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The Alignment of Lean Manufacturing Strategy with Management Accounting Controls: The Case of Egypt

Mohamed Sabry El Attar, Professor of Cost Accounting, Faculty of Commerce, Cairo University,
Nancy Mohamed Mahmoud (Corresponding author), Assistant Lecturer, Faculty of Commerce, Cairo University

Abstract

This paper aims at examining the extent to which management accounting controls (MACs) should be aligned with lean manufacturing strategy in addition to studying the role of MACs in influencing the relationship between lean manufacturing and organizational performance in Egyptian manufacturing firms. Primary and secondary data are collected to test research hypotheses. Questionnaire is used to survey a sample of Egyptian listed manufacturing firms in a wide spectrum of industrial sectors, in addition to financial statements analysis. Structural Equation Modeling (SEM) is used to analyze the collected data. The study found that MACs should be aligned with the lean manufacturing strategy. It is found that lean manufacturing directly affects both operational and financial performance. However, it affects financial performance indirectly only through the use of MACs as a mediator variable.

Keywords *Lean manufacturing strategy, Management Accounting Controls (MACs), Balanced Scorecard, Operational performance, Financial performance.*

1. Introduction

In today's highly competitive and the rapidly changing markets, manufacturing organizations have been enforced to improve quality, flexibility, and customer response (Fullerton and Kennedy, 2009). As a response to those pressures, they have changed their manufacturing strategy to focus on lean manufacturing, which is a complete business system that combines techniques such as Total Quality Management (TQM), Just-In-Time (JIT), and Total Preventative Maintenance (TPM) (Shah and Ward, 2003). Lean manufacturing aims to reduce waste in the production process, produce and deliver highly quality products, decrease inventories, and streamline processes (Kennedy and Widener, 2008). Lean manufacturing strategy examines value from the customer's perspective and then redesigns the production processes to enhance that value (Fullerton *et al.*, 2013).

As firms progress in their implementation of lean manufacturing, previous studies recommend the implementation of a supportive management control systems (Fullerton and McWatters, 2002; and SMA, 2006). In addition, many studies claimed that lean manufacturing has an impact on organizational performance (Holweg, 2007; Shah and Ward, 2007).

Consistent with previous studies, control systems should be aligned with the firm's strategy, however, there is little empirical evidence that examined the relationship between MACs and lean manufacturing strategy, especially in Egypt. Prior studies have discussed either the impact of lean manufacturing

strategy on MACs or the relationship between lean manufacturing and organizational performance. To the best of our knowledge, no study has examined the relationships among lean manufacturing strategy, management controls and organizational performance in the Egyptian environment.

This study is one of the few surveys of lean manufacturing strategy in Egypt through testing the extent to which lean manufacturing strategy affect MACs. MACs include: Balanced Scorecard (BSC), visual performance measurement information, employee empowerment, Standard Operating Rules and Procedures (SOP), and peer pressure. Additionally, it examines the impact of lean manufacturing strategy on organizational performance (financial and operational performance) through MACs.

The rest of this paper is structured as follows: section two presents the literature review and outlined hypotheses development; section three presents research methodology. Data analysis and discussion of results are presented in section four, followed by conclusions, limitations and directions for future research in section five.

2. Review of Literature and Hypotheses Development

2.1. The impact of lean manufacturing strategy and its initiatives on MACs

Several studies found that lean manufacturing initiatives are related to one or more MACs. Daniel and Reisperger (1991), Fullerton and Mcwatters (2002) and Patterson *et al.* (2004) found that, in JIT, organizations should align their MACs with their production strategy. These organizations allow employees' participation in solving problems, improving the process flow, and take decisions related to products' quality. In addition, Ezzamel and Willmott (1998) concluded that the introduction of TQM leads to an increase in peer pressure through reorganizing shop floor workers into teams in order to improve performance. These results suggest that there is a direct positive relation between lean manufacturing strategy and peer pressure.

Moreover, Rondeau *et al.* (2000) found that higher levels of time-based manufacturing systems require higher levels of standardization. Therefore, it can be concluded that lean manufacturing strategy is directly related to SOP. Another MAC examined in lean literature is the BSC. Susilawati *et al.* (2013), Seyedhosseini *et al.* (2011) and Anand and Kodali (2008) introduced new perspectives in the BSC to be used for lean organizations performance measurement. In Susilawati *et al.* (2013), the Performance Measurement Information System (PMIS) proposed framework consists of the following perspectives: financial, customer/ market, processes, people and future. While Seyedhosseini *et al.* (2011) and Anand and Kodali (2008) used five perspectives to evaluate the performance of lean organizations: financial, customer, processes, employees and suppliers. Based on reviewing the literature related to the relationship between lean manufacturing and MACs, the following hypothesis is tested:

> H_1: There is a positive relationship between lean manufacturing strategy and MACs.

2.2. Lean Manufacturing Strategy, MACs and Organizational Performance

Many studies have investigated the effect of implementing lean manufacturing strategy on organizational performance. However, in light of reviewing the literature, it can be noticed that studies that examined the relationship between lean manufacturing and organizational performance paint an ambiguous picture. The relationship between lean production and operational performance has been widely examined and confirmed (Fullerton *et al.*, 2014; Khanchanapong *et al.*, 2014; Chavez *et al.*, 2013; Losonci and Demeter, 2013; Watson, Jr., 2006; and Shah and Ward, 2003). Previous studies showed that lean manufacturing strategy affects operational performance of lean companies in terms of quality, cost, response time, productivity, and inventory control.

Although higher operational performance should lead to higher financial performance (Voss, 1995), usually measured by financial and market indicators, this relationship has been rarely studied scientifically (Losonci and Demeter, 2013). Moreover, the empirical results regarding improvements in financial performance of lean companies are ambiguous. Some studies confirm the positive link (Harris and Cassidy, 2013 and Fullerton and Wempe, 2009), other researchers do not find any relationship (Losonci and Demeter, 2013). Moreover, Meade *et al.* (2010) found that lean manufacturing strategy has negative impact on lean companies' profits during the early stage of its implementation.

Prior studies have discussed either the impact of lean manufacturing on MACs or on performance. To the best of our knowledge, no study has viewed MACs as a mediator between lean manufacturing strategy and performance. Therefore, this study is designed to examine the impact of lean manufacturing strategy on MACs and test the impact of aligning lean manufacturing strategy with MACs on the organizational performance in the Egyptian context. Therefore, the following hypotheses are formulated:

H_2: There is a direct relationship between lean manufacturing and operational performance.

H_3: There is a direct relationship between lean manufacturing and financial performance.

H_4. The effect of lean manufacturing on organizational performance is mediated by the MACs.

This hypothesis is tested through the following sub- hypotheses:

H_{4a}. The effect of lean manufacturing on operational performance is mediated by the MACs.

H_{4b}. The effect of lean manufacturing on financial performance is mediated by the MACs.

3. Research methodology

3.1. Data collection

This study uses both questionnaire and annual reports to collect data from representatives of Egyptian listed manufacturing firms. Questionnaires have been used widely in the literature in surveys on production systems, MACs, and operational performance (for example: Fullerton and McWatters, 2002; Shah and Ward, 2003; Patterson *et al.*, 2004; Watson Jr, 2006; Fullerton and Wempe, 2009; Chavez *et al.*, 2013; and Fullerton *et al.*, 2013). Annual reports are used to extract

measures related to financial performance.

The number of manufacturing firms listed on the Egyptian Stock Exchange Market is 97 companies. The sample compromises 7 sectors; basic resources, construction and material, personnel and household, pharmaceutical, industrial goods and automobiles, chemical and food and beverage industries.

Researchers distribute and pick-up the questionnaires personally to ensure high response rate (80%). A total of 78 questionnaires were returned that are valid for analysis. Table 1 summarizes the sample companies according to the sector.

Sectors	Responses	%
Basic resources industries	7	9
Construction and material industries	19	25
Personnel and household industries	8	1
Pharmaceutical industries	12	15
Industrial goods and automobiles industries	17	22
Chemical industries	3	4
Food and beverage industries	12	5
Total	78	100%

Table 1. Sample companies according to the sector

3.2. Variables Measurements

Lean manufacturing strategy was measured using the eight elements which represent lean manufacturing: standardization, manufacturing cells, kanban system, one-piece flow, reduced lot sizes, reduced buffer inventories, 5S, and Kaizen, which are consistent with the extant literature (Shah and Ward, 2003; Kennedy and Widener, 2008; Marin-Garcia and Carneiro, 2010; and Fullerton *et al.*, 2013).

BSC measures are adopted from Khan *et al.* (2011) and Seyedhosseini *et al.* (2011). BSC was measured using eighteen questions related to the new measures developed by Khan *et al.* (2011) and Seyedhosseini *et al.* (2011) concerning suppliers and shop- floor workers perspectives. These questions were developed in order to determine whether BSC should be modified after lean implementation or lean companies may continue using existing traditional BSC without incorporating additional measures related to suppliers and shop-floor workers to evaluate their performance. Respondents were asked to indicate whether they regard that these measures are appropriate to measure the performance of their suppliers and shop-floor workers.

Six questions, adopted from Fullerton *et al.* (2013) and Marin-Garcia and Carneiro (2010), were used to measure visual performance measurement information. Seven questions were used to measure employee empowerment measures, which were adapted from Kennedy and Widener

(2008) and Fullerton *et al.* (2013). Standard operating rules and procedures were measured using four questions adapted from Rondeau *et al.* (2000). A measure of peer pressure was developed using four questions, adapted from Schultz *et al.* (1997).

Operational performance was measured using four proxy measures were used to assess operational performance: quality, delivery, flexibility and cost. However, financial performance was measured using three proxy measures adopted from Hofer *et al.* (2012), Losonci and Demeter (2013) and Fullerton *et al.* (2014). These proxy measures are: net sales, Return on Sales (ROS) and Return on Assets (ROA). These ratios are calculated using the data from the last published audited financial reports. The researcher used 2014/2015 annual reports of the respondents' organizations to measure these ratios (which is also the year in which the survey data were collected).

The study uses firm size as a control variable. Total assets extracted from respondents' annual reports are used to measure firm size. Table 2 summarizes the independent, the mediator, the dependent and the control variable.

4. Data analysis and discussion of results

4.1. *Reliability test*

As shown in table 2, results of reliability test reveal that Cranach's Alpha for the questionnaire as a whole is about 0.763, which is greater than the minimum acceptable level suggested by Hair *et al.* (2010), meaning that the questionnaire is reliable to a great extent. Cranach's Alpha of lean manufacturing, BSC, employee empowerment, SOP, peer pressure and operational performance is greater than 0.60 indicating that the questions are reliable to a high extent, whereas Cranach's Alpha of visual performance information is marginally below the minimum acceptable level of 0.60 suggested by Hair *et al.* (2010) but above the minimum of 0.50 suggested by Gliem and Gliem (2003), indicating that the questions are reliable to some extent.

	Variables	Proxy Measures	Cronbach's Alpha
Independent variables	Lean manufacturing (X)	- Standardization - Manufacturing cells - Kanban system - One-piece flow - Reduced lot sizes - Reduced buffer inventories - 5S - Kaizen.	0.668

Mediator variable	MACs (Z)	- BSC (Z1) - Employee empowerment (Z2) - Visual performance measurement information (Z3) - Standard operating rules and procedures (Z4) - Peer pressure (Z5)	0.731 0.843 0.506 0.826 0.746
Dependent variables	Operational performance (Y1)	- Quality - Delivery - Flexibility - Cost	0.816
	Financial performance (Y2)	- Net sales (Y21) - ROS (Y22) - ROA (Y23)	Objective
Control variable	Firm size (Z)	- Total assets	Objective

Table 2. Study variables and Cronbach's Alpha coefficients

4.2. *Structural equation model results*

SEM is used to test the hypotheses of the study and to determine whether the data sample support the hypotheses about the population or not. The five MACs are tested as a package in the structural model in order to test the first hypothesis. Figure 1 displays the paths of the initial aggregated model. As shown in table 3, the overall structural model demonstrates no good fit with the sample data. X^2/df = 0.23, RMSEA = 0.0001, CFI = 1.000, GFI = 0.992, All the model fit indices meet the criteria in the strictest sense.

Over Fit Measures (Full model):	
Absolute Fit Measures:	χ2 = 2.31, DF =10, P =0.993, χ2 /df = 0.23 GFI =0.992, AGFI =0.976, RMSEA =0.0001
Incremental Fit Measures:	IFI =1,047, TLI =1.105, CFI =1.000
Parsimonious Fit Measures:	PCFI =0.476, PNFI =0.470, PGFI =0.354

Table 3, Indices of the initial model

The regression weights show that some paths coefficients are significant at P-value >0.20 significant level, other paths coefficients of the model are statistically insignificant as shown in figure 1.

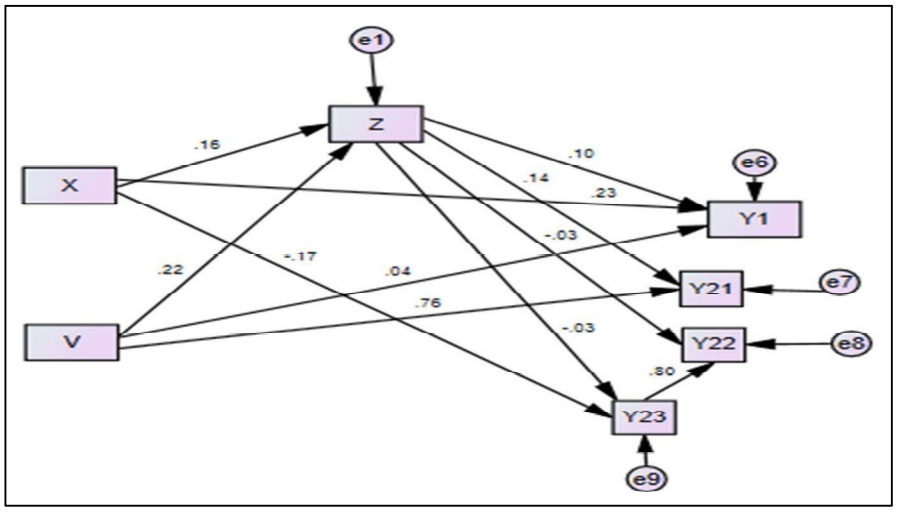

Figure (1): Paths of the initial model

It is clear that the initial aggregated model is not the best solution or the best model. Therefore, the initial aggregated model needs to be improved to better fit the sample data. After several trials to improve the accuracy of research findings, the decision was taken to remove the paths with p- value > 0.1; the structural model will be revised in figure 2 and table 4.

Over Fit Measures (Full model):	
Absolute Fit Measures:	$\chi 2$ = 1.59, DF =5, P =0.903, $\chi 2$/df = 0.32 GFI =0.992, AGFI =0.976, RMSEA =0.0001
Incremental Fit Measures:	IFI =1,040, TLI =1.085, CFI =1.000
Parsimonious Fit Measures:	PCFI =0.500, PNFI =0.491, PGFI =0.331

Table 4. Indices of the final model

Before assessing the path coefficients, the structural model fit is evaluated. As shown in table 5, the goodness of-fit statistics generally indicate a good fit to the data. Although the X^2 is significant, the X^2 /df ratio is less than two, indicating an acceptable fit (Kline, 2015). Each of the remaining model fit indices shown in Table 5 (IFI, TLI, and CFI) exceed the acceptable fit level of 0.90, and the RMSEA is considerably lower than the acceptable fit measure of 0.08 (Cheung and Rensvold, 2002). Further, indicators for the GFI show that the researcher may accept the model shown in figure 2 as a final research model. Figure 2 shows paths and testing of the final aggregated model. It is clear that all paths are significant at P-Value < 0.15, and then the confidence interval is 85%.

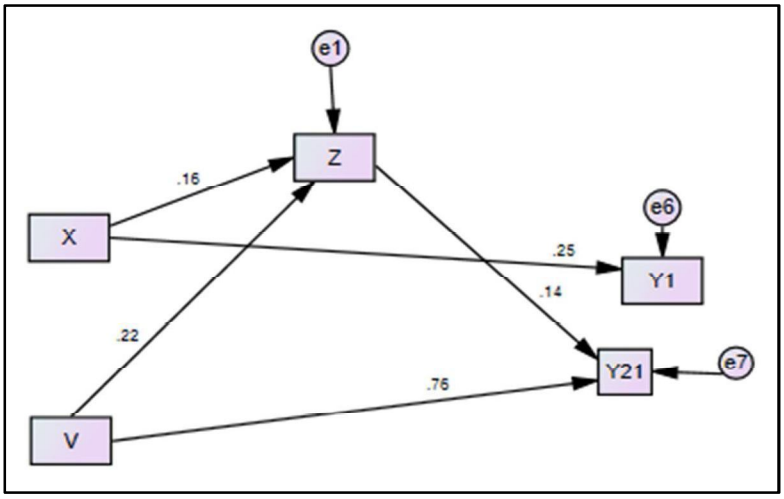

Figure (2): Paths of the final model

From paths and testing of the initial and final aggregated models, the results showed that lean manufacturing strategy significantly affect MACs (P-Value = 0.15). It can be concluded that the selected package of MACs should be aligned with lean manufacturing strategy. Hence, the first hypothesis is accepted. This result is consistent with Kennedy and Widener (2008) and Fullerton *et al.* (2013).

SEM found that lean manufacturing strategy positively affect financial performance (measured by ROA) (p- value<0.05). Therefore, the third hypothesis is accepted. This is consistent with the findings of Fullerton and Wempe (2009), Harris and Cassidy (2013), and Nawanir *et al.* (2016).

The study also found that lean manufacturing strategy significantly affects financial performance (measured by net sales) indirectly through MACs (P-Value < 0.05). It can be concluded that lean manufacturing strategy affects financial performance indirectly through aligning MACs with lean strategy. Therefore, the second sub-hypothesis of the fourth main hypothesis is accepted.

However, the results reveal that lean manufacturing affect operational performance directly only and there is no mediation role for MACs in this relationship. This result is consistent with most of previous studies. Shah and Ward (2003), Watson, Jr. (2006), Chavez *et al.* (2013), Fullerton *et al.* (2014), Khanchanapong *et al.* (2014), and Netland *et al.* (2015) found that lean manufacturing implementation leads to improving quality, time, flexibility, and cost. This result supports the second hypothesis that lean manufacturing directly affect operational performance. However, the first sub-hypothesis of the fourth main hypothesis is rejected as the study failed to find a mediator role for the MACs in the relationship between lean manufacturing and operational performance.

5. Conclusions, limitations and directions for future research

This research provides some of the first empirical evidence of the use of MACs in a lean manufacturing organization, and how the alignment of MACs with lean manufacturing strategy could affect organizational performance of Egyptian companies.

The results of this study revealed that, in testing the effect of lean manufacturing on the five MACs as a package, lean manufacturing should be aligned with the MACs. After implementing lean strategy, the study found that the five MACs, all together, should be aligned with the new manufacturing strategy. BSC should include an additional perspective related to evaluating suppliers' performance; performance measurement information should be visual so that workers could instantly identify their production needs and problems, and process the visual information more easily.

Other components of the MACs package are employee empowerment, SOP and peer pressure. Employees should be empowered so that they have the authority of effectively participating in quick and timely decision-making. SOPs are needed to ensure stable flow of similar products. Moreover, peer pressure should be exerted on shop-floor workers through encouraging them to give their best efforts on performing their works, to maintain high standards of performance, and to develop close and cooperative working relationships.

The study also found that lean manufacturing strategy significantly affects financial performance directly and indirectly through aligning MACs with lean strategy. The study found that lean companies have high net sales compared with non- lean companies. Moreover, it was found that the alignment of MACs with lean manufacturing strategy leads to improvements in financial performance of Egyptian manufacturing companies.

However, the results reveal that lean manufacturing affect operational performance directly only and there is no mediation role for MACs in this relationship. The study found that lean manufacturing strategy directly helps in improving the operational performance of the organization through improving product quality, reducing production lead time, improving on-time delivery, reducing production cycle time, maximizing capacity utilization, reducing production cost, and reducing inventory.

The results of this study are subject to a number of potential limitations; (i) the survey data were collected from one respondent in each firm, the majority of which were working as production managers. Although such respondents are likely to be more knowledgeable about the requested data in their firm, their positions may have led to common method bias, and (ii) the study is limited to listed manufacturing companies. Despite these potential limitations, this study presents a step further in our understanding of production systems in Egyptian context and will help managers to adapt their MACs to fit their needs according to their production system and therefore, improve their performance.

There is a need for further research to (i) investigate differences between the private and public sector of Egyptian firms in terms of the production system that influence their MACs, and (ii) test the impact of lean manufacturing

strategy on organizational performance using longitudinal analysis.

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