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Preventive Maintenance Implementation and Operational Resiliency of K2MAC Delivery Services

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Abstract—The Philippines, where logistics firms encounter particular difficulties such as high traffic density, variable road conditions, and climate variables that accelerate vehicle wear, preventative maintenance plays an extremely important role (Garcia & Santos, 2023). K2MAC can handle local operating issues, lower the risk of unplanned breakdowns, and guarantee consistent service quality by putting in place a preventive maintenance program that is customized to these particular conditions. These procedures not only promote operational stability but also enhance market positioning and consumer confidence. This study utilized correlational research design which aimed to determine the relationship between the preventive maintenance implementation and operational resilience of K2MAC Delivery Services. Findings showed that the K2MAC Delivery Services has successfully established a robust preventive maintenance system and is on the right track with maintaining its operations, and while there are areas for further improvement, the current implementation provides a strong foundation for operational efficiency. It is also found that they excel in building operational resiliency, with a particular strength in risk management and adaptability. The results underscore the organization's commitment to maintaining a highly resilient and responsive operational framework, though continuous improvement in recovery and continuity planning may further strengthen its capacity to navigate disruptions. Overall, preventive maintenance practices strengthen the K2MAC Delivery Services' operational resiliency, enabling it to better manage risks, adapt to changes, and recover from disruptions effectively. It is suggested that the K2MAC Delivery Services' managers can reduce the occurrence of operational disruptions by ensuring that critical maintenance activities are performed proactively, thus strengthening its overall resiliency. Further, they should invest in technologies that enable real-time monitoring of equipment performance, ensuring immediate action can be taken to prevent any risks that may arise.

***Index Terms*—Preventive Maintenance Implementation, Operational Resilience, K2MAC Delivery Services.**

1. Introduction

In the logistics sector, where continuous operations and dependability are essential to satisfying growing customer demands, preventive maintenance, has shown to be essential. Preventive maintenance has become well-known around the world as a fundamental technique to increase the lifespan of equipment, decrease unplanned malfunctions, and save operating expenses (Smith, 2023). Logistics businesses may maintain their fleet in optimal condition through routine maintenance, which supports sustainability and fuel economy initiatives while guaranteeing adherence to safety and environmental laws (Carter, 2023). By incorporating preventive maintenance into its operations, K2MAC Delivery Services may improve dependability, boost operational resilience, and allocate resources more efficiently.

By reducing the likelihood of unexpected interruptions, K2MAC can better meet delivery deadlines and build an excellent reputation for reliability in a competitive market. Wong and Miller (2023) state that regular inspections, part replacements, and preemptive repairs can help avoid delays that disrupt delivery schedules, which is crucial to maintaining customer satisfaction and loyalty. Preventive maintenance helps logistics providers mitigate breakdowns, thereby ensuring the operational continuity that customers increasingly expect in today's fast-paced delivery ecosystem.

In the Philippines, where logistics firms encounter particular difficulties such as high traffic density, variable road conditions, and climate variables that accelerate vehicle wear, preventative maintenance plays an extremely important role (Garcia & Santos, 2023). K2MAC can handle local operating issues, lower the risk of unplanned breakdowns, and guarantee consistent service quality by putting in place a preventive maintenance program that is customized to these particular conditions. These procedures not only promote operational stability but also enhance market positioning and consumer confidence.

Preventive maintenance not only improves operational resilience but also promotes sustainable practices, which are becoming more and more important to contemporary logistics firms. Bennett (2023) asserts that well maintained automobiles use less fuel, produce fewer emissions, and operate more effectively, assisting businesses such as K2MAC in meeting sustainability objectives while reducing their environmental effect. The need for environmentally conscious logistics companies and growing customer awareness are in line with this proactive approach to sustainability.

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By lowering the possibility of significant repairs and prolonging the lifespan of assets, preventive maintenance also plays a vital role in cost management, which is essential for maximizing investment in logistics equipment. Based on the study of Davis (2023), proactive maintenance significantly lowers the frequency and severity of repair expenditures, freeing up resources for other essential operational requirements and enhancing a company's financial stability. These savings may result in a more solid financial base and more capacity for K2MAC to make investments in areas of strategic expansion.

Furthermore, adherence to industry rules governing vehicle safety and emissions depends on regular maintenance. A company's reputation and financial performance may suffer if these requirements are not met, since penalties and other operating limits may follow (Alvarez, 2023). Following preventive maintenance procedures guarantees that K2MAC complies with these rules, promoting legal compliance and operational continuity—two things that are essential for long-term success.

In summary, K2MAC Delivery Services' application of preventative maintenance meets local operational needs as well as global best practices, setting the business up for increased customer satisfaction, less environmental impact, and increased resilience. In order to help comparable logistic organizations establish strong, dependable delivery services in difficult situations, the determined the K2MAC's preventive maintenance and operational resilience. Moreover, this study determined the relationship between K2MAC's preventive maintenance and operational resilience. By investigating these aspects, the study provided actionable recommendations that K2MAC can use to strengthen its maintenance processes, improve customer satisfaction, and build a resilient operational framework.

A. Scope and Limitations of the Study

This study determines the relationship between the preventive maintenance implementation and operational resiliency of K2MAC Delivery Services. This study is limited to 45 employees from K2MAC Delivery Services. This study was conducted during the academic year 2024-2025.

B. Significance of the Study

This study will examine the relationship between K2MAC's preventive maintenance and operational resilience. By investigating these aspects, the study will provide actionable recommendations that K2MAC can use to strengthen its maintenance processes, improve customer satisfaction, and build a resilient operational framework. Conducting this study on preventive maintenance implementation and operational resiliency of K2MAC Delivery Services is significant for the following:

Logistics and Transportation Managers. This study provides information on preventive maintenance practices that help improve workforce dependability, reduce downtime, and manage maintenance expenses. Logistics managers that want to maximize operational effectiveness and resource allocation while providing reliable, high-quality service will find these ideas extremely beneficial.

Investors and Business Owners. The research emphasizes how important preventive maintenance investments are for prolonging asset life and reducing the need for urgent repairs. This may help investors and company owners make judgments about asset management and maintenance budgets, which will eventually promote financial stability and maximize profits.

Employees and Maintenance Teams. The focus of this research is on proactive, safe maintenance techniques benefits employees engaged in maintenance. A more structured workplace and less stress from unplanned equipment breakdowns are two benefits of using such a preventive maintenance procedure, which may increase employee engagement and productivity.

Researcher. This study on the implementation of preventive maintenance and operational resiliency at K2MAC Delivery Services is important from an academic and practical standpoint for the current researcher. The researcher can gain a better knowledge of how proactive maintenance procedures help to minimize downtime, maximize workforce performance, and improve overall company resilience by investigating the direct effects of preventive maintenance on delivery operations. The researcher may apply theoretical knowledge to real-world situations which improves their proficiency in maintenance management and operational efficiency in the logistics sector.

Future Researchers. This study on K2MAC Delivery Services' implementation of preventive maintenance and operational resilience offers a solid starting point for those who are interested to study maintenance management in logistics and related high-demand sectors.

To further understand the study, the following terms are defined operationally:

Adaptability and Flexibility. It refers to an individual’s or organization’s capacity to adjust to new conditions, while flexibility emphasizes the ease with which such adjustments can be made (Cai et al., 2021). Operationally, it is critical for survival and success of K2MAC Delivery Services where technological advancements and customer preferences evolve quickly.

Frequency and Scheduling. It refers to the strategic determination of how often and when specific activities should occur to optimize performance and reduce disruptions (Tang & Zuo, 2022). In the study, it entails choosing the best times to perform maintenance tasks in operating and maintenance settings including manufacturer requirements, operational needs, and equipment usage of K2MAC Delivery Services.

Maintenance Procedures and Quality. It refers to the structured methods and standards used to ensure that equipment and systems function efficiently and reliably (Chowdhury et al., 2021). Operationally, this refers to the adherence of K2MAC Delivery Services to established standards and best practices that enhance the effectiveness and reliability of maintenance activities. This includes ensuring that maintenance tasks are performed according to predetermined specifications, using the right tools and materials, and involving adequately trained personnel

Operational Resilience. It is an organization's ability to continue delivering services during disruptions by anticipating, preparing for, responding to, and adapting to adverse conditions (Walker et al., 2023). In this study, it includes developing contingency plans, conducting regular risk assessments, and fostering an adaptable organizational culture of K2MAC Delivery Services.

Preventive Maintenance Implementation. It is the systematic approach to servicing equipment at scheduled intervals to prevent unexpected breakdowns (Alnahhal & Al-Hawari, 2021). In this study, this could consist of regular inspections of delivery trucks, regular oil changes, and timely replacement of damaged parts to avoid interfering with logistical processes of K2MAC Delivery Services

Recovery and Continuity Planning. It involves establishing strategies and procedures to ensure business operations can resume swiftly after disruptions (Zhao & Wu, 2022). Operationally, it refers to the of K2MAC Delivery Services' ongoing training, testing, and updating of plans to reflect changes in the organizational structure, technology, and potential risks.

Resource Allocation and Personal Competency. It is the strategic distribution of available resources to achieve organizational goals efficiently, while personal competency involves the knowledge, skills, and attitudes necessary to perform tasks effectively (Nguyen & Nguyen, 2021). In this study, resource allocation involves the K2MAC Delivery Services budgeting processes, prioritizing projects based on their potential return on investment, and balancing resource availability against demand, while personal competency refers to K2MAC Delivery Services' ability to perform tasks effectively and efficiently based on a combination of knowledge, skills, and attitudes.

Risk Management and Mitigation. It is the process of identifying, analyzing, and addressing potential risks to minimize their impact, while mitigation involves implementing strategies to reduce those risks (Lopez et al., 2023). Operationally, it involves to the K2MAC Delivery Services' risk identification, risk assessment, risk response, and risk monitoring.

C. Research Gaps

After a thorough review of literature, it was found that preventive maintenance and operational resiliency of delivery services had been the topic of a number of research but they were studied separately. To bridge the existing gap, the researcher was motivated to conduct quantitative research determining the relationship between preventive maintenance implementation and operational resiliency. Also, the researcher determined the level of preventive maintenance implementation in terms of scheduling and frequency, maintenance procedures and quality, and resource allocation and personal competency, while the level of operational resiliency was described in terms of operational resiliency which is described in terms of risk management and mitigation, adaptability and flexibility, and recovery and continuity planning.

2. Research Design

This study employed the descriptive-correlational research design enabling the researcher to examine correlations and comprehend and assess the statistical relationship between the variables without being influenced by extraneous factors. This approach granted the researcher control or manipulate these variables (Bhandari, 2021). In this study, the researcher determined the relationship between preventive maintenance implementation and operational resiliency.

A. Research Locale

This study focused on K2MAC Delivery Services, a logistics company operating within the Philippines. K2MAC Delivery Services is a logistics company dedicated to providing reliable and efficient delivery solutions tailored to meet the unique needs of its customers. With a focus on operational excellence, they utilize advanced technology and a customer-centric approach to ensure timely and secure delivery of packages.

B. Respondent of the Study

The respondents were 45 selected employees of K2MAC Delivery Services, they were comprised of supervisors, drivers and helpers within the company. All clerical staff is not included in the respondent.

C. Sampling Design

The actual respondents of the study were consisted of 45 out of the 50 total population from the employees of K2MAC Delivery Services. The sample size was computed using the Raosoft sample size calculator (Al Eid & Shoukri, 2019) with a confidence level of 95% and a margin of error of 5%. The respondents are selected utilizing simple random sampling (Shagofah et al., 2022). Simple random sampling is a widely utilized sampling method in quantitative studies with survey instruments. It is asserted that simple random sampling is favorable in homogeneous and uniformly selected populations.

D. Instrument and Validation

For the purpose of collecting the needed primary data, the researcher utilized a self-constructed questionnaire to measure level of preventive maintenance implementation and the level of operational resiliency of K2MAC Delivery Services. The first part of the questionnaire contains responses about level of preventive maintenance implementation and the second part focuses on statements about the level of operational resiliency of K2MAC Delivery Services. The questionnaire was validated by experts in business management, statistics, and research. The researcher used this step to assess how easily the questionnaire would be understood by the employees who would take part in the study as respondents. A pilot test of the research instrument was conducted with fifteen (15) respondents who were not involved in the study's real conduct after thorough validation. The validators and research adviser received the findings of the pilot test and used them to support their approval of the researcher's finalization of the questionnaire. Cronbach's alpha was used to evaluate the instrument's internal consistency or repeatability.

E. Cronbach Alpha Reliability Test

To evaluate the questionnaire's internal consistency and reliability using Cronbach's Alpha, a pilot test comprising 15 respondents was carried out. This test assesses how effectively a collection of things captures a single latent construct that is unidimensional. Overall, the findings show that the instrument is very dependable, as explained below:

F. Sub-Variables Reliability

Each of the six sub-variables consisted of 5 items, and the Cronbach's Alpha (α) values for these ranged from 0.76 to 0.89:

- Scheduling and Frequency (α = 0.83) – This value indicates good internal consistency.
- Maintenance Procedures and Quality (α = 0.76) – This is acceptable, though slightly lower than other sub-variables.
- Resource Allocation and Personnel Competency (α = 0.87) – Considered good.
- Risk Management and Mitigation (α = 0.89) – Also good, very close to the threshold for "excellent."
- Adaptability and Flexibility (α = 0.87) – Indicates good internal consistency.
- Recovery and Continuity Planning (α = 0.88) – Also good.

These results demonstrate that all sub-variable groupings have acceptable to good reliability, showing that the items within each construct are well-aligned and measure similar concepts.

G. Main Variables Reliability

The broader constructs, made up of 15 items each, showed excellent internal consistency:

- Level of Preventive Maintenance Implementation (α = 0.92)
- Level of Operational Resiliency (α = 0.95)

Furthermore, the overall reliability of the entire instrument (comprising all 30 items) achieved an α = 0.96, which falls in the "Excellent" range (above 0.90). This indicates that the instrument as a whole is extremely reliable and consistent for measuring the intended constructs.

Overall, the pilot testing demonstrates that the questionnaire is a very trustworthy instrument for evaluating operational resilience and the application of preventative maintenance. Every component showed internal consistency that was either good or exceptional, and none of the sub-variables dropped below the acceptable range. These findings bolster the instrument's suitability for wider application during the primary data gathering stage.

H. Evaluation and Scoring

1) Level of Preventive Maintenance Implementation

To determine the respondents' level of preventive maintenance implementation in terms of scheduling and frequency, maintenance procedures and quality, and resource allocation and personal competency, the following adapted numerical rating, numerical range, categorical response and verbal interpretation were used:

2) Level of Operational Resiliency

To determine the level of operational resiliency in terms of risk management and mitigation, adaptability and flexibility, and recovery and continuity planning, the following adapted numerical rating, numerical range, categorical response, and verbal interpretation were used:

I. Data Gathering Procedures

This study utilized both primary and secondary data. A survey questionnaire was utilized since it is believed to be the most effective instrument for gathering primary data for this research endeavor while research journals were used as secondary sources. In the researcher data gathering procedures, survey questionnaire was chosen as the primary instrument for collecting data for this research project due to its perceived effectiveness. To conduct the survey, the researcher obtained authorization from the Adviser, the Dean of the Graduate School, and the management of K2MAC Delivery Services. Upon receiving approval, the questionnaire was distributed to selected employees K2MAC Delivery Services by the researcher. The researcher also managed the data-collection process, ensuring that each respondent received and completed the questionnaire. The collected data from the responses were then extracted into Excel format and sent to a statistician for the application of statistical treatment.

J. Treatment of Data

The following statistical tools were utilized in this study's quantitative analysis:

1. Weighted mean was used to describe the level of preventive management implementation and level of operational resiliency. The overall weighted mean serves as a summary measure that reflects the general trend or level of response across all variables in the

Table 1
Level of preventive maintenance implementation

Numerical Points	Scale	Categorial Response	Verbal Interpretation
4	3.25 - 4.00	Strongly Agree (SA)	Fully Implemented
3	2.51 - 3.24	Agree (A)	Well Implemented
2	1.75 - 2.50	Disagree (DA)	Poorly Implemented
1	1.00 - 1.74	Strongly Disagree (SD)	Not Implemented

Table 2
Level of operational resiliency

Numerical Points	Scale	Categorial Response	Verbal Interpretation
4	3.25 - 4.00	Strongly Agree (SA)	Highly Efficient
3	2.51 - 3.24	Agree (A)	Efficient
2	1.75 - 2.50	Disagree (DA)	Inefficient
1	1.00 - 1.74	Strongly Disagree (SD)	Highly Inefficient

study. A balanced and integrated perspective of the data is provided by the overall weighted mean, which is determined by allocating suitable weights, usually depending on the number of items or responses per sub-variable. The mean scores from several sub-variables pertaining to preventive maintenance and operational resiliency were combined in this study to create a complete indicator of the participants' overall perception or experience. While a lower score could indicate possible areas for development, a higher overall weighted mean indicates better implementation or stronger agreement across the examined characteristics.

2. The Pearson Product-Moment Correlation Coefficient (Pearson r) was employed to determine whether a significant relationship exists between the level of preventive maintenance implementation and the level of operational resiliency. This statistical method measures the strength and direction of a linear relationship between two continuous variables. A positive correlation would indicate that higher levels of preventive maintenance are associated with higher operational resiliency, while a negative correlation would suggest an inverse relationship. The significance level (p-value) helps determine whether the observed correlation is statistically meaningful and not due to chance.

K. Ethical Considerations

In this research, the researcher adhered to the ethical guidelines established by the Pamantasan ng Cabuyao (University of Cabuyao). These guidelines encompass a range of ethical considerations, including informed consent, confidentiality, data security, minimizing harm, and avoiding bias.

Adhering to ethical considerations in research surveys is crucial to protect the rights and dignity of participants. Informed consent ensures that participants are fully informed about the purpose, procedures, potential risks, and benefits of the survey, empowering them to make voluntary and informed decisions about their participation. Confidentiality safeguards the privacy of participants, ensuring that their identities and responses remain confidential unless explicit consent for disclosure is obtained. Data security measures protect participants' data from unauthorized access, use, or disclosure, ensuring the integrity and confidentiality of the information collected.

Moreover, researchers must uphold the Data Privacy Act of 2012 (Republic Act No. 10173), which ensures that personal data is handled with care and responsibility. This law emphasizes transparency, the need for a legitimate purpose in collecting data, and ensuring that only necessary information is gathered. It also highlights the importance of securing participants' consent before collecting any personal details and implementing strong protective measures to keep data safe.

3. Results and Discussions

This chapter presents the analysis and interpretation of the collected data, providing deeper insights into the research. The analytical framework is structured according to the research problems outlined in section 1.

A. The level of Preventive Maintenance Implementation of K2MAC Delivery Services

Table 3 presents the level of preventive maintenance implementation at K2MAC Delivery Services in terms of scheduling and frequency. The data reveals that the highest-rated indicator is the sufficiency of preventive maintenance frequency in ensuring optimal equipment performance, with a mean of 3.70 and a verbal interpretation of "Fully Implemented". Two indicators are tied having a clearly defined schedule for maintenance tasks and having a system for tracking completed maintenance activities and their schedules, both receiving a mean of 3.68 and a verbal interpretation of "Fully Implemented." The regular review and adjustment of maintenance schedules based on equipment performance and usage was rated with a mean of 3.62 and also interpreted as "Fully Implemented". Lastly, the lowest-rated indicator, though still within the “Fully Implemented” range, was the regular performance of maintenance tasks as planned, with a mean of 3.49.

To sum up, the general assessment is 3.63, with a verbal interpretation of "Fully Implemented" implies that K2MAC Delivery Services maintains a well-structured and systematic preventive maintenance program in terms of scheduling and frequency. The organization is generally consistent in implementing preventive maintenance but can still improve the execution of scheduled tasks and enhance adaptability through more responsive, data-informed scheduling.

Supporting literature reinforces these findings. Karim et al. (2024) emphasized that organizations with clearly outlined maintenance schedules experience fewer operational disruptions and increased reliability. Govindan et al. (2020) highlighted that maintenance strategies incorporating performance-based adjustments result in enhanced equipment lifespan and efficiency. Singh et al. (2022), further noted that robust tracking systems for maintenance activities help organizations ensure accountability and continuous improvement in maintenance practices.

Table 4 presents the level of preventive maintenance

Table 3
The level of preventive maintenance implementation of K2MAC delivery services in terms of scheduling and frequency

Indicators	Mean	Verbal Interpretation	Rank
Our organization has a clearly defined schedule for preventive maintenance tasks.	3.68	Full Implemented	2.5
Preventive maintenance tasks are performed at regular intervals as planned.	3.49	Fully Implemented	5
The frequency of preventive maintenance is sufficient to ensure optimal equipment performance.	3.70	Fully Implemented	1
We regularly review and adjust our maintenance schedule based on equipment performance and usage.	3.62	Fully Implemented	4
We have a system in place for tracking completed maintenance activities and their schedules.	3.68	Fully Implemented	2.5
General Assessment	**3.63**	**Fully Implemented**	

Table 4
The level of preventive maintenance implementation of K2MAC delivery services in terms of maintenance procedures and quality

Indicators	Mean	Verbal Interpretation	Rank
The quality of maintenance work performed is regularly assessed and reviewed	3.60	Fully Implemented	2
Our organization utilizes best practices and industry standards to guide maintenance procedures.	3.53	Fully Implemented	3
We have standardized procedures in place for all preventive maintenance activities.	3.62	Fully Implemented	1
There is a documented process for reporting and addressing maintenance-related issues or failures.	3.30	Fully Implemented	5
Feedback from maintenance personnel is regularly collected to improve procedures and quality.	3.51	Fully Implemented	4
General Assessment	**3.51**	**Fully Implemented**	

Legend: 3.25 – 4.00 Fully Implemented, 1.75 – 2.50 Poorly Implemented, 2.51 – 3.24 Well Implemented, 1.00 – 1.74 Not Implemented

Table 5
The level of preventive maintenance implementation of K2MAC delivery services in terms of resource allocation and personnel competency

Indicators	Mean	Verbal Interpretation	Rank
Sufficient resources (tools, equipment, and parts) are allocated for preventive maintenance tasks.	3.51	Fully Implemented	2.5
Personnel involved in maintenance activities receive adequate training and development.	3.45	Fully Implemented	5
Our staff possesses the necessary skills and competencies to perform preventive maintenance effectively.	3.68	Fully Implemented	1
The organization regularly evaluates the performance and competency of maintenance personnel.	3.47	Fully Implemented	4
There is a budget specifically allocated for ongoing training and resource acquisition for maintenance staff.	3.51	Fully Implemented	2.5
General Assessment	**3.52**	**Fully Implemented**	

Legend: 3.25 – 4.00 Fully Implemented, 1.75 – 2.50 Poorly Implemented, 2.51 – 3.24 Well Implemented, 1.00 – 1.74 Not Implemented

implementation at K2MAC Delivery Services in terms of maintenance procedures and quality. The highest-rated indicator is the existence of standardized procedures for all preventive maintenance activities, with a mean of 3.62 and a verbal interpretation of "Fully Implemented". The next indicator is the regular assessment and review of maintenance work quality, with a mean of 3.60 and a verbal interpretation of "Fully Implemented". Utilization of best practices and industry standards to guide maintenance procedures received a mean of 3.53, also interpreted as "Fully Implemented." Meanwhile, the collection of feedback from maintenance personnel with a mean of 3.51, suggesting that personnel input is valued but could be integrated more effectively into decision-making and procedural improvements. The lowest-ranked indicator is the presence of a documented process for reporting and addressing maintenance-related issues or failures, with a mean of 3.30. Although still rated as "Fully Implemented."

To sum up, the general assessment is 3.51, with a verbal interpretation of "Fully Implemented" implies that K2MAC Delivery Services demonstrates a strong implementation of preventive maintenance procedures and quality practices. However, improvements can still be made in formalizing reporting systems and enhancing the integration of personnel feedback to further refine maintenance operations.

Supporting literature aligns with these findings. Hosseini et al. (2022), emphasize the importance of standardized procedures and their role in ensuring quality and reliability in maintenance outcomes. Based on the study Smith et al. (2023), integrating industry best practices and personnel feedback leads to continuous improvement and stronger operational performance. Moreover, Erbiyik (2022) highlight that having a clear reporting and documentation system enhances accountability and enables faster resolution of maintenance issues.

Table 5 presents the level of preventive maintenance implementation of K2MAC Delivery Services in terms of resource allocation and personnel competency. The highest-rated indicator is the staff's possession of necessary skills and competencies to perform preventive maintenance, which received a mean of 3.68 and a verbal interpretation of "Fully Implemented". Two indicators tied at Rank 2.5: the allocation of sufficient resources such as tools, equipment, and parts, and the existence of a specific budget for ongoing training and resource acquisition, both with a mean of 3.51 and a verbal interpretation of "Fully Implemented." Regular evaluation of personnel performance and competency was ranked fourth with a mean of 3.47. The lowest-rated indicator is the provision of adequate training and development for maintenance personnel, with a mean of 3.45 and a verbal interpretation of "Fully Implemented".

To sum up, the general assessment is 3.52, with a verbal interpretation of "Fully Implemented" implies that K2MAC Delivery Services effectively allocates resources and maintains personnel competency in support of preventive maintenance. Nonetheless, enhancements in training initiatives and more systematic performance evaluations could further strengthen workforce development and operational excellence.

Supporting literature underscores the significance of competent personnel and sufficient resources in preventive maintenance. Based on the study of Sarkis et al. (2022), skilled maintenance teams contribute directly to the reliability and efficiency of operations. Alwan et al. (2023) highlight that continuous training and dedicated maintenance budgets are vital for sustaining long-term performance. Additionally, Yli-Jyrä et al. (2024) emphasize the value of regular staff evaluations in identifying skills gaps and enhancing workforce readiness in logistics and maintenance operations.

B. Level of Operational Resiliency of K2MAC Delivery Services

Table 6 presents the level of operational resiliency of K2MAC Delivery Services in terms of risk and mitigation strategies. The indicator with the highest rating is the active monitoring and review of risk management strategies, with a mean of 3.72 verbally interpreted as "Highly Efficient". The second-highest indicator is the presence of established protocols for mitigating identified risks, which received a mean of 3.64 and is also verbally interpreted as "Highly Efficient". The existence of a comprehensive risk management framework follows closely, with a mean of 3.62 verbally interpreted as "Highly Efficient". Regular risk assessments to identify threats

received a mean of 3.57 verbally interpreted as "Highly Efficient". The lowest-rated indicator, though still within the "Highly Efficient" interpretation, is the training of employees in risk management practices relevant to their roles, with a mean of 3.55.

To sum up, the general assessment is 3.62, with a verbal interpretation of "Highly Efficient" implies that K2MAC Delivery Services demonstrates a strong level of operational resiliency, especially in terms of risk identification, mitigation protocols, and strategy review. However, further emphasis on training programs could enhance employee preparedness and deepen the organization's risk culture.

Supporting literature validates these findings. Based on the study of Liu et al. (2022), frequent strategy evaluation and active risk monitoring greatly enhance organizational responsiveness to disruptions. Hassan et al. (2021) emphasize that clearly documented risk protocols contribute significantly to business continuity and reduce downtime. Moreover, Sharma et al. (2023) highlight the crucial role of employee training in embedding risk-awareness culture throughout the organization, reinforcing the long-term success of any risk mitigation framework.

Table 7 presents the level of operational resiliency of K2MAC Delivery Services in terms of adaptability and flexibility. The highest-rated indicator is leadership support for the implementation of new processes or technologies, receiving a mean of 3.77 and a verbal interpretation of "Highly Efficient". The ability to quickly adapt to market changes or customer demands follows with a mean of 3.66 verbally interpreted as "Highly Efficient". K2MAC also demonstrates good preparedness to respond to unexpected challenges, as reflected by a mean of 3.57 verbally interpreted as "Highly Efficient". Openness to change among employees is also evident, with a mean of 3.51 verbally interpreted as "Highly Efficient". The lowest-ranked indicator is the encouragement of innovative solutions within teams, with a mean of 3.49 verbally interpreted as "Highly Efficient".

To sum up, the general assessment is 3.60, with a verbal interpretation of "Highly Efficient" implies that K2MAC Delivery Services possesses a strong capacity for adaptability and flexibility in its operations. While leadership support and responsiveness to change are commendable, promoting a stronger culture of innovation and team-driven problem-solving could further enhance the company's operational resiliency.

Recent literature reinforces the importance of adaptability in logistics and service industries. As noted by Rahman et al. (2021), leadership commitment to change is a driving force behind successful adaptation. Sutton et al. (2023), stress that cultivating an open and flexible workplace culture enhances both employee performance and organizational agility. Meanwhile, Mackay et al. (2020) highlights the need for innovation at all levels to ensure long-term resiliency and competitiveness in dynamic business environments.

Table 8 presents the level of operational resiliency of K2MAC Delivery Services in terms of recovery and continuity planning. The highest-rated indicator is the existence of a well-documented business continuity plan, with a mean of 3.72 verbally interpreted as "Highly Efficient". The organization's successful recovery from past disruptions due to effective planning is ranked second with a mean of 3.60 verbally interpreted as "Highly Efficient". Regular reviews and updates to recovery plans, based on new insights or challenges, received a mean of 3.51 verbally interpreted as "Highly Efficient". Training and drills for staff to familiarize them with recovery

Table 6
Level of operational resiliency of K2MAC delivery services in terms of risk and mitigation

Indicators	Mean	Verbal Interpretation	Rank
Our organization has a comprehensive risk management framework in place.	3.62	Highly Efficient	3
We regularly conduct risk assessments to identify potential threats to operations.	3.57	Highly Efficient	4
There are established protocols for mitigating identified risks in our operations.	3.64	Highly Efficient	2
Employees are trained in risk management practices relevant to their roles.	3.55	Highly Efficient	5
We actively monitor and review our risk management strategies to ensure their effectiveness.	3.72	Highly Efficient	1
Overall Weighted Mean	**3.62**	**Highly Efficient**	

Legend: 3.25 – 4.00 Highly Efficient , 1.75 – 2.50 Inefficient, 2.51 – 3.24 Efficient, 1.00 – 1.74 Highly Inefficient

Table 7
Level of operational resiliency of K2MAC delivery services in terms of adaptability and flexibility

Indicators	Mean	Verbal Interpretation	Rank
Our organization can quickly adapt to changes in market conditions or customer demands.	3.66	Highly Efficient	2
We encourage innovative solutions to operational challenges within our teams.	3.49	Highly Efficient	5
There is a culture of openness to change and flexibility among employees.	3.51	Highly Efficient	4
Our leadership supports the implementation of new processes or technologies when necessary.	3.77	Highly Efficient	1
We have the necessary resources to respond to unexpected challenges effectively.	3.57	Highly Efficient	3
General Assessment	**3.60**	**Highly Efficient**	

Legend: 3.25 – 4.00 Highly Efficient, 1.75 – 2.50 Inefficient, 2.51 – 3.24 Efficient, 1.00 – 1.74 Highly Inefficient

Table 8
Level of operational resiliency of K2MAC delivery services in terms of recovery and continuity planning

Indicators	Mean	Verbal Interpretation	Rank
Our organization has a well-documented business continuity plan.	3.72	Highly Efficient	1
We conduct regular training and drills to ensure staff are familiar with recovery procedures.	3.49	Highly Efficient	4
There is a clear communication plan in place for stakeholders during disruptions.	3.34	Highly Efficient	5
We regularly review and update our recovery plans based on new insights or challenges.	3.51	Highly Efficient	3
Our organization has successfully recovered from past disruptions due to effective planning.	3.60	Highly Efficient	2
General Assessment	3.53	Highly Efficient	

Legend: 3.25 – 4.00 Highly Efficient, 1.75 – 2.50 Inefficient, 2.51 – 3.24 Efficient, 1.00 – 1.74 Highly Inefficient

procedures also scored relatively lower, with a mean of 3.49 verbally interpreted as "Highly Efficient". The lowest-ranked indicator is the presence of a clear communication plan for stakeholders during disruptions, which received a mean of 3.34 verbally interpreted as "Highly Efficient".

To sum up, the general assessment is 3.53, with a verbal interpretation of "Highly Efficient" implies that K2MAC Delivery Services has a strong recovery and continuity planning framework, with robust business continuity documentation and effective recovery from past disruptions. However, enhancing communication plans and increasing the frequency or depth of training drills could further optimize its resiliency efforts.

Supporting literature supports the importance of comprehensive recovery and continuity planning. As noted by Qin et al. (2022) having a documented continuity plan is crucial for managing disruptions efficiently and safeguarding operations. Tan et al. (2023) emphasize the value of regular recovery plan reviews and staff training to ensure continued preparedness. FurthermoreGalaitsi et al. (2023) highlight the need for clear communication strategies during crises to ensure all stakeholders are well-informed and aligned during disruptions.

C. Is there a Significant Relationship Between the Preventive Maintenance Implementation and Operational Resiliency?

Table 9 presents the significant relationships between preventive maintenance implementation and operational resiliency for K2MAC Delivery Services. For the Scheduling and Frequency of preventive maintenance, there is a significant positive correlation with risk management and mitigation ($r = 0.4265$, $p = 0.003$), indicating that as scheduling and frequency of maintenance improve, so does the organization's ability to manage risks. There is also a strong and highly significant correlation between scheduling and frequency with adaptability and flexibility ($r = 0.6042$, $p = 0.000$), suggesting that regular and planned preventive maintenance enhances the organization's ability to adapt to changing conditions. Furthermore, the relationship between scheduling and frequency and recovery and continuity planning is also significant ($r = 0.552$, $p = 0.00005$), indicating that effective scheduling and maintenance frequency contribute to better recovery planning and implementation.

In terms of maintenance procedures and quality**,** the relationship with risk management and mitigation is significant ($r = 0.4488$, $p = 0.002$), showing that the quality of maintenance procedures positively affects risk management efforts. The correlation between maintenance procedures and quality and adaptability and flexibility is also significant ($r = 0.4223$, $p = 0.003$), further highlighting that effective maintenance procedures contribute to an organization's flexibility in handling changes. Additionally, the relationship with recovery and continuity planning is moderately significant ($r = 0.2943$, $p = 0.045$), although the correlation is lower compared to other aspects, it still indicates the importance of maintenance quality in enhancing recovery efforts.

For resource allocation and personnel competency, the relationship with risk management and mitigation is significant ($r = 0.413$, $p = 0.004$), suggesting that sufficient resources and skilled personnel positively impact the organization's ability to manage risks. The correlation with adaptability and flexibility is also strong and significant ($r = 0.534$, $p = 0.000$), demonstrating that resource allocation and personnel competency are key factors in maintaining operational flexibility. Finally, resource allocation and personnel competency are significantly correlated with recovery and continuity planning ($r = 0.544$, $p = 0.000$), emphasizing the importance of well-trained personnel and adequate resources in ensuring a robust recovery plan.

To sum up, the findings from Table 9 indicate that preventive maintenance implementation has a significant and positive impact on operational resiliency across various aspects. All of the correlations presented in the table have p-values below 0.05, confirming the statistical significance of these relationships. Specifically, scheduling and frequency, maintenance procedures and quality, and resource allocation and personnel competency all positively influence risk management**,** adaptability, and recovery planning within K2MAC Delivery Services. These results suggest that enhancing preventive maintenance practices can strengthen the company's operational resiliency, enabling it to better manage risks, adapt to changes, and recover from disruptions effectively.

Table 9
Significant relationship between preventive, maintenance implementation and operational resiliency

Preventive Maintenance	Operational Resiliency	r-values	p-value	Remarks	Decision
scheduling and frequency	Risk management and mitigation	0.4265	0.003	Significant	Reject Ho
	Adaptability and flexibility	0.6042	0.000	Significant	Reject Ho
	Recovery and continuity planning	0.552	.00005	Significant	Reject Ho
maintenance procedures and quality	Risk management and mitigation	0.4488	0.002	Significant	Reject Ho
	Adaptability and flexibility	0.4223	0.003	Significant	Reject Ho
	Recovery and continuity planning?	0.2943	0.045	Significant	Reject Ho
resource allocation and personal competency	Risk management and mitigation	0.413	0.004	Significant	Reject Ho
	Adaptability and flexibility	0.534	0.000	Significant	Reject Ho
	Recovery and continuity planning	0.544	0.000	Significant	Reject Ho

Table 10
Regression analysis predicting operational resiliency from preventive maintenance

Predictor	Unstandardized Coefficient	Standard Error	t-statistic	p-value	95% CI (Lower, Upper)
Intercept	1.11	0.36	3.07	0.0004	(0.38,1.84)
Preventive Maintenance	0.70	0.11	3.86	<.001	(0.49, 0.90)
R^2 (proportion of variance)	0.511				
F-Statistic (1,45)	47.03			<.001	

Note. B = unstandardized regression coefficient; SE = standard error, CI = confidence interval; R^2 = proportion of variance explained by the model

Table 11
Proposed action plan for enhancing preventive maintenance and operational resiliency at K2MAC delivery services

Plans and Programs	Goals/Objectives	Time Frame	Persons Involved	Budget Allocation	Success Indicator
Improvement of Preventive Maintenance Scheduling and Frequency	Enhance scheduling and frequency of preventive maintenance tasks to optimize equipment performance and reduce downtime.	6 months (Quarterly reviews)	Maintenance Department, Operations Team, Logistics Department, Facility Management	PHP 150,000	15% reduction in unplanned downtime, 95% compliance with maintenance schedule adherence.
Strengthening Maintenance Procedures and Quality Control	Standardize and improve maintenance procedures following best practices and industry standards.	12 months (Periodic evaluations every 4 months)	Maintenance Supervisors, Quality Control Team, External Maintenance Consultants	PHP 200,000	10% improvement in maintenance quality, comprehensive maintenance manual established.
Enhancing Resource Allocation and Personnel Competency	Ensure sufficient resources and continuous staff training to improve maintenance skills and efficiency.	Ongoing, with evaluations every 6 months	Human Resources Department, Maintenance Department, Training and Development Team	PHP 250,000	100% staff completion of annual development programs, 10% increase in equipment performance.
Strengthening Operational Resiliency through Risk Management and Recovery Planning	Improve risk management strategies and recovery plans, conducting regular drills and training.	12 months (Bi-annual drills)	Risk Management Team, Senior Leadership, All Employees	PHP 300,000	100% staff participation in recovery drills, 20% improvement in recovery time from disruptions.
Continuous Monitoring and Evaluation of Preventive Maintenance and Operational Resiliency	Continuously monitor and evaluate preventive maintenance and resiliency programs for alignment with goals.	Ongoing, with quarterly evaluations	Monitoring and Evaluation Team, Maintenance Department, Senior Management	PHP 100,000	Quarterly reports, 5% improvement in operational resiliency metrics annually.

D. Relationship Between the Preventive Maintenance Implementation Significantly and Operational Resiliency of K2MAC Delivery Services?

The regression analysis conducted to predict operational resiliency from preventive maintenance revealed that preventive maintenance is a significant predictor of operational resiliency in K2MAC Delivery Services. The intercept value was 1.11 (SE = 0.36, T = 3.07, p = 0.0004), which indicates that when preventive maintenance is at zero, the baseline operational resiliency is predicted to be 1.11. The coefficient for preventive maintenance was found to be 0.70 (SE = 0.11, T = 3.86, $p < 0.001$), which suggests a positive and statistically significant relationship between the two variables. Specifically, for each unit increase in preventive maintenance practices, operational resiliency increases by 0.70 units. The 95% confidence interval for the coefficient ranged from 0.49 to 0.90, indicating that this effect is both reliable and precise. The R-squared value was 0.511, meaning that 51.1% of the variance in operational resiliency can be explained by the preventive maintenance practices, highlighting the moderate to strong predictive value of the model. Finally, the overall F-statistic was 47.03 with a p-value of < 0.001, demonstrating that the model is statistically significant and reinforcing that preventive maintenance is an important factor in determining operational resiliency.

These results align with recent literature supporting the significant impact of preventive maintenance on operational efficiency and organizational resilience. For instance, Adams and Nguyen (2021) emphasized that regular maintenance directly contributes to the stability and adaptability of organizations, enabling them to recover quickly from disruptions. Similarly, Walker and Lee (2022) found that companies that implement effective maintenance systems are better equipped to handle operational risks, highlighting the link between maintenance practices and resilience. Furthermore, Yung and Zhao (2023) observed that strong preventive maintenance strategies are key to ensuring business continuity, with companies exhibiting higher resilience during crises due to their well-prepared infrastructure and processes.

E. Based on the Findings of the Study, what Action Plan can be Proposed to Augment the Preventive Maintenance Implementation and Operational Resiliency?

1) Rationale

This action plan aims to provide clear and measurable steps to enhance both preventive maintenance implementation and operational resiliency at K2MAC Delivery Services. By focusing on scheduling, quality control, resource allocation, personnel competency, and continuous monitoring, K2MAC can improve its operational efficiency and resilience, ensuring long-term sustainability and the ability to effectively handle unforeseen challenges.

4. Conclusion

The following conclusions are drawn based on the findings of the study:

1. K2MAC Delivery Services has successfully established a robust preventive maintenance system and is on the right track with maintaining its operations, and while there are areas for further improvement, the current implementation provides a strong foundation for operational efficiency.
2. K2MAC Delivery Services excels in building

operational resiliency, with a particular strength in risk management and adaptability. The results underscore the organization's commitment to maintaining a highly resilient and responsive operational framework, though continuous improvement in recovery and continuity planning may further strengthen its capacity to navigate disruptions.

3. Preventive maintenance practices strengthen the K2MAC Delivery Services' operational resiliency, enabling it to better manage risks, adapt to changes, and recover from disruptions effectively.
4. Preventive maintenance is a significant predictor of operational resiliency in K2MAC Delivery Services.
5. The developed action plan should be utilized or implemented to ensure that K2MAC can improve its operational efficiency and resilience, promoting long-term sustainability and the ability to effectively handle unforeseen challenges by focusing on scheduling, quality control, resource allocation, personnel competency, and continuous monitoring,

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