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OPTIMISING BUILDING SERVICE PERFORMANCE FOR LOCAL GOVERNMENT THROUGH STRATEGIC MAINTENANCE MANAGEMENT: A FACTOR ANALYSIS PERSPECTIVE

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Abstract— Malaysian local governments manage public infrastructure and assets, which affect inhabitants' quality of life. Even with large government spending, maintenance management issues like mismanagement, inefficiency, and inconsistent tactics persist. Due to problems, building performance, user pleasure, and sustainability suffer. Malaysian local governments struggle to execute strategic maintenance management, which is essential for effective

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and sustainable operations. The study identifies the parameters that affect SMM in local government maintenance departments' building defect management and examines how these aspects affect service performance. A web-based questionnaire was sent to 155 local government building maintenance managers, yielding 102 valid responses. SPSS Statistics, Version 28, analyses data for reliability and validity. The findings show that this research's conceptual framework includes four independent variables: strategy analysis, formulation, implementation, and evaluation.

I. Introduction

Local governments in Malaysia play a vital role in managing public facilities and assets, impacting citizens' quality of life. However, poor maintenance practices persist despite significant government spending affecting the performance of maintenance services, buildings, and organisations [1]. Local governments face issues like mismanagement, inconsistent standards, and inefficient maintenance strategies [2]. These shortcomings result in reduced building performance, user dissatisfaction, and sustainability challenges.

Effective maintenance management is critical for long-term, cost-efficient operations, yet local governments struggle to implement strategic approaches [3]. While strategic management plans are essential to meeting public demands, this application in maintenance organisations remains limited in Malaysia [4]. Previous research has largely overlooked strategic planning for maintenance management processes [5]. This study highlights an urgent need to address these gaps and

improve local governments' performance in maintaining assets and facilities.

The purpose of this study is to find out what affects the concepts of strategic maintenance management when dealing with building defects in the maintenance departments of local government agencies. Thus, this article examines how SMM elements affect local government service performance in managing building defects.

II. Literature Review

In Malaysia, local governments are responsible for municipal services, facility maintenance, and budget management as stipulated by the Local Government Act 1976 (Act 171) and the Town and Country Planning Act 1976 (Act 172). Nonetheless, it encounters mismanagement, subpar personnel performance, tax inefficiencies, and inadequate maintenance, which undermine credibility and service delivery [3].

Efficient maintenance is essential for the sustainable operation of public assets [6]. Improving governance, benchmarking, and strategic planning effectively addresses these difficulties, fulfilling public needs and enhancing service performance [7].

Managing building defects is a vital aspect of maintenance management, such as addressing issues found during quality inspections [8]. Building defects can result from poor construction, materials, weather, or ageing, and affect a building's functionality and sustainability [9]. In addition, poor maintenance, limited resources, and improper techniques exacerbate managing defect challenges [8]. Thus, a systematic approach is necessary, integrating building defect information with maintenance processes [10]. Hence, this study employs a strategic maintenance management methodology to tackle building defects in local governments. Comprehending strategic maintenance commences with strategic management, which emphasizes strategy analysis, strategy

formulation, strategy implementation and strategy evaluation.

III. Methodology

The primary aim of the research is to identify the determining factors for strategic maintenance management in addressing building defects for local government. SPSS Statistics (Version 28) was used to evaluate the online self-administered questionnaire survey data.

IV. Analysis Results

The analysis results pertaining to the research objective are detailed below.

A. Respondent's Profile

This study selected 155 respondents from the staff directory on Malaysian local government websites. To achieve the research goal, building maintenance managers were invited to participate in this survey. Only 102 of 155 web-based self-administration questions were completed.

B. Reliability Test

The Cronbach's Alpha reliability test was employed in data analysis to assess the reliability of responses from each participant in the questionnaire. A coefficient approaching a Cronbach alpha of 1.0 indicates a higher reliability of the items in measuring the same concept. Cronbach's Alpha values that exceed 0.7 are considered to indicate satisfactory reliability in many studies [11]. Lower values, such as 0.6, are still acceptable in exploratory studies.

Table 1: Cronbach's Alpha Value of Variables

No.	Construct			Number of Items	Cronbach's Alpha
1	IV	Strategic Analyzing	SA	5	0.70
2	IV	Strategic Formulation	SF	5	0.747
3	IV	Strategic Implementation	SI	5	0.796
4	IV	Strategic Evaluation	SE	4	0.703
5	DV	Benefit	BE	5	0.93

The analysis presented in the Table 1 indicates that all five groups of SMM related to service performance benefits for local government demonstrate a high level of reliability, as evidenced by a Cronbach's Alpha value exceeding 0.7, signifying that the data collected is highly reliable. Consequently, the data in this study demonstrate an acceptable level of reliability.

C. Validity

Validity testing in research and assessment ensures tools measure correctly. The validity validates data gathering equipment, which is essential for social science study integrity [12]. A data set's factor analysis suitability depends on sample size and the strength of the correlations between items or variables. Despite ongoing discussions over sample sizes, some research recommends a minimum sample size of 100 participants for exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) [13].

- **Preliminary Analysis:**

The Kaiser-Meyer-Olkin (KMO) sampling adequacy measure and Bartlett's sphericity test were used for preliminary factor analysis. A successful factor analysis requires a least KMO test result of 0.60 and Bartlett's sphericity test significance ($p < 0.05$). Table 2 shows that the measured KMO index is 0.693, which is excellent data because the KMO measurement should be greater than 0.60 and insufficient if less. The KMO test also shows if each element predicts the item well. Additionally, Bartlett's test generates a significant value of <0.001 compared to <0.05. This score indicates that the variables are correlated enough for factor analysis [14].

Table 2: Value of KMO and Bartlett's Test

KMO measure of Sampling Adequacy		0.693
Bartlett's Test of Sphericity	Approx. Chi-Square	1448.097
	Df	276
	Sig.	< .001

- **Anti-Image Correlation Matrix**

The diagonal components of the anti-image correlation matrix are analysed subsequently. All values should exceed 0.50, with larger values being desirable. Table 3 shows that all diagonal elements in this investigation are greater than 0.50, indicating their analysis suitability. Check the diagonal elements of the anti-image correlation matrix for values greater than 50% [15]. These results demonstrate the dataset's factorability and the EFA's robustness.

Table 3: Anti-Image Correlation Matrix

Code	Variables	Matrix Value
SA1	Stakeholder Analysis	0.772[a]
SA2	Situational Analysis	0.544[a]
SA3	Portfolio Analysis	0.588[a]
SA4	Benchmark Analysis	0.625[a]
SA5	Operational Analysis	0.569[a]
SF1	Vision & Mission	0.545[a]
SF2	Achievable Objective	0.534[a]
SF3	Systematic Developing Strategy	0.676[a]
SF4	Policy Guidelines	0.713[a]
SF5	Competitive Strategy	0.777[a]
SI1	Action Plan	0.785[a]
SI2	Service Agreement	0.657[a]
SI3	Work Transaction	0.688[a]
SI4	Performance Measurement	0.531[a]
SI5	Operationalize Strategy	0.760[a]
SE1	Periodic Review	0.609[a]
SE2	Support System Initiative	0.729[a]
SE3	Alternative Strategy	0.829[a]
SE4	Corrective Action	0.590[a]
B1	Reduce Building defect Occurrence	0.630[a]
B2	Valuable Asset management	0.789[a]
B3	Responsive FM	0.791[a]
B4	Effective Maintenance Management	0.793[a]
B5	Good Service Delivery	0.789*

- **Factor Extraction**

Table 4 shows the communalities using principal component analysis. The communality of 1.000 in the 'Initial' column means that all variances in the model are explained by the factors [16]. While the 'Extraction' column shows that the variable has much in common with the other variables taken as a group when the communality is higher than the 0.50 range for samples between 100 and 200 [14]. In this study, all items met the communalities criterion, exceeding 0.50. The minimum extraction value for independent constructs is 0.503, while the maximum is 0.891.

Table 4: Communalities using Principal Component Analysis

Item	Description	Initial	Extraction
SA1	Stakeholder Analysis	1.000	0.643
SA2	Situational Analysis	1.000	0.777
SA3	Portfolio Analysis	1.000	0.659
SA4	Benchmark Analysis	1.000	0.780
SA5	Operational Analysis	1.000	0.785
SF1	Vision & Mission	1.000	0.720
SF2	Achievable Objective	1.000	0.713
SF3	Systematic Developing Strategy	1.000	0.603
SF4	Policy Guidelines	1.000	0.520
SF5	Competitive Strategy	1.000	0.772
SI1	Action Plan	1.000	0.657
SI2	Service Agreement	1.000	0.759
SI3	Work Transaction	1.000	0.676
SI4	Performance Measurement	1.000	0.714
SI5	Operationalize Strategy	1.000	0.726
SE1	Periodic Review	1.000	0.779
SE2	Support System Initiative	1.000	0.706
SE3	Alternative Strategy	1.000	0.642
SE4	Corrective Action	1.000	0.503
B1	Reduce Building Defect Occurrence	1.000	0.891
B2	Validate Asset Management	1.000	0.863
B3	Responsive FM	1.000	0.855
B4	Effective Maintenance Management	1.000	0.793
B5	FM Service Quality	1.000	0.788

The next stage in factor extraction is explaining eigenvalues of total variance as stated in Table 5. The eigenvalues exceeding 1.0 are deemed significant and therefore retained [17]. This study identifies five extractable factors: factor 1 = 7.300, factor 2 = 2.690, factor 3 = 2.234, factor 4 = 1.618, and factor 5 = 1.309. The subsequent factor is 22 = 0.120, which is below 1.000. The five-factor solution accounts for a total variance of 63.128%, which is deemed satisfactory. In the social sciences, where data precision is often limited, it is common to encounter solutions that account for 60% of the overall variance, with 50-60% being considered acceptable in certain instances [18]. This research identifies five factors that collectively account for 63.128% of the total variance explained, surpassing the 60% threshold.

Table 5: Eigenvalues of Total Variance using Principal Component Analysis

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.300	30.417	30.417	7.300	30.417	30.417
2	2.690	11.207	41.623	2.690	11.207	41.623
3	2.234	9.307	50.931	2.234	9.307	50.931
4	1.618	6.743	57.673	1.618	6.743	57.673
5	1.309	5.454	63.128	1.309	5.454	63.128
↓						
22	.120	.500	99.400			
23	.102	.427	99.827			
24	.041	.173	100.000			

- **Factor Rotation**

A factor loading is considered significant if it is 0.40 or higher [15]. Consequently, factor loadings below 0.40 are excluded. A total of 24 factors were subsequently analysed, all of which met the requirement of

being greater than 0.40. Table 8 indicates that five groups account for 63.128% of all constructs in this analysis. This percentage meets the recommended standard for social science research.

The 24 determinants were divided into five groups. Five analyses make up group one: stakeholder, situational, portfolio, benchmark, and operational. Five determinant factors were combined into a single group factor, "Strategy Analysis," with an eigenvalue of 7.300 and a variance of 30.417%.

Group two includes vision and mission, feasible objectives, methodical developing plan, policy guidelines, and competitive strategy. The five deciding factors have been consolidated into one group factor, “Strategy Formulation,” with an eigenvalue of 2.690 and 11.207% variance.

Group three includes action plan, service agreement, work transaction, operationalise strategy and performance measurement. The five determining factors have been consolidated into one factor, “Strategy Implementation,” with an eigenvalue of 2.234 and a variation of 9.307%.

Four variables determine group four: periodic review, support system initiative, alternative plan, and remedial action. The four influencing factors have been consolidated into "Strategy Evaluation," which has an eigenvalue of 1.618 and variance of 6.743%. Group five has five determinants which are reducing building defects, asset management, responsive facilities management, effective maintenance management, and good service delivery. Five deciding factors have been consolidated into one group factor, "Benefit," with an eigenvalue of 1.309 and a variance of 5.454%.

V. Discussion

This study proposes that Strategic Maintenance Management (SMM) affects how local governments fix building problems. The four are strategy analysis, strategy formulation, strategy implementation and strategy

evaluation. These criteria are necessary to understand how SMM affects maintenance management service performance. The data shows that each SMM category significantly affects maintenance management. This study shows that SMM is essential for local governments to control building defects efficiently and effectively. Implementation enhances safety, quality of life, and local government credibility while reducing long-term maintenance costs.

Future studies must focus on key service performance-enhancing factors. To improve understanding, a hypothesis is given:

- Strategy Analysis (SA):

Hypothesis A meaningful association exists between "Strategy Analysis" and improving local government building defect service performance.

- Strategy Formulation (SF):

Hypothesis Determinant factor "Strategy Formulation" improves local government building defect management service performance.

- Strategy Implementation (SI):

Hypothesis "Strategy Implementation" improves local government building fault management service performance.

- Strategy Evaluation (SE):

Hypothesis The decisive factor "Strategy Evaluation" improves local government building defect management service performance.

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VII. References

[1] N. Dzulkifli, N. N. Sarbini, I. S. Ibrahim, N. I. Abidin, F. M. Yahaya, and N. Z. Nik Azizan, "Review on maintenance issues toward building maintenance management best practices," *Journal of Building Engineering*,

vol. 44, no. June, p. 102985, 2021.

[2] T. M. I. Bahardin, Z. Alias, and M. Abdullah, "A systematic review of the issues affecting local government in Malaysia," *Journal of Advanced Research in Business and Management Studies*, vol. 1, no. 15, pp. 33-40, 2019.

[3] S. G. Mong, S. F. Mohamed, and M. S. Misnan, "Current issues and barriers of maintenance management practices for public facilities in Malaysia," *Int J Eng Adv Technol*, vol. 8, no. 5, pp. 119-125, 2019.

[4] A. Zakaria, M. Mohsen, Z. Shamsudin, J. Pengurusan Harta Tanah, and F. Pengurusan Teknologi dan Perniagaan, "Strategi Penyelenggaraan Gerai Milik Majlis Perbandaran Pontian (MPPn)," *Research In Management of Technology and Business*, vol. 3, no. 1, pp. 781-796, 2022.

[5] A. Hauashdh, J. Jailani, I. Abdul Rahman, and N. AL-fadhali, "Building maintenance practices in Malaysia: a systematic review of issues, effects and the way forward," *International Journal of Building Pathology and Adaptation*, vol. 38, no. 5, pp. 653-672, 2020.

[6] F. Simpeh, G. M. Mavangwa, and L. Wentzel, "Strategies to overcome barriers to public facilities management," *Property Management*, vol. 41, no. 3, pp. 365-380, 2023.

[7] M. M. Osman, S. Bachok, N. I. M. Bakri, and N. Z. Harun, "Government Delivery System: Effectiveness of Local Authorities in Perak, Malaysia," *Procedia Soc Behav Sci*, vol. 153, pp. 452-462, 2014.

[8] A. Olanrewaju, S. H. Tee, P. I. Lim, and W. F. Wong, "Defect management of hospital buildings," *Journal of Building Pathology and Rehabilitation*, vol. 7, no. 1.

[9] B. Kim, Y. Ahn, and S. Lee, "LDA-based model for defect management in residential buildings," *Sustainability (Switzerland)*, vol. 11, no. 24, pp. 1-16, 2019.

[10] A. S. Abdullah, S. Y. Said, and L. S. Safiee, "Implementation of Defect Management Principle in Maintenance Practice at Local Authority," *Environment-Behaviour Proceedings Journal*, vol. 6, no. SI4, pp. 193-197, 2021.

[11] M. Tavakol and R. Dennick, "Making sense of Cronbach's alpha," *Int J Med Educ*, vol. 2, pp. 53-55, Jun. 2011.

[12] P. Baghaei and M. T. Yazdi, "The Logic of Latent Variable Analysis as Validity Evidence in Psychological Measurement," *Open Psychol J*, vol. 9, no. 1, pp. 168-175, 2016.

[13] J. Kim, L. Hong, S. Evans, E. Oyler-Rice, and I. Ali, "Development and Validation of a Data Literacy Assessment Scale," *Proceedings of the Association for Information Science and*

Technology, vol. 60, no. 1, pp. 620-624, 2023.

[14] Andy Field, *Discovering Statistics Using IBM SPSS Statistics*: North American Edition, 5th ed. SAGE edge, 2017.

[15] Joseph F. Hair, William C. Black, and Barry J. Babin, *Multivariate Data Analysis: A Global Perspective,* 7th ed. Pearson Education, 2010.

[16] M. S. Bartlett, "A Note on the Multiplying Factors for Various χ2 Approximations," *Journal of the Royal Statistical Society: Series B (Methodological)*, vol. 16, no. 2, pp. 296-298, 1954.

[17] N. L. Leech, K. C. Barrett, and G. A. Morgan, *IBM SPSS for Intermediate Statistics*. Routledge, 2012.

[18] J. F. Hair Jr, M. Sarstedt, L. Hopkins, and V. G. Kuppelwieser, "Partial least squares structural equation modeling (PLS-SEM)," *European Business Review*, vol. 26, no. 2, pp. 106-121, 2014.