

## Market Competition, Lean Manufacturing Practices and The Role of Management Accounting Systems (MAS) Information

*((Persaingan Pasaran, Amalan Pengilangan “Lean” dan Peranan Sistem Maklumat Perakaunan Pengurusan (MAS))*

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### ABSTRACT

*Adoption of advanced manufacturing techniques such as lean manufacturing is one of the strategies that help manufacturing firms to sustain their competitiveness and achieve the desired outcomes. It is argued that the traditional Management Accounting Systems (MAS) are no longer capable of providing information necessary to operate in the ever changing business environment. This study examines the role of MAS information in the relationship between market competition, lean manufacturing and organisational performance. Data were gathered using a questionnaire survey from manufacturing firms listed in the Federation of Malaysian Manufacturers (FMM) Directory. The results reveal the relationships between lean manufacturing and the MAS, as well as between the MAS and performance, are positive and significant, which suggest that the relationship between lean manufacturing and performance is indirect through the MAS. This provides evidence that the use of MAS information in a lean manufacturing environment facilitates firms in improving organisational performance.*

*Keywords: Lean manufacturing; just in time; total quality management; market competition; management accounting systems*

### ABSTRAK

*Penggunaan teknik pengilangan maju seperti pengilangan ‘lean’ adalah salah satu strategi yang membantu syarikat pengilangan untuk mengekalkan daya saing mereka dan mencapai hasil yang dikehendaki. Adalah dikatakan bahawa sistem perakaunan pengurusan (MAS) tradisional tidak lagi mampu menyediakan maklumat yang diperlukan untuk beroperasi dalam persekitaran perniagaan yang sentiasa berubah-ubah. Kajian ini mengkaji peranan maklumat MAS dalam hubungan di antara persaingan pasaran, pengilangan ‘lean’ dan prestasi organisasi. Data dikumpulkan dengan menggunakan soal selidik dari firma-firma pengilangan yang disenaraikan di Direktori Persekutuan Pekilang-Pekilang Malaysia (FMM). Keputusan mendedahkan bahawa hubungan di antara pengilangan ‘lean’ dan MAS, serta di antara MAS dan prestasi, adalah positif dan signifikan, yang menunjukkan bahawa hubungan di antara pengilangan ‘lean’ dan prestasi adalah secara tidak langsung melalui MAS. Ini memberikan bukti bahawa penggunaan maklumat MAS di dalam persekitaran pengilangan ‘lean’ memudahkan syarikat untuk meningkatkan prestasi organisasi.*

*Kata kunci: Pengilangan ‘lean’; ‘just in time’; pengurusan kualiti menyeluruh; persaingan pasaran; sistem perakaunan pengurusan*

### INTRODUCTION

Due to advancements in technology, proliferation of new products, and globalisation, among others, the current business environment has become extremely dynamic and challenging. Escalation in the global competitive markets has resulted in significant changes in the operations and strategies of businesses. To survive and prosper, managers need to be aware of the market faced by their firms to appropriately plan and design the control systems for their organisations (Khandwalla 1972, 1973; Mia & Clarke 1999; Ax et al. 2008; Hoque 2011; Lee & Yang 2011; Ahmad & Mohamed Zabri 2015; Sheikh 2017).

Malaysia, as one of the countries that are practising an open economy, is also vulnerable to uncertainties in the external markets. Vital economic reforms and structural changes are being implemented by The Government of Malaysia to further enhance Malaysia as an investment destination in an increasingly competitive global environment. For example, the introduction of Economic Transformation Programme (ETP) in October 2010 is a comprehensive effort that aims to transform Malaysia into a high-income nation by 2020. Among the targeted key economic areas for growth and investment is in manufacturing sector such as oil and gas, palm oil, and electrical and electronics industries. In view

of these reforms, the role of the manufacturing firms in enhancing the Malaysian economy is very pivotal. In order to compete successfully, Malaysian manufacturing firms need to be continuously alert of the challenges and changes in the global market.

The increased competition in the market causes turbulence, stress, risk and uncertainty (Mia & Clarke 1999). To counter the adverse effects of competition, firms adopt various manufacturing strategies such as lean manufacturing. Lean manufacturing has been identified in the literature as one of the practices adopted by firms to manage and control their costs (Taj 2008; Liker 2004; Zahraee 2016) and help the organisations to sustain in a long term (Abolhassani, Layfield & Gopalakrishnan 2016). Although the main aim of implementing lean production is to increase productivity, reduce costs, improve quality and enhance performance, past studies (e.g.: Balakrishnan et al. 1996; Fullerton et al. 2003; Hofer et al. 2012) show that the implementation of lean manufacturing could not guarantee an improvement in performance. It is conjectured that the relationship between improvement in performance and the adoption of lean manufacturing might not be a direct one. Appropriate information system is pivotal to facilitate managers in these firms to make effective business decisions, which will lead to improve performance. For example, Mia and Clarke (1999) showed that the use of benchmarking and monitoring MAS information help firms to face competition and improve their performance. Mia (2000) also found that the use of MAS information in JIT firms could assist an organisation in improving its profitability. Fullerton and Wempe (2009) also demonstrated that the use of broad scope MAS information that provides non-financial information on manufacturing performance assists firms to improve financial performance in lean manufacturing environment. Using a sample of Malaysian manufacturing firms, Ismail and Isa (2011) demonstrated that the use of broad scope MAS information mediates the relationship between Advanced Manufacturing Technology (AMT) and performance. In addition, Fullerton, Kennedy and Widener (2014) documented that lean manufacturing practices also indirectly affect operations performance through lean management accounting practices (MAP). More recently, Ismail, Isa and Mia (2018) showed that MAS information helps manufacturing firms in Malaysia that adopt Integrated Manufacturing Practices to improve performance.

Based on the above discussion, this study aims to examine whether intensity in market competition is related to adoption of lean manufacturing; whether lean manufacturing is related to use of MAS information; and whether use of MAS information mediates the relationships between market competition, lean manufacturing and performance. This study fills the gaps in the literature as thus far, to the authors' knowledge, no study has examined the relationship between these variables simultaneously. In addition, this study contributes to the extant literature by providing new evidence to help clarify the nature of relationship between lean manufacturing and performance.

The review of prior literature on lean manufacturing and performance shows inconclusive results that warrant further investigation (e.g.: Balakrishnan et al. 1996; Fullerton et al. 2003; Fullerton & Wempe 2009; Yang et al. 2011; Hofer et al. 2012).

The remainder of this paper is structured as follows. The next section provides the review of relevant literature and development of the theoretical framework and hypotheses. This is followed by a discussion on the methodology used in the study, and a discussion on the results of the data analysis from questionnaire survey. Lastly, discussion, limitations and conclusions are presented in the final section.

## LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

### MARKET COMPETITION AND LEAN MANUFACTURING

Market competition causes turbulence, stress, risk and uncertainty to organisations (Mia & Clarke 1999). As mentioned earlier, vital economic reforms and structural changes in Malaysian economy, as well as challenges and changes in the global market contribute to an increase in competition for Malaysian firms. In an advanced manufacturing environment, intensifying market competition could result in increased product range, decreased product life cycles and changes in manufacturing technology. In such an environment, organisations must adopt and implement appropriate practices in order to adapt quickly to the needs of the market and to remain competitive. For manufacturing companies, one way to survive the competition is by providing quality products at the lowest possible costs, which could be achieved through adoption of appropriate manufacturing strategies. One such strategy is lean manufacturing, which can help the manufacturing companies to eliminate waste and non-value added activities without compromising quality. By eliminating waste and non-value added activities, the unnecessary costs are eliminated and subsequently, enhance organisational performance.

Previous studies also showed that the type and degree of competition faced by companies influence the type of manufacturing strategy adopted. For instance, Das et al. (2000) found that international competition influenced the quality practices adopted by manufacturing firms. Chong and Rundus (2004) suggested that firms facing a high level of competition should adopt TQM. Ax et al. (2008) also revealed a link between competition and the adoption of target costing. More recently, Sheikh (2017) showed that product market competition leads to firm innovation. Thus, it is predicted that the higher the degree of market competition faced by companies, the higher will be the level of adoption of lean manufacturing. The following hypothesis summarises the discussion:

- H<sub>1</sub> There is a positive relationship between the intensity of market competition and the adoption of lean manufacturing

#### MARKET COMPETITION, MAS INFORMATION AND PERFORMANCE

As mentioned earlier, advancement in technology, proliferation of new products, and globalisation are among the factors that contribute to the intensity of market competition. It is unclear whether increased competition will lead to increased performance. Patiar and Mia (2008) and Hoque (2011) contend that the positive association between competition and performance is still lacking of theoretical support. Patiar and Mia (2008) report that market competition has a negative impact on firms' financial performance. However, when assessing the direct effect of market competition and MAS information on performance, it was found that market competition has a negative and significant effect on financial performance whereas MAS information has a positive and significant effect on financial performance. Therefore, even though the result of the study shows that competitive environment leads to a decline in financial performance but the use of MAS information by managers improves financial performance. Thus, it can be concluded that the managerial use of MAS information could facilitate firms in making more accurate economic decision, which could then positively impact organisational performance. Contingency theory of management accounting also suggests that firms will perform better if they adopt accounting systems that suit their contexts (Otley 1980; Haldma & Laats 2002; Chenhall 2003, 2007).

Khandwalla (1972, 1973) asserts that the degree of competition faced by firms is an important factor to be considered in control systems design for organisations. He argues that competition has a positive association with the use of appropriate management controls. In Malaysia, Ahmad and Mohamed Zabri (2015) showed that intensity of market competition has a positive influence on the use of costing, performance evaluation and budgeting systems in small and medium firms. Mia and Clarke (1999) and Hoque (2011) also report that the intensity of market competition influences firms' use of MAS information, which subsequently leads to improved organisational performance. As competition increases, the market becomes uncertain. The uncertainty in the market influences firms to look for more accurate and reliable information for decision making. Managers' use of the MAS information would be useful because it can provide comprehensive information to reduce the uncertainty (Chenhall & Morris 1986). Gul (1991) and Mia (1993) found a positive and significant effect of interaction between managers' perceived environmental uncertainty and the use of broad scope MAS information on performance. In addition, MAS information could provide timely, accurate and relevant information that could be used in conditions of highly intensified market competition for more effective decision making. Kaplan (1995) argues that firms that operate in competitive environment would require more timely information as well as more accurate cost and performance information on their activities, processes, products, services, and customers.

Based on the findings of previous research above, it can be argued that the greater is the competition, the greater the need for sophisticated management controls that could provide managers with comprehensive information for better decision making, so that organisational performance could be enhanced. In other words, companies that make more use of the MAS information in facing competition will perform better. Following the above discussion, hypotheses below are proposed:

- H<sub>2</sub> There is a positive relationship between the intensity of market competition and performance.
- H<sub>3</sub> There is a positive relationship between the intensity of market competition and the use of MAS information.
- H<sub>4</sub> There is a positive relationship between the use of MAS information and performance.

Hypotheses three and four postulate that the use of MAS information plays a mediating role in the relationship between the intensity of market competition and performance. A mediating or an intervening relationship exists when the relationship between independent and dependent variables exists at least partly through a third variable. In that case, the third variable plays the mediating role in the relationship between the other two variables (Mia 1993; Mia & Clarke 1999; Ismail & Isa 2011; Ismail et al. 2018). Therefore, if hypotheses three and four are supported, then, the use of MAS information plays a mediating role in the relationship between the intensity of market competition and performance (see Figure 1).

#### LEAN MANUFACTURING, MAS INFORMATION AND PERFORMANCE

Lean manufacturing aims to reduce waste by eliminating non-value added activities. A successful adoption of the lean manufacturing will lead to reduction in costs, increase in productivity, and improvement in quality (Cooper 1995; Karlsson & Åhlström 1996; Liker 2004; Abolhassani et al. 2016; Zahraee 2016), which subsequently will result in improved financial and non-financial performance of an organisation (Fullerton & Wempe 2009; Rahman et al. 2010; Taj & Morosan 2011; Yang et al. 2011). As a result of lean manufacturing adoption, inventory turnover would increase, and the resulted reduction of waste will lead to lower costs and increased efficiency leading to a high profit (Fullerton et al. 2003; Hofer et al. 2012). A successful implementation of lean manufacturing means that the lower costs can be transferred to customers via a lower price for a higher quality product. Reduction in price and improvement in quality will lead to satisfied and loyal customers, which in turn will lead to increased profit (Whiting 1986).

Earlier research (e.g.: Mehra & Inman 1992; Inman & Mehra 1993; Powell 1995; Balakrishnan et al. 1996; Hendricks & Singhal 1997; Terziovski & Samson 1999; Claycomb et al. 1999; Boyd et al. 2002; Kinney & Wempe 2002; Fullerton et al. 2003; Kaynak 2003; Ahmad et al.

2004; Arawati 2005) report mixed results of the relationship between components of lean practices and performance, but much of the earlier research has not used lean manufacturing as a total concept. Due to the fact that lean practices are regarded as world-class manufacturing, the inconclusive results on the relationship between lean practices and performance warrant further investigation. There could be other factors that could mediate this relationship. Managers' use of the MAS information could be an important factor that could explain the inconclusive findings on the relationship between lean practices and performance. Mia and Clarke (1999) suggest that managerial use of the MAS information should be examined in other circumstances including the application and evaluation of new manufacturing technology such as CAD/CAM and JIT manufacturing systems. The use of the information provided by the MAS may assist managers to adopt and implement manufacturing practices more efficiently and effectively (Ismail & Isa 2011; Ismail et al. 2018). The application of new manufacturing technology is expected to change managers' use of different types of MAS information. Broad scope, timely, integrated and aggregated MAS information are expected to be useful to managers in lean manufacturing environments. Chenhall (2003, 2007) proposes that TQM is associated with broadly based MCS including timely and externally focused information. He also proposes that the advanced technologies of JIT are associated with broadly based MCS. Mia and Winata (2008) found that JIT is positively associated with the use of broad scope MAS information. Ahmad and Mohamed Zabri (2015) revealed that AMT has a positive association with the use of costing system, performance evaluation system and strategic management accounting. Therefore, following the studies discussed above, as well as other studies such as Sim and Killough (1998), Mia (2000), Fullerton and Wempe (2009), Ismail and Isa (2011), Fullerton et al. (2014) and Ismail et al. (2018), this study also postulates the influence of MAS information. Specifically, this study postulates the mediating role of MAS information in the relationship between lean practices and performance. Consistent with the discussion above, the following hypotheses are tested:

H<sub>5</sub> There is a positive relationship between lean manufacturing and performance.

H<sub>6</sub> There is a positive relationship between lean manufacturing and the use of MAS information.

Hypotheses four and six postulate that the use of MAS information plays a mediating role in the relationship between lean manufacturing and performance. A mediating or an intervening relationship exists when the relationship between independent and dependent variables exists at least partly through a third variable. In that case, the third variable plays the mediating role in the relationship between the other two variables (Mia 1993; Mia & Clarke 1999; Ismail & Isa 2011; Ismail et al. 2018). Therefore, if hypotheses four and six are supported, then, the use of MAS information plays a mediating role in the relationship between lean manufacturing and performance (see Figure 1).

Figure 1 shows the research framework of this study. The framework shows that intensity of market competition influences a firm's adoption of lean manufacturing. It is also also proposed that that the intensity of market competition and the implementation of lean manufacturing influences managers' use of the MAS information. As asserted by Haldma and Laats (2002), contingency-based research postulates the existing link between context, the use of the MAS information leading to improved performance.

## METHODOLOGY

### SAMPLE AND DATA COLLECTION

Questionnaire survey technique was used for data collection for this study. The questionnaire was distributed using either email or postal mail to the managers in charge of the business unit such as General Manager, Financial Controller, Production Manager, and Operation Manager within the sample companies. These managers were chosen as they are the best persons that could answer the questions related to the competition faced by their organisations, the techniques used, as well as the performance of their business units.

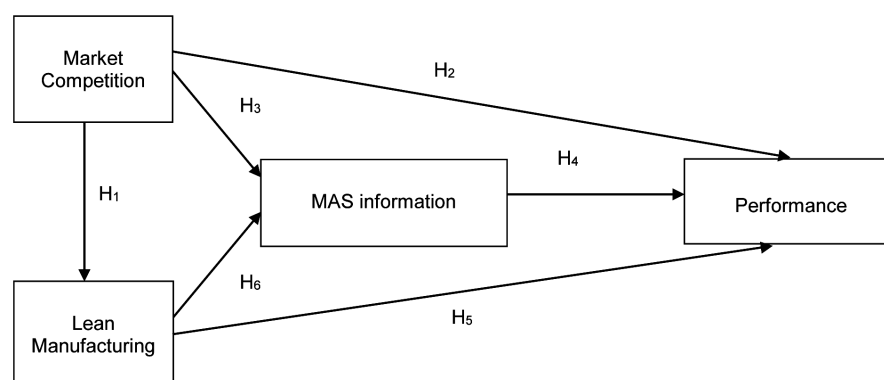


FIGURE 1. Theoretical framework of the research

The population of interest was all manufacturing firms operating in Malaysia. The sample of firms was selected from manufacturing firms listed in the Federation of Malaysian Manufacturers (FMM) Directory. There were over 2000 firms registered as a member of FMM, which came from various sectors and located all over Malaysia. The sample consisted of 1000 manufacturing firms randomly selected from the FMM Directory. Out of 1000 questionnaires sent out, a total of 140 questionnaires were returned. Of the total 140 questionnaire received, 22 were returned unopened while 8 of the remaining contained incomplete responses, thus were excluded from analysis. Finally, a total of 110 questionnaires were used for analysis, giving a final response rate of 11%,

The data were analysed using Partial Least Square (PLS), which is a type of Structural Equation Modelling (SEM). One of the advantages of PLS (SEM) is that it can examine multiple relationships simultaneously in one model at the same time (Hair et al. 1998). This study used SmartPLS software for data analysis.

#### MEASUREMENTS OF THE VARIABLES

*Intensity of Market Competition* The current study adopted Mia and Clarke's (1999) instrument to measure the intensity of market competition. The same measurement was utilised by Chong and Rundus (2004), among others. The degree or intensity of market competition was measured using multiple factors that may affect competition either in isolation or in combination. The respondents were asked to indicate their perception towards competition on a five-point likert scale where 1 represents "low" and 5 represents "high".

*Lean Manufacturing* In this study, lean manufacturing is defined to include two practices: JIT and TQM. The measurement for lean was adopted from Snell and Dean (1992). The same measurement was utilised by Dean and Snell (1991), Snell and Dean (1994), Sim and Killough (1998) and Abdel-Kader and Luther (2008). The measures for JIT can be segregated into two parts. The first part can be termed as JIT manufacturing (production) systems and the second part as JIT inventory (purchasing) systems. The JIT variables used in Dean and Snell (1991), and Snell and Dean (1992, 1994) after the factor analysis was conducted consisted of only five items that are related to JIT inventory systems. It is expected that this classification may be different in Malaysian manufacturing firms and due to time factor. Therefore, this study used all 10 items initially categorised as JIT variables by Snell and Dean (1992). The level of implementation of JIT manufacturing systems was measured on a scale of 1 (Not used at all) to 5 (Extensively used), whereas the level of implementation of JIT inventory systems was measured on a scale of 1 (Huge decrease) to 5 (Huge increase). It has to be noted that measures for items related to JIT inventory systems were reverse coded. Therefore, for the purpose of data

analysis, the score for these items need to be reversed in order to be in the same direction with other items. As for the TQM variables, various measurement scales were used to denote the level of TQM implementation. For example, the scale for items 1 and 2 ranged from "very little" to "a great deal". The scale for item 3 ranged from "not at all" to "precisely", and the scale for item 4 ranged from "building it in" to "inspecting it in". While items 5 to 7 required the respondents to provide the absolute number in the form of a percentage, items 8 to 10 required them to tick on specific statements on the scale ranging from "little or none" to "consistent use".

*MAS Information* MAS information refers to the extent of MAS information being used by manufacturing firms in Malaysia. This study utilised the perceived usefulness of MAS information introduced by Chenhall and Morris (1986), which consisted of four dimensions: scope, timeliness, integration and aggregation. All dimensions for MAS information were measured on a five-point Likert scale. The scale for scope, integration and aggregation ranged from 1 (not used at all) to 5 (extensively used), whereas the scale for timeliness ranged from 1 (strongly disagree) to 5 (strongly agree). A slight modification was made in the measurement scale used in the current study. For example, Chenhall and Morris (1986) examined the "perceived usefulness" of MAS information. However, the current study measured the extent of managers' use of MAS information. This modification is necessary because even though the information is perceived as useful, if it is not used, it would not have any impact on performance. Boulianne (2007) also employed the extent of use of MAS information rather than perceived usefulness of MAS information.

*Business Unit Performance* This study used business unit performance similar to Mia and Clarke's (1999) study. The same measurement was utilised by Jusoh and Parnell (2008), among others. The business unit performance is defined as the extent to which the unit is successful in achieving its planned targets based on eight dimensions of performance: productivity, costs, quality, delivery, service, sales volume, market share, and profitability. The managers were required to indicate their perceived performance of their business unit on a five-point likert scale where 1 represents "poor performance" and 5 represents "excellent performance".

## RESULTS

### PROFILE OF FIRMS AND RESPONDENTS

Table 1 indicates the sample firms representing various industries. More than a quarter (28.2%) of the sample firms were from electrical and electronic sector, followed by transport and automotive parts and components (15.5%), and rubber and plastic products (10%). Most of the sample firms (80%) have been in operation for more than

TABLE 1. Profile of sample firms and respondents

| Demographic Information       | Categories  | Frequency | Percentage |
|-------------------------------|---|-----------|------------|
| Type of Industry              | Building materials/cement/concrete/ceramics/tiles | 3         | 2.7        |
|                               | Chemical/adhesive                                 | 6         | 5.5        |
|                               | Electrical/electronics                            | 31        | 28.2       |
|                               | Food/beverage/tobacco                             | 9         | 8.2        |
|                               | Furniture/wood                                    | 1         | 0.9        |
|                               | Gas/petroleum                                     | 3         | 2.7        |
|                               | Household/appliances                              | 2         | 1.8        |
|                               | Iron/steel/metal                                  | 9         | 8.2        |
|                               | Machinery/equipment                               | 3         | 2.7        |
|                               | Paper/printing/packaging/labelling                | 3         | 2.7        |
|                               | Pharmaceutical/medical /cosmetics/toiletries      | 3         | 2.7        |
|                               | Rubber/plastic                                    | 11        | 10.0       |
|                               | Textile/clothing/footwear/leather                 | 3         | 2.7        |
|                               | Transport/automotive parts/components             | 17        | 15.5       |
|                               | Others  | 5         | 4.6        |
| No information provided       | 1   | 0.9       |            |
| Years in Operation            | Less than 5                                       | 6         | 5.5        |
|                               | 5-10  | 15        | 13.6       |
|                               | More than 10                                      | 88        | 80.0       |
|                               | No information provided                           | 1         | 0.9        |
| Number of Full Time Employees | Not exceeding 150                                 | 27        | 24.6       |
|                               | 151-250   | 15        | 13.6       |
|                               | 251-500   | 24        | 21.8       |
|                               | Above 500   | 43        | 39.1       |
|                               | No information provided                           | 1         | 0.9        |
| Total Gross Assets            | Less than RM50 million                            | 31        | 28.2       |
|                               | RM50-RM100 million                                | 18        | 16.4       |
|                               | RM101-RM150 million                               | 14        | 12.7       |
|                               | Above RM150 million                               | 45        | 40.9       |
|                               | No information provided                           | 2         | 1.8        |
| Annual Sales Turnover         | Not exceeding RM25 million                        | 16        | 14.6       |
|                               | RM26-RM50 million                                 | 11        | 10.0       |
|                               | RM51-RM100 million                                | 24        | 21.8       |
|                               | Above RM100 million                               | 56        | 50.9       |
|                               | No information provided                           | 3         | 2.7        |
| Gender                        | Male  | 95        | 86.4       |
|                               | Female  | 15        | 13.6       |
| Age                           | 20-29   | 13        | 11.8       |
|                               | 30-39   | 35        | 31.8       |
|                               | 40-49   | 42        | 38.2       |
|                               | 50 and above                                      | 20        | 18.2       |
| Length of service             | Less than 3 years                                 | 8         | 7.3        |
|                               | 3 years and above                                 | 100       | 90.9       |
|                               | No information provided                           | 2         | 1.8        |

10 years, indicating that they were matured companies. Examination of firm size based on number of full time employees, total gross assets and annual sales turnover reveals that the sample firms comprised small to large companies. The majority (90.9%) of the respondents had work experience in their present job of at least 3 years, and only 7.3% had work experience of less than 3 years. This information indicates that they were experienced personnel. As such, the information provided by them can be assumed to be reliable.

#### HYPOTHESES TESTING

The purpose of this analysis is to examine the relationship between the variables in the model (Figure 1) of the study. Prior to analysing the relationships, the adequacy of the measurement model is assessed by examining convergent validity, discriminant validity and reliability. Table 2 tabulates the value for composite reliability ( $\rho_c$ ), average variance extracted (AVE), square root of AVE and latent variable correlations. All main constructs are found to

be reliable and valid. The composite reliability exceeded the threshold of 0.70, which indicates that all constructs were reliable (Hair et al. 1998; Chin 1998; Das et al. 2000; and Henseler et al. 2009). The AVE value above 0.50 for all constructs satisfied the test of convergent validity (Fornell & Larcker 1981). To fulfil the test of discriminant validity, the value of AVE for each construct should be higher than its highest squared correlation with any other construct, or the square root of AVE should be

higher than its correlations (Fornell & Larcker 1981). All shaded numbers on the leading diagonals in Table 2 are the square roots of AVEs while the off-diagonal elements are the latent variable correlations. A comparison of the square root of AVEs with the latent variable correlations in the lower left of the off-diagonal elements found that no correlations exceed the square root of AVEs between any pair of the constructs thereby indicating that discriminant validity is achieved.

TABLE 2. Composite reliability, AVE, square root of AVE and correlations

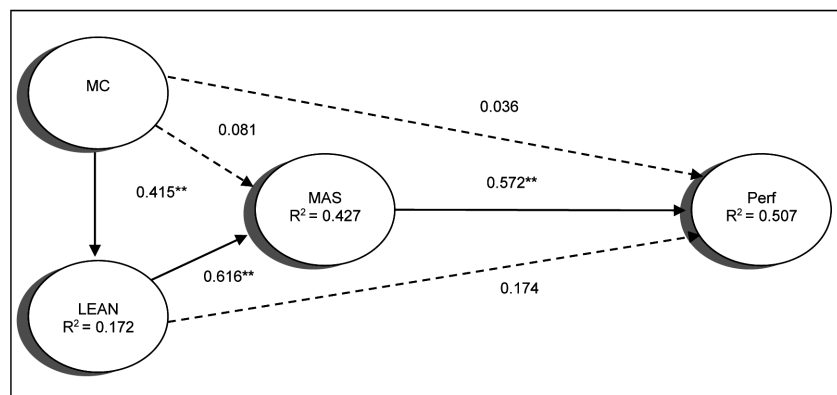
| Construct | Composite Reliability | AVE      | LEAN     | MAS      | MC       | Perf     |
|-----------|-----------------------|----------|----------|----------|----------|----------|
| LEAN      | 0.890681              | 0.802914 | 0.896055 |          |          |          |
| MAS       | 0.887612              | 0.664921 | 0.649522 | 0.815427 |          |          |
| MC        | 0.861136              | 0.609065 | 0.415307 | 0.337020 | 0.780426 |          |
| Perf      | 0.896729              | 0.812797 | 0.560594 | 0.697141 | 0.301300 | 0.901553 |

Note: LEAN = Lean manufacturing  
 MAS = Management accounting systems  
 MC = Market competition  
 Perf = Performance  
 AVE = Average variance extracted

Figure 2 summarises the results of the PLS analysis for the model, including the path coefficients ( $\beta$  estimates), path significance (p-values), and the variance explained ( $R^2$  values) for dependent variables.

Figure 2 shows that the relationship between the intensity of market competition (MC) and lean manufacturing (LEAN) was positive and significant ( $\beta = 0.415$ ,  $p < 0.01$ ). Thus, hypothesis 1 is supported. However, the relationship between the intensity of market competition (MC) and performance (Perf) as well as the relationship between market competition (MC) and management accounting systems (MAS) were positive but not significant ( $p < 0.01$ ) with  $\beta$  equal to 0.036 and 0.081, respectively. Thus, hypotheses 2 and 3 were not supported.

Figure 2 also portrays that the relationship between lean manufacturing and performance was positive but not significant ( $\beta = 0.174$ ,  $p > 0.05$ ). As such, hypothesis 5 was not supported. Both hypothesised paths from lean manufacturing to MAS as well as from MAS to performance were positive and significant at the 1% level with  $\beta$  equal to 0.616 and 0.572, respectively, thus providing support for hypotheses 6 and 4. Market competition explained 17.2 per cent of the variance in lean manufacturing, whereas 42.7 per cent of the variance in MAS was explained by MC and LEAN. The  $R^2$  value of 0.507 also suggests that market competition, MAS and LEAN explained 50.7 per cent of the variance in performance.



Note: LEAN = Lean manufacturing  
 MAS = Management accounting systems  
 MC = Market competition  
 Perf = Performance

FIGURE 2. The model

To test the mediating effects of MAS in the relationship between lean manufacturing and performance, similar procedures to those recommended by Baron and Kenney (1986) and utilised by Bass et al. (2003) were used. Evidence for *full mediation* is present when the following conditions are met: A path from the independent variable (i.e., lean manufacturing) to the dependent variable (i.e., performance) is not significant but paths from the independent variable to the mediator (i.e., MAS) and from the mediator to the dependent variable are significant (Wold 1985). *Partial mediation* is present when all paths are significant. In this study, the results indicated that MAS fully mediated the relationship of lean manufacturing with performance.

Following the procedure utilised by Bass et al. (2003), who used PLS, the indirect effect can be determined by multiplying the path coefficients ( $\beta$  estimates) from LEAN to MAS as well as from MAS to performance. Including MAS as a mediator, the indirect effect of LEAN on performance was 0.352 ( $0.616 \times 0.572$ ). This shows that the indirect effect of lean manufacturing on performance (0.352) was greater than the direct effect (0.174). Furthermore, according to Billings and Wroten (1978), in order for the data to support the theory, any path in excess of 0.05 is deemed to be meaningful. Lau et al. (2008) also recognised the use of indirect effects that are greater than 0.05. Since the indirect effect of lean manufacturing on performance is greater than 0.05, it is deemed to be meaningful. Overall, these results support the expectation that the effects of lean manufacturing on performance are mostly indirect via MAS rather than direct. Similarly, LEAN was found to mediate the relationship between MC and MAS. The indirect effect of MC on MAS was 0.256 ( $0.415 \times 0.616$ ), which was greater than the direct effect of 0.081.

Following Billings and Wroten (1978), the mediating effect of MAS in the relationship between MC and performance was not deemed to be meaningful since the path between MC and performance was less than 0.05 (0.036). Furthermore, the indirect effect of MC on performance was 0.046 ( $0.081 \times 0.572$ ), which was less than 0.05. Thus, it was not deemed to be meaningful (Lau et al., 2008).

#### DISCUSSION, LIMITATIONS AND CONCLUSION

The rapidly changing business environment has led to intense market competition. To survive and prosper in such environment, manufacturing firms have to cope with increase in product range, decrease in product life cycles (Mia & Clarke 1999) changes in manufacturing technology and drastic changes in their cost structure, control and process. These changes demand continuous revision of the firm's manufacturing practices or techniques. One such technique is lean manufacturing practices and it is an important factor that influences business unit performance. Results of the current study reveal that competition was found to have a positive and

significant relationship with the use of lean manufacturing. The result is important as it reveals that firms that face market competition can adopt lean manufacturing as a strategic action to compete with their rivals. This strategy allows organisations to produce and market high quality products that satisfy customer needs (Das et al. 2000). Lean manufacturing assists manufacturing firms to focus on continuous improvements in products and processes. Furthermore, due to intense competition, firms face uncertain customer demands and are constrained by tight budgets. Lean manufacturing, which is based on the concept of the pull system (inventories are only ordered when they are going to be used in producing the product(s) that customers demand) could overcome this problem. Thus, costs could also be reduced due to less space being needed for inventory storage. Generally, the findings of this study support Khandwalla (1972, 1973) that market competition influences the use of management controls; and that of Das et al. (2000), Chong and Rundus (2004), and Ax et al. (2008) that market competition influences the use of manufacturing practices such as TQM and target costing.

However, this study failed to find a significant relationship between market competition and performance. In addition, contrary to the findings of Mia and Clarke (1999) and Hoque (2011), this study also failed to find a significant and direct relationship between market competition and managers' use of MAS information. This study reveals that the relationship between market competition and the use of MAS information existed via adoption of lean manufacturing. Therefore, it can be argued that intensity of market competition influences firms to adopt lean manufacturing practices, which in turn leads to the use of MAS information.

The findings of this study also suggest that the use of MAS information mediates the relationship between adoption of lean manufacturing and performance. This result is consistent with the findings by Sim and Killough (1998), Mia (2000), Fullerton and Wempe (2009), and Fullerton et al. (2014). Sim and Killough (1998) report that the use of inappropriate MAS information contributes to the unsuccessful implementation of TQM or JIT. Mia (2000) report that JIT firms that had a high provision of MAS information performed better compared to those firms that had a low provision of the information. Fullerton and Wempe (2009) suggest that the use of MAS information is a key factor for financial success in the context of lean manufacturing. Managers' use of appropriate information provided by the MAS assists them to adopt appropriate manufacturing practices. The results indicate that use of MAS information by managers could help firms to achieve the ultimate outcome of every organisation, i.e., improved performance. This is consistent with the contingency theory, which states that the nature of control systems such as MAS is contingent upon the context in which the organisation operates. In this study, it is found that firms adopting lean manufacturing need to use MAS information in order to improve performance. In other words, the



performance of these firms is contingent upon managers' use of the MAS information. Consequently, the findings provide evidence that support the argument that today's firms need broader information, more timely, aggregated and integrated information to sustain their performance. More importantly, the results add further empirical evidence in the context of Malaysian manufacturing firms that MAS play an important role in enhancing performance.

There are several limitations to the study that need to be highlighted. First, the sample was drawn only from manufacturing firms operating in Malaysia. The intensity of competition, the implementation of lean manufacturing and the use of MAS information may be different in other industries such as service industries or public sector organisations, as well as other countries. Therefore, the findings from this study cannot be generalised to other industries and countries. Future studies could extend this research for other industries and countries.

Second, since this study used the business unit as the unit of analysis, only one respondent was selected from each firm. The responses given by him/her might be biased and not represent the actual scenario. Furthermore, the respondents hold different positions such as Production Manager, Accountant, Financial Controller, Engineers and other managers. Therefore, their nature of work and responsibilities were different. Consequently, their perceptions of market competition, lean manufacturing, MAS and performance might also be different.

Third, the small sample size and low response rate of 11% received in the survey might affect the results of the study. The findings might be different if larger sample is obtained. Even though it is common for the survey to get low response rate, future study should try to obtain higher response rate for more meaningful results.

Finally, the scales employed in this study were based on individuals' perceptions. Therefore, they may not reflect objective reality. Future studies could replicate the current study by utilising different methodologies such as case studies. In addition, the use of cross sectional data in the current study might be bias and not represent the actual situations. Thus, adopting a longitudinal approach might produce more meaningful results.

Apart from these limitations, the results of the study have implications for theory and practice. First, the significant relationships between market competition and lean manufacturing found in this study indicate the importance of market competition as a contingent variable. Thus far, research on market competition is still scarce compared to other environmental contingent variables such as perceived environmental uncertainty (PEU). As such, this study contributes the literature on market competition.

Second, this study provides evidence of the importance of MAS information for managers. The results from this study suggest that the relationship between the types of practices adopted by the firms and performance could be improved through the use of MAS information. The

results provide empirical evidence that support the contingency theory, which suggests that MAS are adopted in order to assist managers to achieve some desired company outcomes or goals. This also might explain why previous studies (e.g.: Balakrishnan et al. 1996; Dean & Snell 1996; and Fullerton et al. 2003) failed to find a significant positive relationship between these practices and performance.

Overall, this study also shows that the use of relevant, appropriate and sophisticated MAS information is still relevant in managing firms in the current economic situation. The information provided by the traditional MAS has been changed to cope with the changes in the environment. In adjusting to the increasing competition and advanced technological environment, manufacturing firms in Malaysia use broader scope information that focuses more on external, non-financial and future oriented information; emphasis on timely reporting; and concern with integrated and aggregated information in making managerial decisions.

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## APPENDIX

## APPENDIX A: MEASUREMENT OF VARIABLES (QUESTIONNAIRE)

**A. MARKET COMPETITION**

The intensity of competition faced by an organisation in its market depends on a number of factors. Please indicate the intensity of competition faced by your organisation based on the following factors that are relevant to your organisation.

1 = Low <-----> 5 = High

|    |   | 1 | 2 | 3 | 4 | 5 |
|----|---|---|---|---|---|---|
| 1. | Number of major competitors   |   |   |   |   |   |
| 2. | Frequency of technological change in the industry                     |   |   |   |   |   |
| 3. | Frequency of new product introduction                                 |   |   |   |   |   |
| 4. | Extent of price manipulations/exploitations                           |   |   |   |   |   |
| 5. | Package deals for customers   |   |   |   |   |   |
| 6. | Access to marketing channels  |   |   |   |   |   |
| 7. | Changes in government regulation or policy, such as tariff reductions |   |   |   |   |   |
| 8. | Overall competition based on all factors above (1-7)                  |   |   |   |   |   |

**B. TOTAL QUALITY MANAGEMENT**

Please indicate your level of agreement or disagreement of each statement using the five-point scale below.

|    |  | 1 | 2 | 3 | 4 | 5 |
|----|--|---|---|---|---|---|
| 1. | How much time does the plant management staff devote to quality improvement?<br>(1 = very little <-----> 5 = a great deal)       |   |   |   |   |   |
| 2. | How much time is spent working with suppliers to improve their quality?<br>(1 = very little <-----> 5 = a great deal)            |   |   |   |   |   |
| 3. | How well are you able to measure the 'cost of quality' in your plant?<br>(1 = not at all <-----> 5 = precisely)                  |   |   |   |   |   |
| 4. | How would you describe your current approach to providing quality products?<br>(1 = building it in <-----> 5 = inspecting it in) |   |   |   |   |   |

5. What percentage (%) of the plant's manufacturing processes are under statistical control?

\_\_\_\_\_

6. What percentage (%) of the plant's employees has quality as a major responsibility?

\_\_\_\_\_

7. What percentage (%) of the plant's employees is routinely given feedback about quality?

\_\_\_\_\_

**How would you describe the level of use within your plant of the following quality improvement methodologies for the past 5 years?**

1 = Little or none <-----> 5 = Consistent use

|     |  | 1 | 2 | 3 | 4 | 5 |
|-----|--|---|---|---|---|---|
| 8.  | Quality function deployment  |   |   |   |   |   |
| 9.  | Taguchi methods (statistical methods developed to improve the quality of manufactured goods) |   |   |   |   |   |
| 10. | Continuous process improvements  |   |   |   |   |   |

**C. JUST IN TIME**

**To what extent are each of the following methods used in your plant for the past 5 years?**

1 = Not used at all <-----> 5 = Extensively used

|    |   | 1 | 2 | 3 | 4 | 5 |
|----|---|---|---|---|---|---|
| 1. | Attention devoted to minimising set-up times      |   |   |   |   |   |
| 2. | Performance of preventive maintenance             |   |   |   |   |   |
| 3. | Accounting system reflects costs of manufacturing |   |   |   |   |   |
| 4. | Products pulled through the plant                 |   |   |   |   |   |
| 5. | Plant laid out by process or product              |   |   |   |   |   |

**How much has each of the following changed in the past 5 years?**

1 = Huge decrease <-----> 5 = Huge increase

|     |                          | 1 | 2 | 3 | 4 | 5 |
|-----|--------------------------|---|---|---|---|---|
| 6.  | Number of your suppliers |   |   |   |   |   |
| 7.  | Size of their deliveries |   |   |   |   |   |
| 8.  | Length of product runs   |   |   |   |   |   |
| 9.  | Number of total parts    |   |   |   |   |   |
| 10. | Amount of buffer stock   |   |   |   |   |   |

**D. MANAGEMENT ACCOUNTING SYSTEMS**

**Please indicate the extent of usage or applicability for the following information systems in your organisation for the past 5 years. The information systems should include files, reports, document, minutes, accounts, and notes, available for decision-making.**

|           |  | 1 | 2 | 3 | 4 | 5 |
|-----------|--|---|---|---|---|---|
| <b>A.</b> | <b>SCOPE</b>   |   |   |   |   |   |
|           | 1 = Not used at all <-----> 5 = Extensively used   |   |   |   |   |   |
| 1.        | Information that relates to possible future events (if historical information is most widely used, mark the lower end of the scale). |   |   |   |   |   |

|           |   | 1 | 2 | 3 | 4 | 5 |
|-----------|---|---|---|---|---|---|
| 2.        | Non-financial information that relates to:<br>a. Production information such as machine efficiency, output rates, scrap levels, employee absenteeism, etc.<br>b. Market information such as market size, growth share<br>(if you find that a financial interpretation of production and marketing information is most widely used, please mark the lower end of the scale). |   |   |   |   |   |
| 3.        | Quantification of the likelihood of future events occurring (e.g. probability estimates).   |   |   |   |   |   |
| 4.        | Information on broad factors external to your organisation, such as economic conditions, population growth, technological development, labour market, etc.  |   |   |   |   |   |
| 5.        | Non-economic information, such as customer preferences, employee attitudes, labour relations, attitudes of government and consumer bodies, competitive threats, etc.  |   |   |   |   |   |
| <b>B.</b> | <b>TIMELINESS</b>   |   |   |   |   |   |
|           | 1 = Strongly disagree <-----> 5 = Strongly agree  |   |   |   |   |   |
| 1.        | Requested information arrives immediately upon request.   |   |   |   |   |   |
| 2.        | Information supplied to you automatically upon its receipt into information systems or as soon as processing is completed.  |   |   |   |   |   |
| 3.        | There is no delay between an event occurring and relevant information being reported to you.  |   |   |   |   |   |
| 4.        | Reports are provided frequently on a systematic, regular basis, e.g. daily reports, weekly reports (for less frequent reporting, mark lower end of a scale).  |   |   |   |   |   |
| <b>C.</b> | <b>INTEGRATION</b>  |   |   |   |   |   |
|           | 1 = Not used at all <-----> 5 = Extensively used  |   |   |   |   |   |
| 1.        | Presence of precise targets for each activity performed in all sections within your department.   |   |   |   |   |   |
| 2.        | Information that relates to the impact that your decisions have on the performance of other departments.  |   |   |   |   |   |
| 3.        | Information on the impact of your decisions throughout your business unit, and the influence of the other individual's decisions on your area of responsibility.  |   |   |   |   |   |
| <b>D.</b> | <b>AGGREGATION</b>  |   |   |   |   |   |
|           | 1 = Not used at all <-----> 5 = Extensively used  |   |   |   |   |   |
| 1.        | Information provided on the different sections or functional areas in your organisation, such as marketing and production, or sales, cost, or profit centres.   |   |   |   |   |   |
| 2.        | Information on the effect of events on particular time periods (e.g., monthly/quarterly/annual summaries, trends, comparisons, etc.).   |   |   |   |   |   |
| 3.        | Information which has been processed to show the influence of events on different functions, such as marketing or production associated with particular activities or tasks.  |   |   |   |   |   |
| 4.        | Information on the effect of different sections' activities on summary reports such as profit, cost, revenue reports for:<br>a) your particular sections<br>b) the overall organisation   |   |   |   |   |   |

|    |  | 1 | 2 | 3 | 4 | 5 |
|----|--|---|---|---|---|---|
| 5. | Information in forms which enable you to conduct “what if analysis”.   |   |   |   |   |   |
| 6. | Information in formats suitable for input into decision models such as:<br>a. discounted cash flow analysis<br>b. incremental or marginal analysis<br>c. inventory analysis<br>d. credit policy analysis |   |   |   |   |   |
| 7. | Costs separated into fixed and variable components.  |   |   |   |   |   |

**E. PERCEIVED PERFORMANCE**

Performance of your organization/division may be viewed as the extent to which the organisation/division has been successful in attaining its planned target(s). Please indicate your organisation’s average performance in attaining the following planned targets that are relevant to your organisation for the past 5 years.

(1 = Poor performance <-----> 5 = Excellent performance)

|    |  | 1 | 2 | 3 | 4 | 5 |
|----|--|---|---|---|---|---|
| 1. | Attainment of targets related to productivity  |   |   |   |   |   |
| 2. | Attainment of targets related to costs         |   |   |   |   |   |
| 3. | Attainment of targets related to quality       |   |   |   |   |   |
| 4. | Attainment of targets related to delivery      |   |   |   |   |   |
| 5. | Attainment of targets related to service       |   |   |   |   |   |
| 6. | Attainment of targets related to sales volume  |   |   |   |   |   |
| 7. | Attainment of targets related to market share  |   |   |   |   |   |
| 8. | Attainment of targets related to profitability |   |   |   |   |   |

