

## LEAN MANAGEMENT IMPLEMENTATION IN MALAYSIAN PUBLIC SECTORS: CRITICAL SUCCESS FACTORS AND PERFORMANCE IMPLICATIONS

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### Abstract:

This study aims to investigate the effects of lean management implementation on public sector performance along with the critical success factors of its implementation. The cross-sectional quantitative survey collected 131 responses from public organisations in Malaysia selected through a stratified random sampling procedure. Data were analysed using the structural equation modelling (SEM) approach with SmartPLS 4 professional. Lean resources, lean culture, and lean knowledge management are critical success factors for implementing lean management in the Malaysian public sector. Subsequently, the holistic implementation of lean management will enhance their performance. This study provides a practical viewpoint for practitioners to understand and validate the potential benefits lean management can sustain if implemented with the critical success factors. As a result, practitioners and policymakers could use the insight from this study to tailor strategies for leveraging public sectors' performance in Malaysia.

**Key words:** *critical success factors, lean management, Malaysia, performance, public sectors*

### INTRODUCTION

The Malaysian government has taken several measures from the early 1980s to improve the standard of performance and accountability of its members and agencies to provide better services while preserving greater financial transparency [1]. Lean management (LM) is one of the measures, which was first introduced in the service sector in the 2000s, and is now better known for cutting costs and enhancing quality in the public sector [2].

However, despite the reforms, the performance of the Malaysian public sector remained poor [3]. According to the Public Complaints Bureau (PCB) in the Prime Minister's Department, complaints were made by the public regarding the quality of service provided by government departments. The complaints included delays in performing official duties or taking no action, judgments that were considered unfair, failure to enforce the rules and laws, and a lack of public facilities to meet customers' needs [4]. Thus, those complaints affect the organisations' reputation for poor service performance. For this reason, implementing LM in the public sector is needed to enhance organisational performance.

Although LM has been thoroughly explored, the idea of lean is still not well understood in most public sectors [5, 6]. For instance, Aslinda [6] claimed that even though LM

is applied, the Malaysian public sector performance remains ineffective because the public servants are not ready to change the work culture. Furthermore, the public servants could not identify their customer focus and claimed a lack of time and resources to sustain LM [7, 8]. Therefore, it is critical to identify and investigate the critical success factors (CSFs) to strengthen the implementation of LM in public sectors in Malaysia. This study investigates the effect of LM implementation on Malaysian public sector performance and its four CSFs (i.e., lean resources, lean leadership, lean culture, and lean knowledge management).

### PUBLIC SECTOR PERFORMANCES: THE CURRENT ISSUES

Public sector performance defines as managing public programs for outcomes in which the managers use public resources and mandates to ensure that their programs meet public objectives and expectations [9]. Since the 1980s, the Malaysian government has made several steps to enhance the quality and accountability of government agencies and their members to deliver better services. Therefore, the study of public sector performance is crucial since government agencies are responsible for providing continuous critical services to citizens and other stakeholders [10]. However, despite the reforms, many still

complain that the public sector is almost universally designated ineffective [11]. This study identifies that lean wastes are often found in the public sectors that reduce organisational performance.

Eight types of lean waste can be translated to a service context which involves over-production, over-processing, waiting, motion, transportation, inventory, defects, and skills [12, 13, 14]. In public sectors, over-processing and over-production are the most common wastes affecting service performance. It is an unnecessary service provided beyond what is needed for immediate use. It does not give any added values, such as the requirement for several approvals for a single request [14]. As a result, time is wasted indirectly or directly due to queuing or waiting for approval, which is claimed as waiting time. The unnecessary movement of people is also another type of waste which is motion. It is related to the transportation waste where the organisation's poor service layout moves in handling over orders and customers queuing longer.

In the offices, the workspace environment is essential in ensuring process efficiency. Nevertheless, the poor workspace due to the unnecessary or unorganised things (inventory) such as office supplies were criticised by recent studies [6, 15]. Additionally, skill waste is about not using people's full abilities or giving them the wrong work or tasks that can cause a delay in the work process. It is due to the employees' lack of competency and experience to execute the tasks [16]. It is undeniable that mistakes from the employees caused high lead time. This issue can badly affect performance because customers want their service to be fast and efficient. The increased workload can also affect employees' effectiveness, eventually affecting customer queuing time [15]. Therefore, to enhance service delivery in government, this study highlights the effect of LM implementation on public sector performance. The public sector's performance is evaluated by examining its contribution to service performance, customer satisfaction, cost reduction and environmental performance.

## LITERATURE REVIEW

### Related Theory

This study involves two underpinning theories: the resource-based view (RBV) and complementarity theories. The RBV is an internally focused method of strategic planning that mainly depends on the resources available within the organisation [17]. LM is described as valuable, rare, inimitable, and non-substitutable resources that can help maintain a sustainable competitive advantage. On the other hand, capabilities are a firm's capacity to organise resources to achieve the desired result. It is firm-specific as it embeds in the organisation and processes [18, 19]. Therefore, the capabilities supported by RBV theory serve as the CSFs (i.e., lean resources, lean leadership, lean culture, and lean knowledge management) in this study. These factors are intended to strengthen LM implementation in public sectors, subsequently enhancing the public sector's performance.

Besides, complementarity theory was introduced by Edgeworth [20], which described activities as

complements if doing (more of) one of them increases the returns to doing (more of) the others. As a result of the synergistic effects of grouping practices together, the impact of a system of complementary practices would be greater than the sum of its parts [21]. This study shows that LM practices will be more significant than individual practices. Thus, complementarity between Total Quality Management (TQM), Total Productive Maintenance (TPM) and Just-in-time (JIT) is the outcome of the combination of two primary benefits of these three lean bundles: process variance reduction and problem exposure. Each component of lean practices represents a different aspect of improvement initiatives for product, process, and equipment development [22]. Those components mutually support achieving high operational performance levels.

### Service Performance

Service performance in the public sector is a hot topic that receives more attention nowadays. The relation between efficiency and effectiveness of the objectives is used to describe service performance in the public sector [23]. Service characteristics are intangibility, inseparability, and heterogeneity [24]. In the public sector, public servants learn to focus on challenges pressured by the government and deliver a high-quality service to the customers [9]. Nevertheless, many complaints were received from unsatisfied customers because they had to wait more than two hours to meet with the person in charge to serve them at one of the government agencies when it can take only 15 minutes overall [25]. This study assessed the service performance based on the quality and speed of the service delivered.

### Customer Satisfaction

Overall customer satisfaction is determined by one's judgement based on a comparison of actual performance and customer expectations for services [26]. Satisfy customers spread the word quickly, which is rewarding for employees and, most certainly, the owners. However, poor service delivery increases when front-line public servants have language, knowledge, abilities, politeness, and helpfulness difficulties that are assessed at a low level of standard and quality [27]. This situation has led to operation failures in governance as they could not maintain the excellent service quality promised. This paper assessed customer satisfaction with overall service, waiting time at the counter, and respond to inquiries.

### Cost Reduction

Reducing costs is typically an internal concern for federal agencies or departments, which the director-general may oversee and manage [28]. Every country must reduce government spending to gain good ratings with a balanced budget or a lower deficit rate [29]. However, according to Hirschmann [30], Malaysia's total government operating expenditure has been increasing over the years. This issue of ballooning costs has affected the service costs, and at this point, the Malaysian public sector cannot afford to

maintain the operating costs [31]. Therefore, public sector operations' labour, operational and utility costs are assessed to measure the public sector performances.

### Environmental Performance

In Asia, urban environmental management has become more complicated, where multiple levels of public sectors (i.e., global, federal, state, and local) influence how cities impact and are impacted by local and global environmental issues [32]. Therefore, the government should oversee reinvesting in natural capital, rebuilding the ecosystem, and repairing centuries of damage. In addition, lean wastes found in public sectors can affect the environment, such as the usage of paper and utilities. Hence, the reduction of energy and solid wastes are indicators to measure the environmental performance in public sectors.

### CRITICAL SUCCESS FACTORS

Critical success factors (CSFs) are the limited number of areas that lead to successful competitive performance [33]. The pressures arise within the organisations' environment that drive the implementation of LM. In this paper, CSFs pressure the implementation of LM in the public sector. Related to the RBV theory, CSFs are the capabilities that can strengthen the LM implementation Radnor et al. [34] claimed that the implementation of LM in the public sector has failed due to the over-focusing on tools and applications, which lacks attention to the business functions that support the primary strategy. Moreover, a lack of references to governmental or executive vision and continuous improvement initiatives reinforces the notion that lean has been adopted in a fragmented and random manner in the public sector [35]. Therefore, this paper identified four CSFs commonly used to strengthen the LM implementation and sorted them according to the appropriate themes. The factors are lean resources, lean leadership, lean culture, and lean knowledge management.

### Lean Resources

Lean Resources (LR) in organisations involve allocating sufficient resources to operate LM to its most pleasing and full extent [36]. Resources in organisations involve all assets, capacities, organisational processes, qualities, information, and knowledge owned by organisations that enable them to conceive and implement plans that increase their efficiency and effectiveness [37]. Based on the RBV theory, LR is considered capable of strengthening the organisation's LM implementation. Bateman et al. [5] highlighted that organisations must identify the need to implement lean into organisational strategy and have clear teams and resources dedicated to lean to sustain its implementation and focus. Human, flexible, and financial resources are success factors in implementing lean management in public sectors. Thus, the hypothesis formulated in H1, "*LR strengthens the LM implementation*".

### Lean Leadership

Lean Leadership (LL) is a social process in which leaders with personal characteristics aligned with lean concepts drive their organisations to continuous improvement [38]. Leadership is particularly crucial when a company undergoes transition, which is unavoidable when adopting lean [39]. In a lean context, the leader's role must accept all kinds of self-development required to cultivate leadership skills, develop subordinates, eliminate barriers, and set challenges and objectives [40]. Moreover, based on RBV theory, LL act as a capability to enhance the implementation of LM. In this study, LL involves crucial factors such as top management commitment, management coaching and communication. Therefore, the proposed hypothesis in H2 is that "*LL strengthens the LM implementation*".

### Lean Culture

Lean Culture (LC) is a summarised concept that includes organisation members' beliefs, values, behaviours, and practices to eliminate waste and continuously improve [41]. LC can motivate employees to implement LM effectively practices, providing organisations with an opportunity to protect their lean operations. Sarhan et al. [42] justified that culture can affect employee work behaviours and organisational productivity. Employees' readiness to participate in job redesign, such as redesigning existing work or updating technological abilities to create new strategies, are examples of employee openness to promote change [43]. Therefore, the main factors of LC are employee engagement and continuous improvement. LC is also known as a capability that helps to support LM implementation, as mentioned in RBV theory. Hence, the hypothesis formulated in H3 is that "*LC strengthens the LM implementation*".

### Lean Knowledge Management

Knowledge Management (KM) is the basis of all management activities. In modern society nowadays, KM has become an essential tool for enhancing the quality of all processes and improving the organisations' performance by applying the KM practices that are assisted by KM methods, including lean tools and techniques [44, 45, 46]. Therefore, Lean Knowledge Management (LKM) is to help organisations to address change efficiently and effectively by helping in the preparation phase, supporting new processes and procedures of lean implementation, and maintaining the transformation with continuous improvement actions [47]. Additionally, the underpinning RBV theory discussed that LKM is the capability to strengthen LM implementation. Hence, the practices can be carried out, such as providing lean knowledge and experience to the employees and organising regular training or lean workshops. The hypothesis formulated in H4 is that "*LKM strengthens the LM implementation*".

### LEAN MANAGEMENT IN PUBLIC SECTORS

LM is considered a set of management tools or systems often represented as a philosophy or an ideology to eliminate waste [48]. Since the 2000s, lean has become more

well-known for reducing costs and improving quality in the public sector [2]. Previous studies have proven that LM implementation in public sectors can help administrators improve their performance [8], [15, 49]. Since lean positively affects operational and financial performance, [50] viewed lean service as the socio-technical system (STS) that includes people, tools, equipment, techniques and procedures. The technological and social systems are distinct yet interrelated, so improving one requires improving the other to get optimal results [51]. Therefore, the argument supported by Shah and Ward [52] proposed that the lean bundles complement each other to improve operational performance.

The lean practices (i.e., TQM, JIT, TPM and HRM) were adapted from Shah and Ward [52] and McKone et al. [22], which are likely to be referred to as a lean bundle. However, Human Resources Management (HRM) is excluded in this study because the practices will be redundant with the CSFs in LM implementation. Furthermore, the RBV theory supports that LM is considered a strategic resource to enhance the organisation's performance [53] as lean practices fulfilled the requirements of valuable, rare, inimitable, and non-substitutable characteristics [17]. Additionally, the complementarity theory supports that lean practices (TQM, JIT and TPM) complement each other to achieve higher organisational performances [54].

TQM first appeared in the manufacturing industry, but it now influences service organisations in the public and private sectors [55, 56, 57]. TQM is a method to manage and continuously improve an organisation's processes by involving everyone to achieve customer satisfaction from both external and internal at the lowest cost [58]. The advantages of implementing TQM in government are that it helps lower operating costs, increases productivity and service quality, and increases employee and customer satisfaction [15, 58]. Therefore, this study involves kaizen, work standardisation, visual management, and built-in quality as TQM practices in public sectors.

The origin of JIT is from the manufacturing sector. However, the evidence shown by former researchers shows that the JIT concept can also be successful in the service sector as it is vital in both sectors [59, 60]. Instead of pushing parts through manufacturing based on expected demand in the service sector, JIT is a production approach in which parts are pulled through based on customer demand [61]. JIT provides an opportunity to an organisation for better utilisation of resources by providing products or services in the right quantity, quality, place, and lowest possible cost. A previous study from Yasin et al. [62] supported that JIT can improve service quality, operational efficiency, and organisational effectiveness in public sectors if they are willing to amend their procedures and operations. Therefore, JIT practices involved the pull system and Heijunka in this study.

TPM involves practices primarily constructed to maximise equipment effectiveness through the participation and motivation of the entire workforce and the planned predictive and preventive maintenance of the equipment by using maintenance optimisation techniques [52, 63].

However, because there is no machinery to maintain or set up service operations, TPM procedures are not directly replicable. Nevertheless, it does not mean service sectors could not implement TPM [64]. Since TPM is related to equipment maintenance, the TPM approach is broadly helpful in all sectors [65, 66]. Applying TPM in the public sector can help maintain office equipment such as air conditioners, printers, and computers. TPM practices in this context of study include 5S and preventive maintenance. Thus, from LM practices, the hypothesis formulated in H5 is that "*LM has a positive effect on public sectors performance*".

## METHODOLOGY

This study was carried out in a cross-sectional design. The data collection was performed through an online survey with close-ended questions in January 2021. The measurement items were adopted, adapted and self-developed from previous studies where the interval scales were used to measure each item. During the measurement development, a pre-test was done where three academicians and two practitioners validated the measurement items' content validity. Besides, the pilot study was done involving 35 respondents in the public sector to assess the feasibility of the researcher's proposed approach and to correct any errors discovered. The unit of analysis is organisations where the target population for this study is public organisations in Malaysia, encompassing all federal, state, and local governments. According to the Malaysian Administrative Modernisation and Management Planning Unit (MAMPU) [67], the total population of public organisations in Malaysia is 821. By using G\*Power software, the minimum sample size of 98 was calculated. By using a stratified random sampling technique, the surveys were distributed to 650 targeted public organisations identified from the stratification process to get an acceptable response rate. After four months, 155 responses were received, leading to a 23.85% response rate. However, 24 survey responses were discarded due to straightlining issues; thus, 131 surveys were usable for this study.

## RESEARCH FINDINGS

### Demographic Profile

Each tier's stratum for each level of the public sector was obtained proportionally based on the number of organisations. There are 51 respondents (38.93%) from the federal government, which represents the highest number of types of organisations, followed by the local government (43 respondents or 32.82%), and state government (37 respondents or 28.24%). In addition, the organisation's representative who participated in the survey should be from the middle to top-level management and know their organisation's operations and service management. Most respondents are the director or deputy director in their current position in the organisation, representing 39.69% (52 respondents) of the overall percentage. The second most respondent is working as a senior officer, representing 29.77% (39 respondents) from the overall percentage, followed by other positions (29 respondents or 22.14%).

The stated position from the "others" option is mainly from the head of an administrative officer, assistant of administrative officer, secretary officer and senior clerk. On a side note, those respondents are still eligible to complete the survey as long as they are involved in service activities and familiar with lean management. Therefore, the respondents are knowledgeable enough to participate in this study.

**Data Analysis**

The Structural Equation Modelling (SEM) approach was used to analyse the data. This approach provides more comprehensive evidence about the extent to which the model is supported by data and provides a robust estimation for non-normal data and a small sample size. PLS-SEM approach using Smart-PLS software was to analyse the causal relationships between constructs as it can produce sensible results even with little outliers, and the data would not be distorted [68]. The hypotheses were tested using a two-step approach (i.e., the measurement and structural models) [69].

**Measurement Model Assessment: Construct Validity**

The PLS path model was constructed using SmartPLS software between the four CSFs on LM and the constructs between LM and public sector performances. JIT1 and JIT5 were deleted due to low outer loadings. As a result, all outer loadings in each construct are acceptable (above 0.4). Besides, the remaining items sufficiently achieved the convergent validity criteria (i.e., CR, AVE). The output of the convergent validity assessment is shown in Table 1.

**Table 1**  
*Summary of Convergent Validity and Internal Consistency Reliability*

Construct	Range of Outer Loadings	CR	AVE
<b>First order construct</b>			
Lean Resources (LR)	0.678 – 0.867	0.902	0.609
Lean Leadership (LL)	0.853 – 0.937	0.956	0.786
Lean Culture (LC)	0.763 – 0.881	0.935	0.707
Lean Knowledge Management (LKM)	0.786 – 0.874	0.922	0.705
Total Quality Management (TQM)	0.823 – 0.901	0.950	0.729
Just-in-time (JIT)	0.572 – 0.822	0.815	0.529
Total Productive Maintenance (TPM)	0.689 – 0.856	0.917	0.651
Service Performance (SP)	0.905 – 0.940	0.971	0.846
Customer Satisfaction (CS)	0.936 – 0.955	0.978	0.900
Cost Reduction (CR)	0.878 – 0.938	0.949	0.822
Environmental Performance (EP)	0.769 – 0.843	0.902	0.649
<b>Second order construct</b>			
Lean Management (LM)	0.827 – 0.961	0.928	0.812

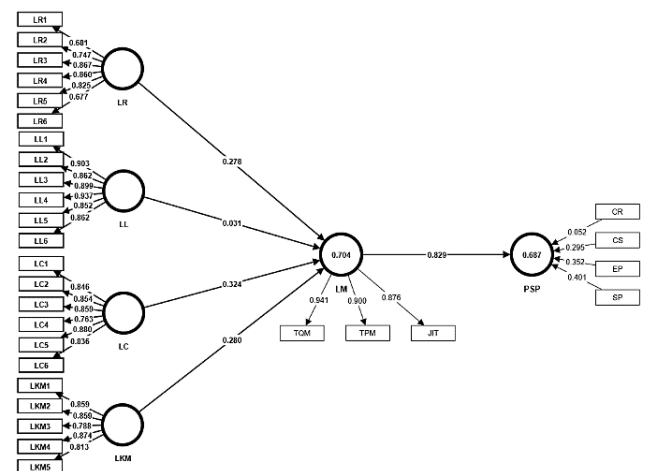
Furthermore, the discriminant validity is also satisfactory, where the HTMT values are acceptable, as shown in Table 2. Therefore, the construct validity of the reflective measurement model is valid and reliable. Nevertheless, there is a lack of discriminant validity if the value of the HTMT is higher than 0.85 [70]. Gold et al., [71] argued with it and proposed a threshold value of 0.90. Table 2 shows that all

values are within the threshold except for the path model constructs from LKM to LC and from LL to LC, which are higher than 0.9. According to Hair et al. [72], if HTMT is higher than 0.9, bootstrapping is applied with the HTMT statistic to derive standard errors for the estimates used to develop bootstrap confidence intervals. A confidence interval containing the value of 1 indicates a lack of discriminant validity (Hair et al., [73]). Nevertheless, discriminant validity is satisfactory if the value 1 falls outside the confidence interval range. Thus, the path model constructs from LKM to LC and LL to LC are considered satisfactory.

**Table 2**  
*Discriminant Validity: Heterotrait-Monotrait Ratio (HTMT)*

	CR	CS	EP	JIT	LC	LKM	LL	LR	SP	TPM	TQM
CR	0.547										
CS	0.811	0.783									
EP	0.679	0.696	0.822								
JIT	0.407	0.683	0.607	0.785							
LC	0.428	0.686	0.629	0.873	0.944						
LKM	0.373	0.641	0.580	0.631	0.905	0.834					
LL	0.463	0.718	0.707	0.755	0.800	0.817	0.846				
LR	0.520	0.881	0.797	0.692	0.734	0.702	0.720	0.756			
SP	0.495	0.758	0.730	0.790	0.754	0.757	0.760	0.784	0.746		
TPM	0.510	0.809	0.776	0.886	0.850	0.828	0.786	0.776	0.851	0.861	
TQM											0.861

In this paper, the PSP construct is measured formatively. Based on Figure 1, the endogenous variable (PSP) is also a second-order reflective-formative construct. According to Hair et al., [72], the use of reflective-formative hierarchical component models is problematic when the higher-order construct (HOC) has an antecedent latent variable(s). It implies that almost all of the HOC's variance is explained by its lower-order constructs (LOCs). Hence, the value of  $R^2$  will be minimal (close to zero) and insignificant. In order to solve this problem, Hair et al., [69] suggested calculating the latent variable scores for all the LOCs of the endogenous variable to identify the standardised beta value. Hence, a new PLS path model with the latent variable score for PSP was developed and presented in Figure 1.



**Fig. 1** *New PLS Path Model with Latent Variable Score for PSP and LM Constructs*

In order to assess the formative construct, convergent validity was used to measure the positive correlation with

other reflective measures in the same construct with different indicators. Thus, through the calculation of redundancy analysis from the global item of PSP, the value obtained is 0.976, which is claimed to be high convergent validity. To measure the collinearity issues, it is important to consider the multicollinearity between indicators in assessing formative measures. If the value of VIF is more than 5, the indicators should be eliminated or merged into a single indicator to treat the collinearity issues [69]. Hence, there is no issue with VIF, as shown in Table 3.

**Table 3**  
**Construct Validity of Formative Construct**

Item	Outer Weight	Outer Loading	VIF	t-value	p-value
SP	0.429	0.950	4.171	4.119	0.000
CS	0.324	0.932	4.044	2.918	0.002
CR	0.003	0.618	2.113	0.026	0.490
EP	0.326	0.886	3.734	2.837	0.002

Then, using the bootstrapping technique, the outer weights of formative measurement models that deviate substantially from zero were determined. The p-values in the formative construct displayed in Table 3 must be lower than 0.05 to establish significant outer weights at a significance level of 5% (i.e.,  $\alpha = 0.05$ ). All items have a significant outer weight value except for cost reduction (CR). However, if the outer weight is insignificant, but the outer loading is more than 0.5, the item should be interpreted as absolutely important but not as relatively necessary [72]. Therefore, CR would generally be retained as the loading is 0.618.

### Structural Model Assessment: Hypotheses Testing

The structural model assessment contains the effects and relationships between the constructs, which will typically be latent variables. Additionally, the interpretation of the coefficient of determination ( $R^2$ ), effect size ( $f^2$ ), and PLSpredict are provided. Finally, the bootstrapping approach is used to test the significance of a structural path. The results of hypothesis testing are summarised in Table 4. There are five hypotheses involved, which are the relationship between LR and LM ( $H1$ ), LL and LM ( $H2$ ), LC and LM ( $H3$ ), LKM and LM ( $H4$ ), and lastly, the relationship between LM and PSP ( $H5$ ). Based on the results in Table 4, all hypotheses are supported except for  $H2$ .

**Table 4**  
**Summary of Hypothesis Testing**

Hypothesis	Path	Std. Beta	Std. Error	p values	t values	Confidence Interval		Decision
						5.00%	95.00%	
H1	LR → LM	0.261	0.102	0.006	2.511	0.084	0.415	Supported
H2	LL → LM	0.085	0.104	0.220	0.771	-0.112	0.235	Not Supported
H3	LC → LM	0.334	0.119	0.003	2.749	0.105	0.496	Supported
H4	LKM → LM	0.244	0.101	0.006	2.542	0.088	0.429	Supported
H5	LM → PSP	0.846	0.034	0.000	24.884	0.768	0.886	Supported

Note:  $p \leq 0.05$  (one-tailed test).

Assessing the coefficient of determination ( $R^2$ ) evaluates the model's predictive accuracy. The coefficient represents the variance in the endogenous constructs

explained by all the exogenous constructs linked to it. According to Hair et al. [72], the  $R^2$  value in the rule of thumb indicates 0.75 as substantial, 0.50 as moderate and 0.25 as weak. The value of  $R^2$  for LM is 0.716, and PSP is 0.706, which indicates a moderate level of predictive accuracy. The effect size is assessed using  $f^2$ . Guidelines for assessing  $f^2$  are those values of 0.02 is small, 0.15 is medium, and 0.35 is large [69]. Effect size values of less than 0.02 indicate that there is no effect. Thus, the effect size for  $H1$  (0.086),  $H3$  (0.067) and  $H4$  (0.056) are small, while there is no effect on  $H2$  (0.005) and a large effect on  $H5$  (2.407). Besides, PLSpredict uses the values for the independent constructs' indicators of instances in the holdout sample to predict the value of the dependent constructs' indicators and then applies the model estimates from the training sample to generate the prediction of the dependent constructs' indicators [74]. Therefore, based on the results shown in Table 5, all indicators have lower RMSE values compared to the naïve LM benchmark. Thus, the model has high predictive power to predict the value of the dependent constructs' indicators.

**Table 5**  
**PLSpredict Assessment**

Item	PLS-SEM		LM	
	RMSE	MAE	RMSE	MAE
JIT	0.730	0.593	0.799	0.644
TPM	0.692	0.539	0.769	0.588
TQM	0.600	0.464	0.693	0.534
CR	0.920	0.703	1.040	0.793
CS	0.733	0.539	0.879	0.642
EP	0.799	0.631	0.913	0.696
SP	0.695	0.515	0.780	0.565

The data analysed has determined the cause and effect of the variables. Based on the Table 4, there are four hypotheses that are supported while another hypothesis is not supported. The results indicated that LR, LC and LKM can strengthen the implementation of LM except for LL. On the other hand, LM has a positive effect on public sector performance.

### DISCUSSIONS AND CONCLUSIONS

The findings of this study provide evidence of the cause and effect between four CSFs and LM implementation in public sectors, as well as the effect of LM implementation on public sector performance.  $H1$  shows the path from LR to LM, and the outcome indicates that the decision is supported. LR from previous studies justified that it can strengthen the LM implementation if the resources used are appropriate and adequate [75, 76]. Adequate expertise can help to strategies the LM implementation focusing on the task force, finances, and skills of the employees. Additionally Sorooshian and Ali [77], claimed that having employees adept at various tasks can increase process efficiency and result in a lean organisation. As a result, implementing LM in the public sector can be influenced by success factors involving human, flexible, and financial resources.

Then, H2 presents the path from LL to LM, where the decision is not supported. These findings are insignificant to previous studies [40, 78]. In the Malaysian public sector, leadership practices are inadequate to strengthen the implementation of LM because there is still a lack of empirical research on leadership practices in government ministries [10]. Thus, research on leadership practices in most developing countries is still in the early stages. The Malaysian perspective indicates that leadership practices remain irregular and relatively underdeveloped [10]. For LL to act as a capability, the top management must gain a thorough understanding of lean to facilitate the need to transition to lean and thus give their full support and dedication to the proposed change [79]. Nevertheless, due to resistance to change or the fact that employees are not correctly informed about the change, many lean developments are already failing at the top levels [80]. Thus, LL could not act as a capability in implementing LM.

The decision is supported in H3, a path from LC to LM. The finding is consistent with the previous studies, where culture is a critical factor for LM implementation [81, 82, 83]. LC involves employee engagement and continuous improvement needed to implement and maintain lean process improvement initiatives successfully. According to Iranmanesh et. al. [84], LC can inspire employees to implement lean, enabling organisations to improve their lean operations. Applying LC is crucial because it is critical in assuring that the employees accept to continue working on lean. For the successful implementation of LM in public sectors, it is essential to have a strong LM foundation.

Then, H4 shows the path from LKM to LM, where the hypothesis is supported. Practices such as providing lean knowledge and experience to the employees and organising regular training or workshops on LM are crucial as they can positively affect lean sustainability [46]. LKM is supported as a capability on LM implementation for competitive advantages. In encouraging government entities or agencies to implement quality improvement in their organisations, exposure to various quality programmes such as lean through workshops and seminars can be done. For instance, accreditation from relevant bodies like the International Standard for the Organization (ISO) and the Malaysian Productivity Corporation (MPC) may improve the organisation's reputation in the public eye and promote employee motivation for implementing lean [8].

Finally, the path from LM to PSP in H5 shows that the hypothesis is supported. The outcome of this study provides further confirmation of previous studies that found LM implementation has a significant effect on public sector performance [2, 5, 55]. Numerous studies have shown the need to provide customers with an effective service from a lean perspective. In public sectors, there will always be an improvement to enhance the service performance based on customer feedback from PCB. Officials in the public sector must assess and better comprehend the needs, wants, and expectations of their citizens about the services offered. Based on the findings on LM implementation among public sectors, this study discovered a need

for LM in the public sector and a significant interest in theories and practices that might improve organisational processes, provide cost savings, enhance organisational culture, and boost service quality.

Moreover, the significant relationship between LM and public sector performance was supported by Shah and Ward [52], who used the term "lean bundles" to represent LM practices (i.e., TQM, JIT and TPM). TPM must be used with TQM and JIT for better equipment maintenance. Additionally, JIT is crucial when putting TQM into practice. Based on the findings, LR, LC, and LKM positively affect LM implementation. It means that having an appropriate resource, applying the lean working culture, and providing knowledge and training on lean can strengthen the implementation of LM. The findings also show that the public sector's performance in Malaysia can be enhanced by having LM. Hence, the more lean practices implemented, the higher the efficiency of the service performance in the public sector.

#### **IMPLICATIONS, LIMITATIONS, AND DIRECTIONS FOR FUTURE RESEARCH**

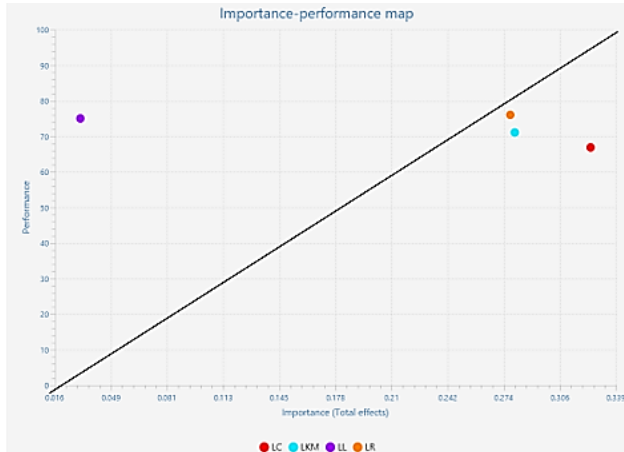
This study has several implications. First, the implications functioned as the contribution to the body of knowledge in operations management and recommendation to practitioners in public sectors. The relationship among the variables was theoretically and empirically supported except for LL on LM implementation. Therefore, this paper conveys contributions that are summarised into two different theories.

The first theory used in this study is RBV theory, which identifies CSFs as capabilities that helps to strengthen LM as strategic resources that lead to organisations a sustainable competitive advantage. The results show that LR, LC and LKM that are available in organisations can help implement LM. On the other hand, LM meets the VRIN criteria that are not used by competitors and cannot be replicated and hence, it is regarded as a competitive advantage. The second theory used to assess the relation between three LM practices (i.e., TQM, JIT and TPM) is complementarity theory. All three practices were needed to enhance public sector performances [54]. For example, public sector TQM practices such as kaizen aim to develop a team to improve the government system continuously. Thus, a pull system in JIT is implemented to help reduce customers' waiting time and less paperwork to process. Consequently, TPM practices such as preventive maintenance are helpful to ensure the functionality of the equipment as well as 5S that focuses on a tidiness workplace environment.

Besides, this study provides a practical viewpoint for practitioners to understand and validate the potential benefits LM can sustain if implemented with the CSFs. The practitioners and policymakers could learn the critical factors as strategies to leverage their overall organisational performance through LM implementation. It also provides a viewpoint for practitioners to implement LM to enhance public sector performance. According to the statistical analysis using Importance-Performance Map Analysis



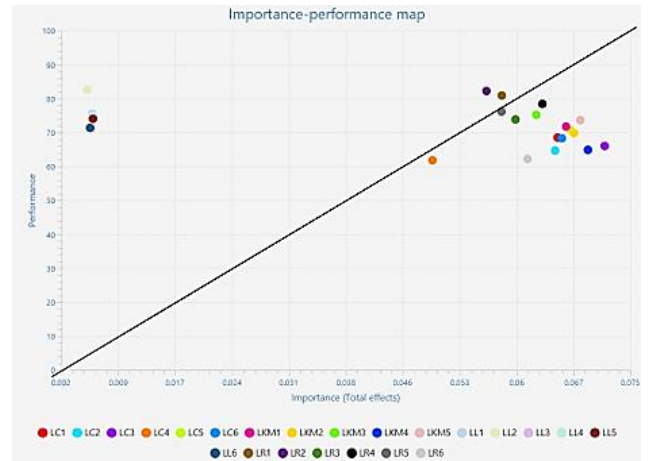
(IPMA), this paper indicates relatively high importance and relatively low performance on the targeted construct, which helps the top management identify significant improvement areas. It stipulates the importance and performance of CFSs on the LM and PSP construct. Figure 2 shows that LC and LKM are important and have high LM performance. On the other hand, LR and LL are important, but LL has a lower performance than LR. Therefore, practitioners must focus on improving LC followed by LKM and LR to improve the LM implementation.



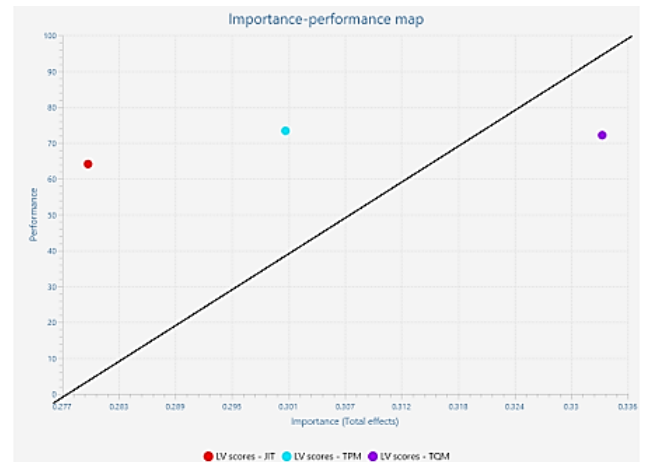
**Fig. 2 Importance-performance map of the targeted construct LM**

Furthermore, IPMA is not restricted to the construct level, as it can also be used to discover important and even more specific areas for improvement at the indicator level. In Figure 3, it is shown that the result indicates that LC3 "there are horizontal and vertical communication channels throughout the organisation", LC5 "continuous searching for possible improvements is part of the daily routine", LC1 "all departments in our organisation strive to eliminate waste (non-value-added activities)", LR4 "our teams consist of employee with diverse skills and are responsible for several functions or responsibilities", LC2 "our employee participates in many of the decision-making processes", LKM4 "our employees are adequately trained on eliminating non-value-added activities", LKM5 "we facilitate our employees to engage in lean continuous improvement-related events (e.g., training, competitions, exhibitions, etc.)", LKM1 "our employees are encouraged to apply their knowledge to solve our organisational problems (e.g., elimination of non-added-value activities)", and LKM2 "our employees have adequate knowledge and know-how" have high importance and low performance, and thus it is suggested to focus on those areas for improvement.

Furthermore, LM practices were involved in the targeted construct PSP, as shown in Figure 4. In PSP, TQM practices are essential and have a high performance where it is in a good position. However, TPM has high performance but low importance, followed by JIT, which has high performance and very low importance. Therefore, the practitioners should focus on improving the practices of TPM and JIT implementation practices to achieve a high level of performance in the public sector.



**Fig. 3 Indicators' importance-performance map of the targeted construct LM**



**Fig. 4 Indicators' importance-performance map of the targeted construct PSP**

Every research has its limitations. The limitations occur when there are constraints regarding methodology or research design. Therefore, it is important to note the limitations so they can be improved in future research. This study's limitation is related to the research design, which only focuses on quantitative data. The quantitative results can lead to general findings, whereas this study lacks in-depth findings. Future research should consider applying a qualitative approach to identify which lean practices are important to be implemented in the public sector. Besides, the data were collected using an online survey where a single respondent represents one organisation. One respondent could have influenced their responses, involving their experiences, knowledge, work situation, self-perception, and even personal circumstances, even though the respondents were important participants in the LM implementation on public sector performance survey. Therefore, even if the questionnaire passed the validity and reliability testing and the data did not show any bias, respondents' responses may have deviated from what was intended. Future research could collect quantitative data from multiple respondents in one organisation to overcome this limitation.



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