Pacific Accounting Review

Evidence on the usefulness of management accounting systems in integrated manufacturing environment

Kamisah Ismail, Che Ruhana Isa, Lokman Mia,

EVIDENCE ON THE USEFULNESS OF MANAGEMENT ACCOUNTING SYSTEMS IN INTEGRATED MANUFACTURING ENVIRONMENT

ABSTRACT

Purpose - This paper reports the results of a study investigating the mediating role of managerial use of management accounting system (MAS) information in the relationship between integrated manufacturing practices (IMP) and organisational performance (OP). IMP comprises three manufacturing practices: Just in Time (JIT), Total Quality Management (TQM) and Advanced Manufacturing Technologies (AMT).

Design/methodology/approach - Using a mailed questionnaire, the data were gathered from senior managers working in 110 manufacturing firms listed in the Federation of Malaysian Manufacturers (FMM) Directory. Partial Least Square (PLS) was used to analyse the data.

Findings - The results reveal that the relationship between IMP and organisational performance exists via managerial use of MAS information: that is adoption of IMP is positively associated with managerial use of MAS information, which in turn, is positively associated with the performance. In other words, managerial use of MAS information plays a significant role in linking adoption of IMP with OP.

Originality/value - The use of MAS information in integrated manufacturing environment is found to assist firms in improving performance. Prior research on the

IMP – OP relationship reports mixed (inconclusive) results. We contend that a possible reason for such results reported in prior studies is that the studies did not investigate the relationship between IMP comprising each of the three manufacturing practices and performance as proposed by Dean and Snell (1991).

Keywords: *Integrated Manufacturing Practices, Just in Time, Total Quality Management, Advanced Manufacturing Technologies, management accounting systems, performance*

1.0 INTRODUCTION

This study investigates the mediating role of managerial use of management accounting system (MAS) information (hereafter, the use of MAS information) in the relationship between integrated manufacturing practices (IMP) and organisational performance (OP). Its focus is on (i) the relationship between IMP and OP, and (ii) the role of the use of MAS information in the IMP - OP relationship. In this study, IMP comprises three manufacturing practices: Just in Time (JIT), Total Quality Management (TQM) and Advanced Manufacturing Technologies (AMT). The extant literature suggests that simultaneous use of these techniques (JIT, TQM and AMT) may enable firms to gain the most benefit as together they create a 'streamlined flow of automated, value-added activities, uninterrupted by moving, storage, or rework' (Snell and Dean, 1992, p. 472) and 'they have important strategic potential in that they blend the stages, functions, and goals of manufacturing' (Dean and Snell, 1996, p. 460). Yet, the results reported in prior research on lean manufacturing (Hofer et al., 2012; Yang, Hong and Modi, 2011; Banker, Bardhan and Chen, 2008) and IMP (Dean and Snell, 1996) are either inconsistent with the expectation above or inconclusive. For example, Dean and Snell (1996) report no significant relationship between IMP and OP. This is also the case for the components of IMP (i.e., JIT, TQM and AMT). For instance, our literature search on JIT adoption reveals inconclusive results. Though some studies (see, Maiga and Jacobs, 2009; Zhou and Ward, 2006; Fullerton, McWatters and Fawson, 2003; Shah and Ward, 2003; Fullerton and McWatters, 2002) provide evidence supporting a positive relationship between adoption of JIT and performance, others (see Narasimhan, Swink and Kim, 2006; Christensen, Germain and Birou, 2005; and Balakrishnan, Linsmeier and

Venkatachalam, 1996) find no such relationship. Similarly, inconclusive results on TQM – performance and AMT – performance relationships are reported in prior research (Koc and Bozdag, 2009; Kaynak, 2003; Kotha and Swamidass, 2000; Hendricks and Singhal, 1997; Dean and Snell, 1996).

Two plausible reasons for the insignificant IMP – OP relationship reported in prior research are: first, prior research use moderating rather than mediating factor(s) in testing the IMP – OP relationship (see for example, Dean and Snell, 1996). A moderating variable is associated with neither the independent nor the dependent variables but to the relationship between the independent and dependent variables (Mia, 1988; Gul, 1986). In other words, theoretically there is no association between the moderator and (1) the independent or (2) the dependent variables. The second plausible reason is that prior research ignored the role of managerial use of information in the IMP - OP relationship though the relevant literature advocates importance of the role of information. Kinney and Wempe (2002) and Dean and Snell (1996) argue that adopting these practices (i.e., JIT, TQM and AMT) alone could not guarantee the desired improvement in organisational performance. Rather, for these practices to assist firms in achieving better performance, managerial use of suitable information for decision making is paramount (see also, Fullerton and Wempe, 2009; Sim and Killough, 1998). Dean and Snell (1996) do not incorporate the role of managerial use of information in their model testing the IMP - OP relationship. They investigate the relationship taking into consideration the moderating role of strategy and competition. In another study, Mia (2000) investigates the relationship between managerial use of MAS information and OP incorporating the moderating role of JIT adoption in the relationship; this study did not test the JIT – OP relationship.

Given that no relationship between IMP and OP is reported by Dean and Snell, and the inconclusive results on JIT-performance, TQM-performance, and AMT-performance relationships reported by prior research as explained above, and following Fullerton and Wempe's (2009), Mia's (2000) and Sim and Killough's (1998) arguments in favour of the role of information for decision making in the IMP environment; we posit that the relationship between IMP and OP is indirect via the use of MAS information. More specifically, we contend that adoption of IMP is positively associated with the use of MAS information, which in turn, is positively associated with OP. The focus of our study is to empirically test the proposition.

Regarding IMP and its relationship with OP, the extant literature reveals that there is a dearth of research examining these three components of IMP (JIT, TQM and AMT) practices taking simultaneously into considerations. Thus far, to the authors' knowledge, Dean and Snell (1996) is the only empirical research that has looked into the association of IMP with organisational performance. However, Dean and Snell (1996) did not take into account the use of MAS information in the relationship between IMP and performance. Most, if not all, studies have so far looked into the relationship between OP and the three different components of IMP individually, rather than simultaneously. As today's dynamic business environment drives manufacturing firms into adoption of world-class manufacturing practices like IMP, it is critically important for organisations to understand the expected positive relationship of IMP adoption with OP and how managerial use of MAS information could facilitate the relationship. The focus of this study is to empirically investigate these expectations.

The remainder of this paper is organised in the following manner. Section 2 provides the development of the theoretical framework and presents the research hypotheses. Section 3 discusses on the methodology used in the study. Section 4 provides a discussion on the results. Finally, discussion, limitations and conclusions are presented in Section 5.

2.0 THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

[Insert Figure 1 here]

2.1 Integrated Manufacturing Practices and Performance

As mentioned in the introduction section, IMP comprising the three components (JIT, TQM and AMT) may enable firms to gain the most benefit. Firms adopt advanced manufacturing practices such as IMP as part of the strategies to improve performance. Each of the manufacturing practices has its own potential in improving performance. JIT, for example, may improve performance by eliminating waste and reducing inventory handling costs while TQM assists firms to improve performance by continually focusing on quality. AMT may improve performance due to its ability to produce products in large quantities with speedier manufacturing processes. Consequently, the joint implementation of these practices will also positively affect performance. Yet, the results reported in prior research on lean manufacturing and IMP (Hofer et al., 2012; Yang et al., 2011; Banker et al., 2008; Dean and Snell, 1996) and individual component of IMP (Koc and Bozdag, 2009; Maiga and Jacobs, 2009; Narasimhan et al., 2006; Zhou and Ward, 2006; Christensen et al., 2005; Fullerton et al., 2003; Kaynak, 2003; Shah and Ward, 2003; Fullerton and McWatters, 2002; Kotha and Swamidass, 2000; Hendricks and Singhal, 1997; Balakrishnan et al., 1996) are either inconsistent with the expectation above or inconclusive.

In view of the mixed findings and dearth of research on the impact of IMP adoption on performance, there is a need to empirically examine the IMP adoption – performance relationship, and thereby help improve current understanding of the issue. We posit that the joint implementation of these practices (i.e., adoption of IMP) will positively affect performance because adoption of IMP may enable firms to gain the most benefit from its streamlined flow of automated and value-added activities (Snell and Dean, 1992), that blends the stages, functions, and goals of manufacturing (Dean and Snell, 1996). Our study tests this proposition as presented by the following hypothesis.

H1: There is a positive relationship between integrated manufacturing practices and organisational performance.

2.2 Integrated Manufacturing Practices and MAS Information

Adoption of IMP is expected to facilitate firms' strategy to improve efficiency and productivity in achieving better performance. However, the mixed findings between these practices and performance warrant further investigation to ascertain the nature of the relationship between IMP and performance. Adoption of IMP is expected to change the way managers use MAS information and compatible MAS would enable IMP firms to achieve the desired performance (Fullerton and Wempe, 2009; Mia and Winata, 2008; Mia, 2000; Sim and Killough, 1998). In advanced manufacturing settings like IMP, effective and efficient decision making demands more broad scope, timely, integrated, and aggregated MAS (Chenhall and Morris, 1986). Broad scope MAS provides information on financial and non-financial, quantitative and qualitative, internal and external, and historical and future oriented matters. Timeliness concerns the speed and frequency of reporting, while integration deals with the interaction between subunits within the same organisation. Aggregation focuses on aggregated information around functional areas, time periods or responsibility centres, provision of unprocessed data, and information used for decision models and analysis. Chenhall (2007; 2003) proposes that TQM is associated with broadly based MCS including timely and externally focused information. He also proposes that the advanced technologies of JIT and Flexible Manufacturing System (FMS) are associated with broadly based MCS. Likewise, Mia and Winata (2008) found that JIT is positively associated with the use of broad scope information. Since the implementation of IMP requires perfection, no slack in resources and production processes, flexibility, and on-the spot decision-making (Mia, 2000), it is expected that the use of broader scope, timely, integrated and aggregated MAS information is highly demanded in IMP environment. This study focuses on these four dimensions of MAS information as all dimensions are critical to provide sufficient, comprehensive, relevant and reliable information for effective planning, monitoring, controlling and decision making in advanced manufacturing environment such as IMP. Faced a very competitive and turbulent business environment where sustainability in performance hinges on the ability of firms to make effective and timely decisions, MAS information, which is timely, integrated, aggregated and broader in scope is pivotal. The MAS information is also crucial in monitoring quality to ensure customer satisfaction, which is also a goal of IMP implementation. However, to date, there is a dearth of research examining the use of MAS information in IMP environment. Hence, the current study attempts to fill the gap by examining the issue as presented in hypothesis two.

H2: There is a positive relationship between integrated manufacturing practices and managers' use of MAS information.

2.3 MAS Information and Performance

Mia (1993) argues that managers' use of appropriate MAS information could assist them in making more accurate decisions, which will lead to improvement in business performance. Chenhall and Morris (1995) show that the extensive use of MAS information led to an improvement in organisational performance. Sim and Killough (1998) suggest that the performance of firms adopting JIT or TQM is higher if they use information provided by MAS. Similarly, Mia (2000) found that higher level of performance is achieved by JIT firms that had greater use of MAS information compared to non-JIT firms. The utilisation of broad scope MAS information for managing non-financial manufacturing performance also helps lean manufacturing firms to improve their financial performance (Fullerton and Wempe, 2009). However, these prior studies are different from our study since they did not look into the effects of the use of MAS information in the context of IMP that comprises JIT, TQM and AMT. In conditions of intensified market competition, Mia and Clarke (1999) and

Hoque (2011) found that the use of MAS information has resulted in improved performance. Correspondingly, Patiar and Mia (2008) indicate that the interaction effect of market competition and the use of MAS information enhance the non-financial performance of hotels. Consistent with the above studies, the current study also postulates a positive relationship between managerial use of MAS information and performance as captured by the following hypothesis:

H3: There is a positive relationship between managers' use of MAS information and organisational performance.

2.4 Integrated Manufacturing Practices, MAS Information and Performance

Hypotheses two and three postulate that managerial use of MAS information plays a mediating role in the relationship between the integrated manufacturing practices 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 such a case, the third variable plays the mediating role in the relationship between the other two variables (Mia and Clarke, 1999; Mia, 1993). Therefore, if hypotheses two and three are supported, then, the managerial use of the information provided by the MAS plays a mediating role in the relationship between integrated manufacturing practices and performance (see Figure 1).

H4: The use of MAS information mediates the relationship between integrated manufacturing practices and organisational performance.

3.0 METHODOLOGY

3.1 Sample Frame and Data Collection Method

In this study, a cross-sectional survey research design was used. Data were collected using a questionnaire[1] distributed through a mail survey addressed to the selected business unit manager in each organisation. As the aim of this study was to examine the impact of IMP adoption, the population of interest was all manufacturing firms operating in Malaysia listed in the Federation of Malaysian Manufacturers (FMM) Directory. The FMM Directory is the official directory of all manufacturing firms in Malaysia and there are over 2000 firms registered as a member of FMM, which come from various sectors and are located all over Malaysia.

The questionnaire was sent to the managers in charge of business units such as General Manager, Financial Controller, Production Manager, and Operation Manager within the sample companies. The managers were chosen as they get involved in their business unit's IMP implementation, their use of MAS information for decision-making as well as their responsibility for managing their business unit/company performance. Using a random sampling method, 1000 manufacturing firms were selected from the FMM Directory. 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%, which is comparable to other survey studies in Malaysia (e.g.: Isa and Foong, 2005).

The data were analysed using both SPSS version 17.0 software for Windows and SmartPLS version 2.0 software. This study used Partial Least Squares (PLS) path modelling analysis, which is a type of Structural Equation Modelling (SEM). One of the advantages of SEM is that it can examine multiple relationships simultaneously in one model at the same time (Hair, Anderson, Tatham and Black, 1998). In addition, PLS was preferred in this study due to its flexibility and less stringent assumptions such as small sample size, the data need not to be normally distributed, and the measurement scale can be nominal, interval or ratio (Chin, 2010).

3.2 Measurements of the Variables

Integrated Manufacturing Practices

IMP comprises three practices: JIT, TQM and AMT. The measurement for IMP was adopted from Snell and Dean (1992) because it comprises a comprehensive measure of these three practices simultaneously. The same measurement was utilised in the study of Dean and Snell (1991), Snell and Dean (1994), Sim and Killough (1998) and Abdel-Kader and Luther (2008). The current study also adopted five items from Koc and Bozdag (2009) to measure AMT. The rationale for adding the measurement for AMT from Koc and Bozdag (2009) is to take into account the use of most advanced or latest technologies in AMT. To measure the participant managers' perception on the extent of use of the items, a five-point Likert scale was used.

MAS Information

MAS information refers to the extent of MAS information being used by manufacturing firms. This study utilised the perceived use 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 “not used at all” to “extensively used”, whereas the scale for timeliness ranged from “strongly disagree” to “strongly agree”. This study utilised all four dimensions of MAS information as suggested by Chenhall and Morris (1986) to avoid suboptimal MAS usage.

Organisational Performance

Following Mia and Clarke (1999), OP is defined as the extent to which the organisation is successful in achieving its planned targets comprising eight dimensions of performance: productivity, costs, quality, delivery, service, sales volume, market share, and profitability. The managers were required to indicate their perceived level of their organisational performance on a five-point likert scale where 1 represents “poor performance” and 5 represents “excellent performance”.

4.0 RESULTS AND DISCUSSION

4.1 Missing Values, Test of Non-Response Bias, and Common Method Bias

After the respondents returned the questionnaire booklet, the answers provided in the questionnaire were checked for completeness and accuracy. If there was any missing data and if the respondent had provided their contact information, they were contacted to obtain the information needed. In the case where no contact information had been provided, then the missing data were treated as missing values. SmartPLS provided two options to deal with missing values: mean replacement and casewise deletion. Since the sample size is small, this study opted to choose the mean replacement method to deal with missing data. Casewise deletion was not used as this may discard a lot of useful information, which may lead to lower efficiency (Temme, Kreis and Hildebrandt, 2006).

A test of non-response bias was conducted on the usable responses. Respondents were categorised into two categories. Those who responded within one month (before the due date) were considered as early respondents, whereas those who responded after one month (after the due date) were considered as late respondents. Out of 110 usable responses, 29 responses were categorised as early responses and the remaining 81 responses were categorised as late responses. The test of non-response bias was conducted on these two groups and no significant difference between early and late responses were found. Therefore, it can be concluded that non-response bias is not a problem in this study.

Potential common method bias was assessed via Harman's single-factor test (Podsakoff and Organ, 1986). The average variance extracted by a single factor is 29.47% indicating that a very small proportion of the variance in the data is accounted for by a single factor. This result helps to mitigate concerns that common method bias may be driving our findings due to self-reported and -collected survey data.

4.2 Profile of Firms and Respondents

Table 1-1 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 10 years and most of the firms are either locally owned (45.5%) or foreign owned (46.3%). 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.

[Insert Table 1-1 here]

Regarding the profile of the respondents, Table 1-2 shows that 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.

[Insert Table 1-2 here]

4.3 Loadings and Cross Loadings

Convergent validity is assessed by examining the factor loading for each indicator. This is also a test for individual item (indicator) reliability (Henseler, Ringle and

Sinkovics, 2009; and Chin, 1998). The factor loadings generated by PLS are interpretable similar to the loadings generated by principal components factor analysis (Bookstein, 1986). An indicator should share more variance with the component score than with the error variance. As such, the correlations between a construct and each of its indicators (standardised outer loadings) should be greater than 0.70. However, Chin (1998, p. 325) argued that the rule of thumb of 0.70 for individual item reliability "should not be as rigid at early stages of scale development. Loadings of 0.50 or 0.60 may still be acceptable if there exist additional indicators in the block for comparison basis". Hulland (1999) also suggested that the value of 0.50 should be adequate as a threshold for individual item reliability. Thus, this study uses 0.50 as an acceptable value for individual item reliability.

The factor loading should be significant and exceed 0.50. Table 2 shows the factor loading for each indicator in the outer model. As can be seen, low loadings were found for the IMP variables, which were then deleted from further analysis. Two items were deleted from JIT and AMT constructs, and one item from TQM. The items that were deleted from JIT constructs are: JIT9 (number of total parts) and JIT10 (amount of buffer stock). These items had outer loadings of 0.497 and 0.252, respectively. Only one item under the TQM construct (TQM4) had an outer loading of less than 0.50 (0.143). This item relates to the current approach in providing quality products. Both items from AMT that were not achieved convergent validity were classified under advanced technology and not computer integration. The loadings for AMT2 (computer aided design/CAD), and AMT14 (local area network/LAN) were 0.445 and 0.339, respectively. All indicators in other constructs (management accounting systems and business unit performance) had fulfilled at least a minimum requirement of convergent validity. Thus, none were deleted from their constructs.

[Insert Table 2 here]

To assess discriminant validity on the indicator level, the loading for each indicator should be higher than all of its cross-loadings (Henseler at al., 2009). Table 3 shows the cross loadings for all indicators. The shaded area consists of loadings for all indicators in each construct. All items were found to load higher on their own block (construct) than on other blocks (constructs). This implies that the construct component score predicts each indicator in its block better than indicators in other blocks.

[Insert Table 3 here]

4.4 Measurement Model

The PLS method is used to test the hypothesised relationships between the main variables of this study, which consist of IMP, the use of MAS information, and organisational performance (OP). Prior to that, the adequacy of the measurement model was assessed by examining convergent validity, discriminant validity and reliability.

Table 4 presents the value for composite reliability (ρ_c), average variance extracted (AVE), square root of AVE and latent variable correlations. All constructs are found to be reliable and valid. The composite reliability exceeds the threshold value of 0.70, which indicates that all constructs are reliable (Henseler et al., 2009; Chin, 1998; and Hair et al., 1998). The AVE value above 0.50 for all constructs satisfies the test of convergent validity (Fornell and Larcker, 1981). Discriminant validity is achieved when the value of AVE for each construct is higher than its highest squared correlation with any other construct, or the square root of AVE is higher than its correlations (Fornell and Larcker, 1981). Table 4 shows the square roots of AVEs, represented by shaded numbers on the leading diagonals, exceed the correlations of the latent variable thus indicating that discriminant validity is achieved.

[Insert Table 4 here]

4.5 Hypotheses Testing

Once the adequacy of the measurement model is established, the next step is the evaluation of the structural model or hypothesis testing. The evaluation of the structural model was performed via the resampling technique to determine the confidence intervals (two-tailed) of the path coefficients and statistical inference. In PLS, this was done by the bootstrapping procedure. In this study, bootstrap samples of 500 were used.

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

[Insert Figure 2 here]

Figure 2 shows that the relationship between IMP and OP is positive but not significant ($\beta = 0.152$, $t = 1.735$, $p > 0.05$). As such, hypothesis 1 is not supported. Both hypothesised paths from IMP to MAS information ($\beta = 0.649$, $t = 9.631$, $p < 0.01$) as well as from MAS information to OP ($\beta = 0.599$, $t = 6.974$, $p < 0.01$) are positive and significant. Thus, hypotheses 2 and 3 are supported. IMP explains 42.2 per cent of the variance in MAS information usage, whereas 50 per cent of the variance in OP is explained by IMP and MAS.

To test the mediating effects of MAS information in the relationship between IMP and OP, similar procedures to those recommended by Baron and Kenney (1986) and utilised by Bass, Avolio, Jung and Berson (2003) were used. Evidence for *full mediation* is present when the following conditions are met: A path from the independent variable (i.e., IMP) to the dependent variable (i.e., OP) is not significant but paths from the independent variable to the mediator (i.e., MAS information) and from the mediator to the dependent variable are significant (Wold, 1985). *Partial mediation* is present when all paths are significant. Thus, in this study, it can be concluded that MAS fully mediates the relationship of IMP with organisational performance and hypothesis 4 is supported. The result is consistent with the argument that performance of IMP firms will be enhanced through managerial use of relevant MAS information (Fullerton and Wempe, 2009; Mia, 2000; Sim and Killough, 1998).

5.0 Limitations and Conclusions

As highlighted at the beginning of the paper, this study focused on examining the mediating role of MAS information in the relationship between IMP and OP. The results reveal that adoption of IMP in a manufacturing firm is positively associated with performance only through managers' use of the MAS information. This is a significant contribution to the existing understanding contained in the literature. The results of the study suggest that the role of MAS information in enhancing performance is crucial in an advanced manufacturing environment. Manufacturing firms that use IMP would demand a greater amount of MAS information. They used all four types of information to assist them in their daily operations as well as in making decisions for the benefit of their organisations. More importantly, the results show that the use of MAS information by managers could help firms to achieve the ultimate outcome of every organisation, i.e., improved performance. Consistent with the findings by Hoque (2011), Fullerton and Wempe (2009), Mia (2000), Mia and Clarke (1999), Sim and Killough (1998), and Chenhall and Morris (1995), among others, the results of this study suggest that suitable information provided by MAS can assist managers to make appropriate decisions, thereby facilitate achievement of desired company outcomes or goals.

There are several limitations to the study that need to be highlighted. First, 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 (Saßenroth, 2013), future study should try to obtain higher response rate for more meaningful results.

Second, the scales employed in this study were based on individuals' perceptions. Therefore, they may not reflect objective reality. Even though financial performance can be measured using a more objective profitability indices, such as return on assets (ROA) and return on investments (ROI), this type of information is too confidential for disclosure by managers. Furthermore, the sample firms used in this study consisted of both publicly listed and private firms. The financial information may be available for the publicly listed firms but not for the private firms.

Finally, the sample was only drawn from manufacturing firms operating in Malaysia. The implementation of JIT and TQM, and the use of MAS information and performance measures may be different in other industries such as service industries or public sector organisations. Moreover, according to many researchers (e.g.: Yang et al., 2011; Naor, Linderman and Schroeder, 2010; O'Connor, 1995), different countries and different cultural values do have differential impacts on management control systems and performance of an organisation. Therefore, the findings from this study may not be generalisable to other industries, countries and culture. Future studies could extend this research for other industries, countries and culture.

Apart from these limitations, the results of the study have implications for theory and practice. As explained above, the results contribute to the literature by providing a new evidence of the relationship between IMP and performance that exists through managerial use of the MAS information. Specifically, this study provides evidence for the usefulness of the management accounting systems in advanced manufacturing environments. Consistent with the arguments made by previous researchers (i.e.:

Davila and Wouters, 2007; Johnson and Kaplan, 1987; among others) that MAS should be modified to be in line with the changes in the business environment, the results of this study show that MAS information plays a mediating role in the relationship between IMP and performance. This suggests that managers in an IMP environment must use appropriate MAS information that focuses on broad scope, timely, integrated and aggregated information to make better decisions in order to enhance performance. Thus, the use of MAS information in an IMP environment is relevant since their usage could assist firms to achieve their performance targets.

In addition, studies that examine three manufacturing practices simultaneously or IMP are very limited. Thus far, only Dean and Snell (1996, 1991), and Snell and Dean (1994, 1992) have examined JIT, TQM and AMT simultaneously. However, none of these studies examined the relationship between IMP and MAS. Hence, this study contributes significantly to the literature on the relationship between these three practices and MAS.

Finally, this study also provides theoretical implications since it combines various disciplines. For example, IMP falls into production and operation management, whereas MAS represents the accounting discipline. As asserted by Sousa and Voss (2008, p. 698), many operation management problems have a cross-disciplinary nature. Thus, by conducting interdisciplinary research, operation management problems could be viewed from another angle and might provide a solution to some of them.

References

Abdel-Kader, M., Luther, R. (2008), "The impact of firm characteristics on management accounting practices: A UK-based empirical analysis", *The British Accounting Review*, Vol. 40, pp. 2-27.

Balakrishnan, R., Linsmeier, T. J., Venkatachalam, M. (1996), "Financial benefits from JIT adoption: effects of customer concentrations and cost structure", *The Accounting Review*, Vol. 71, No. 2, pp. 183–205.

Banker, R. D., Bardhan, I. R., Chen, T. Y. (2008), "The role of manufacturing practices in mediating the impact of activity-based costing on plant performance", *Accounting, Organizations and Society*, Vol. 33, pp. 1–19.

Baron, R. M., Kenny, D. A. (1986), "The moderator–mediator distinction in social psychological research: Conceptual, strategic, and statistical consideration", *Journal of Personality and Social Psychology,* Vol. 51, No. 6, pp. 1173–1182.

Bass, B. M., Avolio, B. J., Jung, D. I., Berson, Y. (2003), "Predicting Unit Performance by Assessing Transformational and Transactional Leadership", *Journal of Applied Psychology*, Vol. 88, No. 2, pp. 207–218.

Bookstein, F. (1986), "The elements of latent variable models: A cautionary lecture", In M. Lamb, A. Brown, & B. Rogoff (Eds.), *Advances in developmental psychology* (pp. 203–230). Hillsdale, NJ: Erlbaum. In Bass, B. M., Avolio, B.

J., Jung, D. I. and Berson, Y. (2003), “Predicting Unit Performance by Assessing Transformational and Transactional Leadership”, *Journal of Applied Psychology*, Vol. 88, No. 2, pp. 207–218.

Chenhall, R. H. (2003), “Management control systems design within its organizational context: findings from contingency-based research and directions for the future”, *Accounting, Organizations and Society*, Vol. 28, pp. 127–168.

Chenhall, R. H. (2007), “Theorizing contingencies in management control systems research”, In Chapman, C., Hopwood, A., Shields, M. (Ed.), *Handbook of Management Accounting Research* (Vol. 2), Elsevier.

Chenhall, R. H., Morris, D. (1986), “The impact of structure, environment, and interdependence on the perceived usefulness of management accounting systems”, *The Accounting Review*, Vol. LX1, No. 1, pp. 16-35.

Chenhall, R. H., Morris, D. (1995), “Organic decision and communication processes and management accounting systems in entrepreneurial and conservative business organizations”, *Omega*, Vol. 23, No. 5, pp. 485-497.

Chin, W. W. (1998), “The partial least square approach to structural equation modeling”, In: Marcoulides, G. A. (Ed.), *Modern Methods for Business Research* (pp. 295-336). Mahwah, NJ: Lawrence Erlbaum Associates.

Chin, W. W. (2010), "How to write up and report PLS analyses", In: Vinzi, V. E., Chin, W. W., Henseler, J. And Wang, H. (Ed.), *Handbook of Partial Least Squares* (pp. 655-690). Springer Berlin Heidelberg.

Christensen, W. J., Germain, R., Birou, L. (2005), "Build to order and just-in-time as predictors of applied supply chain knowledge and market performance", *Journal of Operations Management*, Vol. 23, No. 5, pp. 419-422.

Davila, T., Wouters, M. (2007), "Management Accounting in the Manufacturing sector: Managing costs at the Design and Production stage", In Chapman, C., Hopwood, A. and Shields, M. (Ed.), *Handbook of Management Accounting Research* (Vol. 2), Elsevier.

Dean, J. W., Jr., Snell, S. A. (1991), "Integrated manufacturing and job design: The moderating effect of organizational inertia", *Academy of Management Journal*, Vol. 34, No. 4, pp. 776-804.

Dean, J. W., Jr., Snell, S. A. (1996), "The strategic use of integrated manufacturing: an empirical examination", *Strategic Management Journal*, Vol. 17, No. 6, pp. 459-480.

Fornell, C., Larcker, D. F. (1981), "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error", *Journal of Marketing Research*, Vol. 18, No. 1, pp. 39-50.

Fullerton, R. R., McWatters, C. S. (2002), "The role of performance measures and incentive systems in relation to the degree of JIT implementation", *Accounting, Organizations and Society*, Vol. 27, pp. 711-735.

Fullerton, R. R., McWatters, C. S., Fawson, C. (2003), "An examination of the relationship between JIT and financial performance", *Journal of Operations & Management*, Vol. 21, pp. 383-404.

Fullerton, R. R., Wempe, W. F. (2009), "Lean manufacturing, non-financial performance measures, and financial performance", *International Journal of Operations & Production Management*, Vol. 29, No. 3, pp. 214-240.

Gul, F. A. (1986), "The joint and moderating role of personality and cognitive style on decision making", *The Accounting Review*, pp. 587-600.

Hair Jr., J. F., Anderson, R. E., Tatham, R. L., Black, W. C. (1998), *Multivariate Data Analysis*, 5th Ed., New Jersey: Prentice Hall Inc.

Hendricks, K. B., Singhal. V. R. (1997), "Does implementing an effective TQM program actually improve operating performance? Empirical evidence from firms that have won quality awards", *Management Science*, Vol. 43, No. 9, pp. 1258-1274.

Henseler, J., Ringle, C. M., Sinkovics, R. R. (2009), "The use of partial least squares path modelling in international marketing", *Advances in International Marketing*, Vol. 20, pp. 277-319.

Hofer, C., Eroglu, C., Hofer, A. R. (2012), "The effect of lean production on financial performance: The mediating role of inventory leanness", *International Journal of Production Economics*, http://dx.doi.org/10.1016/j.ijpe.2012.03.025.

Hoque, Z. (2011), "The relations among competition, delegation, management accounting systems change and performance: A path model", *Advances in Accounting, incorporating Advances in International Accounting*, doi:10.1016/j.adiac.2011.05.006

Hulland, J. (1999), "Use of partial least squares (PLS) in strategic management research: A review of four recent studies", *Strategic Management Journal,* Vol. 20, No. 2, pp. 195-204.

Isa, C. R., Foong, S. Y. (2005), "Adoption of Advanced Manufacturing Technology (AMT) and Management Accounting Practices: The Case of Manufacturing Firms in Malaysia", *World Review of Science, Technology and Sustainable Development*, Vol. 2, pp. 35-48.

Johnson, H. T., Kaplan, R. S. (1987), *Relevance lost: the rise and fall of management accounting*. Boston: Harvard Business School Press.

Kaynak, H. (2003), “The relationship between total quality management practices and their effects on firm performance”, *Journal of Operations Management,* Vol. 21, pp. 405–435.

Kinney, M. R., Wempe, W. F. (2002), “Further evidence on the extent and origin of JIT’s profitability effects”, *The Accounting Review*, Vol. 77, No. 1, pp. 203–225.

Koc, T., Bozdag, E. (2009), “The impact of AMT practices on firm performance in manufacturing SMEs”, *Robotics and Computer Integrated Manufacturing*, Vol. 25, pp. 303-313.

Kotha, S., Swamidass, P. M. (2000), “Strategy, advanced manufacturing technology and performance: empirical evidence from U.S. manufacturing firms”, *Journal of Operations Management*, Vol. 18, pp. 257-277.

Maiga, A. S., Jacobs, F. A. (2009), “JIT performance effects: A research note”, *Advances in Accounting, incorporating Advances in International Accounting*, Vol. 25, No. 2, pp. 183–189.

Mia, L. (1988), “Managerial attitude, motivation and the effectiveness of budget participation”, *Accounting, Organizations and Society*, Vol. 13, No. 5, pp. 465-475.

Mia, L. (1993), “The role of MAS information in organizations: An empirical study”, *British Accounting Review*, Vol. 25, pp. 269-285.

Mia, L. (2000), “Just-in-time manufacturing, management accounting systems and profitability”, *Accounting and Business Research*, Vol. 30, No. 2, pp. 137–151.

Mia, L., Clarke, B. (1999), “Market competition, management accounting systems and business unit performance”, *Management Accounting Research*, Vol. 10, pp. 137–158.

Mia, L., Winata, L. (2008), “Manufacturing strategy, broad scope MAS information and information and communication technology”, *The British Accounting Review*, Vol. 40, pp. 182–192.

Narasimhan, R., Swink, M., Kim, S. W. (2006), “Disentangling leanness and agility: an empirical investigation”, *Journal of Operations Management*, Vol. 24, No. 5, pp. 440-457.

Naor, M., Linderman, K., Schroeder, R. (2010), “The globalization of operations in Eastern and Western countries: Unpacking the relationship between national and organizational culture and its impact on manufacturing performance”, *Journal of Operations Management*, Vol. 28, No. 3, pp. 194-205.

O’Connor, N. G. (1995), “The influence of organizational culture on the usefulness of budget participation by Singaporean-Chinese managers", *Accounting, Organizations and Society*, Vol. 20, No. 5, pp. 383-403.

Patiar, A., Mia, L. (2008), "The interactive effect of market competition and use of MAS information on performance: Evidence from the upscale hotels", *Journal of Hospitality and Tourism Research*, Vol. 32, No. 2, pp. 209-234.

Podsakoff, P. M., Organ, D. W. (1986), "Self-reports in organizational research: Problems and Prospects", *Journal of Management*, Vol. 12, No. 4, pp. 531-544.

Saßenroth, D. (2013), "Survey Nonresponse", In: Saßenroth, D. (Ed.), *The Impact of Personality on Participation Decisions in Survey: A Contribution to the Discussion on Unit Nonresponse* (pp. 23-63). Springer Fachmedien Wiesbaden.

Shah, R., Ward, P. T. (2003), "Lean manufacturing: Context, practice bundles and performance", *Journal of Operations Management*, Vol. 21, No. 2, pp. 129-149.

Sim, K., Killough, L. (1998), "The performance effects of complementarities between manufacturing practices and management accounting systems", *Journal of Management Accounting Research,* Vol. 10, pp. 325–346.

Snell, S. A., Dean, J. W., Jr. (1992), "Integrated manufacturing and human resource management: a human capital perspective", *Academy of Management Journal*, Vol. 35, No. 3, pp. 467-504.

Snell, S. A., Dean, J. W., Jr. (1994), "Strategic compensation for integrated manufacturing: the moderating effects of jobs and organizational inertia", *Academy of Management Journal*, Vol. 37, No. 5, pp. 1109-1140.

Sousa, R., Voss, C. A. (2008), "Contingency research in operations management practices", *Journal of Operations Management,* Vol. 26, pp. 697-713.

Temme, D., Kreis, H. and Hildebrandt, L. (2006). *PLS path modelling – a software review*. University of Berlin discussion paper, No. 084.

Wold, H. (1985), "Systems analysis by partial least squares", In P. Nijkamp, H. Leitner, & N. Wrigley (Eds.), *Measuring the unmeasurable* (pp. 221–252). Dordrecht, the Netherlands: Martinus Nijhoff. In Bass, B. M., Avolio, B. J., Jung, D. I. and Berson, Y. (2003). Predicting Unit Performance by Assessing Transformational and Transactional Leadership. *Journal of Applied Psychology*, Vol. 88, No. 2, pp. 207–218.

Yang, M. G., Hong, P., Modi, S. B. (2011), "Impact of lean manufacturing and environmental management on business performance: An empirical study of manufacturing firms", *Int. J. Production Economics,* Vol. 129, No. 251–261.

Zhou, H., Ward, P. (2006), “Impact of information technology integration and Lean/Just-In-Time Practices on lead time performance”, *Decision Sciences,* Vol. 37, No. 2, pp. 177- 203.

[1] A copy of the questionnaire is available from the authors upon request.

EVIDENCE ON THE USEFULNESS OF MANAGEMENT ACCOUNTING SYSTEMS IN INTEGRATED MANUFACTURING ENVIRONMENT

APPENDICES

Appendix A: List of Figures

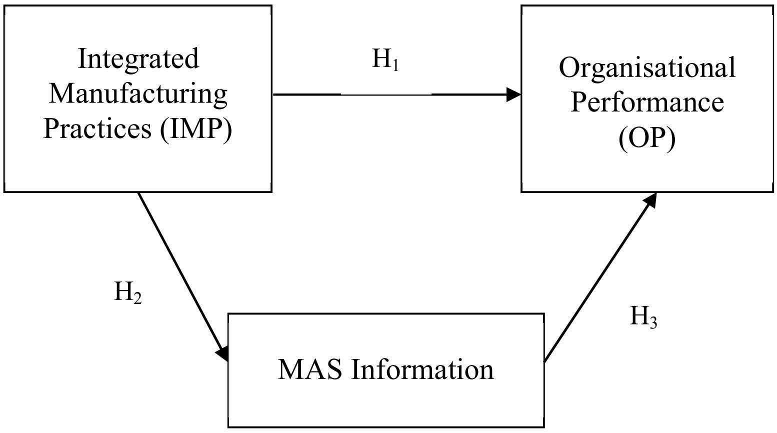
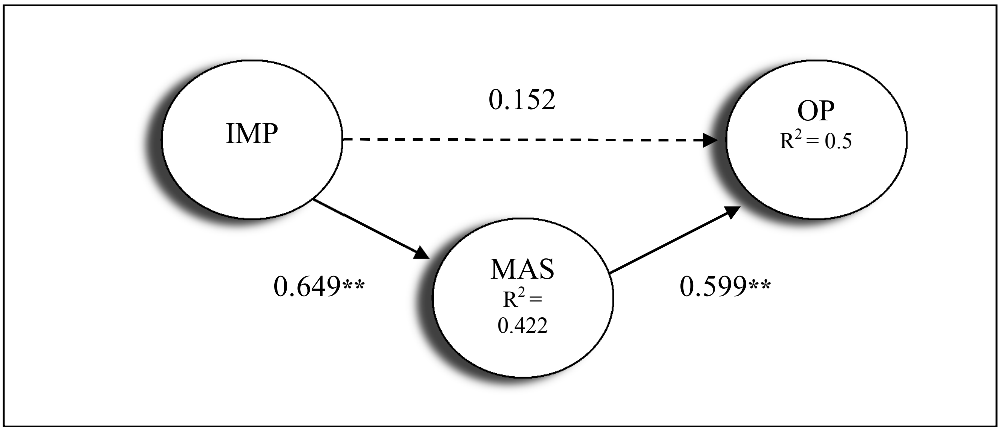


Figure 1: Theoretical Framework of the Research



** Significant at $p<0.01$

Note:
IMP = Integrated manufacturing practices
MAS = Management accounting systems
OP = Organisational performance

Figure 2: The Model

Appendix B: List of Tables

Table 1-1: Profile of Sample Firms

Demographic Information	Categories	Frequency	Percentage
Type of Industry	Building materials/cement/concrete/ceramics/tiles	3	2.7
	Chemical and adhesive products	6	5.5
	Electrical and electronics products	31	28.2
	Food, beverage and tobacco	9	8.2
	Furniture and wood related products	1	0.9
	Gas and petroleum products	3	2.7
	Household products and appliances	2	1.8
	Iron, steel and metal products	9	8.2
	Machinery and equipment	3	2.7
	Paper, printing, packaging and labelling	3	2.7
	Pharmaceutical, medical equipment, cosmetics and toiletries	3	2.7
	Rubber and plastic products	11	10.0
	Textile, clothing, footwear and leather products	3	2.7
	Transport and automotive parts/components	17	15.5
	Others	5	4.6
	No information provided	1	0.9
Years in Operation	Less than 5 years	6	5.5
	5 to 10 years	15	13.6
	More than 10 years	88	80.0
	No information provided	1	0.9
Ownership Structure	Local (more than 50% local equity)	50	45.5
	Joint venture	8	7.3
	Foreign (more than 50% foreign equity):		
	- Anglo American	15	13.6
	- Asian	32	29.1
	- Others	4	3.6
	No information provided	1	0.9
Number of Full Time Employees	Not exceeding 150	27	24.6
	151 to 250	15	13.6
	251 to 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 to RM100 million	18	16.4
	RM101 to 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 to RM50 million	11	10.0
	RM51 to RM100 million	24	21.8
	Above RM100 million	56	50.9
	No information provided	3	2.7

Table 1-2: Profile of Sample Respondents

Demographic Information	Categories	Frequency	Percentage
Gender	Male	95	86.4
	Female	15	13.6
Age	20 to 29 years	13	11.8
	30 to 39 years	35	31.8
	40 to 49 years	42	38.2
	50 years and above	20	18.2
Nationality	Malaysian	104	94.5
	Others	6	5.5
Length of service	Less than 3 years	8	7.3
	3 years and above	100	90.9
	No information provided	2	1.8

Table 2: Outer Loadings (Mean, STDEV, T-Values)

Items	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
A1	0.834	0.833	0.036	0.036	22.886**
A2	0.879	0.879	0.025	0.025	35.768**
A3	0.846	0.845	0.033	0.033	25.536**
A4	0.838	0.835	0.039	0.039	21.605**
A5	0.805	0.801	0.047	0.047	17.249**
A6	0.765	0.763	0.054	0.054	14.087**
A7	0.703	0.703	0.046	0.046	15.358**
AMT1	0.590	0.589	0.068	0.068	8.693**
AMT2	0.445#	0.446	0.095	0.095	4.696**
AMT3	0.564	0.566	0.077	0.077	7.291**
AMT4	0.551	0.549	0.076	0.076	7.252**
AMT5	0.579	0.574	0.076	0.076	7.645**
AMT6	0.500	0.487	0.088	0.088	5.672**
AMT7	0.528	0.524	0.082	0.082	6.440**
AMT8	0.550	0.545	0.077	0.077	7.130**
AMT9	0.609	0.598	0.083	0.083	7.334**
AMT10	0.611	0.605	0.069	0.069	8.845**
AMT11	0.565	0.557	0.097	0.097	5.817**
AMT12	0.662	0.665	0.064	0.064	10.395**
AMT13	0.766	0.768	0.042	0.042	18.099**
AMT14	0.339#	0.328	0.111	0.111	3.060**
AMT15	0.581	0.576	0.078	0.078	7.445**
AMT16	0.622	0.621	0.084	0.084	7.429**
AMT17	0.774	0.773	0.046	0.046	16.706**
AMT18	0.766	0.766	0.042	0.042	18.073**
AMT19	0.784	0.782	0.042	0.042	18.672**
AMT20	0.782	0.779	0.046	0.046	17.174**
AMT21	0.811	0.808	0.036	0.036	22.552**
AMT22	0.791	0.790	0.040	0.040	19.976**
AMT23	0.788	0.785	0.043	0.043	18.116**
I1	0.866	0.864	0.031	0.031	28.071**
I2	0.938	0.937	0.013	0.013	73.492**
I3	0.914	0.914	0.016	0.016	56.708**

** Significant at p<0.01
* Significant at p<0.05
# Low loading

Table 2: Outer Loadings (Mean, STDEV, T-Values) (continued)

Items	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
JIT1	0.629	0.638	0.079	0.079	7.929**
JIT2	0.514	0.508	0.113	0.113	4.540**
JIT3	0.600	0.594	0.087	0.087	6.866**
JIT4	0.698	0.702	0.066	0.066	10.644**
JIT5	0.668	0.662	0.065	0.065	10.268**
JIT6	0.513	0.491	0.145	0.145	3.532**
JIT7	0.606	0.590	0.114	0.114	5.320**
JIT8	0.564	0.544	0.112	0.112	5.022**
JIT9	0.497#	0.473	0.140	0.140	3.554**
JIT10	0.252#	0.222	0.166	0.166	1.523
P1	0.847	0.850	0.029	0.029	29.504**
P2	0.737	0.738	0.059	0.059	12.549**
P3	0.864	0.863	0.028	0.028	30.819**
P4	0.870	0.870	0.027	0.027	32.666**
P5	0.804	0.803	0.038	0.038	21.079**
P6	0.874	0.875	0.021	0.021	41.116**
P7	0.835	0.837	0.036	0.036	23.090**
P8	0.830	0.831	0.039	0.039	21.344**
S1	0.732	0.731	0.060	0.060	12.174**
S2	0.648	0.646	0.077	0.077	8.427**
S3	0.811	0.811	0.035	0.035	23.065**
S4	0.836	0.833	0.035	0.035	24.170**
S5	0.828	0.827	0.032	0.032	25.511**
T1	0.879	0.876	0.025	0.025	34.667**
T2	0.891	0.890	0.021	0.021	41.668**
T3	0.854	0.854	0.031	0.031	27.815**
T4	0.799	0.795	0.042	0.042	18.885**
TQM1	0.605	0.598	0.082	0.082	7.359**
TQM2	0.710	0.708	0.068	0.068	10.456**
TQM3	0.715	0.714	0.067	0.067	10.636**
TQM4	0.143#	0.139	0.139	0.139	1.030
TQM5	0.647	0.640	0.069	0.069	9.367**

** Significant at p<0.01
* Significant at p<0.05
\# Low loading

Table 2: Outer Loadings (Mean, STDEV, T-Values) (continued)

Items	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
TQM6	0.674	0.672	0.068	0.068	9.856**
TQM7	0.678	0.674	0.066	0.066	10.240**
TQM8	0.647	0.654	0.059	0.059	11.041**
TQM9	0.604	0.597	0.083	0.083	7.309**
TQM10	0.696	0.689	0.062	0.062	11.236**

** Significant at $p<0.01$
* Significant at $p<0.05$
# Low loading

Note:

AMT = Advanced manufacturing technology

JIT = Just-in-time

TQM = Total quality management

S = Scope

T = Timeliness

A = Aggregation

I = Integration

P = Performance

Table 3: Cross Loadings

Items	A	AMT	F	I	JIT	NF	S	T	TQM
A1	0.834	0.353	0.519	0.649	0.466	0.547	0.400	0.461	0.432
A2	0.879	0.418	0.553	0.668	0.517	0.480	0.410	0.465	0.453
A3	0.846	0.396	0.581	0.647	0.486	0.473	0.498	0.523	0.469
A4	0.838	0.277	0.550	0.562	0.440	0.415	0.324	0.416	0.348
A5	0.805	0.311	0.419	0.568	0.366	0.403	0.308	0.419	0.310
A6	0.765	0.343	0.533	0.562	0.407	0.449	0.399	0.462	0.406
A7	0.703	0.237	0.413	0.435	0.318	0.432	0.318	0.400	0.288
AMT1	0.424	0.590	0.257	0.318	0.361	0.286	0.338	0.201	0.382
AMT2	0.023	0.445	-0.040	0.022	0.162	0.111	0.054	0.078	0.252
AMT3	0.340	0.564	0.201	0.260	0.298	0.245	0.372	0.248	0.351
AMT4	0.149	0.551	-0.011	0.064	0.305	0.075	0.101	0.108	0.357
AMT5	0.126	0.579	0.035	0.007	0.229	0.016	0.096	0.141	0.391
AMT6	0.155	0.500	0.013	-0.072	0.179	0.012	0.026	-0.056	0.235
AMT7	0.219	0.528	0.121	0.152	0.278	0.186	0.149	0.189	0.389
AMT8	0.219	0.550	0.166	0.144	0.249	0.104	0.187	0.210	0.446
AMT9	0.369	0.609	0.231	0.185	0.213	0.165	0.293	0.398	0.360
AMT10	0.299	0.611	0.173	0.152	0.300	0.129	0.249	0.287	0.385
AMT11	0.277	0.565	0.153	0.112	0.289	0.136	0.149	0.246	0.375
AMT12	0.314	0.662	0.224	0.302	0.327	0.207	0.344	0.224	0.391
AMT13	0.350	0.766	0.307	0.309	0.435	0.230	0.357	0.304	0.485
AMT14	0.293	0.339	0.236	0.247	0.269	0.180	0.175	0.226	0.252

Table 3: Cross Loadings (continued)

Items	A	AMT	F	I	JIT	NF	S	T	TQM
AMT15	0.331	0.581	0.341	0.228	0.336	0.230	0.273	0.234	0.420
AMT16	0.140	0.622	0.211	0.120	0.301	0.270	0.176	0.189	0.324
AMT17	0.265	0.774	0.167	0.229	0.411	0.282	0.245	0.202	0.403
AMT18	0.231	0.766	0.095	0.216	0.379	0.220	0.270	0.221	0.422
AMT19	0.282	0.784	0.142	0.312	0.498	0.319	0.300	0.267	0.511
AMT20	0.279	0.782	0.132	0.259	0.401	0.262	0.275	0.238	0.468
AMT21	0.373	0.811	0.293	0.309	0.437	0.292	0.434	0.329	0.478
AMT22	0.346	0.791	0.314	0.329	0.444	0.338	0.375	0.274	0.486
AMT23	0.277	0.788	0.221	0.275	0.390	0.296	0.298	0.250	0.426
I1	0.643	0.335	0.445	0.866	0.491	0.493	0.528	0.434	0.561
I2	0.673	0.294	0.500	0.938	0.513	0.481	0.570	0.528	0.483
I3	0.656	0.241	0.503	0.914	0.417	0.416	0.588	0.460	0.431
JIT1	0.373	0.414	0.192	0.423	0.629	0.342	0.250	0.282	0.526
JIT2	0.439	0.284	0.324	0.390	0.514	0.342	0.193	0.524	0.414
JIT3	0.464	0.343	0.483	0.408	0.600	0.357	0.324	0.458	0.401
JIT4	0.379	0.495	0.275	0.420	0.698	0.355	0.295	0.293	0.539
JIT5	0.381	0.359	0.248	0.309	0.668	0.330	0.096	0.171	0.437
JIT6	0.019	0.065	0.218	0.067	0.513	0.130	0.112	0.170	0.186
JIT7	0.209	0.144	0.380	0.217	0.606	0.269	0.180	0.259	0.293
JIT8	0.165	0.152	0.208	0.190	0.564	0.188	0.204	0.334	0.299
JIT9	0.164	0.225	0.188	0.122	0.497	0.129	0.140	0.222	0.289
JIT10	-0.042	-0.015	0.004	-0.035	0.252	-0.066	0.064	-0.040	0.012
P2	0.562	0.311	0.737	0.484	0.357	0.558	0.363	0.425	0.438
P6	0.454	0.228	0.874	0.390	0.408	0.601	0.415	0.405	0.410
P7	0.520	0.126	0.835	0.398	0.349	0.412	0.382	0.350	0.252
P8	0.545	0.239	0.830	0.480	0.413	0.512	0.423	0.428	0.354
P1	0.623	0.282	0.634	0.534	0.467	0.847	0.344	0.447	0.459
P3	0.490	0.286	0.543	0.461	0.440	0.864	0.338	0.485	0.434
P4	0.411	0.270	0.536	0.374	0.349	0.870	0.319	0.328	0.367
P5	0.367	0.257	0.435	0.343	0.377	0.804	0.300	0.436	0.339
S1	0.318	0.331	0.305	0.460	0.325	0.199	0.732	0.251	0.378
S2	0.230	0.239	0.356	0.330	0.201	0.318	0.648	0.293	0.329
S3	0.404	0.360	0.367	0.574	0.333	0.306	0.811	0.440	0.374
S4	0.407	0.220	0.449	0.482	0.200	0.344	0.836	0.342	0.377
S5	0.428	0.352	0.392	0.520	0.296	0.324	0.828	0.409	0.401
T1	0.448	0.300	0.410	0.361	0.421	0.394	0.368	0.879	0.454
T2	0.505	0.300	0.410	0.510	0.399	0.411	0.407	0.891	0.413
T3	0.388	0.284	0.386	0.405	0.366	0.403	0.438	0.854	0.388
T4	0.549	0.299	0.471	0.505	0.550	0.500	0.348	0.799	0.487
TQM1	0.243	0.243	0.285	0.269	0.428	0.370	0.075	0.361	0.605
TQM2	0.354	0.485	0.338	0.306	0.450	0.335	0.323	0.337	0.710
TQM3	0.400	0.481	0.392	0.419	0.441	0.405	0.459	0.422	0.715
TQM4	-0.069	-0.038	0.010	-0.041	0.196	-0.038	-0.107	0.081	0.143

Table 3: Cross Loadings (continued)

Items	A	AMT	F	I	JIT	NF	S	T	TQM
TQM5	0.241	0.471	0.339	0.290	0.358	0.265	0.406	0.336	0.647
TQM6	0.272	0.437	0.307	0.318	0.478	0.319	0.383	0.392	0.674
TQM7	0.218	0.402	0.148	0.329	0.451	0.313	0.367	0.295	0.678
TQM8	0.437	0.449	0.243	0.482	0.536	0.300	0.252	0.254	0.647
TQM9	0.365	0.396	0.271	0.439	0.398	0.206	0.356	0.355	0.604
TQM10	0.346	0.257	0.348	0.390	0.482	0.348	0.192	0.298	0.696

Note:

AMT = Advanced manufacturing technology

JIT = Just-in-time

TQM = Total quality management

S = Scope

T = Timeliness

A = Aggregation

I = Integration

P = Performance

F = Financial performance

NF = Non-financial performance

Table 4: Composite Reliability, AVE, Square Root of AVE and Correlations

Construct	Composite Reliability	AVE	IMP	MAS	OP
IMP	0.870	0.692	0.832		
MAS	0.888	0.665	0.649	0.815	
OP	0.897	0.813	0.541	0.698	0.902

Note:
IMP = Integrated manufacturing practices
MAS = Management accounting systems
OP = Organisational performance
AVE = Average variance extracted