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Enterprise resource planning system integration and its effects on relationship between lean practices and organisational performances: A conceptual framework

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Abstract

In the competitive business, world manufacturers are under pressure, and they want to be more efficient in wastage reduction while fulfilling customers' demand. Thus, with the aim of better performance, in this emerging situation, manufacturers are adopting multi-approaches even though systems are contradicting each other, like lean practices and Enterprise Resources Planning system. This study deliberates whether Enterprise Resources Planning system fits within a lean manufacturing environment. This study also develops a conceptual framework which can facilitate to investigate the role of Enterprise Resources Planning system integration on business performances within a lean manufacturing environment. The framework also shows that Enterprise Resources Planning system play are interactional roles on the relationship between lean practices and business performances, indicating the moderating effects of Enterprise Resources Planning system on their relations. This study also discusses the theoretical and managerial implications of the proposed framework. Finally, this study deliberates how the conceptual framework can be extended into empirical research.

Keywords: ERP; Lean Manufacturing; Performances; Moderation

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1. Introduction

In the competitive business, world manufacturers are under pressure. They want to be more efficient in terms of wastage reduction at the same time satisfying customers' demand. However, these two are not only the reason in competitions and struggles, but also the innovativeness of the technology has been creating more struggles. Therefore, manufacturers are concerned about what approach will serve to give better in competition and to become an industry leader. So, the question arises that whether lean practices are adequate for manufacturers? The answer seems is yes, because of its widely acceptances (Belekoukias et al., 2014). The fact is that lean production enables to improve the manufacturing process with the application of it to techniques and practices (Powell et al., 2013a). However, another question ascends that whether lean practices alone able to maximize profits for manufacturers or another system can be accommodated within a lean environment (Powell and Strandhagen, 2011)? Regarding this question, the arguments are given that ERP could be implemented within a lean environment (Dora et. al, 2016; Powell et al., 2013b). Even though both systems have been the opposite of each other, but the main objective of both are making effective and efficient operations with meeting all existing demand as well as be prepared for subsequent operations.

In additions, lean and ERP has been considered as contradictory to each other. "The simultaneous implementation of both ERP and lean has been called a paradox" (Powell and Strandhagen, 2011). The paradox arises from the their individual focuses. For example, ERP planning module emphasizes on fixed lead times, lot sizes and needs for buffer inventory; while, lean concentrates on elimination of lead time, one-piece flow, and just-in-time supply. However, Miller (2002), assert that both ERP and lean coexist in the manufacturing and production. Thus, Powell et al. (2013a) conclude that "modern ERP systems can support lean implementation, and even make its implementation better". Powell and Strandhagen (2011) also suggest that integrating ERP systems within the lean paradigm can provide better performance through creating synergy. Similarly, Riezebos et al. (2009) proclaim that lean environment and performance can make more efficient by adopted tailored modern IT system. HassabElnaby et al. (2012) claim that impact of ERP implementation has positive effects on business performance and business process. Seppala (2004) asserts that companies started adopting the innovative organizational approach and technological environment in order to boost their competitiveness. However, so far, many companies consistently implemented both ERP and Lean practices together for competing in the local market as well as the global market (Carroll, 2007; Powell et al., 2013b).

The existing literature exposes that many researchers and practitioners suggested that ERP can be used in the lean environment and manufacturing industry (Laframboise and Reyes, 2005; Yang et al., 2017). Also, some suggested that how to be implemented (Chakravorty, et. al 2016; Powell et. al, 2013b). However, none of the extant studies have discussed about how the ERP implementation is going to affects business performances with the lean environment. Thus, identifying the knowledge gap in the literature, this study develops a conceptual framework to examine the impacts of ERP system implementation on business performance within a lean environment. Hence, this study bridges the the knowledge gap in the literature, and facilitates to investigate mediating and moderating effects of ERP on the relationship between lean practices and business performance. Hence, the framework will provide a platform to researchers and

practionare answer: what extent implementation of ERP will moderate the relationship between lean practices and business performance in the large lean-manufactures context?

The remaining paper is organized in the following manners. The second section discusses literature support and propositions of the study. The third section presents a conceptual framework of the study. The following section describes the theoretical and managerial implications along with a brief on potential research approach and empirical method to be adopted for future research. The final section provides concluding remarks with future research directions.

2. Literature support and propositions development

2.1. Lean manufacturing and practices

Lean manufacturing was first identified in Japan, the idea of lean modeled by Toyota Motor Company, it is named as Toyota Production System (TPS) (Bhamu and Sangwan, 2014). Lean manufacturing follows principles and working processes of the Toyota production system, which focuses on doing more with less (Tillema et al., 2015). Simply, lean production can be defined as the elimination of waste (Liker, 2004). LM is a multi-dimensional approach that consists of production with least amount of waste (JIT), continuous and uninterrupted flow (Cellular Layout), well-maintained equipment (TPM), well established quality system (TQM), and well-trained and empowered workforce (HRM) that has positive impact on operations and competitive performance (quality, cost, fast response, and flexibility) (Alves et al., 2012).

According to Shah and Ward (2007), Lean is a management philosophy focussed on identifying and eliminating waste throughout a product's entire value stream, extending not only within the organization but also along its entire supply chain network. Furthermore, it is claimed that LM is proven as a model where the persons assume a role of thinkers and their involvement promotes the continuous improvement and gives companies the agility they need to face the market demands and environmental changes of today and tomorrow (Taj and Morosan, 2011). Shah and Ward (2003) document and highlight 22 lean implementation elements which are classified into four bundles (categories) such as just in time (JIT), total productive maintenance (TPM), total quality management (TQM), and human resource management (HRM). A review paper of Bhamu and Sangwan (2014) evidence that many LM tools and practices consisting of JIT, TQM, 5S, Kanban, Kaizen, Continuous Improvement, Cellular Management, TPM, VSM, Visual Control, Poke Yoke, Automation, Simulation, and Production Smoothing.

2.2. Enterprise Resource Planning System (ERP)

ERP system originated from material requirements planning (MRP) systems, which were established in the 1970s with a concentration purely on materials planning, inventory accounting, and purchasing. In the 1980s, the three separate key modules – MRP, MPS, and CRP – were combined and coined as manufacturing resource planning (MRPII). In the 1990s, other functions were also added to this package, including product

design, warehousing, human resources, and accounting that was the formal initiation of ERP (Powell and Strandhagen, 2011).

Miller (2002) defines ERP is a method for the effective planning and controlling of all the resources needed to take, make, ship and account for customer orders in manufacturing, distribution, or service company. An Enterprise Resource Planning System is an integrated information technology, which employs the system concept (Li et al., 2008). In other words, ERP systems are commercial software packages that promise seamless integration of all information flowing through a company – financial, human resources, supply chain, and customer information. ERP systems have been implementing to integrate business processes and support managerial decision making (Powell, 2013)

2.3. Lean manufacturing and performance

The objective of LM is intended to be highly responsive to customer demand by reducing waste (Fullerton and Wempe, 2009; Upadhye et al., 2016). LM aims to produce products and services at the possible lowest cost and deliver within requisite time asked by the client (Dennis, 2016). These two objectives of LM contribute to better performances in several ways. Firstly, producing at lower cost leads to make higher sales margin. Then, meeting customers demand fastest with the satisfactory level lead to bring more potentials customer, which is also an ultimate factor in sales or revenue improvement. Thirdly, having LM system also creates competitive advantages over peer companies within an industry. So, having the competitive advantage of dominating other peers and that bring business to the company.

Empirically, Fullerton et al. (2003) find a positive relationship between company profitability and the degree of implementation of waste reduction practices. They also find a significant association between JIT and financial performance. Shah and Ward (2003) observe many companies are used lean tools like TQM, 5S, JIT, etc., and observed significant improvements in lead time, delivery cycles, productivity and quality levels, rejection rates, and customer satisfaction. Demeter and Matyusz (2011) find that lean practice has a significant impact on high inventory turnover. Panizzolo et al. (2012) discover the LM penetration in the Indian SMEs and found that lean implementation strategy drives significant improvement in manufacturing performance. Thus, this study proposes the following

- Proposition 1: LM will have a positive relationship with firm's performance (financial and nonfinancial).

2.4. ERP implementation and performance

In the emerging business environment, firms need to adopt a new system to compete with competitors, where firms need to redefine integrated process and activities with market changes and new ICT continuous basis (Hong et al., 2010). Thus, when a firm is going to implement ERP, it needs to adapt, reconfigure, and integrate its information flow and business processes on a continuing basis, because markets have been changing rapidly and innovative technologies have been innovating consistently (HassabElnaby et al., 2012). Therefore, a successful ERP implementation encompasses redesigning business processes from an inflexible,

mass-transaction orientation to an agile, lean and others (Tsai et al., 2010). ERP implementation helps to increase the accuracy and the speed regarding information delivery. Accuracy and speed are required conditions that information should be relevant and timely access.

The main concerns of implementing ERP are to improve the firm performance through redesigned business processes, integrated managerial functions, accelerated reporting cycles and expand informational capacity (HassabElnaby, et al., 2012; Wier, et al., 2007). Hayes et al. (2001) suggest that firm may achieve significantly higher stock returns upon announcing the implementation of an ERP system. Hunton et al. (2003) conclude that ERP adopters relatively have greater long-term return-on-assets (ROA) than Non-ERP adopters. Another finds that positive and significant relationship between ERP adoption and non-financial performance, which has a positive impact on both current and long-term ROA and stock return (Wier et al., 2007). HassabEnlaby et al. (2012) report that ERP implementation contributes to the achievement of organizational through building capabilities and increasing financial performances. Thus, this study can posit that-

- Proposition 2: ERP implementation will have a positive relationship with firms' performance (financial and nonfinancial)

2.5. ERP System in lean manufacturing

It has been argued that ERP can be implemented in lean manufacturing. ERP systems have been implementing to integrate business processes in order to support the managerial decision. The integration goal seems fitting the comprehensive approach into the lean manufacturing environment. Powell (2013) presents a framework for implementing ERP system alongside LM practices within lean environments.

LM and ERP systems as enablers of competitive advantage (Powell and Strandhagen, 2011). ERP systems are among most widely accepted choices for manufacturing companies for gaining competitive advantage (Zhang et al., 2005). In the LM perspective, Matsui (2007) explains that the contribution of JIT systems to improve competitive performance. He also suggests that MRP systems and accounting practices (ERP) should be adapted to JIT production systems. Others suggest that right implement of the system provide competitive capabilities to manufacture, MRP II as an example of such technology in JIT production (Swamidass and Winch, 2002). It is also highlighted that the benefits of technology usage include increased return-on-investment, market share, and reductions in manufacturing cost as well as reductions in cycle time (Swamidass and Winch, 2002).

In the support perspective, ERP systems facilities lean manufacturer, mainly, when demand is high for low volume products (Steger-Jensen, 2008). Besides, De-Menezes et al. (2010) list some lean practices those are integrated with computer-based technology. With the list of lean practices, De-Menezes et al. (2010) suggest that ERP is capable to support production in a lean environment. Furthermore, Information Technology is curial for linking with the global market, particularly work with supply chain which will improve the relationship. IT system may be spot-on support for LM as lean paradigm expands to take a supply chain approach (Gunasekaran and Ngai, 2004). The fact is that ERP system helps to increase the speed and quality of management decision. Additionally, the enterprise systems support lean manufacturing through

facilitating streamline work-flow-order which increase productivity, reduce costs, and improve decision, it is being said ERP is an enabler of lean production. Tajhono (2009) shows an alternative method of information system approach, which is by investigating the extent to which visual or multimedia based. This information system has developed for shop-floor works to increase efficiency and productivity of manufacturing operations. This type system can integrate within an ERP system and can be used as training tools and task support tool or memory, in LM such as visualization and standardization. In this context, Parry and Turner (2006) also demonstrate a novel visual solution for communicating production schedules from the ERP system to the shop-floor production cells.

In the perspective of value and information, value, and information both are an integral part of LM and ERP. Shingo (1981) find excess inventory is one of the seven pitfalls in the TPS. On this issue, Chen and Paulraj (2004) suggest that the goal of ERP systems is to replace inventory with perfect information. Information sharing also enhances effective supply chain practice. Furthermore, Zhou and Benton Jr (2007) hypothesize that effective JIT production and supply chain practices have a positive impact on delivery performance and suggest that increased investment in information sharing support technology improves delivery performance.

Supply chain and other system integration perspective, Schonberger (2007) state that supplier partnership is a basic element of the TPS. Kisperska-Moron and de Haan (2011) recommend that when a company desires to be lean, it need to communicate with its supply chain partners on a continuous basis, and the sequencing for producing products on a JIT basis where timely and adequate information sharing among partners is required. Kinder (2003) shows links between JIT and SCM, where IT is main enabler factor in the direction of integration. Thus, SC integration is most important benefits of ERP in LM. ERP is a driver for more efficient internal and external supply chain operations. Botta-Genoulaz and Millet (2005) state that a key role of ERP is to serve as a platform for other applications, such as CRM and SRM. Mefford (2009) advocates that while improvements in ERP systems have contributed to tracking materials across entire supply chains by enabling the companies to integrate their purchasing, production scheduling, inventory, logistics, product design functions, and other technologies such as barcodes and RFID.

Pull vs. Push production perspective; many believe that "push" MRP/ERP system processes do not support the "pull" of the lean physical process flow (Carroll, 2007). However, in some cases, ERP can pull production system. For instance, Kaban is one of the pull production approaches, Bragg (2004) has shown that promotional peaks, seasonal demand, long lead-time supplies, and highly customized orders could lead to difficulties in the Kanban environment (as cited in Halgeri et al. (2010). Lage-Junior and Filho (2010) suggest that IT (ERP) system (e-kanban) will track changes and inventory lead time and supplier relationship also reduce paperwork. They also suggest e-kanban can reduce human error, track production, and performance measurement. Therefore, the study pustules that-

- Proposition 3: ERP system will fit within LM environment.
- Propositions 4: Lean practices and ERP systems will have a positive correlation.

The literature discussion exposes ERP systems fit within LM environment that leads to manufacturers have better performance. It is also exposed that both systems interact with each other. For example, ERP

induces smoothness in manufacturing process allowing customers or clients to order as well as suppliers to update information on raw materials. Also, ERP also helps LM firm by showing demand for products. Furthermore, the presence of ERP allows management to make decisions faster than conventional ways. Moreover, ERP system (e-kanban) track changes and inventory lead time and supplier relationship also reduce paperwork, human error, track production and performance measurement. Even some studies support that ERP implements improve manufacturing industry's performances (Iris and Cebeci, 2014; Yang et al., 2017). Thus, this study believes that the interactional effects on performances could enhance the relationship between LP and firms' performances. Hence, this study proposes the following:

- Proposition 5: ERP system will moderate relationship between LP and performance (financial and non-financial)
- Proposition 6: ERP system will partially mediate relationship between LP and Performance (financial and non-financial)

3. Conceptual framework

Grounded on the literature support and proposition discussions, this study develops a conceptual framework that can facilitate future research for investigating effects of ERP systems on the relationship between the lean practices and performances. The conceptual framework is presented below with figure-1.

The study considers three latent variables in framework namely ERP systems, lean Practices, and performances. The LM practices include standardization, manufacturing cells, reduced setup time, Kanban system, JIT, 5S, Kaizen, Continuous Improvement, Cellular Management, TQM, production smoothing, etc. (Bhamu and Sangwan, 2014; Fullerton, 2003; Matsui, 2007; Shah and Ward, 2003). ERP system includes purchasing (PR), bill-of-material (BOM), production management and scheduling (PM), inventory management (IM), sales (SL), customer relationship management (CRM), finance (FN), Accounting (AC), master planning (PL), quality management (QR), human resource management (HR), budgeting (BT), data automation (DA), maintenance management (MM). Performances variables include measures of Shah and Ward (2003) for operation performances (e.g. self-assessed improvements of scrap and rework, set-up times, queue times, machine downtime, lot sizes, and cycle time over a three-year period.) For measuring financial performance, this study considers four items including self-assessments of changes in net sales, ROA, profitability, and market share over a three-year period.

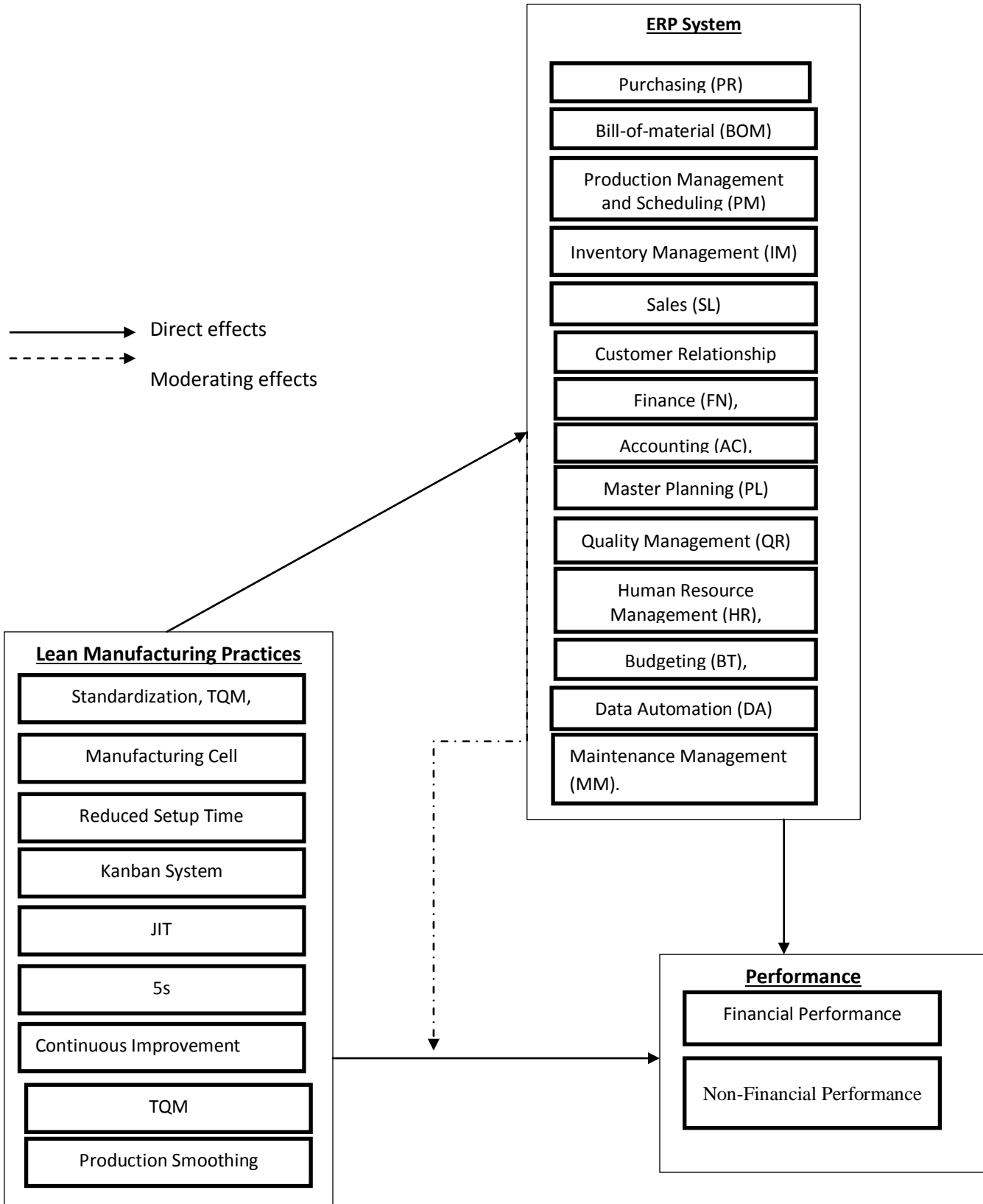


Figure 1. A Proposed Conceptual Framework

4. Discussion and insights

4.1. Theoretical insights

Past studies in this area have not given attention in light of the moderating and mediating role of ERP within the lean environment. Therefore, by detecting this research and literature gap, this paper introduces ERP system the relationship between lean practices and business performances within lean environments. The effects of ERP considered from two perspectives such as moderating and mediating. These contents facilitate to develop a conceptual framework for investigating ERP systems effects on the relationship between lean practices and performances. With best of knowledge within the study scope, this framework could be the initiation of the demonstration ERP system moderator and mediator between lean practices and performances. Thus, the study contributes to initiation to investigate ERP system integration effects on financial and non-financial performances within the different manufacturing environment. Henceforth, this study extends the literature for both ERP system and Lean manufacturing.

4.2. Managerial insights

Discussion in this paper serves several clues for managers of manufacturing industry that which ERP system will be effective within existing lean manufacturing approach. Thus, Manager can choose ERP system particularly according to their lean environment. However, with the comprehensive review, this study suggests that lean manufacturer should ERP system to create competitive advantages over competitors.

4.3. Potential Research Methods

To investigate this study empirically, the systematic sampling approach may be the best option. However, regarding data collection, researchers may find difficulties due to sensitive issues in the questionnaire. That is because the questionnaire may include some question which deals with financial and performance matters. To test the effects, researchers may consider Partial-Least-Square approach.

5. Conclusion and future direction

The technological innovations and customers demand always remain major concerns for manufacturers. Thus, their concern is that what approaches will help them regarding these issues and create the competitive advantage for them. Therefore, this paper suggests, likewise other contributors in this area, that ERP will fit within the lean manufacturing environment. But, at the same time, this paper develops a conceptual framework for showing the different role of ERP integration with the lean environment, especially it effects on the relationship between lean practices and performances. Thus, this study extends the literature by showing that ERP not only fit within LM but also demonstrate a conceptual framework which provides the

insights regarding the moderating role of ERP on the relationship between LP and performances. This framework facilitates a comprehensive knowledge for both academician and practitioner.

This study solely focused on ERP, lean practices and business performance. However, there are many variables such as decision-making style, manufacturing environment can be studied with this framework. Thus, this study drive future research direction that this framework can be conducted empirically in the future. This study also suggests to investigate the effects of decision-making style, manufacturing environment on business performance where both ERP and lean system has been adopted.

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