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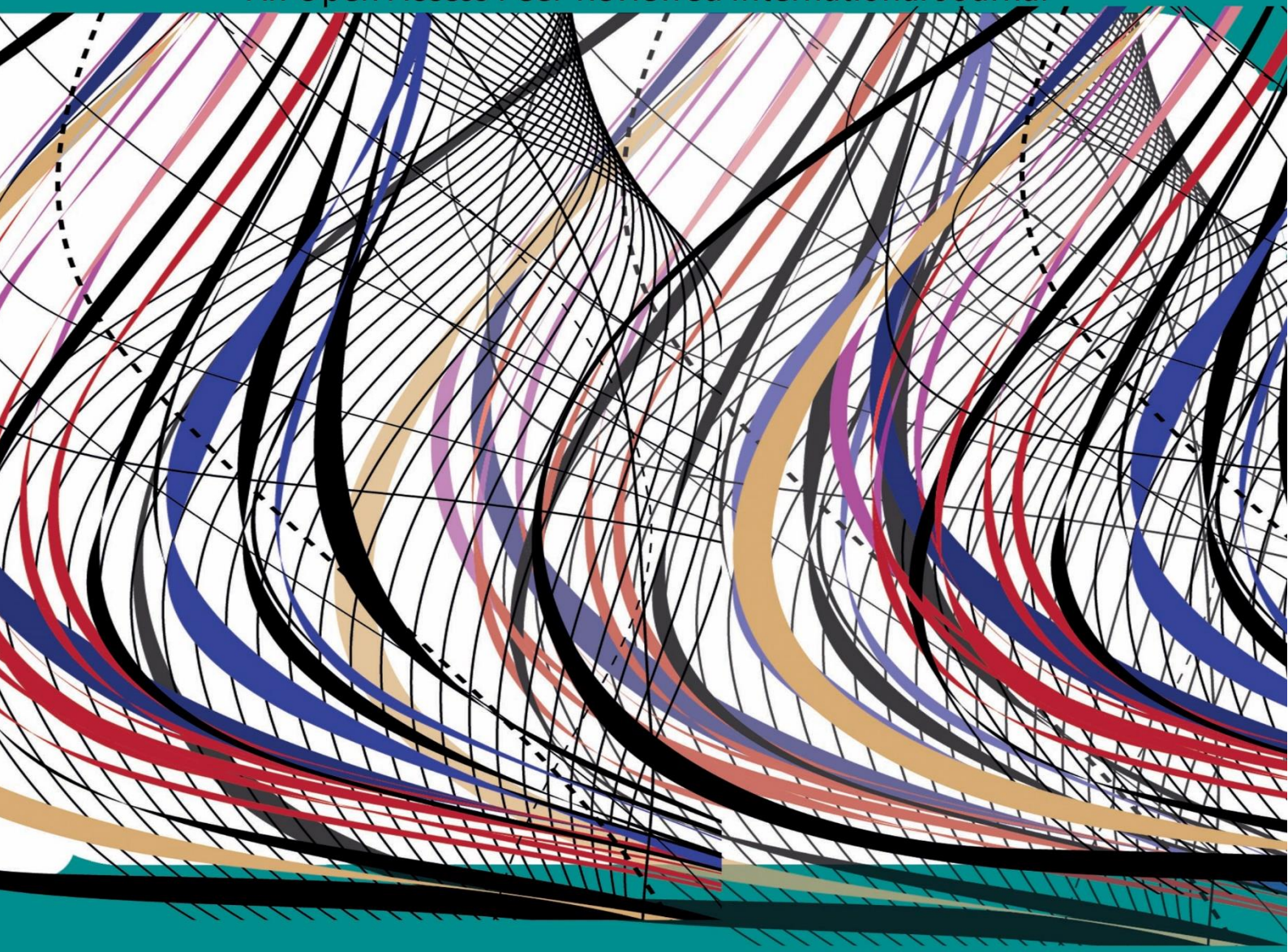

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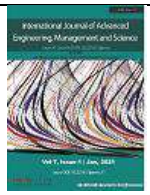

The Relevance of Monitoring Outstanding Audit Issues and Findings in the Development Bank of the Philippines

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Abstract— *This research described the relevance of monitoring outstanding audit issues and findings in the Development Bank of the Philippines. It identified several factors contributing to these issues based on responses from participants. First, the study revealed that the presence of dependencies with other units or external parties is the primary factor leading to unresolved audit issues. Second, change management and personnel issues were also found to be substantial contributors. Organizational culture, while noteworthy, ranked third among the factors. Interestingly, the research found that the current monitoring process using the audit management system is generally satisfactory, with an average rating of 8, indicating overall contentment among respondents. Finally, the study investigated effective mechanisms for tracking the progress of resolving audit findings. Periodic progress reports and updates emerged as the most favored approach, followed by escalation processes and automated notifications. These findings provide valuable insights into the factors contributing to unresolved audit issues and suggest practical strategies for improving the audit resolution process.*

Keywords— ***Automated Systems, Best Practices, Internal Controls, Monitoring Process, Outstanding Audit Findings***

I. INTRODUCTION

Every corporate activity includes monitoring as an essential component. Its role is to oversee and verify if operations align with established plans and if it is executed accurately. Monitoring should be done on a frequent basis so that whenever an issue arises, plans and decisions can be revisited, adjusted, and improved upon. An efficient monitoring system may aid organizations in achieving their goals and objectives by giving guidance, aiding in the creation of successful strategies, and improving performance, accountability, transparency, and quality reporting. Similar to internal auditing, which evaluates, improves, and maintains the effectiveness of the organization's risk management, control, and governance procedures in accordance with the Standards.

Internal Audit is a department or an organization within a company that provides unbiased, independent reviews of systems, business organizations, and processes (Clarke, 2022). In 1999, the Institute of Internal Auditors (IIA) propagated a new definition of internal auditing. The old definition underwent two significant changes, firstly, "the consulting activities as additional to existing assurance activities". Secondly, "additional scope of work" such as evaluating risk management and governance processes (IIA, 2017). Internal auditing became a major part of a company's success ensuring that the business and its stakeholders are protected by overseeing its internal control processes such as accounting and financial reporting. Alzeban, A., & Gwilliam, D. (2014) stated that improper internal audit implementation is what leads to failure in a business organization.

According to the Institute of Internal Auditors (2022), internal auditing is a global profession shared by a network of over 210,000+ professionals from more than 170 nations and territories worldwide. The Institute of Internal Auditors (IIA), a global professional association with headquarters in Lake Mary, Florida, USA, was founded in 1941 and serves as the internal audit profession's leading advocate, global voice, accepted authority, and acknowledged leader.

The Internal Audit in the Philippines is continuously evolving over the years (Carlos et al. 2019). The Internal Auditing Act of 1962, also known as Republic Act 3456, is the first piece of legislation that establishes internal audit in the Philippines. This serves as a fundamental reference for the laws, regulations, and other legal tools relating to government internal audits. In March 1989, Executive Order Number 119 was signed by the late President Corazon Aquino to strengthen the Internal Control System of government offices, agencies, government-owned controlled operations and local government units in their fiscal operations (Mallari et al. 2013). The Philippine government continuously builds the Internal Audit in the country to protect and improve the systems of both government and private organizations.

The Commission of Audit (COA) of the Philippines underwent two (2) transitions with the main goal of switching from the old auditing technique to a risk-based and process-focused technique. The two initiatives are (a) Improving the Philippine Commission on Audit's Public Accountability Program through the use of a Risk-Based Audit Handbook and Training supported by the United Nations Development Program; and (b) Audit Component of the World Bank-funded project Improving Accountability in Poor Local Government Units (Mendoza & Rosales, 2008).

According to the Development Bank of the Philippines (DBP) Internal Audit Charter (2022), the mission of an internal audit is to enhance and protect organizational value by providing risk-based objectives, assurance, advice, and insight. As per the Institute of the Internal Auditors' (IIA) International Standards for the Professional Practice of Internal Auditing (ISPPIA) specifically Standard 2500 which is the monitoring progress, to be able to achieve this mission, the internal audit process must create and maintain a system to track what happens to the results communicated to management.

This study focused on the following research objectives:

1. Determine the factors leading to unresolved audit findings
2. Describe the current method being used in the monitoring process
3. Identify challenges in monitoring outstanding audit issues/findings.
4. Describe the benefits of monitoring outstanding audit issues/findings.

II. METHODOLOGY

This study utilized a descriptive research design to describe (Subia, Mangiduyos & Turgano,2020) The Relevance of Monitoring Outstanding Audit Issues and Findings in the Development Bank of the Philippines". The researchers used purposive sampling based on their specific group and availability to take part in the study. The chosen sampling method is ideal to collect pertinent and accurate information from the respondents.

A total of 10 DBP-IAG senior officers served as respondents of the study to get a broad and balanced perspective in assessing the effectiveness of IAG's operation specifically in the monitoring as they were the subject matter expert of the study. They represent 25% of the DBP-IAG population of 40.

The following ethical guidelines were observed for the research period: 1. The researchers have the permission of the participants before conducting a survey, which involves them. 2. The research data remained strictly confidential throughout the study. 3. The researchers did not reveal the identity of the participants of the study and the dignity and wellbeing of the respondents were protected at all times.

III. RESULTS AND DISCUSSION

Table 1. Factors leading to unresolved audit findings.

Factors	Frequency	Percentage
Inadequate internal controls	3	10%
Lack of documentation	1	3.33%
Staffing and skill gaps	2	6.67%
Complexity of processes	1	3.33%

Changes in regulations or policies	0	0%
Change management/ personnel issues	6	20%
Ineffective communication	3	10%
Organizational culture	5	16.67%
With dependencies with other units/external parties	7	23.33%
Workload related issues	1	3.33%
Others, please specify: Inadequate risk assessment and management	1	3.33%
TOTAL	30	100%

Based on Table 1, respondents were asked to select at most three (3) among the ten (10) options given above. Seven (7) out of ten (10) respondents answered that the top factor leading to unresolved issues are those findings with dependencies with other units/external parties at 23.33% followed by change management/personnel issues at 20% and organizational culture at third place with 16.67%.

Table 2. Satisfaction rating in the current monitoring process using the audit management system.

0	1	2	3	4	5	6	7	8	9	10

The table shows that the respondents were satisfied with the current monitoring process using the audit management system with an average rating of 8. Four (4) out of ten (10) respondents were very satisfied by giving a perfect rating of 10 while the lowest rating received was 6.

Table 3. Methods in monitoring outstanding audit issues/findings.

Methods	**Frequency**	**Percentage**
Tracking in a centralized database or software	5	16.67%
Regular follow-up meetings with responsible parties	3	10%
Automated notifications and reminders	6	20%
Periodic progress reports and updates	9	30%
Escalation process for unresolved findings	7	23.33%
Others, please specify.	0	0%
TOTAL	30	100%

As shown in Table 3, the highest proportion of 30% of the data represents that the method of periodic progress reports and updates was the most effective mechanism to track the progress of resolving audit findings at regular intervals. Roughly 23.33% indicate the presence of an escalation process for unresolved findings and 20% for automated notifications and reminders.

Table 4. Challenges in the monitoring process.

Challenges	**Frequency**	**Percentage**
Resources constraints	2	7.41%
Complexity and volume of findings	5	18.52%
Prioritization of findings	3	11.11%
Lack of clarity in responsibilities	2	7.41%
Inadequate communication and coordination	4	14.81%

Lack of integration with systems	0	0%
Timely resolution and follow-up	8	29.63%
Lack of awareness regarding monitoring processes	1	3.70%
Others, please specify: ● Auditee's lack, disregard or untimely response to the follow-up notification ● Lack of clarity and responsibilities	2	7.41%
TOTAL	27	100%

The table provides insight into the challenges faced during the monitoring process of outstanding audit findings. Respondents were asked to choose at least three (3) among the choices, approximately 29.63% were attributed to timely resolution and follow-up, around 18.52% belonged to the complexity and volume of findings and inadequate communication and coordination with 14.81% were the most challenges in the monitoring process.

Table 5. Benefits of monitoring outstanding audit issues/findings

Benefits	**Frequency**	**Percentage**
Timely issue resolution	8	28.57%
Increased transparency and accountability	3	10.71%
Better decision-making based on insights	2	7.14%
Reduction in compliance/ financial risks	8	28.57%
Improved resource allocation	0	0%
Improved reputation and Stakeholder trust	1	3.57%
Better alignment with organizational goals	5	17.86%
Others, please specify: Facilitation of promotion of employees	1	3.57%
TOTAL	28	100%

Based on Table 5, an equal proportion of approximately 28.57% of benefits is attributed to the timely resolution of issues and reduction in compliance/financial risks and 17.86% in better alignment with organizational goals.

IV. CONCLUSIONS

1. The primary factor leading to unresolved issues in the audit process is the presence of dependencies with other units or external parties, as reported by 70% of the respondents.
2. Change management and personnel issues also significantly contribute to unresolved audit findings, with 20% of respondents highlighting this as a key factor.
3. Organizational culture plays a notable role in unresolved issues, though it ranks third among the factors, as reported by 16.67% of the respondents.
4. The current monitoring process using the audit management system is generally satisfactory, with an average rating of 8, indicating that most respondents are content with the system.
5. The most effective mechanism for tracking the progress of resolving audit findings at regular intervals is through periodic progress reports and updates, favored by 30% of the respondents, followed by escalation processes and automated notifications, each receiving approximately 23.33% and 20% of the responses, respectively.

V. RECOMMENDATIONS

1. Lessen the unresolved issues with dependencies to other business units or external parties by establishing clear communication channels, defined

responsibilities, and robust coordination mechanisms that can lower the number of unresolved issues and mitigate associated risks.

2. To address the issues on change management and personnel, it is recommended that the organization implements a robust change management strategy, emphasizing clear communication and support mechanisms, can help mitigate the impact of organizational changes on the number of unresolved audit issues. Regular evaluations and feedback mechanisms should be established to address personnel issues promptly and ensure a more effective resolution of audit findings.
3. Considering that organizational culture ranks third among the factors contributing to unresolved audit issues, it is recommended to conduct a comprehensive cultural assessment to identify specific aspects impacting the audit process. Implementing targeted initiatives to foster a culture of accountability, transparency, and collaboration can positively influence the resolution of audit issues. Regularly reviewing and adapting organizational policies to align with desired cultural values will further contribute to a more conducive environment for addressing and resolving outstanding audit findings.
4. The organization must continue to invest in and enhance the system. Regularly seek feedback from users to identify areas for improvement and incorporate technological advancements to ensure the sustained effectiveness and user satisfaction with the audit management system. Additionally, provide ongoing training and support for users can optimize their utilization of the system, fostering a more efficient and streamlined monitoring process for outstanding audit issues and findings.
5. Increase the frequency of automated follow-ups, transitioning to a more efficient monthly cycle to optimize resource allocation or dedicating a specific day each month to focus on updates concerning outstanding audit findings. As a regulatory compliance an improved structured and advanced monitoring activities benefited significantly contribute to preventing misappropriation, fraud and fraudulent behavior, reducing risks, and enhancing compliance culture.

This research has underscored the critical importance of monitoring outstanding audit issues and findings in the Development Bank of the Philippines (DBP). The findings reveal that a proactive and systematic approach to monitoring not only ensures the timely resolution of audit issues but significantly contributes to effective risk management, regulatory compliance, and overall governance.

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The Future of Microfinance Industry: Borrowers Facing Challenges Brought by the Technological Advancement

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Abstract *– This study examined the challenges encountered by microfinance borrowers as a result of technical advancements. Furthermore, their perspectives on the imminent future state of MFIs were also examined. The results indicated that the majority of borrowers are utilizing printed application forms to apply for loans from MFIs, which are then sent to the MFI offices. The primary issue faced by most borrowers is a lack of proficiency in digital literacy. The majority of individuals lack proficiency in navigating the websites and mobile applications of MFIs. This suggests that vulnerable populations, such as individuals residing in distant regions or those lacking internet access, face a potential danger of being excluded as a result of their limited digital literacy. The data indicate that borrowers anticipate a complete transition to online operations in microfinance institutions within a timeframe of less than five years. Borrowers anticipate that loan applications will be completed via the web pages or mobile applications of MFIs. Loans can be discharged and reimbursed via internet banking or alternative digital platforms like Gcash and Maya.*

***Keywords*— Borrowers, Challenges, Loans, Microfinance Institutions (MFIs), Technological Advancement**

I. INTRODUCTION

Microfinancing has played a crucial role in alleviating the lives of low-income individuals and small businesses in the Philippines. It has enabled them to start their businesses, provide for their families, and escape poverty. Microfinance, according to Armendariz and Morduch (2010), is the provision of modest loans and other financial services to low-income people who do not have access to standard banking services. Numerous studies have emphasized the benefits of microfinance in reducing poverty and empowering vulnerable groups. For instance, Kabeer (2001) contends that microfinance can increase household income and improve the standard of living for the poor by enabling them to start their businesses.

However, as the world rapidly embraces technological advancements, the microfinance industry finds itself at a critical juncture. The integration of technology has the potential to revolutionize the way MFIs operate, expanding outreach, improving efficiency, and enhancing financial inclusion. Nevertheless, this digital transformation also poses new challenges and risks for borrowers, necessitating a comprehensive analysis of the future of microfinance in the face of technological advancement.

The rise of technology in the financial sector has led to the emergence of innovative financial services such as mobile banking, digital payments, and online lending platforms. These technological advancements have offered new opportunities for MFIs to overcome traditional

barriers, such as geographical limitations, high transaction costs, and limited access to financial infrastructure. With digital financial services, MFIs can now reach remote areas, provide quicker and more convenient access to loans, and enhance transparency and accountability in financial transactions. As a result, the potential impact of technology on the microfinance industry is substantial, with the potential to reshape the dynamics of borrowing and lending.

However, alongside the promises of technological advancement, there are also concerns about the potential challenges faced by microfinance borrowers. The adoption of digital financial services introduces a new set of complexities that borrowers must navigate. These challenges include issues related to digital literacy, data privacy and security, over-indebtedness, exclusion of vulnerable populations, and the potential for a digital divide to widen socioeconomic disparities. Furthermore, the shift to automated decision-making processes, relying on algorithms and artificial intelligence, raises questions about the fairness and inclusivity of lending practices and the potential for discriminatory outcomes.

Due to these challenges, this study was conducted to know the borrowers' perspective on the future of microfinancing institutions. This also provided recommendations to the institutions relating to these challenges. Specifically, it aims to answer the following:

1. How may the profile of the borrowers be described in terms of age, gender, educational attainment, and ways to apply for a loan?
2. Describe the challenges brought by technological advancement that the borrowers are facing.
3. Describe the perceptions of the respondents on the near future situation of MFIs.
4. Provide recommendations to the MFIs to minimize risks from challenges faced by borrowers brought by technological advancement.

This study can be ultimately beneficial to the MFIs to innovate their products and services, as well as benefit the professors and students in business and finance. This could be a baseline research to further know how far MFIs can go into digital advancement without losing their borrowers' trust.

II. METHODOLOGY

This study utilized descriptive research to describe the challenges brought by technological advancements that microfinance faced as well as the perception of the respondents in the near future of MFIs. The researchers utilized a descriptive research method because it was used to obtain information concerning or describing the characteristics of the population or phenomenon that is being studied. This methodology focuses more on the "what" of the research subject rather than the "why" of the research subject (Manjunatha, N. 2019).

The purposively chosen respondents of the study are 100 borrowers of microfinance institutions around Nueva Ecija, Philippines (Salangsang & Subia, 2020). The purposive sampling technique was used. The purposive sampling technique, also called judgment sampling, is the deliberate choice of a participant due to the qualities the participant possesses. It is a nonrandom technique that does not need underlying theories or a set number of participants. Simply put, the researcher decides what needs to be known and sets out to find people who can and are willing to provide the information by virtue of knowledge or experience (Etikan, I., 2015).

This study used a set of questionnaires to gather data and it was distributed in person so the researchers can extract honest and reliable responses. Before they gave the survey, they discussed and explained the importance and objectives of the study.

After the data collection, the researchers analyzed the data using frequency counts, percentages, and mean.

III. RESULTS AND DISCUSSION

1. Profile of the Borrowers

Based on the findings gathered, the majority of the borrowers were at age below 25 years old, indicating that the majority of them are in their early working age.

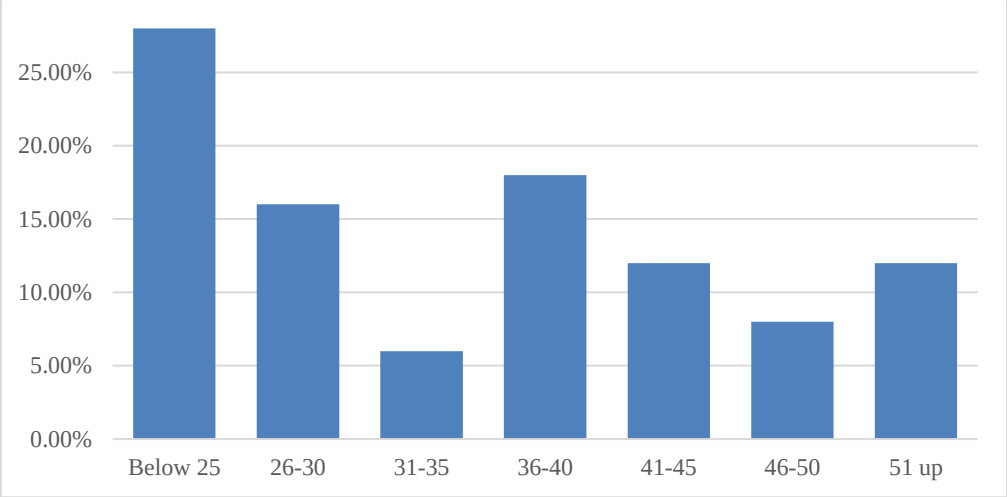

Fig.1. The Age Distribution of the Respondents

Most of them are female and the majority finished their secondary education. According to Khandker (2000), microfinance provides an alternative source of finance for the poor and women. Because they tend to have higher payback rates and use the loans for constructive reasons, studies show that women are more likely to benefit from microfinance programs (Mayoux, 2000). This is based on the assumption that female borrowers will use the loan funds to increase business income and thus improve household welfare (Rebecca N. Coke).

Table 1. The Gender Distribution of the Respondents

	f	*%*
Male	20	20%
Female	80	80%
Total	100	100%

Table 2. The Educational Attainment Distribution of the Respondents

	f	*%*
Elementary	24	24%
Secondary	60	60%
College	16	16%
Post Graduate	0	0%
Total	100	100%

Most of the borrowers (96%) are applying for loans to MFIs through printed application forms. Those forms are then submitted to the MFI offices.

The majority of them also have at least one online platform, such as Gcash and Maya.

2. Challenges Brought by Technological Advancement to the Borrowers

The major problem for the majority of borrowers is digital literacy. Most of them are not knowledgeable on how to navigate MFI websites and mobile applications. It implies that there is a risk of exclusion due to digital literacy to vulnerable populations, such as those living in remote areas or those who have no access to the internet.

Table 3. Digital Literacy Distribution of the Respondents

	f	*%*
Knowledgeable to navigate in online platforms	48	48%
Not knowledgeable about navigating online platforms	52	52%
Total	100	100%

Brought also by the lack of digital literacy is the compliance with KYC verification. The majority of the respondents are not knowledgeable on how to respond to KYC verifications through emails. They still prefer to complete it through phone calls.

Another challenge is data privacy and security. Some borrowers are concerned about how the MFIs will keep their personal data and if they can secure it from data breaches. According to Niranjanamurthy & Chahar (2013), security threats include unauthorized data access, use of software that traverses across the network, data theft, and theft of software via illegal copying from the company‘s servers. Data privacy and security concerns have led people to show reluctance so the regulatory authorities should put

in place strict regulations in order to ensure that no data security breaches will occur (Amin, 2022).

3. Perceptions of the borrowers on the near future situation of MFIs

The findings revealed that the borrowers expect that in less than five years all the processes of MFIs will be done online.

Loan applications are expected by the borrowers to be done through MFIs' web pages or mobile applications.

Release and repayment of loans can be done through online banking or other digital platforms such as Gcash and Maya.

Some government agencies are already using online platforms for loan applications, loan releases, and repayments, such as Social Security Services (SSS) and Home Development Mutual Fund (HDMF).

IV. CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on the findings provided, the following conclusions were drawn:

1. A significant challenge for borrowers is their limited digital literacy. As 96% of borrowers apply for loans through printed application forms and face difficulties navigating MFIs' websites and mobile applications, it is clear that a lack of digital skills is a major obstacle.

2. Borrowers express concerns about the security and privacy of their personal data when interacting with MFIs online.

3. Borrowers' expectations for the near future indicate a strong belief in the digitalization of MFI processes. The majority of borrowers anticipate that within less than five years, all MFI transactions, including loan applications, disbursements, and repayments, will be conducted online.

Recommendations

Below are some of the recommendations of the researchers to the MFIs:

1. To address the issue of digital literacy, MFIs should consider investing in educational programs and training initiatives. These programs can empower borrowers with the knowledge and skills needed to navigate digital platforms, ensuring that they can fully participate in the digital transformation. MFIs can collaborate with community organizations and NGOs and provide digital literacy training within local communities.
2. Aside from conducting training, the MFIs should offer user-friendly interfaces and customer support to assist those who are less digitally proficient. Providing clear instructions and step-by-step guidance can enhance the borrower's experience and increase their confidence in using digital tools.
3. MFIs should show that they invest in good infrastructure. A well-designed infrastructure includes both hardware and software components, as well as policies and practices, that collectively safeguard data from unauthorized access, breaches, and other security risks.

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Challenging the Market: The Future of Hybrid Gasoline-Electric Vehicles in Nueva Ecija

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Abstract**—** *This descriptive research investigated the future of Hybrid Gasoline-Electric vehicles in the province of Nueva Ecija through awareness and buying motivations for the product. The research identified the level of perception of the prospective car buyers and their respective buying considerations in getting Hybrid Gasoline-Electric vehicles. The study employs a mixed-methods approach, including a survey and internet searches on several studies of Hybrid vehicles and several online platforms. The data revealed that there is no significant disparity between knowledgeable buyers and those who are oblivious to Hybrid Gasoline-Electric automobiles. The study also found that when purchasing a Hybrid Gasoline-Electric vehicle, there are important factors to consider regarding the product itself. However, these considerations are not adequately emphasized due to a lack of reliable information from the manufacturer. As a result, many customers rely on information provided by sales representatives and the Internet. Moreover, the study revealed some factors and advantages of the product that receive less emphasis in marketing but can significantly influence the purchasing decisions of purchasers in this particular vehicle class. The study recommends that automakers and their sales representatives focus on the most crucial quality aspects and allocate resources towards customer education and communication. This would help establish trust in the product and foster brand loyalty among customers in Nueva Ecija.*

Keywords**— Buying Considerations, Critical Product Attributes, Gasoline-Electric Vehicles, Hybrid, Market**

I. INTRODUCTION

The constant rise in global temperature may lead to a drastic and catastrophic climate change. This may harm the global environment and all the living things on earth.

The constant rise in global temperature may lead to a drastic and catastrophic climate change. This may harm the global environment and all the living things on earth.

This event calls for global action of every nation, which led the way to the creation of the Paris Agreement last December 12, 2015, in Paris, France. The agreement is to "legally binding international treaty on climate change" and is adopted by 196 nations including the Philippines.

According to UNFCC, the Paris Agreement's overarching goal is to hold "the increase in the average global temperature to a well below 2℃ above per industrial levels and pursue efforts “to limit the temperature increase to 1.5℃ above per industrial level.

Global warming is the slow increase in the average temperature of the earth's atmosphere because an increased amount of energy(heat) striking the earth from the sun is being trapped by the earth's atmosphere and not radiated out

into space.

Transportation is an essential activity that provides access to services and activities such as education, employment, shopping and social events. However, the transportation sector is one of the main contributors to carbon emissions.

According to the recent publication of Statista Research Department, in 2021 the greenhouse gas emissions coming from the transport sector in the Philippines will amount to 31.54 million tons of Carbon Dioxide equivalent. This reflects a 12 percent increase from the previous year's total emissions.

Several car manufacturers have introduced a sustainable mode of transportation through the use of hybrid vehicles.

Hybrid cars entered the Philippine automotive market way back in 2000 when Toyota first introduced the iconic Toyota Prius.

According to the report of CNN Philippines published last June 2019, Toyota only sold 300 units of this model. These low sales are attributed to the high cost of the units which amounts to P2.3 million pesos, which is enough to purchase two passenger non-hybrid cars.

However, the company's optimism was not cut in changing its goal of expanding the hybrid car market in the Philippines. Toyota continues to introduce several new hybrid models such as the Corolla, Cross, Camry, and RAV4 hybrid variants.

However, according to the latest publication of Moneymax dated August 2022, still the Philippine market is too conservative in choosing hybrid vehicles and this segment was not popular in the market even though they were introduced a decade past.

Some of the reasons for not getting a hybrid according to their study are:

1. More expensive upfront
2. Poor in handling
3. High voltage battery.

This factor contributes to the struggles of the Hybrid cars in surviving the market.

With this, the researchers decided to study the possibility of the hybrid cars in surviving the current market, particularly in the province of Nueva Ecija by identifying several factors of reasonable opportunities and challenges it may encounter. The researchers also believe that the timing of the study is right since heavy inflation is hitting the Philippine economy and significant rise in the price of fuel in the country due to the effect of the current war by Russia and Ukraine.

II. METHODOLOGY

This research utilized a descriptive and quantitative approach. A survey questionnaire will be administered to a sample of residents in Nueva Ecija to collect data on their buying considerations and perceptions towards Hybrid Gasoline-Electric vehicles.

Sampling Procedure. The instrument of data collection is in the form of survey questionnaires that were distributed using Google Forms. The distribution was personally done by the researcher to ensure the confidentiality of the information gathered and to assist the participants if they have queries about the questionnaire.

The sampling technique to be used in this study is a simple random technique. The researcher chose this technique to have a general overview of the population.

Respondent. The researcher aims to reach the customers within Nueva Ecija to grasp the actual insights regarding their consideration if choosing Hybrid Gasoline-Electric vehicles.

A total of **70 respondents** answered the questionnaire sent by the researchers through Google Forms.

III. RESULTS AND DISCUSSION

1. Level of Awareness of the Respondent about the Hybrid Gasoline-Electric Vehicle

Table 1. Awareness of Hybrid Gasoline-Electric Vehicles

Level	Frequency	Percent
Fully Aware	11	15.71
Aware	25	35.71
Somehow Aware	19	27.14
No Idea	15	21.43
Total	70	100.00

The data shows the percentage of respondents with their corresponding level of awareness about the Hybrid Gasoline-Electric vehicles. The data shows that 36% or 25 respondents are aware of this type of vehicle model while 21% or 15 respondents rate themselves as unaware of the product. Cambridge Dictionary defines product awareness as knowledge about the particular products a company may offer, especially compared to those offered by the competitor. Based on the blog of Wargrove, A. (2020), brand awareness (which includes product awareness) is the first step to driving performance-marketing goals. It makes

people more aware of the brand or the product, especially when targeting relevant high-quality audiences and increases your chance of generating conversions and dominating your market.

To grasp the current situation, the researcher also looks at the source of information of the respondents about the Hybrid Gasoline-Electric vehicles.

2. Source of Information

Table 2. Source of Information

Source of Information	Frequency	Rank
Word-of-Mouth	16	3
Dealer Personnel	25	1
Manufacturer or Dealership Ads	11	5
Broadcast Media, TV & Radio	13	4
Social Media & Online Advertisement	18	2

As shown in the table, most of the information about the Hybrid Gasoline-Electric vehicle is coming from the Dealer Personnel, primarily the sales frontlines and is ranked 1. It is followed by social media and Online advertisement while the lowest source of information is the advertisement initiated by the manufacturer or dealership. According to the Journal of Live Agent (2022), the importance of the sales front line as the initial source of product information is great because the sales front line is often the first and main contact between the customer and the brand. It has a huge impact on customer's decisions as well as satisfaction with the contact brand.

Furthermore, according to Hausman, A. (2022), that the automotive industry must up its game regarding digital marketing. Based on his journal, the fact that the most prospective vehicle car buyer nowadays spends more time searching the internet, searching inventory and even arranging a test drive argues strongly that the automotive business must recognize digital marketing. Manufacturers-initiated advertisement greatly helps to reach a larger market as compared to the front lines. It also provides the reliability of the product whenever it reaches their prospective buyer.

3. Level of Respondents' Perception when Choosing Hybrid Gasoline Electric Vehicle

Table 3. Respondents' Perception of Choosing Hybrid Gasoline-Electric Vehicle

QUESTION	4f	w	3f	w	2f	w	1f	w	Total f	Total w	WM	Verbal Interpretation
Product QDR	34	136	30	90	6	12	0	0	70	238	3.40	Highly Considered
Price	45	180	18	54	7	14	0	0	70	248	3.54	Significant Highly Considered
Marketing & Promotion	25	100	32	96	12	24	1	1	70	221	3.16	Highly Considered
Unit Availability	48	192	16	48	5	10	1	1	70	251	3.59	Significant Highly Considered
After Sales Services	55	220	12	36	3	6	0	0	70	262	3.74	Significant Highly Considered
Legal Considerations	36	144	25	75	7	14	2	2	70	235	3.36	Highly Considered
GRAND WEIGHTED MEAN											3.46	*Highly Considered*

Data shows the respondent's perception when choosing a Hybrid Gasoline-Electric vehicle. Data shows that After-Sales Services with a 3.74 rating, followed by Unit Availability and Price with 3.59 and 3.54 ratings respectively are the highest aspects when considering this vehicle segment.

Several studies have said that the after-sales cost of owning a hybrid gasoline-electric vehicle is somehow low since it doesn't need to burn more fuel every time. According to Automart. ph (2021), even though a Hybrid vehicle is expensive to buy, it offers huge savings for those who find themselves in a stop-and-go traffic situation. Keeping regular car inspections & checking minor details on the engine, routinely changing basic fluids, observing regular maintenance, and using appropriate viscosity of oil, may prolong vehicle deterioration when having a hybrid vehicle.

Hybrid Gasoline-Electric vehicles are most likely expensive to buy compared to conventional ones. This is due to the complex nature of the powertrain of Hybrid vehicles, aside from the fact that it is equipped with several advanced technology features. Nowadays, several brands offer low-cost Hybrid models in the Philippines. According to Deri Quito, J. (2023, April 11), one of the most affordable Hybrid Gasoline-Electric vehicles in the Philippine market is the Toyota Corolla Altis which is valued from P 1,054,000 to P 1,610,00. In another journal published by Honda, Hybrid vehicles hold their value once they leave the dealership. One study by ACS, published that supply chain weaknesses were brought about by the Covid-19 pandemic, especially in the industries that relied on electronics, as the flow of raw material slowed or sometimes stopped. The batteries in

Hybrid vehicles require rare metals that depending on the supplies, can have volatile and unpredictable prices. This is one of the reasons that hampers the mass production of Hybrid vehicles by the manufacturers which in turn limits the availability of the unit.

4. Level of Respondents' Tangible Consideration when Choosing Hybrid Gasoline-Electric Vehicle

Table 4. Respondents' Tangible Consideration on Choosing Hybrid Gasoline Electric-Vehicle

QUESTION	4f	w	3f	w	2f	w	1f	w	Total f	Total w	WM	Verbal Interpretation
Vehicle Designs and Aesthetics	47	188	18	54	3	6	2	2	70	250	3.57	Significant Highly Considered
Modern Features	56	224	11	33	2	4	1	1	70	262	3.74	Significant Highly Considered
Usability	42	168	22	66	5	10	1	1	70	245	3.50	Significant Highly Considered
GRAND WEIGHTED MEAN											3.60	*Significantly High Influence*

Data shows the respondents' level of consideration when choosing a Hybrid Gasoline-Electric vehicle. Among the three listed tangible features, the highest factor is Modern Features with a 3.74 rating followed by Vehicle Designs and Aesthetics with a 3.57 rating. Meanwhile, the Usability factor got the lowest rating among the three, with a rating of 3.5. This means that this factor is less considered by the respondent when choosing a Hybrid Gasoline-electric vehicle.

Filipino car buyers nowadays are fascinated with the modern technology of the vehicle. According to Mayol, P.A. (2020), the latest technology in vehicles and other in-car apps improves the convenience and safety of passengers. Traditionally, the usability factor means that the vehicle must be useful to the driver with a higher driving task, efficient such that presents minimal distractions, and at ease of use must be compatible with the competing demands on the driver.

5. Level of Respondents' Intangible Consideration when Choosing Hybrid Gasoline-Electric Vehicle

Table 5. Respondents' Intangible Consideration on Choosing Hybrid Gasoline Electric-Vehicle

QUESTION	4f	w	3f	w	2f	w	1f	w	Total f	Total w	WM	Verbal Interpretation
Fuel Efficiency	50	200	16	48	3	6	1	1	70	255	3.64	Significant Highly Considered
Environment Friendly	55	220	12	36	2	4	1	1	70	261	3.73	Significant Highly Considered
Value for Money	43	172	22	66	3	6	2	2	70	246	3.51	Significant Highly Considered
Performance	55	220	13	39	2	4	0	0	70	263	3.76	Significant Highly Considered
GRAND WEIGHTED MEAN											3.66	*Significant Highly Considered*

Intangibles are beneficial elements that provide a personal connection to the product, helping a consumer feel more confident happy and satisfied.

Based on the data shown in Table 8 the level of consideration of vehicle buyers in terms of intangible benefits, vehicle performance got the highest rating of 3.76 followed by Environment Friendly with a 3.73 rating. When the Hybrid Gasoline-Electric vehicle was introduced, several studies highlighted that one of the hesitations of car buyers is that they believe that the performance of this kind of vehicle segment is low. According to the blog of Firestone entitled *The Pros and Cons of Hybrid Vehicles*, hybrid vehicles may have less power compared to standard vehicles because they are manufactured for lower CO2 emissions and improved fuel economy but are rarely designed for race car-like speed acceleration. However, in the report of Reuters (2014, May 20), Toyota Motor Corporation has developed computer chips for its Gasoline-Electric vehicle that could boost vehicle performance by 10% and allow the automaker to install the hybrid system on its vehicles.

6. Level of Respondents' After-Sales Consideration when Choosing Hybrid Gasoline-Electric Vehicle

Table 6. Respondents' After Sales Consideration on Choosing Hybrid Gasoline Electric-Vehicle

QUESTION	4 f	w	3 f	w	2 f	w	1 f	w	Total f	Total w	WM	Verbal Interpretation
Dealer Facility	36	144	28	84	5	10	1	1	70	239	3.41	Highly Considered
Parts Availability	47	188	18	54	4	2	0	0	69	244	3.54	Significant Highly Considered
Service Maintenance Cost	50	200	17	51	3	6	0	0	70	257	3.67	Significant Highly Considered
GRAND WEIGHTED MEAN											3.54	*Significant Highly Considered*

Data shows the data of Respondent's consideration when choosing a Hybrid Gasoline-Electric vehicle based on After Sales Services. The highest factor is Service Maintenance with a 3.67 rating followed by Parts Availability with a 3.54 rating.

Most of the common issues of the Hybrid Gasoline-electric vehicles are its parts and components, particularly the life span of the Hybrid battery. The recent blog of King Toyota (2020) entitled *How Long Do Toyota Hybrid Batteries Last?* says that most manufacturers claim

that the hybrid battery (on average) will last from 80,000 miles up to 100,000 miles. This means that you can run your Hybrid Gasoline-electric vehicle for up to 10 years and up the life span for its battery. Aside from that, Toyota went further by offering a warranty that covers the Hybrid battery for eight years or 100,000 miles whichever comes first. In terms of Service Maintenance, a Hybrid Gasoline-electric vehicle is equipped with an internal combustion engine and an electric motor. What is the common Service maintenance procedure on a typical vehicle is the same on the Hybrid vehicles. According to some journals, the only additional cost in the After Sales Service is the cost you replacing a Hybrid battery.

7. Level of Perception on the Hybrid Vehicle based on Challenges that Buyers May Encounter when Choosing this Vehicle Segment

Table 7. Respondents' Perception of the Hybrid Vehicle

QUESTION	4 *f*	*w*	3 *f*	*w*	2 *f*	*w*	1 *f*	*w*	Total *f*	Total *w*	WM	Verbal Interpretation
Dealer Readiness & Preparedness	33	132	26	78	8	16	3	3	70	229	3.27	Highly Considered
Cost of Ownership	29	116	32	96	7	14	2	2	70	228	3.26	Highly Considered
Community Acceptance	27	108	34	102	6	12	3	3	70	225	3.21	Highly Considered
Vehicle Life Span	28	112	29	87	11	22	2	2	70	223	3.19	Highly Considered
Investments	29	116	29	87	11	22	1	1	70	226	3.23	Highly Considered
GRAND WEIGHTED MEAN											***3.23***	***Highly Considered***

The table presents the data on the respondents' level of perception about the challenges they might encounter when choosing a Hybrid Gasoline-electric model.

The factor that got the highest rating is the Dealerships' readiness and preparedness to sell Hybrid Gasoline-electric vehicles with a 3.27 rating.

According to Toyota Motor Philippines, with the goals of working towards sustainable mobility, TMP continues to prepare their dealership in terms of marketing and selling Hybrid vehicles. Some of the programs they are working on a continual training on both sales front lines and after-sales services such as technicians in terms of several aspects of Hybrid vehicles including its technicalities. The company firmly believes that it will help boost prospective hybrid vehicle owners so that their hard-earned money will not go into ways when they decide to get one of this new vehicle segment.

IV. CONCLUSIONS AND RECOMMENDATIONS

1. The primary sources of information about the Hybrid Gasoline-Electric vehicle in Nueva Ecija are dealer frontlines and social media, indicating a need for manufacturer-initiated advertisements to enhance product reliability and buyer confidence.

2. Prospective buyers in Nueva Ecija have higher expectations for after-sales services and unit availability, highlighting a potential challenge for dealerships in meeting these demands when selling Hybrid Gasoline-Electric vehicle models.

3. The current market consideration in Nueva Ecija emphasizes that Hybrid Gasoline-Electric vehicles are well-equipped in terms of tangible, intangible, and after-sales factors, making them well-suited for the market.

4. To succeed in the Nueva Ecija market, dealers and manufacturers should be prepared (Subia, Mangiduyos, & Turgano, 2020) and pay close attention to factors such as legal considerations, vehicle usability, and dealer facility, as these factors play a crucial role in influencing buyers' decisions regarding Hybrid vehicles.

5. Manufacturer-initiated advertising efforts should focus on providing detailed information about Hybrid vehicles to enhance their reliability and increase buyer confidence.

6. Dealerships and manufacturers should prioritize improving after-sales services and ensuring the availability of Hybrid Gasoline-Electric vehicle units to meet the higher expectations of prospective buyers in Nueva Ecija.

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Awareness & Willingness of Sto. Domingo Farmers to Substitute Corn for Rice Production

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Abstract— *This descriptive research investigated the potential of corn as an alternative to rice production in Sto. Domingo, Nueva Ecija. A total of three hundred fifty-three (353) registered farmers from three (23) barangays was surveyed using stratified random sampling. The study found that the majority of respondents, owning 1-3 hectares of farmland, indicated a basic awareness of the corn farming process. They believed that corn was easier to grow than rice, offered higher yields, lower production costs, and required less water. Respondents also recognized some health benefits associated with corn, such as its richness in fiber, low cholesterol content, suitability for diabetics, bone health, and digestive benefits. However, during the production stage, respondents found corn farming to be more challenging in terms of pesticide and water management compared to rice. Despite these insights, a significant portion of the respondents expressed reluctance to shift to corn production. This suggests that while there is awareness of the advantages of corn farming, various factors may hinder the transition from rice cultivation. Further research and interventions may be needed to address these barriers and promote corn farming as a viable alternative.*

Keywords **– *Awareness, corn, farmers, rice production, Sto. Domingo, Nueva Ecija***

I. INTRODUCTION

Rice is life, especially for Filipinos and other Asians, rice remains the primary choice for staple food in the Philippines. It is a grain crop that has historical and cultural significance. Aside from the diet and culture, rice also plays a huge part in providing income sources for Filipino families, especially the farmers who work day and night just to provide food not only for their own but for all Filipinos who are dependent on rice to sustain the day-to-day nutrient needs (National Nutrition Council, 2020).

Despite being an agricultural country with plenty of resources, unfortunately, the Philippines is now experiencing a high-priced rice problem. While Filipino farmers do produce large quantities of rice every year, due to the rising consumer demand for rice, the country cannot sustain the demand. The Philippines addressed this issue by importing rice from other countries to keep the prices stable and have enough stocks available for local consumption. However, relying on imports can hamper the country's food security and economic growth. This is why the Philippine government has tasked agricultural specialists to find ways to alleviate the rice shortage, several measures are undertaken to solve the alarming crisis.

Inarguably, rice produced by the country cannot keep up with the actual demand and consumption of every Filipino, this gave the researchers an idea to seek for an alternative to the constant rice problem, like the corn. Corn is one of the most important staple crops in the Philippines; it is the second most plentiful cereal grown for human consumption. Corn is a versatile crop, and everything on a

corn plant is usable. No part of the corn is wasted. The husk of the corn is traditionally used in making tamales. The kernels are ground into food. The stalks become animal food and the corn silks are used for medicinal teas (Sailer, 2012).

Corn, like rice, is an important food staple. According to the Department of Agriculture, only 20% of Filipinos in Visayas and Mindanao eat white corn as their main staple. If people cannot afford to buy rice, particularly white rice, combining white rice and corn grits could be a healthy and affordable alternative. According to a study conducted by the Institute of Human Ecology at the University of the Philippines in Los Baños (UPLB), rice blend (or rice composite), which is a mixture of white rice and corn has an acceptable taste similar to white rice alone (National Nutrition Council, 2022).

According to the study entitled Issues Paper on Corn Industry in the Philippines stated that "Among the world's three major staple crops: corn, rice, and wheat, corn (yellow and white) contributes the most in terms of human calorie intake viz 19.5, 16.5, and 15 percent, respectively. This is not surprising because productivity-wise, corn (or maize) is the most physiologically efficient having a photosynthetic mechanism different from rice and wheat (C4 vs C3). Furthermore, while rice is preferred in areas with sufficient water to saturate/irrigate the field and wheat is grown only in cold areas, corn is rainfed. It can be grown in both tropical and temperate environments" (Salazar et al, 2021).

Another study entitled A Summary of the Use of Maize in Nutritional Products for Sportspeople started "The recent decades have seen a growing interest in the impact of plant constituents on sporting health and performance. Maize or corn (Zea mays L.) ranks third after wheat and rice as a staple food for a large proportion of the population worldwide, particularly in Asian and African countries (Sandhu, Singh, Malhi, 2007; Chaudhary, Kumar, Yadav, 2014). Numerous authors (Nuss, Tanumihardjo, 2010; Wildman, Kerksick, Campbell, 2010; Shah, Prasad, Kumar, 2016) have argued that the corn kernel is an edible and nutritive part of the plant, reporting that it contains carbohydrates, proteins, fats, as well as minerals (i.e. phosphorus, sodium, sulphur, calcium, iron, potassium, magnesium, selenium, and copper) and vitamins (C, E, K, B1, B2, B3, B5, B6, B12). Moreover, it is an essential source of various phytochemicals, such as carotenoids, phenolic compounds, and phytosterols, providing human health benefits and reducing the risk of major chronic disease" (Gierałt, 2020).

Another study entitled Corn Phytochemicals and their Health Benefits concluded that "Although the consumption of corn can be traced back to the fifteenth century, corn has drawn increasing attention globally due to it being rich in nutrients, bioactive compounds, and phytochemicals along with potential health-promoting benefits found in the most recent decades. Most phytochemicals in corn are present in bran and germ fractions instead of the endosperm fraction. Human clinical trials, epidemiological studies, and some animal studies have implicated that regular consumption of corn and its derived whole grain products is associated with a reduced risk of developing chronic diseases such as cardiovascular disease, type 2 diabetes, and obesity. The high amylose content in corn contributes to the digestive health by its nature of resistance to digestion thus bringing bioactive compounds to the colon. Therefore, dietary modifications of increasing corn and other whole grain consumption are practical strategies to optimize health and reduce the risk of chronic diseases" (Sheng, 2018).

Another study entitled Corn Commodity Value Chain Analysis and Strategy in Increasing Farmers' Income in Gorontalo Province, Indonesia stated that "The value chain analysis provides strategic issues in improving corn commodity consisting of three categories, they are: firstly; before planting, include: a. aspects of financial for the procurement of seed and fertilizer, b. land clearing disregarding the environmental aspects. Secondly; cultivation, includes a. farmer's knowledge of good farming practices, b. land conditions (slope), and the last is after planting, including a. cash management, b. limitations of post-harvest facilities, c. farmers' weak bargaining position on the selling price, and d. infrastructure and transportation of crops that still need to be developed (Ilato & Bahua, 2014).

In line with this, the researchers decided to conduct this study to determine the potential of corn as a substitute for rice. This research sought the economic importance and health benefits of having corn as an alternative to rice production.

The objective of the study is to describe the potential of corn value chain analysis as a substitute for rice production in Sto. Domingo, Nueva Ecija. Specifically, this study answered the following:

1. What is the level of awareness of the respondents about:

   2.1 Corn farming;

   2.2 Health benefits; and

   2.3 Other uses?

2. What are the challenges/difficulties that the respondents perceived in shifting from rice production to corn production?
3. How willing are the farmers to shift from rice production to corn production?

II. METHODOLOGY

This research follows a descriptive research design to determine (Subia, Mangiduyos & Turgano, 2020) the potential of corn value chain analysis as a substitute for rice production in Sto. Domingo, Nueva Ecija. The respondents of this study are the registered farmers in Sto. Domingo, Nueva Ecija. The municipality of Sto. Domingo consists of twenty–three (23) barangays with three thousand sixty–one (3,061) registered rice farmers as per data gathered from the Department of Agriculture, Municipality of Sto. Domingo, Nueva Ecija. The researchers utilized stratified random sampling in selecting the respondents. This technique was employed to ensure a fairly equal representation of the variables for the study. The sample size was computed using Slovin's formula with a 5% margin of error. A total of three hundred fifty-three (353) target respondents were computed to answer the questionnaire. The researchers utilized survey questionnaires as a data gathering method, which the respondents answered and submitted online. This was administered through Google Forms, Facebook Messenger and email. The questionnaire covered all information sought under the Statement of the Problem section. The researchers adhered to the research ethics expected, bound by moral principles and legalities. In particular, the researchers worked within the set limits of the Nueva Ecija University of Science and Technology Training Office and the Nueva Ecija University of Science and Technology Graduate School. Moreover, the researchers guarantee the confidentiality of the personal data, answers, and identity of the respondents as protected by the Republic Act No. 10173 (R.A. 10173) or the Data Privacy Act of 2012. Consent from the respondents was deemed provided the moment they willingly participated in data gathering by answering the questionnaire.

III. RESULTS AND DISCUSSION

1. Farming Status

Table 1. Current Farming Status of the Respondents

CHARACTERISTIC	FREQUENCY	PERCENTAGE
Land Area		
Less than 1 hectare	*86*	*24%*
1-3 hectares	*167*	*47%*
4-6 hectares	*91*	*26%*
7-10 hectares	*3*	*1%*
More than 10 hectares	*6*	*2%*
Years in Farming		
Less than1 year	*0*	*0%*
1-3 years	*14*	*4%*
4-6 years	*59*	*17%*
7-10 years	*73*	*21%*
More than 10 years	*207*	*59%*
Farmland Type		
Irrigated	*231*	*65%*
Water Pump	*122*	*35%*
Income from Farming		
Less than 50,000	*63*	*18%*
50,001-100,000	*75*	*21%*
100,001-200,000	*128*	*36%*
More than 200,000	*87*	*25%*

Table 1 shows the current farming status of the respondents from Sto. Domingo Nueva Ecija: the majority of the respondents owned 1-3 hectares of farmland or forty-seven (47) percent, twenty-six (26) percent owned 4-6 hectares of farmland, twenty-four (24) percent owned less than 1 hectare of farmland, and minority-owned 7 hectares and above. While in their farming experience, more than half of the respondents have above 10 years of farming experience; 207 respondents or fifty-nine (59) percent, twenty-one (21) percent have 7-10 years of experience, seventeen (17) percent have 4-6 years of experience, four (4) percent have 1-3 years of experience, and zero (0) percent have less than 1 year of farming experience.

For the farmland type, 231 respondents or sixty-five (65) percent have irrigated type of farmland and only 122 respondents or thirty-five (35) percent sustained by a water pump. In terms of annual income from farming, 128 or thirty-six (36) percent were earning 100,001-200,000 annually, 87 respondents or twenty-five (25) percent were

earning more than 200,000 annually, 75 respondents or twenty-one (21) percent were earning 50,001-100,000 annually, and 63 respondents or eighteen (18) percent were earning less than 50,000 annually.

2. Level of awareness of the respondents about corn farming, health benefits and its other uses

Table 2. Level of Awareness of the Respondents about Corn

LEVEL OF AWARENESS	Weighted Mean	Interpretation
Corn Farming		
Easier to grow	*3.15*	*Aware*
Produce higher yields	*1.9*	*Aware*
Lower production cost	*2.75*	*Aware*
Less water needed	*2.75*	*Aware*
A good alternative for rice	*1.8*	*Somewhat Aware*
Health Benefits		
Safe for diabetic	*1.88*	*Somewhat Aware*
Good for the bone	*2.23*	*Somewhat Aware*
Aids digestion	*1.72*	*Somewhat Aware*
Low in cholesterol	*2.89*	*Aware*
Rich in fiber	*2.6*	*Aware*
Other Uses		
Corn cobs for ethanol	*1.8*	*Somewhat Aware*
Corn cobs for cardboard	*1.43*	*No idea*
Corn silk for teas	*1.43*	*No idea*
Corn husk for tamales	*1.12*	*No idea*

Table 2 shows the level of awareness of the respondents about corn farming, its health benefits and other uses. The majority of the respondents said that they are aware of the process of corn farming, they responded that corn is easier to grow than rice, produce higher yields, has lower production cost, need less water, and somewhat aware that corn is a good alternative for rice.

For the health benefits of corn, respondents stated that they are aware that corn is rich in fiber and low in cholesterol; somewhat aware of being safe for diabetics, good for the bone, and aids digestion. For the other uses of corn and its parts, the majority of the respondents have no idea of the other uses of corn cobs, silks, and husks.

3. Challenges/difficulties that the respondents perceived in shifting from rice production to corn production

Table 3. Perceived Challenges in Shifting from Rice to Corn Production

CATEGORIES	Weighted Mean	Interpretation
Land Preparation	*2.28*	*Easy*
Seed preparation	*2.47*	*Easy*
Planting process	*2.27*	*Easy*
Fertilization process	*2.31*	*Easy*
Pesticides management	*4.13*	*Difficult*
Water management	*3.42*	*Difficult*
Harvesting procedure	*2.87*	*Fair*
Selling	*3.3*	*Fair*

Table 3 shows the possible level of challenges that the respondents may encounter in shifting from rice production to corn production. The illustration shows that in the early stage of production, from land preparation to the fertilization process, respondents stated that it is easier to produce corn than rice. However, the during process of production or the pesticide management and water management, it is more difficult for corn production. In the harvesting procedure and selling stage, respondents answered that they were in a fair state.

4. Willingness of farmers to shift from rice production to corn production

Table 4. The willingness of the Respondents to shift from Rice to Corn Production

CATEGORIES	FREQUENCY	PERCENTAGE
Yes	*74*	*21%*
No	*198*	*56%*
Neutral	*81*	*23%*

Table 4 shows the willingness of the respondents to shift from rice production to corn production. 198 respondents or fifty-six (56) percent stated that they were not willing to shift to corn production, 81 respondents or twenty-three (23) percent were willing to shift to corn production, and 81 respondents or twenty-three (23) percent were on a neutral state and still weighing the options.

IV. CONCLUSIONS AND RECOMMENDATION

The following conclusions were drawn from the above-mentioned results of the study:

1. There is a low level of awareness among the respondents on the area of corn health benefits and corn parts' other uses.
2. Respondents perceived that it is more difficult to maintain healthy corn yields than rice or palay yields.
3. The majority of the respondents are not willing to take risks in shifting to corn production.

Based on the findings and conclusions, the following were recommended:

1. Considering the location of Sto. Domingo, Nueva Ecija, it is recommended for the farmers to try corn production especially those who have elevated farmland and have larger farmland areas.
2. Educate the farmers on the good benefits of corn and encourage not only the farmers but also the society to be innovative and utilise all parts of the corn into worthy products.
3. The government must promote the potential of corn as a rice alternative, to sustain the needs of the Filipinos for staple food especially now that rice prices are increasing and the health problems associated with rice consumption.

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Factors Affecting Productivity and Challenges Encountered to Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program among Farmers' Cooperative and Associations (FCAs) of Guimba

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Abstract**—** *The study investigates the factors influencing productivity and the challenges faced by Farmers' Cooperative and Associations (FCAs) participating in the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program in Guimba, Nueva Ecija, Philippines. This program aims to enhance the competitiveness of rice farming by providing modern mechanization equipment and support to smallholder farmers. The research employs a quantitative type of research through survey questionnaires to gather data. Findings reveal several key factors affecting productivity, including access to and utilization of mechanization equipment, training and technical support, and the availability of credit facilities. Additionally, the study identifies a range of challenges faced by FCAs in implementing the RCEF Mechanization Program, including issues related to the maintenance and repair of equipment, coordination among members, and the need for improved access to information and resources. The study underscores the importance of addressing these factors and challenges to maximize the impact of the RCEF Mechanization Program on rice farming productivity and the overall competitiveness of the sector. The findings offer valuable insights for policymakers, agricultural extension services, and farmer cooperatives in designing and implementing effective interventions to support smallholder rice farmers in Guimba, Nueva Ecija, and similar agricultural communities across the Philippines.*

Keywords**— *Farmers' Cooperatives and Associations, Income, Mechanization, Productivity, RCEF***

I. INTRODUCTION

Developing agricultural mechanization is an important stage in the modernization of farmers. Introducing proper machinery to farmers will ensure their agricultural production is not only more environmentally sustainable but is more efficient in growing crops. It is an advanced representative of modern agricultural productivity that plays a vital role in enhancing agricultural labor conditions, promoting agricultural economic output and adjusting agricultural industrial structure (Qiao, 2017).

In the Philippines, agriculture is an important part of the economy and it employs a large percentage of the country's workforce. Unfortunately, the country is still classified as low mechanization level because of the low buying capability of farmers, abundance of rural labor, very small landholdings of every farmer, high cost of machines, and some government policies not favorable to mechanization agriculture. In line with this, the Philippine Center for Postharvest Development and Mechanization (PHilMech) implements a program that is suited to the farmer's needs in

terms of machinery. Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program aims to raise farmers' productivity, profitability and global competitiveness through strengthened access and use of appropriate production mechanization technologies.

The RCEF Mechanization Program is devised to give support to the Farmers' Cooperative and Associations (FCAs) for the utilization of equipment in farming. The goal of mechanization is to lead sustainable agricultural development and to have an appropriate technology for greater production. According to Wilfrido Enverga, a chairman of the House of Committee on Agriculture and Food, RCEF is a game changer which helps agricultural challenges.

II. METHODOLOGY

This study is a quantitative type of research that aims to determine the factors affecting the productivity of the RCEF Mechanization Program among FCAs. It used descriptive statistics to describe the profile (Subia, Mangiduyos & Turgano, 2020), productivity, factors affecting productivity and the challenges encountered by respondents.

The farmer-respondents in this study were described according to their profile; number of laborers, land holding, and number of members in the association, and according to their productivity; Technical progress, productivity growth, capital, and labor. Followed by the survey questionnaire related to factors affecting productivity and challenges encountered by the RCEF mechanization program.

III. RESULTS AND DISCUSSION

In terms of demographic profile, those aged 41-50 have the highest frequency of 13 with 43.33%, while those aged 61 and above have the lowest frequency of 1 with only 3.33%, the remaining groups aged 31-40 have 23.33% and 51-60 has 30%. The respondents consisted of 24 males with 80% of the total number and the rest females with a frequency of 6 or 20%. Land ownership was clustered to less than 1 hectare (10%), 1 hectare – 2 hectares (23.33%), 2 hectares – 3 hectares (40%), and more than 3 hectares (26.67%). Regarding members of the FCA, 12 (40%) of the respondents belongs to an association with 41-50 members which is the most frequent while respondents that belong to an association with 51-60 member only have a frequency of 1 (3.333%) and other ranges of less than 30 has 2 (6.667%), 31-40 has 6 (20%), and 61 and above with a frequency of 9 (30%).

According to the result of the descriptive statistics on productivity in terms of productivity growth, there are ten indicators rated by the respondents and a weighted mean of 3.507. The fourth and last statement, indicating that the mechanization program has significantly increased rice yield and contributed to a reduction in post-harvest losses and waste, has the highest mean of 3.6, while the ninth statement has the lowest mean of 3.4, indicating mechanization helped in better crop management. In terms of the indicators of income, the gathered data has a weighted mean of 3.273, where the statement saying that the income of the farmers increased since their involvement in the RCEF mechanization program has the highest mean of 3.6, whereas the statement saying that income gained during the program is sufficient to cover farming expenses has the lowest mean of 3. With regard to labor, the respondent's rating has a weighted mean of 3.477. The statement that the use of modern farming equipment through the RCEF Mechanization Program has reduced the labor required for rice farming has a mean of 3.667, while the statement that laborers are effectively trained to operate and maintain mechanized equipment provided by RCEF has the lowest mean with only 3.367.

The descriptive statistics on factors affecting productivity in terms of the availability of equipment have a weighted mean of 3.319. Statements saying that the equipment is technologically up-to-date and capable of handling modern farming needs and that the equipment's performance significantly contributes to increased farm productivity have the highest mean of 3.633, while 3.033 is the lowest mean for the statements that farmers have easy access to information about the availability and usage of mechanized equipment and machines provided by the RCEF Mechanization Program and are readily available when needed. On the factors affecting productivity in terms of awareness, the weighted mean is 3.28, where two of the statements mark the highest, with a mean of 3.5 stating that the farmers are aware of the existence of the RCEF Mechanization Program. While 3.1 is the markedly lowest, stating that farmers rely on credible sources for information about the RCEF Mechanization Program.

The descriptive statistics on challenges encountered in terms of literacy on machinery have a weighted mean of 3.223. Statements saying that limited awareness or information about the RCEF Mechanization Program has hindered our farmer's cooperative or association's participation have the highest mean of 3.333, while three of the indicators have the lowest mean of only 3.167. The statements are that seasonal factors, such as weather conditions, significantly impact my income despite mechanization, the availability of qualified trainers or instructors is insufficient for teaching machinery operation, and challenges in machinery literacy hinder my full participation in the RCEF mechanization program. In terms of the distribution of machinery, the data gathered has a weighted mean of 3.013, where the statement that

additional training and technical support should be made available to improve access to mechanization was marked highest with a mean of 3.267, while the statement that the distribution process for machinery in the RCEF program is inefficient and time-consuming and there is a lack of transparency in the machinery distribution process was marked lowest with a mean of 2.767.

On the test correlation between productivity and factors affecting productivity, productivity growth and availability of equipment was identified with no correlation with a correlation coefficient of 0.127. Four pairs were determined with weak correlation coefficients: income and availability of equipment (0.309), labor and availability of equipment (0.476), productivity growth and awareness (0.331), labor and awareness (0.314). In addition, one has a moderate correlation with a coefficient of 0.753, income and awareness.

On the test correlation between productivity and challenges encountered, the three variables under productivity; productivity growth, income, and labor have no correlation to the distribution of machinery with correlation coefficients of 0.039, 0.197 and -0.055. Productivity growth and labor have a weak correlation to literacy in machinery with both coefficients of 0.413 while income and literacy in machinery were identified with a strong correlation with a coefficient of 0.967.

The demographic information is significant as it provides insights into the age distribution of the surveyed population. It suggests that a significant portion of the respondents falls within the 41-50 age bracket, which may have implications for understanding their perspectives and needs. Gender breakdown can be vital in understanding potential gender-specific factors or preferences related to the study's subject matter. Distribution on land ownership provides valuable information about the distribution of land resources among the surveyed population, which can have implications for agricultural practices, income, and livelihoods. The analysis of FCA's number of members sheds light on the distribution of respondents among different cooperative association sizes, which can influence factors like collective decision-making, resource pooling, and the overall functioning of these associations.

The analysis of productivity-related indicators indicates an overall positive perception among respondents. The weighted mean of 3.507 suggests a moderately favorable view of the program's impact on productivity. The fourth statement, which highlights the significant increase in rice yield and the reduction in post-harvest losses and waste due to the mechanization program, received the highest mean of 3.6. This indicates that a majority of respondents believe that the program has been successful in enhancing rice production and minimizing losses, which is a crucial aspect of agricultural sustainability. In terms of income-related indicators, the weighted mean of 3.273 indicates a generally positive sentiment among respondents, slightly lower than the productivity aspect. The statement indicating an increase in farmers' income due to their involvement in the RCEF mechanization program received the highest mean of 3.6. This suggests that a significant proportion of respondents believe that the program has been successful in boosting their income, which is a crucial goal of agricultural development initiatives. Regarding labor-related indicators, the weighted mean of 3.477 indicates that respondents generally view the program positively in terms of labor impact. The statement suggesting that the use of modern farming equipment through the RCEF Mechanization Program has reduced the labor required for rice farming received the highest mean of 3.667. This signifies that most respondents believe that the program has been successful in decreasing the labor-intensive nature of rice farming, which can lead to increased efficiency and reduced physical strain on farmers. This supports the study of Chavas (2008) that mechanization is one of the factors contributing to rapid productivity growth in agriculture. Alternatively, the study of Thomas Daum and Regina Birner (2020) found mixed evidence that mechanization can have a positive effect on yields. The result states that there is a consensus that mechanization increases labor-productivity and several causal mechanisms by which mechanization makes it possible to increase land productivity.

Statements indicating that the equipment is technologically up-to-date and capable of handling modern farming needs and that the equipment's performance significantly contributes to increased farm productivity received the highest mean of 3.633. This suggests that respondents largely believe that the mechanized equipment provided by the RCEF Mechanization Program is technologically advanced and effective in enhancing farm productivity. This is a positive finding as modern equipment can significantly impact agricultural efficiency. Statements indicating that farmers are aware of the existence of the program received the highest mean of 3.5. This indicates that a significant portion of respondents is aware of the program's existence. High awareness is essential for the program's success as it ensures that farmers have the opportunity to access its benefits. In conclusion, the analysis reveals a generally positive perception among respondents regarding equipment availability and awareness about the RCEF Mechanization Program. However, there are variations in the level of positivity across different aspects within these categories.

The analysis of challenges related to machinery literacy reveals a moderately positive perception among respondents, with a weighted mean of 3.223. The statement indicating that

limited awareness or information about the RCEF Mechanization Program has hindered the farmer's cooperative or association's participation received the highest mean of 3.333. This suggests that respondents believe that a lack of awareness or information about the program has been a significant hindrance to cooperative or association participation. Addressing this issue by improving information dissemination could potentially enhance participation rates. In terms of the distribution of machinery, the data reveals a moderately positive perception among respondents, with a weighted mean of 3.013. The statement indicating that additional training and technical support should be made available to improve access to mechanization received the highest mean of 3.267. This suggests that respondents believe that offering additional training and technical support can enhance access to mechanization, which is a valuable insight for program planners. Adequate training can improve the effectiveness of mechanized farming. Addressing challenges related to machinery literacy, such as awareness, training, and seasonal factors, is crucial to maximize the program's impact. Ensuring that farmers have access to information and training resources can help them overcome literacy barriers.

The data analysis shows that there is no significant correlation between productivity growth and the availability of equipment. This means that changes in the availability of equipment do not appear to have a strong impact on the overall productivity growth of the respondents. A weak positive correlation is observed between income and the availability of equipment. While there is a connection between income levels and equipment availability, it's not a very strong one. There is a weak positive correlation between labor and the availability of equipment. This suggests that as the availability of equipment increases, the reliance on manual labor tends to decrease slightly. A weak positive correlation between productivity growth and awareness about the RCEF Mechanization Program implies that being more aware of the program might contribute to a slight increase in productivity growth. Similar to productivity growth, there is a weak positive correlation between labor and awareness. This suggests that having a higher awareness of the program may lead to a slight reduction in the reliance on manual labor. However, the correlation is not strong, indicating that labor is influenced by other factors as well. The strongest correlation observed in the analysis is between income and awareness about the RCEF Mechanization Program. A moderate positive correlation of 0.753 suggests that being more aware of the program is significantly associated with higher income levels among respondents. This indicates that awareness plays a more substantial role in influencing income compared to the other factors studied. In summary, the correlation analysis provides valuable insights into the relationships between various factors and productivity, income, and labor within the context of the RCEF Mechanization Program. While some weak correlations were identified, the most notable finding is the moderate correlation between income and awareness, indicating that raising awareness about the program may have a substantial impact on farmers' income levels.

The data analysis indicates no significant correlation between productivity growth and the distribution of machinery. This suggests that changes in the distribution of machinery do not appear to have a substantial impact on productivity growth among the respondents. Similarly, there is a weak positive correlation between income and the distribution of machinery. While there is some connection between income levels and the distribution of machinery, it is not a strong relationship. This implies that income levels are influenced by various factors beyond the distribution of machinery. There is no significant correlation between labor and the distribution of machinery. This means that changes in the distribution of machinery do not seem to be related to changes in labor utilization among the respondents. A weak positive correlation is observed between productivity growth and literacy in machinery. This suggests that respondents with higher levels of machinery literacy tend to experience slightly higher productivity growth. However, the correlation is not strong, indicating that other factors likely play a more significant role in influencing productivity growth. Similarly, there is a weak positive correlation between labor and literacy in machinery. This implies that respondents with higher levels of machinery literacy tend to rely slightly less on manual labor. However, the correlation is not strong, indicating that labor decisions are influenced by multiple factors. The most notable finding is the strong positive correlation between income and literacy in machinery. This indicates that respondents with higher levels of machinery literacy tend to have significantly higher income levels. Machinery literacy appears to be a critical factor influencing income among the respondents.

IV. CONCLUSIONS AND RECOMMENDATIONS

Understanding the conclusions can guide program planners and policymakers in addressing specific challenges and promoting factors that contribute to increased productivity and income in the context of the study. Program planners and policymakers should closely examine the study's conclusions and use them as a roadmap for targeted interventions and policy adjustments to enhance agricultural productivity and income.

1. Improving the distribution process for machinery is essential to enhance program effectiveness. Implement a

comprehensive overhaul of the machinery distribution process, focusing on efficiency and transparency, to ensure that farmers receive the equipment they need promptly and without unnecessary obstacles.

2. Addressing challenges related to machinery literacy, such as awareness, training, and seasonal factors, is crucial to maximize the program's impact. Develop and implement tailored training programs that address the specific machinery literacy challenges faced by farmers, with a focus on increasing awareness, providing year-round training opportunities, and adapting to seasonal demands.

3. Ensuring that farmers have access to information and training resources can help them overcome literacy barriers. Establish easily accessible information centers and online platforms that provide farmers with up-to-date information on machinery availability, training schedules, and best practices, ensuring information is readily available and user-friendly.

4. To improve the program's effectiveness, it is important to address the areas where perceptions are less favorable. Conduct targeted outreach and communication efforts to improve the program's image and perception among farmers. This includes enhancing communication channels, promoting transparency, and addressing misconceptions or negative perceptions.

5. Efforts should be made to provide farmers with reliable sources of information about the program to build trust and credibility. Collaborate with local agricultural extension services, community leaders, and trusted intermediaries to disseminate accurate information about the program. Establish mechanisms for feedback and continuous improvement to build trust over time and ensure long-term program sustainability.

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Role of Artificial Intelligence in Construction Industry of Pakistan

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Abstract— *The quick development of technology, with a focus on Artificial Intelligence (AI), has resulted in significant changes on a worldwide level. The integration of AI across the full project lifecycle is still in its infancy in the construction sector. To improve the performance of the construction business, rising digital advances like AI must be embraced, although construction companies in developing countries have lagged slightly in doing so. The world has seen tremendous changes as a result of the quick development of technology, particularly Artificial Intelligence (AI). However, the adoption of new digital advances like AI in the construction industry, particularly in developing nations like Pakistan, is still in its early phases. The built sector's construction organizations in these nations have been sluggish to understand the value of integrating AI. This study tries to pinpoint the key organizational elements required to encourage AI adoption in Pakistani construction businesses. This research tries to identify the vital organizational elements that are crucial for promoting the use of AI in the construction industry. To do this, a quantitative survey strategy was used to collect data, using a snowball sampling technique to select industry experts as respondents. These professionals were polled on the issues surrounding the use of AI in building. In order to determine the crucial organizational elements that can accelerate the adoption of AI within the sector, an exploratory factor analysis (EFA) was subsequently conducted on the acquired data. Data from participants will be gathered using a quantitative survey methodology for the project. The relationship between these constructs will also be established via confirmatory factor analysis. The study suggests a number of elements, broken down into four categories, that influence organizational AI adoption: a creative organizational culture, competence-based training, group decision-making, and strategic analysis. Additionally, a confirmatory factor analysis (CFA) was used to provide more light on the connections between the discovered constructs. This study offers a thorough list of characteristics that are essential for promoting corporate AI adoption. Notably, this research presents organizational factors related to AI adoption in the construction and related industries using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), a method that has not been frequently used in the articles identified in the systematic literature review (SLR). Prior studies have addressed organizational factors related to AI adoption in the construction and related industries. A deeper understanding of the underlying elements and how they interact within the context of AI adoption in the construction industry is made possible by the use of CFA, which increases the construct measurement's accuracy. The ultimate goal of this research is to improve knowledge of the underlying elements of these constructs and how they relate to AI application in Pakistan's construction sector. The study aims to add to knowledge and awareness of the potential of AI in Pakistan's construction business by putting light on these organizational aspects.*

Keywords— ***Artificial Intelligence, AI in Construction Industry, Pakistan Construction Industry, Organizational Factors.***

I. BACKGROUND

Numerous productivity issues in the building industry in developing nations pose serious barriers to their advancement. These problems, which are mostly brought on by the repetitive and labor-intensive nature of construction operations, include a lack of competent workers, low productivity levels, excessive material wastage, and unsafe working conditions (Pradhananga et al., 2021). In addition to these issues, Windapo and Cattell (2013) have noted a number of other difficulties that the building sector in developing countries faces. These difficulties include, among other things, the effects of globalization and technology, as well as limitations in the public sector's capability and a lack of the requisite skills. These limitations as a whole reduce the effectiveness of construction procedures and limit the expansion of the construction industry in these nations (Ivanov and Aldeen, 2018).

The importance of the construction sector in the growth of economies around the world must be acknowledged (Isa et al., 2013). Governments can use this sector to accelerate a country's economic development and eventually move from being a developing country to a developed country (Yap et al., 2019). The construction sector must adopt efficient and effective solutions that encourage infrastructure development, boost the local economy, lower prices, and improve construction efficiency in order to bring about this change (Pheng and Hou, 2019). In order to garner more interest from legislators, researchers, and business professionals, the industry must prioritize raising service quality and level of knowledge (Alinaitwe and Ayesiga, 2013). Throughout the lifecycle of a construction project, this procedure entails combining crucial data from several disciplines (Yousif et al., 2021).

In the modern environment, it is becoming increasingly necessary to create construction systems and processes that combine technological advancements that can improve the construction process (Diniz Fonseca, 2021). According to Sun et al. (2020), technical development is the primary force behind the construction industry's continual transformation. As a result, there is increasing pressure on the industry to change from a sector that has been sluggish to adopt new technologies to one that does so wholeheartedly (El Jazzar et al., 2021).

Olanipekun and Sutrisna (2021) point out that industry experts, businesses, and governmental organizations from all over the world are progressively expressing a preference for digital technologies in building. One such technology that stands out and has several benefits for the construction sector is artificial intelligence (AI). These benefits include site planning, clear communication, visualization, logistics, and management of health and safety (Swallow and Zulu, 2019). But it's important to realize that the construction sector has lagged behind in adopting technology to fully address its problems (Nadhim et al., 2016; Delgado et al., 2019).

The majority of current technologies in the construction sector often concentrate on particular activities. For remote safety checks in construction projects, for instance, drones and UAVs have proven to be useful and efficient (Nnaji et al., 2019). The layer-by-layer deposition of materials like metals or polymers is made possible by 3D concrete printing technology (Adaloudis and Bonnin Roca, 2021). Building information modeling (BIM) is frequently utilized for a number of tasks, including as design development, 3D modeling, simulation, risk analysis, and environmental analysis (Shehzad et al., 2021). These technologies do in fact only partially address the issues facing the sector, but when combined with AI, they can provide more complete answers. Conventional design, manufacturing, and building techniques have been transformed by artificial intelligence (Manzoor et al., 2021). AI helps on-site processes in construction, such as automated bricklaying and welding, while also giving operators signals to reduce risks (Chakkravarthy, 2019).

The effects of AI go beyond conventional building techniques. By identifying and deducing specified concepts from architectural patterns, it can automatically enrich models (Sacks et al., 2020). Additionally, economics, geopolitics, sociology, the environment, demographics, and security are all impacted by AI (Yeh and Chen, 2018). Natural language processing, speech recognition, and machine learning are only a few of the quick computing tasks that AI is capable of (Sohn and Kwon, 2020). In addition to supporting site supervision, automatic detection, and intelligent maintenance, these functions allow AI to cluster construction schedules, transform text to speech in building amounts software, and cluster construction schedules (Hong et al., 2021; Olanrewaju et al., 2020; Xu et al., 2021).

The construction sector has a lot of room for intelligence and digitization thanks to artificial intelligence (AI), which is considered the oldest branch of computer science (Holzinger et al., 2019). It efficiently bridges the gap between the physical and digital realms in a variety of industries, offering the potential of significant automation, improved performance, and better reliability (Manzoor et al., 2021). The establishment of standard AI adoption infrastructures is a challenge for construction firms, despite the obvious benefits of AI adoption (Mahroof, 2019). The market value of AI technology may also cause hesitation among stakeholders in the building sector (Merschbrock and Munkvold, 2015). By easing data interchange, AI

applications can significantly improve the development of the construction industry (Lekan et al., 2018).

In order to increase performance and efficiency in the built environment of developing nations, especially, it is urgent to embrace digital technologies (Windapo, 2021). The optimal and productive performance of the built environment is required for economic growth, which strongly depends on infrastructure development (Li et al., 2019). Operations and supply chain management research has centered on AI (Dubey et al., 2019). However, a lack of resources and capabilities limits the ability of many organizations, including those in the construction sector (Girginkaya Akdag and Maqsood, 2019). This constraint makes it difficult to respond to client demands and adjust to market fluctuations, both of which are essential for the successful deployment of AI (Paul et al., 2020).

The productivity of the construction sector depends on integrating applicable AI technology seamlessly and reforming organizations to increase productivity and efficiency (Lakhwani et al., 2020). Long-term sustainability in the construction market and industry depends on learning and innovation (Miranda et al., 2016). Mergers and acquisitions, structural and cultural changes, and procedural adjustments are only a few of the changes that affect companies in the construction sector (Sarala et al., 2019; Boadu et al., 2020). Incorporating technical infrastructure, human resource skills, and organizational commitment to change, organizational adoption is crucial (Saghafian et al., 2021). It's crucial to understand that, when considering technical considerations, organizational perspectives shouldn't be disregarded or dismissed (Metcalf and Benn, 2012). Organizational adoption of AI is a dynamic process that is driven by both internal and external factors. These factors have an impact on the organization's ability to embrace technology and, as a result, the adoption's results (Ren, 2019).

Additionally, the scale of construction companies varies, comprising both major corporations and SMEs. This variability may result in differences in how adoptions are handled. Therefore, a comprehensive approach is needed to solve these issues. The deployment of AI in the construction sector has been studied previously from a variety of perspectives. For instance, Mohamed et al. (2021) investigated the use of AI in the Malaysian construction industry, concentrating on enhancing project quality while reducing project duration, cost, and complexity.

Some of the statistics of construction industry are shown below for understanding the construction market in Pakistan.

Fig.1.1: Projected Growth

(Source: Board of Investment: https://invest.gov.pk/housing-and-construction)

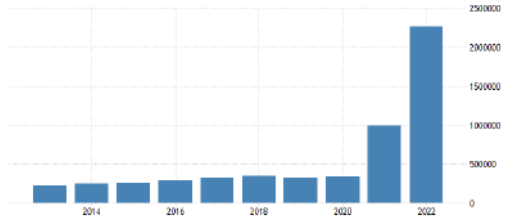

Fig.1.2: Pakistan's GDP from Construction

(Source: State Bank of Pakistan: https://tradingeconomics.com/pakistan/gdp-from-construction)

Problem Statement

The adoption of AI and related technologies has not been the exclusive focus of previous research on the construction sector, nor have these studies examined the connections between organizational elements that affect AI adoption. There hasn't been any actual research done on the use of AI in Pakistan's construction sector up until this point. As a result, it is still unclear what factors affect the adoption of AI in Pakistani construction enterprises. The study issue that examines the organizational variables of AI adoption in Pakistan's construction industry is still unclear as a result of this knowledge gap.

Research Objectives

This study's main goal is to pinpoint the organizational characteristics that are essential to encouraging AI adoption in the construction industry. These driving variables are proposed in the study, which divides them into four categories: creative organizational culture, competency-based growth, group decision-making, and strategic analysis. By doing this, it hopes to advance knowledge of the underlying causes that affect how these elements interact with the adoption of AI in Pakistan's construction sector.

Results of this research will pinpoint the key elements that encourage AI adoption in the construction sector, offering a useful knowledge base for successfully putting AI techniques into practice. Additionally, academics will use

the empirical data acquired to help them create viable roadmaps for the adoption of AI in the construction sector, not just in Pakistan but also in other developing nations. This study will shed light on how the implementation of AI in construction companies might result in more effective and efficient operations by outlining a clear research design.

Research Significance

The research significance/question i.e. "What are the organizational factors of AI adoption in Pakistan's construction industry?" has been developed to fill this knowledge gap and provide light on this crucial field of study. The significance of this study question is to give Pakistani construction companies useful advice on how to integrate AI. This study also tries to discover the many AI-related constructs and then investigate the connections between these constructs. By providing a more thorough understanding of the organizational aspects associated to AI adoption in Pakistan's construction industry and how they are interconnected, this research seeks to fill these gaps and contribute to the literature on AI adoption.

II. LITERATURE REVIEW

- Artificial Intelligence (AI) Definition and Scope

A number of definitions of artificial intelligence (AI) have been offered by academics, all of which emphasize this technology's ability to process data, extrapolate knowledge from the past, and deal with uncertainty in the future. The simulation of cognitive functions similar to those of humans, albeit in a more visible and computational way, is how AI is frequently defined (Trocin et al., 2021). With the ultimate objective of enabling computers to think and act in ways that approximate human cognition, AI has been extensively defined in recent years as a field devoted to the study and design of intelligent agents (Smith, 2016; Shneiderman, 2020). According to Shi et al. (2020), the main goal of AI is to deal with problems that are difficult to formalize but that are relatively simple for people to solve using their natural intuition.

The introduction of big data analytics and the quick development of AI have created new opportunities for the use of various data sources, enabling data-driven decision-making and improving operational efficiency in a variety of fields. Organizations have greatly improved their management practices thanks to IT-enabled data collecting and analysis capabilities (Cho and Wang, 2021).

Organizational operations have been changed by this nexus of AI and data analytics, which has given businesses the means to harness the power of data and provide useful insights. By helping firms to extract important insights from huge amounts of information as well as analyze it, these technologies enable more strategic and informed decision-making. As a result, AI is now a crucial part of contemporary organizational strategy, promoting efficiency, competitiveness, and innovation in a wide range of industries (Addison et al., 2019; Bao et al., 2021).

Additionally, enterprises now have new chances to streamline their operations, improve customer experiences, and gain a competitive edge because to the synergy between AI and data analytics. Organizations are able to anticipate trends, spot patterns, and make in-the-moment adjustments thanks to the use of AI for predictive analytics and machine learning (Li and Zhang 2019; Kim et al. 2020). This improves operational outcomes and boosts customer satisfaction.

In short, AI and data analytics work together as a potent toolkit that enables businesses to fully utilize the potential of their data repositories. In a business environment that is becoming more data-driven and dynamic, this transformational capability not only improves decision-making but also fosters agility, innovation, and adaptability (Nguyen et al., 2021; Pan and Zhang, 2019).

Additionally, the importance of AI goes beyond just data processing; it also includes speech synthesis, image recognition, and natural language comprehension, all of which have numerous applications in industries like healthcare, banking, and customer service. With the help of these AI-driven skills, businesses can automate processes, enhance customer relations, and offer more specialized and effective services (Chen et al., 2021; Schuster et al., 2020).

The meaning and significance of AI have changed throughout time, with more recent interpretations highlighting its ability to mimic cognitive functions that are similar to those of humans and its crucial role in data-driven decision-making. The combination of AI and data analytics has ushered in a new era of efficiency and creativity, allowing businesses to use data for operational improvements and competitive advantage across a variety of industries. The way that businesses negotiate the complexity of the modern business landscape is changing as a result of the dynamic interaction between AI and data analytics.

- AI in Construction Organizations

The field of artificial intelligence (AI) is quickly developing and changing how businesses run and handle their activities. Due to its capacity to use tools like machine learning (ML) to steadily improve performance, AI has gained substantial notoriety in recent years (Dhanabalan and Sathish, 2018). Dhamija and Bag (2020) contend that AI holds the key to enacting significant operational changes inside current organizational frameworks. Arrotéia et al. (2021) say that AI has developed into a crucial tool for

managing organizations and construction projects. In comparison to conventional procedures, it provides a comprehensive model that takes into account all facets, disciplines, and systems within a facility, permitting more precise and effective stakeholder collaboration.

The ability of AI to carry out jobs that previously required human cognitive talents is becoming more widely accepted by organizations. In terms of application range, adoption rates, processing speed, and capacity, AI systems continue to advance quickly (Haefner et al., 2021). Through the growth of technical and social skills, this evolution has given the construction industry a variety of capacities, ultimately improving project outcomes (Sima et al., 2020). These capabilities are the result of investments made by firms in AI, which cover communication, staffing, training, and other human resource areas (Ahuja et al., 2018).

According to Ghosh et al. (2018), machines are getting better at handling non-routine jobs. Organizations undergo a huge transition termed as "digital transformation" as AI and digital technologies continue to converge (Wu et al., 2021). AI is becoming a topic of great interest in industrial business practices and strategic information research.

It is important to remember that AI does not take the place of human intelligence; rather, it enhances it by making the best choices at the appropriate times. As shown by several research, there are a number of elements that affect the adoption of AI within enterprises. Knowledge and competency, as well as information processing management, were highlighted by Ghobakhloo and Ching (2019) as crucial elements in the implementation of organizational AI.

Employees must be knowledgeable and skilled in areas like information and digital technology (IDT), cybernetics, and data analytics because AI is associated with automation, the development of interconnected networks of intelligent machines and materials, and the integration of the real and virtual worlds. This suggests that for people to remain productive in AI-driven environments, their skills must constantly advance. AI plays a crucial role in the construction industry by improving information processing capabilities to handle the growing volume of data. As a result, businesses with greater information processing needs are more likely to use AI (Turner et al., 2020).

Performance, cost, governmental guidelines, and expertise are further elements that affect the adoption of AI (Turner et al., 2020). With less risk than is typically involved with building projects, AI can revolutionize part production, enable cost-effective construction techniques, and ultimately reduce construction costs as a whole. Additionally, the adoption of AI is significantly influenced by productivity, governmental laws, and business size (Likewsie, Mabad et al., 2021). Government laws and regulations can help or hurt the adoption of AI by the construction industry since they frequently influence how decisions are made about adopting new technologies (Likewsie, Mabad et al., 2021).

Additionally, key aspects that affect AI adoption inside enterprises include organizational preparation, top management support, decision-making support, cost considerations, skill development, and attitudes toward innovation (Jöhnk et al., 2020). The possibility of successful AI adoption is increased by organizational preparation, which is also necessary to maximize the business value of AI. A crucial element is top management support, which includes the readiness of senior leadership to launch AI activities from the top down and show support for bottom-up initiatives. Due to the various organizational needs connected with AI implementation, this support is essential. The decision to embrace AI by a company frequently depends on the approval of top management. Top management support is evidently demonstrated by the incorporation of AI adoption into organizational strategy and the development of AI knowledge and awareness (Jöhnk et al., 2020).

Also influencing AI adoption include time savings, cost savings, competitive pressures, and cooperation prospects (Garca de Soto et al., 2019). These incentives encourage firms to adopt AI, especially in the construction sector where there is a need to decrease lead times, improve quality, and lower costs by more effectively fusing design and construction processes.

Other important elements that affect AI adoption include risk assessment, adherence to standards, and decision-making assistance (McAleenan, 2020). For system designers and developers to manage the fast changing technical landscape, governmental entities, industry associations, and individual businesses frequently adopt rules and standards. These guidelines aid in ensuring that technical innovations adhere to moral and philosophical principles. The adoption of AI is also heavily influenced by factors such as costs, workplace cultures, relationships among employees, and attitudes toward innovation (Chatterjee et al., 2020). AI systems urge businesses to reorient their attention away from conventional cost-cutting and profit-boosting tactics. AI technology becomes essential because to the enormous amount of data that must be managed and assessed cost-effectively. Users—often employees within organizations—are more willing to accept AI technologies if they believe they would benefit their productivity. This welcoming mindset toward innovation motivates firms to adopt AI (Chatterjee et al., 2020).

Artificial intelligence (AI) has been increasingly used in construction projects in recent years, indicating the technology's enormous potential to boost efficiency and productivity in the sector. By performing an extensive analysis of papers on AI in construction, this paper seeks to offer an up-to-date viewpoint on the topic by contrasting its findings with those of past reviews (Sofie Bang, 2022).

A complex interaction of elements covering technological, organizational, and cultural dimensions affects the adoption of AI within enterprises. Organizations must carefully take into account these elements as AI develops in order to fully realize its promise, improve operational effectiveness, and maintain competitiveness in a constantly shifting business environment.

III. RESEARCH METHODOLOGY

To successfully accomplish its goals, this study used a variety of research methods. A thorough examination of the available literature was combined with a quantitative survey as the methodology of choice. This research strategy was chosen because, as highlighted by Apuke (2017), it is consistent with the study's objective nature, which aims to substantiate facts, discover patterns, examine links among statistically quantifiable variables, and analyze them using proper statistical procedures. The choice to use a quantitative research approach was purposeful since it makes it easier to develop quantitative assessment indicators, which Basias and Pollalis (2018) highlight as being a key component of the study. With the use of this method, essential factors may be measured and quantified, allowing for a more organized and quantitative interpretation of the research data.

The questionnaire methodology was selected as the main data gathering strategy for the survey component. There were various strong reasons why this decision was made. First, using questionnaires ensures that information is gathered quickly and effectively. They also offer a broad geographic coverage, allowing responders from various places to be included. Additionally, surveys give respondents the chance to thoroughly evaluate and confirm data, encouraging accuracy in their responses, an important component of rigorous research technique (Jones et al., 2013).

Additionally, questionnaires are a resource-efficient way to gather data because they just need a small amount of time, money, and supplies. They are a sensible option for research projects because of their affordability (Datti et al., 2019). In addition, questionnaire administration and setup are both fairly simple, which contributes to their widespread use in research projects.

The study procedure itself was structured and involved several steps, as shown in Figure 3.1. The first step included doing a thorough literature analysis to lay the groundwork for existing knowledge and pinpoint the primary research interests within the field of study. Then, a questionnaire survey was carried out to obtain first-hand information from respondents.

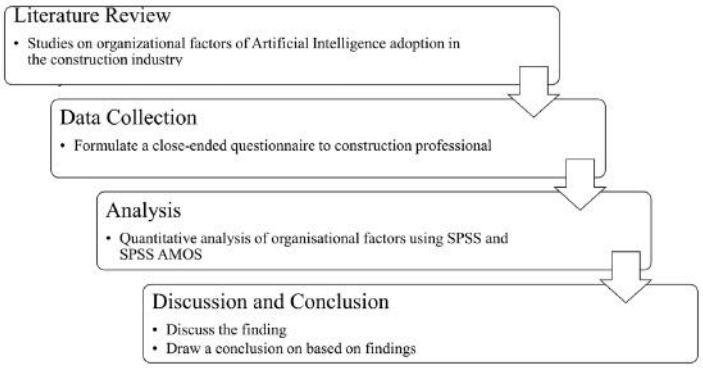

Fig.3.1: Research Process

The study involved data analysis using the Statistical Package for the Social Sciences (SPSS) after data collection. This analysis used a variety of statistical methods, such as exploratory factor analysis (EFA) and the determination of mean item scores (MIS). These analytical techniques played a crucial role in analyzing the connections between constructs and uncovering underlying patterns in the data. The study also used SPSS AMOS for additional analysis, particularly to evaluate the constructions that surfaced during the investigation. This rigorous method to data analysis sought to draw insightful inferences and conclusions from the research results, thereby advancing our comprehension of the subject matter of the study.

Literature Review

The first step in this research project was to perform a thorough literature analysis with the aim of identifying and clarifying the key elements that affect the organizational aspects of AI in the construction sector. A thorough systematic literature review (SLR) was conducted in order to accomplish this. The SLR methodology was chosen on purpose since it has clear benefits for research protocol transparency and accuracy. Systematic literature reviews are recognized for their exacting and systematic way of surveying the amount of knowledge already in existence. With a precise emphasis on the topic of interest—in this example, the organizational aspects relevant to AI within the construction sector, as explained by Tian et al. (2018)—researchers using this approach meticulously search, evaluate, and synthesize pertinent papers within a defined field.

The SLR's systematic design makes sure that the research process follows clear, well-defined protocols, boosting the accuracy and legitimacy of the results. It entails a thorough search for and examination of studies that are pertinent to the study issue, facilitating a thorough grasp of the material. The SLR methodology was used in this study to ensure that all important aspects influencing AI inside construction firms were discovered and thoroughly assessed. The study meticulously acquired and analyzed a wide range of significant scholarly publications. The systematic review approach is particularly useful since it enables researchers to combine findings and derive insightful conclusions by offering a structured and organized overview of the body of literature.

This study's comprehensive literature review, which was carried out in the first stage, was carefully chosen for its transparency and methodological rigor. By methodically assessing and combining significant papers in this area, our approach allows for a full examination of the organizational issues related to AI in the construction sector.

Review Protocol

The creation of an organized review methodology is a requirement of the first stage of a systematic literature review (SLR). This important step includes a number of vital components intended to successfully direct the research process. Let's explore these elements in greater detail.

Research Questions: The design of precise and thorough research questions forms the basis of the review protocol. These inquiries define the parameters and goals of the study and serve as the basis for the entire SLR. The review will be focused on the most important features of the selected issue thanks to carefully constructed research questions.

Systematic Search strategy: A strategic strategy is essential when conducting a comprehensive search for pertinent material. Researchers use the right databases, keywords, and search strings to carefully prepare and carry out their search operations. This methodical technique makes sure that no important studies are missed.

Inclusion Criteria: For the review process to be successful, inclusion criteria must be clearly defined. These requirements specify the precise qualities research must have in order to be taken into consideration for review. These criteria may include elements like publication date, study technique, and relevance to the research topics in the context of AI organizational variables in the construction industry.

Process for Quality Appraisal: The protocol includes a rigorous process for quality appraisal. Researchers evaluate the trustworthiness and methodological soundness of the chosen studies. The most reliable and trustworthy sources of information are determined with the aid of this careful review.

Data Extraction and Synthesis: A well-organized plan is created for data extraction and synthesis. To do this, pertinent data from the chosen studies must be methodically extracted, organized, and synthesized to yield actionable conclusions.

Transparency in methodology: Transparency in methodology is essential. Researchers follow a set of precise instructions to make sure the review process is open, repeatable, and understandable to other academics. The review's findings are more credible and reliable because of this transparency.

Course Direction: The review protocol serves as a compass, directing the researcher through every step of the SLR procedure. It makes sure the investigation stays on course and adheres to its set goals.

Methodological Advancement: A well-structured review methodology can be a useful tool for future research projects in addition to directing the current investigation. For academics interested in researching related subjects, it may serve as a source of methodological advice and a reference.

A systematic literature review is established on the framework of a review protocol. It offers the organization and direction required to manage the challenges of the research process. Additionally, it improves methodological transparency, guaranteeing that the study is carried out precisely and rigorously. An SLR can produce complete and trustworthy insights into the chosen research domain by following these careful processes.

Based on the above discussion, the research question proposed for the research is “What are the organizational factors of AI adoption in the construction industry?”.

A number of rigorous procedures were carried out to make sure the study subject was thoroughly explored. According to de Carvalho et al. (2017), the established research protocol included crucial elements such as information about the research question itself, the choice of sample articles, the creation of a search strategy, and the identification of pertinent keywords to precisely define the study's scope. According to de Melo et al. (2020), the procedure also included a careful assessment of the inclusion and exclusion criteria.

Inclusion and Exclusion Criteria

The criteria for inclusion in this review were specifically chosen to guarantee the selection of empirical studies that were directly relevant to the study's focus, which is the organizational factors impacting the adoption of AI in the

construction industry and adjacent sectors. The following essential components were included in these criteria:

Relevance: The studies that were chosen have to be directly related to the research topic, which is the analysis of organizational variables influencing the adoption of AI technology. This criterion made sure that the studies that were picked had a direct bearing on the area of research that was being done.

Publication Language and Period: Only research published in English was taken into consideration for inclusion in order to ensure consistency and comprehensibility. Recent advancements in the use of AI were taken into account when choosing this particular historical period, which was in line with the research's current setting.

Publication Type: Only articles published in respectable journals and peer-reviewed conferences were included in the review in order to uphold the scientific rigor and credibility of the chosen sources. This criterion was designed to make sure that the studies that were picked had undergone thorough examination and inspection by subject-matter experts.

The thorough use of these inclusion criteria was essential in ensuring that the research review included empirical studies that met strict criteria for academic rigor and quality as well as being directly relevant to the research topic. According to Wager and Wiffen (2011), the review attempted to reduce the possibility of retrieving inaccurate or biased data by adhering to these criteria.

Additionally, precise exclusion criteria were put in place to increase the validity of the results and preserve the review process's integrity. These exclusion criteria were created to weed out studies that did not follow the review's specified guidelines. Excluded research were often deemed unsuitable for inclusion in the review because they did not fall within the purview of the selected industry, did not conform to the established time span, language, or publication type.

The review aimed to make sure that the chosen studies not only met strict requirements for scholarly quality but also were highly relevant and wisely applied inclusion and exclusion criteria. This careful strategy attempted to improve the review's findings' validity and reliability, ultimately resulting in a more solid and reliable study output.

Study Search

Researcher used a wide range of search phrases to cast a wide net in our hunt for related papers. The use of artificial intelligence (AI) within the construction sector, particularly in the context of the Fourth Industrial Revolution (4IR) and digitalization, is the focus of our research. These search phrases covered important parts of this research. We carefully used Boolean operators like AND and OR, as well as specific database operators, to narrow searches and obtain the most pertinent literature. By employing special characters like truncation (*) or (?) throughout the search process, these operators allowed researchers to describe logical linkages between our search phrases and accommodate for variances in terminology. Following the advice given by Madigan et al. (2014), the researcher made sure that our search turned up a wealth of pertinent literature by using this thorough approach. This wide-ranging collection of sources had a crucial role in guiding our research and analysis, making the study more substantial and perceptive.

Selecting Studies (inclusion Based on Pre-Defined criteria)

Several electronic databases, including ASCE Journals, Emerald Insight, Elsevier ScienceDirect, Engineering Village, Google Scholar, ICE virtual library, IOPscience, IEEE Xplore, Elsevier Scopus, SpringerLink, and Taylor & Francis, were searched to find the research' sources.

Data Extraction from Studies

Following the article extraction procedure, we conducted a screening of essential data, eliminating the need for a thorough reading of all the papers. Then, following Samsudin et al.'s (2022) technique, we used ATLAS.ti to systematically arrange and perform a thematic analysis of the chosen papers. These conclusions were used as the basis for creating a questionnaire that was distributed to Pakistani construction industry professionals in order to collect first-hand information. The exhaustive literature review yielded the following table 3.1, which lists seventeen organizational aspects of AI adoption in the construction industry.

Table 3.1: Organizational Factors

S/No	Organizational Factors
1	Information Processing Management
2	Knowledge and competency
3	Improve performance
4	Cost to organization
5	Organizational Culture
6	Government pressure
7	Collaboration
8	Firm size
9	Organizational readiness
10	Top Management support

11	Attitude to innovation
12	Time-saving
13	Competitive pressure
14	Risk involved in using AI technologies
15	Standards
16	Reputation
17	Decision making support
18	Work culture
19	Workplace relationship of staff

Data Collection

A thorough questionnaire was designed by the researcher to elicit opinions from building industry experts around the nation. When created and used appropriately, questionnaires have developed into crucial tools for eliciting statements from certain individuals, groups, or even entire populations (Roopa and Rani, 2012). This methodology is extremely useful for gathering data from a wide range of responders, who are often referred to as subjects.

Researcher used a Google Forms-made online questionnaire to speed up data collecting. The questionnaire was carefully designed to cover a variety of topics, including insights into organizational factors driving the adoption of AI and demographic data about respondents. Using a five-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree), with a midpoint of 3 (neutral), respondents were asked to submit their opinion. The choice of this measure was based on how well it captured the attitudes and thoughts of the respondents (Munyasya and Chileshe, 2018).

Table 3.2: Likert Scale

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

I used a combination of judgmental and snowball sampling techniques in my effort to connect with a wide group of construction professionals. This strategy targeted people in professional networks, especially business professionals. In addition, the researcher used email and social messaging services like LinkedIn to get in touch with possible volunteers who lived in the study's geographic area. These social media sites act as gathering places for people of all backgrounds, helping to build a vibrant social network of industry experts (Kapoor et al., 2017).

Because of its non-random selection method, it's important to keep in mind that the judgmental sampling technique, while useful for focusing in on people with certain viewpoints, does not allow generalization to the entire population (Etikan and Bala, 2017). In contrast, snowball sampling, which is likewise non-random, involves employing a small initial group of respondents to entice the involvement of further cases and thereby increase the sample size (Taherdoost, 2016). Through this small group, the first contacts within the scope of the study were made; these contacts then helped with the recruitment of more participants. By asking each respondent to identify more possible participants, this technique helps create networks and boost participation numbers. Because it was not practical to recruit respondents from the demographic indicated through LinkedIn, I chose these non-probability sampling techniques (Lehdonvirta et al., 2020). Instead, I drew on respondents' desire to take part in the study and their knowledge of construction methods (Darko and Chan, 2018).

According to de Winter et al. (2009) and Pearson and Mundform (2010)'s recommendations, my goal was to collect data from 150 individuals overall for this study, which is more than the minimum required. After the data collection period, 169 completed questionnaires were finally received and examined. A wide range of occupations in the construction industry were represented by these respondents, including architects, quantity surveyors, civil engineers, construction managers, and construction project managers.

Data Analysis, Results and Interpretation

A thorough examination of the data was performed using both descriptive and inferential statistical methods. The determination of means and the extraction of major components were two important outputs produced by this analytical method. The Statistical Package for the Social Sciences (SPSS) and SPSS AMOS (Analysis of Moment Structures) are two potent software programs that were used to help these investigations. The data needed to be summarized and presented in a comprehensible fashion, and descriptive statistics were essential for this. These statistics were useful in clarifying the dataset's central tendencies, dispersions, and distributions. In contrast, inferential statistics went further and allowed for the investigation of connections, distinctions, and patterns that might not have been immediately evident in the raw data. Drawing conclusions and generating judgments about the larger population from whom the data were taken were

made easier thanks to this stage of the analysis. A key measure of the data's average value—the calculation of means—was offered, illuminating the usual or representative value within distinct variables. This was very helpful for comprehending the dataset's general properties.

A more sophisticated analytical method that intended to minimize the dimensionality of the data while keeping its important information was the extraction of principle components. The dataset's underlying structures or patterns were identified using principal component analysis (PCA), which may have revealed hidden variables or associations that were not immediately apparent using more conventional techniques.

The research team used SPSS and SPSS AMOS, two specialized software tools, to conduct these analyses efficiently and thoroughly. A well-known statistical software program called SPSS offered a complete set of tools for carrying out a variety of statistical studies, including inferential tests and descriptive statistics. On the other hand, the team was able to examine more intricate correlations and structural patterns within the data thanks to SPSS AMOS, a program that specializes in the study of structural equation models and moment structures.

The means were calculated and principle components were extracted as part of the data analysis procedure, which included both descriptive and inferential statistics. These studies were carried out utilizing the powerful features of SPSS and SPSS AMOS, ensuring a rigorous and thorough examination of the features and underlying structures of the dataset.

Mean Item Score

The main participant data set underwent thorough analysis, with the Mean Item Score (MIS) serving as the primary analytical tool. According to Sarhan et al.'s 2018 study, MIS acts as a quantitative representation of the degree of consensus or agreement among respondents regarding the major organizational elements driving the adoption of artificial intelligence (AI) in Pakistan's construction industry.

A descriptive statistics technique was used to give a more thorough assessment of the study's participants and the current status of AI applications within businesses in the construction sector. As recommended by Nasila and Cloete in 2018, this involves the development of numerous statistical indicators to capture central patterns and data dispersion.

The average values in the dataset were calculated using the arithmetic mean, a measure of central tendency. This statistic reflected the typical response or rating participants gave to several aspects influencing AI adoption. Additionally, as stated by Evans et al. in their 2021 research, the standard deviation (SD), a quantitative measure of the amount that individual responses deviate from the mean, played a critical role in assessing the variability within the dataset. A low SD suggested that the replies were closely packed around the mean, indicating a high degree of participant agreement. In contrast, a high SD meant that the respondents' responses covered a larger range of values, suggesting a more varied variety of thoughts and attitudes.

As suggested by Ejohwomu et al. in their 2017 study, the MIS was once more used to create a ranking of the factors driving AI adoption from highest to lowest based on their mean scores. The Likert scale, a widely used instrument for evaluating and comparing respondent preferences or attitudes, was used to determine this rating. The study was able to determine the relative importance of several organizational components in the context of AI adoption within the Pakistani construction industry by using this scale.

The Mean Item Score (MIS), which measures participant agreement, was used in the analysis of the original data set. In order to give a thorough overview of respondent characteristics and the state of AI applications in construction sector businesses, descriptive statistics were also used. The arithmetic mean and standard deviation were computed as part of this, with the latter serving as a gauge of data dispersion. The Likert scale and MIS made it easier to rank organizational components according to their mean scores, illuminating their relative significance in influencing AI adoption.

Exploratory Factor Analysis

According to Ngowtanasuwan in 2019, exploratory factor analysis (EFA) is a computational tool used to determine the underlying structure that controls a dataset's various variables. By selecting and keeping only the most important descriptive characteristics, this method is essential for streamlining complex data and improving the dataset's interpretability. It is crucial to carry out a number of preliminary evaluations to make sure the data is appropriate for factor analysis before beginning the EFA procedure. For this, the Bartlett's sphericity test and the Kaiser-Meyer-Olkin (KMO) test are used. According to Zeray et al. in 2021, the KMO test analyzes if the sample size is enough in relation to the number of variables. A KMO score above 0.45 is generally regarded as appropriate. In contrast, Bartlett's test of sphericity evaluates whether the correlations between variables are sufficiently different from random chance, and according to Ul Hadia et al.'s findings in 2016, a significant result (p 0.05) is typically required for factor analysis to be deemed appropriate.

As stated by Effendi et al. in 2020, after performing these first checks, the following phase entails investigating the total variance explained, which is an essential step in the item extraction procedure intended to reduce the number of variables for a more manageable study. According to Matsunaga's 2010 recommendation, objects with eigenvalues greater than 1.0 are divided into multiple components and used to identify discrete components within the dataset.

Additionally, the rotated variable matrix is carefully examined to narrow down the list of objects to be studied in more detail. As indicated by Maskey et al. in 2018, only objects with factor loadings greater than 0.5 are kept in this step. A threshold of 0.5 ensures that only the most significant relationships are taken into account. Factor loadings show the strength of the relationship between variables and factors.

In short, a computational method used to reveal the underlying structure of multivariate datasets is called exploratory factor analysis (EFA). It is preceded by a number of evaluations, such as the KMO and Bartlett's tests, to check the applicability of the data. The extraction of significant components from the dataset is aided by the total variance explained and eigenvalues, and the factor loadings direct the choice of variables for further analysis, all of which together help to reveal the underlying structure of the data and improve its interpretability.

Confirmatory Factor Analysis

As described by Maleti et al. in 2013, Confirmatory Factor Analysis (CFA) was used in this study as a powerful statistical tool to verify convergent validity, examine the suitability of the measurement model, and identify links between distinct dimensions. In order to achieve this, the study used the results of a previous Exploratory Factor Analysis (EFA) as the basis for carrying out the CFA. According to Kim et al.'s findings in 2015, the CFA was conducted to validate the latent variables and measurement variables, and the analysis was carried out using the SPSS AMOS statistical tool.

For accurate results in CFA, ensuring a proper sample size is crucial, with various researchers providing conflicting recommendations. According to Zahoor et al. (2017), a sample size of 200 is adequate to ensure the accuracy of the findings when using confirmatory factor analysis. On the other hand, Kyriazos (2018) contends that a sample size greater than 100 is required to produce reliable results for a CFA model with 3–4 indications per component.

A crucial phase in CFA is the evaluation of the model fit, which entails taking into account a variety of fit indices that each offer insight into various facets of model fit. As a result, the study published a thorough set of goodness-of-fit indexes, based on prior research and suggestions. These indices were chosen in accordance with the recommendations made by Chan et al. in 2017. As a result, a variety of fit indices were used, as shown in Table 4.1, that were comparable to those used by Chan et al. in 2014, Molwus et al. in 2017, Tanko et al. in 2017, Zahoor et al. in 2017, and Puiu in 2020.

Confirmatory factor analysis (CFA) was used in this study as a useful statistical tool to evaluate convergent validity, gauge the suitability of the measurement model, and identify links between constructs. The CFA was performed using the statistical tool SPSS AMOS, with the EFA results serving as the foundation. The study followed recommended sample size guidelines and incorporated Kyriazos' and Zahoor et al.'s and researchers' insights. Additionally, a number of fit indices were used to thoroughly assess the model fit, as shown in

Table 4.1, in accordance with suggestions from the literature.

Table 4.1: Organization Model Fit Indices.

Fit Indices	Recommended Measure
CMIN/df = discrepancy divided by degree of freedom (Chi-square value. If significant, the model can be considered unsatisfactory).	Good < 3, acceptable < 5
Root mean sq. error of approx. (RMSEA)	0.05 (very good) - 0.1 (threshold)
Root mean sq. residual (RMR)	0 – 1 (smaller values = better fit)
Goodness-of-fit index (GFI)	0 (no fit) - 1 (perfect fit)
Comparative fit index (CFI)	
Incremental fit index (IFI)	
Tucker-Lewis index (TLI)	

Validity and Reliability

The consistency and coherence of results acquired with a measurement tool or instrument are referred to as reliability, which is a basic notion in research technique. According to Creswell and Guetterman in 2019, the objective is that scores should remain constant and show little variance when an instrument is administered repeatedly at various times. In essence, it makes sure that the instrument's data are trustworthy and suitable for analysis. The Likert scale proved to be a reliable assessment tool in the context of this investigation. The little variety found in the replies to certain scale items made this clear. In other words,

participants' answers showed a high level of consistency and stability when they responded to the identical questions on various occasions.

On the other hand, validity is concerned with whether the results of an instrument are significant and can help the researcher come to reliable conclusions regarding the sample population under study. Internal validity, a subset of validity, evaluates how closely the measurements obtained in the research setting match the data that the measuring tool was intended to record. As indicated by Mohajan in 2017, researchers frequently utilize Cronbach's alpha (α), a commonly used indicator of internal consistency, to assess the measurement instrument's internal reliability. Cronbach's alpha measures how closely related a group of elements in an instrument are, effectively evaluating how well they capture the same underlying construct. According to Sileyew in 2019, this coefficient is commonly understood as the average of all feasible split-half coefficients, leading to a comprehensive evaluation of internal consistency.

Strong internal consistency and high reliability of the measurement equipment are indicated by a high Cronbach's alpha coefficient, which is near to 1. This suggests that the instrument consistently measures the same underlying construct via its items. However, as evidenced by the results of Nair et al. in 2019, it is generally agreed that a minimum Cronbach's alpha coefficient of 0.70 is required to deem the construct internally consistent and highly dependable. Validity ensures that measurement instrument scores are relevant and enable reasonable inferences about the research population, whereas reliability assures the stability and consistency of measurement instrument scores over time. The study used Cronbach's alpha as a gauge of internal consistency and reliability, with a recommended cutoff point of 0.70 to denote a high degree of the instrument's internal consistency and reliability.

Ethical Considerations

When conducting research, it is essential to thoroughly examine ethical issues in addition to choosing the right study approach and processes. According to Fleming and Zegwaard in 2018, ethical considerations are the cornerstone of good human-participant research, and they demand careful consideration and commitment. This study was guided by a number of important ethical principles, including beneficence, autonomy, and fairness. According to the beneficence principle, it is the responsibility of researchers to preserve research participants' welfare and keep them free from exploitation of any kind. As emphasized by Barrow et al. in 2021, this means making sure that any information supplied by participants during their involvement in the study remains private and secure. The study also highlighted the potential advantages of AI in construction, such as lowering human mistake rates and boosting project productivity, which would be consistent with the principle of beneficence.

Another crucial ethical premise that guided this research was autonomy, often known as respect for persons, as promoted by Singh and Hylton in 2015. It demands that researchers uphold participants' autonomy by giving them the choice of participating or not in the study. This concept emphasizes the significance of getting participants' informed agreement and guaranteeing that their involvement is completely voluntary. As discussed by Soboan et al. in 2018, researchers have an ethical responsibility to avoid any injury or discomfort to research volunteers, whether accidental or purposeful, and to reduce any potential hazards connected with the study. This entails taking precautions to safeguard the physical and mental health of participants during the course of the study.

Finally, choosing research participants fairly is required by the justice principle. According to ydinait in 2018, this involves abstaining from all forms of prejudice and guaranteeing that participant populations are selected fairly and without pressure. Participants in this study came from both public and private companies in Pakistan and represented a varied range of construction professions, including project managers, quantity surveyors, architects, and civil engineers. By including individuals from different racial and cultural origins, emphasizing inclusivity, and avoiding any kind of bias or exclusion, the research embraced diversity.

The research process includes ethical concerns that take into account ideals like beneficence, autonomy, and fairness. This study made sure that the rights and well-being of research participants were upheld and respected, and that the research was carried out in a responsible and equitable manner by abiding by these ethical principles and getting ethical approval.

IV. RESULTS

- **Respondents Profile**

Table 4.2 contains a thorough overview of the 169 respondents' profiles, giving a complete picture of the study's participants. The profiles of the respondents' educational and professional backgrounds, occupations, organizational ties, and levels of experience can be thoroughly analyzed to provide important insights. First and foremost, the results make it clear that a sizeable percentage of the respondents, approximately 67.5% of the total, had a bachelor's or honors degree as their highest level of schooling. This demonstrates a solid basis in terms of academic qualifications and points to a well-educated

responder pool. Furthermore, 16% of the participants had master's degrees, highlighting the sample's diversity in terms of educational background. When evaluating the respondents' distribution of professions, it was found that 48.5% of them identified as quantity surveyors. This demonstrates how common this career is among the participants. Civil engineers trailed closely behind with 24.9% of the responses, showing a significant representation of this occupational group in the research.

Table 4.2: Respondents' Profile

Profile	Description	Frequency	Percentage (%)
Qualification	Matric/Grade12	7	4.1
	National Diploma	19	11.2
	Bachelor's/Honors' Degree	114	67.5
	Master's Degree	27	16
	Doctorate	2	1.2
Profession	Architect	9	5.3
	Quantity Surveyors	82	48.5
	Civil Engineer	42	24.9
	Construction Manager	21	12.4
	Construction Project Manager	15	8.9
Organization	Public Client	22	13
	Private Client	41	24.3
	Contracting Organization	59	34.9
	Consulting Organization	47	27.8
Experience	1–5 years	103	60.9
	6–10 years	31	18.3
	11–15 years	13	7.7
	More than 20 years	8	4.7

The majority of participants, or 34.9%, were employed by contracting organizations in terms of organizational affiliation. This may indicate that a sizable percentage of respondents were actively employed in the construction sector in positions connected to project execution. Following closely after, 27.8% of the respondents worked for consulting firms, illustrative of the range of positions and responsibilities present in the industry. Examining the respondents' degrees of professional experience, the data shows that a significant 60.9% had between 1 and 5 years of experience. This indicates that a sizeable portion of the study's professionals are in their early careers. Furthermore, 18.3% of the participants said that they had between six and ten years of experience, which added to the range of experience levels across the respondent pool.

The 169 respondents' profiles, which are shown in Table 4.2, provide important details about the make-up of the study's participants. The information highlights the prevalence of bachelor's/honors and master's degrees among the respondents, the dominance of the professions of quantity surveyors and civil engineers, organizational affiliations, and professional experience distribution. This thorough profiling prepares the way for a complex and perceptive examination of the research findings in light of the backgrounds and features of the participants.

- **Descriptive Results**

Our detailed descriptive analysis of the replies from the survey participants regarding the organizational elements influencing the adoption of AI within Pakistan's construction industry is presented in Table 4.3 below. This analysis clarifies the numerous criteria listed in the questionnaire and provides a thorough breakdown of their Mean Item Scores (MIS), illuminating the perceived importance of these aspects in relation to the adoption of AI. Overall, it is interesting that every organizational element studied in this study received MIS ratings more than 3.50, suggesting the participants' perceptions of its relevance and significance. This indicates that the respondents generally agreed on the significance of these variables for the adoption of AI technology within Pakistan's construction industry.

Table 4.3: MIS analysis of organizational factors of AI adoption in Pakistan's construction industry.

	Mean	Std. Deviation	Inter-Quartile Rang
Top management Skills	4.02	0.92	4.00
Decision Making support	3.99	0.81	4.00
Cost to Organization	3.98	0.99	4.00
Improved performance	3.95	0.87	4.00
attitude to innovation	3.88	0.97	4.00
Organization's work culture	3.85	0.92	4.00
Collaboration	3.83	0.90	4.00
Organizational readiness	3.83	0.91	4.00
Time-saving	3.83	1.07	4.00
Knowledge and Competency	3.82	1.03	4.00
Standards	3.75	0.95	4.00
Information Processing Management	3.69	0.99	4.00
Governmental pressure	3.64	1.01	4.00
The workplace relationship among staff	3.62	1.01	4.00
Risks involved in using innovative technologies	3.61	1.10	4.00
The reputation of the organization	3.60	1.08	4.00
Firm size	3.57	1.11	4.00

"Top management skills" had the highest MIS score of the evaluated organizational characteristics, achieving an excellent mean score of 4.02. This shows that study

participants gave this factor the greatest weight when discussing the adoption of AI. The importance of leadership skills in directing and managing the integration of AI technology is highlighted by the identification of top management abilities as a crucial component. Following closely behind, "decision-making support" received a MIS of 3.09, indicating that respondents found it to be highly relevant. This aspect emphasizes how crucial it is to have sufficient support systems and procedures in place to encourage well-informed decisions on the deployment of AI.

The organizational component "cost to the organization" also displayed a noticeably high MIS of 3.98, highlighting the importance of this element in the landscape of AI adoption. It's clear that participants used the financial ramifications and cost-effectiveness of AI integration as a major deciding factor. The characteristics that received the lowest MIS scores, however, included "risks involved in using innovative technologies" (MIS = 3.61), "reputation of the organization" (MIS = 3.60), and "firm size" (MIS = 3.57). Despite having lower scores, these factors are nonetheless important in the adoption of AI, albeit with a little lower perceived importance than the elements with higher MIS values.

The participant perspectives on the numerous organizational elements impacting the adoption of AI in Pakistan's construction industry are accurately portrayed in the descriptive analysis that is offered. According to the MIS scores, these elements are deemed to be important, with "top management skills," "decision-making support," and "cost to the organization" standing out as particularly significant factors. However, despite receiving a somewhat lower rating, "risks associated with utilizing innovative technologies," "organizational reputation," and "firm size" are still important when discussing the adoption of AI. This report offers a useful starting point for future investigation and discussion of the elements influencing AI adoption in Pakistan's construction industry.

- **Exploratory Factor Analysis**

A crucial statistic in data analysis, the Kaiser-Meyer-Olkin (KMO) measure of sample adequacy, registered an amazing value of 0.895 in this case. The dataset is suitable for factor analysis if this value is greater than the generally recognized cutoff of 0.70. As a result, their aggregation into related sets for the extraction of factors in the exploratory factor analysis (EFA) is justified because the variables under investigation demonstrate acceptable multi-collinearity structures. Additionally, Bartlett's Test of Sphericity produced a significant result at p 0.001, reiterating that the information about the organizational elements influencing AI adoption is definitely appropriate for factor analysis, as shown in Table 4.4.

Table 4.4: KMO and Bartlett's Test

Kaiser-Meyer-Olkin measure of Sampling Adequacy		0.895
Bartlett's Test of Sphericity	Approx. Chi-Square	1298.571
	Df	136
	Sig	0.000

According to Table 4.4, the EFA procedure entailed extracting principal components while being constrained by the requirement of beginning eigenvalues greater than 1. Four components in total were found to be the ideal number of factors for this particular EFA, and they accounted for an astonishing 62.43% of the explained variance, according to the research. According to how they were distributed, the first component was responsible for 41.747% of the variance, the second explained 7.76%, the third explained 6.852%, and the fourth component was responsible for 6.070% of the variance overall. The data's underlying structure is revealed by these findings, which are depicted in Table 4.5 as discrete variables that capture the essence of the organizational determinants driving AI adoption.

Component **Initial Eigenvalues** **Rotation Sums of Squared Loadings**

Table 4.5: Total Variance

	Total	% Of variance	Cumulative %	Total	% Of variance	Cumu
1	7.097	41.747	41.747	3.609	21.228	21.
2	1.319	7.760	49.506	2.924	17.200	38.
3	1.165	6.852	56.359	2.315	13.617	52.
4	1.032	6.070	62.429	1.765	10.383	62.

The organizational factors discovered for AI adoption by Pakistan's construction professionals are grouped into four main component groups in Table 4.6, which provides an in-depth summary of the EFA results. The first component covers the work culture of the company and discusses how employees interact with one another at work, the cost to the company, organizational readiness, standards, and the company's attitude toward innovation. Competitive pressure, information processing management, business size, expertise, competency, and government pressure are some of the characteristics of component 2. Top management abilities, decision-making support, and teamwork shed light on component three. Improved performance, hazards related to adopting AI technologies, and time-saving considerations are all part of component four. A thorough analysis of the dataset's underlying components was supplied by the EFA method, which also gave a sophisticated knowledge of the organizational

aspects driving the adoption of AI in the context of Pakistan's construction industry. The study's analytical depth and interpretative value are increased by the extraction of four major components and their corresponding explanations in Table 4.6. This deepens our understanding of these factors and their interactions.

Table 4.6: Rotated Component Matrix and Cronbach Alpha

		Factor loading	Cronbach alpha
Component No.1	Organization's work culture	0.781	0.835
	The workplace relationship among staff	0.704	
	Cost to organization	0.697	
	Organizational Readiness	0.681	
	Standards	0.515	
	attitude to innovation	0.488	
Component No.2	Competitive pressure	0.726	0.807
	Information Processing Management	0.709	
	Firm size	0.627	
	Knowledge and competency	0.510	
	Government pressure	0.543	
Component No.3	Top management skills	0.763	0.770
	Decision making support	0.762	
	Collaboration	0.710	
Component No.4	Improved performance	0.67	0.667
	Risks involved in using AI technologies	0.629	
	Time-saving	0.623	

- **Confirmatory Factor Analysis**

The generated output from the confirmatory factor analysis produced scores for the fit indices that were moderately favorable, showing that the measurement model demonstrates a respectable fit to the data. The effectiveness of the model was assessed using a number of important fit indicators. First off, the Chi-square value, which was 311.47 and had a p-value below 0.001, indicated a result that was statistically significant. It is important to recognize that Chi-square is sensitive to sample size and that other indices are often more useful for evaluating model fit than Chi-square.

The degree of freedom, which is calculated as 3.42 (CMIN/df), is the ratio of the Chi-square value to the degrees of freedom. This ratio is within an acceptable range even though it is somewhat higher than the optimum cutoff point of 3, suggesting that the model may still be regarded as having a decent fit.

The Root Mean Square Residual (RMR), with a value of 0.072, and the Root Mean Square Error of Approximation (RMSEA), which both had values of 0.12 and 0.12 respectively, are acceptable. These indices increase confidence in the model's overall fit to the data by indicating that it cannot be rejected with a high degree of certainty.

The Goodness-of-Fit Index (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Incremental Fit Index (IFI) were also assessed as important fit indices. Although particular values for the GFI and CFI were not given, they are crucial metrics for evaluating model fit. The TLI (0.781) and IFI (0.838) stated values show that the fit between the measurement model and the data can be judged to be most definitely acceptable, adding to the confidence in the model's suitability.

The findings of the confirmatory factor analysis are summarized in Table 4.7, which shows that the measurement model reasonably aligns with the observed data, as shown by a variety of fit indices. All of these findings support the model's suitability for describing the relationships between variables.

Table 4.7: Fit Indices

Fit indices	Recommended Measure	
Chi-square	Tabled x^2 value	
Significance		<0.(
value Degrees of Freedom		9
CMIN/df	Good <3, acceptable <5	
Root mean sq. error of approx. (RMSEA)	0.05 (very good)-0.1 (threshold)	
Root mean sq. residual (RMR)	0–1 (smaller values = better fit)	
Goodness-of-fit index (GFI)	0 (no fit)-1 (perfect fit)	
Comparative fit index (CFI)	0 (no fit)-1 (perfect fit)	
Incremental fit index (IFI)	0 (no fit)-1 (perfect fit)	
Tucker-Lewis index (TLI)	0 (no fit)-1 (perfect fit)	

Additionally, Table 4.8 shows that the performed model supports the four discovered components' favorable and statistically significant influence on organizational AI adoption. By offering empirical proof of the significance of these characteristics in promoting AI adoption within the corporate setting, this conclusion significantly contributes to the study's goals.

Table 4.8: Regression Coefficients

Factor	Path-coefficient	Standard error	t-value	Significance (p)
Innovative Organizational Culture	0.239	0.069	3.448	0.001
Competence Based Development	0.304	0.082	3.713	0.001
Collaborative decision making	0.161	0.056	2.897	0.004
Strategic Analysis	0.291	0.095	3.07	0.002

- **Descriptive Results**

From the descriptive statistics, top management skills ($\bar{x}$ = 4.02, SD = 0.92, IQR = 4.00), decision making support ($\bar{x}$ = 3.99, SD = 0.81, IQR = 4.00) and cost to organization ($\bar{x}$ = 3.98, SD = 0.99, IQR = 4.00) are the top three highest-ranked in the descriptive analysis ranked highest in the descriptive analysis. However, risks involved in using innovative technologies ($\bar{x}$ = 3.61, SD = 1.10, IQR = 4.00), the reputation of the organization ($\bar{x}$ = 3.60, SD = 1.08, IQR = 4.00) and firm size ($\bar{x}$ = 3.57, SD = 1.11, IQR = 4.00) were the least ranked variables.

These results are in line with the 2020 study by Jöhnk et al., which underlines the critical importance of senior management support for the implementation of AI programs within enterprises. Managers who develop the appropriate skills and knowledge are essential in fostering an environment that supports the adoption and use of cutting-edge technologies. These managers are specifically

entrusted with learning about industry best practices and studying how their rivals have successfully embraced innovation. According to Yusof et al. in 2014, competitive intelligence becomes a useful tool for managers in making decisions regarding the viability and risk of various technologies, which eventually affect the organization's industry reputation and profitability.

This supports McAleenan's research findings from 2020 regarding the significance of decision-making support. As stated by Sepasgozar et al. in 2018, organizations put a lot of work into risk management techniques because they understand that bad judgments and the subsequent requirement to replace subpar technology can cause major delays and large additional expenditures.

Furthermore, the results concur with the viewpoints offered by Pan and Pan in 2020 and Chatterjee et al. in 2020, particularly with regard to the cost element. However, it's important to note that these findings differ from those of Olawumi and Chan in 2020, mainly because establishing an AI infrastructure in a company comes with substantial initial expenses. Bello et al. in 2020 challenge this view by arguing that AI technologies give construction enterprises access to cutting-edge computing infrastructure and apps, each of which could demand a large financial investment. However, over time, this investment leads to decreased overall project delivery costs, providing construction businesses with a clear competitive and operational advantage. It's interesting to note that the conclusions on the dangers of adopting AI differ from those of McAleenan's research from 2020. Diffusion of technology within the construction sector tends to lessen the perceived risks attached to its deployment in the environment. According to Darko et al. in 2017, this in turn affects industrial practitioners' interest in implementing these technologies.

The results also call into question the viewpoint presented by Garca de Soto et al. in 2019 about the maintenance of corporate reputation. In reality, keeping one's reputation and image is very important to construction companies. According to van Heerden et al. in 2018, the implementation of AI not only improves record-keeping but also aids in preventing bad publicity that can sour ties with stakeholders.

The findings in regards to firm size are consistent with Pan & Pan's perspective from 2020. This suggests that when it comes to the creation and adoption of innovation, both small and large firms have distinct benefits. Due to the fact that innovation orientation is influenced by factors other than organizational size, as emphasized by Kamal et al. in 2016, firm size is not a strong predictor of AI-related activity.

An exploratory factor analysis was carried out to fully comprehend the organizational elements impacting the adoption of AI within the Pakistani construction industry. Four clusters were formed by grouping different variables, and confirmatory factor analysis was then applied to these clusters to reveal the links between the constructs. These organizational characteristics as determined by the exploratory factor analysis are illustrated in Figure 4.1.

Fig.4.1: Diagrammatic Representation of the Organizational Factors

- **Component 1 - Innovative Organizational Culture**

Six sub-components make up this particular component, each of which adds to our understanding of the organizational aspects driving the adoption of AI.

Work Culture in the Organization (0.781): This sub-component indicates the overall culture of the organization and how open-minded it is to adopting AI. It implies that the company culture has a significant impact on whether or not AI technologies are integrated successfully.

Interpersonal interactions in the Workplace (0.704): This sub-component emphasizes the significance of interpersonal interactions in the workplace. It implies that friendly working environments can help create a setting that is more favorable for the successful adoption of AI.

Cost to the Organization (0.697): This sub-component places special emphasis on the financial costs of adopting AI. It emphasizes how the decision-making process for integrating AI technology is heavily influenced by cost considerations within the enterprise.

Adaptability of the organization (0.681): This sub-component explores how ready the organization is to incorporate AI. It includes elements like the organization's capacity to negotiate the complexities of AI technology as well as the availability of resources, both financial and human.

Standards (0.515): Organizational standards are crucial for directing the deployment of AI. This sub-component indicates that the incorporation of AI technologies can be

sped up by clearly established standards.

Organizational Attitude Toward Innovation (0.488): The organization's attitude toward innovation plays a significant role in determining the trajectory of its adoption of AI. This sub-component emphasizes that adoption of AI is facilitated by a favorable attitude toward innovation.

According to the table, this group of sub-components accounts for a significant 41.747% of the total variance. A path coefficient of 0.239 and a p-value of 0.001 highlight the importance of this component. These results, however, run counter to the viewpoint offered by Olawumi and Chan in 2020. The findings imply that when there is strong support from the corporate culture, innovation can flourish within businesses. Routines, practices, conventions, and organizational cultures that encourage innovation help organizations make the change from traditional processes to AI technology. It suggests that before successfully integrating AI into their building operations, businesses may need to go through cultural reforms, which is consistent with the findings of Yap and Toh from 2019.

However, it's critical to recognize that many businesses have financial limitations that prevent them from experimenting with innovation. According to Mark et al. in 2021, this restriction inhibits their capacity to learn from and improve upon successful ideas, which ultimately limits their adaptability and attitude toward innovation. According to Enegbuma et al. in 2015, AI delivers a new tool and procedure that has the potential to significantly alter people, processes, communication, and the ineluctable workplace culture.

The perspectives of Chatterjee et al. in 2020, Olawumi and Chan in 2020, and Pan and Pan in 2020 are all supported by these findings. Together, they argue that effective leadership in businesses should take a comprehensive stance in order to influence workers' attitudes and intents about the adoption of new systems.

Another sub-component, organizational preparation, emphasizes the necessity for both financial and human resources in the context of AI adoption in the construction industry. Additionally, it shows that organizational readiness, as proposed by Salazar and Russi-Vigoya in 2021, offers insights into AI maturity assessments, comprising elements like performance, dependability, durability, and operational experience in the predicted environment.

The results also highlight the crucial role that stakeholders in the construction industry play in promoting innovation uptake. As stressed by Yuan et al. in 2021, stakeholders create regulations and standards, provide guidance, and offer assistance, considerably lowering the risks related to the use of AI technologies.

This component and its subcomponents give insight on many organizational elements, including cultural, relational, financial, and preparedness issues, that influence AI adoption. As shown graphically in Figure 4.1, these insights offer a thorough comprehension of the complex processes at play within enterprises as they negotiate the deployment of AI technologies.

- **Component 2 - Competence-Based Development**

Five different sub-components within this component have been found; each one adds to our understanding of the factors affecting the adoption of AI.

Competitive Pressure (0.726): This sub-component emphasizes the significance of industry-level competition as a catalyst for the uptake of AI. It emphasizes how businesses are under pressure to incorporate AI-based developments in order to stay competitive and gain an advantage in their particular industries.

Management of Information Processing (0.709): The management of information within organizations is covered in this sub-component. It means that efficient information management and processing techniques are necessary for the deployment of AI to be successful.

Firm Size (0.627): Within this cluster, firm size is a crucial sub-component. It implies that an organization's approach to adopting AI depends in part on its size. The adoption of AI is influenced by size-related aspects in both small and large enterprises.

Knowledge and Competency (0.510): This cluster's essential sub-components emphasize the value of human expertise and capacities in promoting the adoption of AI. This sub-component's important features are decision-making and competency-based development.

Government Pressure (0.543): This sub-component discusses how government pressures and policies may affect the adoption of AI in the construction sector. It means that policies or laws from the government may have an impact on the adoption landscape.

As seen in Table 4.3, this group of sub-components accounts for 7.760% of the overall variance. Significantly, with a p-value of 0.001 and a path coefficient of 0.304, this component is statistically significant. These results are consistent with the viewpoints offered in 2020 by Olawumi and Chan. They emphasize the crucial part that human knowledge capacities play in supplying the knowledge that businesses need to effectively adopt AI technologies. The integration of numerous knowledge domains and skills, necessary for making informed decisions in a variety of contexts, is a component of competency-based development. As suggested by Lantelme et al. in 2017,

stakeholders can improve their competencies by dealing with a variety of difficult scenarios.

Organizations, especially those in the construction sector, embrace AI-based innovations to keep their competitive edge as a result of competitive pressure. The findings further support the fact that innovation and knowledge transfer speed are crucial for businesses in this industry, where the importance of innovation as a source of sustainable competitive advantage is becoming increasingly clear. According to Sergeeva and Duryan in 2021, project-based firms' use of AI is evidence that they have come to the conclusion that AI plays a crucial role in the creation of new knowledge and capacities.

According to Ghobakhloo and Ching in 2019, the findings highlight the significance of establishing information management capabilities as this is linked to better AI innovation dissemination across the construction industry. According to Alwan et al.'s 2017 discussion, AI provides construction organizations with optimization strategies and opportunities to use information management techniques and collaboration platforms, benefiting a variety of resource flows, including workforce, building information, equipment hire, and material procurement.

According to Mabad et al. in 2021, small construction enterprises in remote locations would have trouble getting access to the requisite knowledge to facilitate AI deployment. The use of AI may be constrained by a lack of broad government backing for infrastructure-building and construction AI initiatives. As Bolpagni and Bartoletti noted in 2021, this frequently leads to decision-makers giving attention to daily operations over the possible long-term advantages of AI.

This component and its sub-components provide valuable insights into the multifaceted factors influencing AI adoption, encompassing competitive dynamics, information management, organization size, knowledge and competency, and government policies. These insights contribute to a holistic understanding of the intricate interplay of influences within the context of AI adoption, as depicted in Figure 4.1.

- **Component 3 - Collaborative Decision Making**

Three different sub-components have been identified within this component, each of which adds to our understanding of the variables influencing the adoption of AI:

Superior management abilities (0.763): This sub-component emphasizes how important senior management capabilities are for promoting AI adoption within enterprises. It emphasizes the need of leadership in staff training, raising public awareness of AI, and successfully deploying cutting-edge technologies. Top management plays a crucial role in making decisions, reforming regulations, and assisting with training to enable AI integration.

Decision Making Support (0.762): This cluster's essential sub-component emphasizes the contribution of AI to helping enterprises make well-informed judgments. It suggests that using AI to help overcome obstacles, conflicts, and anomalies that arise during project execution will ultimately improve decision-making throughout the project's lifespan.

Collaboration (0.710): This crucial sub-component highlights the significance of organizational staff members cooperating to create AI-based systems. It underlines that the chance of adopting AI technology is increased by an organization's capacity for productive collaboration in the development of AI systems.

As seen in Table 4.3, this group of sub-components accounts for 6.852% of the overall variance. With a p-value of 0.004 and a path coefficient of 0.161, this component was not discovered to be statistically significant, which is important.

These results are consistent with the viewpoints offered by McAleenan, Olawumi, and Chan. AI-enabled digital technology, such as collaborative decision making, is characterized as an integrated process that functions in a shared and virtual environment and involves stakeholders from many domains. Stakeholders can evaluate, plan, and carry out projects at various phases of their life cycles using this collaborative approach. In this collaborative setting, effective information transfer is essential for lowering errors, controlling costs, and improving the caliber of communications across various stakeholders. According to Pidgeon and Dawood in 2021, using cutting-edge technologies and governance procedures is also made possible by it.

The results also highlight the significance of advanced management capabilities in the successful application of AI technology in the construction sector. Top management has a major role to play in educating and raising staff understanding of AI as well as weighing the advantages and disadvantages of implementing construction robots. There are several ways to help leadership, including assisting with decision-making, reorganizing procedures to incorporate novel ideas, and offering training support. The importance of AI in decision-making is stressed, especially in reaction to difficulties and anomalies found while carrying out a project. AI is equipped with tools for gathering and reusing knowledge, which can help with decision-making.

The importance of employee collaboration in creating AI-

based systems is underlined as a key element in encouraging the adoption of AI technology. Collaboration and engagement between various stakeholders and specialists are crucial throughout the project life cycle in construction organizations that prioritize projects. However, as noted by Pan and Pan in 2020, reaching agreement on the implementation of innovations among various groups inside these organizations might be difficult.

This component and its supporting sub-components give light on the critical role top-level management abilities, AI-assisted decision-making, and successful collaboration play in the context of adopting AI. Even though this particular component was not statistically significant, these insights help to create a comprehensive picture of the numerous factors that drive adoption.

- **Component 4 - Strategic Analysis**

Three different sub-components have been identified within this component, each of which adds to our understanding of the variables driving the adoption of AI:

Improved Performance (0.67): The significance of AI technology in improving performance within enterprises is highlighted by this sub-component. In numerous facets of construction organizations and projects, it implies that AI tools help to increase prediction, modeling performance, and accuracy. Additionally, AI enables the development of digital procedures and service innovations, which in turn increase perceived fairness, lessen decision-making bias, offer open feedback, and promote better communication.

Risks Associated with AI Technology Use (0.629): This component's sub-component emphasizes the understanding of potential hazards related to implementing AI technologies. It indicates that businesses consider the benefits and drawbacks of adopting AI, understanding that while these technologies may have long-term advantages, they may also present difficulties and demand trade-offs—especially in Pakistan, where AI adoption is still in its infancy.

Time-Saving (0.623): The third sub-component, time-saving, emphasizes the efficiency improvements made achievable by AI technology. AI has the potential to automate processes and lessen human labor, which will help businesses by saving time.

According to Table 4.3, this group of sub-components accounts for 6.070% of the total variance. With a p-value of 0.002 and a path coefficient of 0.291, this component was not determined to be statistically significant, which is an important distinction to make.

These results are consistent with the viewpoints offered by Turner et al. and Mabad et al. An effective organizational strategy is established in large part through strategic analysis. In order to make educated decisions on potential strategies, it entails a thorough study of an organization's resources, capabilities, and external environment. Organizations must balance the advantages and disadvantages of adopting AI while understanding that, despite initial difficulties and sacrifices, there may be substantial long-term gains. A realistic assessment of the available possibilities should serve as the foundation for the sensible selection of solutions.

The results further highlight the importance of AI technology in raising organizational performance. Improved prediction and modeling capabilities provided by AI tools increase the accuracy of many building project components. AI also makes it easier to construct new digital procedures and services, which improves fairness, lessens decision-making bias, creates open feedback systems, and improves communication.

Additionally, the idea of communities of practice is presented, with the hypothesis that these groups could develop into risk-free, loosely coupled operating systems that support organizational learning and innovation. According to Sergeeva and Duryan, such communities can cross functional and project barriers, encouraging creativity and effective problem-solving.

This component and its sub-components shed light on the significance of enhanced performance via AI, the understanding of dangers connected with AI adoption, and the major time-saving advantages that AI technology can give. Despite the fact that this particular component was not statistically significant, it advances knowledge of the elements impacting AI adoption in the construction sector.

V. CONCLUSION, IMPLICATIONS, RECOMMENDATION AND FUTURE RESEARCH

Implications for Research

The adoption of AI and related technologies as well as the investigation of links among organizational factors are two crucial issues that the corpus of existing research on AI in the construction industry has largely ignored. This study fills in these gaps in the literature and greatly advances the use of AI. First off, by throwing light on the organizational elements involved in AI adoption within Pakistan's construction industry, this study contributes to the body of knowledge on AI adoption. It goes deeply into these complexities, offering a thorough and nuanced explanation of their impact on the uptake of AI technologies. Both academics and industry professionals can benefit from this improved understanding of organizational dynamics and how they affect the adoption of AI.

Additionally, this study takes things a step further by examining the connections between these organizational elements. It provides a comprehensive understanding of the AI adoption process by revealing the complicated relationships and correlations between various variables. Professionals in the construction sector can use this comprehensive viewpoint to help them make well-informed choices about how to incorporate AI technologies into their daily operations.

The development of a solid knowledge foundation on the adoption of AI is another benefit of this study. It not only pinpoints the key elements affecting AI adoption but also lays the foundation for useful suggestions meant to speed up the effective implementation of AI methods in the construction sector. These guidelines are helpful for business people that want to use AI to its full potential within their firms.

Additionally, the empirical data produced by this study is a useful tool for both scholars and decision-makers. It offers a concrete dataset that can assist in the creation of strategic road plans for Pakistan's building sector. Furthermore, other developing nations facing comparable opportunities and problems in adopting AI can gain from the conclusions drawn from this study.

This study makes a variety of contributions to the topic of AI adoption in the building sector. It not only identifies the organizational variables affecting adoption but also looks into how they interact. This information guides the creation of strategic roadmaps and serves as the basis for recommendations that are both practical and efficient for the companies in the construction sector.

Implications for Practice

Organizational management could be revolutionized by incorporating AI into a variety of corporate activities and services. Adopting AI technologies can result in significant cost savings while also improving the quality of the goods and services that organizations deliver. Organizations must constantly evaluate their productivity in the highly competitive environment of today, paying particular attention to the important aspects this study has identified. By doing this, they get a strategic edge that enables them to fully utilize the adoption of AI throughout numerous areas of their operations.

Setting and maintaining targets is one of the key areas where AI can have a transformative effect. Organizations can make data-driven decisions, spot performance trends, and modify their plans thanks to AI-driven analytics and predictive models. This data-centric strategy includes streamlining workflows, improving overall accountability within the company, and optimizing key business processes. Organizations can achieve new levels of performance and efficiency by utilizing AI.

Adoption of AI also considerably aids knowledge management techniques. Organizations may create strong institutional knowledge repositories by using AI-powered solutions that make it easier to store, share, and acquire knowledge. This information can be used to encourage creativity, problem-solving, and well-informed choices. A company's ability to profit from its intellectual assets is improved by the seamless integration of AI into knowledge management operations.

Organizational leadership can be crucial in promoting the use of AI. Management and leadership teams must grasp the strategic importance of AI technologies. Organizations can open up prospects for increasing production, improving efficiency, ensuring quality, and promoting teamwork by adopting AI. Adopting AI is not just a scientific undertaking; it is also a strategic necessity that can have long-term advantages.

Additionally, the implementation of AI can aid in resolving some of the industry's persistent problems. The industry has frequently struggled with problems linked to sustainability, safety, and effectiveness. These sectors could be improved by AI technology, which would eventually boost the industry's reputation. AI-driven solutions can improve safety procedures, streamline the building process, and promote sustainable practices, ultimately changing how people view the sector.

However, as businesses begin their adoption of AI journey, a number of challenges and ambiguities must be resolved. Significant obstacles include the lack of common frameworks for different AI technologies, the rising demand for AI solutions, and the requirement for stronger stakeholder participation and collaboration. In addition, it's important to properly negotiate contractual intricacies, legal issues, and regulatory compliance.

Government agencies and business organizations must take the initiative to make AI adoption in the construction sector easier. Organizations may be encouraged to use AI technologies via industry standards and governmental laws. Pilot projects and workshops can be useful tools for showcasing the real-world uses of AI, in line with the factors our study has highlighted.

Additionally, investing in the development of human capital is necessary to encourage the use of AI. Worker attitudes and behavioral intentions can be changed through the use of training programs and initiatives, which will develop a favorable attitude toward the use of AI in the construction sector. The workforce should be given the training that they need to effectively use AI through these initiatives.

Construction organizations, among others, have a transformative opportunity due to the use of AI. It has the ability to improve organizational management, spur efficiency, and boost the sector's perception as a whole. But for these advantages to materialize, there must be a determined effort on the part of the labor, industry associations, and governing agencies. Organizations can successfully implement AI and enjoy the benefits of a more technologically sophisticated future by tackling difficulties, raising awareness, and investing in human resources.

Conclusions

It's still unclear whether AI will be adopted in the construction sector, especially in organizations in underdeveloped nations. In many areas, the actual advantages of AI adoption have not yet been completely appreciated. This paper makes a substantial contribution to the body of academic work on the usage of AI in developing nations. It clarifies the key issues that Pakistan's construction sector must deal with as it tries to integrate AI technologies into its administrative structure. The complexity of AI adoption variables within the construction and associated industries in developing nations has been the subject of many prior studies, but this one stands out because it took a complete approach. It differs from earlier studies in that it uses both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to systematically measure and validate these important constructs.

This research's thorough literature evaluation and empirical inquiry into this knowledge gap resulted in the identification of distinguishing traits relating to AI adoption inside construction industry organizations in developing nations. The comprehensive literature evaluation revealed a wide range of factors influencing the adoption of AI, offering a solid framework for further investigation. The study then used a factor analysis to identify the underlying organizational elements that affect Pakistani construction industry experts. Participants conscientiously completed 169 online questions in total, resulting in a complete dataset.

The study's portrayal of the organizational elements linked to AI adoption in the construction sector is one important feature that distinguishes it from earlier research attempts. This study offers a new viewpoint by using EFA and CFA, techniques that have not been widely applied in the literature found during the Systematic Literature Review (SLR). In particular, the implementation of CFA improves the accuracy and reliability of construct measurement. As a result, it enhances our comprehension of the fundamental elements of these structures and their complex interactions with AI in the construction sector.

A four-part cluster made up of creative organizational culture, competency-based development, group decision-making, and strategic analysis was revealed by the EFA's findings. These characteristics are crucial to understanding the dynamics of AI adoption in the construction industry. Notably, the CFA was crucial in determining the measurement model's suitability and testing for convergent validity, highlighting the accuracy and rigor of the study's conclusions. With a p-value of 0.001, innovative organizational culture and competence-based growth stood out as highly noteworthy.

Future research should aim to solve such limitations as this study advances the conversation on AI usage in the construction industry. Researchers should specifically work to increase the breadth of their systematic literature reviews and get over the restrictions imposed by geographic boundaries. Future research might also look into the feasibility of using the Delphi method to elicit expert-based opinions and promote agreement on the organizational aspects linked to AI adoption in the construction sector. By including the perspectives of subject-matter specialists, this collaborative method would offer a comprehensive understanding of the matter.

Limitations

Although the study's main objective has been accomplished, it is crucial to identify some restrictions that affect the applicability of the inferences made from the results. Notably, the viewpoints and thoughts of Pakistani construction industry professionals are the only ones included in this research. Therefore, any conclusions and interpretations drawn from the study's findings should be placed within the context of Pakistan's particular environment and circumstances. It is crucial to note that the literature evaluation procedure for this study was limited in a number of different ways. It specifically targeted specified categories of papers, narrowed the range of publication years, and concentrated on particular databases. These limitations add a boundedness component to the study's knowledge base, which could affect how generalizable its conclusions are to a larger global or cross-temporal context.

RECOMMENDATIONS

Following are some suggestions made based on the study's findings.

- Organizations should think about changing their traditional work culture to make AI integration easier. Due to the valuable capabilities it offers, boosting productivity, sustainability, and efficiency across construction companies and projects, this change is crucial.

- To improve the knowledge and proficiency of employees, it is advisable to incorporate learning resources and programs for skill development related to AI.
- Additionally, senior management should actively include staff in developing adoption strategies for AI.

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The Probability of Converting Fort Magsaysay Military Reservation to Solar Farms: Towards Generating Funds for the Armed Forces of the Philippines (AFP)

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Abstract— *The Armed Forces of the Philippines (AFP) currently is facing a challenge in its fiscal budget due to the significant percentage of the allocation going to the pension of retired military personnel and the figure continues to grow due to the automatic indexation system. However, the service of retired soldiers should not be set aside considering the time they have spent for the service to the country. There have been related studies conducted to help with this problem and help the AFP obtain funds that can support its budget needs. One of which is the leasing of its vast lands and converting it to higher economic purposes and several moves by the AFP leadership have been made to start with this effort. The previous experience related to this kind of scheme was done through the Bases Conversion and Development Authority (BCDA). This however includes the leasing and sale of defense land specifically identified under the law. The leasing and sale of defense real estate under the management of BCDA are located within the proximity of urban areas like FBGC, Subic, and Clark which in the case of other military lands cannot follow a similar land use due to their location. Conversion of military base lands for higher economic purposes can however take a different turn by converting them as industrial sites and with that the researchers see fit the erection of solar power plants, especially in the Fort Magsaysay Military Reservation which is by far the largest military reservation the AFP now has. Based on research, the Fort Magsaysay Military Reservation is within the area with the highest solar radiation as compared to other areas tested. Besides that, with the current thrust of the government to increase the contribution of green energy to the energy mix of the country, this is an opportunity for the AFP to open such possibilities of using military lands for higher economic purposes as a source of additional funding.*

Keywords— ***Armed Forces of the Philippines (AFP), Economic Purposes, Funds, Military Reservation, Solar Farms***

I. INTRODUCTION

The Department of National Defense (DND) under which the AFP is under its umbrella increases its budget annually. In 2019, the proposed budget for 2020 climbed up to P258 billion, an increase of 1.43%. However, much of it will go to the pension of retired personnel which represents 29% and continues to grow because of the automatic indexation system, which adjusts the retiree's pension to the prevailing salary of active personnel of the same rank. From the said budget, 46% will go to personnel services, 16% to maintenance and other operating expenses, and 11% to capital outlay. Not to mention the capability development program which also needs a separate budget that is outside of the said allocation.

This matter sounded an alarm and lawmakers are now looking into some solutions to address the problem because mere dependence on the General Appropriations Act (GAA) is not sustainable and could lead to fiscal collapse. Given the situation, DND, the AFP in particular, needs another source of funds to support its financial needs. One option generated was leasing its numerous idle lands for other economic purposes.

The DND has already issued a Department Circular allowing the lease of the agency's real estate property to raise funds. Besides that, a memorandum of agreement has also been signed between the AFP and PEZA for the future use of military reservations as defense industrial ecozones.

Recently the Department of Energy in its circular No. 2022-11-0034 stated that 100% foreign ownership of businesses engaged in the exploration, development, and utilization of solar, wind, hydropower, and ocean energy is allowed. Besides that, one of the top priorities of President Marcos is renewable energy wherein policy reforms have been implemented aimed at helping the country increase its share of renewable energy in the energy mix. (Ruth Abbey Gita-Carlos, PNA, 2023).

With all these coming into place, there is now a probable demand for available real estate for building potential investors' energy facilities. Any venture that would involve this will require a vast area of land to build the required infrastructure. This is now where Fort Magsaysay Military Reservation fits in in conversion, utilizing idle lands for energy production.

II. METHODOLOGY

This research is descriptive in type. It was made to provide a study to determine the probability of converting Fort Magsaysay Military Reservation for higher economic uses, the construction of solar farms in particular for emergency needs of AFP personnel and Novo Ecijanos (Subia, Mangiduyos & Turgano, 2020). Fort Magsaysay is situated in Palayan City, Nueva Ecija.

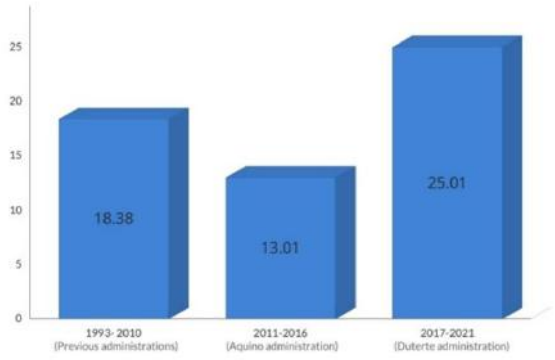
Data gathering focused primarily on document analysis of information related to the possible conversion of the military reservation and the basic requirements that the location should meet to consider it a viable location for its intended purpose. Adding to that is the interview with concerned people who have direct knowledge regarding the case of the military reservation and focus group discussions.

III. RESULTS AND DISCUSSION

Military Reservation Conversions for Economic Uses.

Several military reservations have been converted for higher economic uses that now generate income. In the case of Fort Bonifacio, Subic, and Clark which were converted into a metropolis and Freeport zones under the management of the Bases Conversion and Development Authority (BCDA). The BCDA has contributed to the AFP PhP 56.4 billion from the disposition of its assets proceeds from 1993 to 2021. Table 1 shows the comparative contribution of BCDA to the AFP.

Table 1. Contributions of BCDA to the AFP



Note: Reprinted from https://www.bcda.gov.ph/news/bcda-contributes-record-p25-b-afp-during-duterte-admin

Probability for other land use

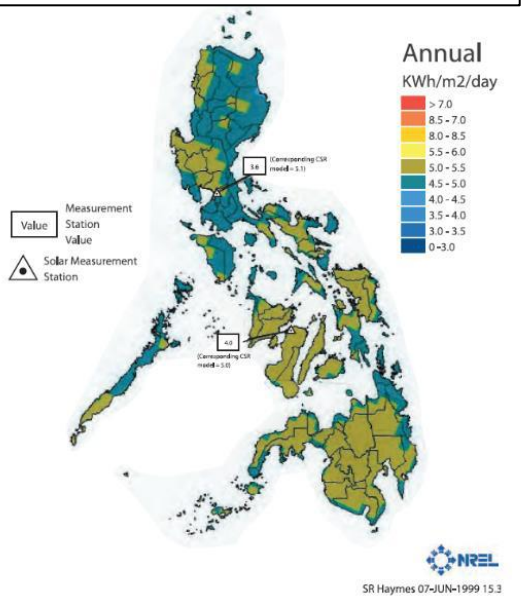
In 2022, the Department of Energy issued circular DC2022-11-0034, which removes the nationality requirement for businesses that explore, develop, and use solar, wind, hydropower, and ocean energy and allows foreign capital to flow into the RE industry of the country. Relatively, the Department of National Defense issued Department Circular Number 13 in 2020 which amends Circular No. 23 thereby providing additional guidelines on

the lease of real estate properties of the Department of National Defense. This now provides a basis for allowing the Fort Magsaysay Military Reservation to be leased to prospective investors who may utilize the land for the possible erection of renewable energy facilities subject to the provisions of the circular and existing laws.

The viability of the Province of Nueva Ecija as a site for solar farms is proven to be promising because based on the study of the US- National Renewable Laboratory (NREL) using Climatological Solar Radiation (CSR) model, the Philippines has an average daily insolation of 5 kilowatt-hour per square meter. Figure 1 illustrates the CSR model.

On a similar note, the study on Solar Energy Resource Assessment Using R. Sun in GRASS GIS and Site Suitability Analysis Using AHP for Ground-mounted Solar Photovoltaic (PV) Farm in the Central Luzon Region (Region 3), Philippines concluded that there is a good amount of solar energy resource potential in the region (Region 3). Further, the suitability of the region according to the criteria established in the study (Physical, Environmental, Socioeconomic, and Risk) indicates that almost the entire region is good for installing ground-mounted solar PV farms, except protected areas, flood-prone areas, and other places where it's not possible. Figure 2 shows the site suitability for ground-mounted solar PV Farms in Region 3.

Figure 1. Climatological Solar Radiation Model



Note: Reprinted from https://policy.asiapacificenergy.org/sites/default/files/NREP_red.pdf

Power Demand

The establishment of RE energy facilities is expected to continue because of the government's desire to increase its share in the energy mix of the country. Targets established from NREP state that RE-based capacity installation targets, in Luzon, is 228.05 MW in 2015 from zero in 2010 wherein the total capacity addition aimed until 2030 is as mentioned.

Solar Farm Estimated Electricity Generated and Gross Profit

Based on the research entitled Cost-Benefit Analysis of Converting Agricultural Land into Solar Farm Using RS & GIS: Case of Tarlac Province by A. D. de Luna et al. (2021), in the study by Pojadas et al., the amount of energy made was estimated using values that were not special to Bohol but instead were for the whole of the Philippines. This is because there aren't enough facts. The values they used to estimate were the capacity factor (CF), which is the ratio of the maximum output to the actual output over a period (Understanding Energy Capacity and Capacity Factor, 2021). It was estimated to be 14.6% using data from the only weather station in the Philippines, which is in Manila. In their study, they took the average of power density (PD) of the 30 current solar farms in the country and found that it was 100MW/km2.

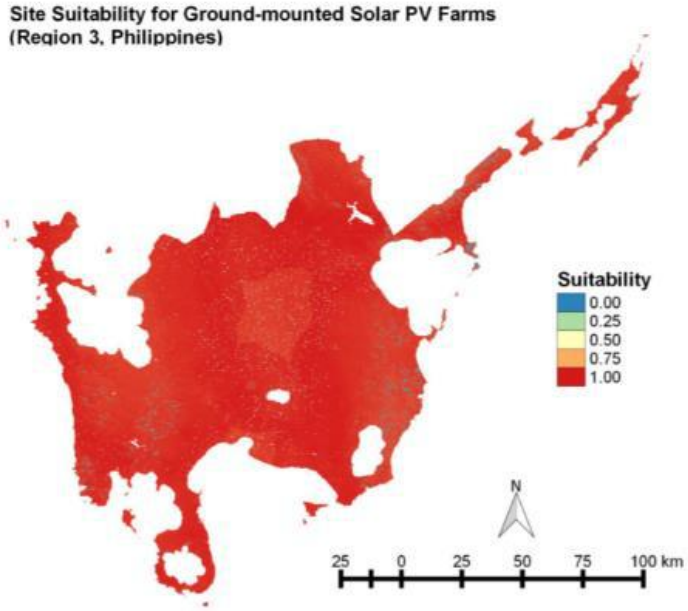
Further, according also from the same research, Agaton (2018) compared renewable energy sources against

coal as a means of generating electricity in the Philippines. The local energy price in the Philippines was utilized in the calculation of the gross profit from a solar farm, which came to Php 9045.05 per MWh.

Income generated by RE plants is assured based on the ERC-approved Feed-in Tariffs (FIT) rates. If the market operator's payments are insufficient, the remaining FIT cost of generated electricity will be paid by consumers through the FIT-allowance (FIT-All) charge per kilowatt-hour (kWh) on our electricity invoices, in other words, there is assurance on the purchase of energy generated.

Comparing the different companies that have revenues from the sale of electricity generated from solar power is very promising as the RE industry continues to grow. Shown in Table 1 is the comparative revenue of identified companies out of the sale of electricity. Although there was a slight decline in revenue between the years 2020 and 2021, experts recognize the effects of COVID-19 that significantly reduced the consumption of electricity during lockdowns.

Figure 2. Site Suitability for Ground-mounted Solar PV Farms (Region3)



Note: Reprinted from https://scholarworks.umass.edu/foss4g/vol15/iss1/3/

Table 1. Revenue of Companies from the Sale of Solar-Generated Electricity

Revenue of Companies from the Sale of Electricity from Solar Energy			
Company	Annual Revenue from Sales of Electricity		
	2021	2020	2019
Citicore Energy REIT Corp	334,519,230	269,076,808	248,010,727
Kirahon Solar Energy Corporation	172,441,291	180,702,522	181,679,438
Raslag Corp	291,762,524	395,881,509	284,305,500

IV. CONCLUSION

In conclusion, the gathered data provide a reasonable basis for considering Fort Magsaysay Military Reservation to be used for higher economic purposes that will become an additional source of funds for the AFP. Based on the results and discussion the following conclusions were made:

1. The inclusion of Nueva Ecija as a suitable place for solar farms makes the location more attractive considering the maximum power that can be generated.

2. The government's program of increasing the share of RE energy in the country's energy mix considering the growing electricity demand would later on require vast areas to erect RE energy sources solar farms in particular in places where it is highly suitable.

3. There is a probability for the Fort Magsaysay Military Reservation to be converted for higher economic purposes, particularly as an RE production site, and if leased to potential investors could contribute a source of additional funds for the AFP.

4. The financial performance of RE companies is promising, hence a probable source of income for the AFP in the form of a lease.

On the other hand, the study has primarily emphasized the climatic suitability of the Military Reservation and the laws allowing its use for economic purposes, hence it is proposed that additional study be made in the following areas:

1. A detailed survey to identify the exact suitable location and extent of usable area based on land requirements for solar farms.

2. Additional study about the profitability analysis of solar farms about the leasing of lands for such industry.

3. A study on the terms of an agreement on the lease of land that could bring a win-win situation for the AFP and the potential investor.

4. A study on mitigation initiatives and economic loss prevention could be conducted by future researchers (Subia, Jocson, & Florencondia, 2019).

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Advantages and Disadvantages of Implementing Modern Agricultural Technology and Development Initiatives on Climate Change and Financial Support for Small-Scale Farmers in Nueva Ecija

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Abstract— *This study explores the complex and diverse field of modern agricultural technology and development programs, uncovering a contrast between advantages and disadvantages. The responders' wholehearted adoption of sophisticated methods highlights the favorable influence on agricultural output, efficient use of resources, and economic sustainability, demonstrating a shared commitment to sustainability and higher yields. Nevertheless, the utilization of these technologies presents notable challenges, such as concerns regarding the quality of the products, increased vulnerability to pest infestations, and financial constraints on agricultural practitioners. To address these issues, it is crucial to adopt a comprehensive approach that encompasses not only the integration of technology but also the mitigation of related difficulties. When considering the particular situation in Nueva Ecija, the implementation of innovative agricultural technology shows potential for small-scale farmers. This is evident in the establishment of strong agreements about empowerment, market-oriented financial services, equitable pricing, and superior productivity. In contrast, the New Agricultural Technology and Development Program in Nueva Ecija has financial drawbacks, highlighting the limitations of the biosphere, the necessity for cutting-edge technologies, heightened financial burdens, and difficulties in fulfilling program requirements. These issues raise concerns about accessibility and financial stress among members of the agricultural community.*

Keywords— ***Agricultural technologies, Climate change, Farmers, Financial program, Nueva Ecija***

I. INTRODUCTION

There has been a drastic transformation in agriculture over the past 40 years. The practices are evolving to embrace new technology. The agricultural sector is one of the mainstays of every economy in the world. There is a high demand for food which is a challenge because there are constraints in supply due to climate change and high labor costs. Every decade, there is a continuous revolution of technology in the agricultural industry. Modern agricultural technology increases employment and food production efficiency, saving time and cost reduction. Farmers gain significant benefits from high innovation of technology. Farming is part of entrepreneurship and a business that depends on nature. However, agriculture is not all about success; farmers are also faced with challenges that are unavoidable like typhoons, el niño, and pests. These problems are caused by enormous changes in climate because of the increase in greenhouse emissions that lead to global warming, the use of fossil fuels, deforestation, and other factors (Foster &

Heeks, 2019). The Philippines is notoriously vulnerable to natural disasters, facing around 20 typhoons each year. For farmers, one typhoon or tropical storm could be enough to wipe out the entire crop. Starting over with the work can be expensive and time-consuming. As a result, 57 percent of agricultural households are impoverished. In comparison, non-agricultural households are three times less impoverished (Thelwell, 2019).

Nevertheless, challenges may limit gains as the digital divide in agriculture is also characterized by ineffective knowledge exchange, management of information content as well and limited human and institutional capacity. Many promising examples of positive digital impacts on small-scale agriculture development have often yet to scale up (Deichmann et al., 2019). New government policies could address inequality and social exclusion by reducing structural roadblocks to drive inclusive innovation. A strong political will is needed to develop small-scale agriculture that involves family farmers, rural women, indigenous communities, youth, and other valuable or marginalized people in rural areas. ICT and agricultural sector policymakers need to support this new technology revolution using digital development, as many social implications have been ignored.

Digital development is described by Heeks 2020 as a socio-technical system where digital technology and society are interrelated as they shape each other. Heeks 2018 further describes these socio-technical systems as of an economic, political, and social nature that are involved in the design use, and governance of digital development.

Discussions about digital technology adoption by small-scale farmers related to the global role of digital technology adoption to exploring the part of digital technology adoption at the farmer level. To start this discussion, a need to capture the economic, political, and social factors affecting these socio-technical systems. This reinforces the requirement to understand the current state of research identifying knowledge gaps, similarities, and differences. Digital technology and innovations will be leveraged throughout the food value chain and logistics, starting with the efficient distribution of inputs to farmers enrolled in the Registry System for Basic Sectors in Agriculture (RSBSA). The automated system will improve farm productivity and cut waste by using analytics to facilitate data-driven farming practices for small farmers (Technology and Innovation Including Digital Agriculture-Official Portal of the Department of Agriculture, 2021).

Digital innovation is vital in improving agricultural production and the value chain, such as post-harvest, transport, and storage (Corallo et al.,2018). Food traceability systems using digital platforms have become vital risk management tools to contain food safety problems and promote consumer confidence. Digital-enabled marketing helps to increase intra-company efficiency and competitiveness in markets. Microfinance institutions (MFI) are formal institutions whose primary business is providing financial services to low-income persons under various institutions, traditional forms, and small informal interactions in developing and newly industrialized countries that are economically excluded from the conventional banking sector. Digital technologies can support trade in agriculture and food products, by connecting private sector suppliers to new markets and enabling new ways for governments to monitor and ensure compliance with standards and to provide faster and more efficient border procedures that are essential for perishable products (Technology and digital in agriculture – OECD). Financial services provided by MFIs include uncollateralized microloans or micro-loans with unconventional collateral through standard micro-lending technology. Agriculture is an important sector of the economy, employing about 70% of the total active labor force and contributing about 40% of the Gross Domestic Product (GDP). Farmers have been described as being very poor with low income, especially in rural areas where the farmers are facing low agricultural production (Juma, C. (2019). For this reason, they are unable to provide enough funds for agrarian activities. Though not visible, welfare could represent the people's standard of living. In theory, a household's consumption expenditure on food and education is used as an alternative welfare indicator. Large household size contributes to poor productivity, affecting farmer's welfare status, reducing household income generation, and reducing household development level. Many households' especially in rural areas which cannot afford to purchase necessary farm inputs or implement such as fertilizer, pesticides, and improved seeds, bring about productivity increases and hence, increase household income which will proactively affect the socio-economic well-being of household positively.

II. METHODOLOGY

The researchers employed a descriptive research method to investigate the impact of the New Agricultural Technology and Development program on Climate Change and Finance for Small-Scale Farmers in Nueva Ecija. The study aimed to determine the effects of these programs on climate change mitigation and adaptation, as well as the financial implications for small-scale farmers. Descriptive research is suitable for such studies, as it provides general information without influencing the data collected, making it appropriate for exploring these phenomena.

The study used descriptive statistics, including frequency count, weighted mean, and percentage, to analyze the impact of the New Agricultural Technology and Development program on Climate Change and Finance for Small-Scale Farmers. Frequency count determined how often each variable occurred, while central tendency measures, such as the mean, summarized the data. The percentage formula was employed to calculate the frequency and percentage based on responses from the participants.

The analysis aimed to understand the advantages and disadvantages of the New Agricultural Technology and Development Program on Climate Change and Finance, particularly concerning consumption and farmers. To achieve this, the researchers used the weighted mean formula, which involves multiplying each data point by a value determined by some characteristic relevant to that data point. This approach helped in assessing the different aspects of the program's impact on small-scale farmers and generating possible recommendations for addressing any encountered disadvantages related to consumption and farming.

III. RESULTS AND DISCUSSION

1. The Advantage of the New Agricultural Technology and Development Program on Climate Change;

Table 1 presents the advantages of the New Agricultural Technology and Development Program on Climate Change. It determines the factors in terms of consumption and farmers.

Table 1. The Advantage of New Agricultural Technology and Development Program on Climate Change

STATEMENT	WEIGHTED MEAN	ADJECTIVAL RATING
A. CONSUMPTION		
a. Higher crop productivity	3.55	Strongly Agree
b. Decreased use of water, fertilizer, and pesticides, which in turn keeps food prices down	3.05	Agree
General Weighted Mean	3.30	Agree
B. FARMERS		
a. More farmers are engaged in buying agricultural technology	3.67	Strongly Agree
b. More farmers are highly encouraged to participate in the development program	3.25	Strongly Agree
General Weighted Mean	**3.46**	**Strongly Agree**
Overall General Weighted Mean	**3.38**	**Strongly Agree**

In terms of consumption, the affirmation of "The Advantage of New Agricultural Technology and Development Program on Climate Change" is underscored by the respondents' strong agreement (3.55) with the proposition that it leads to higher crop productivity. This suggests a widespread acknowledgement of the positive impact of modern agricultural advancements on output. Moreover, the consensus (3.05) in agreement with the statement about decreased use of water, fertilizer, and pesticides reflects an understanding of the broader implications, as it not only contributes to environmental sustainability but also has economic ramifications by keeping food prices down.

For the farmers, the assertion that "The Advantage of New Agricultural Technology and Development Program on Climate Change" resonates strongly with respondents, as evidenced by the robust agreement scores of 3.67 and 3.25 for the statements indicating that more farmers are engaged in buying agricultural technology and are highly encouraged to participate in the development program, respectively. These results suggest a widespread enthusiasm among farmers for adopting new agricultural technologies and participating in climate change-focused development programs.

With technology, farmers can put in less physical effort, at times even less investment, and still see bigger crop yields at the end of the year. For example, one acre that once yielded 125 bushels of corn may get analyzed, irrigated, and fertilized so precisely that the same acre can yield 150 bushels or more. With technology, producing

everything from livestock to vegetables is a data-driven, scientific process with substantial gains involved.

2. The Disadvantages of New Agricultural Technology and Development Program on Climate Change;

Table 2 discusses the Disadvantages of the New Agricultural Technology and Development Programs on Climate Change. It determines the factors in terms of consumption and farmers.

Table 2. The Disadvantages of New Agricultural Technology and Development Program on Climate Change

STATEMENT	WEIGHTED MEAN	ADJECTIVAL RATING
A. CONSUMPTION		
a. Harder for farmers to yield a better product	2.65	Agree
b. Armyworm attack (Pest)	3.52	Strongly Agree
General Weighted Mean	3.08	Agree
B. FARMERS		
a. More farmers are engaged in buying expensive agricultural technology	3.67	Strongly Agree
b. More farmers are highly encouraged to participate in the development program which entails additional cost	3.47	Strongly Agree
General Weighted Mean	**3.57**	**Strongly Agree**
Overall General Weighted Mean	**3.32**	**Strongly Agree**

As to consumption, the implementation of new agricultural technology and development programs to address climate change presents certain drawbacks, as highlighted by the findings. Firstly, there is a concerning impact on consumption, with farmers facing increased challenges in yielding superior products. This could be attributed to the complexity and adjustment period associated with adopting advanced agricultural technologies. Moreover, the study reveals a noteworthy issue of armyworm attacks, signalling a strong agreement among participants. The prevalence of pests like armyworms poses a significant threat to crops, undermining the intended benefits of technological advancements. As such, these disadvantages underscore the need for a comprehensive approach that not only integrates innovative technologies but also considers strategies to mitigate associated challenges, particularly in the realm of pest control,

The findings reveal significant drawbacks of modern agricultural technology adoption, as farmers strongly agree that it involves buying expensive equipment. This financial burden may limit accessibility, exacerbating economic disparities. Additionally, the high encouragement for participation in costly development programs adds financial strain, emphasizing the need for equitable and affordable technology integration to support widespread agricultural advancement.

3. Advantages of New Agricultural Technology and Development program on Finance and Financing of Small-Scale Farmers of Nueva Ecija.

Table 3 presents the Advantages of the New Agricultural Technology and Development program on Finance and Financing of Small-Scale Farmers of Talavera, Nueva Ecija. It determines the factors in terms of consumption and farmers.

Table 3. Advantages of New Agricultural Technology and Development Program on Finance and Financing of Small-Scale Farmers of Nueva Ecija

STATEMENT	WEIGHTED MEAN	ADJECTIVAL RATING
A. CONSUMPTION		
a. Empower poor farmers to increase their wealth and facilities for the development of the value chain	3.45	Strongly Agree
b. Provide market-based financial services and fund long-term and green investments to support sustainable agriculture and agri-food value chains.	3.20	Agree
General Weighted Mean	3.32	Strongly Agree
B. FARMERS		
a. Farmers can sell their products at the right price.	3.05	Agree
b. Farmers can produce high-quality products	3.47	Strongly Agree
General Weighted Mean	**3.36**	**Strongly Agree**

Table 3 shows the adoption of new agricultural technology and development programs in Nueva Ecija yields promising financial advantages for small-scale farmers. Strongly agreeing that these initiatives empower impoverished farmers to enhance their wealth and contribute to value chain development, it reflects a potential uplift in economic conditions (WM=3.45). Moreover, the agreement on providing market-based financial services and funding for long-term, green investments signifies a commitment to sustainable agriculture (WM=3.20).

The endorsement of farmers being able to sell products at fair prices (WM=3.05) and produce high-quality goods (WM=3.47) reinforces the positive impact of technology, fostering economic viability and elevating the overall agricultural landscape in Nueva Ecija.

4. The Disadvantages of New Agricultural Technology and Development Program on Finance and Financing of Small-Scale Farmers of Talavera, Nueva Ecija;

Table 4 presents the Disadvantages of the New Agricultural Technology and Development program on Finance and Financing of Small-Scale Farmers of Talavera, Nueva Ecija. It determines the factors in terms of consumption and farmers.

Table 4. The Disadvantages of New Agricultural Technology and Development Program on Finance and Financing of Small-Scale Farmers of Talavera, Nueva Ecija

STATEMENT	WEIGHTED MEAN	ADJECTIVAL RATING
A. CONSUMPTION		
a. Limits of the biosphere today are much more pressing compared to the resources available during the green revolution	3.45	Strongly Agree
b. Production of more and better-quality food with a lower impact on the environment will require the use of new agricultural technologies, new varieties of crop and animal stock	2.27	Agree
General Weighted Mean	3.11	Agree
B. FARMERS		
a. More farmers will need technology for farming	3.76	Strongly Agree
b. Farmers need to complete all the requirements in programs in agriculture.	3.45	Strongly Agree
General Weighted Mean	**3.60**	**Strongly Agree**
Overall General Weighted Mean	**3.35**	**Strongly Agree**

Table 4 shows the New Agricultural Technology and Development Program in Nueva Ecija face notable financial disadvantages for small-scale farmers. Strong agreement on the pressing limits of the biosphere (WM = 3.45) and the need for advanced technologies reflects challenges in balancing resource constraints (WM=2.27). While acknowledging the necessity of new technologies for sustainable, quality food production, the overall agreement remains at a moderate level.

Furthermore, the strong agreement that more farmers will require technology underscores potential financial burdens (WM=3.76). Completing program requirements, strongly agreed upon (WM=3.45), adds another layer of complexity, raising concerns about accessibility and the financial strain on small-scale farmers in Nueva Ecija.

IV. CONCLUSIONS

The following conclusions were recommended based on the findings of this study:

1. Modern agricultural technology has advantages on crop productivity, resource efficiency, and economic viability, highlighting the enthusiasm of the respondents for adopting advanced techniques that contribute to environmental sustainability and increased yields.

2. While the implementation of new agricultural technology and development programs aimed at addressing climate change offers promising benefits, the study underscores the presence of significant drawbacks, including challenges in product quality, increased susceptibility to pest attacks, and financial burdens on farmers emphasizing the imperative for a holistic approach that addresses not only technological integration but also mitigates (Subia, Jocson, & Florencondia, 2019) associated challenges to ensure sustainable and equitable agricultural advancement.

3. The adoption of new agricultural technology and development programs in Nueva Ecija holds promising financial advantages for small-scale farmers, as evidenced by strong agreements on empowerment, market-based financial services, fair pricing, and high-quality production, reflecting a potential uplift in economic conditions and a commitment to sustainable agriculture.

4. The New Agricultural Technology and Development Program in Nueva Ecija poses notable financial disadvantages for small-scale Novo Ecijano farmers (Subia, Mangiduyos, & Turgano, 2020), as indicated by strong agreements on biosphere limits, the need for advanced technologies, the anticipation of increased financial burdens, and the challenges associated with meeting program requirements, emphasizing concerns about accessibility and financial strain within the agricultural community.

RECOMMENDATIONS

The following were recommended based on the conclusion and findings of the study:

1. For consumption-related challenges, it is highly recommended to develop and implement agriculture finance strategies and instruments that attract private capital, thereby deepening resilient agriculture finance markets.

2. To address financial constraints, conducting diagnostic studies, including the Financial Sector Assessment Program (FSAP), is highly recommended to reform public policies and regulations, creating an enabling environment for mobilizing agricultural finance.

3. Regarding farmers, a highly recommended initiative involves operating a specific program and community of practice focused on financial cooperatives, recognizing their crucial role as providers of financial services to smallholder farmers, rural MSMEs, and households.

4. Farmers' successful participation in agriculture programs is highly recommended, emphasizing the importance of completing all program requirements to maximize the benefits for both farmers and the agricultural sector.

5. Overall, it is highly recommended to prioritize and implement the suggested strategies across consumption and farmer-focused initiatives to achieve a comprehensive and impactful improvement in the agricultural sector.

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Pros and Cons of Utilizing Audit Process Project Management Software in the Internal Audit Functions of Universal Banks

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Abstract— *This paper explored the integration of automated solutions, such as Audit Process/Project Management Software, as a cornerstone of global innovation and digital upskilling to modernize internal audit operations. It delves into how these automated solutions can enhance internal audit efficiency and elevate its organizational value on a large scale. Also, the disadvantages of using this system were studied. Respondents strongly affirm the significance of automated workflows, real-time audit dashboards, centralized audit libraries, defined audit universes, and tracking engagement resources, costs, and timesheets in automated audit project management. Furthermore, the benefits of technology, specifically an Audit Management System, are explored in depth. The respondents express strong agreement on advantages such as heightened productivity, real-time supervisory review, a secure centralized platform for audit projects, expanded audit coverage, and improved collaboration among team members. However, the research also delves into the challenges associated with automation adoption in internal audits, revealing unanimous concerns about high investment costs, management buy-in hurdles, and the necessity for frequent updates and customization. These findings contribute valuable insights for organizations navigating the integration of technology into internal audit processes, balancing benefits with potential drawbacks.*

Keywords— ***Digital upskilling, Internal audit process, Project management software, Pros and cons, Universal banks***

I. INTRODUCTION

Internal Audit (IA) serves as an independent and objective assurance and consulting function, aimed at enhancing organizational value and operational efficiency. By conducting in-depth assessments of governance, risk management, and internal controls, IA supports management and the Board. Consequently, IA holds the authority to evaluate all organizational processes, systems, units, and activities, including outsourced services. While ensuring corporate governance and general controls remain a primary responsibility, IA's scope has expanded to encompass emerging risks, trends, and technologies, as well as the analysis of opportunities and global issues about critical business operations. This diverse range of functions necessitates a systematic and disciplined approach to performing the extensive range of IA activities, ensuring both quality and efficiency.

The development of technology nowadays has expanded comprehensively to various sectors, starting from the education sector, politics, administration, and economy, and especially in the field of accounting (Yasmin, Arifia et.al, 2023). In response to the new normal, many organizations have embraced data analytics, automation, and collaboration tools to accommodate their hybrid

workforces and evolving market demands. However, this rapid technological advancement has also introduced a host of challenges for internal audit functions, particularly in the context of emerging business models. These challenges include heightened cybersecurity threats, potential process degradation, disruptions to control or compliance activities, increased customer fraud risks, and growing concerns over data privacy. The ever-changing nature of digital technologies intensifies competition and drives the need for companies to innovate at an accelerated pace. For businesses, neglecting the importance of digital technologies has never been more dangerous (Ali, 2022). In an automated environment, firms need to adopt cutting-edge technologies for their departments to be able to gain serious competitive advantage, or in some industries, just to survive, considering the aggressive competition in today's fast-changing marketplace. (Oweis, 2022)

Internal audit functions are actively exploring the integration of technology into their business and project management processes to enhance their digital capabilities, work more efficiently, and deliver greater value to their organizations by providing effective risk assurance. The internal audit typically encompasses five phases: enterprise-wide planning and risk assessment, engagement planning, fieldwork, reporting, and monitoring. These phases involve a variety of interconnected procedures and tasks that are often performed manually by internal auditors. Thus, the presence of well-functioning information and communication technologies emerges as a critical facilitator for effective remote communication, collaboration and data exchange (Jarva & Zeitler, 2023). However, due to a broad internal audit scope with limited manpower/resources, most organizations fail to efficiently manage the overall internal audit processes and optimize the expected benefits of conducting internal audit activities. Thus, by using Business processes and project Management Automation, internal audit functions can perform their overall activities with minimal human intervention and complete their tasks at a higher speed with a lower error rate.

Internal auditors must have sufficient knowledge of key information technology risks and controls and available technology-based audit techniques to perform their assigned work (Institute of Internal Auditors, 2019). Internal auditors also need multiple computer-based competencies required to plan and perform internal audit engagements, including applied knowledge- and expert-level competencies related to computer-assisted audit tools and techniques and data analytics methods (Institute of Internal Auditors, 2022).

To tackle the complexities of intertwined internal audit processes, numerous technology service providers offer business process and project management solutions and software designed to enhance internal audit efficiency. These specialized tools employ robotic process automation and dynamic workflows to automate repetitive tasks and streamline collaboration throughout the entire audit lifecycle. Audit process and project management software possesses the capability to automate all phases of the audit process, offering additional features such as report generation and trend analysis, time and expense tracking, audit milestone tracking, and oversight of outstanding audit issues. Moreover, higher usage of technology-based audit techniques is associated with improvements in the effectiveness and efficiency of audit work (Wood et.al. 2022). This results in audit teams gaining speed and efficiency while reducing errors and time spent on manual tasks and activities. Moreover, Information technology reduces the cost of auditing by reducing the size of the audit team (Constantino & Sapateiro, 2016). Big data demands and enterprise resource planning (ERP) systems are now commonplace in the business environment and not restricted to larger audit engagements (Vaserhelyi, M., et. al., 2014). Moreover, automated audit management software facilitates continuous audit services using offline features and remote work mode which is in line with internal audit's mandate of assisting the organization in navigating new normal processes despite crisis and difficult operational periods. This remote audit was also implemented as a form of auditor response and adaptation in continuing the audit process during the Covid-19 pandemic (Eulerich & Wagener, 2021). By adopting automation and other technological tools, audits can drive productivity in monitoring controls, provide greater coverage across large data, time and cost savings that can be redirected to higher priority tasks, and allow for enhanced transparency inside an organization (Lacurezeanu, Tiron-Tudor & Bresfelean, 2020).

Audit process and project management software are specifically tailored to address the contemporary challenges faced by internal audit functions, aiming to transform them from operational specialists into trusted advisors. By harnessing the power of technology, internal audit teams can expand their audit capacity, proactively navigate emerging risks and trends, and effectively provide the Board and Management with robust insights on critical matters, enabling more informed and risk-conscious decision-making. Embracing digitization, internal audit functions are streamlining their internal processes and exploring the potential of big data and new digital tools to enhance value for their stakeholders. This digitization can refine the quality of internal audit services, while automation can elevate the overall quality of audit findings and recommendations.

Specifically, this study addressed the following:

1. Describe the most common challenges of internal audit functions in terms of audit process and project management without the aid of an automated audit process management system.
2. Describe the important features and capabilities of the automated audit process/project management system as perceived by internal audit professionals using the automated solution.
3. Describe the benefits and advantages of automation in internal audit operations to enhance its organizational value.
4. Describe the disadvantages and challenges of automated audit process/project management systems in internal audit operations.

II. METHODOLOGY

The descriptive research design was utilized in this study to describe (Subia, Mangiduyos, & Turgano, 2020) the pros and cons of implementing an audit process and project management automation

The respondents of the study who were chosen purposively (Subia, 2018) were selected internal auditors of various universal banks in the Philippines who utilize automated audit management software in their respective internal audit functions. The researchers used a purposive sampling procedure in the selection of the respondents of the study. The criteria for selection of respondents depend largely on the context of internal audit functions of Philippine universal banks which utilize an automated audit process and project management software.

A survey questionnaire was developed and distributed to fifty (50) selected internal auditors who are using business process and project management software in their respective internal audit functions. Fifty (50) valid responses were obtained and used in data analysis. The researcher also conducted a review of published documentation and articles relative to manual and automated audit processes to acquire additional knowledge and information on the subject of this study.

To obtain reliable and scientific analysis and interpretation of data, appropriate statistical tools were employed such as weighted mean, Likert scale and ranking.

III. RESULTS AND DISCUSSION

Table 1. Challenges of Internal Audit Functions Arising from Lack of Technology

Challenges	WM	VI	Rank
Long lead time for audit projects	3.66	SA	3
Delayed completion and review of audit work	3.82	SA	1
Low productivity and inefficiency in operations	3.76	SA	2
Inadequate risk assessment and audit planning	2.88	A	5
Absence of standard audit workflow	3.46	SA	4

Table 1 shows the top 3 most common challenges of internal audit functions arising from a lack of technology and/or automation in internal audit operations. The respondents strongly agreed that lack of technology and automation results in delayed completion/review of audit work (WM=3.82), low productivity/inefficiency (WM=3.76), and long lead time of audit projects.

Table 2. Key Features and Capabilities of Internal Audit Process and Project Management Software

Features and Capabilities	WM	VI	Rank
Real-time audit dashboards	3.74	SA	2
Defined audit universe	3.46	SA	4
Centralized audit library	3.66	SA	3
Automated workflows	3.84	SA	1
Monitoring/tracking of audit issues	3.26	SA	6
Generation of audit reports	3.20	A	7
Flexible configuration	2.84	A	9
Audit log and access control	2.36	D	11

Alerts and notifications	2.74	A	10
Audit surveys and feedback reports	3.00	A	8
Track engagement resources, costs, and timesheets	3.28	SA	5

Table 2 shows the important features and capabilities of internal audit process software that impact the overall operations of internal audit functions. The respondents strongly agreed that automated workflows (WM=3.84), real-time audit dashboards (WM=3.74), centralized audit library (WM=3.66), defined audit universe (WM=3.46) and tracking of engagement resources, cost, and timesheets (WM=3.28) are some of the major important features of an automated audit process/project management.

Table 3. Advantages of Using Internal Audit Process and Project Management Software

Benefits and Advantages	WM	VI	Rank
Increased productivity and operational efficiency	3.84	SA	1
Centralized and secured platform for all audit projects	3.66	SA	3
Increased audit coverage	3.36	SA	4
Collaboration and interaction among audit team members	3.32	SA	5
Continuous workflow and ongoing communication with audit clients	2.54	A	9
Efficient monitoring of committed action plan and resolution of audit issues	3.16	A	7
Facilitates remote and work-from-home set-up	3.24	A	6
Increased compliance with laws, rules, regulations, policies, and procedures	2.36	D	10
Enhanced credibility of audit results	3.02	A	8
Real-time supervisory review of audit work	3.78	SA	2

Table 3 shows the advantages of using technology such as the Audit Management System by internal audit departments. The respondents strongly agreed that some of the most notable advantages include an increase in productivity and operational efficiency (WM=3.84), real-time supervisory review of audit work (WM3.78), a centralized and secured platform for all audit projects (WM=3.66), increased audit coverage (WM=3.36), and collaboration and interaction among audit team members (WM=3.32).

Table 4. Disadvantages of Using Internal Audit Process and Project Management Software

Disadvantages	WM	VI	Rank
High cost of investment	3.88	SA	1
No buy-in from Organizational Management	3.62	SA	2
Non-financial investments (i.e., timelines, user-trainings)	2.98	A	5
Lack of technical capabilities	2.90	A	7
Frequent updates and customization	3.38	SA	3
Over-reliance on software and loss of flexibility	3.04	A	4
Data privacy/security issues	2.94	A	6

Table 4 shows the most common disadvantages of implementing automation in internal audit operations. The respondents strongly agreed that some of the notable disadvantages include the high cost of investment (WM=3.88), lack of management buy-in (WM=3.62), and the need for frequent updates and customization (WM=3.38).

IV. CONCLUSIONS AND RECOMMENDATIONS

Overall, the findings in this research study suggest that the use of automated solutions, particularly Business Process and Project Management Software, provides various advantages in the overall operations of internal audit functions.

Using automated solutions enables internal audit teams to manage every audit project effortlessly and efficiently. Automated solutions can offer centralization, standardization, and speed which can greatly impact the level of effectiveness and efficiency of internal auditors. With automated workflows, audit teams can conduct more audit projects in less time, thus, more opportunities for strategic insight. Through audit management software grounded in best-in-class methodology, internal audit teams can swiftly scale their operations while adding new processes, requirements, and workflows at the speed of change. Moreover, modern audit management systems and reporting tools enable audit teams to gain real-time visibility into individual audit projects and overall audit strategy where resources are focused on high-risk and significant areas. Automating manual and routine tasks provides more time for internal audit functions for higher-level critical thinking. The benefits of automated software also extend to monitoring of actions to audit issues and remediation which are deemed inefficient when performed using manual processes. Automation serves as an accelerator for monitoring and delivering continuous assurance with a simplified end-to-end audit life cycle. Work duplication and human error are reduced, and internal auditors work more efficiently through the ability to schedule and manage audit projects, eliminating repetitive tasks. Finally, business process/project management automation enables audit teams to operate as strategic partners of organizational management that can contribute to risk mitigation in real time.

While there are various challenges and difficulties in the adoption and implementation of audit processes and project management automation, the researchers recommend some initiatives and action plans that internal audit functions may consider in terms of modernizing their respective internal audit operations. One is to ensure buy-in from organizational management by effectively articulating the benefits of digital transformation to Management and key stakeholders and demonstrating/communicating success indicators, ensuring that internal functions are aligned with business expectations and mandates. The cost of embarking on automation is also one of the biggest drawbacks and financial approval may not be practical for what is not deemed "critical" by Management. Internal audit functions should deploy simpler innovation solutions at the onset and move on to more complex procedures as the function matures digitally. This way, the evolution is gradual and does not require huge investments at once and mitigation and prevention of unnecessary incidental challenges could be addressed easily (Subia, Jocson, & Florencondia, 2019). Adequate planning of data strategy and adopting a suitable resource model are keys to achieving digital upskilling without compromising audit and control quality.

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Services Offered and Sustainable Development Program by the LifeBank Microfinance Foundation, Incorporated: Its Impact on the Branch 220 Members Lives

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Abstract**—** *This study evaluates the awareness levels among the branch 220 members of Muñoz, Nueva Ecija, Philippines regarding the services and products offered by LifeBank Microfinance. Findings reveal that services in terms of Savings received the highest awareness among the respondents, followed by Microinsurance and Wash Loans, while the respondents were not aware of the Regular Project Loans. In terms of sustainable development programs, microfinance services, show potential to influence the demand for education, particularly through the Education Scholarship Program (ESP). The Health Fund also garners significant awareness as it serves as a prerequisite for members. Assessing LifeBank's impact on members' lives, positive outcomes are noted in business and education funding. While saving money is acknowledged, opinions on employment assistance are mixed. The study suggests addressing lower-ranked areas, such as employment assistance and housing, for a more comprehensive impact.*

Keywords**— *Awareness, LifeBank Microfinance Foundation, Inc., Nueva Ecija, Sustainable Development Program, Services Offered***

I. INTRODUCTION

Inadequate access to financial resources is a widespread problem faced by rural women, low-income households, and small to medium-sized businesses. Microfinance programs play a crucial role in addressing this challenge by assisting households in achieving stability and saving for the future, particularly during periods of economic instability. Dessalegn (2013) emphasizes that microfinance helps achieve stability and savings, addressing limited financial access for vulnerable groups.

In the realm of economic disparity, insufficient access to financial resources remains a pervasive hurdle for rural women, low-income households, and small to medium-sized businesses. Tackling this challenge head-on, microfinance programs emerge as vital instruments, extending a lifeline to these underserved demographics. Recognizing the urgency of the matter underscores the pivotal role of microfinance in fostering stability and cultivating a culture of savings, especially during turbulent economic times. This concerted effort not only bridges the financial gap but also empowers vulnerable groups to navigate and thrive in the complex landscape of economic instability (Morrissey, Cha, Wolf, & Khan, 2020).

One of the microfinance institutions supporting poverty alleviation is LifeBank Microfinance Foundation, Inc. Operating under the name LifeBank Foundation (LBF), LifeBank Microfinance Foundation, Inc. has a core mission to break the chains of poverty, offering financial and social services in both urban and rural communities. This initiative economically empowers impoverished women, advocates

for gender equality, and enhances the overall well-being of women in terms of family status, health, and financial literacy.

This study aims to assess the impact of LifeBank Microfinance Foundation, Inc. on its customers' financial well-being. It focuses on the levels of customer awareness regarding LifeBank Microfinance Foundation, Inc. as a whole and specific programs like IKABUHI Microfinance Program (IMP) and Sustainable Development Program (SDP). Additionally, it examines the considerations taken by LifeBank Microfinance Foundation, Inc. when extending credit to individuals and explores how the organization contributes to improving the lives of its members. By addressing these inquiries, the study is essential for advancing microfinance knowledge, enhancing practices, and shaping policies and programs to ensure a transformative impact on financial well-being.

II. METHODOLOGY

The study utilized a descriptive-correlational research design. It has identified the socio-demographic characteristics of the respondents that may show the relationship between the two variables. These characteristics include age, civil status, number of household members, level of education, duration of membership of individuals at LifeBank Microfinance Foundation, Inc., source of income and monthly income. All respondents are Novo Ecijanos (Subia, Mangiduyos, & Turgano, 2020) whom the researchers selected using a simple random technique and surveyed 100 randomly selected members or borrowers from Branch 220 Muñoz of LifeBank Microfinance Foundation, Inc. located in Science City of Muñoz, Nueva Ecija. The instrument used in the study is a questionnaire constructed by the researchers for a survey to collect data from the responses of respondents. The questionnaires were distributed to the respondents by the researchers in a physical manner with the help of the center chief or *purok* leaders. Following the completion of data collection, the data was systematically arranged and subjected to thorough analysis. The data was examined using descriptive statistics such as the mean and frequency. To determine the significance of the relationship between LifeBank Microfinance Foundation, Inc. and the financial status of the respondents, the chi-square test was used. Hayes (2021) defines the chi-square test as the statistical procedure described, which is frequently employed in evaluating hypotheses about a given phenomenon. It involves the comparison of the null hypothesis with the observed outcomes, which are obtained through appropriate calculations.

III. RESULTS AND DISCUSSION

Socio-demographic Characteristics of Participants

Out of 100 respondents, 35% fall in the 51–60 age group. Married individuals constituted approximately 70%, while 55% had attended high school. These findings align with Haq, et al. (2018), Frintner et al. (2013), and Xiao & Yao (2014), emphasizing the influence of age and marital status on financial behaviors.

Years of Membership, Source of Income, and Monthly Income

Participants' average membership duration was 5 years, with 40% having five years or less. It was also found in the paper of Kuchler (2012), that the average membership duration among current members in microfinance was between four and five years. Business was the primary income source for 48% of participants, and 37% had a monthly income in the 5,001-10,000 range. Peprah (2012) and Bangko Sentral ng Pilipinas (2018) support the positive impact of microfinance on income diversification and economic empowerment.

Number of Household Members

To assess the impact on impoverished families, the number of household members was examined, revealing that 28% reported living with three members. This finding aligns with the Asian Development Bank's (2013) emphasis on understanding household dynamics. To thoroughly evaluate the influence of microfinance on economically disadvantaged families, it was crucial to determine the count of household members within the surveyed individuals, excluding the participants from this calculation (Asian Development Bank, 2013).

Awareness of LifeBank (LBMFI) as a Whole

Based on the means computed, the highest level of customer awareness of the products and services offered by LifeBank Microfinance Foundation, Inc. "The purpose of LifeBank Microfinance Foundation, Inc. was to assist its members in establishing their businesses.", With a mean of 4.90, most respondents strongly agreed with this statement, suggesting a high level of understanding about LifeBank's mission to support its members' entrepreneurial efforts. According to Papulova (2014), An organization's mission determines its identity, purpose, and course. It served as a guide for staff members as well as a way for clients, shareholders, and the general public to learn about the core values that guided the company's operations. Word of mouth played a significant role, aligning with the credibility of referrals. However, Agustin et. al (2023) claimed in their paper that partnering with several organizations would help to expand the reach and provide new programs and services to its clients.

Awareness of IKABUHI Microfinance Program (IMP)

Table 1. IKABUHI Microfinance Program (IMP)

	Mean	Standard Deviation	Descriptive Rate*
Regular Project Loan	2.90	1.714	Neither Aware nor Not Aware
Small Business Loan	4.19	1.346	Aware
Water, Sanitation, And Hygiene (Wash Loan)	4.54	1.114	Fully Aware
Loan Insurance	4.52	1.068	Fully Aware
Microinsurance	4.87	0.464	Fully Aware
Savings	4.95	0.219	Fully Aware

**Fully Not Aware 1.00 – 1.80, Not Aware 1.81 – 2.60, Neither Aware nor Not Aware 2.61 – 3.40, Aware 3.41 – 4.20, and Fully Aware 4.21 – 5.00*

Table 1 illustrates varying awareness levels of IMP services and products. Savings received the highest awareness (4.95) followed by Microinsurance (4.87) and Water, Sanitation and Hygiene (Wash Loan), while the Regular Project Loan had the lowest (2.90) in terms of awareness. Tailoring communication strategies based on these insights could enhance program effectiveness. According to Karlan et al., (2014), savings aided households in controlling consumption and funding profitable capital expenditures on people and businesses.

Awareness on Sustainable Development Program (SDP)

The LifeBank Foundation acknowledged that poverty was a complex issue that could not be effectively addressed through a singular approach. In their endeavor to alleviate the burdens of poverty, they allocated resources towards a diverse range of social service initiatives that aimed to tackle multiple dimensions and underlying factors contributing to poverty (LifeBank Foundation, n.d.)

From the results, it could be observed that both the Education Scholarship Program (ESP) which aims to provide scholarships to students and prepare them for the real world of work (Subia, 2020) and the Health Fund had high levels of awareness among the respondents. The provision of microfinance services has the potential to influence the demand for education, according to Viswanath (2018). For the Education Scholarship Program (ESP), the mean score was 4.28, indicating that most respondents were fully aware of this program. This program aimed to assist low-income Filipinos in achieving a higher level of education. Similarly, the Health Fund also had a high level of awareness, with the highest mean score of 4.69, given that it is a prerequisite for members to have a health fund. This program provided a source for purchasing medicine when necessary.

In general, the table illustrated that both the Education Scholarship Program and the Health Fund had been well received and were well-known among the respondents. The high mean scores and low standard deviations suggested that there was a consistent level of awareness about these programs, which could be seen as a positive outcome for the Sustainable Development Program (SDP) in its efforts to support education and healthcare initiatives among low-income communities.

Considerations for Extending Credit

LifeBank's credit extension considerations, emphasise the modified 4 C's framework—Character, Capacity, Capital, and Conditions—reflecting a collateral-free approach. The character had the highest mean (2.85), indicating that, on average, borrowers had a moderate level of credit history or reputation in repaying debts. Conditions had the lowest (1.98), indicating potential challenges in the market which could impact the ability of the members to repay.

According to First Citizens Bank (2022), the attribute of character plays a crucial role in enabling lenders to evaluate an individual's capacity to repay a loan. Credit history holds significant importance in shaping an individual's character.

Impact of LifeBank on Members' Lives

The impact of LifeBank on members' lives was also assessed, indicating positive outcomes in using funds for business (4.66) and education (4.09). Members acknowledged the importance of saving money (4.60), but opinions on employment assistance were mixed (2.34). The organization may focus on addressing areas with lower rankings for a more comprehensive impact such as regarding assistance in obtaining employment and constructing homes.

Chi-Square Test on the Impact on Socio-demographic Factors

Table 2. Chi-Square Test on the Impact of LifeBank Microfinance Foundation, Inc. on the Lives of its Members

	Number of Household Members	Civil Status	Age	Level of Education	Years of Membership at Lifebank Microfinance Foundation, Inc.	Source of Income	Monthly Income
Chi-Square	81.896	34.071	35.050	42.474	40.116	69.761	51.854
df	40	12	12	12	16	24	20
Asymp. Sig.	0.000*	0.001*	0.001*	0.000*	0.001*	0.000*	0.000*
	a. Kruskal Wallis Test						
	*b. * Significant at 5% level of Significance*						

The chi-square test results presented in Table 2 demonstrated the significant impact of LifeBank Microfinance Foundation, Inc. on the lives of its members across various Socio-demographic factors. Curtis & Youngquist (2013) defined the chi-square test as a statistical test used to determine the significance of categorical data, which refers to data that can be classified into nominal or named categories. By analyzing the data, it was evident that there existed a significant association between the impact of LifeBank Microfinance Foundation, Inc. and various Socio-demographic factors, including the number of household members (0.000), civil status (0.001), age (0.001), level of education (0.000), years of membership (0.001), source of income (0.000), and monthly income of its members (0.000).

The analysis of the data highlighted the substantial and statistically significant impact of LifeBank Microfinance Foundation, Inc. on the lives of its members. However, this impact varied across different demographic and socioeconomic groups, underscoring the importance of tailoring services to meet the specific needs and circumstances of its members. Understanding these associations could aid LifeBank in targeting its efforts and resources more effectively to ensure a positive and equitable impact on the lives of its diverse membership base.

IV. CONCLUSION

Based on the data collected and the findings obtained, the researchers have formulated conclusions aimed at addressing the research questions. They are listed below:

1. The levels of customer awareness of the products and services offered by LifeBank Microfinance Foundation, Inc. are as follows:
    a. In reference to the company LifeBank Microfinance Foundation, Inc. in general: The purpose of LifeBank Microfinance Foundation, Inc. is to assist its members in establishing their businesses.
    b. IKABUHI Microfinance Program (IMP): Savings
    c. Sustainable Development Program (SDP): Health Fund
2. The consideration LifeBank Microfinance Foundation, Inc. takes into account when extending credit to an individual is character.
3. The impact of LifeBank Microfinance Foundation, Inc. on the lives of its members is that they can use the funds borrowed from the organization for business purposes.

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Management and Operation Practices of Philmech's Fluidized Bed Dryer: Examining the Challenges, Efficiency, and Impact on Beneficiaries

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Abstract— *This descriptive research explores the management and operation practices of PHilMech's Fluidized Bed Dryer as to challenges, efficiency and impact on its beneficiaries. The findings of the study reveal that the respondents adhere to prescribed guidelines for the administration and operation of the PHilMech Fluidized Bed Dryer, employing explicit, written, easily understood, and enforceable operational policies and procedures. Most of them have assimilated the knowledge acquired through several training programs, as new competencies need to be developed among farmers, particularly those who are introducing machinery. This will enable them to optimize the economic benefits derived from their equipment. There are ongoing challenges in the operation and management of the system that must be resolved to prevent future issues and ensure the system's continued functionality. Furthermore, it is imperative to implement mechanized drying technologies to mitigate postharvest losses and alleviate the labor-intensive and monotonous nature of the drying process. Extensive research has demonstrated the effectiveness and beneficial outcomes of utilizing the fluidized bed drying system, including a reduced drying period for a harvested rice paddy, decreased operating and labor expenses, and a diminished reliance on the laborious and labor-intensive sun drying method.*

Keywords— ***Challenges, Fluidized Bed Dryer, Impact on Beneficiaries, Management, Operational Practices***

I. INTRODUCTION

Rice is a staple food for about eighty (80) percent of Filipinos and is, therefore, a major item in the consumption basket of consumers (Bordey, 2010). It is the single most important agricultural crop in the Philippines and a major source of income for millions of Filipino farmers. In connection with this, several processes were involved in rice production from field preparation and planting until harvest, milling and storage. On the production side, the growth and development of rice production have become completely dependent on yield improvements.

Rice quality is the major factor affecting its market value. Immediately following harvest, rice quality is typically at its peak. A primary measure of rice quality is greatly influenced by drying. The final quality of rice, that is ready to market, is sensitive to all post-harvest processes, such as drying, handling, storage, and milling. Accordingly, rice drying and storage have the potential to increase harvest efficiency and provide more control over grain quality, all of which contribute to the overall quality of harvest. In the Philippines, sun drying is a traditional drying method for reducing the moisture content of paddy by spreading the

grains under the sun. According to Rice Knowledge Bank, it is the most common drying method in Asia because of its low cost compared to mechanical drying. It requires little investment and is environmentally friendly since it uses the sun as the heat source. However, sun drying tends to be labor-intensive and has limited capacity. Temperature control is also difficult in this method and grains can easily be overheated causing cracked grains which leads to low milling quality. It is also not possible to sun dry at night or during rain. Drying of harvested rice paddy remains a major problem of the Philippine rice production industry especially during the wet season when sun drying is not always possible. Wet rice paddy deteriorates rapidly, if not immediately dried, may result in loss in quality, low price and sometimes market rejection.

Rice Knowledge Bank states that sun drying is the most common drying method in Asia because of its low cost compared to mechanical drying. It requires little investment and is environmentally friendly since it uses the sun as the heat source and therefore produces no CO_2. However, sun drying tends to be labor-intensive and has limited capacity. Temperature control is also difficult in this method and grains can easily be overheated causing cracked grains which leads to low milling quality. It is also not possible to sun dry at night or during rain. With this regard, the Philippine Center for Postharvest and Development Mechanization (PhilMech) started developing a fluidized bed drying system in 2012 that aims to boost the production yield to provide a better grain drying system for rice farmers. The ideal moisture content for palay is 14 percent but the prototype tested by PHilMech can dry 20 to 24 tons of palay in 10 to 12 hours. The machine uses heat generated by a PHilMech-designed biomass furnace or a diesel burner. It also has electronic controls that lessen the need for laborers to operate. PHilMech is optimistic that many farmers' cooperatives and associations will gain interest in using the Fluidized Bed Dryer once it is ready for commercialization Based on laboratory drying experiments and pilot-scale model results, an initial full-scale prototype was developed and tested, and results showed good potential for rapid drying of high moisture paddy. The prototype needs further improvement to operate reliably and viably as a first-stage drying component of a two-stage drying strategy recommended for the adoption of rice farmer cooperatives and associations (FCAs) in Nueva Ecija. Two cooperatives are involved in the testing and evaluation process: the Nagkakaisang Magsasaka Agricultural Primary Multipurpose Cooperative in Tabaco, Talavera and the Bagong Buhay ng Mabini Primary Multipurpose Cooperative in Sto. Domingo, Nueva Ecija. The current prototype model has a bigger capacity and once commercialized, will be a great benefit to rice farmers as much of the drying of their harvests, as the Director IV of PhilMech stated in one of his interviews.

This study specifically intends to:

1. Identify the Management and Operational Practices of PHilMech Fluidized Bed Dryer Beneficiaries;
2. Describe the Challenges Encountered in Batch Recirculating Dryers and Fluidized Bed on First Stage Drying; and
3. Describe the Efficiency and Impact of the Fluidized Bed Drying System to its Beneficiaries.

II. METHODOLOGY

This study utilized a descriptive research design to describe the preparedness (Subia, Mangiduyos & Turgano, 2020) on the management and operation practices of PhilMech Fluidized Bed Dryer beneficiaries particularly through a questionnaire to gather the necessary data needed. A review and secondary data gathering were also conducted. Basic descriptive statistics such as frequency count and percentage were used. The researchers gathered the necessary data and information from three of the cooperative members in each of the selected beneficiaries, namely the Nagkakaisang Magsasaka Agricultural Primary Multipurpose Cooperative in Tabaco, Talavera and the Bagong Buhay ng Mabini Primary Multipurpose Cooperative in Sto. Domingo, Nueva Ecija they were the direct beneficiaries based on the set criteria of PHilMech and were selected through a combination of desk research, written communication, and phone interviews and actual visits conducted by the agency. This created a bridge for the researcher to gain a broader sense of understanding and better insight regarding the matter on-hand. Analysis of the result determined the possible recommendations to weed out important impressions and how to address the challenges and opportunities and the feasibility of using a multistage fluidized bed system for complete drying of high moisture paddy and identify ways to accelerate the promotion and adoption of fluidized bed dryers through technology demonstration and training of potential adopters.

III. RESULTS AND DISCUSSION

Table 1. Management and Operation Practices of PHilMech Fluidized Bed Dryer Beneficiaries

Statement	Frequency (f)	Percentage (%)
1. Our management team has received training to operate and oversee the fluidized bed drying system	6	100
2. Our operating policies and procedures are clear, written, comprehensible and enforceable.	6	100
3. We inspect the bed drying system before and after use	4	67
4. We are regularly and actively engaged in government workshops, seminars, trainings, and other activities.	5	83
5. We avail different programs and support from external institutions (LGU, PHilMech, CDA, DA-RFO and other government agencies)	5	83

Table 1 shows the results from the responses of the respondents regarding the management and operation practices of the PHilMech Fluidized Bed Dryer. 100% of the respondents have received training to operate and oversee the fluidized bed drying system; 100% have clear, written, comprehensible and enforceable operating policies and procedures; 67% inspect the bed drying system before and after use; 83% regularly and actively engaged in government workshops, seminars, training, and other activities; and 83% avail different programs and support from external institutions (LGU, PHilMech, CDA, DA-RFO and other government agencies).

The results demonstrate that the majority of respondents follow recommended practices when it comes to the management and operation of the PHilMech Fluidized Bed Dryer. The majority of them have incorporated the knowledge they gained from participating in various trainings conducted by external institutions. A study conducted by Girja Sharan, a professor at the Centre for Management in Agriculture at the Indian Institute of Management Ahmedabad, stated that effective utilization of farm machinery requires more than the transfer of information. New skills have to be built among farmers, especially those introducing machinery. Moreover, skill training will help the beneficiaries to decrease the expense of maintenance and use. It will also increase farmer acceptance and allow them to get the most out of their equipment economically.

Table 2. Challenges and problems encountered in batch recirculating dryers and fluidized beds on first-stage drying

Statement	Frequency (f)	Percentage (%)
1. The management team lacks training (ex. leadership, operating, troubleshooting, etc.)	2	33
2. Low acceptability of the system	2	33
3. Frequent breakdown of the machine (eg: frequent clogging, malfunction, etc.)	3	50
4. The maintenance cost of the system is high (eg: for repairs, adjustments, etc.)	2	33

Table 2 shows the results from the responses of the respondents regarding the challenges and problems encountered in batch recirculating dryers and fluidized beds on first stage drying. 33% of the respondents stated that the management team lacks training (ex. leadership, operating, troubleshooting, etc.); 22% have low acceptability of the system; 50% of the respondents experienced the frequent breakdown of machines (eg: frequent clogging, malfunction, etc.); and 33% experienced high maintenance cost of the system (eg: for repairs, adjustments, etc.).

Table 3. Efficiency and Impact of the Fluidized Bed Drying System to its Beneficiaries

Statement	Frequency (f)	Percentage (%)
1. Shortened drying period/drying cycle of grains/rice paddy.	6	100
2. Lower operating and labor costs.	6	100
3. Improved grain quality and higher volume of moisture grain.	5	83
4. Reduction of drudgery and labor-intensive activity associated with sun drying methods.	6	100

Table 3 shows the efficiency and Impact of the Fluidized Bed Drying System versus the traditional sun drying method. 100% of the respondents experienced shortened drying period/drying cycle of grains/rice paddy; 100% said that using the fluidized bed drying method has lower operating and labor cost; 83% has improved grain quality and higher volume of moisture grain; and 100% experienced reduction of drudgery and labor-intensive activity associated with sun drying method.

The data shows some of the identified impacts of adopting the two-stage fluidized bed drying system. The Philippine rice industry continues to face significant drying issues, particularly during the wet season when sun drying is not always possible. If not immediately dried, wet rice paddy quickly degrades, leading to a loss in quality, a drop in price, and occasionally market rejection. Depending on the moisture level of the harvest, drying takes 1-2 days in a sunny environment. When it rains, drying takes longer, therefore workers must remove the grains from the pavement as it dries and bring them back the next day for the next round of drying. Therefore, there is a need to provide mechanized drying technologies to minimize postharvest losses and reduce the labor-intensive drudgery of drying (Pontawe, 2013).

IV. CONCLUSION AND RECOMMENDATIONS

The following conclusions were made based on the results and discussions:

1. The majority of respondents follow recommended practices when it comes to the management and operation of the PHilMech Fluidized Bed Dryer using their clear, written, comprehensible and enforceable operating policies and procedures. The majority of them have incorporated the knowledge they gained from participating in various training as new skills have to be built among farmers, especially those introducing machinery as this will allow them to get the most out of their equipment economically.
2. There are still minimal issues and dilemmas encountered in the operation and management of the system that need to be addressed to avoid problems in the long run and to be able to continue the operation of the said system.
3. There is a need to provide mechanized drying technologies to minimize postharvest losses and reduce the labor-intensive and drudgery of drying as significant factors were determined that show the efficiency and positive impact of using the fluidized bed drying system such as the shortened drying period or drying cycle of harvested rice paddy, lower operating and labor cost, and reduction of drudgery and labor-intensive activity associated with sun drying method.

Based on the findings and conclusions, the following were recommended:

1. PHILMECH, as the implementer, should continuously conduct technology awareness and promotion simultaneously during the operationalization stage such as techno-forum, field day, techno demo and other activities in collaboration with LGUs, DA-RFOs and other agencies interested in the technology as well as the local manufacturer. Awareness and promotion will be carried out to raise public knowledge of the existence of this technology. In addition to raising awareness, this will demonstrate and prepare the beneficiaries for the reality (Subia, 2020) of how to use the technology beneficially.
2. PHILMECH, as the implementer, should establish linkages and develop exit plans that should be crafted in consultation and coordination with the project cooperator to make sure that the technology adoption is sustainable. This includes regular monitoring and visits of PHILMECH to provide general and specific assistance and guidance to sustain its use as an indispensable facility.
3. The government should continue to provide funds to be allocated to postharvest technologies as through better technologies, facilities, and techniques, quality can be preserved, lower production and labor cost can be

achieved and farmers can sell their commodities at higher prices.

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Automation of the house washing process in the poultry industry

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Abstract**—** *Good manufacturing practices impact the productivity of the processes, farms and food factories aim at operational optimization and continuous improvement seeks to automate the units.In 2022, Miguel Ángel Álvarez Parra carried out a study in which he proposed a cleaning and disinfection protocol in the poultry farms of the "Jehovah is my shepherd" company. The document expresses the importance of always having clean facilities under standards based on biosafety and equipment used by staff to prevent diseases in birds such as avian pox and reduce contamination through an environmental plaque study (Alvarez, 2022).*

Keywords**— Quality, Pig Farms, Maintenance.**

I. INTRODUCTION

In the layer poultry farms of the Cotaló parish of the Pelileo Canton, an investigation was carried out to determine the levels of biosecurity in all the company's farms and identify the strongest or weakest variables. Using descriptive statistics, good biosafety practices were evaluated with a survey-type instrument of 47 questions carried out by Agrocalid according to resolution 0260 with a score of 94 points and the results obtained were the classification of three strata with a range of 26-44%. Therefore, the operating permit is denied in stratum 1, the second stratum, with a low level of biosecurity falls in the range 26-44% where the operating permit was also denied and in stratum three, with a level of The average biosafety falls in the range of 45-59%, the operating permit is granted with an established deadline to comply with 60% in the performance of appropriate conditions, hygienic and biosafety measures according to resolution 0260 (Montero,2019).

At the "Nuevo Amanecer" poultry company, an initial diagnosis of production was carried out, with the help of the Vester matrix, and biosafety protocols were applied, adapted to the needs of production, based on resolution ICA 3651 of 2014. Once finished, support was carried out within the production in pullets in the beginning and lifting stages, corrective actions were taken. The results obtained were the creation of a quality sanitary control with standards based on biosafety, through strict regulations the aim is to establish a quality product with the same live chicken weight (Castillo,2021).

Grupo Pecuario San Antonio has established itself as the main poultry company in southeastern Mexico, generating a great social and economic impact. Today its main objective is to provide its clients and strategic partners with the highest quality standards through a rigorous production, care and distribution process that manages to consolidate the best product on the market.

The focus of the project begins in the broiler chicken farms, which 49 days are for the fattening process, 2 days for extracting the manure, 2 days for cleaning, 2 days for disinfection and 7 days for sanitary vacuum with a total of 62 days in the process, focusing the project on the cleaning part, this distribution is of great impact because it is intended to reduce 1 day with the strategy to be implemented.

OBJECTIVE

Reduce excessive use of water.

Reduce process time.

Increase product quality.

Reduce the number of people in the process.

HYPOTHESIS

Automating the broiler chicken farms of the Grupo Pecuario San Antonio company will reduce water consumption and process time.

JUSTIFICATION

Grupo Pecuario San Antonio has 12 farms, the growth environment of the birds depends on meticulous care of the health, cleanliness, population density as well as the supply of water, food, ventilation and nutrition of the birds.

The objective of this research project is to reduce the installation time of hydro washers. and the decrease in the amount of water used in the process.

II. METHODOLOGY

In the field study, we work with quantitative variables, which allow us to identify the values that give rise to the automation of the washing process.

The project is divided into two stages:

Stage 1.- A study of the place will be carried out to consider the dimensions of the houses to take the measures to consider for the washing machine and not mistreat any component of the farm such as drinker and feeder lines.

Stage 2.- With the measurements obtained in stage 1, the design of the mini excavator with its storage tank and sprinkler system will be carried out using the design program.

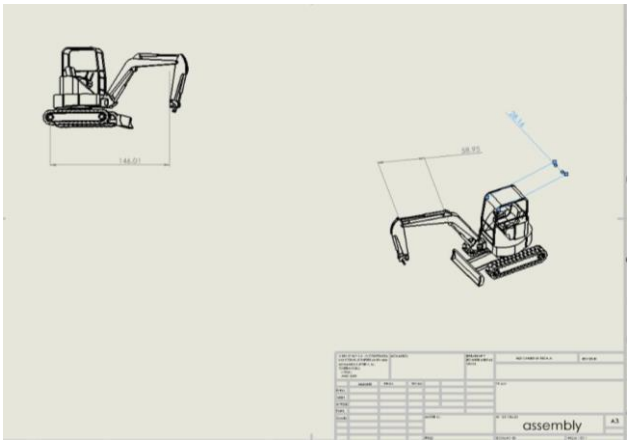

Illustration 1: Dimensions of mini excavator.

For the design of the machine, the location of the farms and the space between houses must be considered. The hoses that will be installed in the machine must provide greater water flow.

Development of the hydrostatic pressure:

DATA:

H= 1m

P= 997

G= 9.8 m/

Ph= (997)(9.8)(1m)

Ph= 9,770.6

Ph= 9,770.6 Pa

Ph= 9.7706 Kpa

DETAILED WET CLEANING PROCESS

1. Preparation of personnel: It consists of the poultry operator using personal protective equipment, gloves, mouth covers or mask, glasses or goggles.

2. Preparation of the dilution: Prepare the mixture for cleaning

3. Preparation of the lines: Check that the entire production line has liquid.

4. Draining: Drain the water lines and flush until the product passes through all the lines. When it reaches the last nipple, it must be closed to keep the liquid in the lines. The product must remain on the line for a minimum of 6 hours and a maximum of 24 hours.

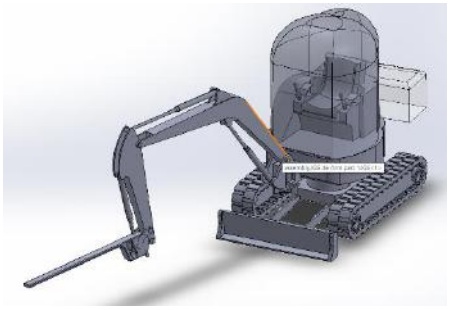

Illustration 2: pressure washer gun

As a result of the automation of the washing house, the cycle was reduced to obtain more tons of chicken,

Water consumption is reduced by 20%.

In addition, the mortality of poultry products is reduced by 5%.

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Effects of Fiberglass on the Strength of Reclaimed Asphalt Pavement (RAP) as a Subbase Materials

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Abstract— *This research study investigates the effect of fiberglass content on the strength of Reclaimed Asphalt Pavement (RAP) material as a subbase layer of flexible pavement. Laboratory modified proctor and California bearing ratio (CBR) tests were conducted on the mixture of RAP and fiberglass. The obtained results show that, 100% RAP material can be used as subbase material. In addition to that, there is a slight reduction in maximum dry density (γ_{dmax}) values when RAP is blended with fiberglass. Similarly, the soaked and unsoaked CBR values of the mixture decreased slightly. However, the mixture of RAP and fiberglass achieved the specification requirements as a subbase layer according to the Egyptian specifications. The relationship between fiberglass content and maximum dry density of RAP is found to be linear. Also, a linear relationship exists between percentage of fiberglass and unsoaked CBR. Finally, the relationship between the percentage of fiberglass and soaked CBR is found to be nonlinear.*

Keywords— ***Reclaimed Asphalt Pavement (RAP), California Bearing Ratio (CBR), Fiberglass.***

I. INTRODUCTION

The Reclaimed Asphalt Pavement (RAP) is defined as a deteriorated asphalt obtained as a result of rehabilitation and maintenance of roads. Or, it is a material obtained from the pavement [1, 2]. In the United States of America, over 50 million tons of RAP are produced annually, and in Egypt, over 3 million tons of RAP are produced annually. Despite significant amounts of RAP recycling in new asphalt paving mixtures, larger quantities of RAP remain unused [3]. Moreover, alternative RAP applications have emerged in highway construction. Saha and Mandal [4] indicated that RAP is suitable for use as subbase and base of flexible pavement when RAP is mixed with crushed stone aggregates in various proportions and stabilized with small percentages of cement. Suebsuk et al. [5] studied soil and RAP mixtures treated with cement. They demonstrated the ability of the treated mixtures to be used in the construction of pavement layers (base and subbase). Taha et al. [6] stated that the RAP and aggregate mixture provided good roadbed layers.

The effect of adding fibers on bitumen binder and Hot Mix Asphalt (HMA) has been studied previously in many studies, as it enhanced asphalt binder stiffness and stability of modified asphalt mix [7]. On the other hand, the air voids content decreased compared to the control mixture [8]. Therefore, the objective of this study is to investigate the effect of fiberglass content on the mechanical properties of cold Reclaimed Asphalt Pavement (RAP) material as a subbase layer. Fiberglass content varies between 0 and 10% by weight of dry constituents. The Optimum Moisture Content (OMC) was kept constant in order to study the effects of fiberglass content on the maximum dry density (γ_{dmax}) and strength of RAP material.

II. MATERIALS AND EXPERIMENTAL INVESTIGATION PROGRAM

Reclaimed Asphalt Pavement (RAP) was collected from an old pavement in Egypt, fiberglass chopped strands with a diameter of (10-13 μm) and a length of (15-25 mm).

The experimental investigation program consists of two specific tasks:

1. Physical characterization of RAP material.

2. Perform modified proctor and CBR tests.

Different percentages of fiberglass (0%, 2%, 4%, 6%, 8%, 10%) by weight of RAP were added, see Table 1.

Table 1 Proportions of the mixture between RAP and fiberglass

Sample No.	Mix composition
(1)	100% RAP + 0% fiberglass
(2)	100% RAP + 2% fiberglass
(3)	100% RAP + 4% fiberglass
(4)	100% RAP + 6% fiberglass
(5)	100% RAP + 8% fiberglass
(6)	100% RAP + 10% fiberglass

III. RAP PHYSICAL PROPERTIES

Table 2 shows a summary of the sieve analysis, specific gravity, water absorption, asphalt content, Los Angeles abrasion and soil classification results obtained from RAP material tests.

Table 2 Physical properties of RAP material

Property	RAP	References
Grain size	100% Passing Sieve 3/4-in. (Dia. 19mm)	ASTM C 136
Specific gravity	2.41	ASTM D 854
Water absorption (%)	3.57	ASTM C 128
Los Angles abrasion (%)	25.37	ASTM C 131
Asphalt content (%)	5.22	ASTM D 2172 Method A
Classification	A-1-a	AASHTO [9]

IV. COMPACTION RESULTS

Modified proctor compaction test followed the guidelines established in ASTM D1557 Method B [10].

The effect of fiberglass content on the maximum dry density (γ_{dmax}) of RAP at constant optimum moisture content (OMC) is summarized in Table 3.

Table 3 Compaction parameters for the mixture of RAP and fiberglass

Mixture	γ_{dmax} (gm/cm^3)	OMC (%)	Percent of reduction in γ_{dmax} (%)
100% RAP + 0% fiberglass	2.14	7.10	0
100% RAP + 2% fiberglass	2.13	7.10	0.47
100% RAP + 4% fiberglass	2.10	7.10	1.87
100% RAP + 6% fiberglass	2.07	7.10	3.27
100% RAP + 8% fiberglass	2.05	7.10	4.20
100% RAP + 10% fiberglass	2.01	7.10	6.07

According to Table 3, it is observed that, the maximum dry density (γ_{dmax}) of RAP decreased by 6% at fiberglass content 10%. The cause of decreased maximum dry density of RAP with increasing fiberglass contents is probably due to increased voids between the RAP particles.

The linear relationship between fiberglass content and maximum dry density (γ_{dmax}) of RAP is depicted in Fig. 1. This empirical formula is as follows:

$$\gamma_{dmax}\ (gm/cm^3) = 2.15 - 0.013*\text{fiberglass}\ (\%) \quad (1)$$

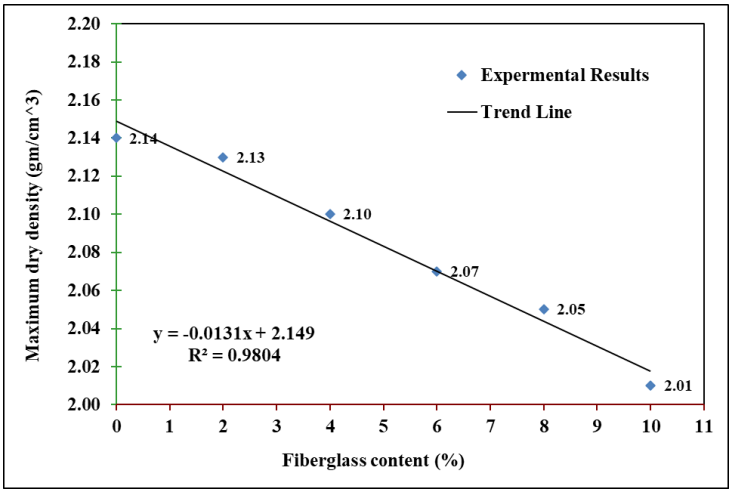

Fig. 1. Correlation between fiberglass content and maximum dry density of RAP

V. CALIFORNIA BEARING RATIO (CBR) RESULTS

The California bearing ratio (CBR) test was performed according to the guidelines established in ASTM D 1883 [11]. Results of unsoaked and 4 days soaked CBR test conducted on the mixture of RAP and fiberglass are indicated in Fig. 2. A summary of CBR values for the mixture of RAP and fiberglass are listed in Table 4.

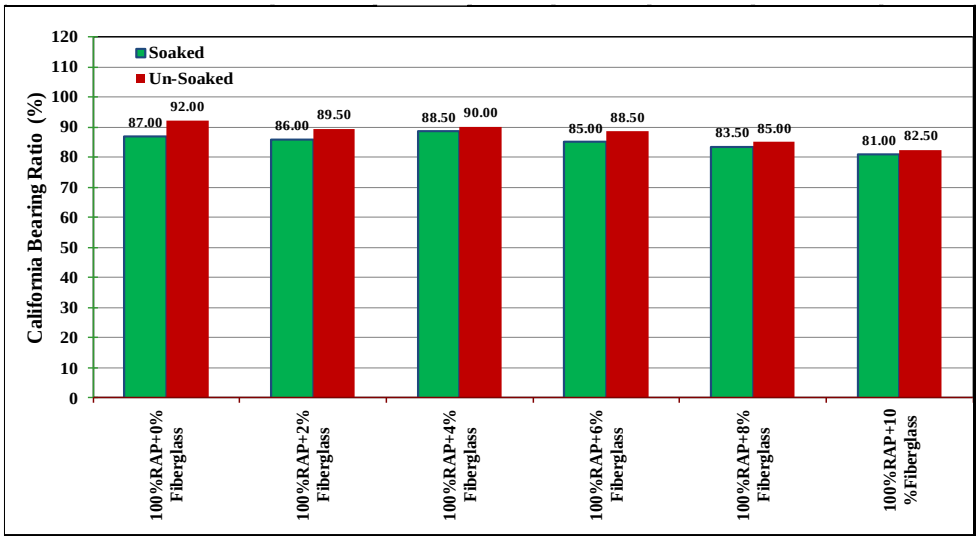

Fig. 2. CBR before and after soaking versus a mixture of RAP and fiberglass

Table 4 CBR values for the mixture of RAP and fiberglass

Mixture	**CBR (%)**		**Reduction percentage in CBR (%)**	
	Unsoaked	Soaked	Unsoaked	Soaked
100% RAP + 0% fiberglass	92.00	87.00	0	0
100% RAP + 2% fiberglass	89.50	86.00	2.71	1.15
100% RAP + 4% fiberglass	90.00	88.50	2.17	0
100% RAP + 6% fiberglass	88.50	85.00	3.80	2.30
100% RAP + 8% fiberglass	85.00	83.50	7.60	4.02
100% RAP + 10% fiberglass	82.50	81.00	10.32	6.90

Based on Table 4, it is remarkable that, the increase of fiberglass content from 0% to 10%, shows that the unsoaked CBR value decreases from 92% to 82.50% respectively, and the soaked CBR value decreases from 87% to 81% respectively. The reduction in unsoaked and soaked CBR value of RAP is associated with the reduction in the maximum dry density of RAP and fiberglass blend.

The graphical representation of the load deformation relationships for soaked and unsoaked CBR of RAP and fiberglass blend is shown in Fig. 3 and Fig. 4 respectively. Also, the relationship between the fiberglass content and CBR before and after soaking is depicted in Fig. 5. These empirical formulas are as follows:

1. For unsoaked CBR value (%) = 92.40 - 0.90*Fiberglass (%) (2)
2. For soaked CBR value (%) = -0.105*Fiberglass^2 (%) + 0.46*Fiberglass (%) + 86.70 (3)

Where: CBR = California bearing ratio (%), Fiberglass = fiberglass in the mixture of RAP and fiberglass (%).

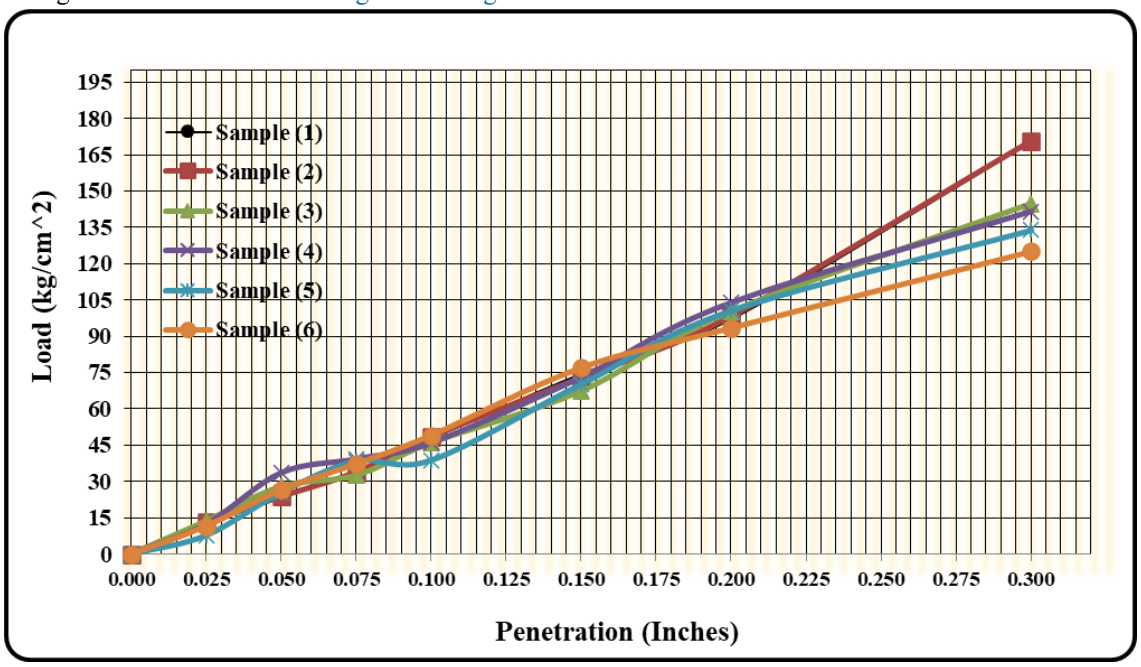

Fig. 3. Load versus Penetration (Soaked CBR)

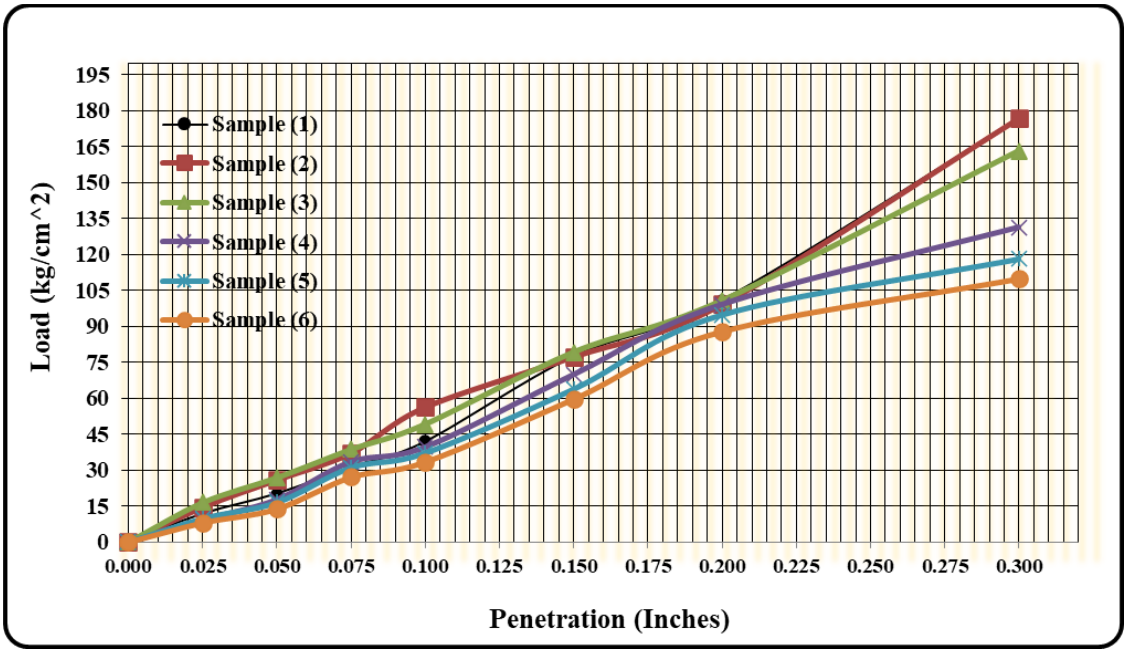

Fig. 4. Load versus Penetration (Unsoaked CBR)

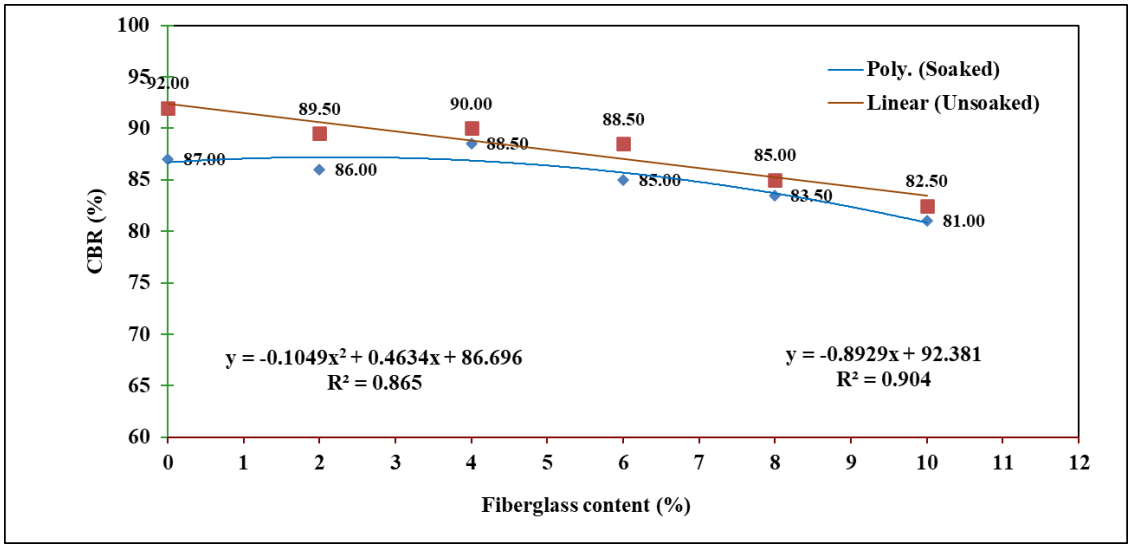

Fig. 5. Correlation between fiberglass content and CBR before and after soaking in the mixture of RAP and fiberglass

Fig. 6 shows the comparison of RAP gradation with Egyptian code standards requirements for granular subbase materials [12]. As seen in Fig. 6, it is observed that the gradation of the RAP material was nearly inside the specification limits. On the other side, the Egyptian specifications recommend a minimum CBR of 30% for a pavement subbase layer. In consequence, the mixture of RAP and fiberglass achieved the specification requirements as a subbase layer according to the Egyptian specifications.

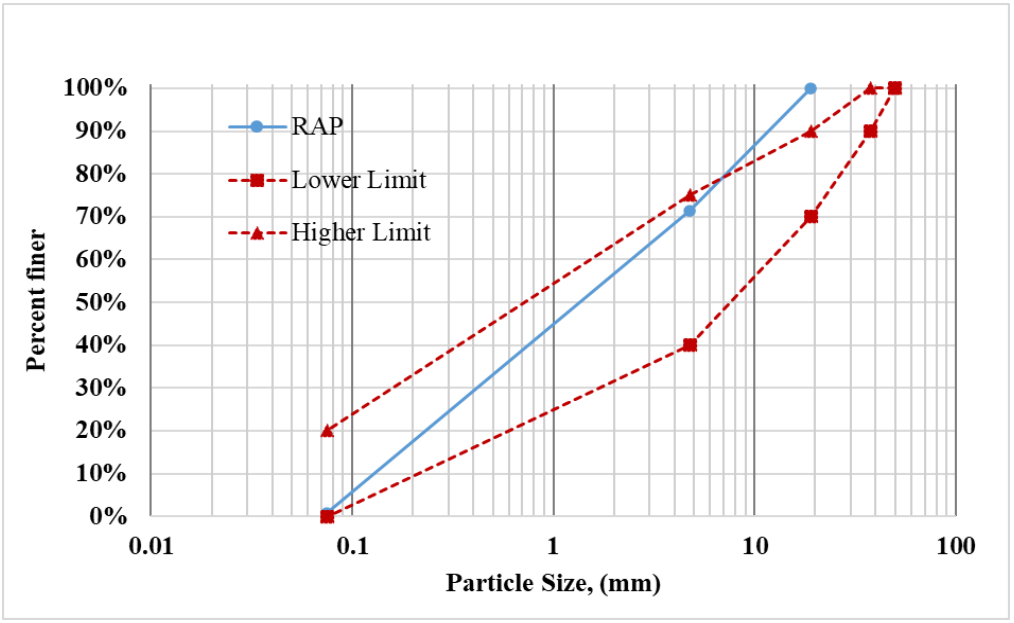

Fig. 6. Comparison of RAP gradation with Egyptian code standards requirements for granular subbase materials

VI. CONCLUSIONS

Based on the results of the research study, the following conclusions can be highlighted:

1. 100% RAP material can be used as subbase material.
2. The maximum dry density (γ_{dmax}) of RAP decreased by 6% with increasing fiberglass content to 10%. On the other hand, the relationship between fiberglass content and maximum dry density (γ_{dmax}) of RAP is found to be linear.
3. Increasing of fiberglass content from zero to 10%, shows that the unsoaked CBR value reduced by about 10%, and the soaked CBR value reduced by about 7%. The relationship between the percentage of fiberglass and soaked CBR is found to be nonlinear. On the other side, there is linear relationship between percentage of fiberglass and unsoaked CBR.

4. The Maximum dry density (γ_{dmax}) and CBR values of RAP decreased slightly when fiberglass is blended with RAP.

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