LEAN MANUFACTURING BASED CLOUD ENTERPRISE RESOURCE PLANNING FOR SME DIGITALIZATION

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ABSTRACT

The Covid-19 pandemic is a right time for SME to grab the benefit of digital transformation. The SME that involved in digitalization will be more ready to deal with challenges of the pandemic. In current situation (2020-2022), the pandemic became a barrier to the face-to face business operations, resulting in a significant decrease of sales. A survey conducted by the Indonesian Chamber of Commerce and Industry (KADIN) in May 2020 found that around 70% of businesses in Indonesia had experienced a decline in sales due to the pandemic. Many businesses and organizations have had to rapidly adapt their operations and processes to comply with changing regulations, keep their employees safe, and meet the needs of their customers or clients. In order to overcome this issue, there is a motivation to find a more effective way of the digitalization framework. The purpose of this research is to develop a new framework of cloud enterprise resource planning (CERP) that is more effective for improving sales through a better productivity and low cost. The new CERP integrates business process re-engineering and lean manufacturing is able to digitalize the process at a minimum cost. The development process of the framework involves forum group discussions with seven expert including manager, director, and consultant. This framework has been implemented for one year in nine cosmetic companies showing the improvement in productivity by 77% through eliminating thirty one necessary non value-added activities (NNVA) and non value-added activities (NVA). The cost comparison shows that the proposed CERP framework has a lowest cost ($1001) compared to existing CERP softwares in the global market.

ABSTRAK

Pandemik Covid-19 adalah masa yang sesuai untuk PKS meraih manfaat transformasi digital. PKS yang terlibat dalam pendigitalan akan lebih bersedia untuk menangani cabaran pandemik. Dalam situasi semasa (2020-2022), wabak menjadi penghalang kepada operasi perniagaan secara bersemuka, mengakibatkan penurunan jualan yang ketara. Tinjauan yang dijalankan oleh Dewan Perniagaan dan Industri Indonesia (KADIN) pada Mei 2020 mendapati kira-kira 70% perniagaan di Indonesia mengalami penurunan dalam jualan akibat wabak itu. Banyak perniagaan dan organisasi terpaksa menyesuaikan operasi dan proses mereka dengan pantas untuk mematuhi peraturan yang berubah-ubah, memastikan pekerja mereka selamat dan memenuhi keperluan pelanggan atau pelanggan mereka. Bagi mengatasi isu ini, wujud motivasi untuk mencari cara rangka kerja pendigitalan yang lebih berkesan. Tujuan penyelidikan ini adalah untuk membangunkan rangka kerja baharu perancangan Cloud Enterprise Resource Planning (CERP) yang lebih berkesan untuk meningkatkan jualan melalui produktiviti yang lebih baik dan kos yang rendah. CERP baharu menyepadukan kejuruteraan semula proses perniagaan dan pembuatan tanpa lemak mampu mendigitalkan proses pada kos minimum. Proses pembangunan rangka kerja melibatkan perbincangan kumpulan forum dengan tujuh pakar termasuk pengurus, pengarah dan perunding. Rangka kerja ini telah dilaksanakan selama satu tahun di sembilan syarikat kosmetik yang menunjukkan peningkatan dalam produktiviti sebanyak 77% melalui penghapusan tiga puluh satu aktiviti tanpa nilai tambah (NNVA) dan aktiviti tanpa nilai tambah (NVA) yang diperlukan. Perbandingan kos menunjukkan bahawa rangka kerja CERP yang dicadangkan mempunyai kos terendah ($1001) berbanding perisian CERP sedia ada di pasaran global.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Research background

In supporting the improvement of Small Medium Enterprise (SME) in Indonesia, the Ministry of Communication and Information during the period 2022-2024, focus on empowering SME by increasing the adoption of digital technology 4.0 (Ministry of Communication and Information Technology, 2020). Indonesia's digital transformation is a key priority for the government as it seeks to achieve its ambitious economic and development goals. Digital transformation has the potential to drive economic growth by increasing productivity, efficiency, and innovation. By leveraging technology, businesses can expand their reach, create new products and services, and enhance their competitiveness in the global market. According to the Ministry of Communication and Information Technology (2020), there are over 64.2 million SME in Indonesia, accounting for over 97% of the country's total businesses. However, many of these SME still operate using traditional methods and have yet to fully embrace digital technology.

The Coronavirus disease-19 (COVID-19) pandemic has had a significant impact on SME in Indonesia, as it has in many other countries. The pandemic has accelerated the need for SME to adapt to digital transformation in order to survive and thrive in the current business environment. The survey conducted by the Indonesian

Institute of Sciences (2022), provides some insight into the impact of the pandemic on SME in Indonesia, according to the survey, the vast majority of SME experienced a decline in sales due to the pandemic, with ultra-micro businesses being the hardest hit. In order to survive, SME needs to make various adjustments, including digital transformation. Several other studies and reports have also highlighted the importance of digital transformation for SME in Indonesia, both in the context of the pandemic and more broadly. For example, a report by the World Bank (2020), notes that SME in Indonesia that use digital technology tend to have higher productivity and profitability than those that do not. Similarly, a study by the Asia Foundation (2020), found that SME in Indonesia that adopt digital technology are more likely to grow and create jobs.

The cloud enterprise resource planning (CERP) system is one of the digital mediums that can support SME during a pandemic. This system can integrate data across departments, allowing for a more effective and efficient business process. This is particularly important in the current business environment, which is increasingly competitive and globalized. Several studies have highlighted the benefits of CERP systems for SME. For example, Sakas et al. (2014), found that implementing a CERP system can lead to increased efficiency, productivity, and profitability for SME. Similarly, Marinagi et al. (2014), noted that CERP systems can improve business performance by providing real-time access to data, streamlining business processes, and reducing costs. In addition to these benefits, CERP systems can also help SME to adapt to the changing business environment caused by the COVID-19 pandemic. For example, a CERP system can allow for remote work and collaboration, which is especially important during a period of social distancing and lockdowns. CERP can be a critical strategic tool for SME during a crisis, and can help to improve efficiency, productivity, and profitability in a competitive and globalized economy. CERP systems have been shown to significantly improve various aspects of business operations, including financial transparency, marketing and customer service, supply chain and operations management, and human resource management. By integrating all resources and information on a single platform, CERP systems can provide SME owners with a comprehensive view of their business, allowing for more informed decision-making. Research has shown that CERP systems can improve financial transparency by providing real-time access to financial data, allowing SME owners to

monitor cash flows, revenue, and expenses more effectively (Dekoulou & Trivellas, 2014). CERP systems can also improve marketing and customer service by providing a centralized database of customer information, enabling SME owners to personalize customer experiences and target marketing campaigns more effectively. In addition, enterprise resource planning systems can enhance supply chain and operations management by enabling SME owners to monitor inventory levels, track orders, and manage production more effectively (Trivellas & Santouridis, 2013). Finally, enterprise resource planning systems can improve human resource management by streamlining recruitment and onboarding processes, tracking employee performance, and managing payroll more efficiently (Dekoulou & Trivellas, 2014).

Based on Abdinnour et al. (2003), the enterprise resource planning (ERP) implementation costs can be prohibitive, especially for SME. In addition to the initial investment in software and hardware, there are often additional costs associated with implementation, such as training and hiring new personnel. ERP can be a complex and time-consuming process, requiring significant planning and resources. It often involves multiple phases, including system selection, design and configuration, data migration, and training and user adoption. These activities can require significant time and resources from both the vendor and the SME, which can drive up costs. Cloud-based enterprise resource planning solutions typically require less investment in hardware and IT infrastructure, and may offer more flexible pricing models that can be more affordable for SME. In addition, cloud-based enterprise resource planning solutions can often be implemented more quickly and with less disruption to business operations than on-premises solutions. According to Al-Johani and Youssef (2013), research, enterprise resource planning solutions are prohibitively expensive. A medium-sized organization will cost around $300 million US dollars. According to a report by the Indonesian Ministry of Cooperatives and SME (2021), published in August 2021, 80.8% of SME in Indonesia experienced a decline in sales during the pandemic, while only 5.9% experienced positive growth). As a result, it may have an impact on the government's target of Go-digital SME by 2024. As an alternative solution to this problem, it is necessary to develop an CERP implementation framework that is productive and low cost.

Business process re-engineering (BPR) can assist in transforming traditional business processes into digital ones, but it may not be sufficient to solve the issue of

high implementation costs for SME. Therefore, the development of an effective and cost-efficient cloud enterprise resource planning scheme is crucial. To reduce the cost of the development system, the statement suggests adopting a Business Process Re-engineering approach based on Lean Manufacturing. Lean's approach emphasizes the elimination of waste, which can play a vital role in saving resources and improving productivity in SME. By adopting Lean's principles, SME can develop an efficient and cost-effective enterprise resource planning system. The statement also suggests the need for investigating better schemes to improve the effectiveness, efficiency, and affordability of cloud-based enterprise resource planning systems. This research can help SME to adopt the latest technological advancements and streamline their business processes. The importance of BPR and Lean Manufacturing principles in developing cost-effective and efficient enterprise resource planning systems for SME. It also highlights the need for further research to improve the effectiveness and affordability of cloud-based ERP systems. Figure 1.1 shows the results of the causal loop diagram of the research.

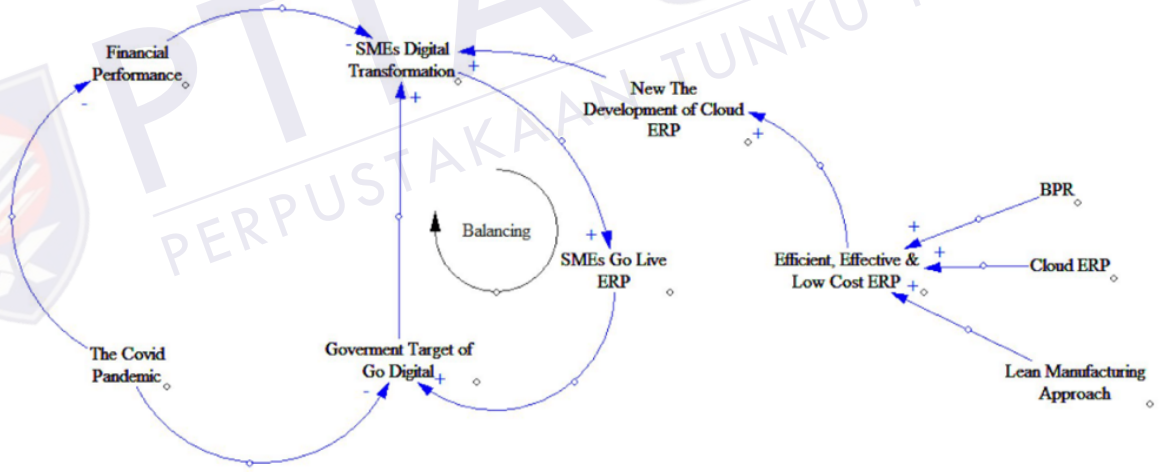

Figure 1.1 Causal Loop Diagram

1.2 Problem statement

The development of CERP has been investigated by previous research (Light, 2001; Rebstock, Seligh, ,2000; Beric et al., 2020; Wang et al., 2014; Shiau et al., 2009; He et al., 2009; Huang et al., 2006). Previous researchers have developed CERP such

as based maintenance implication (Light, 2001), Applying the value/Petri process (Huang et al., 2006), Component library-based (He et al., 2009), Measures Assess (Shiau et al., 2009), Time and cost-based (Wang et al., 2014), Manufacturing Execution System (Beric et al., 2020), standard business process (Rebstock and Seligh, 2000). This previous work has developed a CERP maintenance implication, applying the value/Petri process, component library based, Masure assess, time and cost-based, manufacturing execution system and standard business process. Meanwhile, the integration between business process re-engineering and lean manufacturing approach is not included in the existing development CERP. The research gap is in business process re-engineering (BPR) for CERP development based on lean manufacturing approach. The new scheme, which is based on a radical redesign of core business processes based on a lean manufacturing approach, has the potential to achieve productivity and low cost.

The development of CERP is essential in supporting the progress of Small and Medium Enterprises (SME), as it can increase productivity and provide sustainable flexibility. By simplifying and describing business processes such as finance, human resources, procurement, distribution, and other departments within the company, CERP can make it easier for workers to operate and manage their tasks efficiently. Even with CERP, it can be integrated with E-Commerce to make buying and selling goods easier. The Development of CERP is challenging by doing BPR based on the Lean manufacturing approach. The development of CERP by simply digitizing it radically using BPR is not enough. With most CERP solutions, there are some costs involved, leading to higher prices from licenses to upfront fees, implementation, and potential recurring monthly fees. Radical changes to digitization without paying attention to waste in business processes increases the number of users and modules that may still be possible to do conventionally. This can increase costs during the implementation and development process.

Implementing an CERP system can be an expensive endeavor for many businesses. According to a report by Panorama Consulting Solutions (2018), the average cost of an ERP implementation project is approximately $7.1 million. However, costs can vary significantly depending on the size of the organization, the complexity of the system, and the scope of the project. According to a survey conducted by SelectHub (2019), 58% of respondents reported that cost was the biggest

factor in their decision to implement an CERP system. A study by the Aberdeen Group (2012), found that companies that implemented CERP systems spent an average of 2.2 times more on implementation costs than they did on the software itself. In addition to implementation costs, businesses also need to consider ongoing costs such as maintenance, upgrades, and training. According to a report by Panorama Consulting Solutions (2018), ongoing costs can account for up to 20% of the total cost of an CERP system over a five-year period.

The two pillars of Lean manufacturing theory and its focus on reducing waste to increase the value of a product. Lean concepts have proven to be very effective in the Japanese manufacturing industry and have been adopted by many companies worldwide. In today's competitive world, providing high-quality, large-quantity goods at the lowest possible cost is essential for the success of any company or industry. This is where Lean manufacturing comes into play as a tool for achieving this goal. However, the development and implementation of an expensive CERP system can be a hindrance to achieving the government's goal of going digital in 2024. To overcome this limitation, it is essential to investigate and develop a lean based CERP system that is both productive and cost-effective. By adopting a Lean approach to CERP development, businesses can identify and eliminate waste in their processes, leading to more efficient and cost-effective operations. A waste-based CERP can help businesses achieve their digital goals while also improving productivity and reducing costs. By streamlining business processes and optimizing workflows, businesses can save time and resources, leading to increased profitability and growth. Adopting Lean manufacturing principles in the development of a waste-based CERP system can help businesses achieve their digital goals while also improving productivity and reducing costs. This can be a significant competitive advantage for businesses in today's fast-paced and competitive market.

1.3 Research Objectives

The objectives of this research are as follows:

i. To design a new scheme for the development of CERP with new features of design solutions based on lean manufacturing

ii. To improve the performance of the scheme towards improving productivity and low cost of CERP that could be implemented in SME.
iii. To validate the effectiveness of the scheme.

1.4 Research scopes

The scope of this research are as follows:

i. Lean maufacturing tools is focused on Waste Assesment Model (WAM), Value Stream Analysis (VALSAT), Process Activity Mapping (PAM), Root Cause Analysis (RCA),Value Stream Mapping (VSM).
ii. The manufactures studied are study case in SME Cosmetic Company.
iii. Limitation of development new cloud enterprise resource planning in term of design process, and performance evaluation.

1.5 Significance of the study

This thesis contributes some benefits in several sector such as goverment, industry and society. The new scheme achieves the government's target of 64.2 million Go Digital SME by 2024. This effort is motivated by the massive potential of Indonesia's digital economy. The government has targeted that by 2024, the number of SME owners who are members of the digital ecosystem can increase to 30 million through the National Program for the Proud of Made in Indonesia. Recommendations for improvement obtained from this research can be used as a SME guide in business process re-engineering for the development enterprise resource planning based on lean manufacturing approach. The positive impact of the digital era is that the information needed can be accessed faster and easier, and the growth of innovation in various fields oriented to digital technology facilitates the process in our work.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides a review of the existing research related to the subject of this thesis. This includes a general review of Business Process Re-engineering (BPR), cloud enterprise resource planning (CERP) and Lean manufacturing. Moreover, research works in a specific review of schemes. The need for CERP has led to extensive research. Issue in the development of the CERP and limitations of the existing CERP Development are reviewed. This chapter is organized as follows: Section 2.2 to 2.4 describe the fundamental concept of CERP, Business Process Re-engineering (BPR), and lean manufacturing, which is supported by an industrial example. Section 2.5 focuses on the designs of CERP, Business Process Re-engineering (BPR), and lean manufacturing. Section 2.6 discusses the limitations of the existing CERP. Finally, the summary of the review is outlined in Section 2.7.

2.2 Cloud Enterprise Resource Planning (CERP)

The application of digital technology for integration business process in management systems is one solution to meet the demands of an increasingly competitive market. According to Aulia et al (2019), Enterprise Resource Planning (ERP) is a system integrated into a company's business processes. If implemented

correctly, the implementation of ERP in an organization achieves multiple benefits, including increased productivity, enhanced insights, accelerated reporting, reduced risk, simplified IT, and enhanced agility. ERP utilizes the most advanced technologies, such as artificial intelligence and machine learning, to provide intelligence, visibility, and efficiency across every aspect of a business. It is even predicted that from the present to a certain point in the future, ERP will be able to operate in tandem with cloud systems, whether in high-tech Small Medium Enterprise (SME) or large corporations. Although there have been studies on data privacy and availability, as well as disagreements between high-tech SME owners of large corporations, the cloud's maintenance costs are lower than those of the traditional model (Grubisic, 2014). It is common knowledge that the cost of implementing ERP, including its licensing and maintenance fees, is relatively high; this has become a common issue for organizations' financial aspects (Klos and Krebs, 2008).

Financial, human resource, manufacturing, supply chain, services, and procurement processes, among others, are included in Enterprise Resource Planning (Lufti et al., 2022). ERP role is to integrate these processes into a single system. ERP systems are software applications used to manage a company's data. ERP integrates all necessary data from multiple integrated databases to ensure information integrity within an organization (Lufti et al., 2022). This ERP model was derived from the 4P (people, product, promotion and price). This model was widely used in the 1980s and 1990s, before it was modified to 4Ps: people, product, process, and performance to align with the existing ERP system (Marnewick and Labuschagne, 2005).

In addition, the conceptual components of ERP consist of four components implemented via a methodology: software, process flow, change management, and customer mindset, which are all integrated by ERP. ERP is therefore more than a simple software package. It is also noteworthy that the number of scientific publications on ERP continues to rise. However, the software's relationship with HR influences, strategy, organization, and culture was not always discussed (Klos and Krebs, 2008).

According to Hao and Helo (2014), a conceptual framework has been developed for identifying areas of research concern with regard to cloud ERP and the relationships among different themes, as shown in Figure 2.1.

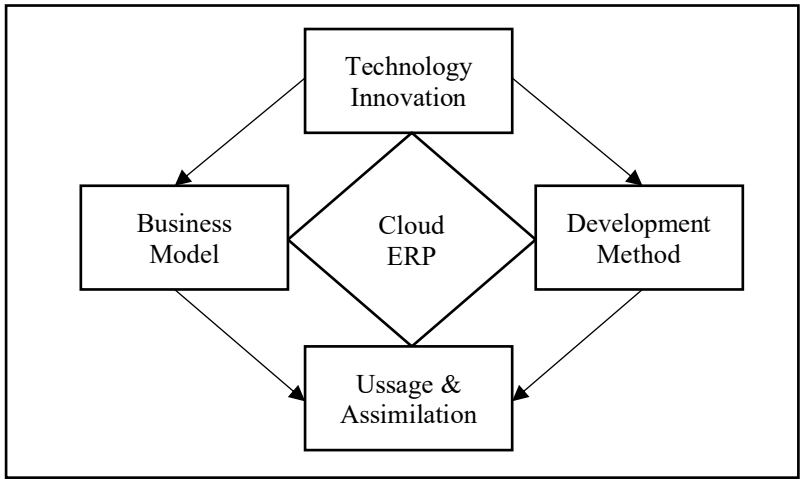

Figure 2.1 Cloud ERP Conceptual Framework (Hao and Helo, 2014)

This framework is defined in terms of four fundamental domains of cloud enterprise resource planning (CERP) research: Technology Innovation, Business Model, Development Method, and Usage & Integration. Each of these domains suggests distinct research directions and offers a theoretical basis for future research. This framework could also be used to identify research gaps and create research agendas to fill them. cloud enterprise resource planning (CERP) is Enterprise Resource Planning (ERP) software that is hosted on a cloud computing platform rather than on-premises in a company's data center. Cloud computing is defined as a new method similar to "cloud" that is more flexible in managing demand and gaining access to stored data resources with less effort than traditional methods (Demi and Haddara, 2018).

2.3 Business Process Re-engineering (BPR)

Business Process Re-engineering (BPR) is the radical redesign of processes to achieve substantial cost, quality, and service improvements (Hammer and Champy, 1993). Over the years, businesses have reengineered a variety of business functions, including strategic sourcing, order fulfillment, and customer relationship management. Business process re-engineering (BPR) projects involve significant modifications to existing business processes, which can cause instability and resistance to change within an organization. These changes may also require significant investment in terms of time, money, and resources. (Abdolvand et. al.,

2008). It is reasonable to anticipate that business process re-engineering projects will have a significant and quantifiable impact on the performance of the organization.

To comprehend business process re-engineering, we must first understand the individual meanings of process, business process, and re-engineering. In the introduction, the process and business process were defined. Nonetheless, the process should have a beginning and end point involving individuals from across organizational boundaries. In addition, clinical workflow and clinical process definition can be used interchangeably.

According to reports, the BPR concept emerged in the 1990s (Hammer,1990). BPR is a management strategy that rethinks current business practices, procedures, and their interactions. It seeks to improve the efficiency of the underlying process by applying fundamental and radical approaches, such as modifying or eliminating non-value-adding activities and redeveloping the process, structure, and culture (Patwardhan and Patwardhan, 2008). As an integrated and systematic approach, BPR improves the analysis and redesign of an organization's functions, workflows, and structure in order to increase service quality and reduce costs and time. Figure 2.2 depicts a conceptual model that explains the significant components of BPR. This model illustrates the relationship between organizational reorganization and behavioral changes facilitated by Information Technology for the reengineering of business processes and, consequently, the implementation of effective process delivery systems in order to increase customer satisfaction. BPR necessitates organizational restructuring (including the facility location, capacity, types of products, technology, and people) and changes in employee behavior (training, education, job enrichment, job enlargement, and employee empowerment) to accommodate and facilitate radical changes in order to achieve significant improvements in business performance. Information technology (IT) has the potential to greatly aid in reorganizing an organization and implementing radical changes. Many of the technologies you mentioned, such as the Internet, E-Commerce, material source planning (MRP), Multimedia, ERP, Word wide web (WWW), Electronic Data Interchange (EDI), and Electronic Funds Transfer (EFT), can be leveraged to streamline processes, improve communication, and enhance customer service. For example, implementing an Enterprise Resource Planning (ERP) system can integrate and automate various business processes, reducing the need for manual data entry and

increasing efficiency. BPR should prioritize issues such as training and education, employee empowerment, teamwork, and incentive programs (Gunasekaran and Kobu, 2002).

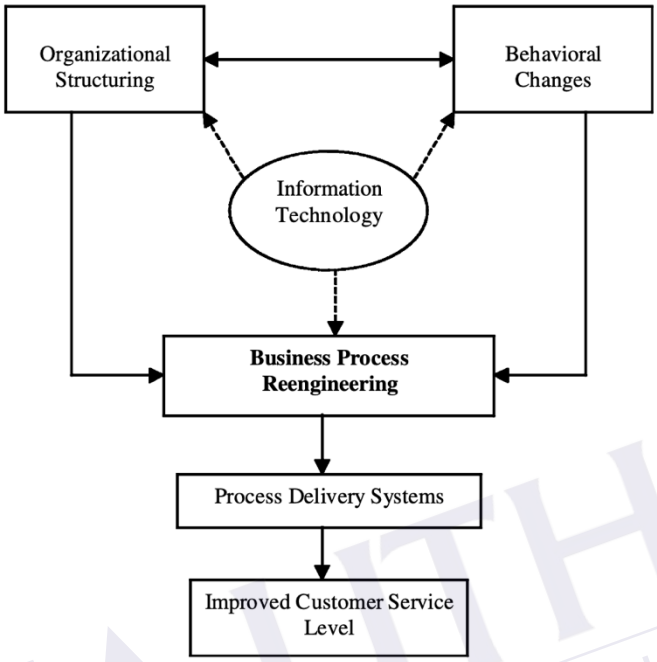

Figure 2.2 A Conceptual Model for BPR (Gunasekaran and kobu, 2002)

A business process is a collection of interdependent tasks to solve a particular problem, which can be subdivided into a number of subprocesses, each with its own characteristics, but interconnected so that each subprocess contributes to the achievement of the goals of the others (Gunasekaran and Kobu, 2002). The primary objective of Business Process Reengineering (BPR) is to reduce the minimum stage of the work process chain. There will be fewer delays between stages of the work process if several valueless stages of the work chain are eliminated en masse.

2.4 Lean Manufacturing

Lean manufacturing is an integrated socio-technical system comprising management practices to eliminate waste and reduce the variability of suppliers, customers, and internal resources and processes (Mostafa et al., 2013). The lean concept has been widely accepted in the service and manufacturing industries. Lean

Manufacturing is the optimal method for producing goods through waste elimination, cost reduction, and increasing human resources. According to Liker (2021), Lean Manufacturing is a process management philosophy from the Toyota Production System (TPS). It is famous for emphasizing eliminating the seven wastes to increase overall customer satisfaction. The Lean Manufacturing approach is carried out by improving quality through waste elimination for cost reduction, increasing production output, and reducing lead time. According to Gaspersz (2007), there are five basic principles of Lean, namely:

1. Identifying product value (goods or services) based on the customer perspective, where customers want superior quality products (goods or services) at competitive prices on timely delivery.
2. Identify the value stream process mapping (mapping the process on the value stream) for each product (goods or services).
3. Eliminate non-value-added waste from all activities throughout the value stream process.
4. Organizing so that materials, information, and products flow smoothly and efficiently throughout the value stream process using a pull system.
5. Continuously and continuously improve by looking for techniques to achieve excellence and continuous improvement.

Figure 2.3 illustrates in the context of the literature review; the house of lean represents an industrialized lean culture. In the first scenario, the focus is on applying specific tools to specific projects within the construction industry (Picchi and Granja, 2004). Lean is addressed through the logic of tasks whose execution has been fragmented. This means that lean approaches have primarily focused on improving project performance using tools and techniques such as flow, value, and buffers (Pavez and Alarcon, 2007).

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Due to the limited number of pages in the thesis devoted to UTHM regulations, the author will only provide a sample appendix in this section, namely appendix A Blueprint Sales, appendix E User Training Script Sales, and appendix I UAT Sales. For an appendix that is not show in this thesis, the reader may ask the author directly.