (Gupta et al., 2021)	The objective of the review was to perceive the way in which the business brand insight (EBE) impacts authoritative citizenship conduct (OCB). It likewise endeavors to	EBE was unequivocally connected with OCB. The normal to mediate piece of E E in the connection among EBE and OCB was comparatively kept up with.	The study is limited to the banking industry, which restricts the generalizability of the results.

	decide the job of representative commitment (EE) as an intervening element in the connection among EBE and OCB.		

Linkage of Organizational Culture & Organizational Citizenship Behavior

(Rita et al., 2018) Strong Organizational Responsibility, seen from the emotional, sane, and regulating components can improve Organizational Citizenship Behavior, reflected from the parts of altruism, honesty, sportsmanship, kindness, and urban prudence.

(Yaseen et al., 2015) the study focused on approving organizational culture as an important indicator of organizational citizenship behavior likewise includes scholastic files. Their investigation gave another measurement in breaking down the predecessors of OCB including OC, SI and IJ, henceforth consolidating new belief systems incomprehension of the build.

(Coyne & Ong, 2007), revealed that Segment factors of OCB identified with turnover goal across societies and the measure of OCB displayed is affected by culture. These discoveries highlight the commitment of OCBs to authoritative execution, accepting turnover as contrarily affecting organizational execution.

(Vijayakumar & Padma, 2014), Adhocracy and pecking order societies show a direct specific effect on certain ID modes. Moreover, show the direct unfavorable result on the other three strategies for conspicuous verification. Clan culture shows a weak tendency, Market culture shows no impact certain recognizable proof.

(Mohanty & Rath, 2012), It might be determined that particular part connect with the Culture rehearsed in a Workplace and which have a ton to do with Organizational Citizenship Behavior among the workers. And furthermore observed that Organizational Culture is determinedly recognized emphatically with the parts of Organizational Citizenship Behavior.

(Pham et al., 2018), this study discussed that directing part of the green authoritative culture at the impact of green preparation on OCBE is clarified. It helps representatives to apply their skills and abilities in the natural exercises discretionarily and effectively.

(Wambui, 2018), found that organizational culture is a contributing variable in deciding worker's hierarchical responsibility which is emphatically identified with worker performance. Managers and pioneers were prescribed to foster a solid culture in the association to improve the work of the employees.

(Ebrahimpour et al., 2011) have talked about the association between genuine culture and OCB. They have isolated the indications of different evened out culture into social and fundamental pointers. Thinking about the signs of culture in the Organization (Robbins) and OCB (Batman and Organ), the reasonable examination model was formed.

The hypotheses of the study

1. There is a positive and direct connection between managing change and OCB.
2. There is a positive and direct connection between achieving goals and OCB.
3. There is a positive and direct connection between coordinated Teamwork and OCB.
4. There is a positive and direct connection between customer Orientation and OCB.
5. There is a positive and direct connection between cultural Strength and OCB.

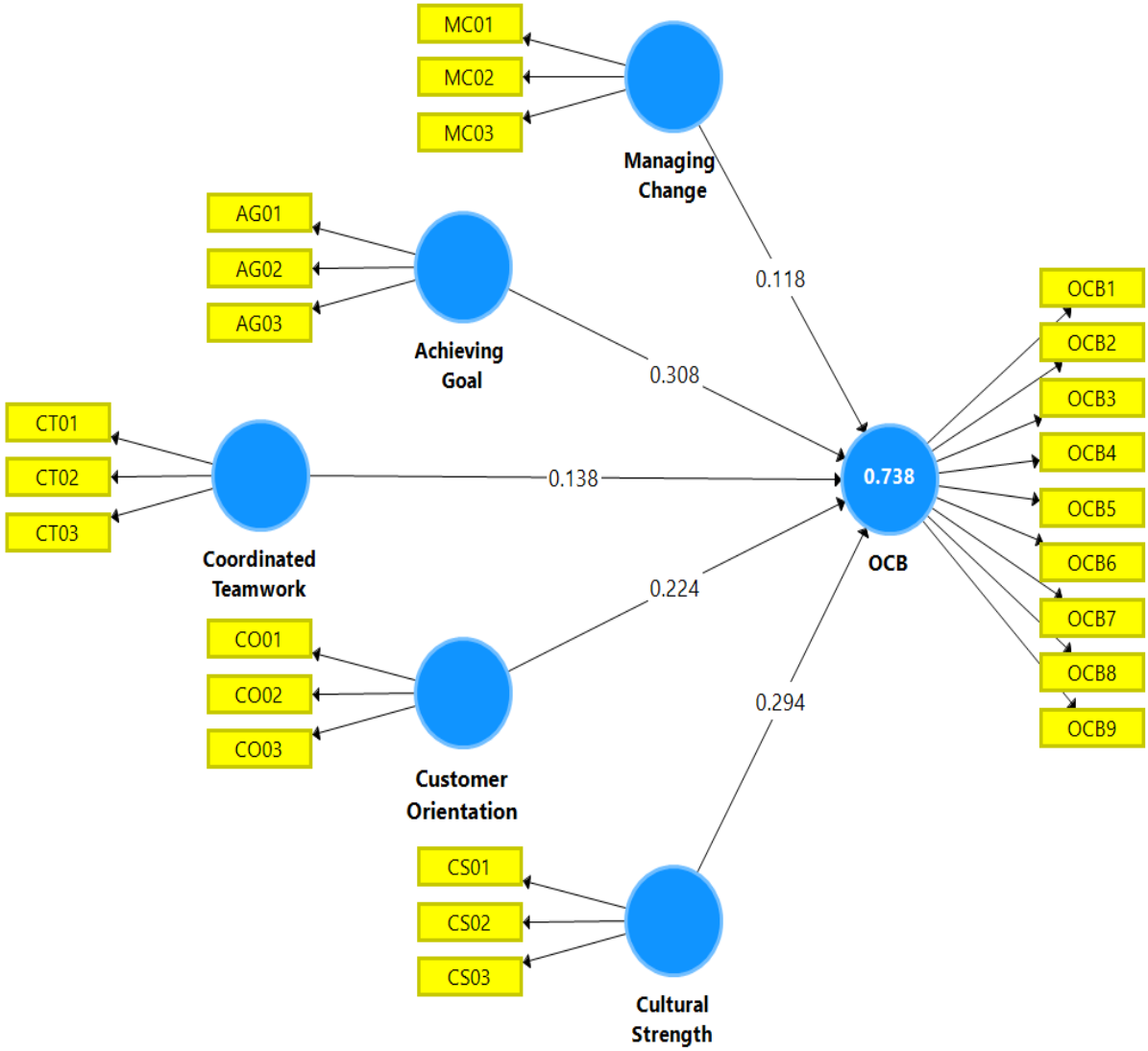


Figure 1: Research Model

Data Analysis

Common Method Variance

(Podsakoff et al., 2003) utilized Harman's single-factor method to check for normal technique inclination prior to continuing on to PLS-SEM examination. The greatest difference depicted by the principal factor was 43.34 percent of the general change, which was not exactly the proposed 50% limit (Podsakoff et al., 2003). Accordingly, normal strategy inclination didn't hinder our exploration.

III. Methods

Data collection utilized for this examination study is controlled utilizing an overview with five-point Likert scales. A google structure for the poll was utilized for the information assortment from IT representatives passed on by an introductory letter. At primary, the link was directed to some IT employees for the pilot survey. After some days, the link was distributed to IT professionals. A conceptual model framework is projected for gaining insights and linkage between organizational culture and OCB. Grounded on the planned framework as publicized in Figure 1, an instrument directed in English was implemented from the former research to collect data to assess the hypotheses.

IV. Results and Discussion

To ascertain the halfway relapse relations in the estimation and underlying model PLS-SEM,(Hair et al., 2011), (Mateos-Aparicio, 2011) has been applied.

Measurement Model

Dependability and legitimacy will be viewed as while assessing the estimation strategy. Composite reliability was utilized to survey inner consistency constancy, while external loadings were utilized to evaluate marker dependability. Moreover, average variance extracted (AVE) was utilized to evaluate united legitimacy (Hair Joseph, Jr., Hult G. Tomas M., Ringle Christian, 2017). Table 2 shows that all composite construct reliability above the recommended benchmark of 0.7 (Gefen et al., 2000), and all AVE has its value more than

the wishful value of 0.5. (Bagozzi & Yi, 1988).

Items with outer loadings of under 0.4 were eliminated as markers. Things with outer loadings of 0.4 to 0.7 ought to possibly be eliminated if they could bring about an expansion in CR and AVE past the predetermined edge esteem.(Hair Joseph, Jr., Hult G. Tomas M., Ringle Christian, 2017).

Table 2: Result of Measurement Model

Construct	Indicator	Loading	rho_A	CR	AVE
Achieving Goals	AG01	0.849	0.780	0.871	0.692
	AG02	0.855			
	AG03	0.791			
Customer Orientation	CO01	0.899	0.855	0.903	0.757
	CO02	0.902			
	CO03	0.807			
Cultural Strength	CS01	0.845	0.852	0.907	0.765
	CS02	0.900			
	CS03	0.878			
Coordinated Teamwork	CT01	0.846	0.805	0.882	0.714
	CT02	0.879			
	CT03	0.808			
Managing Change	MC01	0.848	0.782	0.866	0.684
	MC02	0.786			
	MC03	0.845			
Organizational Citizenship Behavior (OCB)	OCB1	0.810	0.911	0.926	0.581
	OCB2	0.763			
	OCB3	0.789			
	OCB4	0.777			
	OCB5	0.762			
	OCB6	0.740			
	OCB7	0.796			
	OCB8	0.709			
	OCB9	0.707			

Table 3: Fornell and Larcker criteria

	AG	CT	CS	CO	MC	OCB
Achieving Goals (AG)	0.832					
Coordinated Teamwork (CT)	0.448	0.845				
Cultural Strength (CS)	0.565	0.543	0.875			
Customer Orientation (CO)	0.503	0.414	0.613	0.870		

Managing Change (MC)	0.463	0.46	0.552	0.501	0.827	
Organizational Citizenship Behavior (OCB)	0.703	0.583	0.745	0.676	0.599	0.762

The outcome from Table 3 shows that all develops grant the Fornell and Larcker standards. In this way, it shows that there is no discriminant legitimacy issue. The Heterotrait-Monotrait proportion of relationships (HTMT) strategy was utilized to test discriminant validity (Henseler et al., 2015). As seen in Table 4 , All HTMT readings were less than the HTMT 0.90 threshold (Gold et al., 2001). In outline, the estimation model showed satisfactory united and discriminant validity.

Table 4: Heterotrait-Monotrait ratio of correlations (HTMT)

	AG	CT	CS	CO	MC	OCB
Achieving Goals (AG)						
Coordinated Teamwork (CT)	0.565					
Cultural Strength (CS)	0.696	0.654				
Customer Orientation (CO)	0.618	0.501	0.723			
Managing Change (MC)	0.588	0.583	0.667	0.612		
Organizational Citizenship Behavior (OCB)	0.837	0.679	0.845	0.766	0.708	

Structural Model

The issue of collinearity was at first analyzed while concentrating on the primary model. The Variance Inflation Factor (VIF) values comes within 1.448 to 2.416, which are all underneath the 3.33 measure (Diamantopoulos & Siguaw, 2006), showing that this model has no major collinearity issues.

Then, using the bootstrap re-sampling methodology, the strength of the presented hypotheses was determined (320 resamples). Two hypotheses regarding direct links were not validated in Table 4.

Research results exhibited that Overseeing Change, Achieving Goals, Coordinated Teamwork, Customer Orientation and Cultural Strength emphatically connected to OCB, with (β=0.117, t= 2.57, p<0.05), (β=0.304, t= 5.95, p<0.05), (β=0.138, t= 0.049, p<0.05), (β= 0.228, t= 4.697, p<0.05), and (β= 0.296, t= 4.54, p<0.05), respectively.

Table 5: Hypothesis Testing of Relationships

Hypothesis	Relationship	Std. beta	Std. Error	t-value	P-value	Decision
H1	Achieving Goals -> OCB	0.304	0.052	5.953	0.000	In Support
H2	Coordinated Teamwork -> OCB	0.138	0.049	2.837	0.005	In Support
H3	Cultural Strength -> OCB	0.296	0.065	4.537	0.000	In Support
H4	Customer Orientation -> OCB	0.228	0.048	4.697	0.000	In Support
H5	Managing Change -> OCB	0.117	0.046	2.573	0.010	In Support

Next, the R^2 Coefficient of Determination was investigated 0.738% variance of OCB was conjointly explained by the constructs - Managing Change, Achieving Goals, Coordinated Teamwork, Customer Orientation, and Cultural Strength.

Furthermore, (Sullivan & Feinn, 2012) brought up that the p-value alone doesn't reveal the impact size. Cohen's (J., 1988) strategy was utilized to compute the impact size, with upsides of 0.35, 0.15, and 0.02 demonstrating a major, medium, and little impact size, individually.

Meanwhile, achieving goals supported a large effect (.0.220) and cultural strength carried (0.151) in producing R^2 for OCB. While in explanation of OCB, managing change (0.032), coordinated teamwork (0.048), customer orientation (0.108) indicated medium effect size.

Finally, Stone-Q2 Geisser's was used for predictive relevance (Geisser, 1974). The Q2 level of OCB is 0.420 which is higher than 0. As a result, the model proved to be sufficiently predictive.

V. Discussion

This study attempted to be familiar with the variables impacting the authoritative culture on OCB. To determine this issue, an investigation model was made to obtain an unrivalled cognizance of the impact of various leveled culture and OCB in the IT Sector of India. The outcome

showed that the connection between legitimate culture and OCB was basic. This outcome facilitated that OCB was affected by definitive culture.(Laihad & Retnowati, 2018) stated that organizational culture that focuses on security and wellbeing, group arrangement, meticulousness, and great correspondence examples will improve instructor conduct in enduring, and perform errands more than anticipated. Organizational culture has a direct impact on OCB. (STONE, 1974) clarified that a solid organizational culture can't urge workers to improve their exhibition and not have the option to change their conduct towards the association.

VI. Implication

Experts and top management can take advantage of the acquaintance and data shown in this research study, particularly in framing policies and guidelines related to organizational culture. Employees will be benefitted by adopting organizational culture because organizational culture can positively impact OCB. HR managers must be focussed on framing motivational tools and best organizational culture to make Organizational citizenship behavior of employees in a high way as OCB is having a lot of significance of employees, employers and organization.

VII. Conclusion

The research study the findings of the organizational culture on OCB. The consequences show that all the elements of organizational culture have significance on OCB. OCB has crucial influence on establishments usefulness in enhancing employee motivation and gratifying establishments set purposes. Employees can feel comfortable conducting OCB, and organizations can feel comfortable encouraging their employees to do so as well.

References

1. Aboramadan, M., Albashiti, B., Alharazin, H., & Zaidoune, S. (2019). Organizational culture, innovation and performance: a study from a non-western context. *Journal of Management Development*, *39*(4), 437–451. https://doi.org/10.1108/JMD-06-2019-0253
2. Al-Khatib, A. W., Al-Fawaeer, M. A., Alajlouni, M. I., & Rifai, F. A. (2021). Conservative culture, innovative culture, and innovative performance: a multi-group analysis of the moderating role of the job type. *International Journal of Innovation Science*, *ahead-of-p*(ahead-of-print). https://doi.org/10.1108/IJIS-10-2020-0224
3. Anning-Dorson, T. (2021). Organizational culture and leadership as antecedents to organizational flexibility: implications for SME competitiveness. *Journal of Entrepreneurship in Emerging Economies*, *ahead-of-p*(ahead-of-print). https://doi.org/10.1108/JEEE-08-2020-0288
4. Ashfaq, B., & Hamid, A. (2020). Person-organization fit and organization citizenship behavior: modeling the work engagement as a mediator. *Asia-Pacific Journal of Business Administration*, *13*(1), 19–39. https://doi.org/10.1108/APJBA-12-2019-0255
5. Aslam, H., Azeem, M. U., Bajwa, S. U., Ramish, A., & Saeed, A. (2021). Developing organizational citizenship behavior for the environment: the contingency role of environmental management practices. *Management Decision*, *ahead-of-p*(ahead-of-print). https://doi.org/10.1108/MD-05-2020-0549
6. Azila-Gbettor, E. M., Blomme, R. J., Kil, A., & Honyenuga, B. Q. (2021). *Work Values and Organizational Performance: The Mediation Effect of Organization Citizenship Behavior in Family Hotels in Emerging Markets* (pp. 37–63). https://doi.org/10.1108/S1745-354220200000016005
7. Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, *16*(1), 74–94. https://doi.org/10.1007/BF02723327
8. Bogoviz, A. V., Malinovski, L. F., Stroiteleva, T. G., Sharamko, M. M., & Dvoretskaya, V. V. (2019). Connection between Organizational Culture and Specifics of the Process of Decision Making in Modern Business Systems. In *Specifics of Decision Making in Modern Business Systems* (pp. 123–130). Emerald Publishing Limited. https://doi.org/10.1108/978-1-78756-691-020191012
9. Chiboiwa, M., Chipunza, C., Samuel, M. O., & Africa, S. (2011). Evaluation of job satisfaction and organizational citizenship behavior: Case study of selected organisations in Zimbabwe. *African Journal of Business Management*, *5*.
10. Coyne, I., & Ong, T. (2007). Organizational citizenship behavior and turnover intention: a cross-cultural study. *The International Journal of Human Resource Management*, *18*(6), 1085–1097. https://doi.org/10.1080/09585190701321831
11. Diamantopoulos, A., & Siguaw, J. A. (2006). Formative Versus Reflective Indicators in Organizational Measure Development: A Comparison and Empirical Illustration. *British Journal of Management*, *17*(4), 263–282. https://doi.org/10.1111/j.1467-8551.2006.00500.x
12. Ebrahimpour, H., Zahed, A., Khaleghkhah, A., & Sepehri, M. B. (2011). A Survey Relation Between Organizational Culture and Organizational Citizenship Behavior. *Procedia - Social and Behavioral Sciences*, *30*, 1920–1925. https://doi.org/10.1016/j.sbspro.2011.10.373
13. Garg, N. (2019). High performance work practices and organizational performance-mediation analysis of explanatory theories. *International Journal of Productivity and Performance Management*, *68*(4), 797–816. https://doi.org/10.1108/IJPPM-03-2018-0092
14. Gautam, D. K., & Basnet, D. (2021). Organizational culture for training transfer: the mediating role of motivation. *International Journal of Organizational Analysis*, *29*(3), 769–787. https://doi.org/10.1108/IJOA-04-2020-2147
15. Gefen, D., Straub, D., & Boudreau, M.-C. (2000). Structural Equation Modeling and Regression: Guidelines for Research Practice. *Commun. Assoc. Inf. Syst.*, *4*, 7.
16. Geisser, S. (1974). A Predictive Approach to the Random Effect Model. *Biometrika*, *61*(1), 101. https://doi.org/10.2307/2334290
17. Gold, A., Malhotra, A., & Segars, A. (2001). Knowledge Management: An Organizational Capabilities Perspective. *J. of Management Information Systems*, *18*, 185–214.
18. Gupta, S., Bhasin, J., & Mushtaq, S. (2021). Employer brand experience and organizational citizenship behavior: mediating role of employee engagement. *Asia-Pacific Journal of Business Administration*, *ahead-of-p*(ahead-of-print). https://doi.org/10.1108/APJBA-08-2020-0287
19. Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a Silver Bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139–152. https://doi.org/10.2753/MTP1069-6679190202

20. Hair Joseph, Jr., Hult G. Tomas M., Ringle Christian, S. M. (2017). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)* (2nd ed.). Sage.
21. He, J., Zhang, H., & Morrison, A. M. (2019). The impacts of corporate social responsibility on organization citizenship behavior and task performance in hospitality. *International Journal of Contemporary Hospitality Management*, *31*(6), 2582–2598. https://doi.org/10.1108/IJCHM-05-2018-0378
22. Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8
23. J., C. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). NJ Lawrence Erlbaum Associates.
24. Kissi, E., Asare, O. A., Agyekum, K., Yamoah Agyemang, D., & Labaran, M. (2019). Ascertaining the interaction effects among organizational citizenship behavior, work overload and employees' performance in the Ghanaian construction industry. *International Journal of Productivity and Performance Management*, *68*(7), 1235–1249. https://doi.org/10.1108/IJPPM-07-2018-0262
25. Laihad, G. H., & Retnowati, R. (2018). The Effect of Organizational Culture And Decision Making Toward Organizational Citizenship Behavior of Teacher in Pre-School. *JETL (Journal Of Education, Teaching and Learning)*, *3*(1), 155. https://doi.org/10.26737/jetl.v3i1.662
26. Lasrado, F., & Kassem, R. (2020). Let's get everyone involved! The effects of transformational leadership and organizational culture on organizational excellence. *International Journal of Quality & Reliability Management*, *38*(1), 169–194. https://doi.org/10.1108/IJQRM-11-2019-0349
27. Mateos-Aparicio, G. (2011). Partial Least Squares (PLS) Methods: Origins, Evolution, and Application to Social Sciences. *Communications in Statistics - Theory and Methods*, *40*(13), 2305–2317. https://doi.org/10.1080/03610921003778225
28. Mohanty, J., & Rath, B. P. (2012). Influence Of Organizational Culture On Organizational Citizenship Behavior: A Three-Sector Study. *GLOBAL JOURNAL OF BUSINESS RESEARCH*, *6*(1), 65–71.
29. Needle, D. (2004). *Business in Context: An Introduction to Business and Its Environment*.
30. Nguyen, L. A., Dellaportas, S., Vesty, G. M., Pham, V. A. T., Jandug, L., & Tsahuridu, E. (2021). The influence of organizational culture on corporate accountants' ethical judgement and ethical intention in Vietnam. *Accounting, Auditing & Accountability Journal*, *ahead-of-p*(ahead-of-print). https://doi.org/10.1108/AAAJ-05-2020-4573
31. Nguyen, V. T., Siengthai, S., Swierczek, F., & Bamel, U. K. (2019). The effects of organizational culture and commitment on employee innovation: evidence from Vietnam's IT industry. *Journal of Asia Business Studies*, *13*(4), 719–742. https://doi.org/10.1108/JABS-09-2018-0253
32. Olafsen, A. H., Nilsen, E. R., Smedsrud, S., & Kamaric, D. (2021). Sustainable development through commitment to organizational change: the implications of organizational culture and individual readiness for change. *Journal of Workplace Learning*, *33*(3), 180–196. https://doi.org/10.1108/JWL-05-2020-0093
33. Park, S., & Doo, M. Y. (2020). The effect of organizational culture and HR practices on female managers' commitment and job satisfaction. *European Journal of Training and Development*, *44*(2/3), 105–120. https://doi.org/10.1108/EJTD-03-2019-0045
34. Pham, N. T., Phan, Q. P. T., Tučková, Z., Vo, N., & Nguyen, L. H. L. (2018). Enhancing the organizational citizenship behavior for the environment: the roles of green training and organizational culture. *Management & Marketing*, *13*(4), 1174–1189. https://doi.org/10.2478/mmcks-2018-0030
35. Piwowar-Sulej, K. (2021). Organizational culture and project management methodology: research in the financial industry. *International Journal of Managing Projects in Business*, *ahead-of-p*(ahead-of-print). https://doi.org/10.1108/IJMPB-08-2020-0252
36. Podsakoff, N. P., Whiting, S. W., Podsakoff, P. M., & Blume, B. D. (2009). Individual- and organizational-level consequences of organizational citizenship behaviors: A meta-analysis. *Journal of Applied Psychology*, *94*(1), 122–141. https://doi.org/10.1037/a0013079
37. Qi, M., & Armstrong, S. J. (2019). The influence of cognitive style diversity on intra-group relationship conflict, individual-level organizational citizenship behaviors and the moderating role of leader-member-exchange. *International Journal of Conflict Management*, *ahead-of-p*(ahead-of-print). https://doi.org/10.1108/IJCMA-09-2018-0105
38. Rita, M., Randa Payangan, O., Rante, Y., Tuhumena, R., & Erari, A. (2018). Moderating effect of organizational citizenship behavior on the effect of organizational commitment, transformational leadership and work motivation on employee performance. *International Journal of Law and Management*, *60*(4), 953–964. https://doi.org/10.1108/IJLMA-03-2017-0026
39. Singh, J. P., Chand, P. K., Mittal, A., & Aggarwal, A. (2020). High-performance work system and organizational citizenship behavior at the shop floor. *Benchmarking: An International Journal*, *27*(4), 1369–1398. https://doi.org/10.1108/BIJ-07-2019-0339
40. Smith, C. A., Organ, D. W., & Near, J. P. (1983). Organizational citizenship behavior: Its nature and antecedents. *Journal of Applied Psychology*, *68*(4), 653–663. https://doi.org/10.1037/0021-9010.68.4.653
41. Solomon, G., & Brown, I. (2020). The influence of organizational culture and information security culture on employee compliance behavior. *Journal of Enterprise Information Management*, *ahead-of-p*(ahead-of-print). https://doi.org/10.1108/JEIM-08-2019-0217
42. STONE, M. (1974). Cross-validation and multinomial prediction. *Biometrika*, *61*(3), 509–515. https://doi.org/10.1093/biomet/61.3.509
43. Suharnomo, S., & Hashim, F. (2019). Differences in organization citizenship behavior between "serumpun" countries (Indonesia – Malaysia). *Journal of Asia Business Studies*, *13*(3), 349–361. https://doi.org/10.1108/JABS-12-2016-0178
44. Sullivan, G. M., & Feinn, R. (2012). Using Effect Size—or Why the P Value Is Not Enough. *Journal of Graduate Medical Education*, *4*(3), 279–282. https://doi.org/10.4300/JGME-D-12-00156.1
45. Tran, Q. H. N. (2021). Organizational culture, leadership behavior and job satisfaction in the Vietnam context. *International Journal of Organizational Analysis*, *29*(1), 136–154. https://doi.org/10.1108/IJOA-10-2019-1919
46. Vijayakumar, V. S. R., & Padma, R. N. (2014). Impact of perceived organizational culture and learning on organizational identification. *International Journal of Commerce and Management*, *24*(1), 40–62. https://doi.org/10.1108/IJCoMA-01-2012-0003

47. Wambui, L. N. (2018). IMPACT OF ORGANIZATIONAL CULTURE ON ORGANIZATIONAL COMMITMENT. *Strategic Journal of Business & Change Management*, *5*.
48. Wang, M. S., & Lounsbury, M. (2021). *Cultural Encounters: A Practice-Driven Institutional Approach to the Study of Organizational Culture* (pp. 165–198). https://doi.org/10.1108/S0733-558X20200000071007
49. Yaseen, A., Liaquat, M., & Ul, M. (2015). *IMPACT OF ORGANIZATIONAL CULTURE AND SOCIAL INFLUENCE ON ORGANIZATIONAL CITIZENSHIP BEHAVIOR WITH MEDIATING EFFECT OF INTERACTIONAL JUSTICE*. *27*, 2443–2450.
50. Zeb, A., Akbar, F., Hussain, K., Safi, A., Rabnawaz, M., & Zeb, F. (2021). The competing value framework model of organizational culture, innovation and performance. *Business Process Management Journal*, *27*(2), 658–683. https://doi.org/10.1108/BPMJ-11-2019-0464

The Impact of Human Resource Management Practices on Employee Retention

Lwin, N.N
Horizons University, Paris

Abstract
Human resource management practices become the major issues for all organizations because the human workforces are the great assets of both manufacturing and services sectors. Effective HRM practices bring the organizational benefits, including profitability, reputation, and employee retention. Employees' retention is the significant business problem for all companies. The current study focuses on the HRM practices, and its impact on employees' retention at cement manufacturing factories in Myanmar. The results show that HRM practices have a significant direct impact on employees' retention.

Keywords
Human Resource Management Practices, Employees' Retention, Cement Factories, Myanmar

INTRODUCTION

Human resource management is an essential consequence of beginning and growing a business [1]. The practices, procedures, and policies that influence employee behavior, performance, and retention are referred to as human resource management (HRM). Talent acquisition, training and development, rewards and recognitions, performance management, and health and safety are the five important Human Resource Management practices. Talent acquisition has a statistically significant impact on the intention to stay [2]. Talent acquisition plays an essential role in retaining talented staff in every organization. HRM practices include training and development, in which companies spend on the growth of their employees' knowledge, skills, abilities, and other essential capabilities in order to increase production [3]. The intention of an employee to stay in the organization is strongly linked to training and development. The reward and recognition policies have a big influence on whether employees would like to stay [4]. When employees are satisfied with the regular incentive and recognition package provided by the organization, they are more certain to choose to stay in the job and enhance extra-role performance.

Performance appraisal has a strong connection to the intention to stay [5]. A lack of performance appraisal has a negative impact on employee motivation and contribute to employee turnover intentions [6]. Therefore, performance appraisal is an important part of HRM practices that might influence employee retention. The safety literature defines safety climate as a collection of beliefs and expectations that employees have about their workplace's safety [7]. Organizations have used human resource practices to improve their performance, productivity especially in terms of retention. A well-structure HRM practices assist to keep the employee in the organization and also lower the turnover rate.

HRM practices are an organization's most valuable asset because they are the source of competitive advantage. Once employees are satisfied with the job, they will be more committed to their work and the organization, and their performance, productivity, and desire to stay with the organization will all grow. Employees typically leave due to job dissatisfaction, a lack of supervisory help and feedback, a lack of training and development, and inefficient pay [8]. Employee retention is critical for the firm's economic success since an organization may devote more time to creating and less time to training them [9]. Employees may have a positive or negative attitude toward individual work duties, products or services, colleagues or management, or the organization in the workplace. Employee retention is critical for every organization's long-term growth and success. Organizations today must compete not only with external competitors, but also with internal employee retention.

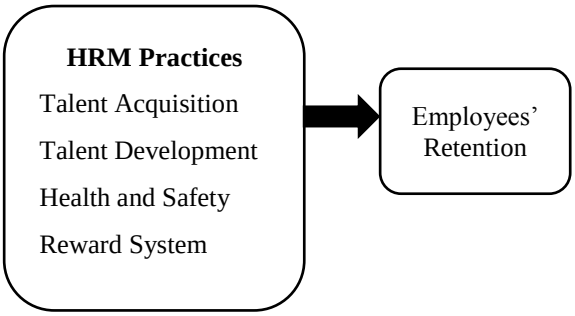


Figure (1): Conceptual Framework

MOTIVATION OF THE STUDY

Most of the organizations are incorporating HRM practices into their operations because of the positive impact HRM practices have on employee retention. Retention is a complex aspect of an organization's human resource practices. Employee retention is one of the most difficult challenges

that any organization has, resulting in a higher employee turnover rate. Both excessively high and low turnover rates have a negative impact on the organization's success and productivity [10]. Employers must develop a workplace that supports performance, productivity, and retention in order to face the challenge of achieving a competitive edge. Employee retention depends on management/leadership abilities and human resource strategies.

Myanmar, being a developing country, is taking a long time to adapt to Human Resource Management practices in the workplace. Manufacturing industries get a significant competitive advantage in the current environment by implementing effective human resource practices. The implementations of excellent HRM practices can assist the employee retention effectively. This article highlights in manufacturing sectors that use HRM practices and how their employee retention is influenced by it.

OBJECTIVES OF THE STUDY

i. To define the employees' perception on HRM practices, and
ii. To analyze the impact of HRM practices on employees' retention among the employees at Cement Manufacturing Industry in Myanmar.

STATEMENT OF METHODS

The purpose of current study is to analyze the impact of HRM practices on employees' retention at Cement manufacturing industries in Myanmar. The quantitative research method is carried out to accomplish the research objectives. The conduct organizations are cement manufacturing industries where a minimum of 200 staff are employed. The researcher selected randomly three factories and send the request letter to get an allowance of research. A total of 700 employees are working at selected industries. The sample size is calculated using Yamane's formula (known population size). A total of 255 employees need to take part in current study. The sample random sampling method is used to select the sample from the population frame. The data are collected using the self-administered questionnaire which composed of (1) socio-demographic factors, and (2) HRM practices and employees' retention questions. The second part is developed from previous related articles. Talent acquisition, training and development, health and safety at work, and reward system are independent variables, and the employee's retention is dependent variables. The data are analyzed using the SPSS software.

RESULTS

The collected data are transferred from the hard-copy questionnaire to Microsoft Excel sheet, and then, code and enter the statistical software (SPSS-version 25). The frequency tables, descriptive statistics, and inferential tests are used.

Table (1) shows that 61.2% of respondents are male, and 38.8% are female workers. Over half of the respondents (62.7%) aged 24 to 29 years, 31% aged 30 to 35 years, and only 6.3% aged between 36 and 41 years.

Table (1): Personal Factors of Respondent

		Frequency	Percent
Gender	Male	156	61.2
	Female	99	38.8
Age	24 to 29 years	160	62.7
	30 to 35 years	79	31.0
	36 to 41 years	16	6.3

Table (2) presents the descriptive statistics of HRM practices and employees' retention. The average mean score of HRM practice is 0.382, and standard deviation score is 0.76. The took part employees have positive perception on the HRM practices (talent acquisition, talent training, health and safety policy at work, and organizational reward system). However, the respondents point out the organization is weak in employees' training and monetary reward systems. The cement factories need to emphasis in planning staff training and development programs, including the health and safety training at work.

Table (2): Descriptive Statistics

	Mean	Std. Deviation
Talent Acquisition		
Selecting the right people for the right positions.	3.91	0.63
Forecast the human resource needs.	3.76	0.74
Providing relevant and adequate job information.	3.94	0.67
Fair recruitment	3.91	0.74
Transparent planning and recruitment	3.90	0.77
Talent Training		
Identifying needs for training	3.95	0.74
The right person at the right job after the training.	3.92	0.68
Plan for the training programs.	3.75	0.79
Training includes general problem-solving skills, social skills, and broad information	3.77	0.78
Encouraged to participate in various seminars	3.84	0.74
Health and Safety at Work		
Effective occupational health and safety policy	3.84	0.73
Implement occupational health and safety policy	3.81	0.84

Proper channels for reporting safety concerns	3.85	0.79
Committee for safety and health training	3.55	0.88
Comprehensive training regarding work place health and safety issues	3.65	0.83
Rewards System		
Fair rewards and recognition	3.82	0.77
Monetary rewards for performance are fair	3.84	0.75
Satisfied with the monetary rewards	3.75	0.82
Excellent monetary rewards	3.86	0.74
Fair non-monetary rewards	3.82	0.79
Average HRM practice	**3.82**	**0.76**

Table (3) shows the correlation between HRM practices and employees' retention. According to results, HRM practices (talent acquisition, talent development, health and safety and reward system) have positive significant impact on the employees' retention (Pearson's r = .590, .655, .658, and .807 respectively). The results approved that the employees' retention will increase when the organization provides effective HRM practices.

Table (3): Pearson's Correlation between HRM practices and Employees' Retention

Correlations

		Retention	Talent Acquisition	Talent Development	Health and Safety	Reward System
Retention	Pearson Correlation	1	.590**	.655**	.658**	.807**
	Sig. (2-tailed)		.000	.000	.000	.000
Talent Acquisition	Pearson Correlation		1	.647**	.549**	.594**
	Sig. (2-tailed)			.000	.000	.000
Talent Development	Pearson Correlation			1	.715**	.719**
	Sig. (2-tailed)				.000	.000
Health and Safety	Pearson Correlation				1	.695**
	Sig. (2-tailed)					.000
Reward System	Pearson Correlation					1
	Sig. (2-tailed)					

**. Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION AND CONCLUSION

The findings of current study concluded that the employees have positive perception on organizational HRM practices at cement manufacturing factories in Myanmar. The HRM practices have a direct significant impact on the employees' retention. The employees will stay in the current working organization for long time when they perceive positive organizational HRM practices. The HRM practices become the primary causes of employees' motivation, satisfaction and also the retention. Employees' retention reduces the extra business costs, and increase the profitability. Kakar, Palwasha, Abdul Raziq, and Faisal Khan supported the findings of current study. The authors found that the positive impact of HRM practices on employees' retention. The employers and managers need to emphasis on implementing effective HRM practices to achieve employees' retention.

REFERENCE

1. Boxall, Peter F., John Purcell, and Patrick M. Wright, eds. The Oxford handbook of human resource management. Oxford University Press on Demand, 2007.
2. Gamage, Aruna S. "Organizational Citizenship Behaviour among Employees in SMEs in Japan: An Analysis of the Link with HRM Practices." In Proceedings of International Conference on Business Management, vol. 10, pp. 129-140. 2014.
3. Gamage, Aruna S. "Organizational Citizenship Behaviour among Employees in SMEs in Japan: An Analysis of the Link with HRM Practices." In Proceedings of International Conference on Business Management, vol. 10, pp. 129-140. 2014.
4. Zin, Md Lazim Bin Mohd. "The mediating role of perceived organizational support on the relationship between pay and intention to stay." Management Review: An International Journal 12, no. 1 (2017): 57.
5. Ghazali, Hazrina, Nasyira Mohd Nasyuki, Xiao Yi Oon, and Maisarah Ishak. "Human resource practices and employees' intention to stay in the Kuala Lumpur hotel industry/Dr. Hazrina Ghazali…[et al.]." Journal of Tourism, Hospitality & Culinary Arts 4, no. 1 (2012): 88-118.
6. Abdullah, Arham, Abdulquadri Ade Bilau, Akintunde M. Ajagbe, and S. A. Bustani. "Small and medium sized construction firms job satisfaction and performance evaluation in Nigeria." the International Doctorial Fellowship (IDF) and the Research University Grant (2011).
7. Neal, Andrew, Mark A. Griffin, and Peter M. Hart. "The impact of organizational climate on safety climate and individual behavior." Safety science 34, no. 1-3 (2000): 99-109.
8. Kemelgor, Bruce H., and William R. Meek. "Employee retention in growth-oriented entrepreneurial firms: An exploratory study." Journal of Small Business Strategy 19, no. 1 (2008): 55-68.
9. Vasquez, Dario. "Employee retention for economic stabilization: A qualitative phenomenological study in the hospitality sector." International Journal of Management, Economics and Social Sciences (IJMESS) 3, no. 1 (2014): 1-17.
10. Croucher, Richard, Geoff Wood, Chris Brewster, and Michael Brookes. "Employee turnover, HRM and institutional contexts." Economic and Industrial Democracy 33, no. 4 (2012): 605-620.
11. Kakar, Palwasha, Abdul Raziq, and Faisal Khan. "Impact of human resource management practices on employee retention: A case of banking sector in Quetta Baluchistan." Journal of Management Info 5, no. 1 (2015): 97-119

Employees Job Satisfaction and Retention at Workplace

Htun, W.T
Lincoln University College, Malaysia

Abstract
All companies rely on effective management of human resource. Satisfied employees are the backbone of the business. Dissatisfied workers intended to leave the job as early as possible, or change to other workplace or professionals. The increase rate of employees' turnover becomes the thread for all organizations. The employees' satisfaction and retention link directly with each other. When the employees satisfy their jobs, they become motivate, and stay in organization for long-term. The satisfied workers are the great assets and also the retention reduces the extra costs of recruitment, selection, and training. The current study analyzes the employees' satisfaction and retention among the middle-level management employees at Sugar factories in Myanmar.

Keywords
Job satisfaction, Employee retention, Middle-level Management Employees, Sugar Factories, Myanmar

INTRODUCTION

In all organizations, human resources are the lifeblood for long-term success. Globalization and technology advancement have caused many organizations to be more competitive. Workers become the major assets for all firms to survive and compete. Organizations emphasis on the employee's satisfaction, because the dissatisfied workers quit the jobs or move to other professionals. Employees' retention becomes the great issue for all business firms. The administrative teams and owners notice the employee job satisfaction and retention as the major concerns in getting sustainable competitive advantage. Employers attract the best talents and also keep employees on the job for a long term [1]. Employees stay or leave organizations for many reasons, including the personal and professional issues. Employees who are happy with their jobs are more dedicated and work for an organization's growth. If employees satisfy at their jobs, then they will stick and work for the organization.

Workplace satisfaction is defined as a combination of positive and negative feelings about one's work. Job satisfaction is a measure of how realistic expectations are compared to actual rewards. Job satisfaction can also be defined as an individual's general attitude toward her or his particular occupation [2]. Particular job satisfaction has a significant influence on employee commitment, turnover, absenteeism, tardiness, accidents, and grievances [3]. Employees who are dissatisfied with their jobs are more likely to be absent [4]. Job satisfaction is a critical component of employee retention, which can only achieve by making employees physically and psychologically comfortable. Employees' Job satisfaction plays a vital role in organization success. There are many factors that effects Employee Job Satisfaction.

(**i) Compensation**: Compensation refers to the bonuses given to employees in order to provide them with financial benefits. At workplace, the salary becomes the primary factor of employees' motivation and satisfaction [5]. The high-pay employees satisfy and perform their tasks well compared with low-paid employees.

(ii) Job Content: The prolong working hours and complex and complicated job contents lead the employees to be dissatisfied and intention to leave the job as early as possible. Job autonomy is a decisive factor in job satisfaction and retention.

(**iii) Supervision:** Employees' perceptions of an organization are influenced by their relationship with their supervisor. Supervision must be fair and consistent. Supervision results present or absent of employees from job.

(iv) Job Promotion and Career development: The lack of promotion and training possibilities drives brilliant employees to leave the company [6].

(**v) Supportive environment**: Employee satisfaction and retention influence by a pleasant work environment [7]. A supportive workplace is defined as a flexible environment in which working is joyful and adequate resources are available.

Employee retention refers to keeping or encouraging employees to stay with a company for as long as possible. Employee retention is becoming more challenging as the skill pool becomes increasingly depleted. The high turnover of employees in the organization increases the cost of hiring new workforce and decreases the productively. An organization can gain the competitive advantage because of keeping of qualified, productive and loyal work force [8]. Employee retention is often viewed as a factor that results in a company's financial performance [9]. Increased turnover has an indirect cost as a burden on the existing personnel, a loss of human capital, and low morale. The current study aims to analyze the impact of employees' satisfaction on employees' retention among the middle-level management employees at Sugar factories in Myanmar.

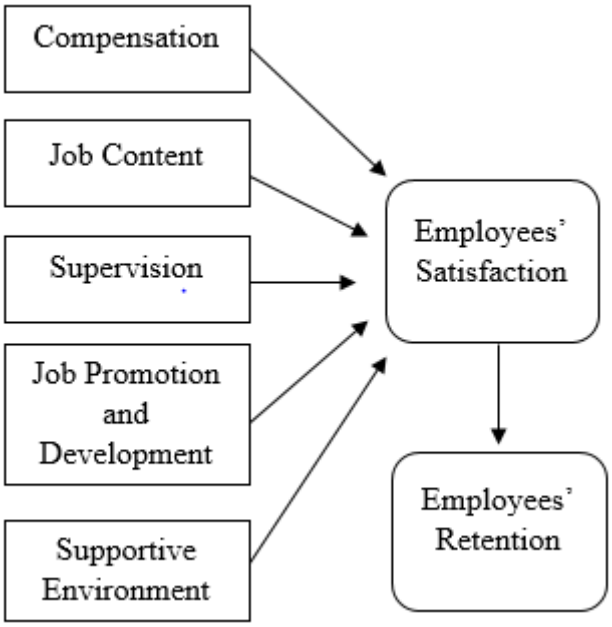


Figure (1): Conceptual Framework

MOTIVATION OF THE STUDY

Human resource management becomes a crucial component of the organization's success. Best employees are regarded as the most valuable assets in today's world, and they influence organization performance. Potential and enthusiastic employees are the most important assets in any firm to accomplish organizational goals and maximize profits. The turnover raises cost and decreases the organization's productivity and efficiency. The aim of this paper is to find out the factors like job context, compensation, supervision, career development and supportive environment of the work that effect the level of job satisfaction.

OBJECTIVES

1. To identify the factors of employees' satisfaction at work,
2. To define the employees' retention factors at work, and
3. To analyze the correlation between employees' satisfaction and retention among the middle-level management employees.

STATEMENT OF METHODS

The quantitative research method is used to conduct the current study. Targeted population of current study is middle level management employees who are currently working at sugar manufacturing factories in Upper Myanmar. The middle management employees' turnover is noticeable during these years. The middle management workers are the important employees because they work as the communicator between high-level management teams, and low-level staff. According to organizational census data, the total number of middle managers who have a minimum of three years' working experience is 159. Yamane's sample size calculation formula is used to estimate the minimum sample size of current study [10]. According to Yamane's formula, the minimum sample size is 114. The sample is withdrawn using the sample random sampling method. The data are collected using the self-reported questionnaire form which is composed of two sections: section (1) personal factors of respondent, and (2) employees' satisfaction and retention questions. The section two questions are five-point Likert scale questionnaire (1 = Totally disagree, to 5 = Totally agree). The section two is developed through previous literature sources. The compensation, job content, promotion, supervisor support, and the supportive working environment are the independent variables, and the employees' retention is the dependent variable. The reliability is measured using Cronbach's alpha test. The collected data are analyzed using the statistical software called statistical package for social-science software (SPSS version 25). The descriptive and inferential tests are used to answer the research objectives.

Results

A total of 114 middle-level management employees took part. The reliability score achieves 0.925 (Cronbach's alpha score) which shows that the applied questionnaire is reliable. Over-half of respondents are female workers (53.5%), and the remaining proportion (46.5%) are male. 55.3% of participants aged less than or equal to 30 years, 24.6% aged 31 to 40 years, and 20.2% aged 41 to 50 years. Most respondents have 3 to 5 years working experience (62.3%) (table 1).

Table (1): Personal Factors of Respondent

Personal Factors of Respondent			
		Frequency	**Percent**
Gender	Male	53	46.5
	Female	61	53.5
Age	30 years and below	63	55.3
	31-40 years	28	24.6
	41-50 years	23	20.2
Working Experience	Between 3 - 5 year	71	62.3
	Between 5 - 7 year	21	18.4
	More than 7 years	22	19.3

Table (2) presents the descriptive statistics (mean, and standard deviation) of compensation, job content, promotion, supervisor's support, and supportive working environment. The results show that all the factors impact the middle-level management employees at sugar factories. Among these factors, job promotion factors, fair payment systems, job tasks, supervisor support, and mutual respect at work achieve

high mean score and represent that the middle-level management employees are satisfied with these factors at work. For employees' retention, the retirement benefits have a high level of impact on employees' intention to stay. When employees achieve workplace fair payment systems, equal workload, job promotion, supervisor's supports, and effective teamwork, they satisfy their works. The achievement of retirement benefits impact on their desire-level of retention.

Table (2): Descriptive Statistics

Descriptive Statistics		
Variable	**Mean**	**Std. Deviation**
Compensation		
Monthly Salary	3.70	.77
Benefits from work	3.60	.96
Fair Payment System	4.07	.84
Bonuses for excellent performance.	3.88	.86
Experimental Rewards	3.78	.85
Job Content		
Working Hours	3.58	.84
Job Tasks	4.07	.84
Autonomy	3.46	.88
Recognition for accomplishment	3.78	.89
Flexible working periods	3.58	.84
Job Promotion and Development		
Opportunities of job promotion	4.07	.84
Additional Training	4.07	.85
Opportunities to learn new skills	4.05	.91
Ability to utilize skills and talents	4.07	.84
Promotion based on performance	4.06	.92
Supervisor		
Fair Treatment from supervisor	3.49	.91
Supervisor's Encouragement	3.66	.84
Supervisor's sharing job information	4.09	.84
Discussion problems with supervisor	4.00	.94
Receive useful and constructive feedbacks from supervisor	4.00	.95
Supportive Environment		
Effective Team Work	3.50	.88
Solve problems, and meet operational goals	3.51	.66
Mutual Respect at work	3.77	.62

Same workload with co-workers	3.74	.64
Supportive with each other	3.74	.66
Retention		
Stay for career advancement	3.78	.64
Retirement Benefits	3.86	.65
Regular increasing salary	3.64	.73
Opportunities to apply skills, experiences, and education	3.73	.62
Receive recognition and rewards systems	3.81	.68

Table (3) approves the significant positive correlation between employees' satisfaction, compensation, job content, job promotion, supervisor's support, and supportive environment. When the employees achieve both monetary and non-monetary compensation, fair job contents (working time, tasks), regular promotion, supervisor's recognition, and support, and effective teamwork, they will satisfy at work. The employees' satisfaction and retention are positively correlated (Pearson's r= 0.310, p-value = 0.001). There is a significant impact of employee satisfaction on employee retention. The result means that employees will stay for long-term when they satisfy at work.

Table (3): Pearson's correlation

	Satisfaction Pearson Correlation	Sig. (2-tailed)
Compensation	.894**	.000
Job Content	.877**	.000
Job Promotion	.879**	.000
Supervisor's support	.872**	.000
Supportive environment	.486**	.000
Retention	.310**	.001
Correlation is significant at the 0.01 level (2-tailed).		

DISCUSSION AND CONCLUSION

The findings of current study show that the employees' satisfaction is positively linked with compensation (monetary and non-monetary benefits), job contents, opportunities for job promotion and personal development, supervisor's supports, and the supportive working environment. In addition, this study found that the employees' satisfaction has a positive impact on employees' retention at Sugar factories in Myanmar. The results are in line with the study by Biason where the research approved the positive significant impact of compensation, job contents, job promotion, supervisor's support, and supportive working environment on employees' job satisfaction [11]. The author concluded the direct impact of employees' satisfaction on the employees' retention. According to findings, the management teams, employers, and managers should emphasis on the employees' satisfaction as the underlying factor of staff's retention. The satisfied workers are the great assets for all organizations, and the employees' retentions show the organizational positive image, brand reputation, and also reduce the recruitment and selection costs.

REFERENCE

1. Kossivi, Bodjrenou, Ming Xu, and Bomboma Kalgora. "Study on determining factors of employee retention." Open Journal of Social Sciences 4, no. 05 (2016): 261.
2. Robbins, Stephen P., and Tim Judge. "Essentials of organizational behavior." (2012).
3. George, Jennifer M. "ORGANIzATIONAL HEHAvoR." (2005).
4. McAllister, Daniel J., and Gregory A. Bigley. "Work context and the definition of self: How organizational care influences organization-basei self-esteem." Academy of Management Journal 45, no. 5 (2002): 894-904.
5. Anis, Atif, Abdul Nasir, and Nadeem Safwan. "Employee retention relationship to training and development: A compensation perspective." African journal of business management 5, no. 7 (2011): 279-2685.
6. Armstrong, Michael. A handbook of MANAGEMENT techniques: the best-selling guide to modern management methods. Kogan Page Publishers, 2001.
7. Spence Laschinger, Heather K., Michael Leiter, Arla Day, and Debra Gilin. "Workplace empowerment, incivility, and burnout: Impact on staff nurse recruitment and retention outcomes." Journal of nursing management 17, no. 3 (2009): 302-311.
8. Khan, Alamdar Hussain, and Muhammad Aleem. "Impact of job satisfaction on employee turnover: An empirical study of Autonomous Medical Institutions of Pakistan." Journal of International Studies 7, no. 1 (2014).
9. Raikes, Lucille, and Jean-Francois Vernier. "Rewarding and retaining key talent: Are you ready for the recovery." Tower Perrin (2004).
10. Adam, Anokye M. "Sample size determination in survey research." Journal of Scientific Research and Reports (2020): 90-97.
11. Biason, Ricardo S. "The Effect of Job Satisfaction to Employee Retention." Retrieved on 1st October (2019)

Integration of Technology Continuance Theory towards LMS acceptance after COVID 19 among Business Administration, Marketing, and Social Sciences Instructor

[1] Filipinas L. Bognot, [2]Adegbite Ganiu Adewale, [3]Solomon Ayodele Oluyinka
[1] City College of Angeles, Philippines [2] Ogun State Institute of Technology, Igbesa, Ogun State, Nigeria, [3] Baliuag University, Bulacan, Philippines

Abstract
The COVID-19 outbreak has brought substantial disruption to life and many sectors at one stroke. The pandemic has forced the closure of three basic levels of education (primary, secondary and tertiary) across the world, teaching and learning activities then shifted to an entirely online environment. The unusual challenges of whether instructors were adequately prepared in terms of their capability in delivering their lessons from traditional to e-learning and their intent to continue after COVID-19 faded prompted the researchers to conduct this study. As a result, this study seeks to extend the reliability of Technology Continuance Theory (TCT) constructs and explore the factors that influence the acceptance and continuity of learning management systems (LMS) used by Business Administration, Accounting, Marketing, Social Science, Entrepreneurship, and related instructors during the COVID-19 pandemic. A total of two hundreds and nine responses collected through online surveys among university and college and senior high schools' instructors in the targeted that exploiting LMS during Covid 19 new normal. Modeling and structuring approaches with a statistical tool known as SmartPLS 3 was utilized. The findings showed that 9 of the 11 hypotheses were supported, with facilitating conditions regressing on satisfaction perception being the most strongly supported, followed by the ease of use perception on information richness. Future studies are recommended to validate ease of use perception on LMS continuation intent and usefulness. In this study, the perception of information richness effects was found to be unsupported.

Keywords
Marketing instructors, usefulness, ease of use perception, LMS continuance, Philippines, Malaysia

INTRODUCTION

The World Health Organization (WHO) has recognized the onset of COVID-19, a global pandemic. Around the world, educational systems were severely impacted, resulting in the near-total shutdown of all levels of basic education. The WHO designated the COVID-19 outbreak a public health emergency of worldwide significance on January 30, 2020. As the pandemic spread, several nations, including the Philippines, implemented lockdowns during which schools, colleges, and other institutions were shuttered. The United Nations Educational, Scientific and Cultural Organization (UNESCO) reported that as of early April, 1.5 billion students were affected by school or university closures across the world [1]. In a nutshell, the three basic levels of education (primary, secondary and tertiary) around the world have been forced to adopt different forms of learning management system (LMS) to ensure continuity of teaching and learning.
However, the temporary closure expected to reduce the spread of the disease in the community by breaking down main transmission chains [2]. In a way the pandemic 2019 represents an opportunity for the three basic levels of education to expand the use of digital resources in learning and teaching [3], [4]. Using the learning management system is a significant ingredient in this paradigm change, but this pandemic hastened the transition to online learning. With most the three basic levels of education embarking on this mode, different mechanisms and approaches have been adopted to ensure that online teaching and learning is feasible and efficient during this pandemic time [5]; [6].
The value of the LMS ensures an effective transition in the three basic levels of education to a more sustainable teaching and learning environment. Learning management systems is an alternative for those who want to move from classroom to online learning [7]; [8], [9]. Learning management system enables learners to access interactive lessons, exchange ideas with their teachers, compile course materials, take online exams, and send classroom assignments [10]; [11].
Several recent articles related to adoption learning management systems during Covid 19 pandemic stated that the current era of COVID 19 has revolutionized online education to a greater extent [12]; [13], also suggested that the usage LMS could be an integrated contentious mode of teaching and learning in all the levels of education after the crisis [14]; [15]; [16]. [17], all the E-learning platforms used by the respondents are free of charge, still, students have encountered problems like lack of resources, difficulty of

Wi-Fi connection, and lack of training among the students and faculty members. this study recommends professional development workshops for both faculty members and students and preparation of advanced lessons, slide presentations, and examinations per unit to cope with the prescribed number of hours set by the Commission on Higher Education (CHED). It is also expected that this action research would serve as a future guide for conducting an in-depth study using a structured interview to validate its findings.

Despite the forceful usage of learning management imposed on schools, colleges and universities in the Philippines due to the Covid 19 crisis. Though studies indicated that some schools, colleges and universities already using different forms of LMS partially used before the occurrence of the pandemic [7]; [11]. Studies suggested that some instructors were struggling to familiarize with different types of LMS plate-form like Canvas, Google classroom, Moodle and others to enhance learning and teaching in all the levels of education in the amidst of pandemic. This lead to subject mattered, if some not finding it interesting, there is tendency of discontinuity in the future among the teachers. Thus, intend to investigate intention to continue usage of LMS particularly google classroom which involved google meet for the virtual teaching and learning.

Besides, [18] the technology continuance theory (TCT) is a combination of three most utilized theories in the study associated with Technology and information system. The three combined included technology acceptance model (TAM) [19], expectation confirmation model (ECM) [20], and cognitive model (COG) [21]. TCT is known as a three-level model with IS continuance intentional as being the finalized dependent variable. TCT consists of satisfaction and attitude as main construct, and confirmation, perceived usefulness, and perceived ease of use suggested as three levels of antecedents, almost of the hypotheses suggested in TAM, ECM, and COG actually included in TCT [18] suggested.

LITERATURE

Technology continuance theory [18] stated that user's satisfaction could be defined as the function of expectations and disconfirmation. The study added that an individual's behavioral intention can be initially defined as a function of attitude, and later is a function of satisfaction, attitude, and it plays a larger role in determining intention for the short-term users. Confirmation formed when the performance after usage is greater than or equal to the prior expectation in the use of a specified technology, confirmation reflects the realization of expected value, which in turn increases levels of intention to continue usage of such technology [18].

Rahim [22] corroborate perceived usefulness, ease of use, satisfaction, and attitude. Furthermore, by combining satisfaction and attitude into a single construct, TCT contributes to the debate over users' continued adoption. The study found that users' satisfaction, as one of TCT's attributes, is an important factor that can be used to improve continued usage of a specific technology. Similarly, Tsai et al. [23] study used the theory of continuance [18] to justify the influences of system usability and user satisfaction regarding intention continued use, concluded that continuance use could be determined by the perceived usefulness and perceived compatibility in relation to satisfaction level.

According to Baticulon, Ronnie, Reyes, et al. [24], the most frequently encountered barriers during online education in the midst of the COVID-19 pandemic were difficulties adjusting learning styles, responsibilities of working remotely, and poor communication between educators and learners. Observations such as technology accessibility, information accessibility, and good communication, especially between instructors and students, should be among the most concerning [25].

Pokhrel [26] present a thorough analysis of the COVID-19 pandemic's influence on online teaching and learning of various articles, as well as recommendations for the future. The study suggested looking into how to use the facilitating elements and how to prevent wastage of resources and information. Likewise, as non-traditional students and those looking to improve their skill sets search for ways to study on the job, Felix [27] suggests that universities should closely investigate certificate and virtual route systems. The findings supported the idea that colleges can use a combination of physical and online resources to expand their student pool.

Furthermore, Ploj et al [28]'s study concluded that organizational support, perceived ease of use, and attitude toward online learning are not good markers of long-term intention to use information technology after the lockout ends, but usefulness and satisfaction are. Thus, there is inconstancies in difference studies. Thus, there is a need to justify the actual facts about the dimensions of perceived ease of use and usefulness of LMS and satisfaction

According to Croucher's [29] investigation, there will be an increase in students' acceptance of online education in the future as a result of various schools' moving from campus-based to online delivery, and thus the experience and benefits of online learning have expanded during the pandemic education measures. They also recommended that this study and its findings be replicated in other regions in the future.

Aliyyah et al [30] conducted a study on instructors' perceptions of online learning in an Indonesian program. According to the research, online collaborative learning among stakeholders (teachers, parents, and schools) has an impact on students' performance as well as their perspective of behavioral control in terms of technological preparedness, which was considered significant in this study.

Gillis [31] stated that effective implementation of learning materials during transition for students should be considered more important than the instructional approach instructors utilize. Barriers to the internet and technology were relatively widespread. As a result, teachers may believe that integrating a learning management system will make it difficult for students to gain knowledge. Therefore, the present research will focus on justification in the view of the instructors during

and after pandemic education.
The conclusion of research assessing user retention intentions toward library self-service technology [32] revealed that post-adoption expectations of perceived performance influenced library users' inclinations to continue. Al-Samarraie [33], explored causal links between these variables and e-learning persistence satisfaction. Information quality, task–technology fit, system quality, utility value, and usefulness are the five key elements. The findings shed new light on how higher education institutions can improve retention satisfaction and keep e-learning relevant
Cheng [34] found that perceived ease of use and satisfaction are major motivators in generating continued intention in the later phases of technology adoption in their research. Students' attitudes about LMS use were linked to satisfaction, and perceived usefulness had a substantial impact on long-term intention and contentment.
Most of the previous studies involved acceptance of LMS in the context of students mostly, and limited studies found related to the role of facilitating condition and effectiveness of information richness in the relationship with other technologic factors towards satisfaction and continuous usage of LMS. Thus, there is a need to investigate their satisfaction on the technology and experience towards continual usage of current adopted LMS or call for change, also to suggest most usable among the common LMS that is mostly adopted within location of this study. There is a need to expand the number of participants by including the three basic levels educations educators.

METHODOLOGY AND RESEARCH MODEL

With eleven posited linkages, Figure 1 depicts a research paradigm for investigating acceptability and continuing use of a learning management system (ACULMS) during and after COVID 19. In order to support acceptance and continued use of LMS, this research model combines three important dimensions of [18] 's technology continuance model (i.e., perception of satisfaction, usefulness, and ease of use) with facilitating conditions from the UTAUT model [35] and information richness effects [36]; [37]) study. The suggested enabled this study to explore the effectiveness of these dimensions on the newly formed conceptual model. Furthermore, information richness may serve as a link between usefulness and ease of use perceptions of ACULMS in a different way, and facilitating factors may impact satisfaction. Finally, elements such as the facilitating situation and the perception of usefulness may have an impact on the satisfaction perception described in this conceptualization.

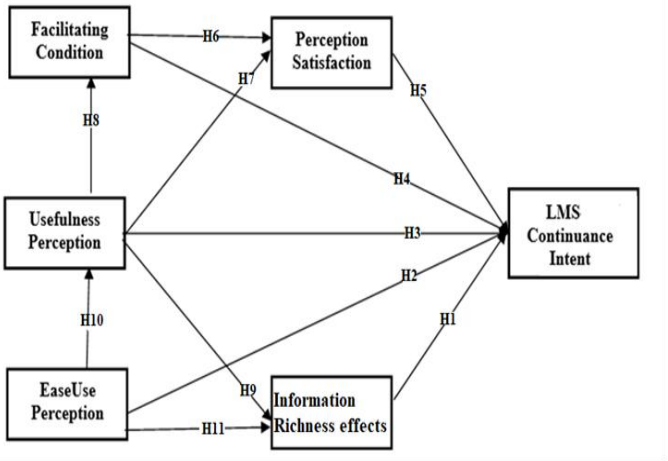


Figure 1: Research Model: Technology continuance theory [18]

HYPOTHETICAL HINTS

This study recognizes that technological acceptance and adoption take place in stages. The behavioral intent variable used in the original model was renamed "LMS Continuance Intent" to better reflect the context of IS continuation and increase the robustness of our findings. Although previous research has demonstrated that "intent" is a good match as a dependable variable to use.
External variables such as confirmation and attitude are not included due to the fact that they are not supported in studies. Finally, this is cross-sectional research that focuses solely on technology acceptance and continuance model variables. Fig 1 of this paper depicts the model. The path assumptions are based on the publications and model developed by [18]. Thus, the assumptions apply to each of the categories of users.

4.1. Effectiveness of information richness and learning management system continuance path dimension

The environment influences information richness in the sense that it has a significant impact on people's behavior. When the information presented is enough, it may be used to enhance an individual's experience and allow for the development of relationships. Reliable information can aid in the development of a better teaching–learning environment and increase technological engagement [37]; [36]. Students prefer to use a learning platform that offers high-quality content, and students who report higher levels of satisfaction have a more positive outlook on using an online learning system [38] and quality of information would be a matter of successful online-based teaching [39]. Thus, hypothesized that effectiveness of information richness may influence learning management system continuance positively (H1)

4.2. Perception of ease of use and usefulness towards LMS continuance intent path dimension

Perceived usefulness and perceived ease of use are among the most important aspects in influencing satisfaction and desire

to continue using any given technology, according to the philosophy of continuation technology [22]. According to a study on the model of forced distance online learning preferences' satisfaction and continuance variance in MS Teams applications, perceived usefulness is a powerful indication of continuum preferences to utilizing information technology after the COVID-19 pandemic [28]; [40]).

Huang [41], previously stated unequivocally that the most significant predictive indicators in analyzing information technology use are usefulness and ease of use assessment. Perceived ease of use and perceived usefulness are important factors in assessing technology's efficacy, and both have a direct impact on user intention to continue usage of the specified. Many investigations have used the TAM major factors to investigate intents to embrace new technology in various settings, with ease of use and usefulness being key factors in their conclusions [42]; [43]). Hence, the following hypotheses are suggested: The intent to continue the usage of LMS is positively affected by the users' perception of ease of use. (H2) and intent to continue the usage of LMS is positively affected by the users' perception of usefulness (H3)

4.3. Facilitating Conditions and perceived satisfaction towards continuance intent path dimension

Reyes et al [17] Although all the e-learning platforms used by the respondents are free of charge, still, students have encountered problems like lack of resources, difficulty of Wi-Fi connection, and lack of training among the students and faculty members. this study recommends professional development workshops for both faculty members and students and preparation of advanced lessons, slide presentations, and examinations per unit to cope with the prescribed number of hours set by the Commission on Higher Education (CHED). It is also expected that this action research would serve as a future guide for conducting an in-depth study using a structured interview to validate its findings [44]. Thus, hypothesized the following that; Facilitating condition may effect on LMS continuance intents (H4) and continuance usage of LMS among business administration and accountancy instructors may be influenced by perception of satisfaction during the trial (H5.). Meanwhile, studies reported that technical material and other resources such as laptop, smartphones, postpaid internet subscription, prepaid mobile data, capable of engaging in online learning lead to poor communication between educators and learners [45]; [24]). Thus, may results into discontinuity of learning management system by the users. Hence, this particular study hypothesized that facilitating conditions may affect the perception of satisfaction of business administration and accountancy instructors to continue usage of the specified LMS (H6)

4.4. Role of usefulness perceived and ease of using towards LMS continuance intent

In a comparative study on the perceptions of instructors and students in terms of their intention to accept and continue a learning management system, Islam [46] suggest that students have more positive perceptions regarding the usefulness and compatibility of the LMS than educators. According to the survey, student satisfaction was also lower than that of instructors. The variation of students' continuous intentions, which were explained by satisfaction and usefulness, was 12 percentage points lower than that of instructors. Similarly, a model tested using statistical data from fewer than 160 university students reveals that perceived usefulness is the strongest predictor of students' continued intention. The study reported that students' attitudes toward LMS and their satisfaction level exert no significant influence on their continuance intention [47]). Considering previous studies' findings, Thus, hypothesized in this study that usefulness perceived by business administration and accountancy instructors has a link with satisfaction perception to continue LMS usage after the pandemic (H7)

In a qualitative study, listed internet connection conditions, mode of interaction, communication, motivation, and student engagement as hindrances to online learning. On the part of the instructors, self-efficacy level, a lack of support, and facilitating resources in using technology to teach online were suggested as reasons why instructors struggle to deliver efficiently [48]. In relation to this publication, this particular study hypothesizes that; usefulness of the LMS to business administration and accountancy instructors may be linked to facilitating conditions(H8) and informative richness effects (H9) towards usage of the technology. The usefulness point of view was substantially influenced by information system quality and self-efficacy, which in turn indirectly affected behavioral intention toward adopting technology. Further [49] claimed there is correlation between information system quality and TAM variables towards the intent to use LMS. As a result, it is replicated that ease of use may influence usefulness perception (H10). It may also be correlated with the informative richness of the aforementioned instructors' intent to continue using the specific LMS technology (H11).

RESEARCH METHODOLOGY

5.1. Data Collection

Instructors from business administration, accountancy, marketing, social science and entrepreneurship departments in the Philippines and Malaysia took part in this study. To collect data, a Google form survey was circulated to colleges, universities, and senior high schools in Region III of the Philippines, as well as two institutions in Johor Bahru, Malaysia via social media apps.

The semester of 2020–2021 was chosen as the study period. Data was collected beginning in August 2021 and ending on December 23, 2021. The researchers transmitted the link using a simple sample data gathering method. The route included social media apps such as WhatsApp and the Facebook wall among the targets.

A total of 209 responses were taken into consideration. Meanwhile, a minimum of 377 samples is recommended by the sample size calculator (Raosoft.com). Because the population number is uncertain, a sample size of 20,000 is

advised. The calculation was based on a margin of error of 5% at a 95% confidence level and a 50% response distribution. This indicates that a sample size of 209 achieved is insufficient. However, studies have claimed that in a structural equation modeling investigation, a thumb rule of ratio (1:20) for each construct may be considered [50]; [51]; [52]. This study suggested six constructs, with a total of 120 participants being sufficient [51]; [52]. As a result, 209 participants decided to investigate the instructors' intent to continue using LMS in conventional education even after a pandemic.

Furthermore, the most recent theories were utilized and modified for utilization in the context of LMS continuity. The measurement model has been evaluated by four technology acceptance experts, who were from the University of Ibadan and the Ogun State Institute of Technology (OGITECH). The third and fourth instrument evaluators came from the University of Tun Hussein Malaysia (UTHM) and the University Teknologi Malaysia (UTM) Johor Bahru, Malaysia.

Researchers confirmed the instrument's significance using a sample size of 25, and a statistical software called SmartPLS Version 3.3.2 confirmed the instrument's significance as all Cronbach Alpha falls within 0.705 to 897. However, a Cronbach alpha of 0.70 is recommended [53].

5.2. Instrument adopted

All eleven hypotheses in this study were validated with the use of a survey instrument. The questionnaire assessed six different constructs. There are 27 indicators in the modeling survey and four questions in the demographic details survey. The observed constructions and their references are listed in Table 1. The applicability of this study has been enhanced by modifying a previous research questionnaire published.

Table 1. Factors and Measurement Indicators.

FACTORS AND MEASUREMENT INDICATORS.	
FACILITATING CONDITION QUESTIONS AND CODES	**SOURCES**
Have a smartphone with an installed necessary application for online teaching and learning (FC 1)	[45], [43]
I have access to a computer/laptop/phone with an internet connection at home (FC 2)	
I have a dependable computer/laptop/phone with a dependable browser (FC 3)	
I am willing to seek connectivity with neighbors/family at home (FC 4)	
I can easily connect my computer/laptop/phone monitor, printer and others (FC5)	
PERCEIVED USEFULNESS QUESTIONS AND CODES	**SOURCES**
Our LMS is useful. I will continue utilizing it after the COVID-19 pandemic (PUSE 1)	[40], [42]
The LMS proves my productivity (assigning assignments, grading, and recording). I will continue to utilize it (PUSE 2)	
The learning management system enhances my effectiveness in teaching and I will continue to use it (PUSE 3)	
After the epidemic, I will continue to use our learning management system since it is a tremendous aid to my teaching (PUSE 4)	
I'll keep using the learning management system since it helps my learners study more effectively (PUSE 5)	
PERCEPTION ON EASE OF USE QUESTIONS AND CODES	**SOURCES**
I believe I will continue to utilize the learning management system since it is simple to use (EASE 1)	[54], [42]
Will continue to use the learning management system since it is simple and straightforward (EASE 2)	
Will continue to utilize the learning platform (LMS) after pandemic since interaction with the students is achievable (EASE 3)	
LMS is "user-friendly" in terms of what I want it to do (such as grading and plagiarism checking. Will continue usage (EASE 4)	
Schools adopt different LMSs and experience simplicity in using them. After the pandemic, it is worth adopting often (EASE 5).	
SATISFACTION PERCEPTION QUESTIONS AND CODES	**SOURCES**
My whole experience while using it was quite positive. I think of continued usage after the pandemic (SATI1).	[40], [44], [18]
The LMS matches professionally during the COVID-19 virtual classroom. I am optimistic about continuing to use it (SATI2).	
I will keep using LMSs because they're such an important resource for instructional materials in face-to-face sessions (SATI3)	
I will continue using the LMS after the pandemic because it fits my plans and I was thrilled with my whole experience (SATI4)	
INFORMATION RICHNESS EFFECTS QUESTIONS AND CODES	**SOURCES**
I think my understanding of the learning management system urges me to keep utilizing it after the COVID-19 pandemic (IRE 1)	[42]
I believe continual usage of the LMS after the pandemic will boost my grasp of teaching objectives and results (IRE 2)	
My perception of additional updates will improve if I continue usage of LMS with face-to-face sessions after the epidemic (IRE 3)	
Using it gives me information that is simple to comprehend, and entertaining, will continue usage even after the pandemic (IRE 4).	
INTENT TO CONTIUE USAGE OF LMS QUESTIONS AND CODES	**SOURCES**
I intend to continue utilizing our LMS rather than discontinue usage after the COVID-19 pandemic (LMSI1).	[44], [43]
My intentions are to continue utilizing our LMS with traditional modes of education after the COVID-19 pandemic (LMSI2).	
If I had the option, I would use it as often as feasible after the pandemic (LMSI3).	
Overall, most of my expectations from utilizing a LMS were confirmed for continuance intention (LMSI4).	

5.3. The questionnaire's pilot study

A pilot research was conducted to verify the consistency of the above-mentioned questionnaire indicator. Twenty-five postgraduate students from Universiti Tun Hussein Malaysia's Faculty of Computer Science and Faculty of Technology Management & Business were chosen at random for the pilot project. The Cronbach's Alpha (CA) test was used to evaluate the results of the pilot research. It uses IBM SPSS Statistics version 20 to help identify internal dependability. As a result, the reliability coefficient for all of the measurement items was 0.70 above, indicating that the results offered were acceptable [53].

5.4. Structure of the instrument

Instructors were given a questionnaire survey to complete via social media [43]; [54]). Two parts were included in the survey. The participant's data (gender by birth, age, location, and educational background) is collected in the first part, and there are twenty-seven indications in the second part pertaining to the intention to continue using LMS after the pandemic in the schools of business administration, accounting, marketing, and entrepreneurship by the instructors.

There are four indicators in each of the information richness effect and satisfaction perception. Meanwhile, perceived ease of use and facilitating conditions both have five indicators, and intent to continue using the LMS has four, making this construct the dependent factor in this study. The four-point Likert scale is utilized to measure all 27 indicators. The scale includes "strongly disagree" (1). "disagree" (2), "agree" (3), and "strongly agree" (4).

FINDINGS AND DISCUSSION

6.1. Participant's demographic data

The demographic data of the participants has been analyzed and is reported in Table 2. Females dominated, with a 55% claim compared to 45% for males. Furthermore, 15.7% of the participants were between the ages of 21 and 30, and 54.1% of the participants were between the ages of 31 and 40. The age brackets 41–50 had a 21.1%, and the age bracket 51-above showed a 9.1% of the total participants of the study. The majority of the participants held Master's degrees in their field of study. In the sample, 24% had earned a bachelor's or equivalent degree, 57% had earned a master's degree, 12% had earned a doctoral degree, and the rest claimed 7%.

This particular study was dominated by instructors from Johor Bahru, Malaysia, with a claim of 63.2% of the whole study, and 36.8% of the participants were from Pampanga Region III of the Philippines. This study claimed a purposive sampling approach since the participants' sources were based on ease of access and voluntary participation [55]. Furthermore, Microsoft Excel was applied to measure the participants' demographic data. A comprehensive respondent demographic data presented in Table 2.

Table 2: Participant's Demographic Data

Criterion	Variables	Frequencies	Percentages
Gender	Female	115	55%
	Male	94	45%
	Total	**209**	**100%**
Age			
	Bracket 21-30	33	15,7%
	Bracket 31-40	113	54.1
	Bracket 41-50	44	21.1%
	Bracket 51-above	19	9.1%%
	Total	**209**	**100%**
Educational Degree Earned			
	Bachelor/Equivalent degree	50	24%
	Master's degree	119	57%
	Doctoral degree	25	12%
	Others	15	7%
	Total	**209**	**100%**
Participants locations			
	Pampanga: Philippines	77	36.8%
	Johor Bahru: Malaysia	132	63.2%
	Total	**209**	

As demonstrated in Table 2, females are more interested in participating in research survey studies than males, according to this study. Furthermore, early in their careers, instructors in these two countries (Philippines and Malaysia) are urged to attain the highest academic degrees. This discovery aligns with the results of some studies [43]; [56]). In comparison to Malaysian instructors in this study, data collection appears to be more challenging among the Filipino instructors.

6.2. Data analysis and tools

The data analysis of the research study was carried out using the SmartPLS V.3.3.2 software and the partial least squares–structural equation modeling (PLS-SEM) [57], a two-step evaluation technique used to analyze the acquired data [53]). The PLS-SEM is the best option since current research involves the use of existing theory [58]) and may be used to easily manage exploratory research of complicated models [53]. Furthermore, the PLS-SEM evaluates the full model rather than dividing it into different segments [59]. Another benefit of employing the PLS-SEM is that it allows a simultaneous equation analysis of the measurement and the modelling, resulting in exact computations [11].

6.3. Convergent validity

When evaluating the measurement model, [53] suggest considering validity, which includes convergent and discriminant validity, as well as construct reliability, which includes composite reliability (Comp-R), Rho-A, and Cronbach alpha (C-alpha). value of 0.70 or above should be used as the cutoff point, and all achieved in this study and presented in the table 3. Furthermore, the convergent validity should be measured by testing the average variance extracted (AVE) and factor loading (FA). Where the AVE expected to be greater than 0.5 and the FA to be greater the 0.6 value. Table 3 indicate that the suggested values achieved for the constructs. According to Table 3, values between 0.633 and

0.815 noted by AVE, and these are higher than the 0.5 threshold value.

Table 3: Convergent validity reports

Variables/ Indicators	FA	C-alpha	Comp-R	Rho-A	AVE
FC 2	0.854				
FC 3	0.761	0879	0.871	0.764	0.715
FC 4	0.865				
FC 5	0.896				
PUSE 1	0.701	0.719	0.817	0.829	0.673
PUSE 2	0.862				
PUSE 3	0.763				
PUSE 4	0.905				
PUSE 5	0.854				
EASE 1	0.887	0.801	0.783	0.872	0.633
EASE 2	0.771				
EASE 3	0.700				
EASE 4	0.812				
SATI1	0.906	0.896	0.823	0.874	0.800
SATI2	0.899				
SATI4	0.877				
IRE 1	0.792	0.808	0.856	0.819	0.730
IRE 2	0.831				
IRE 4	0.934				
LMSI1	0.922				
LMSI2	0.898	0.865	0.810	0.879	0.815
LMSI3	0.890				
LMS4	0.909				

Moreover, Convergent validity suggested the removal of four indicators which include (FC 1; EEAS 5; SATI 3; and IRE 3)

6.4. Discriminant validity

Towards the measuring discriminant validity, two criteria, Fornell–Larcker and Heterotrait–Monotrait ratio (HTMT), have been suggested [53]. Table 4 shows that the Fornell–Larcker criterion is satisfied since the AVEs and their square roots are greater than the rest of the correlation constructs [60]. Figure 2 presents the HTMT ratio data, which shows that the 0.85 threshold value consistently outperforms the other construct values [61].

Table 4. Fornell–Larcker Scale.

	EASE	FC	IRE	LMSI	PUSE	SATI
EASE	0.798					
FC	0.450	0.872				
IRE	0.682	0.363	0.885			
LMSI	0.626	0.538	0.296	0.880		
PUSE	0.505	0.502	0.237	0.601	0.818	
SATI	0.444	0.583	0.573	0.592	0.407	0.746

Note: Ease of use perception connote *(EASE)*, Facilitating condition connote *(FC);* Information richness effects connote *(IRE);* LMS Intent to continue usage connote *(LMSI*); Perceived usefulness connote(*PUSE)* and Perceived satisfaction connote *(SATI)*

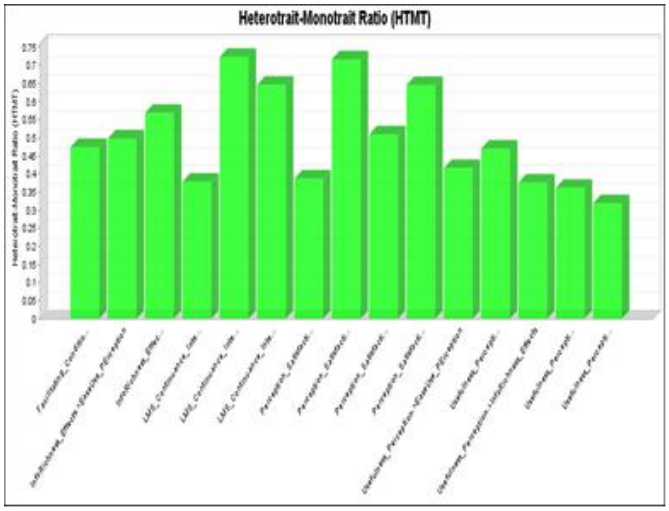


Fig 2. Heterotrait–Monotrait Ratio (HTMT).

6.5. Hypotheses testing using PLS-SEM

The relationship between the structural model and a range of theoretical variables was investigated using a Smart PLS with maximum likelihood estimate [62]). Nevertheless, the stated hypotheses were tested. According to earlier research [11]; [63]), the model's predictive significance for the LMS's continuing usage intentions after the pandemic was 58.6 percent, as shown in Table 5.

Table 5: Exhibit R-square models achieved

Matrix	R-Square	R-Square Adjusted
EaseUse_PErception	0.364	0.355
Facilitating_Conditions	0.448	0.439
InfoRichness-Effects	0.506	0.491
LMS_Continuance_Intent	0.586	0.564
Perception _Satisfaction	0.485	0.472

According to the data analysis in this study, nine of the eleven hypotheses were shown to be valid. The results confirmed the study's hypotheses. Four of the five direct regressions on the intent to continue using a learning management system after the pandemic were found to be supported at a p value less or equal to 0.01, indicating that the model is valid. It was rather surprising that the instructors' perception of the ease of use of the LMS after the epidemic was not supported.

The findings revealed that the information richness effect, perceived usefulness, facilitating conditions, and satisfaction perception all have a significant effect on business administration, accounting, marketing, entrepreneurship, and other related areas' instructors' intent to use LMS after the pandemic.

In terms of the relationships between the suggested variables and instructors' intent to continue using the LMS, the results showed that facilitating conditions (FC) have the greatest impact on instructor satisfaction (SATI) (t-stat: 6.701, p 0.000) and are suggested to be the most valuable, followed by usefulness perception (PUSE) (t-stat: 4.830, p 0.0001). Next, was the perception of ease of use (EASE) on information richness effect (IRE) and usefulness perception (PUSE)

(t-stat: 4.712, p 0.000) and (t-stat: 4.317, p 0.000) respectively.
Meanwhile, the study also indicated that the usefulness perception (PUSE) on information richness effect towards the instructors' intent to continue using the LMS was (t-stat: 1.532, p 0.126), which values were not supported because the pvalue was greater than 0.05 and the t-statistic was less than 1.96, as recommended [53]. Table 6 summarizes the sample mean, standard deviation error, t-statistic, and p-values for the hypotheses.

Table 6: Standards deviation error, t-statistic, and p-values achieved

Modeling Dimensions			Sample Mean	Standard. Dev. Error	T-Statistics	P-Values	Supp Yes/N
EaseUse PErception	→	InfoRichness Effects	0.397	0.083	4.712	0.000	Y
EaseUse PErception	→	LMS Continuance Intent	0.011	0.092	0.158	0.875	N
EaseUse PErception	→	Usefulness Perception	0.428	0.096	4.317	0.000	Y
Facilitating Conditions	→	LMS Continuance Intent	0.332	0.106	3.157	0.002	Y
Facilitating Conditions	→	Perception Satisfaction	0.575	0.085	6.701	0.000	Y
InfoRichness Effects	→	LMS Continuance Intent	0.281	0.097	2.858	0.004	Y
Perception Satisfaction	→	LMS Continuance Intent	0.251	0.095	2.592	0.010	Y
Usefulness Perception	→	Facilitating Conditions	0.400	0.092	4.223	0.000	Y
Usefulness Perception	→	InfoRichness Effects	0.149	0.093	1.532	0.126	N
Usefulness Perception	→	LMS Continuance Intent	0.313	0.076	4.197	00.00	Y
Usefulness Perception	→	Perception Satisfaction	0.420	0.096	4.310	0.000	Y

Moreover, Figure 3 shows the structural equation modeling results achieved through the bootstrapped properties in the SmartPLS based on the instructors' intention to accept and use LMS after the pandemic.

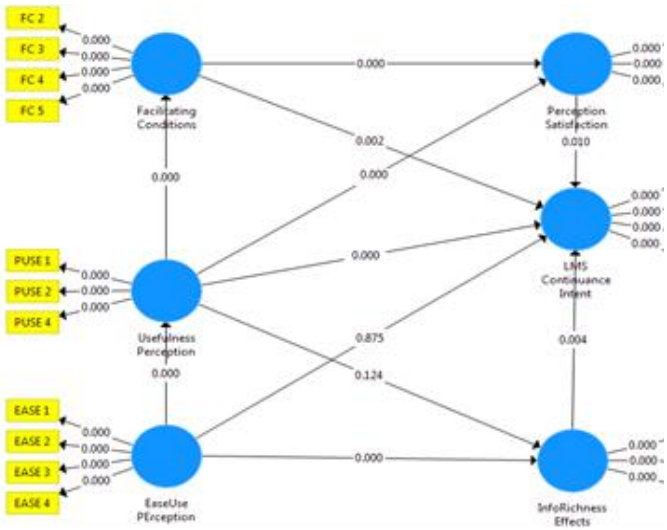


Fig 3 Bootstrapped equation modeling achieved

DISCUSSION OF THE RESULTS

The study was based on a total of eleven hypotheses and two found not supported. The dimension of this structural equation modelling of intention of Business Administration, Accountancy, Entrepreneurship, Marketing and other Management related instructors included TCT factors (Facilitating conditions and satisfaction perceptions) [18]. TAM factors (perception of ease of use and usefulness) and effect of information richness. The effect of information richness, facilitating conditions, perception of usefulness and satisfaction have a decisive role in the structural modeling of LMS continuance after pandemic. The relationship effect models findings also indicated the role of facilitating conditions in terms of satisfaction perception, and significant role of TAM two main factors in the study.

The current findings are consistent with previous studies on the effect of information richness, facilitating conditions, usefulness, and satisfaction perceptions in assessing the acceptance of online learning technologies after the pandemic, and the five link assumptions play a significant role in LMS acceptance [38]; [59]; [43]; [44]). According to the direct effect dimensions, the more the availability and reliability of a computer, laptop, phone, printer, and other devices, the greater the likelihood of continued use.

The learning management system improves teaching efficiency. It was hailed as a remarkable teaching tool that allows students to study more productively. This also implied that the overall experience of utilizing it was satisfactory. During the COVID-19 virtual classroom, the LMS matches professionally. It's a better fit for the instructor's plans. Meanwhile, understanding of the learning management system may urge use of it after the COVID-19 pandemic. Furthermore, the report of this study implied that using the LMS following the pandemic would improve their understanding of teaching objectives and results as well as provide simple and relevant information.

In terms of the correlation dimension, the findings suggested that having access to a computer, laptop, or phone with an internet connection would result in a positive experience and encourage continued usage after the pandemic. Also, it is implied that the provision of useful gadgets and other related materials will encourage satisfaction, which may lead to the intention to continue usage and personal academic development of the instructors that are engaged in the virtual classroom in the amidst of COVID 19 [38]. Nonetheless, the study's findings imply that the concept of usefulness is supported by the fact that usage is easy and straightforward. It's also "user-friendly" in terms of grading and plagiarism detection, which will be beneficial to instructors and students in the course of education [43]).

In a nutshell, this analysis has shown that the success of e-learning platforms will be seen after the outbreak. Since e-learning platforms are simple to use and beneficial, schools and instructors will continue to utilize systems even if face-to-face sessions are reinstated. The level of satisfaction indicated by participants in this study is increased by facilitating conditions and usefulness perception. The other TAM main factors in the relationship with information richness have added more advantages to using these learning management systems (LMSs). The implementation of these technologies in the classroom has a significant impact on educational settings. Furthermore, acceptance increases once the perception of usefulness and information affluence are aligned with the academic tasks. Thus, the study has shown that learning management platforms are an influential means of teaching along with traditional classes due to their specific

and unique features.

7.1. Contributions and Implications

The findings of this study may be used both conceptually and practically by educationists. The report gives concise and dependable suggestions that may be used to quantify the levels of technological acceptability and consistency among a sample of academics. In terms of practical relevance, the findings of the study may be used in a variety of learning management systems (LMS) that are user-friendly and have features that can benefit the teaching–learning setting. The efficiency relates to the fact that they may provide resources and materials that encourage individuals to gain information more frequently by using their online learning platform.

The findings of this study contributed to and demonstrated that university and college administrators can design LMSs in such a way that users are motivated to use the system on a regular basis. It is noted that system enhancement is successful based on their provided assumptions, which may be useful from a productivity standpoint. The study's findings underline the need for system managers to closely monitor the intention of using the provided e-learning platforms.

7.2. Limitations and recommendation for Future Studies

Despite the fact that the research study added to the literature by considering unique technological models and external elements that have been exploited in previous studies, it has several limitations and acknowledges that the studies chosen are confined to a specific population and cover two time periods, one before and one after the pandemic began. Continued studies might expand the time frame to include studies conducted after the pandemic's impact has faded.

Nevertheless, this concluded study is limited to business administration, accountancy, marketing, and management instructors' intentions towards acceptance and continual usage of LMS after the pandemic fades. The effects of information richness, TAM constructs, and aspects of the UTAUT and TCT models were considered in structuring the model. Future studies can include other factors such as attitude, perceived security, and perceived trust.

Furthermore, the samples are confined to a limited set of instructors from two Southeast Asian countries. Future research may focus on perceptions of ease of use of technology in connection to LMS continuance and usefulness regressed on information richness effect, since two of these assumptions were not supported in this study. Despite this, the findings are collected through questionnaires with closed-ended questions. Future research should explore utilizing a qualitative questionnaire and a data gathering strategy based on interviews or experiences.

REFERENCE

1. 1] Smith, C. (2020). Challenges and opportunities for teaching students with disabilities during the COVID-19 pandemic. International Journal of Multidisciplinary Perspectives in Higher Education, 5(1), 167-173. DOI: https://doi.org/10.32674/jimphe.v5i1.2619
2. [2] Di Domenico, L., Pullano, G., Coletti, P., Hens, N., & Colizza, V. Expected impact of school closure and telework to mitigate COVID-19 epidemic in France. www.epicx-lab.com/covid-19.html]
3. [3] Longhurst, G. J., Stone, D. M., Dulohery, K., Scully, D., Campbell, T., & Smith, C. F. (2020). Strength, weakness, opportunity, threat (SWOT) analysis of the adaptations to anatomical education in the United Kingdom and Republic of Ireland in response to the Covid- 19 pandemic. Anatomical sciences education, 13(3), 301-311.
4. [4] Ali, W. (2020). Online and remote learning in higher education institutes: A necessity in light of COVID-19 pandemic. Higher Education Studies, 10(3), 16-25.
5. [5] Gacs, A., Goertler, S., & Spasova, S. (2020). Planned online language education versus crisis- prompted online language teaching: Lessons for the future. Foreign Language Annals, 53(2), 380-392.
6. [6] Chakraborty, P., Mittal, P., Gupta, M. S., Yadav, S., & Arora, A. (2021). Opinion of students on online education during the COVID- 19 pandemic. Human Behavior and Emerging Technologies, 3(3), 357-365.
7. [7] Oluyinka, S., Endozo, A. N., & Daenos, R. G. (2019, October). Impediments to Acceptance of Online Learning in Two Developing International Locations. In Proceedings of the 2019 11th International Conference on Education Technology and Computers (pp. 127-131)
8. [8] Ayodele, S. O., Oga, O. E., Bundot, Y. G., & Ogbari, M. E. (2016, October). Role of power supply towards e-learning acceptance: VBSEM-AMOS. 2016 6th International Conference on Information Communication and Management (ICICM (pp. 151-155) IEEE. DOI: 10.1109/INFOCOMAN.2016.7784233
9. [9] Oluyinka, S., & Endozo, A. N. (2019). Barriers to e-learning in developing countries: a comparative study. Journal of Theoretical and Applied Information Technology, 97(9). www.jatit.org
10. [10] Nielson, B (2017). Learning Management System Basics (LMS) http://www.elearninglearning.com/learning-management-system
11. [11] Ayodele, S., Endozo, A., & Ogbari, M. E. (2018, October) A study on factors hindering online learning acceptance in developing countries. Proceedings of the 10th International Conference on Education Technology and Computers (pp. 254-258) ACM. https://doi.org/10.1145/3290511.3290533
12. [12] Kukreja, V., Kaur, A., & Aggarwal, A. (2021). What factors impact Online Education? A factor analysis approach. Journal of Engineering Education Transformations, 34, 365-374.
13. [13] Al Maqbali, L. (2021). Impact of E-learning factors on Students Satisfaction: Sohar University-a Case study. International Journal of Research in Entrepreneurship & Business Studies, 2(1), 1-9.
14. [14] Raza, S. A., Qazi, W., Khan, K. A., & Salam, J. (2020). Social Isolation and Acceptance of the Learning Management System (LMS) in the time of COVID-19 Pandemic: An Expansion of the UTAUT Model. Journal of Educational Computing Research
15. [15] Demir, A., Maroof, L., Khan, N. U. S., & Ali, B. J. (2020). The role of E-service quality in shaping online meeting platforms: a case study from higher education sector. Journal of Applied Research in Higher Education.
16. [16] Joaquin, J. J. B., Biana, H. T., & Dacela, M. A. (2020, October). The Philippine Higher Education Sector in the Time of COVID-19. In Frontiers in Education (Vol. 5, p. 208). Frontiers.
17. [17] Reyes-Chua, E., Sibbaluca, B. G., Miranda, R. D., Palmario, G. B., Moreno, R. P., & Solon, J. P. T. (2020). The status of the implementation of the e-learning classroom in selected higher education institutions in region IV-A amidst the covid-19 crisis. Journal of Critical Reviews, 7(11), 253-258.
18. [18] Liao, C., Palvia, P., & Chen, J. L. (2009). Information technology adoption behavior life cycle: Toward a Technology Continuance Theory (TCT). International Journal of Information Management, 29(4), 309-320.
19. [19] Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. Management science, 35(8), 982-1003.
20. [20] Bhattacherjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. MIS quarterly, 351-370.

21. [21] Oliver, R. L. (1980). A cognitive model of the antecedents and consequences of satisfaction decisions. Journal of marketing research, 17(4), 460-469
22. [22] Rahim, N. F. A., Jaaffar, A. R., Sarkawi, M. N., & binti Shamsuddin, J. (2021). Fintech and Commercial Banks Development in Malaysia: Continuous Intention to Use Fintech Services in IR 4.0 Environment. In Modeling Economic Growth in Contemporary Malaysia. Emerald Publishing Limited.
23. [23] Tsai, Y. H., Lin, C. H., Hong, J. C., & Tai, K. H. (2018). The effects of metacognition on online learning interest and continuance to learn with MOOCs. Computers & Education, 121, 18-29.
24. [24] Baticulon, R. E., Sy, J. J., Alberto, N. R. I., Baron, M. B. C., Mabulay, R. E. C., Rizada, L. G. T., ... & Reyes, J. C. B. (2021). Barriers to online learning in the time of COVID-19: A national survey of medical students in the Philippines. Medical science educator, 31(2), 615-626.
25. [25] Vitales, V. A., Aquino, K. J. M., De Leon, E. F., Lacap, P. P., Maranan, S. S., & Duldulao, J. J. (2021). Preparedness and challenges of the new normal: perspectives of Filipino students in virtual learning. Technium Soc. Sci. J., 23, 199
26. [26] Pokhrel, S., & Chhetri, R. (2021). A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. Higher Education for the Future, 8(1), 133-141.
27. [27] Felix, J. J. (2021). Higher education in times of instability and disruption: Rethinking notions of values, value creation and instructional practices in Vietnam and beyond. Frontiers in Communication, 6, 22.
28. [28] Ploj Virtic, M., Dolenc, K., & Šorgo, A. (2021). Changes in Online Distance Learning Behaviour of University Students during the Coronavirus Disease 2019 Outbreak, and Development of the Model of Forced Distance Online Learning Preferences. European Journal of Educational Research, 10(1), 393-411.
29. [29] Croucher, G., & Locke, W. (2020). A post-coronavirus pandemic world: some possible trends and their implications for Australian higher education. Melbourne Centre for the Study of Higher Education: The University of Melbourne.
30. [30] Aliyyah, R. R., Rachmadtullah, R., Samsudin, A., Syaodih, E., Nurtanto, M., & Tambunan, A. R. S. (2020). The perceptions of primary school teachers of online learning during the COVID-19 pandemic period: A case study in Indonesia. Journal of Ethnic and Cultural Studies, 7(2), 90-109.
31. [31] Gillis, A., & Krull, L. M. (2020). <? covid19?> COVID-19 Remote Learning Transition in Spring 2020: Class Structures, Student Perceptions, and Inequality in College Courses. Teaching Sociology, 48(4), 283-299.
32. [32] Wu, C. G., & Wu, P. Y. (2019). Investigating user continuance intention toward library self-service technology. Library Hi Tech.
33. [33] Al-Samarraie, H., Teng, B. K., Alzahrani, A. I., & Alalwan, N. (2018). E-learning continuance satisfaction in higher education: a unified perspective from instructors and students. Studies in higher education, 43(11), 2003-2019.
34. [34] Cheng, M., & Yuen, A. H. K. (2018). Student continuance of learning management system use: A longitudinal exploration. Computers & Education, 120, 241-253.
35. [35] Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 425-478 DOI: 10.2307/30036540
36. [36] Galdolage, B. S. (2021). Prominence of Information Richness in Accepting Online Based Self-Service Technologies. Archives of Current Research International, 31–42, doi:10.9734/acri/2021/v21i230231
37. [37] Wu, J. J., Khan, H. A., Chien, S. H., & Wen, C. H. (2021). Effect of customization, core self-evaluation, and information richness on trust in online insurance service: Intelligent agent as a moderating variable. Asia Pacific Management Review, https://doi.org/10.1016/j.apmrv.2021.04.001
38. [38] Al-Maroof, R. S., Alnazzawi, N., Akour, I. A., Ayoubi, K., Alhumaid, K., AlAhbabi, N. M., ... & Salloum, S. (2021, December). The effectiveness of online platforms after the pandemic: will face-to-face classes affect students' perception of their Behavioural Intention (BIU) to use online platforms?. In Informatics (Vol. 8, No. 4, p. 83). Multidisciplinary Digital Publishing Institute.
39. [39] Syakur, A., Junining, E., & Mubarok, M. K. (2020). Developing English for Specific Purposes (ESP) Textbook for Pharmacy Students Using On-Line Teaching in Higher Education. Britain International of Linguistics Arts and Education (BIoLAE) Journal, 2(1), 467-474.
40. [40] Allo, M. D. G. (2020). Is the online learning good in the midst of Covid-19 Pandemic? The case of EFL learners. Jurnal Sinestesia, 10(1), 1-10
41. [41] Huang, H. M., & Liaw, S. S. (2018). An analysis of learners' intentions toward virtual reality learning based on constructivist and technology acceptance approaches. International Review of Research in Open and Distributed Learning, 19(1).
42. [42] Abd Malik, A. N., & Annuar, S. N. S. (2021). The Effect of Perceived Usefulness, Perceived Ease of Use, Reward, and Perceived Risk toward E-Wallet Usage Intention. In Eurasian Business and Economics Perspectives (pp. 115-130). Springer, Cham.
43. [43] Oluyinka, S., Endozo, A. N., & Cusipag, M. N. (2021). Integrating Trialability and Compatibility with UTAUT to Assess Canvas Usage During COVID-19 Quarantine Period. Asia-Pacific Social Science Review, 21(2).
44. [44] Alkhateeb, M. A., & Abdalla, R. A. (2021). Factors influencing student satisfaction towards using learning management system moodle. International Journal of Information and Communication Technology Education (IJICTE), 17(1), 138-153.
45. [45] Gupta, A., Dogra, N., & George, B. (2018). What determines tourist adoption of smartphone apps? An analysis based on the UTAUT-2 framework. Journal of Hospitality and Tourism Technology.
46. [46] Islam, A. N., & Azad, N. (2015). Satisfaction and continuance with a learning management system: Comparing perceptions of educators and students. The International Journal of Information and Learning Technology.
47. [47] Ashrafi, A., Zareravasan, A., Rabiee Savoji, S., & Amani, M. (2020). Exploring factors influencing students' continuance intention to use the learning management system (LMS): A multi-perspective framework. Interactive Learning Environments, 1-23.
48. [48] Cardullo, V., Wang, C. H., Burton, M., & Dong, J. (2021). K-12 teachers' remote teaching self-efficacy during the pandemic. Journal of research in innovative teaching & learning
49. [49] Wilcox, D., Thall, J., & Griffin, O. (2016, March). One canvas, two audiences: How faculty and students use a newly adopted learning management system. In Society for Information Technology & Teacher Education International Conference (pp. 1163-1168). Association for the Advancement of Computing in Education (AACE).
50. [50] OLUYINKA, S. A. (2016). THE ROLE OF TRUST AS A MEDIATOR IN THE RELATIONSHIP BETWEEN TECHNOLOGY FACTORS AND INTENTION TO ACCEPT INTERNET BANKING IN NIGERIA (Doctoral dissertation, Universiti Tun Hussein Onn Malaysia).
51. [51] Kyriazos, T. A. (2018). Applied psychometrics: sample size and sample power considerations in factor analysis (EFA, CFA) and SEM in general. Psychology, 9(08), 2207.
52. [52] Feskens, R., & Hox, J. J. (2018). Multilevel Structural Equation Modeling for Cross-Cultural Research: Exploring Resampling Methods to Overcome Small Sample Size Problems. In Cross-Cultural Analysis (pp. 347-362). Routledge.
53. [53] Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. European Business Review. https://doi.org/10.1108/EBR-11-2018-0203
54. [54] Solomon, O (2021) Exploring the Facets of e-learning acceptance in developing country. Kasetsart Journal of Social Sciences 42 (4), 854-861 https://so04.tci-thaijo.org/index.php/kjss/article/view/255742
55. [55] Alghizzawi, M.; Ghani, M.A.; Som, A.P.M.; Ahmad, M.F.; Amin, A.; Abu Bakar, N.; Salloum, S.A.; Habes, M (. 2018). The Impact of Smartphone Adoption on Marketing Therapeutic Tourist Sites in Jordan. Int. J. Eng. Technol, 7, 91–96, doi:10.14419/ijet.v7i4.34.23587

56. [56] Ismail, S. N., Muhammad, S., Omar, M. N., & Raman, A. (2020). The Great Challenge of Malaysian School Leaders' Instructional Leadership: Can It Affect Teachers' Functional Competency across 21st Century Education? Universal Journal of Educational Research, 8(6), 2436-2443
57. [57] Ringle, C. M., Sarstedt, M., Mitchell, R., & Gudergan, S. P. (2018). Partial least squares structural equation modeling in HRM research. The International Journal of Human Resource Management, 1-27. https://doi.org/10.1080/09585192.2017.1416655
58. [58] Roman, R. G., Trobada, C. S. P., Gaton, F. P., Gania, C. K., Oluyinka, S. A., Cuenco, H. O., & Daenos, R. G. (2020). A Study on the Utilization of e-Resources among College Students. International Journal of Knowledge Engineering, 6(1) http://www.ijke.org/vol6/127-X388.pdf
59. [59] Endozo, A. N., Oluyinka, S., & Daenos, R. G. (2019, October). Teachers' Experiences towards Usage of Learning Management System: CANVAS. Proceedings of the 2019 11th International Conference on Education Technology and Computers (pp. 91-95). https://doi.org/10.1145/3369255.3369257
60. [60] Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. https://doi.org/10.1177/002224378101800313
61. [61] Henseler, J., Ringle, C. M., & Sarstedt, M. (2015) A new criterion for assessing discriminant validity in variance-based structural equation modeling. Journal of the academy of marketing science, 43(1), 115-135. https://doi.org/10.1007/s11747-014-0403-8
62. [62] Al-Emran, M., Arpaci, I., & Salloum, S. A. (2020). An empirical examination of continuous intention to use m-learning: An integrated model. Education and information technologies, 25(4), 2899-2918. https://link.springer.com/article/10.1007/s10639-019-10094-2
63. [63] Al Kurdi, B., Alshurideh, M., Salloum, S., Obeidat, Z., & Al-dweeri, R. (2020). An empirical investigation into examination of factors influencing university students' behavior towards elearning acceptance using SEM approach. https://www.learntechlib.org/p/216583/

Development Of Cost Planning Standard For Mechanical And Miscellaneous Work On Stadium Field Of Play Works In Integrated Contracts Of State Building Design Based On Indonesian Minister Of Public Works Regulation No 22 Of 2018 To Improve Cost Accuracy

[1]Pardamean, Yosua Manaek and [2]Latief, Yusuf
[1]Student and [2]Supervisor
yosua.m@ui.ac.id and latief73@eng.ui.ac.id

Abstract
A building has its own complexity characteristics. There are many public facilities buildings that have a fairly high level of complexity, for example, the stadium. Public facilities buildings that have high complexity certainly require efficient contract methods because conventional work contract methods are considered not qualified to accommodate those who are influenced by the complexity of the building work. One suitable and better method is the Integrated Design and Build contract, this contract involves the contractor from planning to implementing the construction work completed properly, but in the event of failure, the contractor bears all the risks caused. This type of contract is considered necessary to be applied because some examples of public facilities work projects, especially sports facilities, are problematic in the implementation process. One example is the renovation of Helsinki Olympic Stadium experiencing an over-budget of up to €38 million. Another example refers to Indonesia, the 2018 XVIII Asian Games project, the initial cost of the project is Rp 7.4 trillion, then the cost rises drastically to Rp 12.7 trillion. Due to the frequent similar cases, we aim to develop specific cost planning standards for the mechanical work section, and Miscellaneous in the field of play area of the stadium with an integrated contract based on PUPR Ministerial Decree No.22 of 2018 to improve cost accuracy. The expected outcome of the entire study is to develop new Cost Planning Standards for stadium projects to improve the accuracy of project costs.

Keywords
Integrated Design And Build Contract, Improve Cost Accuracy, Stadium, Public Facilities

INTRODUCTION

Design and Build is a work construction contract related to the construction of a building where the provider has a unity of responsibility for designing and implementing construction. This design is different from conventional methods where service users do not need to prepare detail engineering design (DED), but only prepare basic design. (Inspectorate General of the Ministry of PUPR, 2020). But in its implementation, there are still many obstacles in the field. Here are some examples of problems with obstacles in using design and build contracts. The audit process of the inspection team is not separated into a problem. The examiner asks for details of the quantity and price of the unit of work which of course causes differences so that disputes or claim disputes occur between service users, service providers and auditors. The construction of the stadium building, can not be separated from the basic needs for lighting, fire extinguishers, air conditioning or other electronic equipment. ME's work is one of the largest budget contributors in project cost estimates. Often in the midst of the implementation of the project, there is less work added to mechanical and electrical work which sometimes makes a difference in documenting that is not well recorded or changes in the use of materials from the predetermined. As was the case with the stadium construction project at U.S. Bank Stadium, it is known that 90 percent of the $15.4 million in unpaid work was caused by construction companies working on power projects, drywall and other projects. This is due to changes made by the Minnesota Sports Facilities Authority and the hks architects have added costs beyond what has been agreed. Aligned with U.S. Bank Stadium, the total cost of the new Mercedes-Benz Atlanta Falcons Stadium has reached $1.5 billion after an additional $9.1 million in change orders for ME jobs in June, according to the Atlanta Journal-Constitution. The additional cost in May was largely due to an accelerated schedule to complete construction in June 2017—in time for the 2017-2018 NFL season.

LITERATURE REVIEW

Based on the Regulation of the Minister of Public Works No. 22 of 2018, the state building is one of the state-owned assets that has strategic value as a place for the implementation process of the state that is regulated and managed so that it is functional, reliable, effective, efficient and organized in an orderly manner. In preparing the financing of the construction of this State Building must get recommendations from technical agencies, so that the financing is prepared in accordance with existing provisions, both from the amount of price, standard and non-standar, classification of State Buildings, and the implementation of its construction. Design and Build can be described as a procurement method in which one entity or consortium is contractually responsible for the design and construction of a project (Ndekugri & Turner, 1994; Akintoye, 1994; Akintoye & Fitzgerald, 1995; Griffith, Knight & King, 2003). According to Hale & Shrestha, (2009), "Design and Build can be described as a project delivery method in which the owner provides the requirements for a particular project and gives a contract to one company that will design and build the project".

According to Minister of Youth and Sports Regulation No. 400 of 2013, a stadium is a piece of sports infrastructure that must be predominantly used for sporting activities/practices. The stadium is prioritized as a center for athletics and football. However, because the stadium is equipped with stands with sufficient seats for spectators and a reasonably wide arena, it can be used for a variety of non-sports activities, such as music concerts, religious activities, social activities, and other activities that involve visitors. In general, stadium work is separated into three parts: the main stadium building, field of play, and regional work. The field of play zone's scope of work comprises a football field and an athletic track.

According to Permen PU No. 28 of 2016 there are 7 categories for the scope of work, namely: Design Development, Sitework, Structural Work. Architectural Work, Mechanical Work, Electrical Work, Exterior Facilities and Miscellaneous Work. Mechanical work is work related to large tools and machinery, such as elevators and escalators for large buildings, air conditioners, as well as the installation of water pumps, and other supporting installations. Types of mechanical work according to Permen PU No. 28 of 2016 include Plumbing, heating, ventilation and air conditioning, fire prevention. Mechanical work activities in the field of play to be studied include the procurement and Installation of HDPE Pipes, installation of Saddle Clamp and installation of GIP Pipes, Gate Valve, Quick Coupling, etc. Miscellanious work is another job. Miscellanious work types according to Permen PU No. 28 of 2016 include equipment, special construction, communication systems, lightning prevention. Miscellanious work activities in the field of play that will be studied include Soil Breeding, Grass Planting, Fertilizing and Watering, etc. Standard costs are used for the implementation of standard physical construction which includes architectural work, structures, utilities that include plumbing work, and lighting installation networks, and finishing. Standard costs include construction overhead, insurance, occupational safety, inflation, and taxes in accordance with the provisions of the standard cost in addition to standard construction implementation work, including construction implementation overhead, insurance, occupational safety, inflation, and taxes in accordance with the provisions of the laws and regulations.

Table Error! No text of specified style in document.**.1 Indicators and Variables of Standard Cost**

No	Variable	Indicator	Reference
1	Standard Cost	Work component	Jauzy A. (2012); BPSDM PUPR (2016); Public Works Ministerial Decree (2017)
		Technical specifications	Fisk, E.R (1992) Public Works Ministerial Decree (2018); Public Works Ministerial Decree 22 Tahun 2018; Ghallab and Hosain (2020);
		Standard area	Jauzy A. (2012); BPSDM PUPR (2016); Public Works Ministerial Decree (2017); Public Works Ministerial Decree (2018)
		Number of seats	UEFA Guide to Quality Stadiums (2011); Permen Menpora No.0400 Tahun 2013;
		The highest unit price for state buildings	Jauzy A. (2012); BPSDM PUPR (2016); Public Works Ministerial Decree (2017)
		Construction cost index	Hikmah J. dan Idris (2019)

According to Presidential Decree No. 73 of 2011, non-standard costs are costs used for the implementation of non-standard physical construction (for which there is no standard), such as: licensing other than IMB, and utility splicing. Non-standard costs for the implementation of non-standard physical construction work: preparation and maturation of land, increase in building architecture work, increased building structure work, special construction completeness consisting of mechanical and electrical work, and special buildings are environmentally friendly.

Table Error! No text of specified style in document.**.2 Indicators and Variables of Non-Standard Cost**

No	Variable	Indicator	Reference
1	Non-Standard Cost	Volume details	Jauzy A. (2012); BPSDM PUPR (2016)
		Buildings and environment	Public Works Ministerial Decree (2017)
		Significant function	Public Works Ministerial Decree (2017); Permen PU (2018)
		Other works	Public Works Ministerial Decree (2017)

Additonal costs are not included in standard or non-standard costs. Examples include the issue of an IMB (Building Permit), internet connection fees, soil investigation testing, and costs of safety.

Table Error! No text of specified style in document.**.3 Indicators and Variables of Additional Costs**

No	Variable	Indicator	Reference
1	Additional Costs	IMB or PBG	Governor Regulation No. 147 of 2018; Herea and Ungureanu (2018); PP No. 16 of 2021
		Internet Connection Fee environment	Rusniati (2020); KOMINFO Decree Candy No. 14 of 2017
		Soil Investigation Test	SNI 8460:2017; Rena. M (2011)
		Cost of Safety	Public Works Ministerial Decree No. 10 of 2021

Based on the literature and previous studies that discussed the Cost Planning Standard followed by regulations or policies from Permen PU No. 22 of 2018 and previous studies that discussed cost accuracy, in this study there was a variable X (Free Variable) which is a standard cost and non-standard cost that can affect variable Y (Bound Variable) namely cost accuracy.

Table Error! No text of specified style in document.**.4 Research Synthesis – Relation Between Variables**

No	Relation Between Variables	Reference
1	Standard Cost → Cost Accuracy	Permen PU No. 22 (2018); Perpres No. 73 (2011)
2	Non Standard Cost → Cost Accuracy	Muhammad T. H (2017); Pradana & Miftahul (2019)
3	Other Cost → Cost Accuracy	Muhammad T. H (2017); Alfredo F. (2005)

Based on the background of the problem and the study of literature, it can be concluded the hypothesis of this study, namely:

1. Standard Cost Variables affect the accuracy of costs significantly.
2. Non-Standard Cost variables affect cost accuracy significantly.
3. Other Cost affect cost accuracy significantly.

METHOD

Material, to determine variables and indicators, this research begins with the collection of secondary data, including literature reviews and archive analysis. Then collect primary data, which includes expert confirmation of the literature study's findings and distribution of questionnaires to respondents.

Samples, Secondary data are collected through literature studies, namely in journals that discuss cost planning standards and how to improve cost accuracy, in order to get the variables and indicators indicated in sub chapter 2.5. The first stage of data collecting was to solicit expert advice on cost accuracy. There are five professionals with more than ten years of expertise and the most recent education is a Master of Engineering. After obtaining agreement and input from experts, move to the second stage of data collection in order to validate the language used in the questionnaire that will be disseminated to the primary respondents in the third stage of data collection. After obtaining the findings of the second stage of data collection, move to the third step of data collection, which involved the distribution of questionnaires to respondents based on the respondent criteria.

1. Minimum education of three years
2. Minimum education S1 (Bachelor) majoring in Civil Engineering / Architecture / Mechanical or Electrical Engineering.
3. Have or are currently in construction work

Procedure, the procedure selected for this research is archive analysis, questionnaire-based surveys, statistical analysis using SPSS and SmartPLS tools, and expert validation. The questionnaire that will be used in this study as a research tool. The Research Question (RQ) data collection process is divided into many stages. Prior to performing a pilot survey for the first questionnaire, a review of the archives of prior literature research was conducted to gather material for questionnaire development. The first stage of data collection is to ascertain the elements of standard costs, non-standard costs, and other costs that may affect the accuracy of costs on cost planning standards for the scope of design development work, sitework, and stadium structures by validating content and constructs through interviews and discussions with experts.

Research Process, several research methods were used in this study to address the problem formulation, including archive analysis, questionnaires, and expert validation. The study used a questionnaire to collect data from respondents, and

then analysed the association between standard cost variables, non-standard costs, and cost accuracy using SEM-PLS and subsequent validation with experts or experts. The data collected will be analysed to create a standard form of cost planning that will be transformed into cost planning standards in accordance with Minister of Public Works Regulation No. 22 of 2018 in order to increase cost accuracy.

Data Analysis, following the collection of all data, data analysis is performed. Data analysis was used to ascertain whether the independent factors influenced the dependent variable. The obtained data will be analyzed using the SPSS and SmartPLS tools. Before analyzing the respondent data, a test was undertaken to ensure that the obtained data was usable and met the requirements. The following tests are performed on the respondent's data: data adequacy, homogeneity, validity, reliability, and KMO data adequacy. After the data was validated and found to meet the requirements, the authors analyzed the respondent's data. SmartPLS software was used to conduct the analysis. To ascertain the effect of planning standards on cost accuracy in state buildings, this research is extended by evaluating respondent questionnaire data using the SmartPLS tool after it has been analyzed using the SPSS tool.

Test Validity with SPSS, the product moment Pearson correlation test results in a correlation coefficient which is used to measure the strength of the linear relationship between two variables. The result to be analysed in this test is the Pearson correlation value "r" which can be said to be valid if "r" is greater than the significance where the significance value obtained in the distribution table of the "r" table is 0.24. It was found that the Pearson value on each indicator was greater than the "r" table = 0.24 where it can be concluded that all data are valid.

Reliability Test (Cronbach's Alpha) with SPSS, in this study, the reliability test (Cronbach's Alpha) was used to determine the reliability and consistency of the measuring device by measuring the consistency and stability of the responses or data. The researchers used the SPSS tool to conduct a reliability test using the Cronbach's Alpha method under the following conditions:

• Cronbach's Alpha value > 0.06 then reliable
• Cronbach's Alpha value < 0.06 then not reliable

The result test as follow :

Table 3.1 Results of Reliability Test

Reliability Statistics	
Cronbach's Alpha	N of Items
0.712	19

The reliability test results in Table 4.9 showed that the 19 indicators in the study had Cronbach alpha's values of 0.712 > 0.6 which means all indicators are reliable and the study is reliable.

Data Sufficiency Test – KMO (Kaiser Meyer Olkin) with SPSS, the KMO & Bartlett test was used to determine the data adequacy in this study, which was conducted using the SPSS program tool. After calculating the KMO and Bartlett, the following findings are obtained:

Table 3.2 Calculation Result of KMO dan Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.761
Bartlett's Test of Sphericity	Approx. Chi-Square	507.369
	df	171
	Sig.	0.000

Kmo & Bartlett's Test results in Table 4.11 showed that the study had a KMO value of 0.761 > 0.5, so the sample of this study has been sufficiently used. Bartlett's Test of Sphericity value has a significance value of 0.000 < 0.05 which means there is a significant correlation relationship between research variables so that it can be continued to the next stage of analysis.

RESULT

Because each indicator has a T-statistic more than 1.96 or a P-Value < 0.05, they all have a significant effect on the latent variable. Additionally, the following table contains the path coefficient obtained results using bootstrapping to determine the significance of the relationship between variables. Table 4.1 Bootstrapping Results by Path Coefficient.

Table 4.1 T-Statistic Results (Boot Stramping)

Relation	**Original Sample (O)**	**T Statistics (|O/STDEV|)**	**P Values**	**Description**
Non-standard Cost -> Cost Accuracy	0.399	5.019	**0.000**	Significant Impact
Standard Cost -> Cost Accuracy	-0.296	2.973	**0.003**	Significant Impact
Other Cost -> Cost Accuracy	0.300	3.703	**0.000**	Significant Impact

The Path Coefficient result in Table 4.19 shows variable X1. Standard Cost, X2. Non-Standard And X3 Costs. Other costs have a significant effect on Y1. Cost Accuracy due to T-Statistic value > 1.96 or P-Value value < 0.05. Standard costs (0.399) and other costs (0.300) have a positive path coefficient value which means standard costs and miscellaneous costs have a positive and significant effect on increased cost accuracy. While non-standard costs (-0.296) have a negative path coefficient value which means non-standard costs negatively and significantly affect the decrease in cost accuracy. If sorted from the smallest p-value to the largest coefficient, then the variables that most affect cost accuracy are standard costs, other costs and the last is non-standard costs.

R Square, is the coefficient of determination that explains how far the dependent data can be explained by independent data. R Square is worth between 0 – 1 with the provision that

the closer to 1 (one), the better. R Square is owned by variable Y (dependent variable).

Table 4.2 R Square Table, Result of Bootstrapping

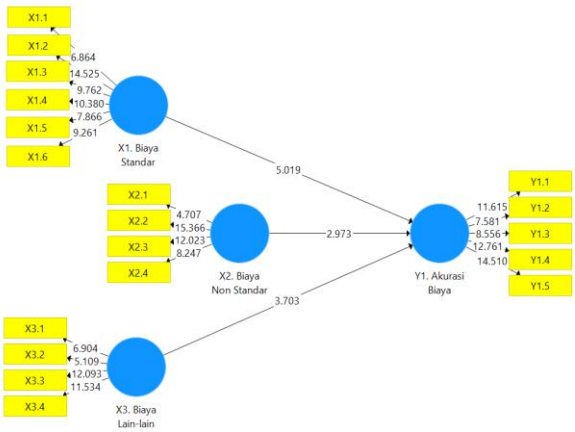
	R Square	R Square Adjusted
Y1 - Cost Accuracy	0.597	0.579

Table 4.2 shows the variable R-square value of cost accuracy is 0.597 which indicates that cost accuracy can be explained by standard fees, non-standard costs and other costs of 59.7% which fall into the moderate category. (Joe F Hair et al., 2011). The remaining 40.3% can be explained by variables other than those used in the study.
Model Fit, shows how good the model is.

Table 4.3 Result of Fit Model

	Saturated Model	Estimated Model
SRMR	0.100	0.100
d_ULS	1.902	1.902
d_G	0.701	0.701
Chi-Square	2478.195	248.195
NFI	0.562	0.562

the model in this study was able to represent the actual state of the field by 56.2%.



Picture 4.1 Structural Equation Modelling Overview on Inner Model

T-Statistics (Boot Stramping) results are also obtained from Table 4.1 for the mathematical model of the research findings based on the Original Sample (O), namely Y = 0.399 X1 – 0.296 X2 + 0.300 X3. Additionally, the level of accuracy increases if the variable X1 Standard Cost and X3 Additional Cost is increased, and the accuracy rate is also increased if the X2 variable is increased. Non-Standard Fees reduced.

ACKNOWLEDGEMENT

I would like to thanks to Prof. Yusuf Latief as a supervisor research, to Mr. Anggoro Putro as a supervisor on this research, my wife Firsty Anastasia, Taleya Joanna and Omar Theo my son and my daughter, my parents and my brother who always support for this research.

REFERENCE

1. UEFA. (2011). UEFA Guide To Quality Stadiums. Nyon: Union of European Football Associations.
2. Basrowi dan Suwandi. (2012). Memahami Penelitian Kualitatif. Jakarta: Rineka Cipta. CA. Umar. A.A.A.F., Ronald, M., Simanjuntak, A. (2020). Analisis Risiko Metode
3. Dandan, T.H., Sweis, G., Sukkari, L.S. (2019). Factors Affecting the Accuracy of Cost Estimate During Various Design Stages. Journal of Engineering, Design and Technology, Vol. 18, No. 4, pp. 787-819.
4. Design Build Institute of American (DBIA). (2018). Revisiting Project Delivery Perfomance 1998-2018.
5. Hatamleh, M.T., Hiyassat M., Sweis G.J., Sweis R.J. (2018). Factors Affecting the Accuracy of Cost Estimate: Case of Jordan. Enggineering Construction and Architectural Management. Vol. 25, No. 1, pp. 113-131.
6. Kwon, H, and Kang, C.W. (2019). Improving Project Budget Estimation Accuracy and Precision by Analyzing Reserves for Both Identified and Unidentified Risks. Project Management Journal. Vol. 50, No. 1, pp. 86-100.
7. Latief, Y., Wibowo, A., Wisnu, I. (2013). Preliminary Cost Estimation Using Regression Analysis Incorporated With Adaptive Neuro Fuzzy Inference System. International Journal of Technology (2013) 1: pp. 63-72.
8. Ling, F.Y.Y. and Leong, E.F.K. (2002). Performance of Design-Build Projects in Terms of Cost, Quality and Time: Views of Clients, Architects and Contractors in Singapore. The Australian Journal of Construction Economics and Building, Vol. 2, No. 1, pp. 37-46.
9. Omran, A. and Hooi, L.B. (2018). Determining the Critical Factors in Ensuring the Accuracy of Cost Estimate in Obtaining a Tender. Acta Technica Corviniensis – Bulletin of Engineering, ISSN: 2067-3809, Fascicule 3, pp. 23-26.
10. Park, J. and Kwak, Y.H. (2017). Design-Bid-Build (DBB) vs. Design-Build (DB) in the U.S. Public Transportation Projects: The Choice and Consequences. International Journal of Project Management, Vol 35, pp. 280-295.
11. Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 12/PRT/M/2017 Tahun 2017 Tentang Standar dan Pedoman Pengadaan Pekerjaan Konstruksi Terintegrasi Rancang dan Bangun (Design and Build).
12. Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 19/PRT/M/2015 Tahun 2015 Tentang Standar dan Pedoman Pengadaan Pekerjaan Konstruksi Terintegrasi Rancang dan Bangun (Design and Build).
13. Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 22 Tahun 2018 Tentang Pembangunan Bangunan Gedung Negara.
14. Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 28 Tahun 2016 Tentang Pedoman Analisis Harga Satuan Pekerjaan Bidang Pekerjaan Umum.
15. Putro, A. and Latief, Y. (2020). Implementation of Design and Build Contract in Government Building Construction Project Practice. IOP Conference Series: Materials Science and Engineering.
16. PMBOK. (2017). Project Management Body Knowledge 6th Edition.
17. Seng, N.G.W. and Yusof, A.M. (2006). The Success Factors of Design and Build Procurement Method: A Literature Visit. Proceedings of the 6th Asia-Pacific

Structural Engineering and Construction Conference (APSEC 2006), 5-6 September 2006, Kuala Lumpur, Malaysia.
18. Sequeira, S. and Lopes, E. (2015). Simple Method Proposal for Cost Estimation from Work Breakdown Structure. Procedia Computer Science, Vol 64, pp. 537-544.
19. Sridarran, P., Keraminiyage, K., Herszon, L. (2017). Improving the Cost Estimates of Complex Projects in the Project-Based Industries. Built Environment Project and Asset Management, Vol. 7, No. 2, pp. 173-184.
20. Standar SK SNI T-25-1991-03: Tata Cara Perencanaan Teknik Bangunan Stadion. Standish Group International. (2015). Chaos Report 2015. www.standishgroup.com
21. Sugiyono. (2009). Metode Penelitian Kuantitatif, Kualitatif dan R&D, Bandung : Alfabeta.
22. Tarigan, A.M., Abdullah, A., Rani, H.A. (2018). Faktor-Faktor Risiko Design and Build yang Mempengaruhi Kesuksesan Proyek Rehabilitasi Total Gedung Pendidikan di Provinsi Daerah Khusus Ibukota Jakarta. Journal of Archive in Civil Engineering and Planning. E-ISSN: 2615-1340; P-ISSN:2620-7547, Vol.1, No. 2 pp. 156-165
23. Taurano, G.A. and Hardjomuljadi, S. (2013) Analisa Faktor Penyebab Klaim pada Proyek Konstruksi yang Menggunakan FIDIC Conditions of Contract for Plant and Design Build. Jurnal Konstruksia, Vol. 5, No. 1, pp. 14-25.
24. Tsai, T.C. and Yang, M.L. (2010). Risk Assessment of Design-Bid-Build and Desgin-Build Building Projects. Journal of the Operations Research Society of Japan, Vol. 53, No. 1, pp. 20-39.
25. Umar, A.A.A.F.CA., Ronald, M., Simanjuntak, A. (2020). Analisis Risiko Metode Konstruksi Design and Build Terhadap Waktu Pelaksanaan Proyek Pada Pembangunan Gedung PT ABC. Prosiding Seminar Nasional Teknik Sipil 2020, ISSN: 2459-9727, pp. 241- 249.
26. Tarigan, A.M., Abdullah, A., Rani, H.A. (2018). Faktor-Faktor Risiko Design and Build yang Mempengaruhi Kesuksesan Proyek Rehabilitasi Total Gedung Pendidikan di Provinsi Daerah Khusus Ibukota Jakarta. Journal of Archive in Civil Engineering and Planning. E-ISSN: 2615-1340; P-ISSN:2620-7547, Vol.1, No. 2 pp. 156-165
27. Taurano, G.A. and Hardjomuljadi, S. (2013) Analisa Faktor Penyebab Klaim pada Proyek Konstruksi yang Menggunakan FIDIC Conditions of Contract for Plant and Design Build. Jurnal Konstruksia, Vol. 5, No. 1, pp. 14-25.
28. Umar, A.A.A.F.CA., Ronald, M., Simanjuntak, A. (2020). Analisis Risiko Metode Konstruksi Design and Build Terhadap Waktu Pelaksanaan Proyek Pada Pembangunan Gedung PT ABC. Prosiding Seminar Nasional Teknik Sipil 2020, ISSN: 2459-9727, pp. 241- 249.
29. Young, B.E., Seidu, R.D., Ponsford,S., Robinson, H., Adamu.Z. (2021). Cost Changes in UK Design and Build Project. Journal of Emerging Trends in Economic and Management Sciences (JETEMS), ISSN: 2141-7024, Vol.12, No. 1, pp. 49-57.

Swarm Intelligence Based Maze Solver

[1*]Digya Acharya, [1]Pranish Bhagat, [1]Pratik Bhandari, [1]Sijan Bhattarai, and [2]Dinesh Baniya Kshatri
[2]Department of Electronics and Computer Engineering
[1]Institute of Engineering, Pulchowk Campus, Tribhuvan University
[2]Institute of Engineering, Thapathali Campus, Tribhuvan University

Abstract
Efficient collision-free motion through environments comprising obstacles is crucial to developing autonomous navigation systems used for target detection and tracking. In this paper, we have designed a two-robot system with swarm intelligence, whereby one bot helps the other autonomously navigate through a maze and arrive at the destination. The bot commencing the navigation uses infrared sensors to avoid obstacles whilst following the Left Wall Follower Algorithm. Upon reaching the target position, the initial bot wirelessly transfers the unoptimized path information recorded while traversing the Maze to the second bot, which then extracts the optimum path and autonomously follows it. We have used short-range Bluetooth for communication and Arduino Uno chip-set to program both the bots. Rather than stepper motors, we have opted for direct current motors together with differential kinematics. This hardware modification avoids slippage, reduces cost, and increases the bots' degrees of freedom and speed. Furthermore, establishing a communication pathway between two Arduinos using a Bluetooth module for coordinated search with a novel encoding algorithm is a significant milestone of this project.

Keywords
Bluetooth, Left wall follower algorithm, Maze solving, Swarm robotics

INTRODUCTION

Sahin *et al.* (2007) defined swarm robotics as a novel approach to the coordination of large numbers of robots and the study of how large numbers of relatively simple physically embodied agents can be designed such that a desired collective behaviour emerges from the local interactions among agents and also between the agents and the environment. Beni (2004), scholar, University of California describes this kind of robots' coordination as: "The group of robots is not just a group. It has some special characteristics found in swarms of insects i.e. decentralized control, lack of synchronization, and simple and (quasi) identical members." Although swarm robotics is still in its infancy, it can effectively be adopted to tackle many real-world engineering problems. Some of them are natural disaster zones (Ross *et al.* 2018; Karasi and Rathod 2016), hostage rescue situations (Zhang *et al*. 2019; Winfield *et al.* 2006), navigation in unknown territory (Banks *et al.* 2008; Tan and Zheng 2013) and waste removal (Hsieh and You 2014). The communication between two bots with different complexities can even enable the bot with lower complexity grade to achieve more intelligence than the one with higher complexity. The second bot and all the other subsequent bots require less hardware and computational power.

For the Robot to traverse an unfamiliar surrounding and identify obstacles successfully, individual sensors are required. Infrared (IR) sensors (Ismail *et al.* 2016; Rahman *et al.* 2018) and ultrasonic sensors (Win *et al.* 2011) have widely been used in such robots. Among them, IR sensors are more extensively used because of their narrow range of field, whereas ultrasonic sensors have a wider sensing area (Sasidharan *et al.* 2016; Mustapha *et al*. 2014). Light Detection and Ranging (LiDAR) is another technology that has brought recent developments in the use of autonomous navigation (Fernandez *et al.* 2013).

In this paper, Bluetooth technology has been used to establish a communication link between two robots for simplicity and ease of use within a short-range. Similarly, differential kinematics in direct current (DC) motors enabled smooth movement and direction control by providing more degrees of freedom. Since the trajectory used in this project is a wall-linked maze with the target point located at the periphery, Left Wall Follower Algorithm is implemented.

1.1 Motivation

Unlike a single bot, which emulates the action of humans and accomplishes the tasks solely (Coradeschi *et al.* 2006, Wu 2009), the swarm robotics is inspired by social insects' behaviour. Inside the colony of these insects, there are interactions between the individuals and the individuals and the environment (Gordon 2016, Fewell 2003). These interactions propagate throughout the colony and enable them to solve the tasks that couldn't have been accomplished by a lone bot. By adopting social insects' characteristics in a multi-robot setting, the robotic swarm can be made robust to individual failure with fewer hardware components and adaptable to solve unforeseen maze complexities in the shortest time.

MATERIAL AND METHODS

2.1. System architecture

The system contains two robotic agents. First, one of the agents traverses the whole Maze and relays the information it

gathered to the second agent via Bluetooth, as demonstrated in Fig. 1.

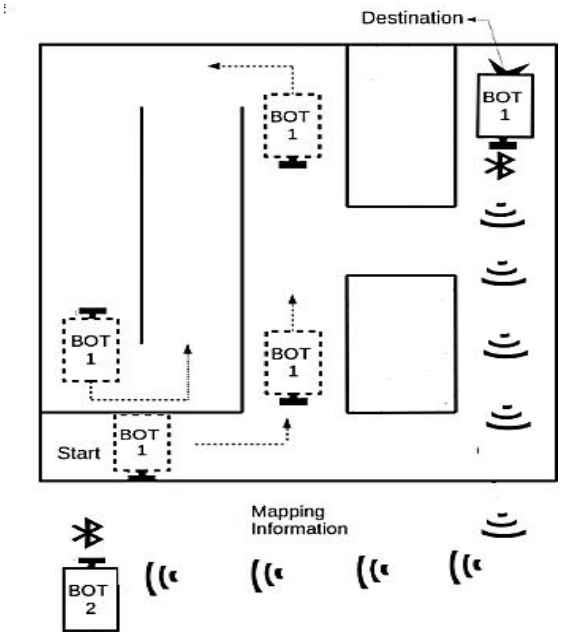


Fig. 1 Overall System Architecture

The Maze solving is carried out in several steps, as shown in the functional block diagram in Fig. 2. The IR sensors of the first Robot detect the walls based on which the ATmega328P microcontroller makes the movement decision. As the motor action drives the Robot either left, straight, right or back, it reaches a junction at some point. This process continues until the target is detected by the smoke sensor (MQ-2 Gas Sensor).

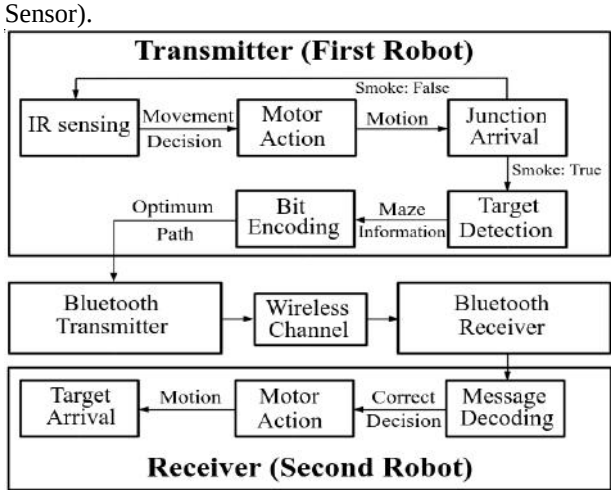


Fig. 2 Functional Block Diagram of the system

While traversing through the Maze, the first bot encodes and stores the direction changes that it makes. After the target gets detected, it calculates the shortest path information encoded and sends to the second bot via Bluetooth. The second bot decodes the message it obtains from the first bot to extract the optimum path at the receiving side, and guides itself to the destination using this path information. It is also equipped with IR sensors to restrict the deviation from the scheduled path.

2.2. Maze structure

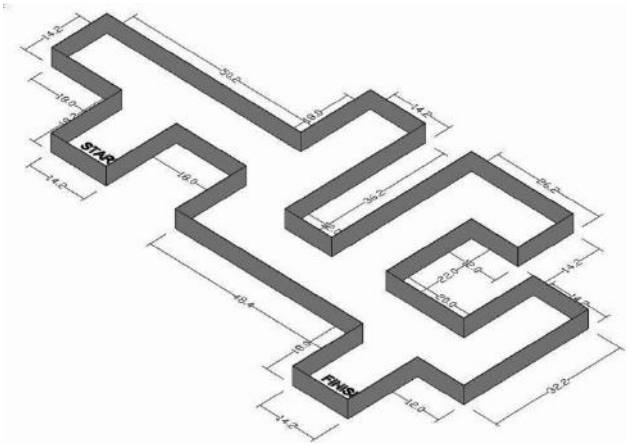


Fig. 3 Three-dimensional view of the Maze

The walls of the Maze have a uniform height of 6 inches. The width of the path that the Robot drives in is 14.2 inches. The appropriate distance between the two walls for the Robot to drive through was selected by a trial and error process where the Robot was made to run through various widths' paths. Suitable width was required for the Robot to make U-turn properly without making contact with the walls. Similarly, the sensing distance for the right and left sensors were kept in mind while determining the width.

To implement the Left Wall Follower algorithm, a single-entry, single-exit maze was designed. The maze walls were connected with cellulose-based adhesive tape. The start and target point of the Maze was selected, as shown in Fig. 3.

2.3. Robot configuration

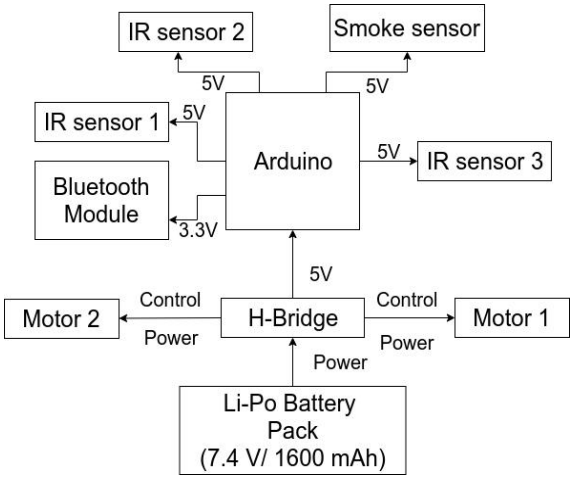
The agents used in this project have two rear wheels rotated using a DC motor mounted on the wheel's axle. Each of the rear wheels has two degrees of freedom, i.e. they can be rotated in two directions (forward and backward). At the front end of each of the robots is a caster ball wheel that balances it. The use of the caster ball wheel can be justified as our project is not concerned with the rough terrain's motion. The physical dimensions of the robots are illustrated in Table 1.

Table 1. Physical Dimension of Robots

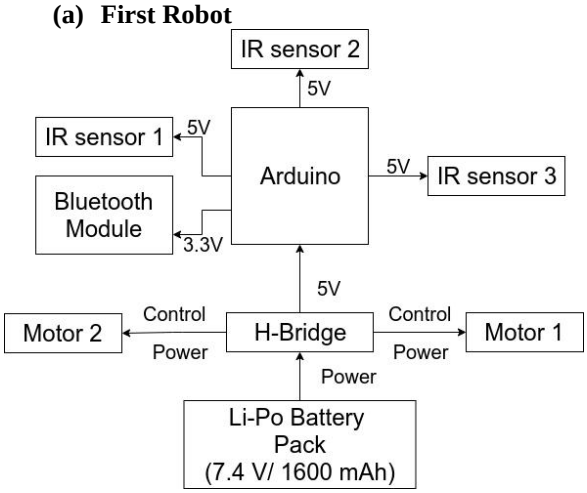
Attributes	Dimension (in inch)
Length	8.27
Width	3.93 (short side) / 5.9 (longer side)
The diameter of rear wheels	2.52
The diameter of the caster wheel	0.433

Aside from the descriptions above, each of the robots consists of several sensor modules. The first Robot has 3 IR sensors, each attached to the front, left and right side of the body as shown in Fig. 4a. The smoke sensor is attached to the front end beside the IR sensor. Similarly, the Bluetooth module HC-05 is placed at the rear end. The motor controller is placed at the center of the body, and the battery is connected at the backside. Small holes are drilled at various body locations to allow sensors and modules to be attached firmly.

The second Robot is intentionally made simpler for utilizing the benefits of swarm intelligence and does not contain the smoke sensor (Fig. 4b).



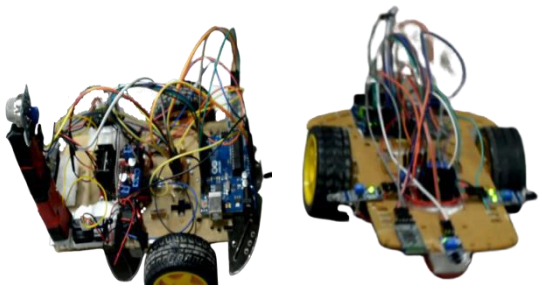
(a) First Robot



(b) Second Robot

Fig. 4 Schematic Representation of Robots

The H-Bridge motor controller (L298N) is used as an interface between the microcontroller and DC motor to prevent the circuit from damage and automate the switch of the voltage's polarity applied to motors. The supply to the UNO is provided via the 5V output socket of the motor controller powered by the Lithium Polymer battery. The final view of both the robots after all the configurations is displayed in Fig. 5.



(a) First Robot (b) Second Robot

Fig. 5 Final view of the Robots

2.4. Robot locomotion

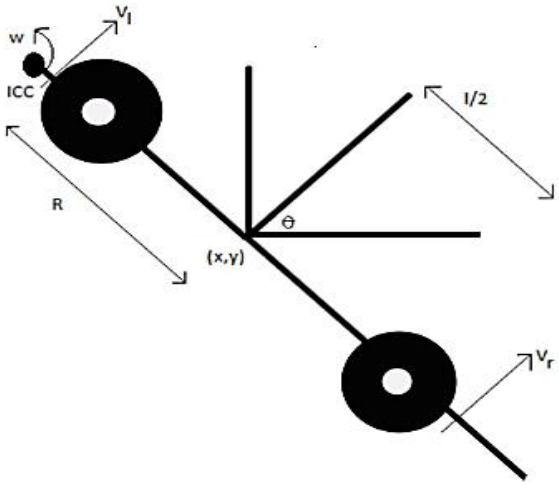


Fig. 6 Arrangement of Differential Drive Kinematics

Each of the robots moves with a differential drive and contains 6 degrees of freedom expressed by the pose: *(x, y, z, Roll, Pitch, Yaw)*. Here, *(x, y, z)* is the position and *(Roll, Pitch, Yaw)* provides the altitude information. If v_r and v_l are the velocities of the right and left wheels, *T* is the time taken by wheels to complete one full turn around Instantaneous Center of Curvature (ICC), *R* is the distance between ICC and the midpoint of the wheel axis, *l* is the length of the wheel axis, and *w* is the angular velocity then, the velocity of each of the wheels is given by:

$$v_r = w(R + l/2) \quad (1)$$

$$v_l = w(R - l/2) \quad (2)$$

By varying the velocity of the wheels, we can alter the trajectory and angular velocity in which the Robot moves:

$$R = \frac{l}{2}\frac{(v_l + v_r)}{(v_l - v_r)} \quad (3)$$

$$w = \frac{(v_r - v_l)}{l} \quad (4)$$

There is a forward linear motion in a straight line if $v_l = v_r$, the wheels rotate in place about the midpoint of the wheel axis if $v_l = -v_r$ and there is a rotation about the left and right wheel if $v_l = 0$, $v_r = 0$ and $R = l/2$. Using differential kinematics, robots can quickly move and change their direction because of more degrees of freedom. The rear wheels are driven by the Pulse Width Modulation (PWM) signal generated from the processor, which in our case is ATmega328P. PWM signal affects the differential drive and motion of the wheels.

2.5. Maze traversal

Left wall follower algorithm has been used for maze traversal, which moves following the sequence in Fig. 7.

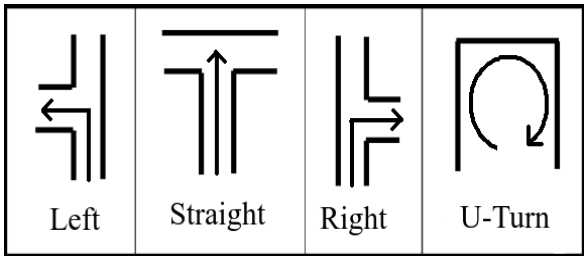


Fig. 7 Movement Precedence in Left Wall Follower Algorithm

The first agent, irrespective of the target's position, always prefers the left path over a straight path and straight path over the right one. However, the second Robot has to eliminate the mistakes made by the first Robot to avoid reaching the dead ends. The information about the Maze structure and decisions made at every junction gathered by the first agent must be moulded into the appropriate payload that can be sent through the Bluetooth module HC-05 to the second Robot.

Table 2. Encoded Binary Values of the Decisions made by the Robot

Decision	Bits
Left	001
Straight	010
Right	011
U-turn	101

The payload for the Bluetooth communication can be generated by encoding the Robot's distance between the points of interest, but for the implementation of this, we need an encoder. However, our implementation algorithm encodes the decision made at every junction and does not require an encoder's integrated circuit.

In this implementation model, all the junctions are assigned a number that gives the junction position. Then, the decisions made at each junction are sent as a string of encoded binary data which are later decoded by the second Robot in the course of finding the most optimal path. All the possible decisions that can be made at any junction are encoded using 3-bits as shown in Table 2. 3-bits have been used to encode four possible decisions because, during the decoding step, the second Robot substitutes the undesired decisions with bits "000" to eliminate those decisions. Thus, the use of 2-bit encoding would have caused a problem while eliminating the undesired message bits.

RESULTS

From the initial position, the first Robot traversed the Maze, and the required decisions at the junctions were taken based on the priorities provided by the left wall follower algorithm. The final path travelled by the first Robot is displayed in Fig. 8. The Robot detected the target (smoke) at the finish position using MQ-2 Gas Sensor, as shown in Fig. 10. For the detection of the target, the sensor analogue output voltage was read, and when it reached a certain threshold, the target detection decision was taken as positive and subsequently, the first Robot was stopped for any locomotion after that.

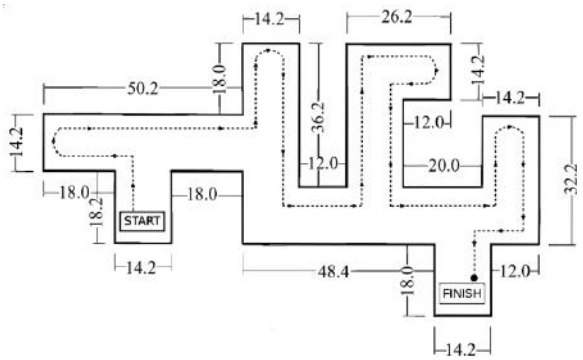


Fig. 8 Path Travelled by First Robot

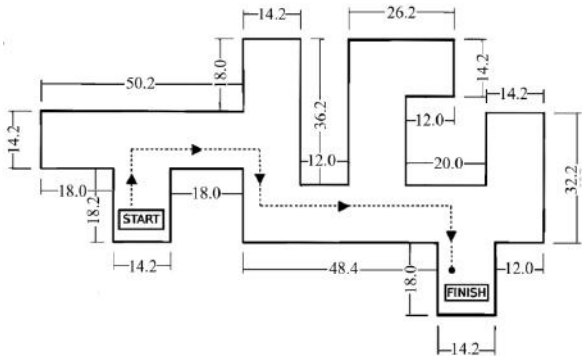


Fig. 9 Path Travelled by Second Robot

Both the master and slave LEDs setup HC-05 blinked at the rate of two fast blinks every two seconds, indicating that they have paired with each other. The encoded decisions taken at the junctions were then decoded and were sent to the second Robot via Bluetooth.

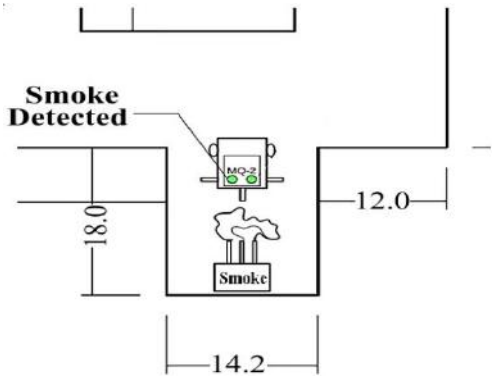


Fig. 10 Detection of Target at the Finish Position

Thus, based upon the decoded message, the second Robot traversed the Maze in the shortest path possible as demonstrated in Fig. 9. The decision taken at various junctions by the first Robot are:

S	L	U	S	L	U	S	L	U	L	S	U	L

Here, 'S' denotes the straight path, 'R' denotes right direction, 'L' signifies left and 'U' means U-Turn. The decoded decisions sent to the second Robot are:

S	R	R	S	R

We also examined the PWM waveforms of DC motors (Fig. 11). The direction of current H-Bridge flow was changed, and the Robot was moved in left, right, clockwise and anticlockwise direction. From the PWM waveforms, we observed that motor 2 is mobilized 75 percent of the time during motion in the left direction, and motor 1 is used the

most during rightward motion. During both left and right motion, the other motor remains stationary while one is moving. Similarly, for the motion in the clockwise direction, both the motors are operated most of the time, and they are least exploited in the anticlockwise direction.

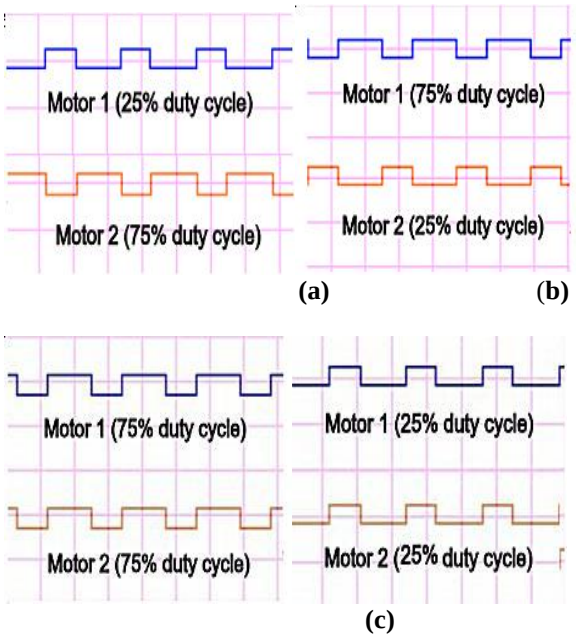


Fig. 11 PWM Waveforms of DC Motors (a) when the motor was moved in the left direction (b) when the motor was moved in the right direction (c) when the motor was moved in the clockwise direction (d) when the motor was moved in the anticlockwise direction

CONCLUSION AND FUTURE ENHANCEMENTS

This paper demonstrated the concept of swarm robotics in Maze solving using Left Wall Follower Algorithm. We also used a new method to encode the bits while communicating through Bluetooth. By using castor wheels, H-bridge and DC motors with differential kinematics for locomotion and interface, we avoided unforeseen problems like slippage, circuit damage and rotation issues.

In the future, we plan to use robust IR sensors that work under various lighting conditions, integrate the camera with the robots to map the Maze surrounding and implement dynamic path planning. We will also use the IEEE 802.11 protocol for communication and add more robots in the swarm.

ACKNOWLEDGEMENTS

We would like to express our sincerest gratitude towards the Robotics Club, Pulchowk Campus, Tribhuvan University for providing valuable suggestions. We also thank all the reviewers for their valuable input to the work.

REFERENCE

1. Erol Sahin, William Spears, and Alan Winfield. 2007. Swarm Robotics.
2. Gerardo Beni. 2004. From swarm intelligence to swarm robotics. Volume 3342. Pp. 1–9.
3. Ross D. Arnold, Hiroyuki Yamaguchi, and Toshiyuki Tanaka. 2018. Search and rescue with autonomous flying robots through behaviour-based cooperative intelligence—Journal of International Humanitarian Action.
4. A.Karasi and A. P. S. Rathod. Finding a safe path and locations in the disaster-affected area using swarm intelligence. 2016. In 2016 International Conference on Emerging Trends in Communication Technologies (ETCT). Pp. 1–5.
5. Sanfeng Zhang, Lianjie Li, Shifu Wang, Lifeng Liu, Fei Yang, and Zhiyong Wang. 3d aircraft path planning for hostage rescue by artificial immunity algorithm. 2019. IOP Conference Series: Materials Science and Engineering. 490:042005.
6. Alan Winfield, Christopher Harper, and Julien Nembrini. 2006. Towards the application of swarm intelligence in safety-critical systems. Pp. 89 – 95.
7. Alec Banks, Jonathan Vincent, and Keith Phalp. Particle swarm guidance system for autonomous uncrewed aerial vehicles in an air defence role. 2008. Journal of Navigation.
8. Ying Tan and Zhong Yang Zheng. Research advance in swarm robotics. 2013. Defence Technology.
9. Y. C. Hsieh and Peng-Sheng You. An artificial intelligence approach for the stable waste collection problem. 2014. Applied Mathematics Information Sciences. 8:283–291.
10. R Ismail, Z Omar, and S Suaibun. Obstacle-avoiding Robot with IR and PIR motion sensors. 2016. IOP Conference Series: Materials Science and Engineering. 152:012064.
11. Samiur Rahman, Sana Ullah, and Sehat Ullah. Obstacle detection in an indoor environment for visually impaired using a mobile camera. 2018. Journal of Physics: Conference Series, 960:012046.
12. Yin Win, Nitin Afzulpurkar, Chumnarn Punyasai, and Hla Htun. 2011. Ultrasonic system approach to obstacle detection and edge detection. Sensor and Transducer. 127:56–58.
13. Adarsh Sasidharan, S Kaleemuddin, Dinesh Bose, and K Ramachandran. Performance comparison of infrared and ultrasonic sensors for obstacles of different materials in vehicle/ robot navigation applications. 2016. IOP Conference Series: Materials Science and Engineering. 149:012141.
14. Baharuddin Mustapha, Aladin Zayegh, and Rezaul Begg. Ultrasonic and infrared sensors performance in a wireless obstacle detection system. 2014. Proceedings - 1st International Conference on Artificial Intelligence, Modelling and Simulation, AIMS 2013. 487–492.
15. Carlos Fernandez, Raul Domınguez, David Fernandez-Llorca, Javier Alonso, and Miguel A. Sotelo. 2013. Autonomous navigation and obstacle avoidance of a micro-bus. International Journal of Advanced Robotic Systems.
16. Silvia Coradeschi, Hiroshi Ishiguro, Minoru Asada, Stuart Shapiro, Michael Thielscher, Cynthia Breazeal, Maja Mataric, and Hiroshi Ishida. 2006. Human-inspired robots. Intelligent Systems, IEEE. 21: 74– 85.
17. Xianghai Wu. 2009. Human-inspired robot task teaching and learning.

18. Gordon D.M. 2016. From the division of labour to the collective behaviour of social insects. 1101–1108.
19. Jennifer Fewell. 2003. Social insect networks. Science (New York, N.Y.). 301: 1867–70.

The Pattern of Principal Instructional Leadership at Indonesian Senior High Schools

[1]Rahayu, S, [2]Usman,H. [3]Wibawa, S
[1]Yogyakarta State University,[2]Yogyakarta State University, [3]Sarjanawiyata University
[1]yustinasrrh@gmail.com,[2] husainiusman@gmail.com [3]sutrish@gmail.com

Abstract
This research aimed to find an effective pattern of instructional leadership for high school principals. This research was conducted using the qualitative approach. This research was conducted by analyzing and discussing effective instructional leadership practices in reference schools, as well as to find best practices that could have an impact on other schools. This research used the research object at the referral high schools in the Special Province of Yogyakarta, Indonesia, to determine what characteristics made effective instructional leadership in some of these reference schools. This research found that the principals inclusively carried out the instructional leadership in establishing the vision, instructional program, instructional supervision, and instructional evaluation by involving and giving greater autonomy to the staff, and indirectly executed through the development of a conducive culture and climate. Generally, instructional leadership practice starts from a complete understanding of the learning vision, communicating the vision, and then realizing the vision through the culture and school climate. The following vision is realized in the instructional program, instructional supervision, and instructional evaluation that are carried out inclusively by involving and giving greater autonomy to vice-principals, teachers, and staff. Monitoring and evaluation activities are carried out, including ensuring teachers teach the required curriculum, encouraging them to involve students in activities, meeting teachers individually to discuss student progress issues, discussing student learning outcomes with teachers, and requesting teachers to send reports on student progress to parents. Overall, learning evaluation is carried out jointly between the principal, teachers, and staff, both mutually (in formal meetings) and in personal consultations.

Keywords
Principal Instructional Leadership, Effectiveness, Senior High School

INTRODUCTION

Instructional leadership is one of the school leadership models that has become a research topic in the last few decades (Hallinger & Hosseingholizadeh, 2019). The early concept of instructional leadership was developed in the effective school movement in the 1980s in the United States (Hallinger, 2018). Early research in the 1980s demonstrated the vital role of principals in learning success (Hallinger & Murphy, 1985). Instructional leadership focuses on student learning processes and outcomes, deep and ongoing involvement in learning and curriculum issues, and having a stake in various activities to improve teaching and learning in schools (Shaked, 2020; Brazer & Bauer, 2013; Neumerski et al., 2018). The application of instructional leadership has been shown to positively correlate with student academic outcomes (Glickman, Gordon, & Ross-Gordon, 2017). Although the principal's instructional leadership has a direct and low impact on student achievement (Hallinger & Heck, 2011a, 2011b; Heck & Hallinger, 2014), it contributes to higher student achievement growth than other leadership styles (Bush & Glover, 2014; Murphy, Neumerski, Goldring, Grissom, & Porter, 2016; Hallinger, 2003). As a senior teacher, a principal plays an essential role in the administrative aspect and as a leader who provides direction in achieving learning goals (Shaked, 2020). The learning goals are students' academic success, such as their knowledge breadth and depth in various disciplines, creative and analytical thinking skills, building a love for learning, and sparking curiosity (Pritchard, 2013).

Early studies (Hallinger & Murphy, 1985) revealed that the personality characteristics (trait theory) of ideal principals (strong mindset, directives, top-down management, and charisma) determine the effectiveness of the learning process in schools. During the 1990s, the instructional leadership model was widely criticized for focusing too much on the heroic role of individual principals. In recent studies, the concept of instructional leadership has developed not only to focus on the ability of principals (exclusive) but also inclusive leadership, such as involving staff, shared leadership (Breyer, 2014; Seobi & Wood, 2016), distributed leadership (Almarshad, 2017), internal and external collaboratives (Erdal et al., 2016; Kaparou & Bush, 2016), and transformational leadership (Quin et al., 2016; Nedelcu, 2013; Almarshad, 2017).

Studies of recent years have also found that the instructional leadership effectiveness on learning processes and outcomes is not performed directly yet indirectly, such as by building school culture and school climate: such as by regulating work processes, relationships, and involvement (Heck & Hallinger, 2014; Hallinger & Hosseingholizadeh, 2019). Another study (McNeill et al. 2018) suggests the importance of principal's instructional leadership in the practice of scientific learning. This study found that principals' leadership practices focused

more on imparting knowledge; however, few focused on scientific learning practices.

Instructional leadership or teaching leaders is different from a principal's duties as a regulator or a manager in many ways. A principal who focuses as a manager is generally too focused on strict administrative tasks than a principal who acts as an instructional leader. The latter role involves setting clear goals, allocating resources for instruction, implementing curriculum, monitoring lesson plans, and evaluating teachers. In contrast, Instructional Leaders prioritize the quality of teaching as a school's top priority and strive to set that vision into reality (Lunerberg & Irby, 2006).

Murphy (1988) suggests four critical dimensions for instructional leadership: 1) Developing mission and goals, 2) Managing the educational production function, 3) Promoting an academic learning climate, and 4) Developing a supportive work environment. Spillane, Halverson, and Diamond (2004), through a literature study, identified that instructional leadership has several functions: 1) building a learning vision, 2) developing and managing a conducive school culture, 3) procuring and distributing resources, 4) supporting growth and teacher development both individually and collectively, 5) providing supervision and learning innovation both summative and formative, and 6) building a school climate. Hallinger (2011) developed indicators and instruments for the practice of instructional leadership known as the Principal Instructional Management Rating Scale (PIMRS), consisting of three dimensions. The first dimension relates to school leadership's role in formulating the learning process's objectives and academic outcomes that are easy to understand and assess; the principal must also socialize these goals to various stakeholders. The second dimension is to manage instructional programs, which relates to the role of school leaders in planning, monitoring, and evaluating the implementation of learning. The third dimension is to develop a positive school learning climate and culture.

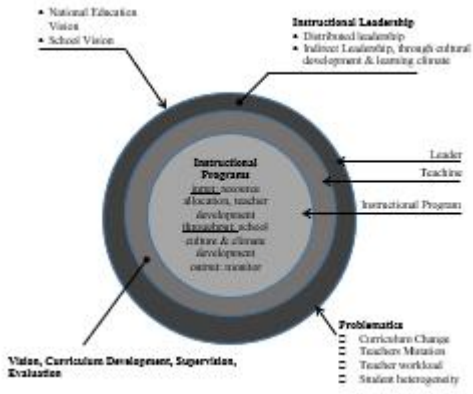
This research aims to find an effective instructional leadership pattern for high school principals. Hallinger (2018) suggests that the effectiveness of a principal's instructional leadership can differ depending on the context. This research discusses the principal's instructional leadership at high schools. Principal leadership in high schools plays a role as learner leadership to prepare future generations to be more dynamic, complex, and uncertain. School leadership plays a role in developing the future generations' characters: religious, active, creative, innovative, and solutive in facing various opportunities and challenges in the digital era, complexity, and environment dynamics (Kemendikbud, 2014). Pattern-oriented leadership focuses on personal leadership and antecedents (influence factors) and their impacts (Arnold et al., 2017; McClelland & Boyatzis, 1982). Pattern is an arrangement or configuration of regular shapes through repetition, similarity, consistency, modularity arrangement, and interrelated components. It is a technique of matchmaking, dominant, integrated, or central characteristics (Creswell, 2014).

RESEARCH METHOD

This research used a qualitative approach through interviews with five principals at high schools in the Special Region of Yogyakarta province, Indonesia. A sampling of five regions to represent the region's various socio-cultural, economic, and geographical statuses. Referral schools were schools that had met or exceeded the National Education Standards and developed programs of excellence following the school's potential and the needs of the community. This research used the research object of reference schools to know what characteristics made effective instructional leadership in some of these referral schools. The qualitative analysis was to delve deeper into the practice of instructional leadership in the schools. The data collection activities through observations and interviews were carried out from September 2019 to January 2020. The research subjects were the Principals (Key Informant), vice-principals, and teachers in the five high schools. In-depth individual interviews, lasting an average of one hour each, were conducted in each of the five schools. In each school, researchers interviewed the principals and senior teachers. The senior teachers were selected in each school based on years of experience working with the current principals. The qualitative data analysis was continued with developing an initial description of the instructional leadership practices that each principal often applied. This was done by comparing the perceptions of principals, vice-principals, and teachers to see the extent to which the interviewees had agreement or disagreement. Furthermore, a comparative analysis was carried out among the five schools.

RESULT, DISCUSSION AND CONCLUSSIONS

This research found that several common characteristics made instructional leadership effective in several reference schools. They were: (1) the learning was started from the school's vision and curriculum, which were implemented through a conducive culture and climate; (2) the curriculum implementation planning, and learning supervision and evaluation were carried out inclusively through guidance, discussion, consultation, collaboratively.



In carrying out the general instructional leadership, the principals of the referral high schools started from a complete understanding of the vision of both the school vision and the national education vision implemented in the curriculum.

The school's vision was prepared jointly by school leaders, teachers, education staff, including soliciting input from students' parents through the school committee; hopefully, the vision was compiled into a shared vision. (P1d, 05/09/2019). The teachers were required to implement the school's vision and mission during teaching and learning activities. *"Our vision is the spirit; it must be the soul of every human being in this school"* (P1c, 03/10/2019). *"The school's vision is a spirit that will provide energy for us to make it happen. Every member of the school must live this vision"* (P1d, 05/09/2019). Every principal hoped that teachers had a vision and mission in learning. Through vision, teachers would have the ability to innovate to realize the school's vision and education vision in the learning curriculum (P2c. 04/10/2019).

The next vision was realized through culture (habituation) and a conducive climate in both academic and non-academic programs. The communication on the vision and cultural development in the five reference schools was carried out at every event, for example, in ceremonies, displayed in the front hall, through writing on posters and pamphlets, pictures, articles on wall magazines, and written documents in announcements or circulars (P2a, 04/09/2019; P1c. 03/10/2019), so that teachers, students, parents, and school stakeholders could see it easily (P2a, 04/09/2019). Principal C used the slogan *the school of leadership* and continuously conveyed it. Hence, it became the vision of every school community to lead graduates to become future leaders, leaders in all fields, and useful for development.

The next vision was realized in program planning, supervision, and evaluation of instructional programs. In general, the principal's role in successfully implementing the new curriculum was not carried out exclusively, namely principal-centered leadership. However, it was carried out inclusively by involving the vice principal in the field of curriculum, teachers, school committees, and parties related to developing curriculum at the education unit level. Democratization, the implementation of curriculum management, placed managers, implementers, and students in the proper position in carrying out their duties with full responsibility to achieve curriculum goals. School resources, in this case, teachers, staff, and special service officers as educators and education staff, were optimized in the division of tasks by teaching according to their educational background and competency skills (P1a, 03/09/2019). The principals gave full autonomy to the teachers to develop teaching materials, teaching materials, learning models, teaching methods, and learning media, while still referring to the applicable provisions or curriculum; if there are difficulties, they were discussed in the Subject Teacher Consultation and consulted with the principal and/or supervisor" (P1a, 03/09/2019). Of course, this was done by monitoring the principals and supervisors under applicable regulations

3.1 Instructional Program

Schools responded to policies related to curriculum changes with work programs in the field of curriculum, including management of instructional resources (inputs), teaching and learning process (throughput), and performance monitoring (output). The resource management included: procurement of curriculum tools, workshops on learning preparation, workshops and revision of Education Unit Level Curriculum, procurement of learning tools, improvement of teacher competencies related to 4C competencies (Critical Thinking, Communication, Collaboration and Creativity, and Innovation), increasing teacher capabilities with information technology, and the evaluation tools learning (P1b. 11/10/2019), in collaboration with supervisors, as well as reference school resource persons (P2b. 11/10/2019). Regarding teacher readiness, the schools have sent teachers to attend training (workshops). Many teachers were left behind in the early stages of changing and revamping the new curriculum; however, by workshops and mentoring, students and teachers finally got used to the curriculum (P1a, 03/09/2019; P1b. 11/10/2019). The schools also facilitated continuous professional development activities for teachers, especially subject teacher deliberations at the schools and regency levels. The innovations related to improving learning were e-raport workshops, stem workshops, (Higher Order Thinking Skills (HOTS)-based assessment workshops, and classroom action research assistance (P3a, 29/01/2019). The learning and assessment workshops were held, including the preparation of HOTS questions and computer-based questions" (P1c, 03/10/2019; P2a, 03/09/2019). Planning for infrastructure played an essential role in implementing learning, culture, and a favorable school climate. The principals acted as facilitators to prepare facilities and infrastructure that supported the implementation of the 2013 Curriculum by gradually budgeting in the activity plans and school budgets, such as procurement of textbooks both teacher and student books, procurement of LCDs, printers, laptops, wi-fi networks, and learning media (P1a, 03/09/2019). The financial resources were managed well by the treasurers under their jobs; the funds from the Committee and Regional School Operational Assistance were accounted for periodically" (P1a, 03/09/2019).

In terms of throughput, the instructional program consisted of programs of academic and non-academic activities. The knowledge improvement was carried out through academic programs. The skills improvement was carried out at extracurricular activities, both individually and in groups. The attitudes and behavior improvements were through motivation, exemplary, and school culture and climate development. The principals of the five high schools emphasized that it was also essential to create an excellent atmosphere to create excellent and conducive learning conditions. The principals in the five referral high schools had strategies in agendas (activities) for learning activities implemented by building an organizational culture that could be seen in the habits.

Academic programs were mandatory programs carried out by reference schools, namely: Quality Improvement and Natioanl Standard Fulfillment, which consisted of syllabus analysis and learning implementation plans; development of assessment based on information and communication technology; development of HOTS questions; the Ministry of Education and Culture's Policy Implementation Program which included Character development; and Implementation of local content development. Various activity programs for

academic achievement development at School A (P1a, 03/09/2019): material deepening, providing achievement motivation, try out, scientific competitions, National Science Olympiad assistance, literacy movement, reading culture, ready for university mentoring, mastery learning program, e-report, and e-library. various program activities for developing non-academic achievements: referral schools, healthy canteens, accredited libraries, e-report, Training of Trainers (ToT) program in team teaching, Extras based on talent and demand, schools based on arts and culture, and the talent development for sports and artistic achievements.

The strategies carried out by the principals in building scientific attitudes and behavior (solving scientific-based problems) were to build a climate and culture, such as through habituation, motivation, and exemplary in both academic and non-academic activities (P1a, 03/09/2019; P1b. 11/10/2019; P1c, 03/10/2019). Scientific learning started from observing the environment, identifying problems (inquiring), reasoning (finding theories to solve problems, solving problems, and finally, the communication process and forming networks.

The five schools built a positive culture and climate by encouraging the students to respect humans and the environment. The culture was developed in writings, slogans, and mottos needed to build awareness and good habits (P1a, 03/09/2019; P1b. 11/10/2019; P1c, 03/10/2019), and exemplary (P2a, 04/09/2019). Various program activities for the development of academic achievement at School B (P2b, 20/01/2020): the healthy school program, the services for students with extraordinary intelligence, and the guide to be success in national exams and passing universities. Furthermore, to develop the talents and interests of our students, we developed compulsory and optional extracurriculars.

School C developed the *safe school* program, school of leadership program, and the entrepreneurial spirit; "safe" schools are schools where the students and other school members feel comfortable and happy to be in the school environment performing learning activities, both curricular and extracurricular. The School Literacy Movement existed in three schools. The School Literacy Movement is a comprehensive effort to make schools a learning organization whose citizens are lifelong literate through public involvement. School D carried out continuous development for students in addition to classroom learning according to the curriculum. The school gave priority to academic activities through tutoring, training to improve achievement in subject and scientific competitions, optimizing information and communications technology-based learning in schools, and English (P1d. 11/09 2019).

The discipline culture in the five schools was instilled through daily activities such as getting to school on time, entering class on time, not being late at the flag ceremony, and fully dressed according to the daily provisions. School C applied a point system for the students covering several aspects of discipline (P1a, 03/09/2019). At the same time, School A used a fingerprint system (P1a, 03/09/2019).

The clean-and-healthy-living culture was developed through habituation activities such as the healthy culture by washing hands and throwing garbage in its place and, according to its type, the culture of loving the environment (P1a, 03/09/2019; P1b. 11/10/2019; P1c, 03 /10/2019). The events held by the schools were almost entirely the responsibility of the students who were also the members of the events, thus training their independence and responsibility. The human respect culture was built with the culture of smile, greeting, salutation (P1a, 03/09/2019). The positive school cultures were built on a shared commitment by all school members. The exemplary came from the principals and teachers as parents. (P2a, 04/09/2019). The development of attitudes, caring, creative, and innovative behavior was manifested in a culture (habituation) and conducive climate, therefore the student character development did not stop at school but became habituation in the family and community (P1a, 03/09/2019; P1b. 11/10/2019; P1c, 03/10/2019). The skills improvement should have been carried out at extracurricular activities. The principals emphasized that it was also vital to create a good atmosphere at school to create excellent and conducive learning conditions.

Various program activities for the development of academic and non-academic achievements in schools were written in the School Work Plan, and were socialized to all school members, committees, teachers and parents, so that all parties supported these activities (P1a, 03/09/2019; P1b. 11/10/2019). The principals played a role in socializing the new curriculum, preparing and developing human resources, preparing infrastructure, and providing instructional strategy directions. The socialization was carried out, such as at flag ceremonies and meetings. The preparation and development of human resources were through training and mentoring. The schools carried out workshops and mentoring themselves as well as mentoring by supervisors. The principals guided teachers in implementing the Curriculum and were further strengthened in classroom supervision and direct direction by the principals themselves. Indeed, learning implementation plans cannot be separated from the syllabus because the syllabus is a guideline for making learning implementation plans. Principals are usually only direct input/direction from them regarding the components of the learning implementation plan, namely an identity that includes the name of the school, theme, sub-theme, learnings, time allocation, basic competencies, material indicators, methods, learning media, and learning steps. There are initial, core, and final activities; the last one is to conduct an assessment. Principals always encourage teachers to have better teaching plans, communicative teaching methods according to the new curriculum, participate in professional development activities, and achieve higher education (P1b. 11/10/2019).

3.2 Instructional Supervision

The principals conducted academic supervision in collaboration with the School Supervisor, and were assisted by the Supervisor Team doubled as the Teacher Performance Assessment (TPA) Team. The supervision was scheduled once a semester, while the TPA was carried out twice annually. The monitoring was carried out in every aspect of activities to ensure activities could be carried out under the program (P1c, 03/10/2019). The principals carried out the monitoring in senior teachers, including TPA Assessors. The TPA Assessor Team assisted the principals in supervising

both planning and implementation (P2c, 04/10/2019). The monitoring was done through CCTV, performed by the IT admins who monitored the student attendance, the picket teachers who monitored and handled learning per class to ensure that it ran well, and the principals and vice-principals of curriculum division. The supervision was carried out by school principals and supervisors, and the TPA assessment by the school principals and the TPA assessor team, every November each year. According to P1c, the supervision was carried out once a year through TPA, learning documents, and classroom implementation. The student attendance was monitored through fingerprints by the IT admin, which was then reported on the condition of student attendance through the discipline group, the picket teachers who monitored and handled learning per class to ensure it ran well, and the principals and vice-principals of curriculum division; using CCTV. The teachers were free to choose and innovate their learning models (P1c, 03/10/2019). The monitoring was carried out in every aspect of activities to ensure they could be carried out under the program. *"We evaluate learning performance with the PKG teachers, both formative and summative"* (P2c, 04/10/2019).

The principals provided simple directions on implementing scientific learning, especially the importance of student's motivation, critical, active, creative, and innovative attitudes and behavior towards knowledge of theory and practice in life rather than just theoretical knowledge (memorization). The teachers and employees were managed and encouraged to have better teaching plans, communicative teaching methods according to the demands of curriculum participated in professional development activities, and achieved higher education (P1b. 11/10/2019). The principals routinely received monitoring in the preparation of learning tools, even starting at the beginning of the semester by signing the learning planning document. Then periodically, the teachers were also monitored by the principals and supervisors in verifying the planning and implementation of learning documents (P1c, 03/10/2019). The learning was monitored from the preparation carried out by the teachers to the reporting. *"*As a reference school, our documents are complete because one of our functions is as a reference for other schools*"* (P1d, 05/09/2019). The issue of monitoring and evaluation was fundamental related to maintaining school quality. *"*We carry out monitoring assisted by the vice-principal, and we carry out joint evaluations periodically*"* (P1e, 07/10/2019).

After supervising, the principals then analyzed possible ways to improve the school successfully. Principal A, among others, always supported and encouraged the teachers and students to create better school programs in the future (P1a, 03/09/2019). The principals carried out this feedback activity to strengthen and coach learning activities that have been supervised previously. In the implementation of this supervision, the main target of feedback activities was teaching and learning activities. The principals analyzed the observations so that they could be used as improvement programs to improve teacher performance. Feedback activities were utilized for the development of teaching skills and teacher professionalism. With feedback, it would provide an opportunity to encourage teachers to improve their appearance and performance.

The principals applied distributed leadership by giving the teachers full authority in the learning process in the classroom. Teachers are leaders in their respective classes (P3a, 29/01/2020). Class visits. The indirect supervision through CCTV, and meetings held by the principals, made this supervision implementation improve in learning. The principals always had discussions with the teachers to observe and supervise the difficulties in improving the quality of learning because, in this way, the principals could get information about the weaknesses and strengths of the learning in the classroom.

The principals observed directly and indirectly (through) to provide input to teachers about teaching methods and students. The principals communicated the barriers with the teacher (P1a, 03/09/2019). Communication is the main thing to do to overcome obstacles. Likewise, with school B, the principal discussed the obstacles with the teachers, staff, and the school community (P1b. 11/10/2019). The supervision results were evaluated with the help of school supervisors, and used for improvement in the following semester. The vice-principal of the curriculum division coordinated these activities and assisted in implementing and reporting (P2a, 04/09/2019). *"*We verify the RPP with the PKG Team on the RPP components, both KI, the appropriate KD, learning models, Learning Media, and their assessment. We are accompanied by the school supervisor, too*"* (P1b, 11/10/2019).

In implementing the supervision, the principals treated the teachers as the people who could progress and develop better. The Supervision implementation was not just carrying out tasks, looking for teacher mistakes, or being patronizing. However, it was a systematic and sustainable coaching process. In supervising, the principals were not autocratic but required a creative attitude in solving various problems in the learning. In this case, the principals always listened to the teachers' input when conducting the supervision. The principals always created situations where the teachers felt comfortable and accepted as subjects who could develop themselves. The difficulties and complaints of teachers were addressed by the existence of IT improvement workshops, mastery of learning methods, assessment, questions writing, and the fulfillment of infrastructure related to the learning (P2a, 04/09/2019).

The principals supervised learning with the concept of controlling (supervising) the learning process without the teachers feeling supervised and without the impression of being *teacher*s. The supervision was the learning process in the classroom and the attitudes and behavior of students outside the classroom. This was done through CCTV, for instance. The monitoring and evaluation were carried out by ensuring the teachers teach the required curriculum, encouraging them to involve students in activities, meeting with teachers individually to discuss student progress issues, discussing student learning outcomes with teachers, requesting teachers to send reports on student progress to parents. Whenever the teachers felt difficulty implementing the curriculum learning, the principals guided them through discussions about the obstacles and challenges in curriculum

implementation; especially, the new 2013 curriculum, whose characteristics are different from the previous curriculum.

3.3 Instructional Evaluation

Schools have regular agendas of official meetings, plenary meetings, and limited meetings to discuss programs that will be implemented, whether programmed or not, and evaluate activities that have been carried out. Principals arrange regular meetings with all teachers to discuss future planning. For the most part, they revise the goals of existing schools. Principals hold a special meeting to design a school plan together with the teachers. In this meeting session, principals and the teachers shared the teachers' ideas (P2a, 04/09/2019). The curriculum requires that the evaluation of student learning outcomes use authentic assessment. Authentic assessment is more focused on complex or contextual tasks. Conventional assessments used to measure achievement, with multiple-choice, true-false, matchmaking, and so on, have failed to determine students' actual performance. Such tests are seen as failing to obtain a complete picture of students' attitudes, skills, and knowledge concerning their real lives outside of school or society. Types of authentic assessments, which include: (1) performance appraisal, (2) project appraisal, (3) portfolio assessment, and (4) written assessment. Principals open up vast opportunities for teachers to develop the development of learning evaluation tools. The teacher stated that they would prefer the principals to give her a target with the freedom to create their teaching methods and develop their learning evaluation tools. Good cooperation between principals and the teachers can be created when the principals provide flexibility in teaching and learning activities, such as autonomy in making their learning evaluation tools.

Learning evaluation is carried out qualitatively and quantitatively; it can differ according to their talents and interests, which becomes a challenge for teachers. Principals and teachers need to carry out continuous process evaluations through close monitoring of processes and achievements. Assessment is based on the student's progress in learning (relative to himself in the previous period). Overall, learning evaluation is carried out jointly between the principal and teachers and staff both jointly (in meetings) and personal consultations. Learning evaluation is carried out to evaluate achievements, process barriers for continuous improvement.

Evaluation of learning performance is carried out using Teacher Performance Assessment, both formative and summative. Evaluation determines the value and significance of the activity. The evaluation also helps schools to develop existing school programs or create new ones. Each school principal conducts regular evaluations through school meetings with teachers and school stakeholders. Principal A tries to innovate by making feedback forms for teachers and students to fill out (P1a, 03/09/2019). Forms are distributed at the beginning and end of the school semester, consisting of; (1) supervisor form, filled out by the principal, (2) teacher reflection form, filled out by the teacher, (2) student reflection form, filled out by students.

The principal in providing feedback using instruments that have been prepared previously, the principal himself is expected to be able to provide feedback and evaluation so that the results of the implementation of supervision are clear. The principal analyzes the results of the implementation of supervision to determine the strengths and weaknesses of the supervised teachers as a reference for providing feedback. Weaknesses and the advantages of teachers in carrying out learning, the level of mastery of teacher competencies, then sought solutions for coaching and feedback so that teachers can correct existing deficiencies while maintaining excellence in carrying out learning. Therefore, with feedback in the implementation of academic supervision, the principal will provide improvement programs to teachers to correct their shortcomings during the implementation of subsequent academic supervision.

School principals involve teachers in developing learning evaluations. This is because the teacher is the party who best knows the ability or progress of student learning, not the principal, supervisor, or structural officials in the Department or Service. This is partly because it is the teachers who communicate and interact with students in the classroom and the school environment daily. The principal gives very flexible authority to teachers to assess student learning outcomes. Reports on the results of the assessment by the teacher are submitted to the principal and other related parties (eg homeroom teachers, Guidance and Counseling teachers, and parents/guardians) within the specified period. Principal A (P1a, 03/09/2019) held an evaluation meeting with his teachers to discuss the progress of the school program. Meetings take place regularly or spontaneously. The principal holds regular meetings with his teachers to evaluate the teacher's work. During the evaluation, they discussed the results of several school activities based on the standards set by the principal as well as the teachers.

The principal and the team evaluate learning to ensure that the class gets learning according to the schedule (P1a, 03/09/2019). At the beginning of the semester, by collaborating with supervisors, the principal ensures that teachers are ready with learning planning documents, namely semester programs, syllabus assessment programs, and lesson plans, by verifying teacher learning planning documents. Then further monitor learning in class directly with class visits and indirectly through teacher picket reports and the use of CCTV in classrooms (P1a, 03/09/2019).

CONCLUSIONS

The results of this study in general also found that the Principals of the Referral High School in DIY were very effective in implementing Instructional Leadership, from establishing a vision, curriculum development, supervision, and evaluation development. The Principals of the Referral High School in DIY in carrying out instructional leadership in general starts from a complete understanding of the vision of both the school vision and the national education vision implemented in the curriculum. The vision is then communicated to all school members, manifested in a conducive culture and climate. Principals in the planning curriculum implementation, supervision, and evaluation are inclusively involved and gave greater autonomy to waka, teachers, and staff. The problems of learning leadership are curriculum changes, teacher and principal transfers, teacher workloads, diverse student abilities, Solutions to overcome

the problems of curriculum changes, teacher and principal transfers; teacher workloads are by: involving teachers in workshop programs, consultations, and guidance. The solution to overcome students' diverse abilities is with remedial and enrichment programs for students with below-average abilities and multiple intelligences and material deepening for students with above-average abilities. This study has implications for effective principals' instructional leadership patterns amid curriculum changes, emphasizing the importance of scientific learning and building character (religious, active, creative, innovative). The effectiveness of instructional leadership in setting vision, planning curriculum implementation, supervising learning, and evaluating learning can be achieved through distributed leadership, shared leadership, and indirect leadership. Indirect leadership is through the development of school culture and climate. Distributed leadership, shared leadership, and indirect leadership are needed as a driving force and controller for students, teachers, and stakeholders in shaping students' character in a sustainable learning process anywhere and anytime.

This study has several limitations. First, the research was conducted with a qualitative approach so that further research is needed in developing instructional leadership assessment indicators such as through confirmatory factors analysis. Second, the relationship between research variables, such as the impact of instructional leadership activities on the quality of learning such as: target behavior, culture, and student achievement, cannot be measured and identified. Third, the research was conducted in several public high schools, which are reference schools in Special Province of Yogyakarta, Indonesia. The research object was carried out in several reference schools in Special Province of Yogyakarta, Indonesia, to accommodate regional and cultural differences. However, the research results have the opportunity not to be applied (as a reference) for schools with different levels, private schools, informal or formal schools, and homeschooling. Best practice may also exist in the school model.

Further research can be carried out on different levels of school, private schools, other model schools (boarding schools, informal schools). Fourth, the research was conducted on conditions before and after the COVID-19 pandemic. On the one hand, Pandemic conditions provide a research context on environmental dynamics. However, on the other hand, they can affect the constraints and effectiveness of instructional leadership practices. In pandemic conditions, the learning process is often carried out through online media. This facilitates dynamic learning; namely, learning can be done anytime and anywhere and gives students autonomy and independence in learning. However, students' attitudes and behavior cannot be fully controlled through camera media on gadgets. This becomes an obstacle in learning. The research results have the opportunity not to be applied (become a reference) for different environmental conditions, other technological developments, and different government policies.

REFERENCE

1. Abonyi , U.K., & Sofo, F., (2019) Exploring instructional leadership practices of leaders in Ghanaian basic schools, *International Journal of Leadership in Education*, DOI: 10.1080/13603124.2019.1629628
2. Almarshad, Y. O. (2017). The Effects of Instructional, Transformation and Distributed Leadership on Students' Academic Outcomes: A Meta -Analysis. *International Journal of Education*, 9(2), 1. doi:10.5296/ije.v9i2.10263
3. Alsaleh , A.(2019) Investigating instructional leadership in Kuwait's educational reform context: school leaders' perspectives, *School Leadership & Management*, 39:1, 96-120, DOI: 10.1080/13632434.2018.1467888
4. Andrews, R. L., Basom, M. R., & Basom, M. (1991). Instructional leadership: Supervision that makes a difference. *Theory into Practice*, 30(2), 97–101. DOI: 10.1080/00405849109543484
5. Arnold, K.A., Connelly, C.E., Gellatly, I.R., Walsh, M.M., Withey, M,J,, (2017), Using a pattern-oriented approach to study leaders: Implications for burnout and perceived role demand, *Journal of Organizational Behavior, J. Organiz. Behav. Published online in Wiley Online Library* (wileyonlinelibrary.com) DOI: 10.1002/job.2182
6. Barrett, C.E., & Breyer, R. (2014). The Influence of Effective Leadership on Teaching and Learning. *Journal of Research Initiatives*, 1, 3. DOI: 10.2139/ssrn.2541105
7. Berkowitz, M. W. (2021). Implementing and Assessing Evidence-Based Character Education. *Journal of Education*. DOI:10.1177/00220574211026908
8. Beytekin, O.F., Toprakçı, E., & Chipala, H.C. (2016). A Case Study of Instructional Leadership in Malawian Secondary Schools. DOI:10.17679/INUEFD.17314606
9. Brazer, S. D., & Bauer, S. C. (2013). Preparing Instructional Leaders: A Model. *Educational Administration Quarterly*, 49(4), 645–684. https://doi.org/10.1177/0013161X13478977
10. Bush, T., & Glover, D. (2014). School leadership models: What do we know? *School Leadership and Management*, 34(5), 553–571. DOI: 10.1080/13632434.2014.928680
11. Creswell J (2014) *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (4th ed.). Thousand Oaks: SAGE.
12. Duke, D. L. (1982). Leadership Functions and Instructional Effectiveness. NASSP Bulletin, 66(456), 1–12. https://doi.org/10.1177/019263658206645601
13. Glickman, C. D., Gordon, S. P., & Ross-Gordon, J. M. (2017). *Supervision and instructional leadership: A developmental approach* (10th ed.). London, UK: Pearson.
14. Glickman, Gordon & Ross-Gordon (2007), *SuperVision and Instructional Leadership: A Developmental Approach*, 9th Edition. Pearson
15. Hallinger, P., & Hosseingholizadeh, R. (2020). Exploring instructional leadership in Iran: A mixed methods study of high- and low-performing principals. Educational Management Administration & Leadership, 48(4), 595–616. https://doi.org/10.1177/1741143219836684
16. Hallinger, P. (2003). Leading educational change: Reflections on the practice of instructional and transformational leadership. *Cambridge Journal of Education*, 33(3), 329–351. https://doi.org/10.1080/0305764032000122005
17. Hallinger, P. (2015). The Evolution of Instructional Leadership. Assessing Instructional Leadership with the Principal Instructional Management Rating Scale, 1–23. doi:10.1007/978-3-319-15533-3_1.

18. Hallinger, P. (2018). *Principal Instructional Leadership. The Wiley Handbook of Teaching and Learning, 505–528.* doi:10.1002/9781118955901.ch21
19. Hallinger, P., & Heck, R. H. (1996). Reassessing the Principal's Role in School Effectiveness: A Review of Empirical Research, 1980-1995. Educational Administration Quarterly, 32(1), 5–44. https://doi.org/10.1177/0013161X96032001002
20. Hallinger, P., & Heck, R. H. (1998). Exploring the Principal's Contribution to School Effectiveness: 1980-1995. *School Effectiveness and School Improvement*, 9(2), 157–191. DOI:10.1080/0924345980090203
21. Hallinger, P., & Heck, R. H. (2011a). Conceptual and methodological issues in studying school leadership effects as a reciprocal process. *School Effectiveness and School Improvement*, 22(2), 149–173. DOI: 10.1080/09243453.2011.565777
22. Hallinger, P., & Heck, R. H. (2011b). Exploring the journey of school improvement: Classifying and analyzing patterns of change in school improvement processes and learning outcomes. *School Effectiveness and School Improvement*, 22(1), 1–27. DOI:10.1080/09243453.2010.536322
23. Hallinger, P., & Murphy, J. (1985). Assessing the instructional management behavior of principals. *The Elementary School Journal*, 86(2), 217–247. DOI:10.1086/461445
24. Heck, R. H. (1992). *Principals' instructional leadership and school performance: Implications for policy development*. Ronald H. Educational Evaluation
25. Heck, R. H., & Hallinger, P. (2014). Modeling the effects of school leadership on teaching and learning over time. *Journal of Educational Administration*, 52(5), 653–681. DOI:10.1108/JEA-08-2013-0097
26. Heck, R. H., Larsen, T. J., & Marcoulides, G. A. (1990). Instructional Leadership and School Achievement:Validation of a Causal Model. *Educational Administration Quarterly*, 26(2), 94–125. https://doi.org/10.1177/0013161X90026002002
27. Kaparou, M. and Bush, T. (2016), "Instructional leadership in Greek and English outstanding schools", *International Journal of Educational Management* 30(6), 894-912. https://doi.org/10.1108/IJEM-03-2015-0025
28. Kemendikbud (2014) *Konsep dan Implementasi Kurikulum 2013*. Paparan Wakil Menteri Pendidikan dan Kebudayaan R.I Bidang Pendidikan
29. Lunenburg FC and Irby BJ (2006).*The principalship: Vision to action*. Belmont, CA: Wadsworth.
30. Marsh, D. D. (1992). Enhancing Instructional Leadership: Lessons from the California School Leadership Academy. Education and Urban Society, 24(3), 386–409. https://doi.org/10.1177/0013124592024003006
31. McClelland, D.C., & Boyatzis, R.E., (1982) Leadership Motive Pattern and Long-Term Success in Management, *Journal of Applied Psychology* 67(6), 737-743. DOI:10.1037/0021-9010.67.6.737
32. McNeill, KL, Lowenhaupt RJ, Katsh-Singer R., (2018), Instructional leadership in the era of the NGSS: Principals' understandings of science practices. Sci Ed.;1–22. https://doi.org/10.1002/sce.21336
33. Mulyasa, E. (2005). *Menjadi Guru Profesional*. Bandung: PT. Remaja Rosda Karya .
34. Murphy, J. (1988). Methodological, Measurement, and Conceptual Problems in the Study of Instructional Leadership. Educational Evaluation and Policy Analysis, 10(2), 117–139. https://doi.org/10.3102/01623737010002117
35. Murphy, J., Neumerski, C. M., Goldring, E., Grissom, J., & Porter, A. (2016). Bottling fog? The quest for instructional management. *Cambridge Journal of Education*, 46(4), 455–471. DOI: 10.1080/0305764X.2015.1064096
36. Nedelcu, A. (2013). Transformational Approach to School Leadership: Contribution to Continued Improvement of Education. *Manager Journal*, 17, 237-244.
37. Neumerski, C. M., Grissom, J. A., Goldring, E., Rubin, M., Cannata, M., Schuermann, P., & Drake, T. A. (2018). Restructuring instructional leadership: How multiple-measure teacher evaluation systems are redefining the role of the school principal. *The Elementary School Journal*, 119(2), 270–297. DOI:10.1086/700597
38. Pritchard, D. (2013). Epistemic virtue and the epistemology of education. *Journal of Philosophy of Education*, 47(2), 236–247. DOI: 10.1111/1467-9752.12022
39. Quin, J., Deris, A.R., Bischoff, G., & Johnson, J.T. (2015). Comparison of Transformational Leadership Practices: Implications for School Districts and Principal Preparation. *The Journal of Leadership Education*, 14, 71-85. DOI:10.12806/V14/I3/R5
40. Seobi, Boitshepo Audrey, & Wood, Lesley. (2016). Improving the instructional leadership of heads of department in under-resourced schools: A collaborative action-learning approach. *South African Journal of Education*, 36(4), 1-14. https://dx.doi.org/10.15700/saje.v36n4a1326
41. Shaked, H. (2020), "A paradoxical approach to instructional leadership", International Journal of Educational Management, Vol. 34 No. 10, pp. 1637-1646. https://doi.org/10.1108/IJEM-04-2020-0181
42. Spillane, Halverson, and Diamond (2004) Towards a theory of leadership practice: a distributed perspective. *Journal of Curriculum Studies*, 36(1), 3-34. DOI: DOI:10.1080/0022027032000106726
43. Thapa, A., Cohen, J., Guffey, S., & Higgins-D'Alessandro, A. (2013). A Review of School Climate Research. Review of Educational Research, 83(3), 357–385. https://doi.org/10.3102/0034654313483907

Understanding the Importance of Project Planning and Scheduling in Indian Construction Projects

Sagar Gaur, PRINCE2® Registered Practitioner
[1] B. Tech (Civil) from JUIT (H.P.), PG in Project Engineering and Management (PEM) from NICMAR (Pune), MBA in Project Management from UCAM, Spain (Pursuing) & currently working in Ramboll India Pvt. Ltd. as Senior Consultant in Gurgaon

Abstract
The Project Planning & Scheduling is the second phase of the project life cycle. In this phase, the planner understands the contract and define Project Deliverables/ Key Milestones. The planner then creates a detail project plan (also known as Detailed Work Programme (DWP)) to guide the execution team. Planner breaks the Project Deliverables in Work Breakdown Structure (WBS) and further into activities and assign the required resources to complete those activities. Activities are tasks which needs to be performed by the execution team like excavation, concreting and so on. While resources are Manpower, Equipment and Material which are assigned to these activities for estimation of activities duration. A detail list of WBS and activities are created along with the required resources. All these activities are interconnected (using relationship like FS, SS, FF & SF) from start till end to create a working project plan. The planner then coordinates with Construction Manager/ Project Manager for validation of the project plan. The project planning & scheduling helps to cover the full scope as per contract into a plan which benefits the project by reducing the time, cost, and risk on the project. This phase is a vital step in conducting the construction work smoothly. There is a need to understand the importance of Project Planning & Scheduling in success of a project. Project Planning & Scheduling directly affects the HR functions in an organization. Not limited to this, other departments are affected by the Project Planning & Scheduling phase. There are various available software's like Primavera P6 or MS Project to assist planner in preparation of project plan. Further, AACE provide recommended guidelines (RP) like 39R-06 or 91R-16 on Schedule Development which is very helpful and comes handy while preparing the Detailed Work Programme (DWP). Lastly, Risk Register needs to be updated and incorporated in project plan.

Keywords
Project Planning, Project Scheduling, AACE, Planner, CPM, Primavera P6, MS Project & Risk Register.

I. INTRODUCTION

From olden times till today's technological world, planning is always considered the most significant tool whose importance is growing more with digitalization of construction projects. Project planning is the process of detailing steps for accomplishing the project within a certain time frame by using the available resources. Those steps are called WBS (Work Breakdown Structure) which further divides into activities leading to preparation of project plan. The project plan clearly defines how the project will be executed, monitored, controlled, and closed. Planner/Planning Engineer plays an important role during project planning & scheduling stage. The four important factors considered during this stage are scope, milestones, deliverables, timeframes, and resources. Detailed Work Programme (DWP) contains various plans like Design Plan, Utility Diversion Plan, Execution Plan, Resource Plan, Budget Plan, Procurement Plan & so on.

I. Research Aim

Project planning is the process of doing a project step by step by dividing the project into WBS (Work Breakdown Structure) & further into activities and scheduling is the process of linking the activities using relationship like FS, SS, FF & SF and arranging resources and also optimizing the project i.e. Scheduling is the process of arranging the work and also gathering the resources which are required. The main aim of the project is to get the importance of project planning and scheduling, project planner & project controls in the Indian construction sector.

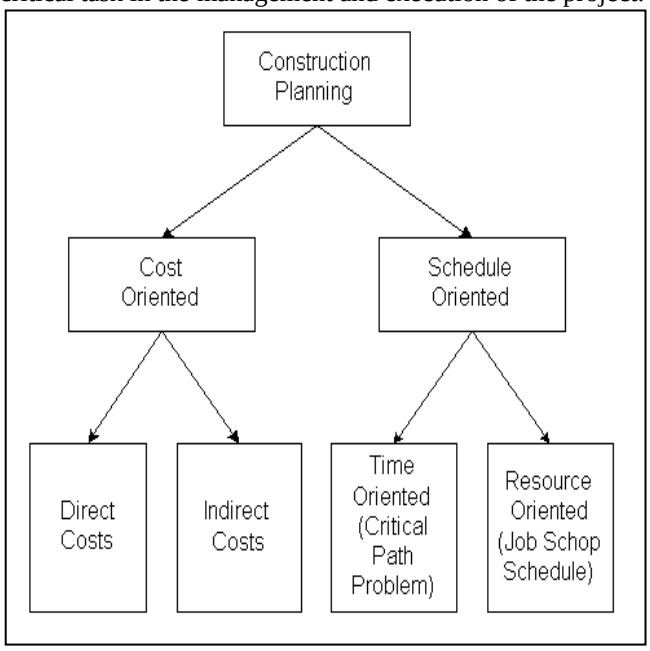
II. RESEARCH OBJECTIVES

There are some objectives of the research are given below:
To evaluate how project planning & scheduling works in the construction sector.
To evaluate how the pre-Project planning reduced the cost of the construction.
Importance of Risk Register.
To discuss Detailed Work Programme of any successful project using Primavera P6 & MS Project.

III. BACKGROUND

Project planning and scheduling in the construction sector is the process to know what exactly to do, when to do and what resources are needed to complete the task. Project planning serves as a roadmap for the entire project & project management process by breaking down the scope of work as per contract into WBS and activities while scheduling is the process to identify the resources which are needed to

complete those tasks (Prasad, Vasugi, Venkatesan, & Bhat, 2019). This arrangement of the resources along with the activities is called scheduling. It not only handles the pace of the work but also handles how the tasks are executed. The project management methodology started to grow from 1950 by the CPM method. The Great Wall of China is a big example of project management that was done in the 90s century. The project management techniques are largely based in 1960 on the waterfall technique. So, the concept of scheduling is not new around the world. Mainly, construction planning is a challenging and fundamental activity in the management of a construction project. A good project plan not only calculate timeframe to complete the project but also develop the budget of the project. Hence, developing a construction plan is a fundamental, challenging & very critical task in the management and execution of the project.



Source: (Hendrickson, 2008)
Figure 1: Construction Planning

In this figure, the project plan is described. Through the project plan, the factors which are affecting the construction sector are also described. By planning a task, it can help to reduce the time and budget of the plan. (Muneeswaran, 2020).

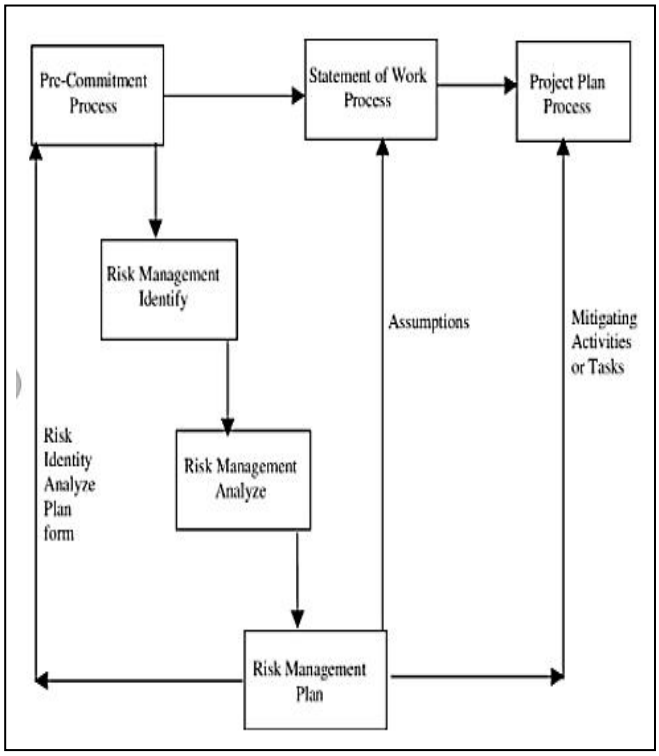
Cost is divided further into direct cost i.e. labour, equipment, material cost and so on while indirect cost i.e Transportation cost, Overhead cost, Depreciation cost, Taxes and so on. While Schedule is prepared based on 02 types i.e. Time based or resource based.

The construction planning restricts the further extension of the time within which the task or the project must be done. The overall project plan has been divided into some tasks. Those tasks also need some resources to do those tasks within time. The resources are arranged according to the task and through managing those tasks, which are the biggest matter of scheduling of a project plan.

II. Literature Review

The literature review is the section where the whole process of planning and scheduling is discussed.

According to Khun-anod and Limsawasd 2019, there are many challenges in the construction projects (Khun-anod, 2019). Lack of knowledge, skill, and experience are the main three barriers to completing a construction project (Dixit, 2017). The effort directly affects the project's success. Efforts are directly proportional to the success of the project. The pre-project plan is the process to develop sufficient strategies to avoid the risks and arranging resources. Pre-project planning is an owner-driven process. The pre-commitment process, risk management, and statement of the work process are involved in the process of planning (Bhosale, 2017). The pre-commitment is the process of committing to something in advance. Risk management is also an important one in planning. Risk management is the process of controlling threats, identifying, and assessing organizational capital. And the work process is the process the work has been done. And the working procedure is the procedure by which the work is going in step by step.



Source: (Pat Ferguson, 2015)
Figure 2: Project Plan

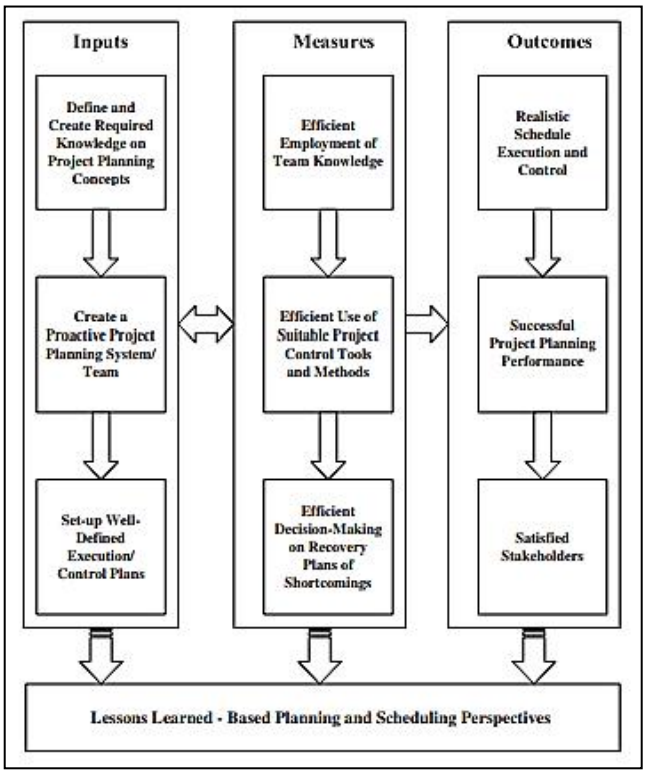
According to Venkateswaran and Murugasan, 2017, the aim of the study is the factors affecting to delay of the project (Venkateswaran, 2017). And the study also determines what factors also affect the budget of the project (Nouban, 2017). There are more than twenty factors that can affect the time and money of the constriction. The factors which affect the cost and the time delay of the project are,

- Insignificant project planning.
- Underestimate the schedule of the project.
- Underestimate the cost of the project.
- Bidding procedure.
- Long duration of the process.

• Project execution based on Experience rather than based on Project Detailed Work Programme (DWP).
• Unethical activities.
• Poor Procurement Planning.
• Poor communication with the stakeholders.
• Negligence in the site visit.
• No Risk Management Plan.

Those are the most important factors that affect the project time and the cost of the project. Those are the main factors for which 'planning and scheduling' are very important.

According to (Ryad, 2019), planning is the process of doing something in some specific steps. And the scheduling is the process of gaining resources from the outside and also arranges materials to do those steps (Ryad, 2019). There is mainly the process of suitability and the efficient existing planning method, scheduling the performance and development control, scheduling concept and the knowledge-based study. The process of scheduling and planning goes in some steps. By completing those steps, the full project is completed.



Source: (Aulin, 2015)

Figure 3: Planning and Scheduling

The figure contains the basic formula to complete a project (Hasan M. L., 2019). In the input stage, the project planner needs to have knowledge about the project by going through the contract agreement and need to have a good understanding about the project plan. The DWP is a document which establishes the means of monitoring, controlling, and executing the project. The plan is the main communication vehicle that can run between the start till end of the construction. Measures carried by the efficient deployment of team, team knowledge and sustainable project control tools or the methods used in the project control, decision making, and the recovery plans can further make the overall DWP works efficiently. This all will help in following the realistic schedule and execution control leading to stakeholders' satisfaction and the successful project planning performance.

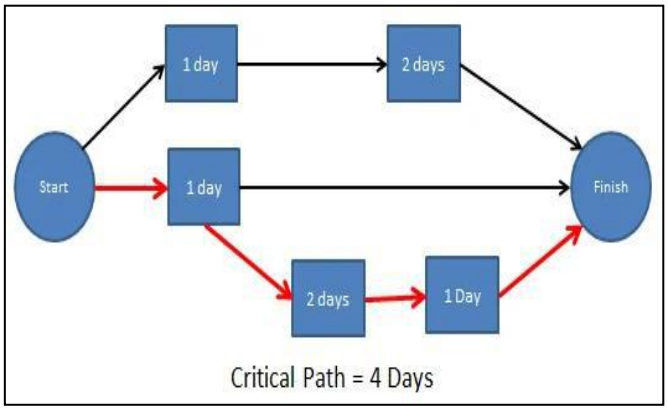
According to Chowdeswari et al. 2017, the planning process in the construction industry is to develop the project plan and the project documentation. In a construction project, many risks can affect the whole project (Chowdeswari, Optimal planning and scheduling of high-rise buildings., 2017). To maintain the risk measure for the project, we must prepare a risk register, and project scheduling which can show the relationship between the project activities in order to estimate project timings (Issa, 2017). The risk register can identify the risks of the project and also gives a sufficient mitigation plan. The causes of delay of the projects are insufficient technical knowledge, lack of procurement plan, no manpower planning, no proper project controls department and absence of risk management plan. The risks are the most important thing to handle in any type of project. Proper planning and scheduling can optimize the whole procedure of the project. The project must use those methods to improve the risk management of the project.

IV. RESEARCH METHODS

The research is based on the importance of the planning and scheduling of the project. The methodology of the project of research is meant for collecting and gathering the data or the information in a relevant manner for exploring the effects of some variable and decision-making process. The methodology section hereby is delivered to include in which way the study will proceed in collecting data after making sampling (Kumar, 2019).

There are various methods used for planning and scheduling like Gantt chart, Critical Path Method (CPM) or Kabana Method. CPM is the most popular method of planning. The CPM method is to create a list of tasks which is required to complete the project, dependences between tasks, resources required to complete those tasks like Excavation quantity can be 1000 Cum and one hydraulic excavator can excavate around 200 cum of soil in one day. Hence, 05 days will be required to complete the task with one hydraulic excavator. This calculation helps us to estimate the time required to complete the task.

In the below mentioned figure, we can easily see various activities along with the time duration required to complete the project. The below figure is also able to show the exact "Critical Path" of the project (highlighted in red) which should be following by the project planner, project manager or by senior management of the project to monitor the overall status. The other paths should also be monitored at only project manager level as leaving them unmonitored may lead them to be critical in future.



Source: (AcqNotes, 2021)

Figure 4: Critical Path Method (CPM) Model Plan using Finish-to-start relationship

Due to the complexities of the project in modern world, the scheduling plans are mainly created through the software like MS project or Primavera P6 (Lehtimäki, 2017). The planner plays an important role in preparing the Detailed Work programme (DWP).

The programme file i.e. Detailed Work programme (DWP) contains:

a) Key Milestones,
b) Work Breakdown Structure (WBS),
c) Activities,
d) Relationships,
e) Sequencing of Activities,
f) Activity Durations,
g) Define Resources,
h) Assign Resources to each activity,
i) Assign Calendars based on the public holidays and other critical information,
j) Assign expenses to activities, if required.

Following extract is taking to analyzing the overall time schedule of any successful project using Primavera P6:

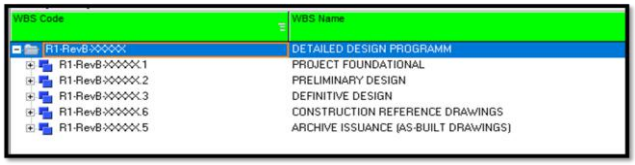


Figure 5: Work Breakdown Structure

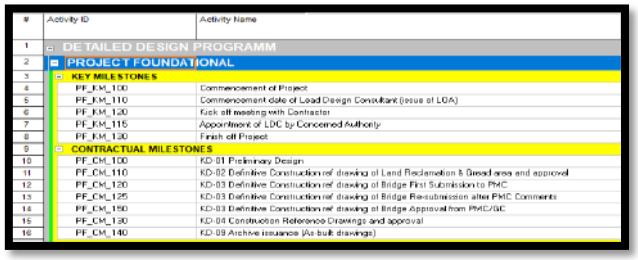


Figure 6: Activities under WBS

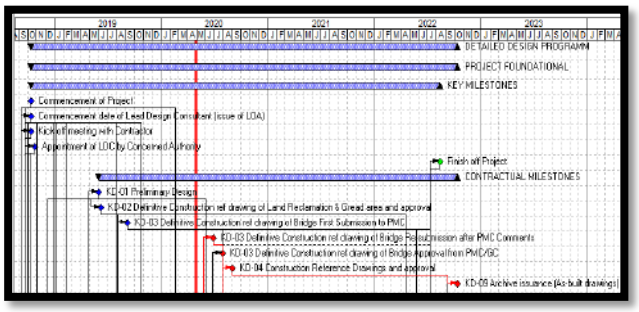


Figure 7: Sequence of activities and relationships between activities

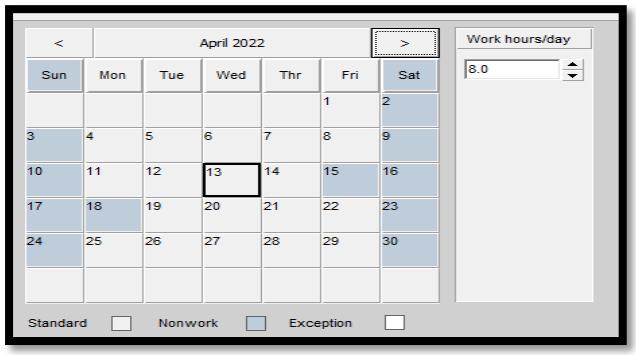


Figure 8: Project Calendar

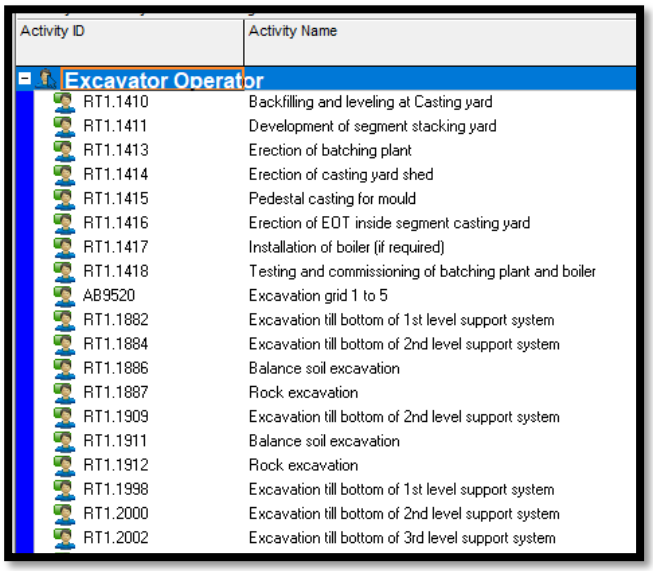


Figure 9: Creating Resources

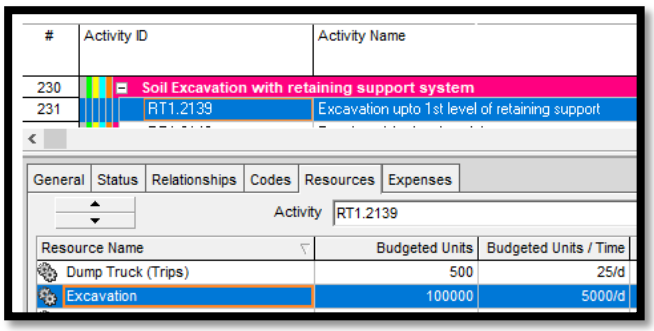
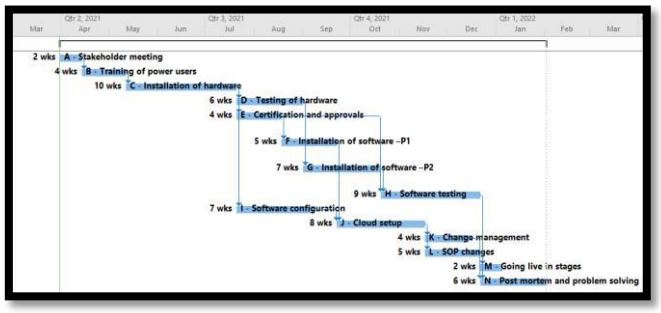


Figure 10: Assign resources to activities

One Example of Project Plan using MS Project:

	Task Name	Duration	Start	Finish	Predecessors	Total Slack
1	Implementation of AI Software	44 wks	Wed 31-03-21	Tue 01-02-22		0 wks
2	A - Stakeholder meeting	2 wks	Wed 31-03-21	Tue 13-04-21		0 wks
3	B - Training of power users	4 wks	Wed 14-04-21	Tue 11-05-21	2	0 wks
4	C - Installation of hardware	10 wks	Wed 12-05-21	Tue 20-07-21	3	0 wks
5	D - Testing of hardware	6 wks	Wed 21-07-21	Tue 31-08-21	4	4 wks
6	E - Certification and approvals	4 wks	Wed 21-07-21	Tue 17-08-21	4	0 wks
7	F - Installation of software –P1	5 wks	Wed 18-08-21	Tue 21-09-21	6	0 wks
8	G - Installation of software –P2	7 wks	Wed 01-09-21	Tue 19-10-21	5	4 wks
9	H - Software testing	9 wks	Wed 20-10-21	Tue 21-12-21	6,8	4 wks
10	I - Software configuration	7 wks	Wed 21-07-21	Tue 07-09-21	4	2 wks
11	J - Cloud setup	8 wks	Wed 22-09-21	Tue 16-11-21	7,10	0 wks
12	K - Change management	4 wks	Wed 17-11-21	Tue 14-12-21	11	1 wk
13	L - SOP changes	5 wks	Wed 17-11-21	Tue 21-12-21	11	0 wks
14	M - Going live in stages	2 wks	Wed 22-12-21	Tue 04-01-22	9	4 wks
15	N - Post mortem and problem solving	6 wks	Wed 22-12-21	Tue 01-02-22	12,13	0 wks



The project schedule modelling allows seeing the big picture on the primary task which is to be completed. The project schedule involves mainly three major items i.e. deliverables, milestones and the activities needed to complete the project. Then the research comes to the analysis of project risk planning. Project risk planning is the process to identify how to carry out the activities or the tasks of the project risk management. The main work of that is identifying the risk of the project and proper mitigation measures against those risks (Chowdeswari, Optimal planning and scheduling of high-rise buildings, 2017). The design of the project is the procedure where the exact steps of the project have been designed and mapping, so that it couldn't make any problem in future. From the analysis part of the research, information related to the implementation of the new procedure is discussed, that helps to easily complete the whole construction project.

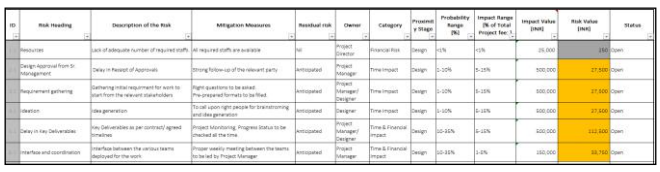


Figure 11: Risk Register as Sample

AACE Guidelines

The AACE international standard guidelines are the accepted standard and give excellent project management suggestions. The construction sector in India needs to evolve its project control department, and the recommendations will be crucial to the project's smooth progress. There are a number of suggested guidelines, some of which are expanded, that are applicable to project management in the Indian construction business.

AACE recommends schedule development as one of the practices, and the ID for this guideline is 91R-16. This procedure entails converting the project's scope into functionality, feasible milestones, time-duration, time limitations, and other schedule-related data into a schedule model (AACE, 2020). A well-crafted schedule contains sufficient detail to enable effective project management. The many sorts of schedules can be classified into five tiers based on the degree of schedule information. The schedule's highest level is provided by Level 1. The schedule's fifth level is used to manage task needs for the completion of the functionality specified in the schedule. The working schedule is a level five schedule that depicts work demands on a weekly, daily, or hourly basis. The next AACE-recommended guideline for the construction sector is EVM, or "Earn value management," with the ID number 82R-13 (AACE, 2020). The "32 EIA-748-C recommendations" for employing EVM are defined first in this recommended practice. "Earned value management" (EVM) is a construction project management system that combines time, price, and scope to measure project performance (Chen, 2012). EVM predicts the future based on predicted and observed values, allowing project managers make adjustments as needed. The "Responsibility and required skills for a project planning and scheduling" guideline, with ID 14R-90, is another AACE guideline whose objective is to establish the accountabilities of project planners and scheduling specialists during various project planning stages and schedule creation. This procedure also specifies the abilities and expertise that project schedulers must possess. The execution of project control in the Indian construction sector necessitates the use of competent and experienced personnel, as well as the proper training of workers. Project planning, schedule formulation, and schedule control or management are the three aspects of this approach.

The "Schedule update review," with the ID 53R-06, is the next AACE worldwide guideline. This "schedule update review" recommended practice (RP) is meant to be a guideline rather than a set of rules. As recommended by AACE International, this paper offers instructions for the project scheduler to write a professionally scheduled update or analyze the appropriateness of schedule modifications to be made as a result of a change in project status and progress. This RP is tied to "Total Cost Management" (TCM) progress and performance measurement, as well as change management processes, for building projects (Igwe, 2020). These best practices document outlines guidelines for construction entities delivering schedule updates (contractors) and organizations evaluating schedule submittals (owners or clients) to respond proportionately to the submittal.

Another AACE worldwide guideline is "Developing the project control plan," which has the ID 60R-10. Instead, then being a set of rules, this proposed practice is designed to be used as a guideline (AACE, 2020). The guideline's purpose is to increase communication among stakeholders involved in the creation, evaluation, and use of project controls

information. It is an AACE International recommended practice. This deliverable can be part of a larger "Project execution plan" (PEP), or it can be used on its own to outline the specific approaches that each functional unit, such as engineering, procurement, construction, safety, and quality, will take. All of the aforementioned rules are critical in project management, and the Indian construction industry, in most cases, lacks project control.

III. Discussion

Planning is a challenging task but at the same time it is also a fundamental activity in managing any type of construction project. Good monitoring and controlling of construction projects are based on developing the budget and the schedule for the work. In layman term, the project plan is the process that defines the project goals, project aims and objectives. It specifies the task that how the project will proceed, and total time required to complete the project. It also specifies what resources will be required for undertaking the task (Bajjou, 2020). The project plan also gives the information of the team role.

The planning of the project includes the risk register. Now a days, there are various software available to prepare the project plan like MS project and Primavera P6. The project plan is mainly referring to time schedule which involves the steps to complete the project. The project planning also includes documentation of the project and an effective method of creating a flow chart to complete a construction project. A project plan defines all of the work which has to be done in the project and also identifies who will do that work. The project plan is focused on the scope, time, cost, quality, environment, safety, quality and risk of the work.

There are some basic steps involved in planning & scheduling for successful completion of the project:

• Scope Planning: Specify the requirements for the entire project and in order to create the WBS structure, scope planning for the entire project is required so that the Engineers and the managing authority of the project are able to finish the entire project according to the timeline by fulfilling all the requirements.

• Development of the project schedule: Mapping the overall work of the entire project, develop the entire schedule for the project by creating WBS and activities in detail and implement within the timeline.

• Resource Planning: Planning for the resources is also required so that it is possible to gather all the possible resources, or any extra resources required before start of the project in order to complete the overall project successfully. Otherwise, the overall timeline and the overall cost for the entire project might be hampered.

• Design Planning: One of the most important planning phase where Preliminary, Detailed, Good for construction and As-built drawings programme is prepare.

• Procurement Planning: Besides scope planning and budget planning focusing on the outside vendors and the subcontracting are also required to prepare the procurement of materials and equipment to complete the overall project successfully.

• Planning for the overall Budget: In order to complete the overall project within the budget the planner needs to pre-planned for the estimate budget for the entire project so that they are able to finish their work and also able to measure if any extra cost is required for completing the project.

• Risk Management Plan: Before start any of the projects, the planner needs to list down the possible risks while performing the overall work and also needs to be pre-planned against those in order to estimate those risks within time. Otherwise, it will lead to cost & time overrun. So, Risk Register needs to be prepared showing probability and impact of risk, thus, calculating the risk value for each risk.

• Communication Plan: For any project, communication plan is required to make a suitable communication between the various stakeholders to have timely decision. Also, the communication between the workers, managers and the supervisors are also required so that there have no difficulties or misunderstanding arises.

Scheduling is the process of planning about providing the resources, relationships, and schedule of the tasks to calculate the completion time (Kanit, 2021). The schedule of the construction is based on the task, material, labor, and the time needed for completing the project. There are many ways to create a schedule which includes curve S, network planning, the scheduling linear, etc.

The construction planning and the scheduling are to improve the work efficiency of the project. Effective material management and proper distribution of the material or the resources reduce the cost of the project and reduce the lifetime of the project. Site planning is a task that is done step by step on the site (Hasan, 2019). Planning is the process by which the work simplifies. Scheduling is the process of arranging the resources and managing those steps in a tabular form. The scheduling is the steps of the planning activities. That's why planning and scheduling are very important criteria to do work properly. And reduce the project time and cost of the project.

IV. Recommendation

Mitigate the limitation of the project planning and the scheduling of the project. These above sections must be improved further, so that the importance of the project planning and scheduling can be focused further and proper planning to be carried out before construction (Saad, 2020). The planning and scheduling can help the project complete within time without cost overruns. The plan can define the work purpose and the schedule of the work can define the requirements. To complete the project, monitoring and controlling is also important which is not discussed in this research article. Further, the importance of planner is touched upon here but should be discussed in detail. Moreover, Project Controls department impotence needs to be highlighted for successful planning & scheduling. So, the readers and the future researcher can gather the information related to the importance of the project planning and scheduling by including above mentioned points.

Conclusion

The research is based on the importance of planning and scheduling in construction. The introduction we have discussed about the project plan, project planner and DWP. In background section, CPM was discussed. After collecting the data from various resources such as online articles and also from journals, this overall research is performed. In the literature review section, pre-project plan was discussed

along with the factors affecting project delay. In this article, the challenges of the project planning and scheduling has been described. The methodology section and the methods of the research have been described. Following which process the research has been done which also mentioned in that section. Also, the data were critically evaluated and the result which came-out as the output of the analysis are also satisfy the project aim and objectives. DWP explained in detail with successful projects examples where project plan was prepared using Primavera P6 and MS Project. Risk Register was also explained with example. From the discussion part of this research, it is also possible to gather the various information related to the pros and cons of the project planning and scheduling. In the recommendation section, the requirement of the strategies to improve the planning and scheduling system is mentioned.

References

1. AACE, 2020. *AACE International.* [Online] Available at: https://web.aacei.org/docs/default-source/toc/toc_91r-16.pdf?sfvrsn=6
2. AcqNotes, 2021. *Schedule development.* [Online] Available at: https://acqnotes.com/acqnote/tasks/critical-path-critical-path-method [Accessed 2 Feb 2022].
3. Anon., n.d. *Planning and Scheduling Bridge Girders Fabrication Through Shopfloor Operations Simulation.*. s.l., s.n.
4. Aulin, H. A. &. R., 2015. Assessing Understanding of Planning and. *Engineering Management Journal*, Volume 27, p. 17.
5. Bhosale, V. S. S. a. K. M., 2017. A review of the genetic algorithm used for optimizing the scheduling of resource constraint construction projects.. *International Research Journal of Engineering and Technology*, 4(5), pp. 2869 - 2872.
6. Chen, S. &. Z. X., 2012. An analytic review of earned value management studies in the construction industry. *In Construction Research Congress 2012: Construction Challenges in a Flat World*, pp. 236-246.
7. Chowdeswari, C. C. D. a. A. S., 2017. Optimal planning and scheduling of high rise buildings. *Technology*, 8(1), pp. 312 - 324.
8. Dixit, S. M. S. S. A. a. S. S., 2017. Area of linkage between lean construction and sustainability in the Indian construction industry.. *International Journal of Civil Engineering and Technology*, 8(8).
9. Hasan, M. L. M. a. B. K. 2. J., 2019. Europe, European Conference on Computing in Construction.
10. Hendrickson, C., 2008. Fundamental Concepts for Owners, Engineers, Architects and Builders. *Project Management for Construction*, 2(2).
11. Igwe, U. S. M. S. F. &. A. M. B. M. D., 2020. *Recent Technologies in Construction; A Novel Search for Total Cost Management of Construction Projects.* US, IOP Publishing, p. 21.
12. Khun-anod, K. a. L. C., 2019. Pre-project Planning Process Study of Green Building Construction Projects in Thailand.. *Engineering Journal*, 23(6), pp. 67 - 81.
13. Muneeswaran, G. M. P. A. P. a. A. A., 2020. A statistical approach to assess the schedule delays and risks in the Indian construction industry.. *International Journal of Construction Management*, 20(5), pp. 450 - 461.
14. Pat Ferguson, G. L. P. P. S. R. G. S., 2015. Software Process. *Advanced Information Services Inc.*, p. 50.
15. Prasad, K., Vasugi, V., Venkatesan, R. & Bhat, N., 2019. Analysis of causes of delay in Indian construction projects and mitigation measures. *Journal of financial management of property and construction.*
16. Saad, I., 2020. Teaching Construction Planning and Scheduling: Why, What, When, and How.. *EPiC Series in Built Environment*, Volume 1, pp. 26 - 35.

Strengthening Farmers' Social Capital to Build the Sustainable Agriculture in Tidal Swamplands, South Sumatra, Indonesia

[1] Bunaiyah Honorita, [2]Muhammad Yazid, [3]Riswani
[1] Agribusiness Master Study Program, Faculty of Agriculture, Sriwijaya University, Indonesia
[2]Agribusiness Master Study Program, Faculty of Agriculture, Sriwijaya University, Indonesia
[3] Agribusiness Master Study Program, Faculty of Agriculture, Sriwijaya University, Indonesia

Abstract
The existence and role of social capital is needed in the success and sustainability of agricultural development in tidal swamp land. This study aims to measure the condition of farmers' social capital and formulate strategies for strengthening social capital in developing sustainable agriculture in tidal swamp land. The research was conducted in Muara Telang District, Banyuasin Regency, South Sumatra Province, Indonesia in 2021 on 150 farmer respondents and 13 expert respondents. Data obtained through direct interviews with respondents using a questionnaire. The strategy for strengthening social capital is formulated using the Analytical Network Process (ANP) analysis. The results showed that the social capital of farmers in tidal swamp rice farming was in the high criteria with a score of 39.86. The strategy of strengthening social capital in developing sustainable agriculture in tidal swamplands can be carried out through: (a) transformational leadership support, (b) increasingly routine and strong interaction between group members, (c) regular and scheduled assistance from extension workers on an ongoing basis, (d)) involvement and organizational roles from the village/hamlet/group level, (e) involvement of the roles of community and family leaders and (f) a variety of programs that prioritize social and human capital capacity building. The strengthening of social capital in this tidal area is expected to empower small farmers in particular to be more empowered in managing their farms in a sustainable manner, building a sustainable corporate farm for mutual prosperity.

Keywords
Analytical Network Process, Social Capital, Strengthening, Tidal Swampland

I. INTRODUCTION

The strategy of agricultural development in swamps must be pursued towards a sustainable agricultural system through optimizing the use of various resources according to land characteristics, specific commodities and still paying attention to the culture of the local community (Ar-Riza and Alkasuma, 2008). Susilawati, et al. (2017) states that the success and sustainability of sustainable agricultural development in tidal land can be done through the application of appropriate land and commodity management technology, supported by human resource capabilities, support for adequate facilities and infrastructure as well as effective and efficient institutions. According to Anggreany and Rohaeni (2020), the development of a technology must be balanced with the competence of farmers in working on it so that it need reinforcement on the social side in order the activities that take place can increase rice production and income farmers in a sustainable manner.

Social capital provides an increase in individual awareness of the many opportunities that can be developed for the benefit of the community, especially in terms of increasing agricultural production.

Putnam (1995) defines social capital as characteristics of social organizations such as social cooperation, mutual trust and norms that facilitate coordination and cooperation for mutual benefit. Burt (1992) states that social capital is the ability of an individual to relate to one another and become a very important force for aspects of economic life as well as social aspects. Fukuyama (1999) defines social capital as a set of values and norms that live in groups as a common grip. In general, there are 3 (three) types of indicators that can be used as an approach to illustrate social capital at the micro level, namely indicators relating to attitudes of trust and adherence to prevailing norms, membership in local associations and networks, and indicators related to collective action (Grootaert and Bastelaar, 2002).

Sawitri and Soepriadi (2014) stated that in agricultural activities, social capital also determines the level of productivity. Especially for rice commodities, the role of social capital is very large because it requires great togetherness and cooperation. Pre-production, production and post-production activities will not run optimally without social capital. Unfavorable experiences for farming communities in dealing with other parties interfere with the sustainability of agricultural activities, which economically and socially are still very much needed. The lack of social capital empowerment is especially the case in the agricultural sector in various regions, including South Sumatra.

The hallmark of the people in South Sumatra Province, especially in the tidal swamp land area, is the existence of a

heterogeneous community inhabited by many tribes, namely the indigenous tribes of South Sumatra, Bali, Bugis, Javanese and Sundanese. The Javanese dominate this area due to the transmigration program that has been organized by the government aimed at developing food production centers. Similar to the people of South Sumatra in general, the people who live in these tidal areas build cooperation in the form of "gotong royong" and have been embedded in a variety of behaviors with intensities and nuances that are in accordance with the local environment as well as various needs and attractiveness between behaviors within the community group.

However, in social life, there are still gaps between farmers who have a lot of capital and those who don't. Farmers of productive age tend to be receptive to new technologies that are disseminated, but older farmers are more resistant (laggard). The programs that have been implemented so far have been able to increase productivity and the Planting Index (IP) but are felt to have not had a broad impact but have not been able to encourage farmers to be stronger and more empowered in a sustainable manner. The strengthening of social capital in this tidal area is expected to empower small farmers in particular to be more empowered in managing their farms in a sustainable manner, building a sustainable corporate farm for mutual prosperity.

This study aims to: (1) measure the condition of farmers' social capital; (2) develop a strategy for strengthening social capital in developing sustainable agriculture in tidal swamp land. An understanding of social capital (about the underlying values in farming), its practice in agricultural life, and its role is expected to become a strategy formulation and policy recommendation to increase productivity and income.

II. METHODS

A. Time and Place

This research was conducted in August-October 2021 in Muara Telang District, Banyuasin Regency, South Sumatra Province.

B. Research Methods

The method used in this research is a survey method, conducted directly through interviews using questionnaires and followed by in-depth interviews with key informants. The respondents in this study were 150 tidal swamp rice farmers and 13 expert respondents from the Agriculture Agency, AIAT, field extension workers, local government (village and sub-district) and academics.

C. Data Analysis Methods

The social capital attached to farmers in tidal swamp rice cultivation is measured using 4 (four) variables, namely (1) trust, (2) participation, (3) organization/network and (4) the role of norms. The data analysis used to measure the condition of farmers' social capital is descriptive analysis using a Likert scale with a score range of 1-3 and class intervals (Nasution and Barizi in Rambe and Honorita, 2011):

NR = NST – NSR PI = NR : JIK

Description:

NR = Value Range
NST = Highest Score
NSR = Lowest Score
PI = Interval Length
JIK = Number of Class Intervals

Table 1. Value of Farmers' Social Capital Level Indicators in Tidal Swamp Rice Farming

No.	Indicators	NST	NSR	JIK	NR	PI
1.	Trust	12	4	3	8	2,6
2.	Participation	18	6	3	12	7
3.	Organization/networ	9	3	3	6	4,0
4.	ks	12	4	3	8	0

Table 2.Class Interval Score Total and Per Question for Assessment Farmers' Social Capital in Tidal Swamp Rice Cultivation

No.	Class Interval Value (Total Score)	Class Interval (Per Question)	Criteria Mark
1.	17.00 x 28.33	1.00 x 1.66	Low
2.	28.33 < x 39.66	1.67 < x 2.33	Medium
3.	39.66 < x 51.00	2.34 < x 3.00	High

The Analytical Network Process (ANP) was used to formulate a strategy for strengthening social capital in building a sustainable tidal swamp rice farm, using the Super Decission 2.10 software application. The results of the data analysis on the condition of social capital are used as a basis for compiling alternatives, criteria and sub-criteria at the model construction stage in the ANP analysis in order to formulate strategies for strengthening social capital in tidal swamp land in Muara Telang District. The form of the ANP network used in this study is a general network form. The stages of ANP research are as follows: (1) model construction, (2) model quantification and (3) analysis of results.

III. RESULTS

D.Farmers' Social Capital Conditions in Tidal Swamp Rice Farming

The results showed that the overall condition of farmers' social capital was in high criteria with a total score of 39.86 (Table 3).

Table 3. Existing Conditions of Farmers' Social Capital in Tidal Swamp Rice Farming

No.	Components of Social Capital	Score	Criteria
1.	**Trust**	**8.59**	**Medium**
	- Willingness to cooperate with other farmers in terms of rice cultivation in tidal swamp land	2.36	High
	- Trust in information on rice cultivation technology from production and production kiosks	1.87	Medium
	- Trust in information on rice cultivation technology from the Department of	2.02	Medium
2.	Agriculture/BPTP/Universities and others	**14.54** 2.46	**High** High
	- Have empathy for fellow farmers and respect each other even though they are of different	2.47	High

	ethnicity and religion		
	Participation	2.45	High
	- Always attend an event or meeting organized by agricultural extension workers	2.45	High
	- Always willing to help when asked to help other farmers in managing their paddy fields	2.31	Medium
	- Activeness in giving ideas or ideas in farmer group meetings	2.40	High
	- Participate with local government regarding	**7.49**	**High**
3.	agricultural progress on tidal land in my village	2.62	High
	- Willing to continue to use the technology delivered even though there is no assistance or program from the government	2.55	High
	- Actively participate in preparing the planting schedule and the stages of rice cultivation	2.32	Medium
		9.24	**Medium**
4.	carried out	2.51	High
	Organization/Network		
	- Cooperating with other farmer groups in cultivating tidal rice	2.44	High
	- Collaborating with research institutions, agricultural services, AIAT, universities and others regarding rice cultivation technology in tidal land	2.29	Medium
	- Use of internet technology to obtain information related to rice cultivation technology in tidal land	2.00	Medium
	Social norms		
	- I pay the loan money / goods lent by other farmers / farmer groups / savings and loan institutions / banks on time		
	- I pay the group dues on time for the needs of the farmer group		
	- I am willing to help small farmers who need help without being burdensome to jointly increase productivity		
	- Comply with regulations regarding the time of planting preparation (land processing) that has been agreed within the farmer group		
	Amount	**39.86**	**High**

A. Farmers' Social Capital Conditions in Tidal Swamp Rice Farming

Priority Criteria

The criteria in the strategy of strengthening social capital to support sustainable agriculture in Muara Telang District consist of 4 (four) criteria, namely (1) Trust, (2) Participation, (3) Organization/Networks and (4) The role of norms (Figure 1).

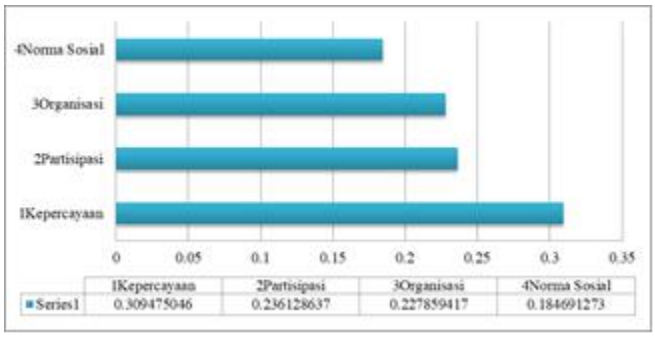


Figure 1. Priority Criteria for Strengthening Social Capital in Supporting Sustainable Agriculture in Muara Telang District

Priority Sub Criteria

The four social capital criteria analyzed, each has 2 (two) sub-criteria based on the results of the analysis of the first objective which is lower than the other sub-criteria (Figure 2).

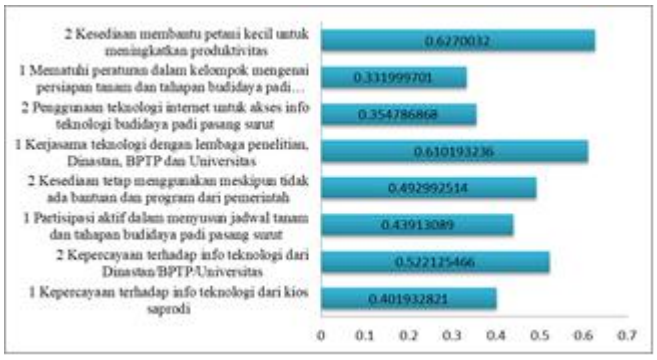


Figure 2. Priority of Sub Criteria for Strengthening Social Capital in Supporting Sustainable Agriculture in Muara Telang District

Alternative Priority

To formulate a strategy for strengthening social capital, 6 (six) alternatives were determined based on the literature study as presented in Figure 3.

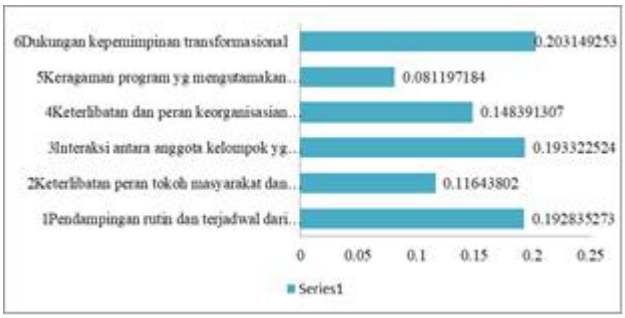


Figure 3. Alternative Priorities for Strengthening Social Capital in Supporting Sustainable Agriculture in Muara Telang District

Table 4. Alternative Priority Strategies for Strengthening Social Capital in Tidal Swamp Land

No.	Alternative Priority	Normalization Value	Party Role
1.	Transformational leadership support	0.203	Local government (Village and District)
2.	Interactions between group members are becoming more routine and stronger	0.193	Head of Gapoktan, Head of Poktan
3.	Regular and scheduled assistance from extension workers on an ongoing basis	0.192	Extension coordinator at the sub-district level (BPP) and PPL at the village level
4.	Involvement and organizational roles from the village/dukuh/group level	0.148	Village heads and administrators, hamlet heads
5.	Involvement of the role of community leaders and families	0.116	Public figure
6.	Diversity of programs that prioritize capacity building for social capital and human capital	0.081	Related agencies and institutions (Department of Agriculture, Center for the Study of Agricultural Technology and Universities)

IV. RESULTS

Table 6 informs that of the 4 social capital indicators of farmers, the trust indicator has the lowest score with a moderate criterion of 8.59. This means that trust has the greatest potential to be empowered by its existence as social capital that has a more active role and is in a stronger condition in the management of tidal swamp rice farming.

Farmers' trust in information on rice cultivation technology disseminated by related institutions such as the Department of Agriculture/BPTP/University as well as from production and production kiosks is in moderate criteria or in other words, the condition of farmers' trust in these two sources of information is still quite adequate. "*Farmers don't immediately follow the technological recommendations that are conveyed, it takes a long time, it needs to prove tangible results. Especially for farmers who are quite old, they need tangible results and then slowly accept them. The program provided and the technology conveyed can be disseminated and implemented continuously and consistently, it needs to be applicable, not just 1 time, 1 planting season or 1 year and after that it is abandoned*".

It can be taken an effort to view and policy that the technology delivered in the form of programs, activities or assistance, needs to be developed continuously and consistently, must be applicable accompanied by the selection of appropriate extension methods, which are preferred by farmers so that the innovative nature of the technology used delivered is acceptable to farmers. There needs to be an effort to involve field agricultural extension workers as the spearhead of changing the behavior of farmers in the area. This effort is necessary to continue to foster and strengthen farmers' confidence in the technology that is disseminated both from related institutions and from other sources of information such as production and production kiosks.

As stated by Pamungkas and Sunaryanto (2018) that social capital trust is formed from social relations between two or more individuals based on trust and mutual belonging. So to build strong trust within the farmer environment in farming, it takes a long time and happens consistently.

Similar to trust social capital, social norms are also in the moderate criteria with an average score of 9.24. This criterion indicates that the farmer simply complies with the existing rules that have been agreed within the farmer group. This condition is manifested by the willingness of farmers to help small farmers who need assistance without being burdensome to jointly increase productivity, comply with regulations regarding planting preparation time, pay loans and group fees in a timely manner. This social norm is included in the dimension of relational social capital, especially in the sub-dimension of tolerance and social sanctions (Rabbani et al., 2019).

In contrast to the two social capitals above, the results of the measurement of participation social capital are in high criteria with an average score of 14.54. This high participation indicates that farmers play an active role in tidal swamp rice farming activities. The high participation of farmers is expected to encourage farmer behavior in the management of tidal swamp rice.

Grootaert and Basteler (2001) suggest that a person's participation and social networking will increase the availability of information at a low cost. In addition, the participation of individuals and local networks supported by mutual trust will make it easier to obtain joint decisions and implement them in joint activities. According to Widodo and Sugiyanto (2015), in voluntary associations, participation is a key factor in social capital. This is because in a participation there is a fabrication and relationship between group members such as altering ideas, information and knowledge as well as discussing and finding solutions to problems faced by the group.

The organization/network indicator has the highest score (score 7.49). This shows that the cooperation between individual farmers and other parties is well established and the need to join farmer groups and organizations in the community that is attended by individual farmers is quite large, such as the Water User Farmers Association (P3A). The cooperation in question is the cooperation of farmers in a farmer group with other farmer groups in cultivating tidal

rice. It can be seen from the exchange and purchase of seeds between farmers and farmer groups, rental and borrowing of agricultural machinery and production equipment and mills. Ernanda et al. (2019) states that relationships that occur within a network/organization both formal and informal are usually formed based on mutual empathy or friendship.

The results of the synthesis (Figure 1) conclude that in formulating a strategy for strengthening social capital to build sustainable agriculture in tidal swamp land, it is necessary to first strengthen trust in social capital, followed by strengthening social capital for participation, organization/network and social norms. Social capital trust is the main thing to be empowered because trust is an important aspect that underlies the strength of other social capital. This trust needs to be built through a long process and time using the same system.

According to Santoso (2020), the idea of trust is the most important thing in the concept of social capital. It is also mentioned that trust is a crucial aspect because its presence and absence will affect the activities carried out. In addition, an activity that provides benefits can be carried out smoothly if there is mutual trust.

In developing sustainable agriculture in tidal swamp land through strengthening social capital, the main and best alternative strategy is transformational leadership support. As stated by Pradana and Istriyani (2020) that in optimizing social capital it is necessary to manage other resources owned by the village. To optimize the role of social capital, support from various parties is needed which must be followed by transformational leadership support. Transformational leadership is able to give birth to new things from old things that can bring about various fundamental changes, such as values, goals and needs of subordinates (Avolio and Bruce, 1997). In addition, transformational leadership plays a role in leading that can encourage values, attitudes and beliefs and behaviors of other leaders to accomplish organizational goals (Rouche in Pawar and Eastman, 1997). Suseno and Sugiyanto (2010) conclude that transformational leadership can increase subordinate awareness of the importance of work output, prioritize group interests and advance the various needs of subordinates to a higher level in order to meet a decent quality of life.

The results of this ANP synthesis are generally in line with the results of research conducted by Cahyono and Adhiatma (2012) which concluded that transformational leadership is indispensable in optimizing social capital. The existence of transformational leadership is able to influence community members, encourage individual creativity, provide inspiration and motivation and have ideals. In addition, this study also reports that strengthening social capital requires the support of human capital because it can provide innovations to community members. To improve the skills of rural communities, especially in cultivation skills and increase agricultural diversification, it is necessary to have a mentoring program. Strengthening social capital aims as social strengthening in the community which can be done through optimizing the functions of BPD, LKMD, Gapoktan, PKK, BUMDes and Cooperatives. The strengthening of social capital is carried out by maximizing the role of social institutions which emphasizes on optimizing the side of trust, mutual respect and mutual benefit, as well as focusing on the prevailing culture and values.

According to Pranadji (2006), in strengthening social capital, the role of leadership is very important. Strengthening social capital will be effective if it begins with strengthening local community leadership, social governance and community organization at the hamlet level. Empowerment of social capital also needs to start from strengthening local cultural values as well as developing parts of social capital that are considered fundamental, such as human capital capabilities, social management and civil society organizations, balance social structures, and strong local leadership. , strong moral and legal systems and good governance.

The results of the study of Sylviani, et al. (2020) shows that strengthening social capital in the aspects of trust, norms, and networks will spur the empowerment of farmers and farmer groups. This is a part of social capital that must be further optimized in order to achieve optimal benefits. Mudiarta (2012) in his research concluded that the high role of social capital in increasing income must be supported by policy intervention in terms of budgeting development programs that can stimulate the growth and development of social networks. Agribusiness policies, especially the application of technological innovations, must be transformative towards changes in culture and social forms of society.

V. CONCLUSION

Based on the results of the research that has been done, it can be concluded that:

1. Farmers' social capital in rice cultivation in tidal swamp land is in high condition.
2. The strategy for strengthening social capital in developing sustainable agriculture in tidal land is formulated as follows: (1)transformational leadership support, (2) more routine and stronger interaction between group members, (3) regular and scheduled assistance from extension workers on a continuous basis, (4) involvement and organizational roles from the village/hamlet/group level, (5) involvement of leaders community and family and (6) a variety of programs that prioritize the capacity building of social capital and human capital.

The authors are grateful for the support of the Agribusiness Master Study Program, Faculty of Agriculture, Sriwijaya University. We are also great thankful to the supervisors Ir. Muhammad Yazid, M.Sc., Ph.D and Dr. Riswani, SP, M.Si for their direction and adviser. Finally, the authors express appreciation and gratitude to farmers and extension workers for their active participation in this research.

REFERENCES

1. Anggreany, S and Rohaeni, E S. Strategi Penguatan Modal Sosial dalam Membangun Lumbung Padi Nasional Berkelanjutan di Kalimantan Selatan. Jurnal Informasi Teknologi Pertanian (JITP) Vol 1 No 1, 2020:34-53. 2020.
2. Ar-Riza and Alkasuma. Pertanian Lahan Rawa Pasang Surut dan Strategi Pengembangannya dalam Era Otonomi

Daerah. Jurnal Sumberdaya Lahan Vol. 2 No. 2, Desember 2008.
3. Avolio, B J and Bruce, J. Effect of Leadership Style Anonymity on Group Potency and Effectiveness in a Group Decision Support System Environment. Journal of Applied Psychology, 82(1), 89-103. 1997.
4. Burt, Ronald S. Structural Holes. Cambridge Mass: Harvard University Press. 1992.
5. Cahyono, Budhi and Adhiatma, Ardian. Peran Modal Sosial dalam Peningkatan Kesejahteraan Masyarakat Petani Tembakau di Kabupaten Wonosobo. Proceedings of Conference in Business, Accounting and Management (CBAM) Vol. 1 No. 1 Desember 2012.
6. Ernanda, R., Burhanuddin and Purwono, J. Karakteristik Modal Sosial Petani Cabai Kopay di Kota Payakumbuh. Jurnal AGRISEP Vol. 18 No. 1 Maret 2019 Hal. 41 – 52. 2019.
7. Fukuyama, Francis. Trust : The Social Virtues and the Creation of Prosperity. NY: Free Press. 1995.
8. Grootaert and Bastelaer, T.V. Understanding and Measuring Social Capital: A Synthesis Of Findings And Recommendations From The Social Capital Initiative. Social Capital Initiative Working Paper No. 24. World Bank. 2001.
9. Mudiarta, Ketut Gede. Kapital Sosial dan Peningkatan Pendapatan Petani Komunitas Banjar: Suatu Analisis Ko-Produksi Tripartit Pemerintah, Swasta dan Masyarakat. Jurnal Pengkajian dan Pengembangan Teknologi Pertanian Vol. 15 No. 1 Maret 2012: 74-84.
10. Pamungkas, L S and Sunaryanto, L T. Analisis Dampak Kepemilikan Modal Sosial Terhadap Keberlangsungan Industri Kecil di Rumah Makan Niswa. Jurnal Sosial Ekonomi Pertanian Vol. 15 No. 1, Februari 2018.
11. Pawar, B S and Eastman, KK. *The nature and Implications of Contextual Influence on Transformational Leadership: a Conceptual Examination. Academy of Management Review, 22(1), 80-109*. 1997.
12. Pradana, M Y A and Istriyani, R. Sepakat-Sepaket: Modal Sosial Politik Masyarakat Kalitekuk dalam Mewujudkan Desa Wisata. Jurnal Ilmiah Ilmu Sosial Volume 6 Number 2 Desember 2020, pp. 138 – 149. 2020.
13. Pranadji, Tri. Penguatan Modal Sosial untuk Pemberdayaan Masyarakat Pedesaan dalam Pengelolaan Agroekosistem Lahan Kering. Jurnal Agroekonomi, Vol. 24 No. 2 Oktober 2006.
14. Putnam, Robert. Tuning In, Tuning Out : The Strange Disappearance of Social Capital in America. Political Studies Vol. 4 No. 28. 1995.
15. Rabbani, F N, Rifai, A and Kausar. Strategi Pengembangan Modal Sosial untuk Peningkatan Keberdayaan Petani Karet di Kecamatan Singingi Kabupaten Kuantan Singingi. JOM Faperta Vol. 6 Edisi 1 Januari s/d Juni 2019.
16. Rambe, Sri Suryani M and Honorita, B. Perilaku Petani dalam Usahatani Padi di Lahan Rawa Lebak. Prosiding Seminar Nasional Budidaya Pertanian. Urgensi dan Strategi Pengendalian Alih Fungsi Lahan Pertanian. Bengkulu 7 Juli 2011 ISBN 978-602-19247-0-9. 2011.
17. Santoso, P B and Darwanto. *Strategy for Strengthening Farmer Groups by Institutional Strengthening*. Jurnal Ekonomi Pembangunan, 16 (1), Juni 2015, 33-45. 2015.
18. Sawitri D and Soepriadi IF. Modal Sosial Petani dan Perkembangan Industri di Desa Sentra Pertanian Labupaten Subang dan Kabupaten Karawang. Jurnal Perencanaan Wilayah dan Kota. 25(1): 17-36. 2014.
19. Suseno, M N and Sugiyanto. Pengaruh Dukungan Sosial dan Kepemimpinan Transformasional Terhadap Komitmen Organisasi dengan Mediator Motivasi Kerja. Jurnal Psikologi Volume 37, No. 1, Juni 2010: 94-109. 2010.
20. Susilawati, A., Wahyudi, E., and Minsyah, N. Pengembangan Teknologi untuk Pengelolaan Lahan Rawa Pasang Surut Berkelanjutan. Jurnal Lahan Suboptimal: Journal of Suboptimal Lands ISSN: 2252-6188 (Print), ISSN: 2302-3015 (Online, www.jlsuboptimal.unsri.ac.id) Vol. 6, No.1: 87-94 April 2017.
21. Sylviani, Suka, A P., Surati and Kurniasari, D R. Social Capital in Managing Community Plantation Forest: a Case Study at KPH Boalemo, Gorontalo Province. Indonesian Journal of Forestry Research Vol. 7 No. 1, 71-82, April 2020.
22. Widodo, K., and Sugiyanto, F. Analisis Pengaruh Modal Sosial Terhadap Produktivitas Lahan Jagung (Studi Kasus: Kecamatan Pulokulon, Kabupaten Grobogan). Skripsi, Fakultas Ekonomika dan Bisnis Universitas Diponegoro. 2015.

Analysis of the Sustainability of Oil Palm Farming on Plasma Farmers in Sungai Lilin District Musi Banyuasin Regency South Sumatra Province Indonesia

[1] Destiya Rospiani, [2]Lifianthi [3]Dwi Wulan Sari
[1][2][3] University of Sriwijaya

Abstract
The aims of this research are to 1). Assessing the sustainable condition of smallholder oil palm farming based on social, economic, technical, environmental ,and institutional dimensions on Indonesia Sustainable Palm Oil (ISPO) criteria in Sungai Lilin District, Banyuasin Regency. The location was selected by purposive location sampling in Sungai Lilin District, Musi Banyuasin Regency, and collected data research on October 2021. This research used a survey method and the sample used a random method (simple random sampling) by taking 72 palm oil plasma farmers. Empirical data were analyzed using the Rapfish Software and data was collected through in-depth interviews. The results of the analysis of The sustainability of sustainable oil palm plantations are included in the medium criteria with average sustainability index value of 51.92%, the social, economic, and technical dimensions are in the less criteria, while the environmental dimensions are in the good criteria and the institutional dimensions are in the medium criteria. Furthermore, the most sensitive indicators to the social dimension are public perception and the intensity and effectiveness of extension. The economic dimension is land productivity or income and agricultural inputs. The technical dimensions are technical planting and pest control.

Keywords
Farming, Oil Palm. Smallholders, Sustainability

I. INTRODUCTION

Sustainable agriculture is the implementation of the concept of sustainable development in the agricultural sector. According to Salikin (2003) conceptually the sustainable agriculture approach is a pattern and perspective that must be developed by integrating economic, social and environmental aspects in a synergistic manner.

Agriculture in Indonesia, especially oil palm plantations, also supports sustainable agriculture by implementing Indonesian Sustainable Palm Oil (ISPO). This can be seen from the production of palm oil (CPO) in 2019 is estimated to increase by 12.92 percent compared to 2018 to 48.42 million tons. Currently, cooking oil is the main absorber of domestic oil consumption, reaching 70 percent of the amount marketed domestically (Directorate General of Plantations, 2015).

Opportunities for the development of oil palm agribusiness are still quite open in Indonesia, mainly due to the availability of natural resources/land, labor, technology and experts. Indonesia is the world's largest producer and exporter of palm oil. In addition to increasingly open export opportunities, the domestic market for palm oil and palm kernel oil is still quite large. This is because Indonesia is a country with the largest area of oil palm plantations in the world and it always increases every year from 2010 of 5,780,000 hectares to 2014 of 7,407,090 hectares (Data and Information Center of the Directorate General of Plantations, 2016). However, Indonesian farmers still have problems in the cultivation process, from planting to farming processes.

According to the Data and Information Center of the Directorate General of Plantations in 2016, the condition of Indonesian palm oil is developing following the world market which changes every year with an average productivity of 16.99 tons/ha. This is because the interest in the use of oil palm for various industrial sectors makes the palm oil commodity continuously strived to increase its production and quality. However, the fact is that oil palm production in Indonesia does not always increase even though the area of oil palm plantations in Indonesia increases every year. This is inseparable from several problems found in the field. The problems that occur in oil palm plantations can be seen from the financial and non-financial aspects.

The financial aspect is an aspect that looks at the changes that may occur in the form of changes in production value and variable costs, while the non-financial aspect will look at the market, technical, management and legal, economic and social aspects, as well as the environment which are directly related to the business of doing sustainability in oil palm plantations in Indonesia. These problems indicate that oil palm plantations in Indonesia must be improved and developed in accordance with the demand on the world market which is currently concentrated on fulfilling sustainable oil palm plantations (Demiyanti et al., 2013).

South Sumatra Province, which is the fifth largest producer of palm oil in Indonesia after Riau, North Sumatra, and Central Kalimantan and West Kalimantan, with South

Sumatra's palm oil production estimated at around 4,388,731 tons in 2021 and always experienced a growth of 6.74% recorded from 2017 to 2021 (Pusdatin 2021).

In 2018-2019 the area of oil palm plantations in Musi Banyuasin Regency is still the largest district in South Sumatra Province with an area of 356,131 Ha and 314,442 Ha. Therefore this problem is important to be investigated further in an effort to improve the development of community welfare which makes oil palm a regional superior commodity.

Sungai Lilin Sub-district is the seventh largest producer of palm oil in Musi Banyuasin Regency with a total production of 17,516 tons and a land area of 1,450 Ha in 2019. Consequently, the commodity of oil palm is one of the regional superior commodities that must continue to be improved because it involves the livelihoods of local people. There are various problems in oil palm plantations, especially in Sungai Lilin District, Musi Banyuasin Regency, starting from the social aspect: lack of knowledge and information about environmentally and sustainable plantation management; economic aspect: low production and decreased in 2016 by 19,272 tons and in 2017 by 17,516, unstable income due to price fluctuations in 2016 FFB price of around IDR. 1447.3 and in 2017 the FFB price was IDR. 1335.5 (Rospiani, 2018), difficult access to capital; technical aspects: problems in the cultivation process, from planting to farming processes; environmental aspects: there is no legal force over the land use area for oil palm plantations; to the institutional aspect: less active institutions such as Oil Palm Plantation Cooperatives.

II. MOTIVATION AND OBJECTIVE

From the various problems above, the issue of sustainability is becoming a priority in every aspects such as social, economic, technical, environmental and institutional. Therefore, researchers are interested in conducting a study on the analysis of sustainable plasma oil palm plantations in Sungai Lilin District, Musi Banyuasin Regency, which is expected to be an input in efforts to develop oil palm farming that can be felt equally by farmers, institutions, and companies.

III. METHODS

Time and Place

This research was conducted in Sungai Lilin Sub-district, Musi Banyuasin Regency, South Sumatra Province, Indonesia, October 2021.

Research Methods

The survey method was used to obtain accurate information and descriptions about sustainable palm oil in 5 dimensions (social, economic, technical, environmental and institutional) of plasma farmers. The collection of data, information collected directly through interviews using a questionnaire. The sustainability indicators are based on Indonesia sustainable palm oil (ISPO), such as:

1. The social dimension is measured using 7 indicators: local wisdom related to sustainable agriculture, level of education, intensity and effectiveness of extension, community perception of sustainable agriculture, participation of women workers in farming management, frequency of conflicts, knowledge and experience of the community in plantation management of sustainable palm oil.
2. The economic dimension used 7 indicators: land tenure or garden legality, labor potential, price stability of farmers' production or price fixing, land productivity and income, interest in farming, availability of agricultural input materials, and availability of business credit.
3. The technical dimension is measured by 7 indicators, namely land clearing, oil palm nurseries, oil palm planting techniques, control of plant pest organisms, plant maintenance to support productivity, harvesting, fruit transportation.
4. The environmental dimension: the suitability of oil palm plantation land, fire prevention and control, the area of managed plantations, conservation actions taken in case of land damage, the location of self-help gardens must be in accordance with spatial and environmental planning, pest management and disease, biodiversity conservation.
5. The institutional dimension: the existence of institutions such as farmer groups and cooperatives, farmer involvement in institutions, institutional management, institutional existence, institutional functions and benefits, membership of oil palm plantation farmer groups, business partners (companies).

The samples used were 72 farmers from 720 palm oil plasma farmers. Meanwhile, the indicators based on Indonesia Sustainable Palm Oil (ISPO) and used an ordinal scale with a scoring of 1-3: 1 (low), 2 (moderate), and 3 (high). Then, it is processed using RAPFISH software and the results are in the following categories:

Table 1. Percentage of Sustainability Index Value

Index Value	Category
0% - 25%	Bad
25.01% - 50%	Not enough
50.01% - 75%	Enough
75.01% - 100%	Good

Source: Nurmalina, R. 2008. Journal of Agro-economy. Bogor Agricultural Institute

Research Hypothesis

Based on various previous research related tosustainable of palm oil plasma farmers. One of them isAccording to Muani, Ani., et.al. (2018)The results of the RAP-ISPO analysis of palm oil sustainability on five dimensions with 41 multidimensional attributes included in the moderately sustainable status with a sustainability index value of 69.77%. The highest sustainability index value is found in the technological dimension, which is 81.91%, while the lowest value occurs in the institutional dimension (53.80%) but is still considered quite sustainable, while the social dimension (70.45%) is ecological (72.18%) and economy (70.44%) are categorized as quite sustainable. Identified 15 sensitive/leverage attributes that affect the sustainability of oil palm. The conclusion is that the Ngabang plasma

plantation in its management has implemented ISPO although it is not optimal, but through the improvement of the 15 attributes of the lever, the sustainability status of oil palm can still be improved in order to produce palm oil that is economically viable, socially feasible, and environmentally friendly according to ISPO standards. The hypotheses are formulated as follows:

1. It is suspected that the achievement of smallholder oil palm farming is quite (medium) sustainable in Sungai Lilin District, Musi Banyuasin Regency.
2. It is suspected that the achievement of smallholder oil palm farming based on the ISPO criteria dimensions, economic, social and technical dimensions will be more sustainable than the environmental and institutional dimensions.

Data Analysis Method

The analysis used to answer the first objective of this research is RAP (Rapid Appraisal Technique) with the Multidimensional Scaling (MDS) method. The achievement of sustainable plasma oil palm plantations measured from five dimensions, such as social, economic, technical, environmental and institutional. the researcher used the sustainability analysis of the multidimensional scaling (MDS) method which is integrated in the Rapfish software modification. The statistical technique used is the ordinal measurement scale, where this scale not only categorizes variables into groups, but also ranks the categories.

The Rapid Appraissal method using the Rapfish software produced outputs such as diagrams, ordinances and distributions obtained through three stages of analysis, namely rapfish ordination, leveraging and monte carlo. In simple terms, the sustainability value scale is determined by a function of the attribute values of economic, technical, social, environmental and institutional aspects, with the formula:

IKb = f (E,L,S,T,K)

Where:

IKb = sustainability index value scale
E = economic aspect attribute score
L = environmental aspect attribute score
S = social aspect attribute score
T = technical aspect attribute score
K = institutional aspect attribute score

IV. Results

Demographic Characteristics of Respondents

The demographic characteristics of respondents consist of age, education, experience, land area, and residence status. The sample farmers in Sungai Lilin Sub-district, Musi Banyuasin Regency have an average age of 52 years and are classified as productive age. According to BPS (2021), a person's productive age ranges from 15 to 60 years plasma farmers with the most recent education at the elementary school level in the low category with 33 farmers or 45.84 percent. . In this study, the sample farmers have an average land area of about 2 ha. The largest land area is 2.37 ha, while the smallest land area is around 1.61 ha with a total area of oil palm plantations for sample farmers, namely 143.72 ha. Oil palm plasma smallholders in Sungai Lilin District 91.67% are transmigrants from Java, while 8.33% are local residents of South Sumatra. The number of sample farming families in Suka Damai Baru Village and Sri Gunung Village reached 253 people with 72 family heads. Meanwhile, based on gender, the majority were men with 67 farmers with a percentage of 93.06 percent while women were 5 people with a percentage of 6 ,94 percent.

Table 1. Characteristics of sample farmers in Sungai Lilin Sub-district, Musi Banyuasin Regency in 2021 (n=72)

Characteristics	Frequency	Percentage (%)
Age (years)		
21-30	3	4.17
31-40	2	2.78
41-50	20	27.78
51-60	32	44.44
61-70	15	20.83
Education (years)		
No school	0	0.00
SD	33	45.84
junior high school	14	19.44
senior High School	16	22.22
Bachelor	9	12.50
Residence status		
Transmigrant	66	91.67
Local	6	8.33
Gender		
Male	67	93.06
Female	5	6.94

Source: Primary data analysis (2021)

Sustainability of Oil Palm Farming for Smallholders in Sungai Lilin District

Wigena et al. (2009) stated that problems in the management of plasma oil palm plantations began to arise when the oil palms began to produce (fruit sand) where the management of the plantations was completely left to the farmers, while the Company was only a source of technical guidance. The behavior of plasma farmers becomes focused on efforts to pursue maximum short-term income and less concerned about long-term risks such as decreased land productivity, environmental pollution and social conflicts.

The sustainability of smallholder oil palm farming in Sungai Lilin District was analyzed using a modified Rap-Fish analysis which includes five dimensions of sustainability, social, economic, technical, environmental and institutional dimensions. The measurement of these five dimensions uses 35 indicators or attributes referring to ISPO (Indonesian Sustainable Palm Oil).

Table 2. Maize Farming Sustainability Status in Tanjung Lago District, Banyuasin Regency

Sustainability Dimension	Index Value (%)	Mark S-Stress	RSQ	Sustainability Status
Social	45.93	0.13	0.92	Not enough
Economy	40,13	0.13	0.93	Not enough

Technical	33.45	0.13	0.92	Not enough
Environment	76.93	0.14	0.91	Good
Institutional	63.14	0.13	0.92	Enough
Average	51.92			Enough

Source: Primary data analysis (2021)

The results of the analysis show that the opportunity for the sustainability of smallholder oil palm farming in Sungai Lilin District, Musi Banyuasin Regency is 51.15% which means "quite sustainable". There are three dimensions that are below the criteria: the social dimension of 45.93%, the economic dimension of 40.13% and the technical dimension of 33.45%. While the environmental dimension is in the good category, its sustainability status is 76.93%. Furthermore, the institutional dimension is 63.14%, which is enough (medium) category. Table 2 shows the sustainability status of smallholder oil palm farming in Sungai Lilin District, Musi Banyuasin Regency.

The S-Stress value for each dimension is lower than 0.25. According to Pitcher and Preikshot (2001) the S-Stress value which is below 0.25 indicates that the goodness of fit modified by Rap-Fish and can present the model well. Thus, the modification analysis *Rap-Fish* has interpreted the sustainability model of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency well.

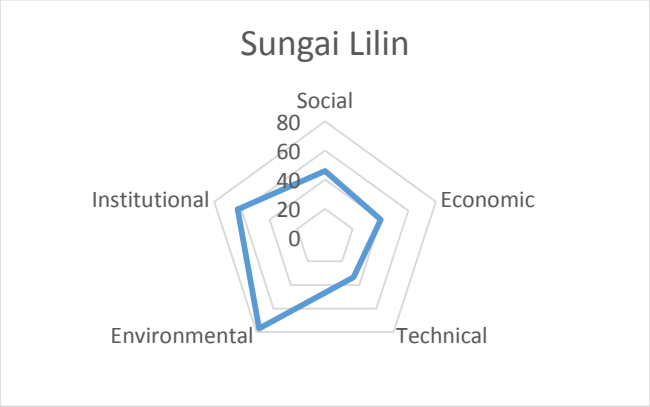


Figure 1. Kite Diagram of Palm Oil Farming Sustainability

To determine the closeness between the data and the perceptual map, the RSQ (Squared Correlation) value is used. The RSQ value which is close to 1.00 explains that the existing data will be mapped perfectly. The results of the analysis show that the RSQ value of the five sustainability dimensions has a value close to 1, therefore the sustainability of oil palm farming has been mapped perfectly. The results of the analysis of the sustainability of smallholder oil palm farming in Sungai Lilin District with five dimensions of sustainability are schematically shown in Figure 1.

Social Dimension

The level of sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency from the social dimension was measured using 7 indicators: local wisdom, level of education, intensity and effectiveness of counseling, community perception, participation of female workers, knowledge and experience. Based on the results of the Rap-Fish analysis, the level of sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, from the social dimension, obtained a value of 45.93% which is categorized as not enough (low) sustainable. The distribution of respondent data in the sustainability index of the social dimension can be seen in Figure 2.

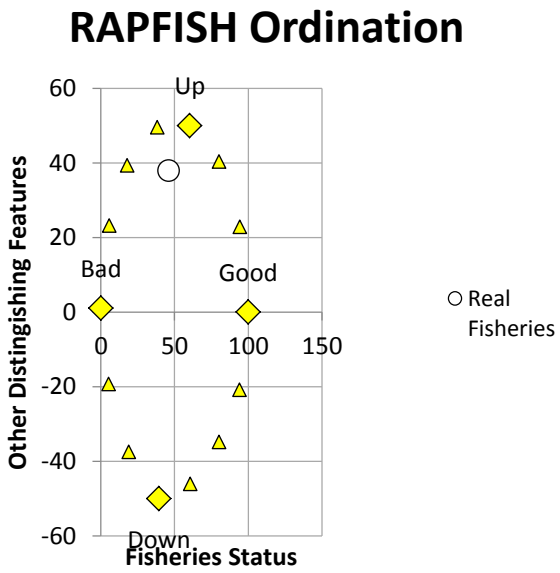


Figure 2. Oil Palm Farming Sustainability Index

Leverage analysis is an analysis that shows the sensitivity of each attribute to the sustainability value. Based on the results of the analysis of social dimension Leverage, there is one attribute that has more influence on the sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, that is the Community Perception attribute which helps with a value of 17.44 which is the largest compared to other indicators. Therefore, to improve the sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, it is necessary to pay attention to these attributes.

Economic Dimension

The level of sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency from the economic dimension was measured using 7 indicators: plantation legality, labor potential, price stability of production, income, interest in farming, availability of agricultural input materials, and availability of business partners. Based on the results of the Rap-Fish analysis, the level of sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, from the economic dimension, obtained a value of 40.13% which is categorized as less sustainable because it has not entered the productive age of the plant. The distribution of respondent data in the sustainability index of the economic dimension can be seen in Figure 3.

Based on the results of the economic dimension Leverage analysis, there are indicators that have the most influence on the sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, namely indicators of land

productivity (income) with a value of 16.03 which is the largest compared to other indicators. Therefore, to improve the sustainability of the economic dimension of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, it is necessary to pay attention to these attributes.

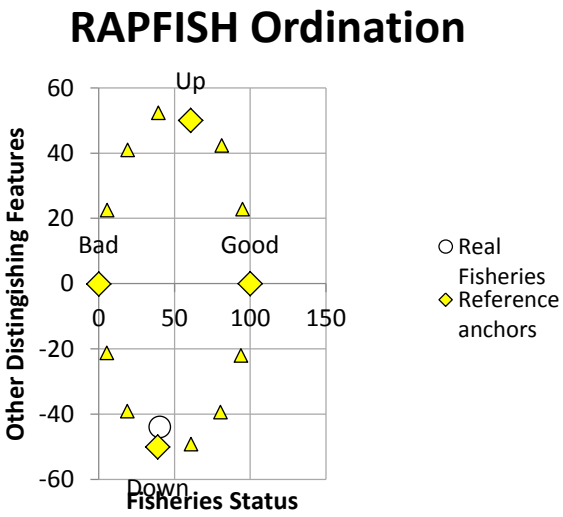


Figure 3. Sustainability Index on the Economic Dimension

Technical Dimension

The level of sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency from the technical dimension was measured using 7 indicators: land clearing, oil palm seeds, oil palm planting techniques, controlling plant pest organisms (OPT), plant maintenance to support productivity, harvesting, transportation Fruit.

Based on the results of the Rap-Fish analysis on the level of sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, from the technical dimension, it was obtained a value of 33.45% which was categorized as less sustainable. This is because technically the management of oil palm plantations is managed by the Oil Palm Farmers Cooperative so that on average they pay workers from outside the family. The distribution of respondent data in the technical dimension sustainability index can be seen in Figure 5.

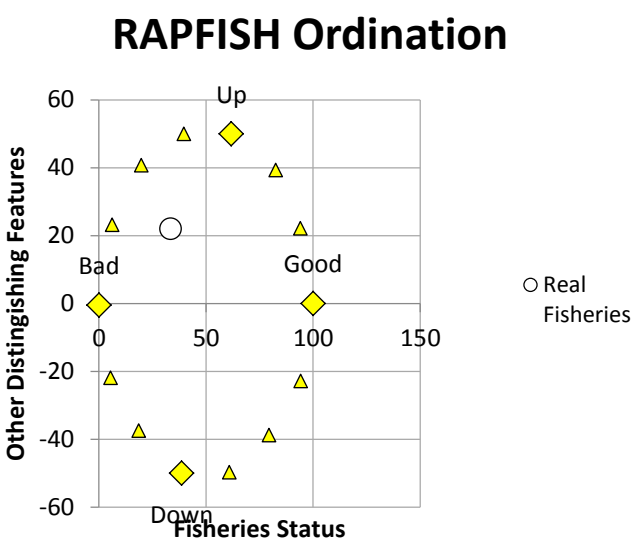


Figure 4 Technical Dimension Sustainability Index

Based on the results of the technical dimension Leverage analysis, there are indicators that most influence the sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, namely the technical indicators of oil palm planting with a value of 17.37 which is the largest compared to other indicators. Therefore, to improve the technical dimension sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, it is necessary to pay attention to these attributes.

Environmental Dimension

The level of sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency from the environmental dimension was measured using 7 indicators: the suitability of oil palm plantation land, fire prevention and control, the area of planted land that is managed, conservation actions taken in the event of land damage, the location of the plantation. The environmental planning, pest and disease management, and biodiversity conservation.

Based on the results of the Rap-Fish analysis, the level of sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, from the environmental dimension, obtained a value of 76.93% which is categorized as good in sustainable because the plasma oil palm farmers in Sungai Lilin Sub-district have received ISPO and RSPO certificates. The distribution of respondent data in the environmental dimension sustainability index can be seen in Figure 5.

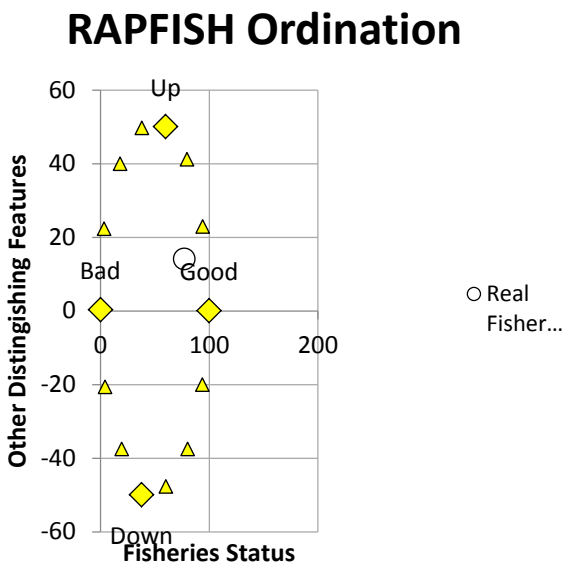


Figure 5. Environmental Dimension Sustainability Index

Based on the results of the technical dimension Leverage analysis, there are indicators that have the most influence on the sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, that is the garden location indicator must be in accordance with the spatial & agricultural environment with a value of 15.03 which is the largest compared to other indicators. Therefore, to improve the sustainability of the institutional dimensions of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, it is necessary to pay attention to these attributes.

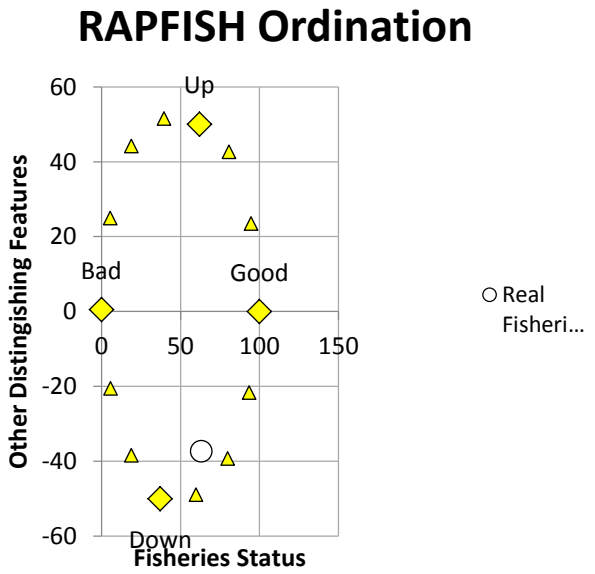


Figure 6. Institutional Dimension Sustainability Index

Based on the results of the Rap-Fish analysis, the level of sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, from the environmental dimension, obtained a value of 63.14% which is categorized as quite (medium) sustainable. This is because the plasma oil palm farmers in Sungai Lilin District are already actively participating in farmer groups or oil palm plantation cooperatives. The distribution of respondent data in the sustainability index of the institutional dimension can be seen in Figure 6.

Based on the results of the institutional dimension Leverage analysis, there are indicators that have the most influence on the sustainability of oil palm farming in Sungai Lilin District, Musi Banyuasin Regency, that is the institutional existence indicator with a value of 13.34 being the largest indicator.

V. CONCLUSION

The results of the analysis of The sustainability of sustainable oil palm plantations are included in the medium criteria with average sustainability index value of 51.92%, the social, economic, and technical dimensions are in the less criteria, while the environmental dimensions are in the good criteria and the institutional dimensions are in the medium criteria.

Acknowledgments

Author thanks for the support of the Agribusiness Master Study Program, Faculty of Agriculture, Sriwijaya University.

REFERENCES

1. Adams M, Ghaly AE. 2007. An integral framework for sustainability assessment in agro-industries: Application to The Costa Rican Coffee Industry International Journal of Sustainable Development and World Ecology13:83-102
2. Arikunto. 2002. Research Methodology A Proposal Approach. PT. Rineka Cipta. Jakarta.
3. Central Bureau of Statistics. 2020. Musi Banyuasin Regency in Figures 2020. Central Statistics Agency of South Sumatra.
4. Central Bureau of Statistics. 2020. South Sumatra Province in Figures 2017. ISNN: 2356-4172. Central Bureau of Statistics of Musi Banyuasin Regency.
5. Central Bureau of Statistics. 2019. Statistics of Indonesian Oil Palm 2017. Sub-directorate of Plantation Crops Statistics. CV. Dharmaputra.
6. Bridges and Wilhelm (2008). Going Beyond Green: The "Why and How" of Integrating Sustainability Into the Marketing Curriculum. Journal of Marketing Education. 2008 30: 33 originally published online January 4, 2008
7. Charles, AT, Boyd H., Lavers, A., and Benjamin, C. 2002. Measuring sustainable development application of the genuine progress index to nova scotia. Management Science/Environmental Studies. Saint Mary's University. Halifax.
8. Demiyati T. Budi WP 2013. Feasibility Analysis of Smallholder Oil Palm Plantation Investment with Profit Sharing System in Budi Asih Village, Tungkal Ilir District, Banyuasin Regency, South Sumatra. Agribusiness forums. Published by: Master Sciences of Agribusiness Program IPB in Bollaboration with Agribuisness Association of Indonesia. Volume 3, No. 1.
9. Firdaus, M. 2007. Agribusiness Management. First Edition. Jakarta: Earth Literacy Publisher.
10. Herminingsih, Hesti. (2011). Strengthening the Role of Farmer Group Institutions in the Development of People's Coffee Farming Business (Case Study of Farmer Groups in Sidomulyo Village, Silo District, Jember Regency). Journal of Agricultural Socioeconomics Vol. 5 No. 1. Faculty of Mathematics and Natural Sciences, Jember Open University.

11. Palm Information. 2013. Plasma Farmers. http://www.infosawit.com/Info-Plasma Farmers.html. Retrieved on 01 August 2021.
12. International Institute for Sustainable Development. 2014. The State of Sustainability Initiatives Review. Canada
13. Ministry of Agriculture. 2016. Outlook Coffee: Agricultural Commodities Plantation Subsector. Center for Agricultural Data and Information Systems Secretariat General of the Ministry of Agriculture. Jakarta.
14. Kospa. 2016. Concept of Sustainable Oil Palm Plantation. Journal of Global Techno Volume 5 No. 1. Department of Urban and Regional Planning, Indo Global Mandiri University.
15. Muani, Ani. 2018. Palm Oil Sustainability According to Indonesia Sustainable Palm Oil (ISPO) in the Ngabang Plasma Plantation of PTPN XIII, Landak Regency, West Kalimantan Province. (Doctoral Dissertation, Gajah Mada University, 2018). Accessed from http://etd.repository.ugm.ac.id/
16. Muharani L, Yazid M, Adriani D. 2020. Evaluation of smallholder oil palm plantation sustainability in tidal lowlands of Pulau Rimau Sub-District of Banyuasin Regency. Journal of Suboptimal Lands: Journal of Suboptimal Lands 9(1): 80-88.
17. Munasinghe M. 2010. Sustainomics Framework and Practical Application. MIND Press. Sri Lanka: Munasinghe Institute for Development.
18. Nababan, BO, Yesi, DS, and Maman, H. 2007. Analysis of the Sustainability of Small-Scale Capture Fisheries in Tegal District, Central Java (RAPFISH Approach Technique). Journal of Marine and Fisheries Policy and Socio-Economic Research. Marine and Fisheries Research Agency. 2(2): 137-158
19. Nazir, M. 2009. Research Methods. Jakarta: Ghalia Indonesia.
20. Ngadi, Noveria M. 2017. The sustainability of oil palm plantations in Indonesia and prospects for development in border areas. Indonesian Society Journal. 43(1): 95-111.
21. Novita, Suryaningrat, Andriani, and Widyotomo. 2012. Analysis of the Sustainability of the People's Coffee Plantation Business Area (KUPK) in Sidomulyo Village, Jember Regency. Journal of Agritech. Vol. 32 No. 2 online May 2012.
22. Pahan, Iyung. 2010. Complete Guide to Palm Oil Agribusiness Management from Upstream to Downstream. Self-Help Spreader. Jakarta
23. Peattie, K, & Crane, A. (2005). Green marketing: Legend, Myth, farce or prophesy Qualitative Market Research. International Journal 8: 357-370.
24. Pusdatin (Center for Agricultural Data and Information), 2016. Outlook for Palm Oil in the Plantation Subsector. ISSN 1907-1507. Secretariat General – Ministry of Agriculture.
25. Rahim and Hastuti. 2007. Agricultural Science. Jakarta: Self-Help Spreader.
26. Saaty, Thomas L. (2006). The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation. Pittsburgh: University of Pittsburgh Press;
27. Copy KA. 2003. Sustainable Agricultural Systems. Yogyakarta: Kanisius.
28. Sjarkowi F. 2018. Processing of Farming VS Agribusiness "Policy Strategy and Business Management Strengthening State Economic Fundamentals". ISBN 979-96207-1-6. CV. Kaffah Satria Usaha.
29. Soekarno. 1995. Farming Analysis. Jakarta: University of Indonesia.
30. Sriati. 2012. Social Research Methods. Palembang: Sriwijaya University.
31. Sutamto, YE. 2007. Multidimensional Scale. Essay. Mathematics Study Program, Department of Mathematics, Faculty of Science and Technology, Sanata Dharma University, Yogyakarta.
32. UNESCO. (2004). United Nations decade of education for sustainable development. Retrieved March 13, 2007, fromhttp://portal.unesco.org/education/en/en/ in Going Beyond Green: The "Why and How" of Integrating Sustainability Into the Marketing Curriculum
33. United Nations Development Program (UNDP). 2007. Human Development Report 2007/2008. New York: United Nations Development Programme.
34. Wigena IGP, Siregar H, Sudradjat, Sitorus SRP. 2009. Design of a sustainable plasma oil palm plantation management model based on a dynamic system approach (case study of plasma oil palm plantations PTP Nusantara V Sei Pagar, Kampar Regency, Riau Province). Journal of Agro-Economics. 27(1): 81-108.

Artificial Intelligence Trends and Ethics: Issues and Alternatives for Investors

Prof. Dr. Yoser Gadhoum
Institute of Strategic Studies on Governance, Former Dean of Research and Graduate Studies, Prince Mohamad Bin Fahd University (PMU), KSA

Abstract
Artificial Intelligence (AI) based technology, Machine learning, and cognitive systems have played a very active role in society's economic and technological transformation. For industrial value chains and international businesses, it means that a structural change is necessary since these machines can learn and apply new information in making forecasts, processing, and interacting with people. Artificial Intelligence (AI) is a science that uses powerful enough techniques, strategies, and mathematical modelling to tackle complex actual problems. Because of its inevitable progress further into future, there have been considerable safety and ethical concerns. Creating an environment which is AI friendly for the people and vice versa might be a solution for humans and machines to discover a common set of values. In this context, the goal of this study is to investigate the emerging trends of AI (the benefits that it brings to the society) the moral challenges that come from ethical algorithms, learned or pre-set ideals, as well as addressing the ethical issues and malpractices of AI as well as AI security. This paper will address the consequences of AI in relation to investors and financial services. The article will examine the challenges and possible alternatives for resolving the potential unethical issues in finance and will propose the necessity of new AI Governance Mechanisms to protect the efficiency of the capital markets as well as the role of financial authority in the regulation and monitoring of the huge expansion of AI in finance.

Keywords
Artificial Intelligence Machine learning, Banking sector, Ethical AI

I. INTRODUCTION

Medicine, public health & medical research, Banking technology, the Manufacturing sector, etc. are all being transformed by digital technology and artificial intelligence (AI), especially machine learning. AI-based technologies are now being tested in low- and middle-income nations, and their value is being examined in the Organization for Economic Co-operation and Development (OECD) (LMIC). The Secretary-General of the United Nations has remarked that the safe deployment of new technologies, such as AI, could assist the globe in achieving the United Nations Sustainable Development Goals (1), which also include health-related, finance related, and manufacturing related goals within United Nations Sustainable development 3. AI might potentially assist the world attain its goal of universal development. Nonetheless, the use of Machine learning for these sectors presents ethical, regulatory, commercial, and cultural challenges across borders. Most of these issues aren't specific to AI. For more than a half-century, the use of computing & software in different economic sectors like healthcare, finance, mechanics has posed ethical issues to programmers, policymakers, and practitioners, and AI raises new potential dilemmas that are outside the jurisdiction of conventional legislators and players in these economic sectors. Most of these challenges have to be addressed amicably if AI is to be successful in creating sustainable development in all economic fronts. Especially in the field of finance, manufacturing and healthcare which affect daily human consumption.

1. What is AI?

Artificial intelligence is defined as the theories and development of complex computer programs and systems which are intended to execute functions and tasks that would require human intelligence, such as the recognition of speech, visual perception, forecasting and decision-making, deciphering complex language algorithms and translating them, as well as making informed, independent decisions which can help them survive on their own (Dick, 2019). Tech companies are developing software and hardware systems that integrate machine learning with programmed data to learn and apply the newly acquired information to perform tasks. Starting from self-driven cars, chatbots, quantum computers, etc., most companies are investing in artificial technology to help them maximize productivity by ensuring tasks are executed quicker and more accurately than the traditional human effort would.

Emerging Trends in AI

Siri

Siri has become one of Apple's most known software's which act as assistants, which are available in most of their electronic devices, i.e., iPad, phone. Uses interact with the nice female voice-activated assistance frequently at a moment's notice. She is crucial in discovering information, obtaining travel routes, making phone calls, sending texts, opening apps, and scheduling activities.

Tesla

Cars have also become increasingly popular as a target for artificial intelligence. For vehicle enthusiasts, they are losing

out on Tesla. It is perhaps the greatest vehicle selling in the market. The automobile has received several awards and characteristics like predictive skills, self-drive, and ultimate technological innovation.

Cogito

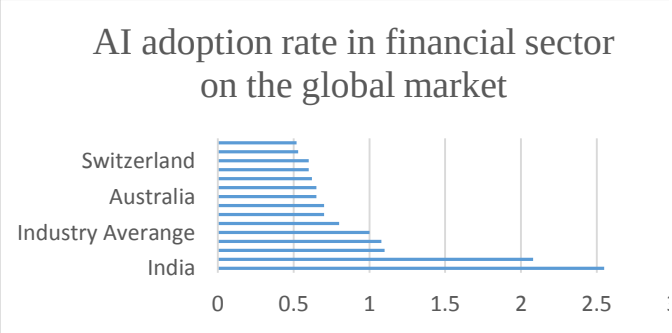
Dr Sandy and Joshua co-founded Cogito, which is presently on the market as one of the greatest instances of the behavioral version to boost the intelligence of customer service professionals. The organization combines machine learning and behavioral science to improve customer collaboration for phone experts. Cogito may be used on the millions of voice calls every day. The AI technology monitors human speech and gives real-time feedback to help people improve their behavior.

Echo

Amazon unveiled the Echo, which has become intelligent and added new functions. It is a revolutionary solution that offers the Alexa Voice Service to help you check the internet for personal data, appointment scheduling, make purchases, ways to navigate, switches, and heating systems, respond to inquiries, read audiobooks, report weather and traffic, providing information regarding local companies, providing sports schedules and scores, and more. The application of AI, as well as its potential benefits, have been discussed below.

2. Uses of AI in Financial services and financial management

(i) AI is being used by financial services organizations to aid them in differentiating their competitors from themselves and improve client experience. In reality, a large number of businesses have incorporated some of the first AI technologies, such as speech recognition, predictive analytics, and engines for a recommendation, which is a critical tool for forecasting what customers would want (Strusani et al. 2). The companies are using artificial intelligence to promote productivity, customer engagement, fraud detection, risk mitigation, and assist customers in making educated purchasing decisions. The capacity to gather and analyses large volumes of data is required for financial services firms to deliver their goods and services. Those companies who can use client data to improve their services will be successful in the future. According to experts, AI, which has become the most popular emerging trend in informatics and machine and IT, has become the key to improved consumer pleasure (Aziz et al., 2019). The table below shows the rate at which different countries have adopted AI in their financial sectors.



Source: www2.deloitte.com

Artificial intelligence is a major section of the science of computers, mainly associated with developing smart machines to perform tasks with similar efficacy as humans. This subject is quickly becoming a necessary component of today's technologies. In this sector, research is very specialized and technical reasoning. Knowledge, problem-solving, perception, planning, and the capacity to controlling and moving objects are among the key human elements of artificial intelligence (Banerjee et al., p.34). Concurrently, financial services refer to the services offered by banks and other financial organizations. Artificial intelligence (AI) is being more widely used in finance. Banks sees artificial intelligence as a means to improve client engagement and productivity, among other things. Artificial intelligence is being used in financial organizations to improve productivity, particularly in contact centers (Beck, et al. 34). in recent years, Banks and other financial institutions have highly relied on AI to improve their operations as well as communication with their customers, as shown in Table 2 below. In this approach, artificial intelligence deployment in contact centers is crucial because it can manage more inquiries than humans.

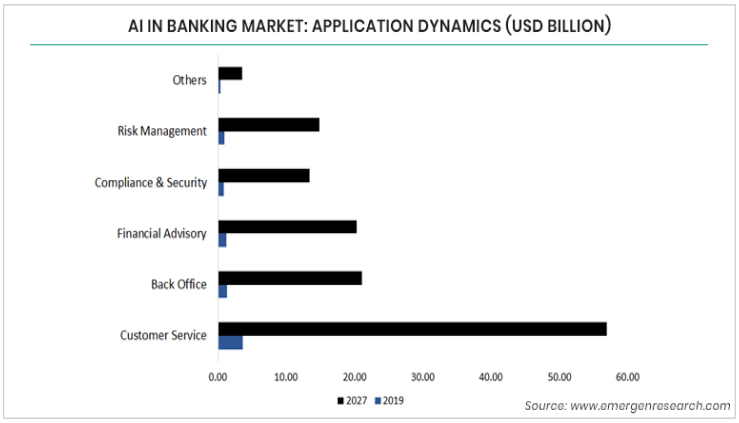


Table 2: *Investment in AI in different Banking sectors form 2017 and expected adoption till 2027. Source:* ***www.emergenresearch.com***

(ii) In the financial industry, artificial intelligence has a variety of uses. It has influenced how individuals bank, invest and obtain credit, and prevent financial crimes. Machine learning, a subset of AI, aids in the detection of fraudulent transactions by examining a variety of data points. The rise in popularity of E-commerce has increased the prevalence of online fraud. According to recent data, both wholesalers and retailers lose $118 billion due to bogus rejects and legitimate transactions incorrectly denied (Cambridge Centre for Alternative Finance, World Economic Forum 25). As a result, many businesses are looking towards implementing an al-based crime prevention strategy. The recent development of MasterCard's Decision Intelligence Technology is an excellent illustration of artificial intelligence in financial crime. As a result, artificial intelligence will assist banks in preventing financial crimes in the present and future. Another use of artificial intelligence in the banking business is bank chatbots. In recent years, chatbots that employ natural

language processing and machine learning algorithms have become strong tools for providing tailored and conversational experiences to many user areas. Chatbots can assist bankers in managing and planning for savings, in naming a few ways they may improve quality in the banking business. Plum, which can be accessed through Facebook Messenger, is an example of a chatbot (Buchaket al. 45). Cleo is another example that aids with tracking income and expenses across many accounts. Banks are also using chatbot services to improve self-service interfaces.

(iii) Finally, algorithm trading has benefited from machine learning. Banking institutions have been able to crunch statistics, resulting in the discovery of trade patterns and the forecasting of trends, resulting in profitable trading of stock choices (Beck et al. 2). Numerai is one of the few perfect examples of algorithm trading. The company has hired data analytics experts anonymously to compete for the best algorithms and, as a consequence, to earn cryptocurrency for their work. Algorithmic trading has enhanced revenue for the corporation in this way.

(iv) It is expected that the use of robotics in financial and legal services would increase staff efficiency by roughly 50% ("Robotics, Artificial Intelligence, and the Workplace of the Future"). In entertainment, for example, Virtual reality existence has changed human interface dynamics in several ways. As Deloitte concludes, applying artificial intelligence by top-level management in financial institutions is required for enhanced development and efficiency ("The Future Of AI In Banking | Deloitte Luxembourg"). Because of the availability of hosted analytics systems and outsourced data storage facilities, small and large businesses may profit from AI to the most feasible. The people's role in the financial sectors is being re-evaluated in light of the growth of artificial intelligence (Silvester et al., p355). The fact that artificial intelligence technology such as robotics will put humans out of work sparked this research. The key issue was if humans are relevant in the sector (Banking) in the age of AI. The table below shows that most of the jobs available in today's financial sector are heavily attached to AI, meaning most banks and financial organizations have adopted robot-technology to increase output.

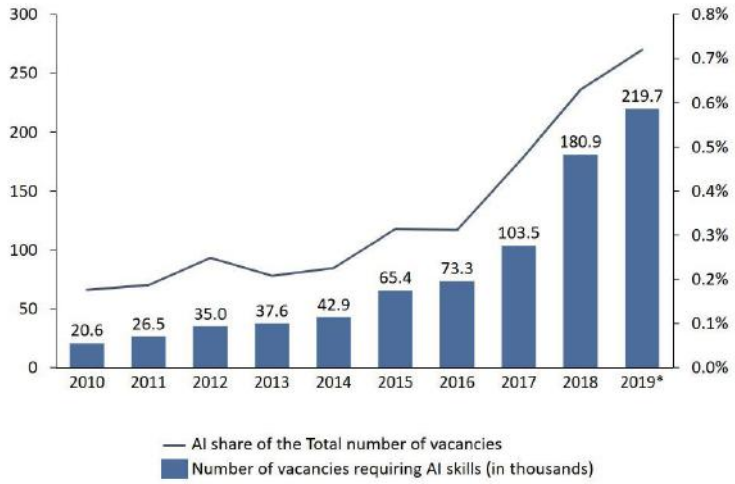


Table 3: showing the demand for AI skills in the financial sector since 2010.

Source voxEU

(v) Parkes and Wellman (2015) propose that in complex scenarios including asymmetry of knowledge, such as bank lending, humans fail to act rationally. Parkes et al., 2015 propose that AI may be used to research these standards and, consequently, assist in making reasonable lending decisions. Vig et al., p.45 examine the influence of changes in the environment of borrowers' bank information and their possible impact on the loan process. On the other hand, the credit registry is boosted by artificial intelligence. The registry communicates critical lender information, and the response by financial institutions is by delegating numerous jobs to loan officers. The information hardening leads to a shift in focus toward relationship banking. If organization invest in communication technologies and information—artificial intelligence—the bank manager will be assigned more authority at the local level. With the manager being granted more autonomy, they make more artificial intelligence investments enabling them to gather soft consumer data. According to Bartoli et al. (p.5477), opaque models' wide utility is likely to result in some consequences which are unintended. For example, if several banks use artificial intelligence and machine learning to implement a variety of strategies, but the models are so complicated that they are difficult to comprehend, it becomes difficult for both the company and its management to foresee the market impact of such models. It is conceivable that the market interactions of such models would have a detrimental influence on the profitability market. Furthermore, some unexpected consequences in credit scoring, cybercrime prevention and detection applications, and associated dangers are likely. The objective of artificial intelligence in the banking industry might be to better coordinate lending officers' motivations with the bank's set targets. Paravisini and Schoar (22) investigate the changes in lending in financial institutions as a result of credit rating technology deployment. According to the findings by Graepel and Hassabis, 2017, credit committees are more inclined to support problematic loan applications. Credit scoring technology minimizes the likelihood of loan default and

boosts loan profitability. They also believe that credit score data helps lending committees solve difficulties.

3. Positive and Negative Impact of AI on financial services

3.1. Positive impact

(i) AI may aid a bank in determining a customer's spending habit, developing a tailored investment strategy, and assisting consumers with budgeting. Banks can also send notifications regarding recommendations for keeping track of costs and investments based on data. To maximize the customer's experience, transactional and other data sources may be used to track their habits and patterns. AI can sift across massive amounts of data and recognize trends that humans might overlook. Many financial service providers utilize artificial intelligence and machine learning analytics to track fraud on a real-time basis, a critical capacity (Truby et al., pp113). AI allows banks to have accessibility to client data such as detailed demographic trends, click-through rates, and records of offline and online payments and purchases, and algorithms can aggregate and assess data.

(ii) By assessing essential data from the potential borrower, ai systems can manage and streamline this procedure. Machine intelligence can integrate and evaluate data linked to the most recent transactions, industry trends, and banking transactions to identify possible hazards in lending. The mobile app may detect any suspicious activity in the user's account depending on behavioral science, and any online transaction of a significant amount from a user's account with a history of modest transactions can be recognized promptly.

(iv) AI improves staff efficacy and enhances customer service through specific target email messages as well as other offers, it tends to increase income, it tends to increase sales reproductivity, AI provides better quality and reliability, from cash transfers to bill payments, card maintenance, as well as other support, Machine learning can increase your customers' overall satisfaction, and all of these operational processes can indeed be effectively handled via desktop computers, cell phones, as well as other smart applications. In banks, ai systems may use statistics to search for patterns, groupings, and correlations in massive volumes of data (Wiek et al., pp16). Machine learning may help with fraud detection, pose threats, person authentication, and credit underwriting. Because Artificial Intelligence regards each contact as a teaching opportunity, chatbots (digital aides) improve as they learn new clients. Chatbots already have been included in the majority of large banks' instant online automation, voice monitoring system, and mobile apps. AI can help robo-advisors deliver better customer service. Machine learning can identify fraud elements and forensic aid experts; it enhances financial stability through advanced fraud detection and prevention; it serves as a legitimate scam solution for the commercial banks when faced with complex situations; AI can proactively identify and prevent Fraud by identifying anomalous behavior; and it filters down into the user's profile, resulting in a safe environment.

(v) Because Artificial Intelligence regards each contact as a teaching opportunity, chatbots (digital aides) improve as they learn new clients. Chat bots already have been included into the majority of large banks' instant online automation, voice monitoring system, and mobile apps. AI can help robo-advisors deliver better customer service. Machine learning can identify fraud elements and aid forensic experts; it enhances financial stability through advanced fraud detection and prevention; it serves as a legitimate scam solution for the commercial banks when faced with complex situations; AI can proactively identify & prevent Fraud by identifying anomalous behavior; and it filters down into the user's profile, resulting in a safe environment.

(vi) AI basically fulfills numerous jobs via complicated automation, which results in increased production capacity. AI, which is based on an algorithm for machine learning, can swiftly absorb as well as analyze a vast data quantity at a high level. This incredible speed improves banking services by allowing for customers a customized offering option. AI is able to make fast judgements while executing activities rapidly. Machine learning is being used in the finance industry to reduce operational costs and increase profitability. This section basically involves activities from multiple institutions moving both front and back. Machine learning makes so many data point analysis thereby flagging suspicious transactions.

(vii) Artificial intelligence enhances the effectiveness, precision, as well as calculation speed; it can store large amounts of data; and financial institutions can determine the most appropriate mixture of initial trade percentages based on degrees of minimum past reserve reduction under varying configurations of the trades in real time.

3.2 Negative Impact of AI

(i) AI bias

One of the biggest challenges that AI poses today is bias. This would occur in situations where the individuals who have attributed the algorithms have created them or trained the data sets with bias. The immediate impact of this is the production of bias results, which would result in unintended consequences like in the scenario where the Twitter chatbot by Microsoft became racist. As a remedy, companies need to monitor the development, training and entry of datasets to the machines to eliminate bias.

(i) Increased cybercrime

With autonomous machines, the speed of task execution becomes much faster, meaning that multiple tasks can be accomplished at once. This creates a situation where humans cannot follow along with what the machines are carrying out. This means that malicious activities such as the development and delivery of virus software, phishing, and taking advantage of the vulnerabilities in AI systems can be carried out without immediate notice by humans. This creates losses and time wastage as mechanisms to correct the damages are developed.

4. How AI could harm the financial sector and investors.

(i) Because artificial intelligence robots are extremely complicated, they necessitate exorbitant production and maintenance expenses. AI also comprises powerful software programs that should always be updated regularly to meet changing environmental needs. In the case of a serious breakdown, the method of system restoration and retrieving lost codes may take an inordinate amount of time and money (Lee et al., 2017).

(ii) Although AI can learn and get better, it still cannot make the decisions. Humans could indeed take particular judgment calls into consideration when making decisions, which AI may never be able to do. Trying to replace adaptive individual interactions with AI would result in aberrant behavior within human-thing ecosystems.

(iii) AI can provide a lot of power to the few people who control it; thus, AI carries the risk of taking control away from the people while demeaning actions in various ways. Artificial Intelligence delivered into the wrong hands can turn out to be a significant threat to serve humanity; if people start to think damagingly, wreaking havoc with this modern machinery (Petteri, 2018).

(iv) Machine intelligence allows individuals to end up replacing the working population with machines, which can lead to widespread unemployment; when AI utility becomes widespread, people will become strongly reliant on this equipment hence losing their creative ability; whether in other sectors or banking, AI could lead to reduced employment; and individual people without anything else to do could indeed result to the destructive use of their thinking.

5. How could AI be unethical in general?

(i) Access to technology by wicked people- While artificial intelligence has the potential to accomplish a great deal of good, humans should be concerned about AI under the control of hazardous users. Artificial intelligence (AI) is potentially capable considerable harm if used improperly as technology improves. What happens when individuals, criminal syndicates, and rogue nations employ ai technology for nefarious reasons? Many firms are already thinking themself such questions and taking precautions against hostile AI threats. New technologies can take advantage of vulnerabilities in AI and machine learning systems. As Ai technologies improve in intelligence, they will be able to alter the structure of threats, rendering them increasingly undetectable, more random in appearance, more responsive to protocols and settings, as well as more effective at detecting and exploiting system weaknesses.

(ii) Furthermore, the providers of machine learning services, particularly those offering the cloud-based services which are on demand, should be aware of the identities of their clients. Suppose harmful persons utilized dangerous platforms to Organized AI attacks or other actions. In that case, States will start to tighten and follow up on the perpetrators and apply "Know Your Customer (KYC)" rules, similar to how financial institutions do (Marr, 2021). If such persons do not wish to be on the regulatory cycle's wrong side, they must get smarter and begin their efforts to ensure that they ensure their customers are aware of their activities and who they are on their platforms.

(iii) Rise in misinformation - AI systems have over time adapted to the unscrupulous traits of producing bogus photos, conversations, movies, and other forms of material. People are skeptical of everything they see, hear, read and see. What occurs if you are unable to detect or distinguish if a picture is genuine or artificially made or whether you are speaking to bots or a human? It has been widely stated that bots played a part in distributing political misinformation during the US Presidential elections in 2016. These profiles in the social media platforms, which have been automated, aided in the dissemination of misinformation on the internet, seeking voter deception and feeding the fires of partisanship (Marr, 2021). Bots, unlike humans, never tire of working 24 hours a day and may create a great volume of material in a short period. When this news is retweeted and re-tweeted by others, whether genuine or false, it quickly spreads and becomes unstoppable. These bots are adept at disseminating fake or significantly distorted data, message amplification, and implanting thoughts and ideas in the minds of people. Criminals and terrorists can employ fabricated pictures or audio messages to bring commercial or personal harm or disrupt state activities. All it takes now is a few malevolent actors circulating misleading accusations to traumatize public opinion and swiftly affect the public's attitude.

(iv) Companies will need to make considerations on ways to limit the potential harm which has been caused by AI-enabled production of content. Most governments and businesses are encouraged to view bogus information as harmful as cybersecurity risks and respond accordingly. Misinformation, propaganda, blackmail, hostile interference, and other "information crime" types may just devastate systems as electronic and physical attacks. The world is equipped for the unleashing of AI on individuals who have not been protected. Corporations that free trade in the user-generated material face the same penalties as governments when it comes to policing it.

6. How Companies protect their investors from non-responsible and malpractices of AI

(i) *Responsible AI leadership is being empowered*.
The Responsible AI program should be led by an internal advocate, such as chief AI ethical officers. This leader gathers stakeholders, develops advocates within the company, and creates policies and principles to govern the development of AI systems. However, leadership which has authority is insufficient. No individual processes all of the solutions to the complicated situations identified. To have a real influence, organizations must have ownership that includes various opinions. An AI committee responsible for AI-related discipline helping in directing the whole program

and addressing complicated ethical concerns such as unintended repercussions and prejudice is a strong method to guarantee various viewpoints. The committee should involve representations from various business departments (public relations, compliance, legal, etc.), geographies, and backgrounds. The same may be said about Responsible AI. Navigating the complicated difficulties that will certainly arise when businesses implement AI systems requires diversified leadership.

(ii) *Creating human-AI governance*
Roles, responsibilities, and processes, in addition to senior leadership and a generally understood ethical framework, are required to guarantee that firms incorporate Responsible AI into the goods and services they generate. Effective governance entails bridging the gap between the teams developing AI products and the leaders and governance committees providing supervision, allowing high-level ideas and policies to be implemented. Responsible AI governance can take many different shapes. Elements include established escalation channels when hazards arise at a certain project stage, consistent code reviews, ombudspersons responsible for analyzing individual complaints, and continual improvement to increase capabilities and face new difficulties (The 5 Biggest Technology Trends In 2022 | Bernard Marr, 2021).

7. How could we constrain AI from harming financial ecosystem?
AI governance - Mankind had grown up and moved past an era when AI development was limited to the laboratory. Artificial intelligence (AI) is now a continuous integration technology that is deeply embedded in modern life. People think that if AI is used correctly, technology may provide significant benefits to economies and civilization and help better, safer, more equitable, and informed choices. However, such promise would never be achieved without significant caution and commitment, which includes thinking about how the technology's creation and use should be managed and what level of legal and ethical monitoring — with whom and when — is required. Till present, self- and co-regulatory measures based on current laws and opinions from businesses, academia, and related technical groups have been mainly effective in limiting inappropriate AI usage (Dafoe, 2018).

Within the restrictions imposed by present governance processes, scientists believe that such measures will continue to be sufficient in the great majority of cases (e.g., sector-specific regulatory bodies). However, this does not negate the necessity for government intervention. On the contrary, this report calls for governments and civil society organizations throughout the world to contribute meaningfully to the AI governance debate (Gasser, 2017). In particular, the study identifies five areas where the government, in conjunction with civil society and AI practitioners, may help to clarify expectations regarding AI's implementation in different contexts. Standards for explainability, ways to judge fairness, safety considerations, criteria for human-AI collaboration, and general responsibility frameworks are among them.

The paper has included commentary mostly on concerns and tangible steps that the government, with the help of other stakeholders, may provide further direction in each area. These proposals are realistic suggestions that individuals feel would have a demonstrable impact on ethical AI use. This paper expresses its viewpoint on these specific concerns. Google does not have all of the solutions; on the contrary, it is critical for policymakers worldwide to participate in the debate. Researchers hope that as AI technology advances and our personal experience improves, the international society will gain more and more nuances, including better awareness of the market and potentially undesirable consequences that tough decisions imply.

Conclusion
In conclusion, Artificial intelligence is an emerging trend that is quickly shaping today's financial sector. As shown in the Literature review, AI is being integrated into the IT framework, creating a huge demand for AI skills from employees, meaning that IT skills will be a mandatory requirement in the future of Banking. The essence of AI cannot be understated since there is a myriad of ways that this technology is useful in the financial sector. It includes the detection of crime, trading algorithms, and others. Additionally, the challenges presented by AI are being explored, and amicable ways to control them being approached while the trend is still on the take-off stage. The financial sector's future is bright with Artificial Intelligence.

Works Cited
1. Autor, D. H., and D. Dorn (2013). The Growth of Low-Skill Service Jobs and the Polarisation of the US Labor Market. American Economic Review, 103(5), 1553–1597.
2. Aziz, S., and Dowling, M. (2019). Machine learning and AI for risk management. In *Disrupting finance* (pp. 33-50). Palgrave Pivot, Cham.
3. Bernard Marr. 2021. *The 5 Biggest Technology Trends In 2022 | Bernard Marr*. [online] Available at: <https://bernardmarr.com/the-5-biggest-technology-trends-in-2022/> [Accessed 14 December 2021].
4. Banerjee, R. N., L. Gambacorta, and E. Sette (2016). The Real Effects of Relationship Banking and Finance, 37(12), 5476–5485.
5. Bartoli, F., G. Ferri, P. Murro, and Z. Rotondi (2013). SME Financing and the Choice of
6. Beck, T., H. Degryse, R. De Haas, and N. van Horen (2015). When Arm's Length Is Too Far. Lending Technology in Italy: Complementarity or Substitutability? Journal of Lending, September 14, 2016.
7. Cambridge Centre for Alternative Finance, World Economic Forum. 2020. "Transforming Paradigms—A Global AI in Financial Services Survey."
8. January 2020, p. 6. See also Chapter 2 in this report, "The Adoption of AI in Financial Services" pp. 25–36
9. Dafoe, Allan. "AI governance: a research agenda." *Governance of AI Program, Future of Humanity Institute, University of Oxford: Oxford, UK* 1442 (2018): 1443.
10. Dick, S. (2019). Artificial intelligence.

11. Emergen Research, https://www.emergenresearch.com/. "AI In Banking Market Size USD 130.00 Billion By 2027 | Artificial Intelligence In Banking Industry Trend And Forecast". *Emergenresearch.Com*, 2021, https://www.emergenresearch.com/industry-report/ai-in-banking-market
12. Gasser, Urs, and Virgilio AF Almeida. "A layered model for AI governance." IEEE Internet Computing 21.6 (2017): 58-62.
13. Lee, Keun Young, Hun Yeong Kwon, and Jong In Lim. "Legal consideration on the use of artificial intelligence technology and self-regulation in financial sector: focused on robo-advisors." *International Workshop on Information Security Applications*. Springer, Cham, 2017.
14. Marr, B., 2021. *The 7 Biggest Artificial Intelligence (AI) Trends In 2022*. [online] Forbes. Available at: <https://www.forbes.com/sites/bernardmarr/2021/09/24/the-7-biggest-artificial-intelligence-ai-trends-in-2022/?sh=7ff9a6dc2015> [Accessed 14 December 2021].
15. Murugesan, Rukmini, and V. Manohar. "AI in Financial Sector–A Driver to Financial Literacy." *Journal of Commerce* 7.3 (2019): 66-70.
16. Paravisini, D., and A. Schoar (2015). The Incentive Effect of Scores: Randomised Evidence from Credit Committees. Revised July 2015. NBER Working Paper No. w19303. Science, London, UK.
17. Parkes, D. C., and M. P. Wellman (2015). Economic Reasoning and Artificial Intelligence. Relationship banking over the Credit Cycle. SRC Discussion Paper, No 33. Science, 349(6245), 267–272.
18. "Robotics, Artificial Intelligence, And The Workplace Of The Future". Opentextbc.Ca, 2021, https://opentextbc.ca/businessethicsopenstax/chapter/robotics-artificial-intelligence-and-the-workplace-of-the-future/.
19. Strusani, Davide and Georges Vivien Houngbonon. 2019. "The Role of Artificial Intelligence in Supporting Development in Emerging Markets." EM Compass Note 69, IFC, July 2019, pp. 1–2. This definition is also guided by the AI100 Panel at Stanford University, which defined intelligence as "that quality that enables an entity to function appropriately and with foresight in its environment." See "One Hundred Year Study on Artificial Intelligence (AI100)." 2016. Stanford University
20. "The Future Of AI In Banking | Deloitte Luxembourg". Deloitte Luxembourg, 2021, https://www2.deloitte.com/lu/en/pages/banking-and-securities/articles/future-ai-in-banking.html
21. "The Demand For AI Skills In The Labour Market | VOX, CEPR Policy Portal". Voxeu.Org, 2021, https://voxeu.org/article/demand-ai-skills-labour-market.
22. T. Graepel, D. Hassabis (2017). Mastering the game of Go without human knowledge.
23. Nature 550, 354–359
24. Truby, Jon, Rafael Brown, and Andrew Dahdal. "Banking on AI: mandating a proactive approach to AI regulation in the financial sector." Law and Financial Markets Review 14.2 (2020): 110-120.
25. Virtanen, Petteri. "Applying Artificial Intelligence Platforms to the Financial Sector: Opportunities and Threats." (2018).
26. Wiek, Arnim, and Olaf Weber. "Sustainability challenges and the ambivalent role of the financial sector." *Journal of Sustainable Finance and Investment* 4.1 (2014): 9-20.

The Impacts of the Covid-19 Pandemic on Developing Countries versus Developed Countries

Prof. Dr. Yoser Gadhoum
Institute of Strategic Studies on Governance, Former Dean of Research and Graduate Studies, Prince Mohamad Bin Fahd University (PMU), KSA

Abstract
Globally, the Covid-19 pandemic has been creating a global human disaster with the two million cases of infection by the SARS and over one hundred million of deaths. In this paper, some of the evidence of socioeconomic impacts of the Covid-19 pandemic are provided. The catastrophic cascade results in a global and even a collapse of the economy at the peak moments. However, this study aimed to examine and evaluate the social and financial impacts on a sample of developing (*Tunisia*, *India*, *Senegal*, *Thailand*, and *Rwanda)* versus developed countries (*United States*, *Australia*, *France*, *Germany*, and *Italy)*. Other countries are considered as a controlling group for robustness check. First evidence compares the adversely consequences of the disease using the following proxies for developed versus developing countries: Growth Rate; Unemployment Rate; Poverty Index; External Debt; Stock Market Index; GDP. Econometric model was used for the study. The main findings show disruptive consequences on poverty index and unemployment rate. The comparison between the two groups of the countries shows that the developing countries have been facing more negative impacts compared to the developed countries. Though both groups have faced tremendous adverse impacts on the socioeconomic level, the developing countries are more vulnerable to manage the crisis than the developed countries. The reasons of the different impacts are discussed in the paper and could be essentially related to economic infrastructure, political stability and the tardy and slowness of the decision-making process. The regional development discrepancies in the developing countries could also be a determinant factor of the severity of the pandemic impact as the spread of the disease is stronger in small, far side and poor regions which are less equipped with the needed health infrastructure like hospitals, medical supplies, and ER. Lack of digitalization capabilities have made the vaccination process less efficient in developing countries and none of them have developed vaccines. The reliability on the developed countries with big pharma firms emphasises the gap in poverty between the two groups especially at the beginning of the pandemic. Social distancing, self-isolation and travel restrictions not only forced a decrease in the workforce across all economic sectors in both groups, but it also affects the psychology and the wellbeing of Citizens in both groups.

Keywords
Covid-19 Pandemic; Socioeconomic Impacts; Developed versus Developing Countries; Growth Rate; Unemployment Rate; Poverty Index; External Debt; Stock Market Index; GDP

I. INTRODUCTION

Globally, the pandemic of Covid-19 increased since 2019 with two million cases of infection by the SARS and over one hundred million of deaths. There are four phases of Covid-19 that have a major impact on developing countries and developed countries. Developing countries are faced with many pre-pandemic vulnerabilities economically and socially compared to developed countries which adversely impact these countries. Developed countries are relatively more economic stability and better health infrastructure which could allow them to have a better response to the pandemic. However, the developing countries are relatively less stable and less ready to face the crisis. In addition to that, developing countries already have a lack of resources that have a major impact on their finances and consequently on their general infrastructure such as hospitals infrastructure, medical supplies, emergency rooms (ER) capacity, political stability and public governance. Hence, it is legitimate to think that the consequences of the pandemic in these countries would be more catastrophic at different levels. The motivation of this research is to analyse the economic and social impacts of developed and developing countries.

2. Impact of COVID-19 pandemic in developed countries
In the global countries, the pandemic has a great impact such as it has an impact on the economic situation, health situation, and social impact also shown. The developed countries are those countries are the US, Canada, Austria, and others. The developed countries such as the US faced the issues in their economic condition and social condition such as the lockdown increased the challenges in the country. In the phase of lockdown, the developed countries faced issues in the business processes and stopped many businesses. In addition to that, the pandemic also had a major impact on the dental care sectors, export and import businesses, and banking sectors. As per the views of Maital and Barzani (2020), the unemployment rate of the developed countries increased, and the GDP growth rate of developed countries deteriorated during the pandemic.

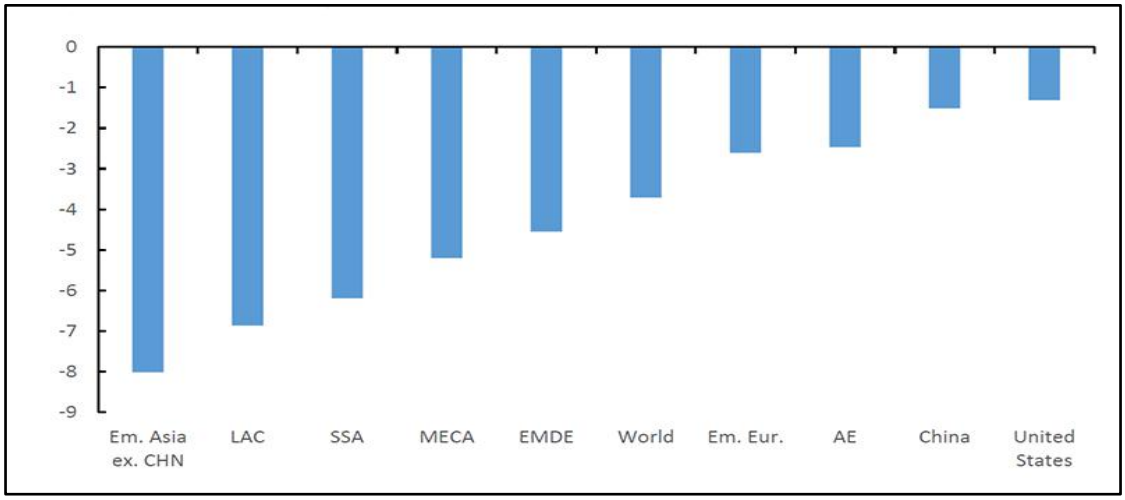


Figure 1: Impact of Covid-19 in Economic Development
(Source: Fadlallah and El-Jardali, 2020)

It is evident that the developed countries also decreased their inflation rate and cannot achieve the target of the annual income. Besides, the lockdown phase increased social distancing that has a positive impact on the health condition and prevented the spread of Covid-19 (Fadlallah and El-Jardali, 2020). As per the above figure, it is shown that in Latin America and the Caribbean had faced more impact of the Covid-19 than other countries. On the contrary, the lockdown phase closed many companies, the social distance increased more issues in the interaction process that had an impact on the relationship between two countries. During the pandemic, the poverty in the countries increased and payment status of the developed countries changed as per the country's economic condition.

3. Impact of COVID-19 pandemic in developing countries

In the developing countries, the pandemic has a major impact in the financial development and health condition improvement. Needless to say, in developing countries, technologies are new and the knowledge of technology is the least. Due to this case, the pandemic of Covid-19, in developing countries spread more and also the death rate increased. As mentioned by Erokhin and Gao (2020), the developing countries also used finance in the development process and due to the pandemic; the economic growth rate decreased more that developed countries. In addition to that, the developing countries have decreased their unemployment rate and increased poverty.

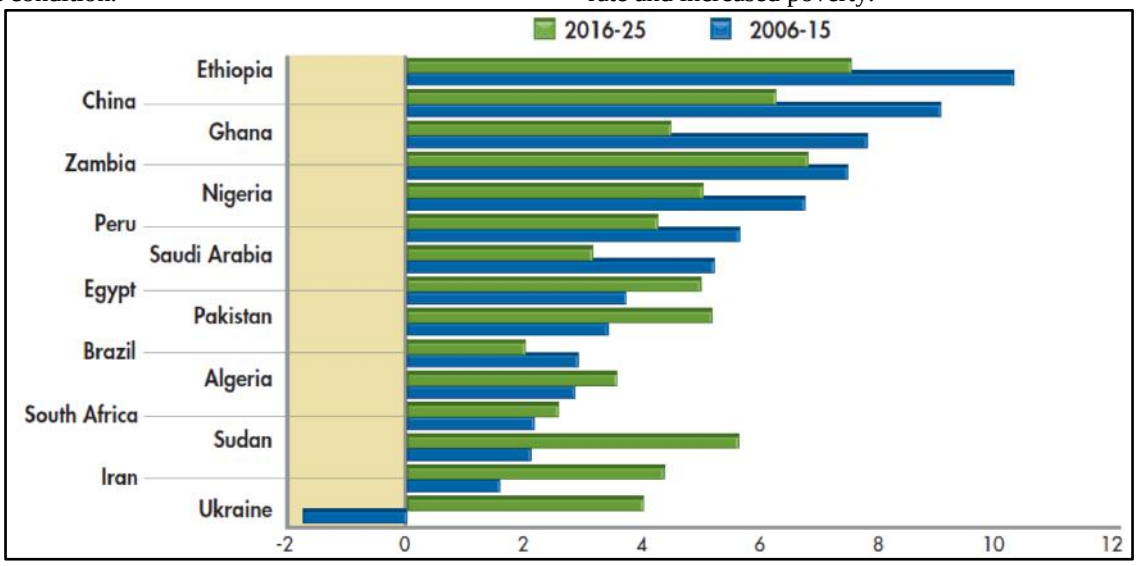


Figure 2: GDP Growth Rates in Developing Countries
(Source: Wattagnet, 2021)

As per the above figure, it can be stated that the developing countries decreased their GDP growth rate during the pandemic. In this figure, it is shown that the Ukraine had a GDP growth rate of 4% in 2006-15 and it decreased to -2% during the pandemic (Wattagnet, 2021). The pandemic increased in the countries of Australia and Tunisia is a developing country. In this country, people are middle-income people and this country is still developing due to poor governance. The pandemic in this country impacted more in this country due to the poor governance and poverty, unemployment rate, and other issues. This country faced a sharper decline in the financial growth during the pandemic. In 2019, the unemployment rate of Tunisia was 15.13% and inflation rate was 6.72% (Statista, 2021). The GDP of Tunisia, the country of Australia, was $140.190 billion (PPP, 2019).

4. Methodology

In this research work, the variables are the poverty index, unemployment rate index, the balance of payment status, and the political risk index that is collected from Moody of developed and developing countries. Along with that, the inflation rate, GDP per capita, Stock market index, External debt, and corruption index of developed countries and developing countries to differentiate the impact of pandemic. This information is collected from World Bank, IMF, and other journals and pdfs. The information of the research article is collected from secondary resources through using stratified sampling methods. Apart from that, the research article follows the secondary quantitative data collection method and the data is analysed from the SPSS software. The correlation and regression analysis are done in this research to test the following hypothesis using macro-economic data. Data is collected from different sources mentioned below.

Hypotheses Testing

***H_0 (Null hypotheses)*: Developing countries faced more social and financial issues rather than developed countries during Covid 19 pandemic**

***H_1 (Alternative hypotheses)*: Developing countries did not face more social and financial issues than developed countries duringCovid-19 pandemic**

We start the analysis by comparing two extreme countries to observe the results that will be generalized for the whole sample of ten countries. This study aims to examine and evaluate the social and financial impacts on a sample of developing (*Tunisia*, *India*, *Senegal*, *Thailand*, and *Rwanda)* versus developed countries (*United States*, *Australia*, *France*, *Germany*, and *Italy).*

Economic Impact in the year 2020

Countries (developed / developing)	GDP Growth rate	Inflation Rate	Poverty rate	Unemployment rate	Balance of Payment Status	External Debt	Stock market index
Tunisia	-8.6%	5.64%	19.10%	16.69%	143.300	55.77%	21.85%
United States	-3.5%	1.40%	11.40%	8.10%	-647.218	102.2%	13.95%

Table 1: Economic impact of the Pandemic in US and Tunisia

(Source: Developed Based on World Bank, 2021)

5. Results and discussion for other developed and developing countries

5.1 SPSS Analysis

In this research work, the SPSS is done using the data of poverty, GDP per capita and other information that is already mentioned. The Regression and correlation are done in the SPSS to analyse the validity and reliability of findings.

5.1.1 Correlation

Correlations

			GDP Growth rate	Poverty Rate
Spearman's rho	GDP Growth rate	Correlation Coefficient	1.000	.166
		Sig. (2-tailed)	.	.307
		N	40	40
	Poverty Rate	Correlation Coefficient	.166	1.000
		Sig. (2-tailed)	.307	.
		N	40	40

Figure 3: Correlations between GDP Growth and Poverty Rate of Developed and Developing countries

The above figure shows the result of the relation between GDP Growth rate and poverty rate of developed and developing countries. As per the result of this matrix, the correlations are replicated. It is evident that the correlation table represents the Spearman's correlation that the relation is between two variables is non-linear. The relationship between these variables is not stronger because the GDP growth rate is not only dependent on poverty rate of countries.

Correlations

			Inflation rate	Unemployment rate
Spearman's rho	Inflation rate	Correlation Coefficient	1.000	.149
		Sig. (2-tailed)	.	.360
		N	40	40
	Unemployment rate	Correlation Coefficient	.149	1.000
		Sig. (2-tailed)	.360	.
		N	40	40

Figure 4: Correlation between Inflation rate and Unemployment rate of Developed and Developing Countries

Above figure depicts the relation between inflation rate and unemployment rate of developed and developing countries. In this instance, as per the result of this analysis, it can be stated that the relationship between poverty rate and inflation rate is strong. The correlation result assists that poverty rate can be reason of decreasing inflation rate of a country.

5.1.2 Regression

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.317[a]	.100	.077	17.10229%

a. Predictors: (Constant), Unemployment rate

Figure 5: Model Summary of Unemployment Rate and Poverty Rate of Developed and Developing Countries

R value of .317 signifies that 31% of prediction is correct and R square value of this table signifies that 10% of the variability of dependent variable can be interpreted by the independent variable. As per this model summary, it can be said that the variables that are selected for the research are positive, however, those variables are appropriate for the comparison to get the information of impact of pandemic on the developing countries. This result helps to prove alternative hypothesis of the research.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1238.357	1	1238.357	4.234	.047[b]
	Residual	11114.561	38	292.488		
	Total	12352.918	39			

a. Dependent Variable: Poverty Rate

b. Predictors: (Constant), Unemployment rate

Figure 6: ANOVA Table of Poverty Rate and Unemployment Rate of Developed and Developing countries

The F-ratio of the ANOVA table investigates whether the entire regression model is a good fit data. The above table displays that the independent variable (poverty rate) statistically significantly predict the dependent variable (unemployment rate), F (1, 38) = 1238.357, p< .0005. As per this result of variable, it can be stated that the results are significant.

5.2 Graphical Representation ***5.2.1 Economy of Developing countries***

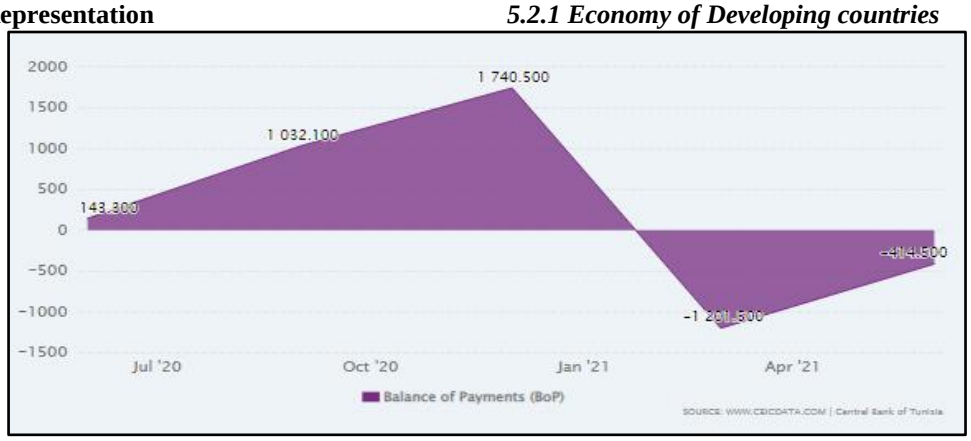


Figure 7: BoP status Index of Tunisia
(Source: Ceicdata, 2021)

In this figure, it is shown that the balance of payment of the developing country decreased during the pandemic phase 3. As per the views of Eisenschmidt*et al.* (2017), Balance of Payments (BoP) is the information of entire transactions of a particular country that is made between entities in one country and the rest of the world. In this case, the country records all the transaction information that is done with other international countries. During the pandemic, the BoP status of the country decreased and majorly decreased during the phase 3 of the pandemic.

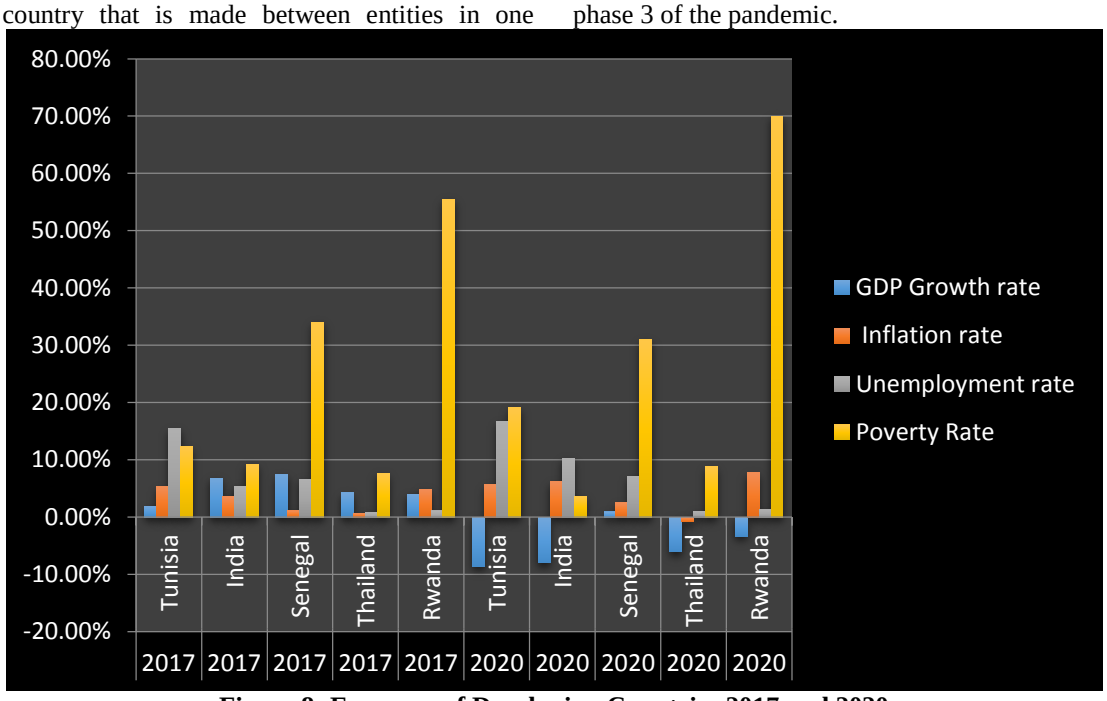


Figure 8: Economy of Developing Countries 2017 and 2020

As per the above representation, it can be demonstrated that developing countries had the issues in economy and they were implementing new technologies in their countries. In addition to that, the countries also now implements new technologies to reduce the impact of the pandemic. The above graphical representation depicts that unemployment rate and poverty rate had increased more during the pandemic compared to 2017. The pandemic had reduced the GDP growth rate more of developing countries in 2020. The pandemic has impacted on the technological development and economic development of developing countries.

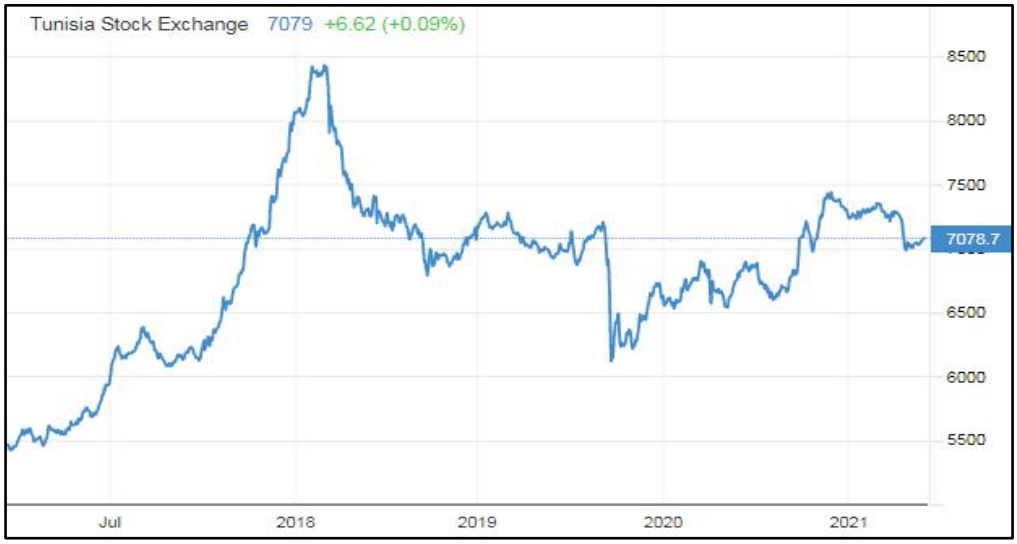


Figure 9: Stock Market Index of Tunisia
(Source: Trading Economics, 2021)

The Stock market of the developing country named Tunisia decreased during the pandemic. In June 2020, the Stock Market Price was 6747 and in December 2020 was 6890. During the third phase of the pandemic, the Stock market price was 7158 and during the fourth phase of pandemic, the stock price was 7272 (Trading Economics, 2021).Compared with two scenarios before and after pandemic, it can be said that the developing countries has faced more impact in their business development and educational development for technology. In this case, developing countries has faced the issues of economic development of the countries and reduced the inflation rate of developing countries. Needless to say, developing countries had the issues of poverty, and also technological invention capabilities were less than others that increased the issues during the pandemic.

5.2.2. Economy of Developed countries

In this case, it can be stated that the United States is the developed country and the pandemic has impacted on the economy in this country. In the following figure, the BoP status index of the US is given. In addition to that, in this section, the impacts of the pandemic on developed countries are properly demonstrated.

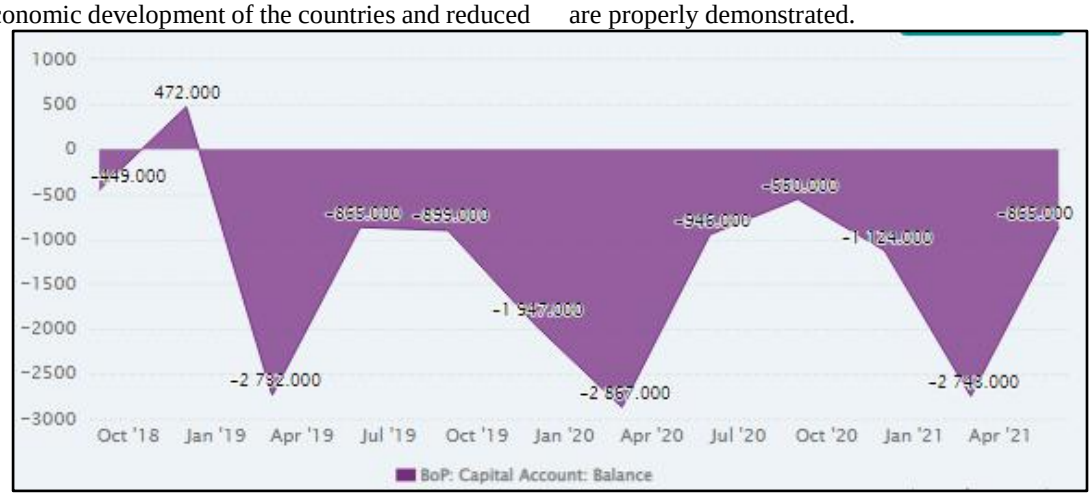


Figure 10: BoP status Index of the US
(Source: Ceicdata, 2021)

In the US market, the entire transaction was more decreased during phase 1 to phase 4. In the above figure, it is shown that -2867.000 transactions were done by the US during pandemic phase 1. Besides, the country managed their transaction during the phase 4 of the pandemic.

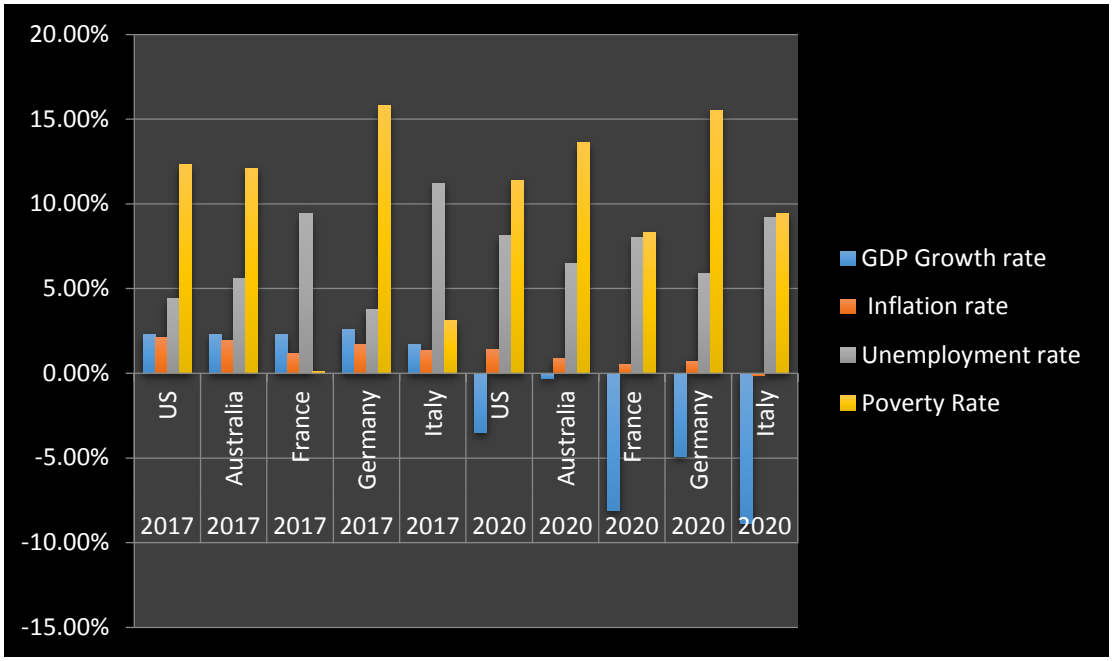


Figure 11: Economy of Developed Countries 2017 and 2020

The pandemic is the major trend of marketplace that has improved more technologies in the developed countries. On the contrary, it has impacted in the economy of the developed countries. Compared to 2017, the GDP growth rate and inflation rate of developed countries of 2017, the result of 2020 helps to understand the impact of the pandemic in the developed countries. The above figure depicts the poverty rate and GDP growth rate of developed countries. Due to the pandemic, the GDP growth rate has decreased in 2020 and also the unemployment rate and poverty rate has increased. The economic breakdown has increased in developed countries and also the BoP status of developed countries has decreased in 2020.Politically and technically, the developed countries was stable, however, due to the decision of lockdown, the economic breakdown has been shown in developed countries.

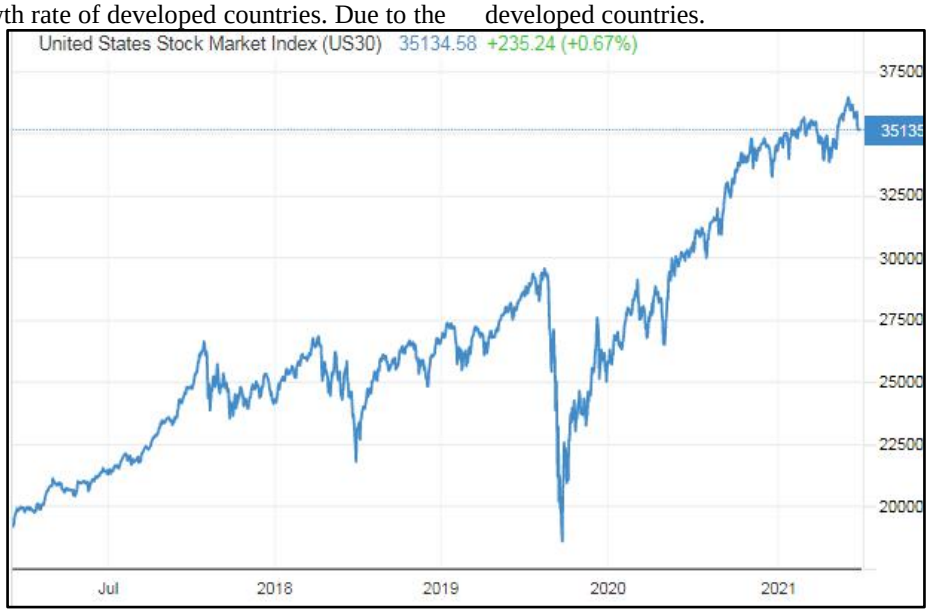


Figure 12: Stock Market Index of the US
(Source: Trading Economics, 2021)

The stock market price of the country faced many issues during the pandemic situation and the developed country increased their stock market price during the pandemic. The stock market prices were 26951 in July 2020 and in December was 30066 (Trading Economics, 2021). As per the above information and figure, it can be stated that the country increased their stock market prices during the pandemic and improved their economy. It helps to achieve the return properly and improve the economy of the country.

5.2.3. BetweenDeveloped and Developing Countries ***5.2.3.1. GDP Growth***

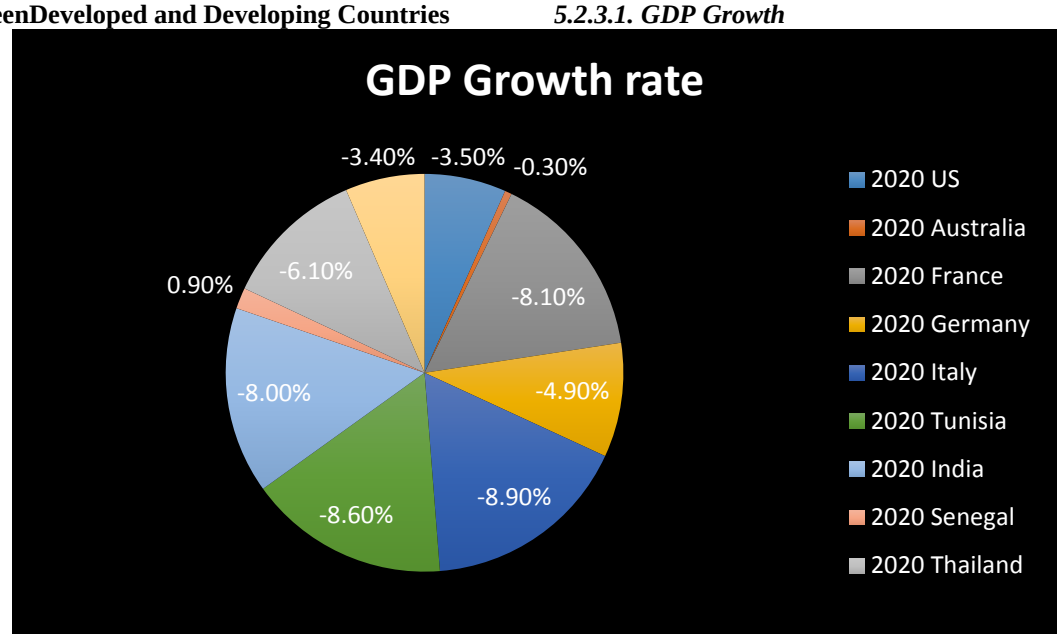


Figure 13: GDP growth of Developed and Developing Countries

As per the above study, it can be said that the impact of the pandemic had more in the Tunisia and also in India. On the contrary, the less impact on GDP growth rate had in Australia and US. In this case, it can be evaluated that the developing countries has faced more impact than developed countries in their GDP growth rate.

5.2.3.2. Inflation Rate

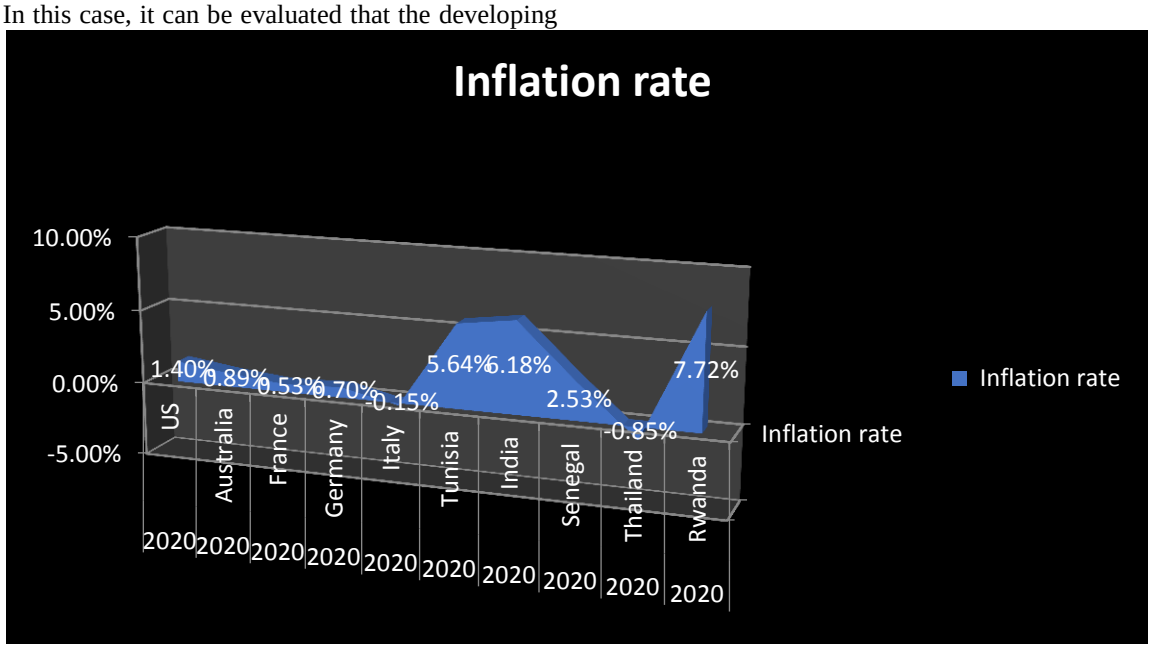


Figure 14: Inflation Rate of Developed and Developing Countries

As per the graphical representation of inflation rate of both developed and developing countries are depicted properly. In this case, the major impact of the Covid-19 pandemic has faced Thailand and Italy. In this case, compared to Thailand and Italy, the inflation rates of both countries are -0.85% and -0.15% respectively. As per this view, it can be demonstrated that the developed countries faced less impact of the pandemic compared to developing countries.

5.2.3.3. Poverty Rate

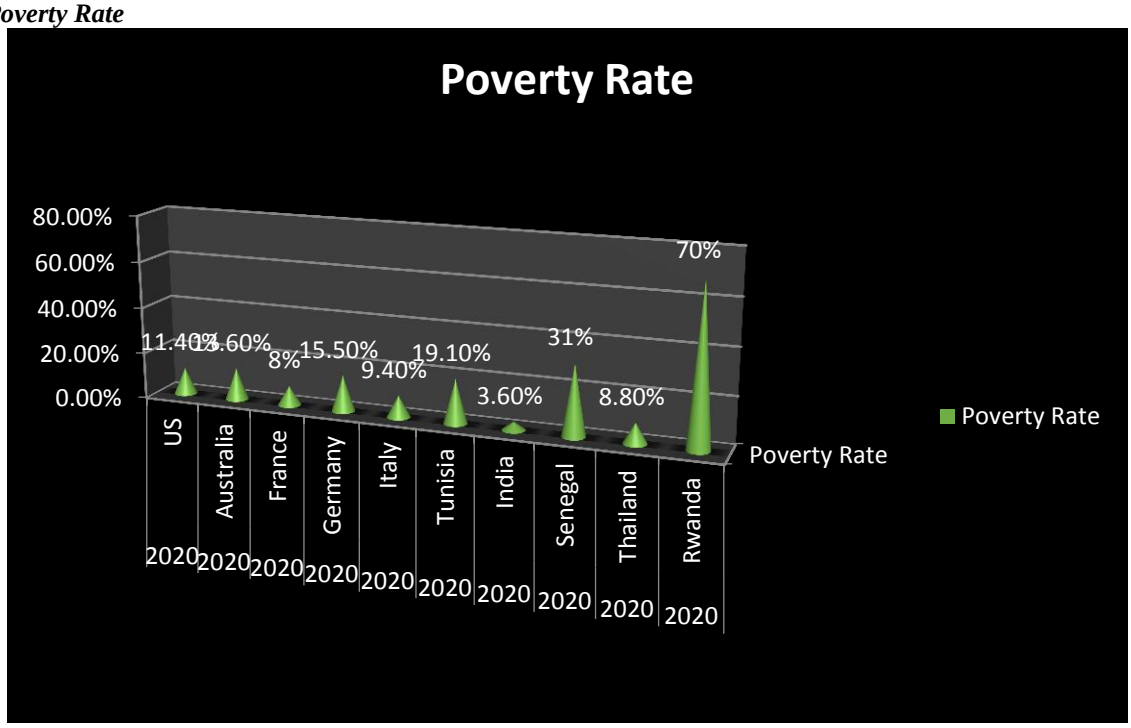


Figure 15: Poverty rate of Developed and Developing Countries

As per the above figure, the poverty rate of developing countries has increased more than developed countries. The excessive poverty rate has increased in Rwanda 70% and less poverty rate has increased in France 8%.

5.2.3.4. Unemployment rate

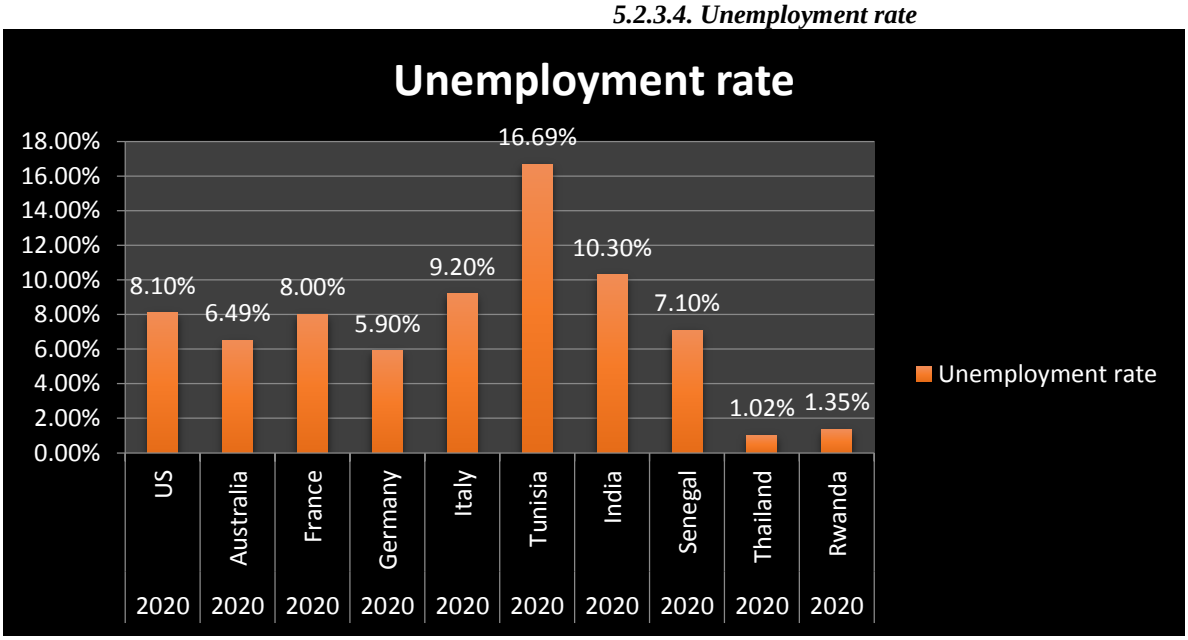


Figure 16: Unemployment rate of Developed and Developing Countries

In the above figure, it is shown that the unemployment rate of developing and developed countries appropriately. The result of unemployment rate helps to depict the impact of the pandemic in developed and developing countries. In addition to that, the information helps to demonstrate that more unemployment rate has increased in Tunisia. The result depicts that the unemployment rate has increased in developing countries more than developed countries. Compared with US and Australia, the unemployment rate has increased more in Tunisia and India.

5.2.3.5. Balance of Payment

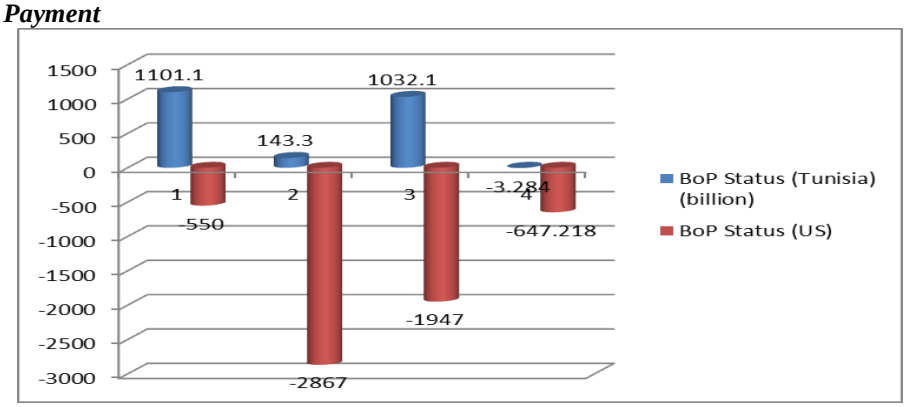


Figure 17: BoP of Developed and Developing Countries

Balance of Payment of the country developed country anddeveloping country faced the impact due to the pandemic. Needless to say, the pandemic increased the health issues that stopped the interaction between countries. In this case, BoP status decreased for the countries. The above figure shows that BoP status of Tunisia had been managed by the country because the interaction between countries was not properly stopped. Due to this case, the country increased the BoP status of Tunisia compared to the US country BoP status rate.

5.2.4. Vaccination impact on the US

5.2.4.1. New Cases of Covid-19 in the US

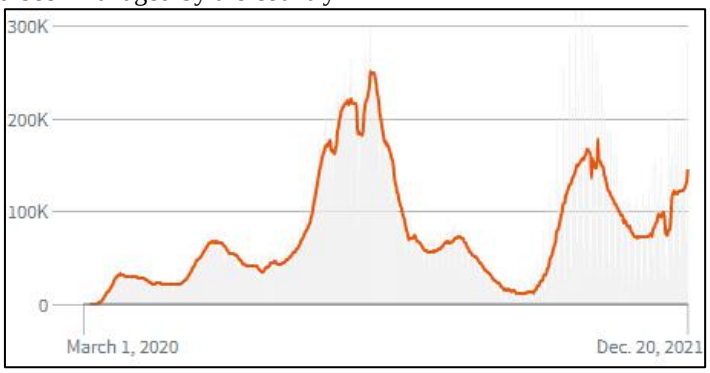


Figure 18: New Cases of Covid-19 in the United States

(Source: Reuters, 2021)

In the US, from March 1, 2020 to December 20, 2021, the new cases have increased and it has managed properly through giving vaccination to the community people. As per the above figure, in December 2021, the new cases of the pandemic have not increased more than 100K in the US.

5.2.4.2. New Deaths Due to Covid-19 in the US

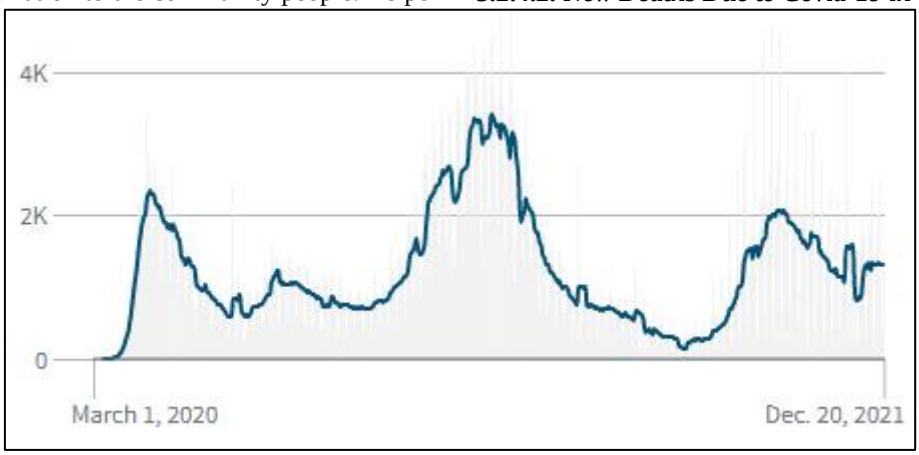


Figure 19: New Deathsdue to Covid-19 in the United States

(Source: Reuters, 2021)

The above figure depicts that the death rate in the US due to the pandemic has been managed through giving the vaccination to the community people. In this case, the death has managed in December due to the Covid-19 and it has not increased more than 2K.

5.2.5. Financial Impact due to pandemic in developing and developed country

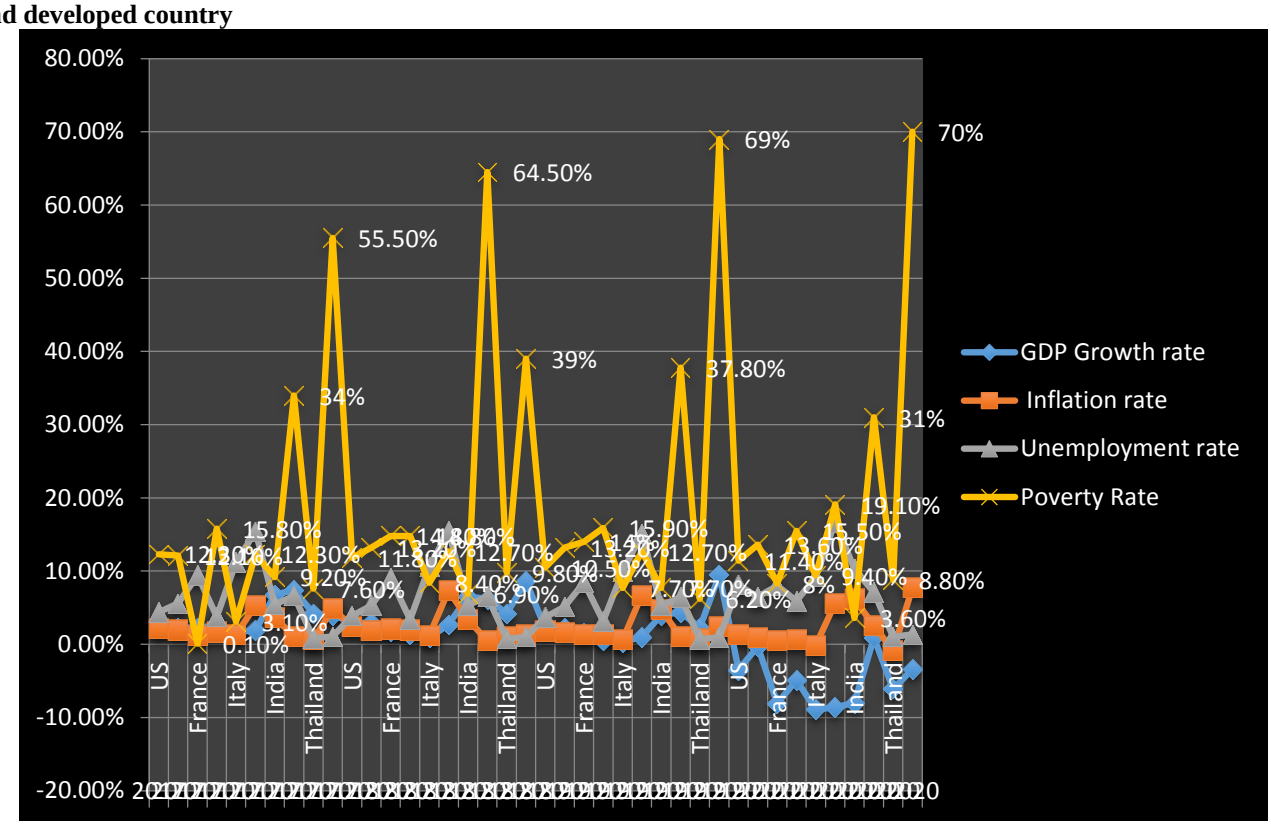


Figure 18: Financial Impact due to pandemic in developing and developed country

The above chart depicts the inflation rate, GDP growth rate, poverty rate, and unemployment rate of 5 developing countries and 5 developed countries. Five developed countries are US, Australia, Germany, France, and Italy, and five developing countries are Tunisia, India, Senegal, Thailand, and Rwanda. In this figure, the highest poverty rate is shown in Rwanda in 2020 as 70% during pandemic and lowest poverty rate is shown 8% in France in 2020 during pandemic. In this case, it can be argued that the pandemic has impacted on developing countries more than developed countries.

5.2.6. Comparison between developed and developing countries during the pandemic and pre-pandemic scenario

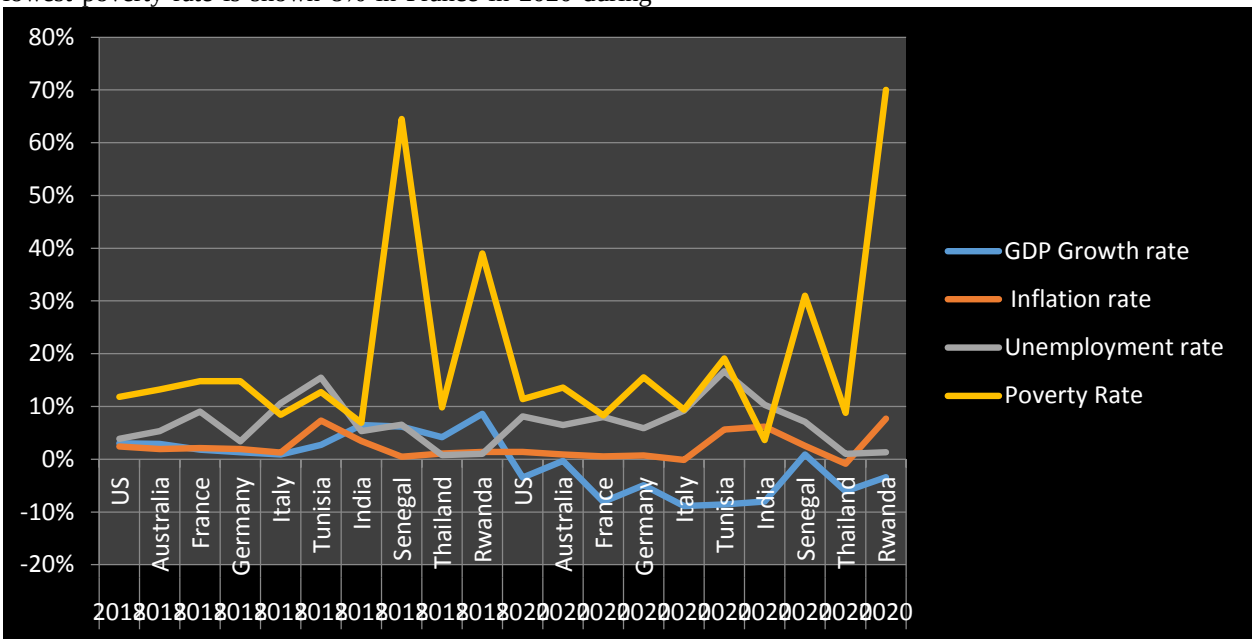


Figure 19: Comparison between developed and developing countries during the pandemic and pre-pandemic scenario

As per the above representation, it can be said that the developed countries had more developed economy before pandemic rather than developing countries. Apart from that, the developed countries had faced less negative impact on the

economy than developing countries. On the other hand, the pandemic reduced the economic growth of global countries including developed and developing countries. Poverty rate and unemployment rate have increased in the developing and developed countries due to the pandemic.

5.2.7. Discussion

As per the above analysis and the result, it can be discussed that the country US faced major issues in their economic development process during the pandemic. On the contrary, the country Tunisia faced less impact of the pandemic of Covid-19 than the US (Amirat and Zaidi, 2020). Due to the major transaction process of the country Tunisia helped to manage the economic development of the country, where the unemployment rate increased. On the other hand, the unemployment rate of the US was not more than Tunisia; however, the BoP status of the country was less than Tunisia. Financial impact of the pandemic has more in developing countries than developed countries. In addition to that, political risks in the developing countries increased due to low GDP growth. Moreover, due to the pandemic, health of citizens faced more impact such as death rate increased due to Covid-19.

As per the above result, it also can be discussed that the GDP growth rate and inflation rate of both developed and developing countries have faced the impact of Covid-19. In this case, the developing countries faced major impact due to their economy was unstable due to the adaptation process of technologies (Wattagnet, 2021). With the exception of, the developed countries have the availability and accessibility of technologies, conversely; the developing countries have the issue of technological development. In this case, the developed countries faced less impact compared with developing countries.

6. Conclusion

Based on the above discussion it is found that the recent pandemic of Covid-19 has affected the global economy in an adverse manner. Both the developed and developing countries have faced several difficulties in respect to financial development, employment generation, poverty reduction, providing adequate health facilities and other parameters related to the common public wellbeing. It is found that the unemployment rate in the US has been affected less in comparison to Tunisia. On the other hand, the BoP rate of Tunisia is found to be more than the US. Same results were observed between the developed countries and the developing countries for most of the following macro-variable indicators. Main reason behind the aforementioned issue is found in the number of financial transactions between Tunisia and other global countries during the pandemic situation than the US. The pandemic had a major impact on finance, health, politics, and other factors of society. Indeed, the comparison between the two groups of the countries shows that the developing countries have been facing more negative impacts compared to the developed countries. Though both groups have faced tremendous adverse impacts on the socioeconomic level, the developing countries are more vulnerable to manage the crisis than the developed countries. The reasons of the different impacts are discussed in the paper and could be essentially related to economic infrastructure, political stability and the tardy and slowness of the decision-making process in developing countries. The regional development discrepancies in the developing countries could also be a determinant factor of the severity of the pandemic impact as the spread of the disease is stronger in small, far side and poor regions which are less equipped with the needed health infrastructure like hospitals, medical supplies, and ER capacity. Lack of digitalization capabilities have made the public awareness and vaccination processes less efficient in developing countries. Besides, none of them have developed their own vaccines remaining at the mercy of developed countries which served their own citizens at the beginning of the pandemic. The accessibility of the developed countries to big pharma firms emphasises the gap in poverty between the two groups especially at the early stage of the COVID-19 contagion. Social distancing, self-isolation, lockdowns, quarantines, and travel restrictions not only forced a decrease in the workforce across all economic sectors in both groups, but they also affect the psychology and the wellbeing of Citizens in both groups.

References

1. Amirat, A. and Zaidi, M., 2020.Estimating GDP growth in Saudi Arabia under the government's vision 2030: a knowledge-based economy approach. *Journal of the Knowledge Economy*, *11*(3), pp.1145-1170.
2. Ceicdata.com. 2021. *Tunisia Balance of Payments (BoP) | Economic Indicators | CEIC*. [online] Available at: <https://www.ceicdata.com/en/tunisia/balance-of-payments/balance-of-payments-bop> [Accessed 20 November 2021].
3. Ceicdata.com. 2021. *United States BOP: Capital Account: Balance | Economic Indicators | CEIC*. [online] Available at: <https://www.ceicdata.com/en/united-states/bpm6-balance-of-payments/bop-capital-account-balance> [Accessed 20 November 2021].
4. Eisenschmidt, J., Kedan, D., Schmitz, M., Adalid, R. and Papsdorf, P., 2017.The Eurosystem's asset purchase programme and TARGET balances. *ECB Occasional Paper*, (196).
5. Erokhin, V. and Gao, T., 2020. Impacts of COVID-19 on trade and economic aspects of food security: Evidence from 45 developing countries. *International journal of environmental research and public health*, *17*(16), p.5775.
6. Fadlallah, R. and El-Jardali, F., 2020. K2P COVID-19 series: exiting the COVID-19 lockdown: a road map for action. *Knowledge to policy (K2P) center, beirut, Lebanon, Apri l*, *20*, p.3.
7. Maital, S. and Barzani, E., 2020. The global economic impact of COVID-19: A summary of research. *Samuel Neaman Institute for National Policy Research*, *2020*, pp.1-12.
8. Reuters. 2021. *Where U.S. coronavirus cases are on the rise*. [online] Available at: <https://graphics.reuters.com/HEALTH-CORONAVIRUS/USA-TRENDS/dgkvlgkrkpb/index.html> [Accessed 20November 2021].
9. Rosca, E., Agarwal, N. and Brem, A., 2020. Women entrepreneurs as agents of change: A comparative analysis of social entrepreneurship processes in emerging markets. *Technological Forecasting and Social Change*, *157*, p.120067.
10. Statista. 2021. *Tunisia - inflation rate 1986-2026 | Statista*. [online] Available at: <https://www.statista.com/statistics/524512/inflation-rate-in-tunisia/> [Accessed 20 November 2021].

11. Statista. 2021. *Tunisia - unemployment rate 1999-2020 | Statista*. [online] Available at: <https://www.statista.com/statistics/524516/unemployment-rate-in-tunisia/> [Accessed 20 November 2021].
12. Tradingeconomics.com. 2021. *Tunisia Stock Market (TUNINDEX) | 2021 Data | 2022 Forecast | 2006-2020 Historical*. [online] Available at: <https://tradingeconomics.com/tunisia/stock-market> [Accessed 20 November 2021].
13. Tradingeconomics.com. 2021. *United States Stock Market Index (US30) | 2021 Data | 2022 Forecast*. [online] Available at: <https://tradingeconomics.com/united-states/stock-market> [Accessed 20 November 2021].
14. Wattagnet.com. 2021. *GDP growth rates in developing countries 2006-15 vs. 2016-25 | WATTPoultry*. [online] Available at: <https://www.wattagnet.com/GDP-growth-rates-in-developing-countries-2006-15-vs-2016-25> [Accessed 20 November 2021].

A Pragmatic Strategy Approach to Optimize Performance of Parent Company and Its Business Entities through Policy Alignment

[1]Subramaniam Anbanathan, [2]Ernie Tisnawati Sule, [3]Nury Effendi, [4]Aldrin Herwany
[1][2][3][4] Faculty of Economics and Business, Universitas Padjadjaran, Bandung, Indonesia

Abstract
This paper is aimed to develop insights and capabilities to optimize Corporate Advantage (CA) of Parent company with the entities in its business portfolio. A conceptual approach and potential solution are established to align and integrate Parenting Characteristic (PC) and its potential Parenting Opportunity (PO) to influence the performance of Parent company and entities within its business portfolio. Most Parent companies have established policies to ensure the effectiveness of strategies applied to each entity to create corporate and competitive advantage; however, such initiatives have potential impact to destroy value rather than create. A balance perspective of perception and tool to assess parenting fit are required as well as, the way to select policies accordingly. Such approach is expected to drive appropriate strategic choices for parent company and its entities. This paper uses a study case approach of one corporate company with 5 (five) subsidiaries. The outcomes of this paper demonstrate that some of the decisions which have been made at Parent office are proven to create value, but others are indeed destruct the value. Through this finding, Parent can revise its policy and expand activities to synergize in vertical and horizontal approaches to further optimize the overall performance.

Keywords
parenting characteristic, parenting opportunity, critical success factor, value, policy.

1. INTRODUCTION

Uncertainty in business environment, followed by era of industrial and social revolution have significantly spurred changes in the way how management formulate strategy and make decision on surviving and growing. A considerable amount of literature has emphasized the importance of screening inward rather than outward to exploit unrevealed resources and capabilities (Wernerfelt, 1984; Collis & Montgomery, 2008; Fahy, 2000; Jay Barney, 1991; Gibson et al., 202; Clemons, 2019). Subsequently, transformation of knowledge and experience to creativity and innovation also confer an important role in building sustainable value creation. Various corporate company continuously and deliberately seek vital elements to remain competitive and become reconcile with learning process and its potential implications to provide causal ambiguity (Lippman & Rumelt, 1982; Adams & Lamont, 2003; Yu et al., 2017; Mahdi et al., 2019; Yang et al., 2021). Enabling such inward orientation also requires leadership and commitment from top management, especially in integrating strategy with people in respect to appropriate competencies and insights but simultaneously possess inclusivity to social and environment forces, both at parent and subsidiaries level accordingly (Haseeb et al., 2019; Silvestre & Ţîrcă, 2019; Mooney, 2007; Shvetsova, 2019; Kim & Kim, 2021; Adamsen & Swailes, 2018; Prahalad & Hamel, 2009).

Albeit inward-looking orientation are facilitated with proper understanding about the existing resources and capabilities along with competency, aligning perception of how to create value remain unsolved and at some extend promotes value destruction. Being hypnotized to potential value creation, managers are blinded to value destruction. The push from complexity of transitional business conditions creates a need for creating value through aggregation of different business in complex corporate enterprise, which ultimately forms multi-business firm. Later on companies start implementing various initiatives to extend business and product scope through partnership or investment even to unrelated business diversification (Hamel & Prahalad, 1993; Jarillo, 1988; Gupta & Govindarajan, 2017; Cyriac et al., 2012; Mauborgne & Kim, 1999).

Business-level strategy alone cannot meet the strategic needs of large, multi-business companies. Such companies need strategies for each of their businesses, therefore they need a corporate-level strategy. The corporate-level strategy provides a rationale for keeping all these businesses grouped together under common ownership and at some distance from outside shareholders and investors. The businesses are directly involved in value creation: they produce goods and services and attempt to sell them for more than their cost. But the parent is involved much less directly. Its ability to create value depends largely on its characteristic and potential to influence on the businesses and the way it supports them. The parent acts as an intermediary between the businesses and outside investors. It clearly incurs costs, both direct and indirect. It is justified only if it creates more value than these costs. If it does not, businesses and shareholders would be better off without it. To justify its

existence, the parent should be able to demonstrate that its businesses perform better in aggregate than they would as a series of individual, stand-alone entities. Few corporate parents appear to pass this test. Most destroy value, not primarily through bloated departments or excessive pay, but through the damaging influence they inadvertently exert on their businesses.

The concept of parenting advantage is clearly distinguished from the widely known concept of core competencies Prahalad & Hamel, (2009). On the other hand, Goold & Campbell, (2003) criticize the core competence theory's sole focus on technical or operative core competencies and the resulting failure to deliver practical guidelines for the formulation of an overall company strategy and inability to explain the existence of successful diversified multi-business companies. The concept of parenting advantage picks up the thread at this articulated deficit and demands that the corporate parent not only formulates a successful overall strategy, but also provides evidence that it is the best possible owner of each individual business in the corporate portfolio. Consequently, corporate parents should not only endow the business units with value; they must also guarantee that the value they contribute is greater than the costs they cause, and that this net value is the highest among all potential owners. Otherwise, the corporate strategy is suboptimal and destroys shareholder value.

Typically, parents have potential to destroy value in several ways. If they do not have a good feel for a business, they are likely to focus on the wrong issues, appoint unsuitable managers, or press for inappropriate levels and measures of performance. Even if the business is more familiar, capital rationing and political pressures distort the flow of information that reaches the parent, frequently encouraging misperceptions. Attempts to gain economies of scale through central departments all too often lead to unresponsive or compromised services; apparent synergies are sponsored with little appreciation of the opportunity costs involved; business managers are pressed into corporate policies that fail to match their individual circumstances. Underlying such value destruction is some type of misfit between the parent and the business in question.

In order to create value, parent must do more than simply avoid creating damaging misfits. It must have some skills or resources that are especially helpful to its businesses. It must help its businesses address opportunities to improve their performance that they would fail to realize by themselves. The nature of these opportunities varies from one business to another. In one business, there may be an opportunity to improve performance by applying tighter controls than would exist if the business were independent. In another business, there may be an opportunity to facilitate the sharing of complex know-how that would not occur between stand-alone entities. Such different opportunities can be realized only by applying different parenting skills or characteristics. The essence of successful parenting is therefore to create a fit between the way the parent operates – the parent's characteristics – and significant improvement opportunities that exist in its subsidiaries, especially to satisfy the critical success factor of its subsidiaries. A parent company that is well-suited to address certain opportunities may be ill-suited to address others.

In complex structures, Goold & Campbell, (2002) noted that parent company consists of a variety of levels of line management, supported by different types of staff. The parent, particularly at group and division levels, is often more hands-on, and shares more responsibilities with the operating units than in simple structures. There is therefore a spectrum of general management levels, from the corporate CEO, through intermediate parent levels, down to business units and, eventually, sub-businesses. While the differences in role between a hands-off corporate level CEO and a deeply involved business unit general manager are clear, there are several shades of grey along this spectrum.

2. CONCEPTUAL FRAMEWORK

2.1. *Parenting Characteristics*

As part of research on corporate parenting, Kruhler et al., (2012) have developed a simple tool that can be used to assess a company's parenting strategy and to visualize its key dimensions. The parenting strategy is leading to the existence of parenting characteristic. There are five categories of parenting activities identified by factor analysis of the survey data, which each defined three primary sub-activities. The strategy provides parent with distinctive profile, such as:

a. Key sources of value added: provide cheap and flexible external and internal funding, protection from capital market pressure and reporting requirements, alignment of planning and budgeting process, reporting and improvement initiatives among subsidiaries with the present of parent.
b. Key risk of value destruction: solve conflict of goal against short terms and long terms value creation target, cost of complexity and inefficient corporate process.

In order to create value, the parent must do more than simply avoid creating damaging misfits. It must have some skills or resources that are especially helpful to its businesses. It must help its businesses address opportunities to improve their performance that they would fail to realize by themselves. The nature of these opportunities varies from one business to another. In one business, there may be an opportunity to improve performance by applying tighter controls than would exist if the business were independent. In another business, there may be an opportunity to facilitate the sharing of complex know-how that would not occur between stand-alone entities. Such different opportunities can be realized only by applying different parenting skills or characteristics (PC).

2.2. *Parenting Opportunity*

Goold et al., (1995), the essence of successful parenting is to create a fit between the way the parent operates, the parent's characteristics, and significant improvement opportunities (PO) that exist in its businesses, . A parent that is well-suited to address certain opportunities may be ill-suited to address others. For example, a parent whose systems and staff are well-suited to squeezing cash out of mature businesses and to resisting unprofitable growth strategies that will destabilize the market will not be well-suited to facilitating complex linkages across emergent high-growth applications of new technology. The parent's skills are not good or bad in any absolute sense; their value depends on the nature and needs of their businesses. If these elements fit well together, value will be created. Once there is a fit between parent and its subsidiary, then corporate advantage exists. The configuration of parenting advantage can be seen at Figure 1.

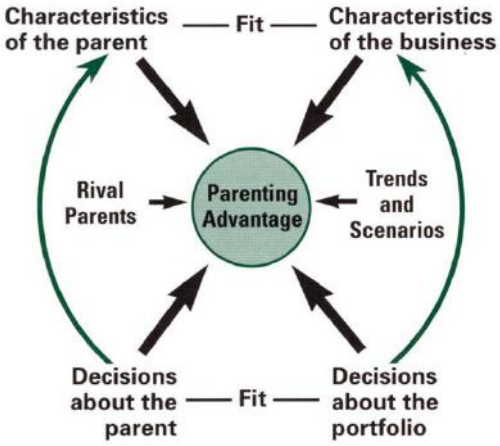


Figure 1: Parenting Advantage Configuration

Kruhler et al., (2012) mentioned that at least there are 10 area to look for PO, which parent can seek to select accordingly. They are:

1. Size and age: large and old successful business often accumulate bureaucracies and overhead that are hard to eliminate from the inside. Whereas small and new businesses may have in sufficient functional skills, managerial-succession problems, and insufficient financial resources.
2. Management: configuration and existence of top-quality managers compared with competitors, ability to focus on right objectives, able to attract and retain people with hard-to-find skills.
3. Business Definition: way of how managers understand about the going on business and consequently target market. The trend of outsourcing and aligning, configuration of business portfolio to maximize competitive advantage.
4. Predictable Errors: potential for managers to make prediction mistake, such as decision to excessive diversification, long product cycle can encourage excessive reliance on old products, and cyclical markets can lead to overinvestment during upswing.
5. Linkage: effectiveness of business linkage among subsidiaries.
6. Common Capabilities: potential to share capability that are common to all the subsidiaries.
7. Special expertise: subsidiary benefit from specialized or rare expertise that the parent possesses.
8. External Relations: parent can manage better the external stakeholders, such as shareholders, government, union, supplier, etc.
9. Major Decision: subsidiary face difficult decision in the area in which it lacks expertise, such as making big acquisition, extending capacity, major funding, etc.
10. Major Changes: subsidiary need to make major changes in areas with which its management has little expertise.

2.3. *Critical Success Factor*

Leidecker & Bruno, (1984) define critical success factor (CSF) as factor that influence limited number of areas in which results, when satisfied, will insure the successful competitive performance for the organization. CSF is variable for management through its decision that can affect significantly the overall competitive positions of firm. Furthermore, in analysis of CSF, there are three level that will satisfy common elements of the strategy formulation process, such as strategy identification, environmental analysis, resource analysis, gap analysis, strategic alternatives, strategic evaluation, and strategic choice.

Boynton & Zmud, (1984) define as factors that must go well to ensure success for a manager or and organization. It attempts to make explicit specified key areas that dictate managerial and organizational success. At the operational level, CSF enable critical organization information processing needs are explicitly addressed. The development of organizational CSF and their use as a guidance for bounding and directing implementation efforts also provide a means to improve the overall integration of information system efforts. On the other hand, at strategic planning, CSF connects corporate strategic interest and the strategic planning efforts of the information function.

Moeuf et al., (2020), the role of CSF cannot be separated to the efforts to identify risks and opportunities, especially when industry is facing the disruption era of Industry 4.0. Assessing risks and opportunities will leverage the enrichment of context, where CSFs determination become optimized.

3. RESEARCH METHODOLOGY

The conceptual approach in the research is conducted to parent company which has five subsidiaries with difference business, such as Hotel, Food, Travel, Transport and Logistics. The structure of sampling is shown in Figure 2.

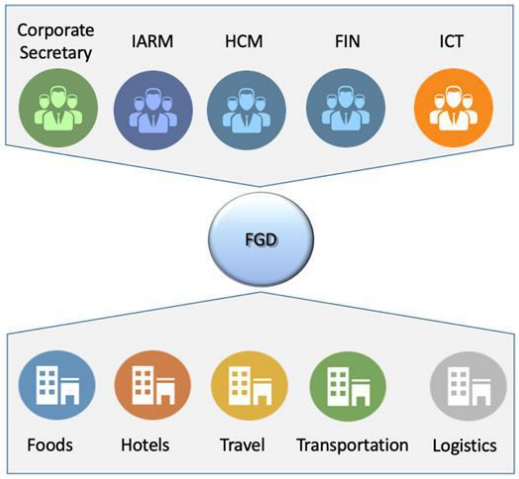


Figure 2: Respondents Configuration

Data are collected based on respondent perception from corporate office to representation from each subsidiary. From parent company, the respondents are corporate secretary, IARM (internal audit dan risk management), HCM (human capital management), FIN (financial) and ICT (information, communication, and technology).

Data are collected via focus group discussion and the same worksheet are used for parent company respondents and respondent from subsidiaries. The idea is to figure out whether there are significant discrepancies on both parties.

The worksheet satisfies measurement of value added and destroy in respect to top-down approach (parent and its subsidiaries) and synergy among subsidiaries. Figure below provides an idea to find how is the profile of perception influences the discrepancy among parent and subsidiaries which is measured by the disparity distance (DD) and disparity angle (DA). DD reflects how far is the gap of valuation between parent and each subsidiary and DO reflects the polarity of perception among them. Positive DA means that there is the same way of perception between them whereas when its negative means that parent and subsidiary have reverse perception between them, so if parent says that his existence has provide potential value-added, then the subsidiary says that due to parent interference it experiences value destroy. The final decision is made through moderate approach, where it balances the gap among parent and all its subsidiaries. Potential perception scenario in respect to DD and DA can be seen Figure 3.

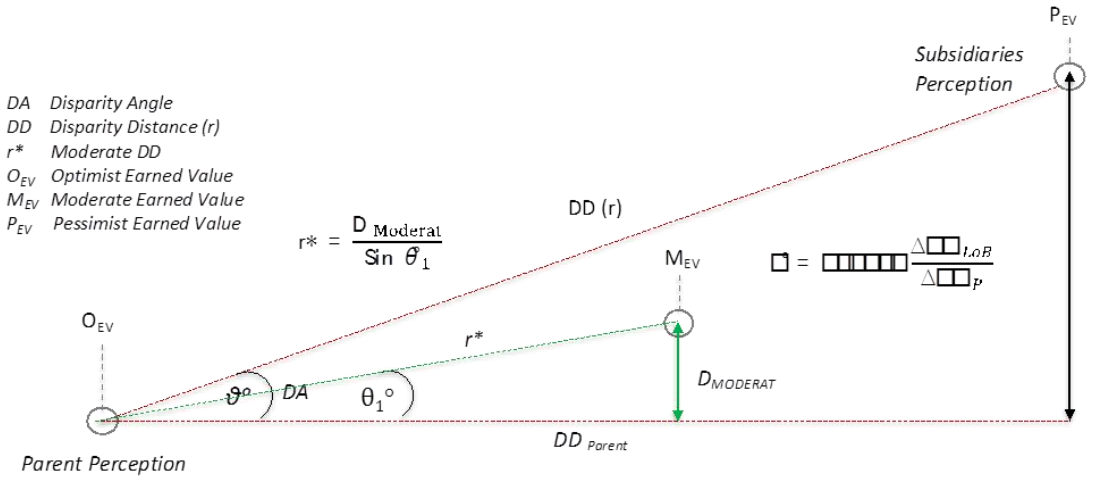
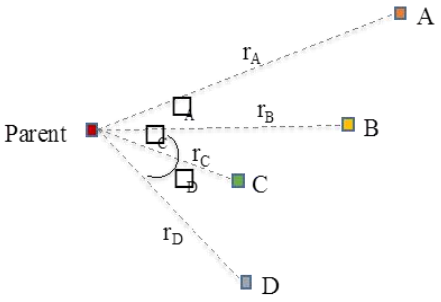


Figure 3: The structure to determine DD and DA

To further understand DD and DA concept, below in Figure 4, there are four scenarios that explain the application of DD and DA.



Potential Scenario
Parent DD with subsidiary A is high as well as the DA. Subsidiary A have the same orientation which follow Parent
Parent DD with subsidiary B is high and DA is 0, therefore Parent and B same orientation
Parent DD with subsidiary C is relatively close but both have negative orientation
Parent DD and DA with subsidiary D are worst, means that what Parent think about D is totally different by D.

Figure 4: The scenario for DD and DA

To figure out fitness level among parent and its subsidiaries, Ashridge Matrix or Parenting Fit Assessment is introduced. The matrix is configured with based on the fitness among PC and CSF of subsidiary, and

the fitness among PC and PO. Based on the option given, the matrix consists of five areas, known as:

1) Heathland
2) Hedge of Heathland
3) Ballast
4) Value trap
5) Alien territory

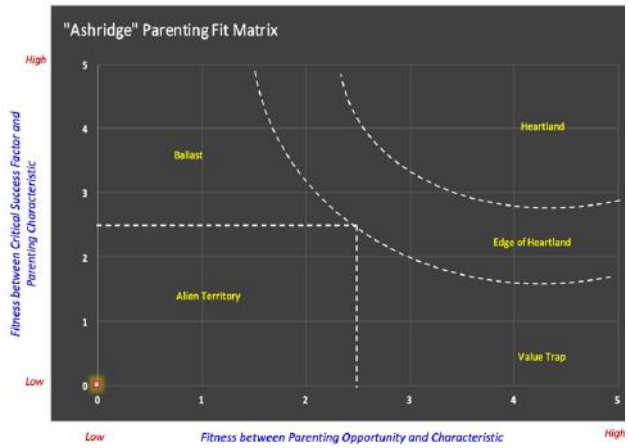


Figure 4: The worksheet of Parenting Fit assessment

Figure 4 shows the worksheet of parenting fit matrix. The score of 1 to 5 for each axis represents the fitness level, where 1 is defined misfit and 5 is fit. The application of this matrix starts with positioning all the subsidiaries by calculating the DD and DA.

A worksheet is prepared, and deep interview is conducted to the related personal both at the parent level and subsidiaries. Once conducted, then analysis and evaluation are carried out accordingly and finally the coordinate value is plotted to the worksheet parenting fit assessment.

Table 1-A shows the check sheets for conducting deep interview in Value Creation by Parent

A.1	Value Creation of Parent (Corporate Headquarters)			
A.1.1	**Strategic Guidance and Support**	**W**	**S**	**W x S**
A.1.1.1	Parent provides an overall vision and strategic direction to LoB	10%		0,00
A.1.1.2	LoB is supported by the parent with specific strategic expertise (e.g., Strategic planning process/methods)	14%		0,00
A.1.1.3	Parent actively promotes LoB's M&A projects (e.g., through active involvement in the deal process)	8%		0,00
A.1.1.4	Company resources are allocated efficiently by the parent	14%		0,00
A.1.1.5	Parent staff reduces value-destroying behaviour of LoB through tight performance monitoring	9%		0,00
A.1.1.6	Operational performance is improved by parent interference (e.g., manager replacement, turnarround help)	13%		0,00
A.1.1.7	LoB can pursue longer-term perspectives due to protection from external capital market pressure	14%		0,00
A.1.1.8	Parent actively foster cooperation between LoBs (e.g., operations, marketing, or research)	8%		0,00
A.1.1.9	LoB is encouraged by the parent to share knowledge and talent (e.g., through corporate initiatives)	10%		0,00
	Sub-value	**100%**		**0,00**

A.1.2	**Central Resources and Sevices**	**W**	**S**	**W x S**
A.1.2.1	LoB benefit from central assets provided by the parent (e.g., brands, or patents)	10%		0,00
A.1.2.2	Parent provides essential capabilities to the LoB (e.g., risk management, safety and health management)	14%		0,00
A.1.2.3	Lob realizes cost advantages by using centrally bundled functions (e.g, procurement, IT)	8%		0,00
A.1.2.4	LoB benefits from short-term internal financing to avoid expensive external debt	14%		0,00
A.1.2.5	Parent offers lower cost of external funding than LoB could achieve (e.g., greater negotiation power)	9%		0,00
A.1.2.6	LoB benefits from tax optimization across the corporate portfolio	13%		0,00
A.1.2.7	External reporting requirements for the LoB are minimized due to consolidated disclousers	14%		0,00
A.1.2.8	LoB benefits from a higher attractiveness as an employer (e.g, career opportunities)	8%		0,00
A.1.2.9	LoB benefits from a broader pool of management talent	10%		0,00
	Sub-value	**100%**		**0,00**

Table 1-B shows the check sheets for conducting deep interview in Value Creation through Sinergy among Subsidiaries

B.1	Value Creation from Linkages with Other LoB			
B.1.1	Sales and Mangerial Synergies	W	S	W x S
B.1.1.1	LoB increases sales through cross-selling to the same customer base (e.g, sales of complementary goods)	23%		0,00
B.1.1.2	LoB increases sales through bundling of products from different LoBs	25%		0,00
B.1.1.3	LoB benefits from sharing capabilities with each other (e.g., customer knowledge)	17%		0,00
B.1.1.4	LoB benefits from sharing market related experiences with other LoBs (e.g., product launches)	15%		0,00
B.1.1.5	Lob benefits from joint development of new strategic assets and capabilities with other LoBs	20%		0,00
	Sub-value	100%		0,00
B.1.1	Operating Synergies	W	S	W x S
B.1.2.1	LoB realizes economies of scope due to cooperative actions within an integrated value chain	23%		0,00
B.1.2.2	LoB realizes economies of scale from combined activities (e.g., joint sales force, product platform)	25%		0,00
B.1.2.3	LoB benefits from pooling assets among each other (e.g., utilization of product platform)	17%		0,00
B.1.2.4	LoB has cost advantages through combined purchasing power on supplier markets	15%		0,00
B.1.2.5	LoB benefits from lower internal transfer pricing compared with arm's-length transactions	20%		0,00
	Sub-value	100%		0,00

Table 1-C shows check sheets for conducting deep interview in Value Destruction by Parent

A.2	Value Destruction of Parent (Corporate Headquarters)			
A.2.1	Negative Influence	W	S	W x S
A.2.1.1	Parent has insufficient expertise and skills with regard to the critical success factors of the LoB	18%		0,00
A.2.1.2	Central decision-making is predominantly driven by political matters (e.g, justification of past decision)	10%		0,00
A.2.1.3	Parent prefers investing in LoB that corporate-level management is familiar with	12%		0,00
A.2.1.4	Parent favors growth over value creation (empire-building)	10%		0,00
A.2.1.5	Parent favors corporate risk disversification over creating (e.g, minimizing own job risk)	14%		0,00
A.2.1.6	Being part of corporate portfolio, LoB are eluded from beneficial capital market pressure	17%		0,00
A.2.1.7	Ongoing parent interference decreases LoB managers' motivation (e.g., central over-ruling practice)	19%		0,00
	Sub-value	100%		0,00
A.2.2	Overhead Costs	W	S	W x S
A.2.2.1	Parent offers services which are not needed by the LoB	25%		0,00
A.2.2.2	Overhead charges are too high in regards to the scope and quality of the services offered	22%		0,00
A.2.2.3	Some LoB resources are only needed to fulfill parent's requirements (e.g, reporting obligations)	15%		0,00
A.2.2.4	Parent requirements prevent LoB managers from running their business effectively (e.g, inward focus)	18%		0,00
A.2.2.5	Complex parent processes reduce flexibility and slow down decision-making	20%		0,00
	Sub-value	100%		0,00

Table 1-D shows check sheets for conducting deep interview in Value Destruction through Sinergy among Subsidiaries

B.2	Value Destruction form Linkages with Other LoBs			
B.2.1	Resource Competition	W	S	W x S
B.2.1.1	Marginal LoB are deprived of management attention at corporate level	40%		0,00
B.2.1.2	Strong LoB have to subsidize weak LoBs in terms of CAPEX allocation	35%		0,00
B.2.1.3	LoB has to play a specific role in the portfolio that prevents them from realizing their value potential	25%		0,00
	Sub-value	100%		0,00
B.2.2	Cost Complexity	W	S	W x S
B2.2.1	LoB are wasting resources on additional effforts for internal corporate processes	30%		0,00
B2.2.2	Decision-making processes are slowed down due to high coordination requirements	40%		0,00
B2.2.3	Internal power struggles lead to wrong-decision and prevent LoB from realizing their value potential	15%		0,00
B2.2.4	LoB are wasting resources and time on tactical maneuvers for influencing parent decision-making	15%		0,00
	Sub-value	100%		0,00

In interpreting the data, all measurements, both from parent level and each subsidiary, the final value will be taken as average value, which means that the perception calculation is based on moderate approach (not 100% follow parent and 100% follow subsidiaries.

4. SIMULATION RESULTS

After conducting the deep interview for both the parent level at divisional level and subsidiaries, data is collected

and shown in Table 2. TV = travel, TR = transport, HT = hotel, LG = logistic, FD = food.

Subsidiaries Perspectives

PoF	Section	Sub-Section	Lob Perceptions				
			TV	TR	HT	LG	FD
Parent Value [Verical]	Creating Value	Strategic Guidance and Support	3,03	2,50	2,09	2,98	0,00
		Central Resources and Services	2,97	2,68	2,46	2,34	0,00
	Destroying Value	Negative Influence	-2,84	-3,35	-3,05	-2,94	0,00
		Overhead Costs	-2,53	-3,06	-2,86	-2,47	0,00
		∑ Value	0,32	-0,61	-0,68	-0,04	0,00
LoB Linkages [Horozontal]	Creating Value	Sales and Mangerial Synergies	3,88	2,26	4,00	0,92	0,00
		Operating Synergies	3,01	2,25	1,00	0,00	0,00
	Destroying Value	Resource Competition	-1,00	-1,00	-3,10	-1,80	0,00
		Cost Complexity	-1,00	-1,30	-1,85	-1,00	0,00
		∑ Value	2,45	1,11	0,02	-0,94	0,00
Overall LoB Value Earned			2,76	0,49	-0,66	-0,99	0,00

Parent Perspectives

PoF	Section	Sub-Section	Lob Perceptions				
			TV	TR	HT	LG	FD
Parent Value	Creating Value	Strategic Guidance and Support	3,28	3,15	3,30	3,00	2,91
		Central Resources and Services	2,35	2,41	2,44	2,05	2,29
	Destroying Value	Negative Influence	-0,33	-1,03	-1,09	-1,07	-1,03
		Overhead Costs	-0,52	-0,81	-0,81	-0,81	-0,81
		∑ Value	2,39	1,86	1,92	1,59	1,68
LoB Linkages	Creating Value	Sales and Mangerial Synergies	1,21	1,01	1,17	0,92	1,01
		Operating Synergies	1,57	1,46	1,50	1,30	1,38
	Destroying Value	Resource Competition	-0,57	-0,33	-0,50	-0,33	-0,47
		Cost Complexity	-0,59	-0,62	-0,72	-0,64	-0,58
		∑ Value	0,81	0,76	0,73	0,62	0,67
Overall LoB Value Earned			3,19	2,62	2,64	2,21	2,35

Table 2: Recapitulation of Deep Interview Data Collection

The recapitulation of data analysis can be seen in Table 3.

Parameters	Description	TV	TR	HT	LG	FD
Δ VP	Optimist Difference in Vertical Perspectives	2,07	2,48	2,60	1,63	2,93
Δ HP	Optimist Difference in Horizontal Perspectives	-1,64	-0,35	0,70	1,56	1,82
r	Optimist Disparity Distance	2,64	2,50	2,69	2,26	3,45
α	Optimist Disparity Angel	-51,68	-82,02	74,96	46,26	58,17
r*	Moderate Disparity Distance	1,32	1,25	1,35	1,13	1,73
α_*	Moderate Disparity Angel	-25,84	-41,01	37,48	23,13	29,09
OEV	Optimist Earned value	3,19	2,62	2,64	2,21	2,35
PEV	Pessimist Earned value	2,76	0,49	-0,66	-0,99	-2,40
MEV	Moderate Earned value	2,98	1,55	0,99	0,61	-0,02
CSF-PC	Normalized LoB Perspectives	1,44	0,76	2,00	2,11	4,13
PO-PC	Normalized Parent Perspectives	3,18	2,60	2,63	2,19	2,34

Table 3: Data analysis to acquire the coordinate of subsidiaries

The ΔVP is the difference in perception due to the exitance of Parent and ΔHP is the difference in perception due to synergy among subsidiaries. The result is shown as point of coordinate for all the subsidiaries, which can be seen in the CSF-PC and PO-PC, refer to Figure 4.

The subsidiary of food industry is in edge of heathland, travel, transport and hotel at ballast and logistic is at alien territory. This means that parent should be aware to handle all of its subsidiaries and special treatment need to be applied to logistic.

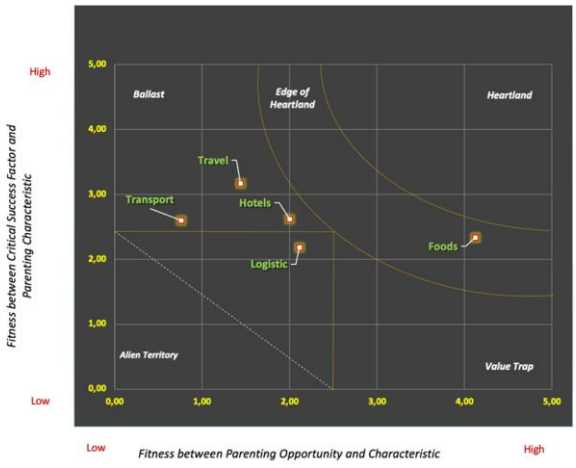


Figure 5: The Position of each subsidiaries in Parenting Fit Assessment.

On the other hand, the DA and DD analysis can also be analyzed in moderate disparity responses in polar coordinate. Its moderate because it considers the parent perceptions as well as subsidiaries perception, refer to Figure 6.

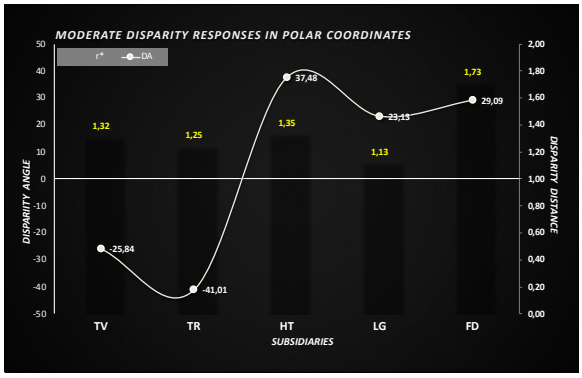


Figure 6: The profile of DA and DD

The profile of DA at hotel, logistic and food are at positive angle, whereas travel and transport are negative. On the other hand, the DD of travel, transport, hotel and logistic are relatively not much difference, except at food business, its significantly high.

5. DISCUSSION AND IMPLICATION OF THE STUDY

The findings of present research indicate that parent decide strategy for its subsidiary to gain competitive advantage, but in real parent do not understand fully what subsidiary need to have competitive advantage. By doing so, parent is not creating value, but destroying value and as a whole parent lost its competitive advantage. The solution provided in this research start by understanding PC, which competence parent must influence its subsidiary. At the same time parent need to understand the CSF of its subsidiary. But parent should also need to be aware the opportunity to influence the subsidiary. Based on the evaluation from the parenting fit assessment, parent can act accordingly, such as:

5.1. Heartland

Subsidiary which is plotted at this zone knows well about parent characteristic and parent also know well about the CSF of the subsidiary. Normally most of the manager at the subsidiary are from parent and therefore parent has opportunity to influence.

5.2. Edge of Heartland

Parent must be selective to influence the subsidiary which is plotted at this zone. Not all characteristics (competencies) possessed by parent can meet the needs of food business. There are two options that can be done, namely (1) parent first learn about CSF in food business, then change their behavior and business strategy according to the needs, (2) parent conducts studies and observe when it is appropriate, when to intervene directly and when is more sensitive and selective to meet subsidiary needs. This guidance can be used to ensure value creation to food business.

5.3. Ballast

In the past parent was able to create value but currently parent does not have the potential to influence the activity of subsidiary. Normally it happens due to disruption in technology or new supports required in hospitality, which parent don't have. Travel, transport, and hotel are plotted at this ballast zone. Even parent characteristic is fit with CSF of the subsidiaries, but the opportunity is mis-fit. Once parent has less opportunity to get involved in those subsidiaries, significant issue will arise. Subsidiaries will slowly conduct business as usual or routine. There is a chance that business growth slows down and productivity declines. Due to any significant changes to the business environment, and manger at travel, transport and hotel businesses need to anticipate and recover their businesses, unless this Ballast zone has potential to enter the Alien Territory zone. On the other hand, if managed well, this zone has also potential as a source of cash flow stability (cash cow) for parent.

5.4. Value Trap

Value trap is a zone where parent has opportunity to deliver its capability to provide value creation at subsidiary, but parent must aware that its characteristic is not fit with the required CSF of subsidiary. The case is similar with Unilever (mass products provider) acquire Calvin Klein or CK (nice market in perfume). As parent, Unilever don't force CK to follow its promotion program, because CK has its unique way to promote its product. But Unilever conduct monitoring about financial performance of CK.

5.5. Alien Territory

Subsidiary which is plotted in this zone is the result of excessive business diversification in the past and often referred to as the "Pet Project of Senior Managers" But there are also other explanation, such as: (1) subsidiary still earns revenue/profit because there are still loyal customers, (2) parents are still under review to determine ways to improve subsidiary performance, because the business still has potential to grow, (3) management has made the decision to maintain it or often referred to as "Special Favorite of Top Management"

6. CONCLUSION

This study aimed to develop insights and capability for parent company to realize corporate advantage by managing the integration of resource, business, and organization of its subsidiaries. Parent must realize it characteristic (PC) and ensure its opportunity (PO) before intervening the activities at subsidiaries. Therefore, parent must understand the CSF of its subsidiaries.

By grouping the fitness test among parent and its subsidiaries into five zones, parent get clear picture and idea how to manage its subsidiaries in such a way that all are creating value and prevent destroying value. Through perception analysis of DD and DA, parent acquire balance evaluation and enable value creation to all its subsidiaries simultaneously.

The findings further indicate that parent should first be wise and realize about its resources and capabilities

before influencing or intervening the way how subsidiaries operate their businesses.

7. LIMITATION AND FUTURE RESEARCH

Although this research provided some useful insights about handling the performance of parent company and its subsidiaries, there are still additional approach which can be carried out for the future studies. First, the scope of business in parent portfolio involves affiliate companies, where parent should be aware of its minor share and satisfaction of governance requirements. Second, one of the subsidiaries is already go public and other one has Government share. Handling such potential difference of perception is quite challenging and parent must play wise in selecting proper strategic choices. Third, the results of parenting fit assessment is align with policy for each zone to ensure optimization of strategy that parent can establish.

REFERENCES

1. Adams, G. L., & Lamont, B. T. (2003). Knowledge management systems and developing sustainable competitive advantage. Journal of Knowledge Management, 7(2), 142–154. https://doi.org/10.1108/13673270310477342
2. Adamsen, B., & Swailes, S. (2018). Managing talent: Understanding critical perspectives. In Managing Talent: Understanding Critical Perspectives. https://doi.org/10.1007/978-3-319-95201-7
3. Boynton, A. C., & Zmud, R. W. (1984). An assessment of critical success factors. Sloan Management Review, 25, 17–27.
4. Clemons, E. K. (2019). Resources, Platforms, and SCA: How to Win and Keep on Winning. New Patterns of Power and Profit, 93–104. https://doi.org/10.1007/978-3-030-00443-9
5. Collis, D. J., & Montgomery, C. A. (2008). Competing on resources. Harvard Business Review, 86(7–8). www.hbr.org
6. Cyriac, J., Koller, T., & Thomsen, J. (2012). Testing the limits of diversification. McKinsey Quarterly, February, 1–5.
7. Fahy, J. (2000). The resource-based view of the firm : some stumbling- blocks on the road to understanding sustainable competitive advantage. Journal of European Industrial Training, 24(2/3/4), 94–104. https://doi.org/https://doi.org/10.1108/03090590010321061
8. Gibson, C. B., Gibson, S. C., & Webster, Q. (2021). Expanding Our Resources: Including Community in the Resource-Based View of the Firm. Journal of Management, XX(X), 1–21. https://doi.org/10.1177/0149206320987289
9. Goold, M., Alexander, M., & Campbell, A. (1995). Parenting Advantage : The Key to Corporate-Level Strategy. Prisms 2, Exhibit 1, 23–33. http://www.adlittle.com/downloads/tx_adlprism/1995_q2_08-12.pdf
10. Goold, M., & Campbell, A. (2002). Parenting in complex structures. Long Range Planning, 35(3), 219–243. https://doi.org/10.1016/S0024-6301(02)00052-3
11. Goold, M., & Campbell, A. (2003). Making matrix structures work: Creating clarity on unit roles and responsibility. European Management Journal, 21(3), 351–363. https://doi.org/10.1016/S0263-2373(03)00048-3
12. Gupta, A. K., & Govindarajan, V. (2017). Converting global presence into global competitive advantage. International Human Resource Management: From Cross-Cultural Management to Managing a Diverse Workforce, 15(2), 431–444. https://doi.org/10.4324/9781315252025-30
13. Haseeb, M., Hussain, H. I., Kot, S., Androniceanu, A., & Jermsittiparsert, K. (2019). Role of social and technological challenges in achieving a sustainable competitive advantage and sustainable business performance. Sustainability (Switzerland), 11(14). https://doi.org/10.3390/su11143811
14. Jarillo, J. C. (1988). On strategic networks. Strategic Management Journal, 9(1), 31–41. https://doi.org/10.1002/smj.4250090104
15. Jay Barney. (1991). Firm Resources and SCA.
16. Kim, I., & Kim, H. (2021). An Empirical Study on the External Environment , Brand Expansion Strategy , and Core Competence of Business. Turkhish Journal of Computer and Mathematics Education, 12(10), 987–995.
17. Kruhler, M., Pidun, U., & Rubner, H. (2012). First, Do No Harm.
18. Leidecker, J. K., & Bruno, A. V. (1984). Identifying and using critical success factors. Long Range Planning, 17(1), 23–32. https://doi.org/10.1016/0024-6301(84)90163-8
19. Lippman, S. A., & Rumelt, R. P. (1982). Uncertain Imitability: An Analysis of Interfirm Differences in Efficiency under Competition. The Bell Journal of Economics, 13(2), 418. https://doi.org/10.2307/3003464
20. Mahdi, O. R., Nassar, I. A., & Almsafir, M. K. (2019). Knowledge management processes and sustainable competitive advantage: An empirical examination in private universities. Journal of Business Research, 94(May 2017), 320–334. https://doi.org/10.1016/j.jbusres.2018.02.013
21. Mauborgne, R., & Kim, W. C. (1999). Creating New Market Space. Harvard Business Review, 77(1), 83–93.
22. Moeuf, A., Lamouri, S., Pellerin, R., Tamayo-Giraldo, S., Tobon-Valencia, E., & Eburdy, R. (2020). Identification of critical success factors, risks and opportunities of Industry 4.0 in SMEs. International Journal of Production Research, 58(5), 1384–1400. https://doi.org/10.1080/00207543.2019.1636323
23. Mooney, A. (2007). Core Competence, Distinctive Competence, and Competitive Advantage: What Is the Difference? Journal of Education for Business,

83(2), 110–115. https://doi.org/10.3200/JOEB.83.2.110-115
24. Prahalad, C. K., & Hamel, G. (2009). The core competence of the corporation. Knowledge and Strategy, 41–60. https://doi.org/10.1016/b978-0-7506-7223-8.50003-4
25. Shvetsova, O. A. (2019). Core Competence Development while Carrying out Organizational Changes. World Academy of Science, Engineering and Technology International Journal of Economics and Management Engineering, 13(2), 85–92.
26. Silvestre, B. S., & Ţîrcă, D. M. (2019). Innovations for sustainable development: Moving toward a sustainable future. Journal of Cleaner Production, 208, 325–332. https://doi.org/10.1016/j.jclepro.2018.09.244
27. Tlanusta Garret, M., Borders, L. D., Cruchfield, L. B., Torres-Rivera, E., Brotherton, D., & Curtis, R. (2001). Do your really have a global strategy. Journal of Multicultural Counseling and Development, 29, 147–158.
28. Wernerfelt, B. (1984). A Rewsource-Based View of the Firm. Strategic Management Journal, John Wiley & Sons, 5(2), 171–180. http://links.jstor.org/sici?sici=0143-2095%28198404%2F06%295%3A2%3C171%3AARVOTF%3E2.0.CO%3B2-L
29. Yang, M., Wang, J., & Yang, J. (2021). Boundary-spanning search, knowledge integration capability and sustainable competitive advantage. Baltic Journal of Management, ahead-of-p(ahead-of-print). https://doi.org/10.1108/BJM-08-2020-0314
30. Yu, C., Zhang, Z., Lin, C., & Wu, Y. J. (2017). Knowledge creation process and sustainable competitive advantage: The role of technological innovation capabilities. Sustainability (Switzerland), 9(12). https://doi.org/10.3390/su9122280

Quality Concerns in Higher Education with Reference to State Private Universities in Rajasthan, India

[1] J. Ernest Samuel Ratnakumar,[2] Prof. J V Desai
[1][2] Research Scholar, MVN University, Palwal, Haryana.

Abstract
In the case of higher education, quality assessment technique is one of the main themes that need to be assessed by a university for enhancing competitive advantages. Higher education needs to consist of a high range of integrity for attracting students in their direction. *Rajasthan* is one of the popular states in India which consists of the highest number of universities. Quality concerns in higher education are directly divided into some sections that *include a range of technical integrity.* This study includes a statewide analysis of the quality education for proceeding with the best outcome, Apart from that, quality management for the research has also been described in this context for proceeding with the best result. The growth of private universities has also been observed frequently in *Rajasthan* in a qualitative manner. *GER or the gross enrollment* ratio is also included in this context for quality assessment programs.
Section of UGC pertaining to the *issue involved* in quality education has been described in this article for enhancing integrity. Accreditation of the private universities in *Rajasthan* has also been described in this context for proceeding with the best outcome. *The national and international ranking* of the private universities has been compared and contrasted under this article for measuring the quality assessment program. The key message for this article is about *increasing the number of* higher education in *Rajasthan* as well as in India for managing the current employment ratio. The article has managed data according to *2022* for understanding the current status of the quality of higher education in *Rajasthan.*

Keywords
Quality concern, Higher education, Private universities, Gross enrolment ratio, UGC, national and international ranking.

Introduction

Quality concern in higher education is directly dependent on the thinking and the learning perspectives for ***quality assessment*** for managing the best outcome. The role of UGC is also the topmost priority which needs to be managed as per the level of quality assessment in private universities. ***Inspection details and the role of the expert committee*** is another recommendation that decides the role of the quality check in a university. ***Complaints of submission*** as well as ***acceptance of complaints*** decide the quality assessment program of a university. Private universities of ***Rajasthan*** indicate that the quality concern program has been maintained by ***NAAC status of accreditation.*** The status of ***NAAC accreditation*** is directly dependent on the education environment of a university. Not only the ***Rajasthan*** but there are also some other universities that are investigated to construct a friendly learning environment that is beneficial for quality learning. Some universities of ***Rajasthan*** are ***Amity University, Manipal universities*** that have managed themselves according to the ***terms and recommendations*** of ***NAAC*** which need to be understood for proceeding with the quality construction of the article.

Higher Education in Rajasthan

In recent times, investment in higher education is considered to be one of the main themes that need to be managed to an ample extent. ***Public interest*** is rising that resulting in the enhancement of the working ability in higher education. As per the view of Sahoo and Chakraborty (2018), the ***scientific manpower committee*** has invested a lot for this purpose for proceeding with ***expansion and quality improvement.*** On the contrary, Jain and Jain (2019), describes that the construction of multifarious generation in the commission is one of the main themes in this scenario.
Gaining social mobility needs to be managed in the case of higher education for a good outcome. If a new student observes that the outcome of higher education is satisfactory then the student will move for more. Department of college education in ***Rajasthan*** has been enhanced in recent times but there is the inclusion of the private universities that have been observed throughout the study. Assessment of social farming is also related to the education system because, in the case of the lower levels of education, people tend to go into the field for cultivation (Nama and Choudhary, 2020). Apart from that, ***40 colleges*** were established to an extent for enhancing quality improvement programs in this study.
Management of existing government colleges in ***Rajsthan*** has focused on enhancing technical education which is one of the main themes in this scenario. One of the best examples for the technical universities are the ***2021 educational year*** shows the establishment of ***MBM (Master of Business Management) universities*** which is situated in ***Jodhpur.*** This city is observed to deliver the ***best education*** that is needed for reinforcing the employment status to an ample extent.

Growth of Private Universities

The growth of ***GDP*** and the current enhancement of technical education are observed to be the best in this scenario. Secondary and tertiary investment in the growth of education is facing a wide range of capital generation by which integrity is enhancing exponentially. ***Rajasthan*** has made a state-wide expenditure for increasing economic growth in the long run. Details of the complaint submission in the ***private universities*** of ***Rajasthan*** are***72.22%*** under the ***UGC act.*** There are ***52 universities*** in the ***Rajasthan*** that consists of both section A and section B. In the case of ***section, A,*** there are ***3 universities*** in ***Rajasthan.*** Out of that ***49 universities*** are excluded from ***Section 12 (B).*** According to the existing UGC Regulations 2019, it is necessary to have a PhD is must, for the appointment as Asst Professor. It will now be given effect only from 01st July 2023 in view of the Covid Pandemic. The Central Government of India, has accordingly given directions.

As per the documentation of ***2017,*** there are seven ***deemed universities*** in Rajasthan are as follows:

Name of deemed universities	**Place**	**Description**
Birla institute of technology and sciences	Pilani	Higher education of these universities offers engineering and sciences to an ample extent.
IIS University	Jaipur	This university is considered to be one of the best universities in the Rajasthan that conferred deemed status in the year ***2009.***
Jain VishvaBharati University	Ladnun	This university is ***A graded*** and ***affiliated by NAAC, AICTE, BCI and MHRD.***
JanardanRai Nagar Rajasthan VidyapeethUniversity	Udaipur	This university is also a deemed university that is affiliated with ***CCH, NAAC, NCTE and BCI.*** It is one of the oldest universities in the Rajasthan and has made the status of deemed universities in the year ***1987.***
LNM Institute of Information Technology	Jaipur	This university is the technological university of higher learning and provides a venture of the partnership between ***LNM foundation and the Government of Rajasthan.***
Institute of Advanced Studies in Education	Sardarshahar	This university is accredited as a ***B+ institute*** by ***NAAC.*** It is located in the ***Churu district of Rajasthan.***
BanasthaliVidyapith	Vanasthali	These universities are located in the ***Tonk district of Rajasthan*** and are considered to be deemed universities that provide ***secondary, a senior secondary level of education.*** The level of postgraduate has also been given by this university.

Table 1: Deemed universities in Rajasthan

Issues involved in Quality Higher Education

Education at university relies on quality than that of the education environment. The government of ***Rajasthan*** has focused deeply on the ***4 areas*** of an education ***facility, quality, delivery and employability.*** Innovation and skill development are still at the probationary level is the main problem in the educational framework in ***Rajasthan.*** According to the ideas of Kandpal *et al.* (2019), improvement of the online counselling website is the main theme that needs to be incorporated under the education system in Rajasthan for proceeding with the best result. As the counselling

website is beneficial then it can be said that the ***acquisition of students*** will be pure and more specific. ***The directorate of the secondary education of Rajasthan*** indicated that the problem is arising due to ***improper funding.*** In the case of ***remote areas, security-related issues*** are main that needs to be managed by the ***Government of Rajasthan.*** Development of the security websites is also main in this context that needs to bet met which is regarding the ***slow opening of websites.*** A website named ***'rajeducon.com'*** is considered to be one of the main websites that are linked with the development program of higher education. Exhaustion of the resource provided by the ***host*** is facing some complaints pertaining to the entry in the server.

There are ***26 universities*** that submitted complaints regarding the problem related to the server. Apart from that, a ***decline of humanities and foundational skill gaps*** are principal problems related to the quality of higher education. Division of faculty's staff and unevenly distributed operations are also current issues regarding the problems related to education. ***NAAC accreditation status*** of multiple universities indicates that the ***number of male and female*** teachers is also an important aspect for deciding the potentiality of education. The increase of the enrolment status is ***5.26 %*** but the growth rate failed from ***7.18% to 5.26%*** in the financial year of ***2021*** (Khan, 2022). ***Enrolment*** status in higher education in ***Rajasthan*** is high but the ***growth rate*** becomes reduced at the time of the ***2020-2021 educational years.***

Quality Management parameters for the Research

There are six quality assessment parameters that need to be covered for establishing integrity in the education system. These are as follows:

1) Educational content

Relevant teaching and learning material need to be assessed in this context which focuses on the ***basic literacy level*** and ***emphasizes sufficient numeracy skills.*** Maintenance curriculum also needs to meet that focuses on ***natural and international issues.*** Workplace conflict, gender equity knowledge need to be assessed to an ample extent.

2) Teacher and teaching method

Point of view of the teachers needs to be assessed ***based on the quality of education.*** As per the ideas of Bi *et al.* (2019), a traditional method of teaching need to be properly assessed in this scenario for the best result. It can provide the best result because it conveys in-depth knowledge related to a subject. Contrarily, the views of Subia (2018), shows that the collaborative model of the teacher is best fitted in this scenario. Students can only get succeed when the teacher motivated them by collaborative learning.

3) Learning environment

It is another important parameter that needs to be incorporated for proceeding with a proper learning outcome. Stereotyping is required to be avoided in this scenario for establishing integrity in the education system. Apart from that, the ***learning environment*** also needs to be equal for ***people with disabilities*** (Rodrigues *et al.* 2020). Many private universities of ***Rajasthan*** are trying to fix the problem related to the enhancement of the learning environment for the ***SEDB children.***

4) University management

This is another quality assessment parameters that need to meet the guidelines the of the higher education construction (Norad, 2022). Equalities and respect between the principal and other assistant professors are the first and foremost crucial priorities that need to be addressed for understanding the management capacities of the universities.

5) Funding and organization

These are two important requisites for making all of the six key elements in this scenario. Funding is the national responsibility for an education that is beneficial in the case of higher education. Periodically constructed self-studies are crucial in this context which needs to meet.

6) Precondition for pupils

Experiences of the students need to be judged under the higher education system for addressing special challenges faced by them. Language efficiency and differentiation between own and university environment need to be addressed.

7) Curricular Aspects

Quality of an educational institution can be measured in terms of extracurricular activities organised along with learning practices. As opined by Geetanjali (2019), curricular aspects associated with an educational organisation help to motivate students and make the overall learning environment flexible.

8) Innovative practices

It is an important parameter for any higher level educational institutions to improve the expertise level of students. In accordance with Iyer (2018), quality innovation in education sector leads to improve the overall cognitive status of students. It is also coupled with developing research capacity of students along with upgrading their entrepreneurship skills.

9) Advanced infrastructure and learning resources

Infrastructural development leads to improvising academic resources for students to ensure overall quality enhancement. As stated by Naveed *et al.* (2020), infrastructural development includes technological improvement, providing better opportunity for interaction, technical support to students and maintaining ethical issues around educational environment.

10) Research facilities

Higher learning opportunities are beneficial to improve research capabilities of students associated with an educational organization. According to Jange (2022), facilities regarding research projects, internship and practical based master degree educational programme are beneficial for ensuring innovative research activities by students associated with higher studies. Inception of ***"Research Support Unit"*** is significant in this regard in case of higher education institutions.

Section 10B UGC Grant

Under section 10B ***UGC grant,*** universities have got ***statutory right*** for imparting education and award qualification in call courses of education. The ***Authority of law*** is recognized for all intents and purposes. Under this section, ***Mehrotra committee on teacher recruitment*** examinesthe structure of the education regarding the service of university ***and college teachers.*** Central assistance of the

teacher education is another important aspect which is included for this purpose. Under this act, ***financial assistance*** can be received by the students who are pursuing a ***PhD*** in any subject. It can be understood from the current studies that all of the private universities have followed the norms of the universities in this context.

Accreditations of private universities in Rajasthan

As per the recommendation of the ***National Assessment and Accreditation council***, quality education of India, as well as Rajasthan, has been maintained in all fields of research especially ***engineering, social sciences and management*** (Singh *et al.* 2021)***.*** ***The*** Council of the NAAC has given ***scores out of 4 and grades*** have also been calculated by them according to the score (NAAC, 2022). A list can be prepared as per the guidelines. The guidelines by NAAC and accreditation are as follows:

Name of the university	NAAC grade	NAAC score	Type
Birla Institute of Technology and sciences	A	3.45	Deemed
Suresh Gain Vihar University	A	3.01	**State private**
Amity University of Rajasthan	B++	2.77	**State private**
Jain Vishva Bharati Institute	B+	2.73	Deemed
Jayoti VidyapithWomen University	B+	2.63	State private
NIMS University	B+	2.54	State private

Table 2: Accreditations of private universities in Rajasthan

(Source: NAAC, 2022)

Apart from the table, ***Jaipur National University*** is one of the principal universities in the ***Rajasthan*** which is accounted for the first university accredited for the ***comprehensive education.*** It has earned value after ***seven years of its establishment.*** Members of the association of the Indian universities are international tie-ups accredited by the ***American University of Accreditation council*** in this context (Ghatole and Dahikar, 2021). Therefore, the grade of the ***Universities*** is well reputed for proceeding with a quality higher education system.

National rankings and the Role of private universities in Rajasthan

NIRF ranking is one of the key decision criteria for taking admission in any institute. The national ranking system has the ability to help students and improve their ranking for proceeding with the best outcome. ***NIRF ranking*** is focused on the quantitative ranking ***whether NIRF*** is focused on the ***quantitative methodologies*** in this scenario (NK *et al.* 2018). The benefit of the student in the smaller class size is considered to be an important aspect that is more focused pertaining to the devoted curriculum (Selvanathan *et al.* 2019). ***Banasthali Vidyapeeth of Rajasthan*** has taken some persuasive in this scenario which is supported by the own ***endowment funds*** and student tuition fees. Flexibility in the learning is beneficial in the case of private universities that run for not only provide benefit to the graduate but also they pay their loan at a faster rate.

NIRF ranking of the private university indicates that ***Sir Padmapat Singhania University*** has ranked ***95*** by scoring ***48.20*** in the educational year of ***2016.*** The latest data of ***2021*** indicate that ***Rajasthan*** has the highest number of ***universities*** but none of the state government universities has acquired rank in between the ***top 100 as per the ranking*** of ***NIRF*** (TNN, 2022)***.*** Fresh investment has been done in the educational year of ***2021*** and ***113 new colleges*** have opened in this context. The ranking of universities are as follows:

Institute	Ranks
BITS, Pilani	29
Banasthali Vidyapith	66
MNIT, Jaipur	72

Table 3: Ranking of universities in Rajasthan, 2021

(Source: TNN, 2022)

International Rankings and Role of Private Universities in Rajasthan

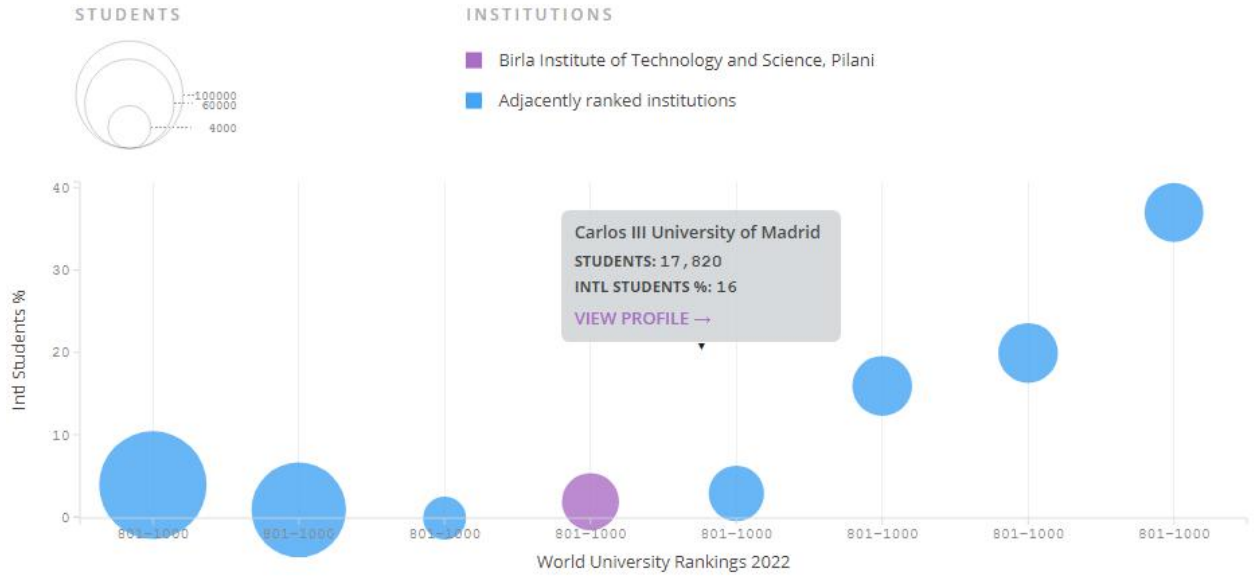


Figure 1: International rank of BITS, Rajasthan
(Source: The World University Rankings, 2022)

BITS' rank is found as 801-1000 among the international educational institutions **(**The World University Rankings, 2022). Whereas, as per QS world ranking; BITS ranks as 1001-1200 in 2022 (QS World University Rankings, 2022).

According to the university ranking of ***2021,*** there are 71 recognized private universities in Rajasthan which is popular for providing quality in higher education. Economic impact regarding higher education is considered to be one of the important concerns for making a good rank. As per the current ranking of universities, the ***Birla Institute of Technology and Sciences*** is the number one university in this state. From another perspective, the ***University of Rajasthan*** has a national rank of ***50*** and a ***world rank*** of ***1759.*** A regulatory body for the private universities becomes mooted by the ***state of higher education of Rajasthan.*** This regulatory body is observed to regulate the ***PhD, duration and teaching staff*** to form a cell for making a safe ground of interest. Considerable student activities become observed for this purpose which is the main theme for enhancing ***quality concerns of a university.*** An intense process of collaboration has been taken into consideration to measure the role of the private universities in ***Rajasthan.***

Curriculum development and work on the pedagogy is the principal part of the development of quality teaching. ***BITS*** strategic plan with a vision of 2020 has given birth to administration and campus life. A quality campus life can change the future perspective of an individual in the direction of success. Funding and the incorporation of the western culture is another aspect that is observed to be beneficial in this scenario. The quality concern of a university is dependent on the infrastructural framework of the University for proceeding with the best outcome. The top-ranked University of Rajasthan ***Birla Institute of Technology and Science*** is observed to be ranked between ***801-1000th*** in world university rankings 2022 (TOI, 2022). The role of these universities is observed to be abundant in enhancing the attraction of participants all over the world.

BITS Pilani - Model for obtaining Institution of Eminence

Institutes of Eminence or ***IOE*** are considered to be a scheme of recognition for higher education institutes in India. As per the ***University Grant Commission, 2017,*** higher education institute in India encompasses ***twenty institutions all over,*** of which 11 of them is only selected for ***institutional eminence.*** There are multiple benefits of institutional eminence because they are free to design a transparent merit-based system for this purpose. Apart from that, foreign students can also get admitted under this model (IT, 2022). ***BITS Pilani*** has been considered being ranked high with both ***Governmental and private*** ranking agencies for the innovative process of development. Under the model of ***BITS Pilani,*** continuous development for enhancing the quality concern is another important aspect that is needed for ***managing student cohort.*** A cohort of students and managing pedagogical intervention is one of the important facets of this model that is helpful for e enhancing institutional ranking to an ample extent. ***"Managing intensive teaching workshop"*** is the pivotal part of this model that is needed for the continuous development of facilities, coupled with the cutting edge of the research (Krishnan and Deshpande, 2021). In order to do recognition of the high standard, this ***BITS Pilani*** has strived to uphold its quality, confirmed by the ***University grant commission.*** The creation of the teaching-learning centre has also been promoted under ***BITS Pilani,*** which is related to the actively seeking strategies. Culture and regency have been witnessed in ***Rajasthan*** that also boost the quality concern of higher education in this state. Benefits of this model become well established regarding academic and administrative autonomy. Research indicates that this ***university*** has complete ***administrative autonomy*** which provides freedom for entering into a framework for development.

The growth path and future quality Management in Higher Education

In recent times, quality management concerns in the higher universities need to work on the self-studies by following some important objectives. As per the views of Berková *et al.* (2019), higher education needs to be focused on ***practical preparations*** of ***future entrepreneurs*** regarding their engagement in higher education. Catering to the financial sector is another important facet for enhancing quality. On the contrary, Galiya *et al.* (2018), suggests that vocational training incorporation in the university is also beneficial for enhancing the quality of a university. The development of pedagogical mastery in ***future higher education*** can also enhance the role of the professor in shaping the future of students. Current investigation indicates that the ***expansion of educational institutions*** relies on the ***enhancement of gross enrollment ratio or GER*** for increasing organizational practices.

In Rajasthan, there are ***12 Government universities and 51 private,*** which offer various courses in higher education. ***Arts, science, commerce*** streams are incorporated with quality in the higher education system. It can be associated with ***informal Private-public partnership or PPP*** for the development of the infrastructure and other facilities to an ample extent. Rajasthan has strategically enhanced its engagement with the educational fairs and summits (DE, 2022). It has helped it to brief out agenda to establish integrity in the higher education system. Multifarious training and practices have been incorporated under these practices such as ***YES or Youth employability skills*** in this scenario. No additional cost becomes incorporated for this purpose for promoting entrepreneurship among youth. Many departments of universities in ***Rajasthan*** have signed again ***8 MoUs*** in the year 2022 to assure quality education and assess employee playability to an ample extent. ***Rajasthan skill and Livelihood Development Corporation*** is found to train different employee skills to an ample extent. Therefore, the growth path of future quality management in higher education has been enhanced by the multifarious initiatives for this purpose.

Conclusion

Lack of funds and lack of quality faculty members is one of the main themes which need to be incorporated for enhancing quality concerns in higher education. ***Rajasthan*** is a state which has a reputation regarding the quality concern of higher education to an ample extent. All segments of educational processes, such as ***management, organization and interpersonal relations*** are an important concern for providing the foundation for equity in society. Appropriate skill development and general parity need to be incorporated with both students and professors for enhancing the competitive advantages in higher education. As per the view of ***NAAC,*** internal quality assurance cells need to be well incorporated for proceeding with the best outcome.

REFERENCE

1. Berková, K., Krpálek, P. and Krelová, K.K., 2019. Future economic professionals: development of practical skills and competencies in higher education from the point of view of international employers. *Економічнийчасопис-XXI*, *176*(3-4), pp.91-98.
2. Bi, M., Zhao, Z., Yang, J. and Wang, Y., 2019.Comparison of case-based learning and traditional method in teaching postgraduate students of medical oncology. *Medical teacher*, *41*(10), pp.1124-1128.
3. DE, 2022 *Rajasthan: New face of Higher Education with Private-Public Partnership.* [Online]. Available at: https://digitallearning.eletsonline.com/2020/12/rajasthan-new-face-of-higher-education-with-private-public-partnership/ [Accessed on: 14 February, 2022]
4. Galiya, A., Malika, K., Kuanyshbek, A., Salima, S. and Gulmira, B., 2018.Managerial competence of future specialists of the education system (Preschool education and upbringing) and medicine in the comparative aspect. *Opción*, *34*(85), pp.44-62.
5. Geetanjali, J.V.R., 2019. Total Quality Management Practices in Autonomous and Non-Autonomous Colleges: A Study. *Journal of Educational Planning and Administration*, *33*(1), pp.19-31.
6. Ghatole, S.M. and Dahikar, P.B., 2021. NAAC Accreditation: A Quality Initiative Reform in Indian Higher Education. *The Research Journal (TRJ): A Unit of I2OR*, *7*(1), pp.42-47.
7. IT, 2022. *Institute of Eminence: BITS Pilani left out after government notifies status for 5 institutions.* [Online]. Available at: https://www.indiatoday.in/education-today/news/story/institute-of-eminence-tag-for-5-institutions-1295638-2018-07-25 [Accessed on: 14th February, 2022]
8. Iyer, V.G., 2018, February. Total Quality Management (TQM) or Continuous Improvement System (CIS) in Education Sector and Its Implementation Framework Towards Sustainable National Development. In *the Proceedings of the ASSEHR 2018 International Conference on Education Reforms and Management Science (ERMS2018) CD-ROM held at Wuhan, China during April* (pp. 22-23).
9. Jain, S. and Jain, R., 2019. Role of artificial intelligence in higher education—An empirical investigation. *IJRAR-International Journal of Research and Analytical Reviews*, *6*(2), pp.144-150.
10. Jange, S., 2022. NAAC Accreditation and Academic Libraries: Librarians' role beyond Librarianship. *Journal of Indian Library Association*, *57*(4), pp.12-23.
11. Kandpal, N., Singh, H.P. and Shekhawat, M.S., 2019. Application of web usage mining for administration and improvement of online counseling website. *Int J ApplEng Res*, *14*(7), pp.1431-1437.
12. Khan, S., 2022. *Rajasthan: Higher education enrolments rise but growth rate falls.* [Online]. Available at: https://timesofindia.indiatimes.com/city/jaipur/higher-edu-enrolments-rise-but-growth-rate-falls-study/articleshow/85442860.cms [Accessed on: 11 February, 2022]
13. Krishnan, A. and Deshpande, A., 2021.Disruptive Teaching Methodology for STEM Education.Journal of Engineering Education Transformations, 34(SP ICTIEE), pp.752-756.

14. NAAC, 2022. *ASSESSMENT & ACCREDITATION*. [Online]. Available at: http://naac.gov.in/index.php/en/assessment-accreditation#outcome [Accessed on: 11th February, 2022]
15. Nama, K.S. and Choudhary, K., 2020. Impact Assessment of Cattle Farming on Forest and Socio-Economic Status, Village Borabas, Mhtr, Kota (Rajasthan), p.1
16. Naveed, Q.N., Qureshi, M.R.N., Tairan, N., Mohammad, A., Shaikh, A., Alsayed, A.O., Shah, A. and Alotaibi, F.M., 2020. Evaluating critical success factors in implementing E-learning system using multi-criteria decision-making. *Plos one*, *15*(5), p.e0231465.
17. NK, S., Mathew K, S. and Cherukodan, S., 2018. Impact of scholarly output on university ranking. *Library Review*, *67*(3), pp.154-165.
18. Norad, 2022. *Key elements of quality: Six basic elements influence the quality of education.* [Online]. Available at: https://www.norad.no/en/front/thematic-areas/education/education-quality/six-key-elements-of-quality/ [Accessed on: 11 February, 2022]
19. QS World University Rankings, 2022. *Rankings.* [Online]. Available at: https://www.topuniversities.com/university-rankings/world-university-rankings/2022 [Accessed on: 15th February, 2022]
20. Rodrigues, e.g., Gontijo, c.m.m. And Drago, R., 2020. Teacher Training and Teaching Method for Deaf Children. *RevistaBrasileira de Educação Especial*, *26*, pp.143-158.
21. Sahoo, I. and Chakraborty, C., 2018. Trends in Public Expenditure on Higher Education: Evidence from Selected Indian States. *IUT-JARD (ISSN 2455–7846)*, p.28.
22. Selvanathan, M., Buga, M.M., Arumugam, T.H., Supramaniam, M. and Jayabalan, N., 2019.Determinants of job hopping factors among lecturers in private universities, Malaysia. *Utopía y Praxis Latinoamericana*, *24*(6), pp.234-242.
23. Singh, A.P., Yadav, S.P. and Tyagi, P., 2021. Performance assessment of higher educational institutions in India using data envelopment analysis and re-evaluation of NIRF Rankings. *International Journal of System Assurance Engineering and Management*, pp.1-12.
24. Subia, G.S., 2018. Think Like My Teacher (TLMT): A New Method in Assessing Millennial Learners. *International Journal of Arts, Humanities and Social Sciences*, *3*(1), pp.57-61.
25. The World University Rankings, 2022. *Birla Institute of Technology and Science, Pilani.* [Online]. Available at: https://www.timeshighereducation.com/world-university-rankings/birla-institute-technology-and-science-pilani [Accessed on: 14th February, 2022]
26. TNN, 2022 *Rajasthan institutes fail to make a mark in national ranking.* [Online]. Availabe at: https://timesofindia.indiatimes.com/city/jaipur/raj-institutes-fail-to-make-a-mark-in-national-rankings/articleshow/86081538.cms [Accessed on: 11th February, 2022]
27. TOI, 2022, *World University Ranking.* [Online]. Available at: https://www.timeshighereducation.com/student/best-universities/best-universities-india [Accessed on: 11th February, 2022]

IFERP International Conference
IFERP Explore
https://icstm.net/ | info@icstm.net

UPCOMING CONFERENCES

Technoarete® Group
Integrating Researchers to Incubate Innovation

SUPPORTED BY

ALL CONFERENCE ALERT
Academics conferences at a glance

ECA
Get World wide Engineering Conferences Update..

Conference Alerts
Global Academic Conferences

INTERNATIONAL CONFERENCE ALERTS

ISBN : 978-93-92105-49-4