The Influence of Organization Capability On Preventive Maintenance Practices and SMEs Performance in Malaysia

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***Abstract*— Preventive Maintenance (PM) is one of the key approaches towards realizing the goal of organization performance. Hence, it is extensively applied and become an important aspect in the manufacturing sectors. PM plays a pivotal role to avoid potential stoppages and disruptions of equipment from occurring in daily operations. PM utilizes total employee involvement in the maintenance activities to avoid potential disruptions, breakdowns, stoppages, and failures. Despite the sector contribution to the Malaysia economy for which the Small Medium Enterprises (SMEs) makes up 95% of the total manufacturers, preventive maintenance practices remain relatively lacking. In the highly competitive manufacturing industries, the ability and reliability of equipment is very important in order to achieve desired manufacturing performance. However, empirical evidence on the potential impact of PM practices towards manufacturing performance remains limited and indecisive. For Small Medium Enterprises (SMEs), the extent of how organizational capability influences manufacturing performance is also inconclusive. Henceforth, this study aims to investigate potential relationships between PM practices and manufacturing performance moderated by organizational capability with a focus on Malaysian SMEs. The study is intended to put forward a new framework and hypotheses to examine the above mentioned relationships. The proposed framework includes PM team, PM strategy and planned maintenance as the independent determinants, while organizational capability serves as the moderating variable. At the other end, measurement for manufacturing performance comprises of innovation and financial factor is considered. Research direction and conclusion are then discussed at the end of the study.**

Keywords— *Innovation, Organizational Capability, Performance Measures, Preventive Maintenance*

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1. Introduction

Small and Medium Enterprises (SMEs) plays a vital role in contributing to the Malaysia economies and it considered as the backbone of economic growth, as well as developed nations. Malaysia SMEs were more concern on quality defects rather than equipment or machinery losses [1]. However, to operate efficiently and effectively, manufacturing sectors need to ensure no disruptions due to equipment breakdowns, stoppages, and failures. Despite the obvious role of PM for sustainable manufacturing performance, empirical evidence on its impact towards local SMEs in Malaysia is remaining lacking. Hence, the aim of this research is to investigate the potential relationship between PM practices and manufacturing performance moderated by organizational capability. In particular, two objectives that motivate this study are to examine the moderating effect of organizational capability a) on the relationship between PM strategy, PM team and planned maintenance and financial performance, and b) on the relationship PM strategy, PM team and planned maintenance and innovation performance.

2. Literature Review

2.1 Performance measurement

Performance is a measuring tool that helps the organization to understand what are the current status of the products, services, and the processes [2]. Performance are measured financial and non-financial [3],[4]. Many scholars were found that performance measurement was lead to a substantial benefit which helps to understand overall performance in the organization [5],[6],[7]. Meanwhile, performance measurement was used in quantifying the efficiency and effectiveness in order to improve the productivity [8],[9].

Performance measurement into four: cost, time, flexibility and quality [10],[11]. In short, successful measuring performance in the marketplace is determined by the present of the absence of two foundation stones, financial and non-financial. Thus, this paper the performance will be focused on financial and non-financial attributes.

2.1.1 Financial Performance

Revenues, service offerings, and profits are play an important indicator to manufacturing companies to position themselves as industrial service providers [12]. Meanwhile, the ratios Return on Asset, Return on Equity and Basic Earning Power can be used as an indicator in determining the firm performance and operations strategy [13]. There are positive relationships between operational innovations and financial performance [14]. On other hand, company's value can be measured using the market value ratio [15].

2.1.2 Innovation

High-speed technological innovation combined with severe competition shortens the equipment life cycle and puts equipment under higher stress [16]. Thus, an organization needs to implement proper maintenance strategy. The reason is maintenance have proof that it can keep the life cycle of the machine and at the same time it will cut down the cost to ensures proper operations and smooth internal logistics. Moreover, the bottom-up innovation have proven a successful wisdom which making the employees efforts to be better [17]. Meanwhile, one of the most important elements that drive the successful marketing is product innovation [18]. In mean time, [19] organizational innovation has a greater impact on small firms these because costs and benefits of government policies encourage innovation in small and medium-sized enterprises.

2.2 Preventive maintenance (PM)

Preventive maintenance (PM) is a regular and systematic inspection, cleaning, and replacement of worn parts, materials, and systems. In PM, periodic maintenance is always been given priority and directed towards predictive maintenance, which can detect any equipment deterioration and failure more effectively using new embedded technology and condition-based inspection technology such as vibration, spectroscopy, thermography and others. PM helps the organization to prevent failure of parts, materials, and systems by ensuring that they are in good working order. In order to enable employee participation, training and education should be provided sufficiently through a proper and well-structured program. Thus, in PM implementation various authors stressed the contribution of training towards performance such as Ahmed, Masjuki, and Taha [1], [20], [21], [22].

A PM plan is developed based on the needs of the equipment, and the most common forms of this policy are scheduled PM and condition-based maintenance [8]. In the former approach, the PM action is performed on the item at a scheduled time regardless of its actual condition. However, a scheduled PM policy some components may be over maintained, which is replaced prematurely. Thus, if the condition of the item can be monitored continuously or even frequently, PM actions will be implemented only when failure is judged to be imminent.

2.2.1 Preventive maintenance team (PMT)

Qualified and well-trained machine operators and maintenance technicians are the driving force behind any effective maintenance measurement system. Most of the maintenance tasks are handled directly by operators instead of the on-site maintenance team. Thus, flexible, co-operative and a shared responsibility approach among production and maintenance personnel is required to promote operator ownership and free up maintenance personnel to perform more technically challenging maintenance works [23]. As such, the effectiveness of the different facets of the performance system is very much dependent on the competency, training, and motivation of the overall human factor in charge of the maintenance system [24]. In this context, factors such as, years of relevant work experience on a specific machine, personal disposition, operator reliability, work environment, motivational management, training and continuing education, are all relevant factors which tend to impact the effectiveness of the performance of the maintenance system [25]. As in all quality-oriented management programs, employee participation is critical for success. The attitude, conduct, and personality of maintenance personnel are critical to the effectiveness of the maintenance effort [26].

2.2.2 Preventive maintenance strategy (PMS)

Maintenance strategy as "the management method used in order to achieve the maintenance objectives" [27]. The content in the maintenance strategy is a mix of techniques and/or policies which depend on factors such as the nature of the plant, the maintenance goals or the equipment that will be maintained, the work environment and the work flow patterns [28]. The strategy reflects the organization's conception of its intended long – term goal and the approach to achieve it [29]. Maintenance strategies are a means of transforming business priorities into maintenance priorities [30]. The importance of preventive maintenance strategy as one of the essential elements in lean manufacturing best practices. Each maintenance action allows one to maintain or restore the system to a specified state by using the appropriate resources [31]. There are three maintenance strategies in which are proactive, reactive and aggressive maintenance strategy [32]. Five elements/strategies in total productive maintenance for which are top management leadership, planned maintenance management, focus improvement, autonomous maintenance and education and training [33].

2.2.3 Planned maintenance (PlM)

Planned maintenance process is measured by schedule compliance i.e. the percentage of work orders completed during the scheduled period before the late finish or required by date. Effective maintenance will extend equipment life, improves equipment availability and retains equipment in proper condition without delay of production schedules [29]. There are various concepts associated with the effectiveness of maintenance activities has been developed, but the two common concepts discussed in the literature as, Reliability Centered Maintenance (RCM) and Total Productive Maintenance (TPM) [34]. TPM was established to maximize equipment effectiveness or improving overall efficiency through a comprehensive productive-maintenance system covering the entire life of the equipment, spanning all equipment related fields and the participation of all employees from all levels, to promote productive maintenance through motivation management or voluntary small-group activities [35]. Frequently noticed that in many cases, there is no clear understanding of how the preventive maintenance was developed or the rationale behind it, and there also many instances where seemingly comprehensive PM programs have no real value .

2.4 Organization Capability (OC)

Capabilities can be considered as business processes to shape the resources that assist to the accomplishment of certain jobs or activities in an organization. When organizations tend to develop its capabilities by using new information it will give the positive impact on organization performance to be more flexible [36]. In adding, organization must create a strategic value to gain sustainable competitive advantages in order to develop its capability [37],[35]. Environmental factors also effect the organizational capabilities. However, [38] and [39] state that optimal performance of organizations was influenced by both internal and external constraints which indicate that internal capabilities must fit into the external environment.

3. Resource Based View and PM

The resource-based view (RBV) is a competitiveness theory that emerged in 1980s and 1990s mainly based on works [40], [41], [42]. RBV stated that competitive advantage can be achieved via optimal utilization of all available resources, both tangible and intangible. It also highlights the importance of internal resources that organization should look into it for competitive strength. RBV aspires to explain the internal sources of a firm's sustained competitive advantage (SCA) and its central proposition is that if a firm is aiming to achieve a state of SCA, it must acquire and control valuable [42]. This proposition is shared by several related analyses; core competences [43], dynamic capabilities [44],[45] and the knowledge-based view [46]. RBV model suggests that a firm will adopt an increasingly proactive environmental management strategy if it possesses or can acquire resources and transform those into competences instrumental to competitive advantage and higher returns [15]. The RBV is also a strategic management theory that is widely used in many different industries. It basically examines how resources can drive competitive advantage [47].

In this study, TPM had been used as one of the independent variables to gauge the manufacturing capabilities and performances. Maintenance management is considered to be a core business activity, yet it is vital to business success and survival [48]. Thus it must be managed strategically. Hence, the RBV is appropriate to emphasize the importance of a firm having available resources to sustain competitive advantage through maintenance management, specifically TPM, which accentuates a large number of human factors.

4. Hypotheses

Based on the literature reviewed in the previous section, therefore these hypotheses are formulated:

H1: There is a moderating effect of organizational capability on the relationship between PM team and financial performance
H2: There is a moderating effect of organizational capability on the relationship between PM strategy and financial performance
H3: There is a moderating effect of organizational capability on the relationship between planned maintenance and financial performance
H4: There is a moderating effect of organizational capability on the relationship between PM team and innovation performance
H5: There is a moderating effect of organizational capability on the relationship between PM strategy and innovation performance
H6: There is a moderating effect of organizational capability on the relationship between planned maintenance and innovation performance

5. Proposed Framework

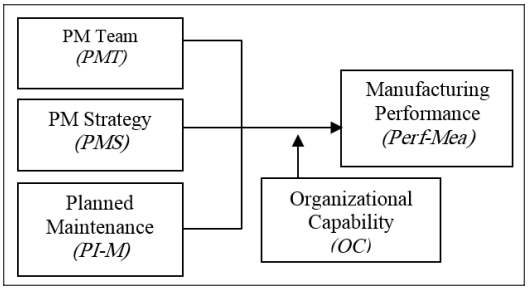

Figure 1. Research Framework

6. Finding and Discussion

6.1 Methodology

A total of more than 250 self-administered questionnaires were distributed through enumerators to respondents who were managers of quality, operations, plants, engineering and those who were familiar with PM in the SMEs. The measures of this study were taken from various sources. In terms of the scale PM team was measured using a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). While the dependent variables were measured using a 5-point scale ranging from 1 (not at all) to 5 (a very great extent). The performance is conceptualized as consisted of three items namely innovation, financial and organizational capability.

6.2 Participants

This research selected managers and owners of small and medium enterprises specifically classified under the manufacturing sector. The sample representativeness was found to be high. In sum, the survey has achieved an overall acceptable representativeness of the population analysed (Table 1)

Table 1. Frequencies of Demographic variables

Description of Samples	Number	Percentage
Size of Company		
Small	15	12.20
Medium	108	87.80
Types of Industry		
Electrical and Electronics	20	16.26
Automotive	96	78.05
Rubber Based and Plastics	7	5.69
Years of Operation		
Below 10 years	101	82.1
More than 10 years	22	17.9
Type of Company		
Local Owned	68	55.28
Joint Venture	55	44.72

6.4. Measures

Preventive maintenance practices contain a total of 31 items covering preventive maintenance team (9 items), preventive maintenance strategy (12 items), planned maintenance (10 items), organizational capability (4 items), manufacturing performance,

contains 11 items covering innovation (6 items) and financial (5 items). A pre-test was conducted to assess the suitability of the wording and format, and the extent to which measures represented all the facets of the constructs. All the items were measured on a five-point Likert-type, ranging from 'strongly disagree', 1, to 'strongly agree', 5.

6.5. Data analysis

The study utilized the Partial Least Squares (PLS) which is a variance-based structural equation modelling technique in testing the research model. PLS allows the assessment of both the measurement model and the structural model. Usage of PLS in this study is justified because of the aim of the study is orientated towards the prediction of the dependent.

6.6. Measurement model

The reliability and validity of the constructs are evaluated through the reflective measurement models. The individual item reliability as shown in Table 2. The loadings are well above the acceptable threshold value of 0.708 [49]. With regards to the construct validity, all constructs achieve the value of composite reliability greater than 0.707, required in exploratory research and 0.8 for basic research [50]. The convergent validity is assessed by the average variance extracted (AVE) where it is suggested to be greater than 0.5 [51]. In this study, all variables indicate AVE values greater than 0.663 (Table 2).

Table 2. Measurement model: loadings, construct reliability and convergent validity.

Con_ struct	Item	Loadings/ Weight	AVE[a]	CR[b]
FIN	Fin1	0.827	0.736	0.893
	Fin3	0.856		
	Fin5	0.890		
INN	Inn3	0.746	0.674	0.861
	Inn4	0.886		
	Inn6	0.825		
OC	Oc1	0.892	0.732	0.891
	Oc3	0.828		
	Oc4	0.846		
PlM	PlM1	0.834	0.683	0.895
	PlM2	0.901		
	PlM3	0.848		
	PlM7	0.711		
PMS	PMS10	0.865	0.792	0.884
	PMS9	0.914		
PMT	PMT2	0.766	0.663	0.908
	PMT5	0.855		
	PMT6	0.795		
	PMT7	0.751		
	PMT9	0.896		

a) Average variance extracted (AVE) = (summation of the square of the factor loadings)/[(summation of the square of the factor loadings)+(summation of the error variances)]
b) Composite reliability (CR) = (square of the summation of the factor loadings)/[(square of the summation of the factor loadings) + (square of the summation of the error variances)]

In order to satisfy the discriminant validity, the diagonal value should be significantly greater than the off-diagonal values in the corresponding rows and columns [52]. This condition is met as shown in Table 3.

Table 3. Measurement model: discriminant validity

	FIN	INN	OC	PM	PMS	PMT
FIN	0.858					
INN	-0.079	0.821				
OC	-0.056	-0.151	0.856			
PlM	-0.207	-0.090	0.143	0.826		
PMS	-0.139	0.182	0.054	-0.014	0.890	
PMT	0.162	-0.048	-0.145	0.054	-0.001	0.815

Note: Diagonals represent the square root of the AVE while the off-diagonals represent the correlations.

6.8 Structural model

After ascertaining the validity, reliability and common method bias of the instrument, the path analysis will be conducted to test the hypotheses generated in the present study. This is done through the structural model which is assessed based on the

algebraic sign, magnitude and significance of the structural path coefficients, R2 values and the Q2 (redundancy) test for predictive relevance. A minimal level of explanatory power of a particular endogenous construct is achieved through the explained variance of R2 and deemed to be adequate. The R2 value 0.043 and 0.098 indicating that 4.3% and 9.8 % of the variance in extent of 'Innovation' and 'Financial' can be explained by independent variables of 'Preventive Maintenance Team', 'Preventive Maintenance Strategy, and 'Planned Maintenance'. Moreover, the R2 increased as additional of 15.3% and 5.4% from the moderation of 'Organizational Capability' in the relationship. Besides the estimating the R2, the study has also included predictive relevance Q2 (2011) as an additional model fit assessment. Predictive relevance Q2 is a criteria that evaluates how well the omitted data are estimated by the model where if the Q2>0, it shows that the model has predictive relevance. The blindfold procedure was performed in Partial Least Square to assess the predictive relevance and the results indicated that the Q2 value of that greater than zero implies the model has predictive relevance as suggested by Chin [53], [54], [48]. The predictive relevance of both 'Innovation' and 'Financial' is shown in Table 4 which indicates that they are far greater than zero. In sum, the model exhibits acceptable fit and high predictive relevance.

Table 4. Blindfolding Results

Construct	CV Red (Q^2)
Innovation	0.093
Financial	0.049

The hypothesis testing were conducted by testing for significance by the measure, as suggested by Hair, Ringle, and Sarstedt [55], bootstrapping (500 resamples) was deployed to produce standard errors and t-values, which allow the evaluation of statistical significance of the path coefficients. The procedure allows the reporting of bootstrapping confidence intervals of standardized regression coefficients. A significant path is ascertained when p-value is below 0.01 (t-value >2.33) and 0.05 (t-value >1.65) respectively for a one tail test. Table 5 presents the summary of the hypothesis testing of this study. "Organizational Capability" moderates the relationship between "Preventive Maintenance Team" and "Financial" (β=0.188, p<0.05) and the relationship between "Planned Maintenance" and "Innovation" (β=-0.242, p<0.01) whereas the relationship between "Preventive Maintenance Team" and "Innovation" and the relationship between "Planned Maintenance" and "Financial Innovation" were not moderated by Organizational Capability. Surprisingly the relationship between "Preventive Maintenance Strategy" and both "Financial" and "Innovation" was not moderated by "Organizational Capability". Thus H1 and H6 were supported whereas H2, H3, H4, and H5 were not supported.

Table 5. Structural Model

Hypo_theses	Relationship	Beta	Stand Error	*t*-value	*Dec*
H1	PMT*OC -> Financial	0.188	0.115	1.648	S
H2	PMT*OC -> Innovation	-0.203	0.139	1.459	NS
H3	PMS*OC -> Financial	0.037	0.145	0.253	NS
H4	PMS*OC -> Innovation	-0.127	0.117	1.092	NS
H5	PM*OC -> Financial	-0.160	0.179	0.893	NS
H6	PM*OC -> Innovation	-0.242	0.085	2.869	S

**p<0.01 (2.33), *p<0.05 (1.645)
Note: Dec=Decision; S=Supported; NS=Not Supported

7.0 Conclusion

There is no doubt that preventive maintenance is one of the major concerns of manufacturing organizations, especially small medium enterprises. However, ensuring preventive maintenance practices is one of the key challenges for small and medium enterprises in order to ensure no daily operation unexpected stoppages. As that these organizations typically are argued to have a lack of strategy, instituting a comprehensive and integrated

preventive maintenance practices is quite an intimidating project. If such claim is valid, it should not mean that SMEs should not pay attention to aspects of preventive maintenance practices. In this paper, we propose ways and means of how SMEs can address the preventive maintenance without having to institute a formal and structured system. The preventive maintenance practices, composed of various elements, when implemented as a whole, are likely to help increase financial and innovation performances. However, our propositions and speculations need to be empirically investigated as studies in preventive maintenance SMEs are quite limited.

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