



KEY INDICATORS INFLUENCING THE MAINTENANCE PLANNING OF MASJID KARIAH'S FRAMEWORK IN KELANTAN, MALAYSIA

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Abstract

Effective maintenance is crucial for preserving mosques as sacred spaces and community hubs, requiring coordination and commitment to meet the needs of worshippers. In Malaysia, there are 6,351 Masjid Kariah, the highest among mosque types, yet most maintenance planning studies focus on Masjid Negeri. Additionally, no formal measurement criteria exist for Masjid Kariah maintenance, creating a significant research gap. This study examines maintenance planning in 59 Masjid Kariah across 10 districts in Kelantan, representing 10% of the total in the state. The research evaluates the relationship between seven Maintenance Performance Measurement indicators (organization management, planning and scheduling, financial provision, service quality, assessment, resource allocation, and safety and health) and three Maintenance Strategy Criteria (Planned Preventive, Planned Corrective, and Unplanned Maintenance). A total of 354 questionnaires were distributed to key committee members, including nazir, deputy nazir, secretary, deputy secretary, treasurer, and the bureau of development, using systematic and stratified sampling. Findings reveal that four indicators: planning and scheduling, service quality, assessment, and resource allocation were positively influence the maintenance planning. However, organization management, financial provision, and safety and health did not show significant effects. These findings provide practical insights to improve maintenance strategies for Masjid Kariah in Kelantan, addressing the less impactful indicators for better overall maintenance planning.

Keywords: Masjid Kariah, Maintenance Strategy Criteria, Maintenance Performance Measurement, Malaysia

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INTRODUCTION

According to Johnson & Crossing (2020), the global Muslim population increased from about 570 million in the 1970s to 1.9 billion in 2020, with the most substantial growth occurring in Asia; within this trend, Malaysia has emerged as Southeast Asia's second-largest Muslim nation (Latief et al., 2021). For Muslims, the mosque (Masjid) functions as the primary place of prayer and is commonly defined as "a place for prostration" (Sofii & Pertiwi, 2021; Hassan et al., 2021; Shoemaker, 2021). In Malaysia, where the Muslim population exceeds 19 million and the number of mosques surpasses 6,000, mosques are classified into four levels: Masjid Negara, Masjid Negeri, Masjid Daerah, and Masjid Kariah (Department of Islamic Development Malaysia, 2021). Masjid Kariah is the most prevalent typology and is established across districts nationwide; however, maintenance research and planning have largely prioritised State and District Mosques, leaving Masjid Kariah underexplored, often due to resource constraints. In practice, mosques face persistent maintenance challenges such as limited funding, shortages of skilled labour, and the need to reconcile traditional architectural elements with modern construction techniques (Hamdan et al., 2023). Since buildings, including mosques, inevitably require maintenance throughout their life cycle to remain functional (Ali et al., 2013), this study addresses the gap by examining Masjid Kariah maintenance planning and evaluating the relationships between seven Maintenance Performance Measurement indicators and Maintenance Planning (Maintenance Strategy Criteria).

MAINTENANCE PLANNING IN MASJID KARIAH'S PERSPECTIVE

The British Standard 3811 (BS3811) provides a key framework for building maintenance in sectors such as offices, hospitals, and apartments. Maintenance includes technical and administrative actions to keep facilities functional, while maintenance planning focuses on timely replacement of worn components to reduce cost and extend service life (Laham & Dalalah, 2020). As important religious facilities, Masjid institutions require structured maintenance planning to support daily worship and community programs. Masjids are classified into five levels, with Masjid Kariah at the community level under State Islamic Religious Councils (e.g., MAIS, MAINS). However, limited funding and weak institutional focus often cause deterioration (Kalumbu et al., 2016; Mohamad, 2019b). This gap highlights the need for a formal framework using maintenance strategies and performance indicators, supported by evidence that proactive maintenance improves outcomes (Swanson, 2001).

Maintenance Planning (Maintenance Strategy Criteria) Indicator

Maintenance planning is effective only when supported by an appropriate strategy that guides organisations toward their objectives (Ding & Kamaruddin, 2015; Waeyenbergh & Pintelon, 2002). Strategy evaluation also helps detect weaknesses and refine actions for better results (David, 1986). Guided by British Standard 3811 (BS3811), this study focuses on three maintenance strategies for Masjid Kariah: planned preventive, planned corrective, and unplanned maintenance. Planned preventive maintenance consists of scheduled or condition-based activities to prevent defects, reduce failures, and minimise emergency repairs (Izobo-Martins, 2014). Planned corrective maintenance restores function after failure and is widely practised (Waeyenbergh & Pintelon, 2002). Unplanned maintenance is triggered by unexpected damage requiring immediate response (Ing, 2008; Rani et al., 2015). These strategies collectively aim to improve the overall maintenance planning and performance of Masjid Kariah. Figure 1 shows the overview of maintenance strategy in buildings based on British Standard BS3811.

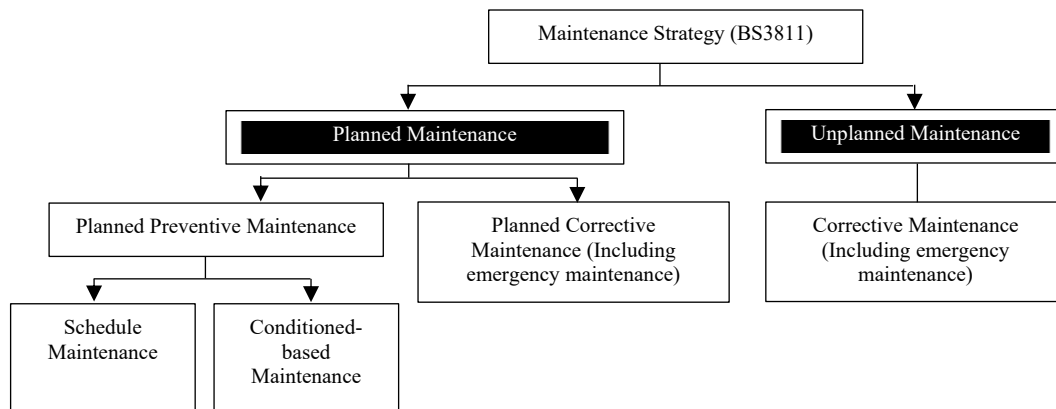


Figure 1: The Overview of Maintenance Strategy in Buildings based on British Standard BS3811 (the shaded box shows maintenance strategy criteria that has been employed in this study)

Source: BS3811 (1993); Chanter and Swallow (2008); Leong (2004); Mohammed and Wan Mat (1991); Seeley (1987); Wireman (2013)

Maintenance Performance Measurement Indicator

Maintenance performance measurement, as defined by Amaratunga (2001), quantifies the efficiency and effectiveness of maintenance activities, helping to assess strengths and weaknesses in planning (Amaratunga & Baldry, 2002a). These measurements evaluate the success of maintenance strategies and have

been adapted to fit Masjid Kariah maintenance planning in Malaysia based on models like the General Maintenance Management Model (Tsang et al., 1999) and Performance Measurement Model (Cholasuke et al., 2004), alongside other studies. Seven key indicators have been identified: organization management, planning and scheduling, financial provision, service quality, assessment, resources allocation, and safety and health. Organization management covers policy deployment, human resource management, and continuous improvement. Planning and scheduling focus on arranging and optimizing maintenance work within a set timeframe through approaches such as record management and communication. Financial provision involves budgeting and fund allocation to ensure cost efficiency. Service quality ensures user satisfaction by emphasizing reliability, assurance, and responsiveness. Assessment addresses the sustainability of building assets through evaluations of structural and service conditions. Resource allocation involves managing contracts, spare parts, and equipment to support maintenance goals. Safety and health focus on creating a safe and comfortable environment for users. These indicators provide a structured framework for enhancing Masjid Kariah maintenance performance.

Relationship between Maintenance Planning (Maintenance Strategy Criteria) and Maintenance Performance Measurement

What are the key indicators in the relationship between seven indicators of Maintenance Performance Measurement (organisation management, planning and scheduling, financial provision, service quality, assessment, resources allocation and safety and health) towards the Maintenance Planning (maintenance strategy criteria: Planned Preventive Maintenance, Planned Corrective Maintenance and Unplanned Maintenance) of the Masjid Kariah? The PLS-SEM model assessment has been used to verified the hypothesis of this study:

H1: Organization Management (OM) has significantly positive influence on Masjid Kariah Maintenance Planning (MKMP)

H2: Planning and Scheduling (PS) has significantly positive influence on Masjid Kariah Maintenance Planning (MKMP)

H3: Financial Provision (FP) has significantly positive influence on Masjid Kariah Maintenance Planning (MKMP)

H4: Service Quality (SQ) has significantly positive influence on Masjid Kariah Maintenance Planning (MKMP)

H5: Assessment (AS) has significantly positive influence on Masjid Kariah Maintenance Planning (MKMP)

H6: Resource Allocation (RA) has significantly positive influence on Masjid Kariah Maintenance Planning (MKMP)

H7: Safety and Health (SH) has significantly positive influence on Masjid Kariah Maintenance Planning (MKMP)

RESEARCH METHODOLOGY

The aim of this study is to evaluate the key indicators in the relationship between seven indicators of Maintenance Performance Measurement (organisation management, planning and scheduling, financial provision, service quality, assessment, resources allocation and safety and health) towards the Maintenance Planning (maintenance strategy criteria) which includes three main indicators i.e. Planned Preventive Maintenance, Planned Corrective Maintenance and Unplanned Maintenance. The study utilized probability sampling methods, specifically systematic and stratified sampling. In total, there are 584 Masjid Kariah from 10 districts have been situated in the Kelantan State. By considering 10% of the total numbers of Masjid Kariah from each district, 59 Masjid Kariah have been chosen as a case study area in this study.

This study employed an empirical questionnaire survey. Sample adequacy was determined using the Raosoft Sample Size Calculator, which recommended 385 respondents based on Kelantan's population of 1,857,600, a 95% confidence level, and a 5% margin of error (Department of Statistics Malaysia, 2023). The planned sample was distributed across 59 Masjid Kariah located in ten districts: Kota Bharu, Pasir Puteh, Jeli, Machang, Gua Musang, Tanah Merah, Pasir Mas, Tumpat, Kuala Krai, and Bachok. Due to limited participation from committee members, 354 usable responses were collected. Respondents targeted key Masjid Kariah committee roles, including nazir, deputy nazir, secretary, deputy secretary, treasurer, and development bureau members. Table 1 summarises distribution details.

Table 1: Positions Held at the Masjid Kariah

No.	District	Frequency	Percentage (%)	10% of Total Masjid Kariah (Unit)	Empirical questionnaire survey Distribution	Target Group
1.	Kota Bharu	130	22	13	85	Nazir, deputy Nazir, Secretary, Deputy secretary, Treasurer and Bureau of development
2.	Pasir Puteh	65	11	7	46	
3.	Jeli	21	4	2	13	
4.	Machang	43	7	4	26	
5.	Gua Musang	39	7	4	26	
6.	Tanah Merah	44	8	4	26	
7.	Pasir Mas	91	16	9	59	
8.	Tumpat	45	8	5	32	
9.	Kuala Krai	50	9	5	32	
10.	Bachok	56	10	6	40	
Total		584	100	59	385	

The reliability and validity of the model measure were assessed through partial least squares-structural equation modeling (PLS-SEM) analysis using the SmartPLS software application. This study evaluated both reliability, ensuring the measurement instruments are free of random errors, and validity, assessing the dimensions' capacity to distinguish real differences related to the characteristic being measured (Hashim et al., 2023). Additionally, the PLS-SEM analysis was performed to assess two main aspects: firstly, to test the measurement model, which aimed to validate the instruments used in the study; and secondly, to examine the structural model, which aimed to test the hypotheses formulated in the research. Figure 4 shows the two stages of PLS-SEM and assessments.

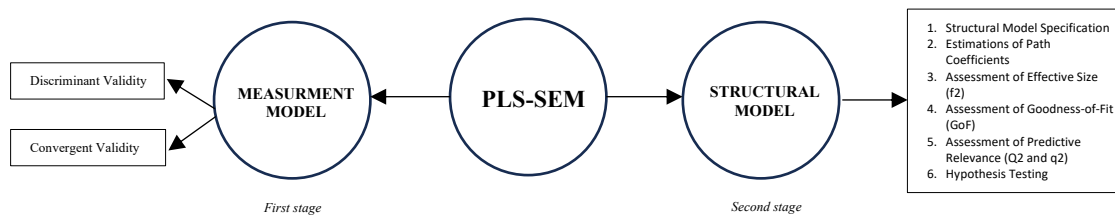


Figure 2: The two stages of PLS-SEM and assessments
 (adopted from Hashim et al., 2023)

For statistical analysis in this study, SmartPLS 4.1.0.0 software was utilized, employing the partial least squares structural equation modeling (PLS-SEM) approach. For statistical analysis in this study, SmartPLS 4.1.0.0 software was utilized, employing the partial least squares structural equation modeling (PLS-SEM) approach. PLS-SEM employs variance-based partial least squares techniques to estimate causal models rooted in established theory. It adopts an iterative approach akin to multiple regression analysis (Sakip et al., 2023). The main objective of PLS-SEM is to maximize the explained variance of endogenous constructs (Fornell & Bookstein, 1982). Selecting PLS-SEM aligns with the study's objective of extending established theory, as recommended by Hair et al. (2019).

RESEARCH FINDINGS

The findings and discussion initiates with descriptive findings elucidating the profile of the study participants. Subsequently, the measurement model findings for each variable are presented to assess convergent validity. Following this, discriminant validity is checked to ensure that correlations between constructs are lower than correlation estimates between factors. The analysis then proceeds to

the examination of the structural model to address the formulated research hypotheses.

Descriptive Analysis

The study respondents comprised 354 Masjid Kariah committee members, including nazir, deputy nazir, secretary, deputy secretary, treasurer, and bureau of development members, with each role representing 16.7% of the total. All respondents were male, with 41.0% aged 51 and above, another 41.0% aged 41-50, and 0.8% aged 31-40. They all served as contract workers and had academic qualifications evenly distributed among SPM, Diploma, and Degree certificates at 33.3% each. Regarding the Masjid Kariah's general characteristics, all studied mosques were government-owned, with 93.2% being over 15 years old, followed by 5.1% aged 6-10 years, and 1.7% aged 11-15 years. These mosques were fully registered under the Department of Agama Islam dan Adat Istiadat Melayu Kelantan (JAHEAIK). Concerning maintenance strategy implementation, all Masjid Kariah had a written maintenance policy, with 66.1% practicing planned corrective maintenance and 33.9% relying on unplanned maintenance. Maintenance responsibilities were fulfilled regularly, with 42.4% performed monthly, 39.0% every six months, and 18.6% every three months.

Assessment of the Measurement Model

Following the recommendation of Hashim et al. (2023), Abu et al. (2021), Jayasingam, et al. (2018), and Kashif et al. (2018), the convergent validity (CV) was assessed using factor loadings, average variance extracted (AVE) and composite reliability (CR) – the recommended values for loadings were set at >0.5, AVE at >0.5 and CR at >0.7. From Table 2, the results showed that the measurement models' results surpassed the proposed values hence suggesting adequate convergent validity and all of the reflectively measured constructs were above the threshold of 0.5. However, 84 lower loading items were dropped to obtained better reliability and discriminant validity. The CR are varied between 0 and 1. Hair et al. (2019) and Abu et al. (2021) stated that, CR values of above 0.7 were still considered satisfactory. Besides, all the AVE assessed were higher than the critical value of 0.5. This indicates that the main construct captures more construct-related variance than error variance.

Table 2: Convergent Validity

No.	Model Construct	Measurement Item	Loadings	AVE	CR
1.	Masjid Kariah Maintenance Planning (MKMP)	D PPT	0.776	0.674	0.861
		D PBT	0.847		
		D_PTT	0.838		
2.		C1_PD_01_PPT	0.872	0.579	0.803

No.	Model Construct	Measurement Item	Loadings	AVE	CR
	Organization Management (OM)	C1_PD_01_PTT	0.649	0.526	0.768
		C1_PD_02_PPT	0.745		
3.	Planning and Scheduling (PS)	C2_RM_02_PTT	0.715	0.696	0.873
		C2_Com_02_PPT	0.647		
		C2_Com_02_PTT	0.805		
4.	Financial Provision (FP)	C3_AB_01_PTT	0.857	0.503	0.752
		C3_FE_01_PTT	0.768		
		C3_FA_01_PTT	0.874		
5.	Service Quality (SQ)	C4_Ass_01_PPT	0.650	0.501	0.750
		C4_Rel_01_PBT	0.733		
		C4_Tan_01_PTT	0.742		
6.	Assessment (AS)	C5_ALR_01_PTT	0.719	0.643	0.844
		C5_ASC_01_PBT	0.687		
		C5_ABC_01_PPT	0.716		
7.	Resources Allocation (RA)	C6_CM_01_PPT	0.836	0.529	0.769
		C6_SP_01_PPT	0.788		
		C6_TE_01_PPT	0.780		
8.	Safety and Health (SH)	C7_Health_01_PTT	0.609		
		C7_Health_02_PTT	0.735		
		C7_Health_02_PBT	0.822		

Finally, after confirming the convergent validity (CV), the discriminant validity (DV) was assessed using HTMT method. The DV assessment shows that all the HTMT values were significantly lower than 0.9. According to Tehseen et al. (2017), the constructs were distinct from each other because they were below the suggested cut-off of 0.9. All the HTMT values were significantly lower than the threshold value and different from 0.9. Thus, this result indicates as valid and significant to measures the structural model analysis in the next sub-topic. Table 3 shows the discriminant validity (HTMT).

Table 3: Discriminant Validity (HTMT)

	MKMP	OM	PS	FP	SQ	AS	RA	SH
Masjid Kariah Maintenance Planning (MKMP)								
Organization Management (OM)	0.425							
Planning and Scheduling (PS)	0.087	0.757						
Financial Provision (FP)	0.311	0.347	0.468					

	MKMP	OM	PS	FP	SQ	AS	RA	SH
Service Quality (SQ)	0.307	0.128	0.274	0.781				
Assessment (AS)	0.203	0.603	0.186	0.342	0.017			
Resources Allocation (RA)	0.497	0.010	0.601	0.141	0.379	0.720		
Safety and Health (SH)	0.293	0.870	0.322	0.521	0.433	0.300	0.363	

The evaluation of analysis on PLS-SEM (version 4.1.0.0), the determination of model fitness is achieved through PLS-predict analysis – these involves examining measures of goodness-of-fit, including R^2 (evaluate the extents to which the model explains variance) and Q^2 (assesses the model's ability to predict outcomes accurately). A Q^2 value greater than 0 indicates adequate predictive relevance for the model (Ramayah, 2016 and Abu, 2021). In this study, the Q^2 for Masjid Kariah Maintenance Planning (MKMP) was 1.000 which means, the model's ability to predict outcomes are accurate. Besides, the measurement of model-fit and predictive relevance was confirmed by collinearity statistic (VIF). The predictor constructs' VIF values were assessed to ensure that there are no collinearity issues between the construct's indicators. As all of the VIF values were below 3, the results presented ideal VIF values ($VIF < 3$) indicating no multi-collinearity problems (Hashim et al., 2023). Thus, this study indicates all the VIF values constructs are below than 3 (OM : 1.124; PS : 1.213; FS : 1.038; SQ : 1.176; AS : 1.199; RA : 1.066; SH : 1.034) and the model's ability to predict outcomes (Q^2) are accurate.

Structural Model Analysis

According to Hair et al. (2019), by utilized a 5,000-sample re-sample, bootstrapping procedure are used to assess the structural model's path coefficients, standard errors, t-values and p-values. This method, recommended for its robustness, involves generating numerous bootstrap samples from the original dataset to estimate the sampling distribution of statistics. Moreover, in response to the critique raised by Hahn & Ang (2017) regarding the limited reliability of p-values as the sole criterion for hypothesis testing, the integrated a variety of criteria has been used in their analysis – these included not only p-values but also confidence intervals. By incorporating multiple criteria, the researchers aimed to provide a more comprehensive evaluation of the hypotheses, thereby enhancing the validity and reliability of their findings. Therefore, these criteria were incorporated into the analysis and have been examined. Table 4 shows the hypotheses testing results of this study and Figure 5 shows the research framework of relationship between Maintenance Strategy Criteria's indicators and Maintenance Planning via Maintenance Performance Measurement's

indicators in which visually illustrates the findings of the study, showcasing several significant relationships (Constructs: AVE, Outer model: P values, Inner model: Path coefficients and P values).

Table 4: Hypotheses testing

Hypotheses	Path Co-Efficient (β)	Standard Deviation	t-Value	p-Value	Bias Confidence Interval (BCI)		Results
					5.0%	95.0%	
H1: OM → MKMP	-0.058	0.169	0.344	0.365	-0.595	0.031	Not Supported
H2: PS → MKMP	0.254	0.184	1.385	0.000	0.103	0.588	Supported
H3: FP → MKMP	-0.203	0.053	3.814	0.000	-0.292	-0.116	Not supported
H4: SQ → MKMP	0.070	0.076	0.929	0.000	0.066	0.179	Supported
H5: AS → MKMP	0.037	0.073	0.511	0.000	0.111	0.129	Supported
H6: RA → MKMP	0.100	0.057	1.754	0.040	0.056	0.169	Supported
H7: SH → MKMP	-0.059	0.049	1.210	0.113	-0.100	0.140	Not Supported

The results presented in Table 4 above and Figure 5 below reveal that three out of seven hypotheses did not demonstrate a statistically significant positive relationship i.e. (1) Organization Management (OM) has not significantly positive influence with Masjid Kariah Maintenance Planning (MKMP) ($\beta=-0.058$, $p<0.365$), (2) Financial Provision (FP) has not significantly positive influence with Masjid Kariah Maintenance Planning (MKMP) ($\beta=-0.203$, $p<0.000$), and (3) Safety and Health (SH) has not significantly positive influence with Masjid Kariah Maintenance Planning (MKMP) ($\beta=-0.059$, $p<0.113$). In contrast, the remaining four out of seven hypotheses exhibited a statistically significant positive relationship i.e. (1) Planning and Scheduling (PS) has significantly positive influence with Masjid Kariah Maintenance Planning (MKMP) ($\beta=0.254$, $p<0.000$), (2) Service Quality (SQ) has significantly positive influence with Masjid Kariah Maintenance Planning (MKMP) ($\beta=0.070$, $p<0.000$), (3) Assessment (AS) has significantly positive influence with Masjid Kariah Maintenance Planning (MKMP) ($\beta=0.037$, $p<0.000$) and (4) Resources Allocation (RA) has significantly positive influence with Masjid Kariah Maintenance Planning (MKMP) ($\beta=0.100$, $p<0.040$). Thus, the findings supported hypothesis for H1, H2, H3, H4, H5, H6 and H7.

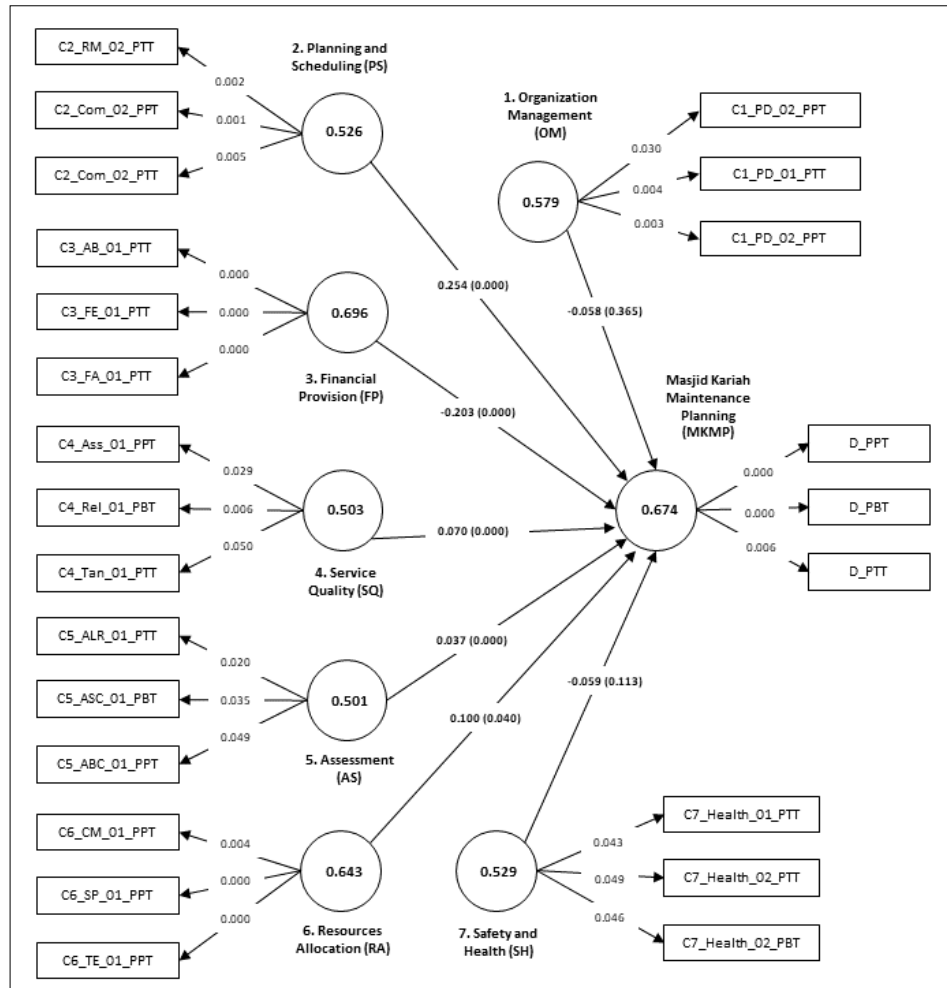


Figure 3: The Research Framework of relationship between Maintenance Strategy Criteria's indicators and Maintenance Planning via Maintenance Performance Measurement's indicators

DISCUSSION AND CONCLUSION

This study aimed to assess the relationship between seven key indicators of Maintenance Performance Measurement—organization management, planning and scheduling, financial provision, service quality, assessment, resources allocation, and safety and health—and the Maintenance Planning strategies of Planned Preventive Maintenance, Planned Corrective Maintenance, and Unplanned Maintenance. Using PLS-SEM, seven hypotheses were tested within the Masjid Kariah maintenance planning framework. Findings indicate that

Planning and Scheduling (PS), Service Quality (SQ), Assessment (AS), and Resource Allocation (RA) significantly influence Masjid Kariah Maintenance Planning (MKMP), while Organization Management (OM), Financial Provision (FP), and Safety and Health (SH) showed no significant impact. Specifically, record management and communication under PS were found to enhance maintenance planning, and adequate budgeting and fund allocation under FP were crucial despite lacking significant influence. The study highlighted the importance of tangible elements and trustworthiness in SQ, and the role of contract management and spare parts availability in RA. Additionally, policy usage within OM was seen as more influential than human resource management, though it did not significantly impact maintenance planning. The study emphasizes the importance of improving record-keeping, financial management, and resource allocation to enhance maintenance effectiveness, ensuring sustainable management of Masjid Kariah facilities.

Therefore, based on the study's findings, it is evident that three independent constructs – Organizational Management (OM), Financial Allocation (FP) and Safety and Health (SH) – did not show significant relationship values in the context of Masjid Kariah Maintenance Planning in the Kelantan State. It is crucial to address the need for improvement in these areas when planning a maintenance strategy for Masjid Kariah in the Kelantan State by:

- a. **Organizational Management (OM):** since there was no significant relationship found between OM and Masjid Kariah Maintenance Planning, efforts should be focused on enhancing organizational management practices within these establishments. This may involve improving communication channels, streamlining decision-making processes, and fostering a culture of accountability and efficiency.
- b. **Financial Allocation (FP):** the lack of significant relationship between FA and Maintenance Planning suggests that attention should be given to how funds are allocated and utilized for maintenance activities in Masjid Kariah. This may involve conducting thorough financial assessments, budget planning, and ensuring transparency and accountability in financial management practices.
- c. **Safety and Health (SH):** given the non-significant relationship between SH and Maintenance Planning, it is imperative to prioritize safety and health measures within Masjid Kariah. This includes implementing proper safety protocols, conducting regular inspections, addressing potential hazards, and providing necessary training and resources to ensure the well-being of staff and worshippers.

In summary, addressing the need for improvement in Organizational Management, Financial Allocation, and Safety and Health aspects is essential for developing effective maintenance strategies for Masjid Kariah in the Kelantan State. By focusing on these areas, it is possible to enhance the overall management and maintenance practices, leading to better upkeep and sustainability of these important religious institutions.

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