PHILOSOPHICAL TOOLS OF LEAN SIX SIGMA IN SERVICE SECTOR: IMPLICATIONS FOR ORGANISATIONAL LEARNING

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PHILOSOPHICAL TOOLS OF LEAN SIX SIGMA IN SERVICE SECTOR: IMPLICATIONS FOR ORGANISATIONAL LEARNING

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DECLARATION

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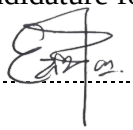
Signed  (EZRA TAN YI CHYN)

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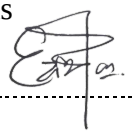
Signed  (EZRA TAN YI CHYN)

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LIST OF ABBREVIATIONS

ADDIE	Analyse, Design, Develop, Implement, and Evaluate
ADKAR	Awareness, Desire, Knowledge, Ability and Reinforcement
ANOVA	Analysis of Variance
CEO	Chief Executive Officers
CMS	Content Management System
CSF	Critical Success Factors
DPMO	Defects per Million Opportunities
DMAIC	Define-Measure-Analyse-Improve-Control
DMADV	Define-Measure-Analyse-Define-Verify
LSS	Lean Six Sigma
MDEC	Malaysia Digital Economy Cooperation
PDCA	Plan-Do-Act-Check
ROI	Return on Investment
SEO	Search Engine Optimisation
SOP	Standard Operating Procedures
SPC	Statistical Process Control
TQM	Total Quality Management
TPS	Toyota Production System
VOC	Voice of Customer
VSM	Value Stream Mapping

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ABSTRAK

Kelengkapan dan keberkesanan Lean Six Sigma (LSS) telah menyebabkan LSS menjadi salah satu metodologi yang paling popular digunakan dalam pelbagai industri sejak beberapa dekad yang lalu. Walau bagaimanapun, ramai pengamal LSS hanya menganggap LSS sebagai kotak peralatan dan mengabaikan falsafahnya. Tujuan kertas kerja ini adalah untuk membentangkan kepentingan falsafah LSS dalam sektor perkhidmatan dan mengaji hubungan LSS dengan pembelajaran organisasi melalui pembuatan modul latihan LSS. Walaupun ramai penyelidik telah membuktikan bahawa LSS menyumbang kepada kejayaan organisasi dalam sektor perkhidmatan, masih terdapat jurang antara memahami kaedah LSS dan mengamalkannya dalam sesebuah organisasi. Oleh itu, hubungan antara lima topik falsafah LSS (Lean Leadership, Lean Management, Lean Culture, Change Management and Employee Engagement) dan tiga konstruk utama pembelajaran organisasi (komitmen, pengetahuan dan prestasi) telah disiasat. Lima topik falsafah LSS telah menjadikan modul untuk sektor perkhidmatan melalui model ADDIE dan dilaksanakan di sebuah syarikat pembangunan IT dan perisian di Pulau Pinang, Malaysia. Pelaksanaan latihan LSS telah membawa hasil yang memberangsangkan kepada syarikat dari segi peningkatan prestasi, keberkesanan dalam perkongsian pengetahuan dan komitmen yang lebih tinggi. Selain itu, kertas kerja ini juga mengkaji kesan LSS terhadap pembelajaran organisasi dengan membina soal selidik untuk mengumpul data daripada syarikat tersebut dan menjalankan analisis statistik menggunakan Analisis Varians (ANOVA). Keputusan mengesahkan perbezaan signifikan untuk semua konstruk dan membuat kesimpulan bahawa LSS mempunyai kesan positif yang kuat terhadap pembelajaran organisasi. Namun begitu, lebih banyak bukti empirikal diperlukan untuk membuat generalisasi kebolehgunaan modul kerana modul ini hanya dilaksanakan dalam satu sektor perkhidmatan. Selain itu, kertas kerja ini hanya mengemukakan lima alat falsafah. Kajian lanjut mengenai tema lain boleh dilakukan untuk meluaskan topik kajian.

PHILOSOPHICAL TOOLS OF LEAN SIX SIGMA IN THE SERVICE SECTOR: IMPLICATIONS FOR ORGANISATIONAL LEARNING

ABSTRACT

Due to the comprehensiveness and effectiveness of Lean Six Sigma (LSS), it has become one of the most popular methodologies in various industries over the past decades. However, many LSS practitioners only treat LSS as a mere toolbox instead of applying its philosophy. This paper aims to present the significance of LSS philosophy in service sector and discover its relationship with organisational learning through the development of LSS training modules. Although many researchers have proven that LSS contributes to organisational success in service sector, there is still a gap between understanding the benefits of LSS and practicing it in an organisation. Therefore, the relationship between the five LSS philosophical topics (Lean Leadership, Lean Management, Lean Culture, Change Management, and Employee Engagement) and the three key constructs of organisational learning (commitment, knowledge, and performance) were investigated. The five LSS philosophical topics were developed into modules for service sector using ADDIE model and implemented in an IT and software development company in Penang, Malaysia. The implementation of LSS trainings have brought fruitful results to the company in terms of performance improvement, effectiveness in knowledge sharing, and higher commitment. Besides, this paper also examines the impact of LSS on organisational learning by constructing questionnaires to collect data from the partner company and conduct statistical analysis using Analysis of Variance (ANOVA). The results confirmed the significant differences for all constructs and concluded that LSS has a strong positive impact on organisational learning. Nonetheless, more empirical evidence is required to generalise the applicability of the module as the modules were only implemented in one service sector. Besides, the paper only presents five philosophical tools. Further research on other themes can be done to expand the research topic.

CHAPTER 1

INTRODUCTION

1.1 Research Background

Since the emergence and combination of Lean and Six Sigma (LSS) as an approach, LSS has become one of the most successful continuous improvement methodologies compared to the others (Gupta, et al., 2018; Mustapha et al., 2019). As an integrated methodology, it considers the human and process aspects of process improvement (Vijaya Sunder, 2016). LSS not only instils a continuous improvement mindset among the workers but also helps to improve the flow of a working process by eliminating waste. Today, LSS is applied in various sectors, from manufacturing to service sectors like information technology (IT) and financial to public industries such as hospitals and higher education. A service can be defined as a one-off, non-physical, and intangible benefit delivered by a service provider commissioned to the customer (Andrés-López et al., 2015). Four characteristics of the service sector are intangibility, inseparability, variability, and perishability. Intangibility refers to the quality that is incapable of being perceived by touching, such as it is based on customer's feelings and expectations, while inseparability refers to the generation and consumption of the service that occurs simultaneously. Variability indicates the process of transforming resources such as information, concepts, and ideas into service but lacks a consistent, homogenous, and repetitive quality. Perishability refers to services that cannot be produced and stored to be sold later.

Although LSS has proven its success in various sectors, risks may happen because of inappropriate implementation of LSS (Raja Sreedharan et al., 2017). For instance, if the employees lack the knowledge to select an appropriate tool for a project, the organization would not see a return on investment (ROI) on its LSS investment. On the other hand, it is also crucial to consider the topic of organisational learning as implementing LSS will undoubtedly impact organisational learning (Wang & Huzzard, 2011). It is cumbersome for every individual in an organization to apply LSS appropriately and consistently without proper training and knowledge. As a result, an organisation must educate and prepare its employees for the effective

implementation of LSS while maintaining a balance between LSS practices and learning via exploration (Enoch, 2013; Anttila & Jussila, 2018).

1.2 Problem Statements

LSS has been well established in the manufacturing field for decades. Since the first study of Lean in service in 1998, more research and investigations have been done to investigate the applicability of LSS in various service sectors. Thanks to the hard work of researchers and LSS practitioners, multiple frameworks and conceptual models for LSS implementation were proposed to assist more industries, including service sectors, in implementing LSS. However, viewing LSS as a toolbox consisting of 5S, Kanban board, Ishikawa diagram, and Kaizen events has dreadfully caused many LSS practitioners to miss the sensible philosophy behind these valuable tools. While it is constructive to expand LSS implementation from manufacturing to other fields, such as service sectors, most researchers only focus on implementing the LSS tools in service sectors. On the other hand, there is still a gap between the understanding and implementation of LSS in the service organisations, especially the personnel at the lower management level. Inevitably, an organization must provide sufficient training to its employees to ensure successful LSS implementation. Nevertheless, only a few recent studies are concerned with module development of LSS training. Despite the lack of discussion of the significance of module development, the module would be less effective without examining how humans learn new knowledge and transfer it to others within an organisation. Taking this as a valuable opportunity, the purpose of this study is to develop LSS training modules from the LSS philosophical perspectives and investigate how LSS relates to organisational learning by implementing the modules in service sector.

1.3 Scopes of the Project

The scopes of this project are:

- Scope 1: Investigate the relationship between LSS and organisational learning
- Scope 2: Development of LSS philosophical tools modules for training
- Scope 3: Implementation of the modules is scoped to a service sector
- Scope 4: Only LSS philosophical tools are focused

1.4 Project Limitation

Although the research presents the vitality of LSS and investigates its relationship with organisational learning, more empirical evidence will be required to generalise the applicability of the module. One of the reasons is that the modules were only implemented in one service sector, the IT & software development field. This has provided a future opportunity to expand the scope of this research to more service sectors. Besides, this study is limited to five philosophical tools: Lean Leadership, Lean Management, Lean Culture, Change Management, and Employee Engagement. Hence, it paves a chance to research other LSS themes and apply them to other service sectors.

1.5 Objectives

The main objectives of this research are:

i. To develop modules for philosophical LSS tools in the service sector.
ii. To implement the philosophical LSS tools in the service sector.
iii. To investigate the relationship between the philosophical LSS tools and organisational learning.

1.6 Significance of the research

This study reveals a strong positive correlation between LSS and organisational learning. Besides, it also consolidates the significance of viewing LSS from philosophical perspectives and highlights the vitality of implementing LSS training in service sectors. Since LSS is a holistic methodology that focuses on humans and processes, it is crucial to understand how humans learn and transfer new knowledge within an organisation so that LSS can be understood and implemented effectively. This study investigates the linkage between LSS and organisational learning by developing modules for LSS philosophical tools and implementing the modules in a service sector company. The questionnaire results have validated the correlation between LSS and organisational learning through statistical analysis.

1.7 Thesis Outlines

This paper is categorised into six sections. Chapter 1 presents the project background and mentions the problem statements, project objectives, and scopes. Chapter 2 contains extensive literature reviews on research topics, such as the background of Lean Manufacturing, Six Sigma, LSS, organisational learning, and LSS training. From the literature review, the top five Critical Success Factors (CSFs) of LSS and three key constructs in organisational learning were determined, followed by the construction of five research hypotheses. In chapter 3, research methodology such as the research designs, module design and development, case study, and survey settings were discussed in detail. Chapter 4 presents the results obtained from the questionnaires after statistical analysis, and chapter 5 elaborates on the results by relating to LSS and organisational learning. Conclusion, research limitations, and future recommendations were discussed in Chapter 6.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discussed the topics related to the study, including the brief history of Lean Manufacturing, Six Sigma, and Lean Six Sigma, then moved to the CSFs of LSS listed by various researchers. Five topics were selected and discussed from the CSFs findings and discussion with LSS experts. Next, papers regarding organisational learning and its relationship with LSS were studied and reviewed. Finally, the section ends with studying training and module development topics.

2.2 Overview of Lean Manufacturing, Six Sigma, and Lean Six Sigma

In this highly competitive era, every business needs to strive for quality and continuous improvement to stay ahead of the curve. Without an effective improvement strategy, it will be burdensome for an organisation to achieve its organsational goals. Over the past decades, LSS has become a well-accepted and proven business process improvement methodologies (Rodgers et al., 2021). One of the critical success factors of LSS is its ability to maximise shareholder value by improving process speed, enhancing product quality, and reducing production costs (Laureani & Antony, 2019). LSS proved to be an effective methodology due to its combination of two strong and time-tested philosophies. The next section explains the introduction of LSS, and the transition from Lean Manufacturing and Six Sigma to LSS.

2.2.1 Lean Manufacturing

Lean thinking was introduced and developed by the former executive vice president of the Toyota Production System (TPS), Taiichi Ohno, in the 1930s. The term "Lean thinking" was proposed by Womack et al. It consists of a set of lean practices (Leite & Vieira, 2015). At first, Lean was developed for the manufacturing industry to eliminate non-value-added activities and wastes, and it was quickly expanded to a new area, especially in the services sectors. Later, the philosophy was integrated with various tools and techniques such as the Kanban system, 5S, cause and effect analysis, value stream mapping (VSM), and others (Singh & Rathi, 2019). To

grasp the core of the Lean concept, Womack et al. (2007) have studied and discussed five core principles of Lean (Asnan et al., 2015). These five principles create a solid framework that assists every individual in an organisation to discover the true value from their customer perspective and remove wastes from their working process through continuous improvement.

- Value – Determine the value to be delivered to the customers according to what they actually want
- Value Stream – Define and optimise value stream by determining all value-added non-value-added, and non-value-added but necessary activities
- Flow – Produce a flow process by minimising stoppage and delay
- Pull – Respond and provide service based on customer's demand
- Perfection – Pursue service excellence by continuously improving and fulfilling customer's need

Besides the five tenets of Lean, Taiichi Ohno has categorised waste into eight types: waiting, motion, inventory, transportation, defect, overproduction, overprocessing and under-utilised staff (Asnan et al., 2015; Ferreira Brito et al., 2019). Initially, only seven wastes were developed by Taiichi Ohno, and the eighth (under-utilised staff) was added in the 1990s when TPS was introduced in the western world (Suárez-Barraza et al., 2016). During several visitations of Taiichi Ohno and his friends to Ford and Detroit, they found tons of waste throughout the production. This situation has inspired him to develop the concept of waste so that value-added and non-value-added activities can be differentiated. In terms of the definition of "Lean", various exhaustive literature reviews show no consistent agreement on the definition of Lean (Gupta et al., 2016; Raja Sreedharan & Raju, 2016; G. Yadav & Desai, 2016). The drastic development of Lean over several decades and many misconceptions among practitioners toward Lean, such as perceiving Lean as a mere toolbox, have added to the difficulties in defining Lean. However, Gupta et al. (2016) have summarised lean as "an integrated multidimensional approach encompassing a wide variety of management practices based on eliminating waste through continuous improvement." Unquestionably, Lean is more about philosophy where it consists of culture-shaping, way of thinking, and practical philosophy instead of a mere toolbox for quality improvement.

2.2.2 Six Sigma

Six Sigma originated from the Motorola Research Centre by engineer Bill Smith in the manufacturing arena in 1987 (Vijaya Sunder, 2015; Antony et al., 2017; Singh & Rathi, 2019). Later, it was popularised by Jack Welch, the Chief Executive Officer (CEO) of General Electric, and implemented in business areas of project management, customer support, supply chain management, human resources, and finance (Suppremaniam et al., 2011; Duarte et al., 2012). The foundation of Six Sigma is Statistical Process Control (SPC) and a hybrid of several approaches such as Total Quality Management (TQM) and Deming Philosophy. Six Sigma is a data-driven process improvement methodology that helps businesses be stable by predicting process results and decreasing process variation and defects (Laureani & Antony, 2019). Its principles can shift the process average and create robust products and processes by removing extra process variations that lead to poor quality (Antony et al., 2017). Cited by Vijaya Sunder (2015), Tjahjono et al. (2010) identified four interpretations of Six Sigma - a set of statistical tools, an operational philosophy of Management, a business culture, and an analysis methodology that uses scientific methods.

In Six Sigma, a sigma symbol (σ) was used to portray the standard deviation in statistics and to express the variation in a process. As a process variation reduction methodology, Six Sigma (6σ) aims to achieve defects reduction of up to 3.4 defects per million opportunities (3.4 DPMO) by relying on statistical and scientific methods (Singh & Rathi, 2019). In percentages, 99.99966 percent of the products from a Six Sigma process are without defects (Council for Six Sigma Certification, 2018). The practical application of Six Sigma methodology is Define-Measure-Analyse-Improve-Control (DMAIC), aiming to minimise variations in its repeatability and reproducibility (Suppremaniam et al., 2011).

2.2.3 Lean Six Sigma

Due to both Lean and Six Sigma have their drawbacks and limitations, many organisations merged both improvement methodologies to maximise the results. LSS was introduced by integrating the prime elements from continuous improvement theories and scientific management (Singh & Rathi, 2019). Vijaya Sunder (2016) stated that without Six Sigma, Lean lacks tools to enhance improvement to its full

potential. On the other hand, without Lean, Six Sigma is just a toolbox for improvement which has no structure to drive forward the application to a system. Lean cannot resolve complex problems that require exhaustive data analysis and advanced statistical methods. In contrast, Six Sigma requires huge data collection even though it is unnecessary to solve every problem (Antony et al., 2017).

Besides, other quality improvement methodologies that were developed during the era, such as Total Quality Management (TQM), also have some noteworthy limitations. Antony et al. (2017) pointed out four significant limitations. The first limitation is the focus on customer satisfaction and culture change but neglects bottom-line improvements. The second limitation is that there is no formal methodology or overall strategy associated with TQM, which causes the development of a new approach when there is a new project. The next is TQM implementations often lack supporting infrastructure, including dedicated resources and formal project selection, while the fourth is that it does not emphasise the measurements and metrics that cause difficulty tracking project progress and impact.

The issues above have raised the discussion among researchers about whether Lean and Six Sigma can be integrated to achieve breakthrough results. Although it is difficult to determine the exact time when LSS was launched, some research showed that the usage of the term 'Lean Six Sigma' could be traced back to the year 2003, when it refers to a way to describe the integration of Lean and Six Sigma philosophies (Suppremaniam et al., 2011; S. Albliwi et al., 2014).

Since the emergence of the LSS, various researchers have conducted substantial reviews of the definition of LSS (Raja Sreedharan & Raju, 2016; G. Yadav & Desai, 2016). Yadav & Desai (2016) have divided the meaning of LSS into cost reduction and business perspective. From a cost reduction perspective, LSS aids in removing wastes and determining the number of opportunities that could result from defects so that a smooth process can be created. From a business perspective, LSS is a hybrid approach that enables an organisation to drastically determine customer desires, eliminate all non-value-added activities, and decrease process variability. LSS also aims to transform the organisations from separate reactive operations into cross-functional process-focused organisations (Vijaya Sunder, 2016). Table 2.1 shows the key difference between Lean and Six Sigma.

Table 2.1 Key differences between Lean and Six Sigma (Antony, 2011; Vijaya Sunder, 2015)

	Lean Manufacturing	Six Sigma
Functions	• Using a knowledge-based approach by applying time-tested principles • Focus on eliminating waste, improving the speed and productivity to create a smooth process flow • Reduction of cost by eliminating non-valued added activities and waste • Focus on rapid improvements	• Using a statistical approach, data-driven methodologies by collecting data and analysis to solve baffling problems • Focus on process flow with minimum variation • Reduction of cost by systematically tackling the cost of poor-quality items in various processes • Focus on robust improvements
Core Principles/Key methods	Value, value stream, flow, pull, perfection	DMAIC/DMADV Process
Tools	Kanban system, 5S, value stream mapping, Andon, Plan-Do-Act-Check (PDCA) cycle	Statistical tools – ANOVA, SPC, Pareto Chart

2.3 Lean Six Sigma in Service Sectors

Grönroos (1990) defined service as "an activity or series of activities of more or less intangible nature that normally, but not necessarily, occur in interactions between the customer and service employees and systems of the service provider, which are provided as solutions to customer problems." (Gupta et al., 2016). Although there are some differences between the core of manufacturing and service industries, from an improvement perspective, service organisations are likened to other sectors where they have processes that can be upgraded by collecting data and applying scientific methods and tools of LSS (Snee, 2010).

Due to the vast advantages of the Lean implementation in the manufacturing industry, some researchers started to think about whether it can be transferred to other areas such as service sectors to reap its benefits. Bowen and Youngdahl (1998) were the first to conduct studies about the transfer of lean principles and techniques to the service sector (Leite & Vieira, 2015). Later, it was implemented in service organisations such as healthcare, sales, and marketing, banking service, education, logistics, finance, real estate, etc. (Akpolat. H, 2014; Chaplin & O'Rourke, 2014; Antony et al., 2018). Besides, Vijaya Sunder (2016) reported that the LSS methodology is preferred over Lean, Six Sigma or other continuous improvement

methodologies in the service industry. One of the encouraging factors is that improvement is independent of process complexity (Sarkar et al., 2013).

Antony et al. (2017) discovered some amazing benefits of LSS implementation in the service sector, including increased customer satisfaction, employee morale, enhanced cross-functional teamwork, and consistent service levels. Sunder M & Antony (2018) also found that LSS methodology is preferred over other quality approaches in the service sector because it puts the Six Sigma methods and tools to identify variation in business processes. At the same time, implement Lean principles to eliminate waste to streamline business processes that result in customer satisfaction. Besides, they have also listed the following advantages of implementing LSS in the service industry. For instance, LSS provides a structured and systematic deployment approach to eliminate the root cause of the problem and involve stakeholders at every stage of the roadmap. LSS also combine walk-the-floor and statistical methods, enhancing teamwork and team engagement. On the other hand, it also creates sustainable improvements for customer delight by reducing process waste and variation.

2.4 LSS Tools

Although LSS has a proven set of tools and techniques that helps practitioners solve their issues, Arumugam et al. (2012) indicated that LSS should be viewed not only from the perspective of tools but as a business improvement strategy. While tools are important for LSS implementation, they are just a means for problem-solving but not the solutions to the problems. According to Trakulsunti & Antony (2018), a tool has a narrower scope as it is utilized to solve a particular task. They also discovered that recent studies define "LSS tools" as the tools used in DMAIC method. However, LSS not only consists of tools used to solve a task but also contains the philosophical part that shapes the behaviour, character, thinking and mindset of a person. For instance, Lean Leadership in LSS consists of both the tools (i.e., A3 charters) and its philosophical approach (i.e., the mindset and models of Lean Leadership). Therefore, it is necessary to classify LSS into practical tools and philosophical tools. A practical tool refers to the tool that is utilized to solve certain issues. Some examples are Voice of the Customers (VOC), VSM, Pareto chart, A3, 5 Whys root cause analysis, Kanban, 5S and PDCA Cycle, etc. (Costa & Godinho Filho, 2016). On the other hand, a

philosophical tool is a set of ideas, concepts, or principles that helps people to think, feel and act (Morris, 2015). In LSS context, it encompasses the ethics, thinking, attitudes, and mindset of LSS philosophy. It requires the practitioner to have a deeper understanding of LSS philosophy and principles and adapt to them before implementing the tools in an organisation. Some example of LSS philosophical tools are Lean Culture, Lean Management, and Lean Leadership.

2.5 Critical Success Factors of LSS Implementation in Service Sectors

Although many companies gain a lot of success after deploying LSS, some companies still suffer losses after implementing LSS (Laureani & Antony, 2019). Hence, understanding the CSFs of LSS implementation is necessary. After an intensive literature review of the CSFs of LSS implementation, the top five CSFs of LSS implementation: leadership, management, culture, change, and employee engagement are identified. Table 2.2 below summarises CSFs gathered from research papers from 2011 to 2022.

Table 2.2 A Summary of the Critical Success Factors and their sources

Critical Success Factors (CSFs)	**References**
Culture	Fadly Habidin, 2008; Jeyaraman & Teo, 2010; Pamfilie et al., 2012; Psychogios & Tsironis, 2012; Asnan et towardal., 2015; Tsironis & Psychogios, 2016; Yadav & Desai, 2016; Allen & McCarthy, 2017; Alston, 2017; Laureani & Antony, 2017; Rodgers, et al., 2018; Sunder M & Antony, 2018; Nath Dhakal et al., 2019; MacIel-Monteon et al. 2020; Juliani & de Oliveira, 2021.
Leadership	Cima et al., 2011; Pamfilie et al., 2012; Zarbo, 2012; Tsironis & Psychogios, 2016; Yadav & Desai, 2016; Allen & McCarthy, 2017; Galli et al., 2017; Laureani & Antony, 2017; Sunder M & Antony, 2018; Antony, Rodgers, et al., 2018; Pathiratne et al., 2018; Nath Dhakal et al., 2019; MacIel-Monteon et al. 2020; Juliani & de Oliveira, 2021.
Management	Fadly Habidin, 2008; Jeyaraman & Teo, 2010; Antony et al., 2012; Hilton & Sohal, 2012; Psychogios & Tsironis, 2012; Setijono et al., 2012; S. A. Albliwi et al., 2015; Asnan et al., 2015; Bakar et al., 2015; Yadav & Desai, 2016; Tsironis & Psychogios, 2016; Antony et al., 2017; Pathiratne et al., 2018 Nath Dhakal et al., 2019; Iberahim et al., 2020; N. Yadav et al., 2021.
Change	Fadly Habidin, 2008; Baker, 2011; Jaca et al., 2012; Assmenan et al., 2015; Asnan et al., 2015; Galli et al., 2017; Pathiratne et al., 2018; Antony, Rodgers, et al., 2018; Sunder M & Antony, 2018; Juliani & de Oliveira, 2021; N. Yadav et al., 2021.

Employee Engagement	Baker, 2011; Pamfilie et al., 2012; Sunder, 2013; Yadav & Desai, 2016; Allen & McCarthy, 2017; Nath Dhakal et al., 2019; Laureani & Antony, 2019; Iberahim et al., 2020; N. Yadav et al., 2021.
Training	Fadly Habidin, 2008; Antony et al., 2012; Psychogios & Tsironis, 2012; Jaca et al., 2012; Tsironis & Psychogios, 2016; G. Yadav & Desai, 2016; Laureani & Antony, 2017; Galli et al., 2017; Pathiratne et al., 2018; Nath Dhakal et al., 2019; Sreedharan V et al., 2020; MacIel-Monteon et al., 2020; N. Yadav et al., 2021

From the table above, leadership, Management, change, culture, and employee engagement are crucial factors contributing to the successful implementation of Lean Six Sigma. The term "training" is added to consolidate the vitality of providing appropriate LSS training to every employee in an organisation. These topics will be further discussed in the section below.

2.5.1 Lean Culture

According to Mann (2017), culture refers to “a concept that people make up to organise and handle what they have seen or experienced.” Culture depicts the personality of an organisation and shows the values and principles upheld by its employees (Iranmanesh et al., 2019). When people habitually involve themselves in Lean Management process, a Lean culture is formed. There is a difficulty in describing Lean Culture due to its complex construct encompassing various dimensions such as knowledge sharing, continuous improvement, and implementation of Lean tools (Osman et al., 2021). Alston (2017) viewed Lean Culture as a culture that contains all the elements and attributes that are necessary to sustain and implement Lean process improvement initiatives. Dorval et al. (2019) have gathered a series of definitions proposed by researchers. They found that more than 80 percent of the researcher view Lean Culture as an organisational aim. In other words, Lean Culture is not a tool or an extra from organisational change but a mirror of Lean transformation journey and proficiency. Lean Culture is progressively built by every action and decision made by the members of an organisation according to Lean principles.

Jeyaraman & Teo (2010) also endorsed the importance of the organisational culture in making LSS implementation successful. Irfan (2012) surveyed CSFs of LSS and obtained a positive correlation between CSFs of LSS with organisational belief and culture. Kundu & Manohar (2012) studied the CSFs from the perspective of the IT service sector and proposed organisational as one of the CSFs of LSS. Tsironis &

Psychogios (2016) explored the literature that discussed CSFs of LSS implementation and found that quality-driven organisational culture is one of the essential CSFs. A successful LSS implementation in an organisation requires the expansion of LSS philosophy to culture and environment shaping. Pathiratne et al. (2018) suggested that culture should be considered the most significant factor for LSS implementation. MacIel-Monteon et al. (2020) categorised quality culture implementation under management involvement and commitment, which is one of the CSFs of LSS.

2.5.2 Lean Leadership

Leadership is critical in Lean implementation as it ensures the system of an organisation and its employees are committed to daily improvement activities (Aij & Teunissen, 2017). Dombrowski & Mielke (2013) define Lean Leadership as a well-organised system that ensures continuous improvement and implementation of Lean system. A successful Lean leader forms a culture of striving for perfection in an organisation. The two dimensions of perfection include customer-centred in every process and continuous development among employees and leaders. Besides, they have identified five fundamental principles of Lean Leadership, which are improvement culture, self-development, qualification, Gemba, and Hoshin Kanri. Improvement culture points to the mindset of striving for perfection, while self-development indicates a constant upgrading of individual competencies and skills. Qualification refers to training employees consistently by involving them in solving the actual problem, whereas Gemba focuses on making a decision based on first-hand knowledge. Finally, Hoshin Kanri refers to strategic planning to ensure the company's goals are executed at every level (Dombrowski & Mielke, 2013; Aij & Teunissen, 2017).

The review by Tsironis & Psychogios (2016) found that committed leadership is one of the CSFs in LSS implementation. Nath Dhakal et al. (2019) have done an extensive literature review and concluded that leadership is one of the eight CSFs for successful LSS implementation. Pathiratne et al. (2018) consolidate the vital role of leadership in CSFs of LSS by analysing more than 90 CSFs. Research from Hilton & Sohal (2012) highlighted the importance of leadership in successfully deploying LSS. Laureani & Antony (2017) have proved the correlation between leadership approaches and LSS deployment. A study by Pamfilie et al. (2012) reveals that a leader that is

efficient in communication and plays a prominent role in employee support and motivation will lead to successful lean implementation. MacIel-Monteon et al. (2020) conducted a study on measuring CSFs of LSS in higher education institutions and endorsed the CSFs that ensure successful improvement projects, including leadership from top Management. Zarbo (2012) has proposed a lean leader's checklist that shows how a good leader can create a constancy of purpose toward improving work product and service outcomes at all levels as the basis of a culture of continuous improvement.

2.5.3 Lean Management

According to Sony (2018), Lean Management is the medium to execute Lean thinking. The core of Lean thinking is to provide the greatest value to a customer by eliminating waste within a process and in the organisation. Therefore, Lean Management within an organisation strives to identify and eliminate waste. In terms of value maximisation, five principles are used: (1) Determine the value from customer's perspective. (2) Identify and map all values along a process chain. (3) Create a flow for value stream. (4) Give only what customer wants through the pull system. (5) Move towards perfection (Womack & Jones, 1997). In Lean Management, there are eight types of waste: transportation, inventory, motion, waiting, overproduction, over processing, and defects (Ohno & Bodek, 2019). To effectively apply Lean Management, tons of valuable tools are developed, such as Value Stream Mapping, Pull systems, Kaizen events, Visual control and Management, Jidoka, and 5S (Sony, 2018). Although most of the research investigated Lean Manufacturing environment, other research shows that Lean Management is fully applicable to various areas, including healthcare, IT services, public administration, and education (Kadarova & Demecko, 2016).

Jeyaraman & Teo (2010) studied the CSFs proposed by researchers from 1996 to 2010 and found that Management is a CSFs endorsed by all researchers. Without consistent support and commitment from the management team, doubt and ambiguity will weaken the LSS implementation initiative. Antony et al. (2012) also provided a summary of CSFs of LSS and surveyed them to determine the top CSFs of LSS implementation. The results showed that Management is in the top six CSFs. Kwak and Anbari (2006), cited from Setijono et al. (2012), summarised the CSFs in four main areas: management involvement and organisational commitment; project

selection, Management, and control skills; acceptance of cultural change continuous training. The need for a process management system, especially the tracking and review of projects, was highlighted in the research. Bakar et al. (2015) identified five significant CSFs of LSS out of 97 CSFs listed in 13 papers. They concluded that management commitment and leadership are among the five significant CSFs (Pathiratne et al., 2018). A recent CSFs review by N. Yadav et al. (2021) found that commitment from top management is the top CSFs of LSS implementation.

2.5.4 Change Management

A change without Management will lead to chaos. Asnan et al. (2015) define change management as "a structured approach to shift individuals, teams, and organisation from a current state to a desired future state to fulfil vision and strategy." Every change will involve a transition phase where people must let go of the old ways of working and embrace the new ways of thinking. However, resistance to change always occur as change requires people to move out of their comfort zone. Since lean implementation requires a radical change in various aspects, understanding change management is the key to preventing failure in lean implementation (Asnan et al., 2015). One of the most popular change management models is Kurt Lewin's change model, which consists of three stages: (1) Unfreezing, (2) Changing, and (3) Refreezing (Cummings et al., 2015). However, due to the lack of focus on dealing with people issues, numerous change models such as John Kotter's 8 Steps Change Model, 7S ADKAR Model, The McKinsey 7-S Model, etc., were developed to enhance the process of managing change (Galli, 2018).

The change will inevitably occur during the implementation of LSS. Galli et al. (2017) have found a significant correlation between change management and leadership in each phase of DMAIC. Asnan et al. (2015) found the importance of change management in LSS implementation as LSS requires a shift and transformation from the current state to a desired future state to fulfil vision and strategy. A case study from Jaca et al. (2012) insisted that the challenges of lean adoption in the distribution sector are the volatility of customer demand and the high degree of human participation in the job. According to the authors, change management needs to link to specific lean activities to assure actual change. Anthony et al. show that change management is one of the keys to driving LSS as the implementation of LSS will

involve a culture change. Juliani & de Oliveira (2021) found six significant challenges in LSS deployment and considered proposed guidelines for the public sector. McIvor (2016), cited by Pathiratne et al. (2018), stated that service companies require process improvement techniques and change management to ensure process improvement.

2.5.5 Employee Engagement

Since Kahn proposed the first concept of employee engagement in 1990 as the "harnessing of organisation members' selves to their works", various definitions of employee engagement have been proposed by the researcher (Sun & Bunchapattanasakda, 2019). Sendawula et al. (2018) refer to it as the involvement and commitment of employees towards the values of an organisation. Chanana & Sangeeta (2021) indicated that it is a workplace attitude that ensures every employee is giving their best in everyday tasks and is committed to the objectives of their organisation. They also mentioned that the term "engagement" contains numerous facets such as cognitive (i.e., beliefs of leaders), emotional (i.e., positive or negative attitude toward the organisation), and physical (i.e., devotion to accomplish a role). Hence, employee engagement occurs in the inner state of mind of an employee that brings commitment, satisfaction, and work effort to an employee (Chanana & Sangeeta, 2021). When employees are engaged in their work, they are more willing to collaborate with colleagues to enhance the performance of their organisation. Besides, engaged employees make fewer work-related mistakes and errors as they have a positive attitude and mind towards their work (Sendawula et al., 2018).

Pamfilie et al. (2012) have revealed the critical factors needed to create a unique framework that can lead the organisation to business excellence through personnel improvement. One of the keys is employee motivation or engagement. Iberahim et al. have determined the factors that enhance employee engagement in LSS, indicating its importance in a successful LSS project (Iberahim et al., 2020). Other than leadership and involvement of top Management, Nath Dhakal et al. (2019) also found that the empowerment of employees is critical to the establishment of lean culture. Besides, an extensive literature review by N. Yadav et al. (2021) found that the term employee involvement appeared in 19 out of 32 articles related to CSFs in LSS that they reviewed.

2.6 Organisational Learning

Learning is an ability given to humans to adapt to the changing environment and gain new insights to enhance their quality of life. If human is given the ability to learn, the same goes for an organisation built by a group of people. Sony & Naik (2012) suggest that organisational learning occurs when the team members use learning to solve a common problem. Hasson et al. (2016) insisted that learning and knowledge generated by individuals need support from the team through actions to be sustained in an organisation. It is different from individual learning as organisational learning involves sharing, action, and common understanding among a team. Hence, organisational learning can be defined as a change in the organisation's knowledge that occurs as a function of experience (Argote, 2011; Hasson et al., 2016). It is an ongoing process that involves continuous change in individuals' cognitions and behaviours (Argote, 2011).

Based on the literature review, most scholars suggest that organisational learning occurs at three levels: individuals, groups, and organisations (Jyothibabu et al., 2010; Barba Aragón et al., 2014; Hasson et al., 2016). Barba Aragón et al. (2014) discuss the learning levels in detail: Individual-level learning refers to how individuals generate new insights and knowledge from existing implicit or explicit information and knowledge. Group-level learning involves individuals transferring their knowledge within a group so that all members develop a shared understanding. Organisational level learning occurs when individual and group knowledge is institutionalised, and they are interrelated where individual learning is the prerequisite for the other two levels of learning. Sony & Naik (2012) noticed two types of organisational learning: exploitative learning and explorative learning. Exploitive learning involves the acquisition of new behavioural capacities framed within existing insights, known as "single-loop" learning. On the other hand, explorative learning happens when organisations acquire behavioural capacities that differ fundamentally from existing insights. Both types of learning are required to maintain constant growth. To compete in this competitive era, organisations need to enhance their learning capabilities by establishing a system where individual learning can be shared among members as it is the basis of a group and organisational learning.

2.6.1 Key Constructs of Organisational Learning

By reviewing CSFs of LSS listed by academic researchers, practitioner publications, and recommendations by LSS experts, five LSS constructs were developed: Lean Leadership, Lean Culture, Lean Management, Change Management, and Employee Engagement. In terms of organisational learning, three key constructs were developed after reviewing various research publications. Below are the descriptions for the three key constructs.

2.6.1(a) Knowledge

Learning occurs in every organisation regardless of training. Some researchers proposed that organisational learning is the source of constructing new organisational knowledge (Cheng et al., 2014; Chiva et al., 2014). Argote (2011) found that most researchers would agree to define organisational learning as a change in the organisation's knowledge that acts as a function of experience. The researcher categorises organisational learning into three sub-processes: creating, retaining, and transferring knowledge. When learning from experience occurs, an organisation is gaining new knowledge. As sharing occurs, the knowledge will be retained and transferred within and between units. As organisational learning is a process of knowledge acquisition, sharing, and application, knowledge is tightly related to organisational learning (Jiménez-Jiménez & Sanz-Valle, 2011). During the learning process, change in the organisation's knowledge occurs and manifests itself in the employee's cognitions and behaviours. Argote & Miron-Spektor (2011) mentioned that organisational learning is an ongoing cycle that involves converting performance experience to knowledge that impacts the organisation's context and affects the future experience. Research by Basten & Haamann (2018b) indicates that other than learning culture, knowledge is a decisive factor in the effectiveness of implementing organisational learning approaches. Hence, knowledge is the crucial key measure of organisational learning.

2.6.1(b) Commitment

Organisational commitment refers to a "psychological state that binds the individual to the organisation" (Somaskandan et al., 2022). Most researchers categorised commitment into affective, normative, and continuance (Usefi et al., 2013;

Somaskandan et al., 2022). All these three types of commitment interact with each other. When organisational learning works together with commitment, it helps organisations cope with various interruptions and restore normalcy (Somaskandan et al., 2022). A literature review by Hanaysha (2016b) found that organisational learning is positively correlated to organisational commitment. The research also proved the relationship between commitment and organisational learning and concluded that a higher organisational learning culture would lead to higher organisational commitment. When an organisation forms a culture of continuous learning, it will cultivate job satisfaction and organisational commitment among employees, leading to long-term stability and positive work outcomes. Usefi et al. (2013) pointed out that commitment mediates organisational learning and performance because organisational learning expands employees' skills and improves work efficiency and performance. Besides, it also develops bonds with other members, which makes the employee committed to the organisation. Therefore, organisational learning is closely connected to commitment.

2.6.1(c) Performance

In terms of organisational learning and performance, it will improve the overall performance of a company when employees obtain and apply knowledge in their everyday tasks. Performance can be referred to as the outcomes of the business process, the tasks of organisation's operations, and the attainment of both the internal and external goals (Hindasah & Nuryakin, 2020). Argote (2011) indicated that learning is the cornerstone of a successful organisation and thus claimed that a deeper understanding of organisational learning will improve the performance of the organisation. The literature review by Patky (2020) found that plenty of researchers agree on the positive correlation between exploratory learning and performance related to innovation after reviewing numerous facets of firm performance. Another research by Hindasah & Nuryakin (2020) also indicates a notable impact of organisational learning on financial performance, especially on small-and-medium-sized enterprises (SMEs). According to research, most studies provide evidence for their correlation (Jiménez-Jiménez & Sanz-Valle, 2011; Noruzy et al., 2013; Hanaysha, 2016c) but some studies show a weak relationship between organisational learning and

performance (Hendri, 2019). However, Barba Aragón et al. (2014) proved that organisational learning plays a mediating role between training and performance.

2.7 Lean Six Sigma and Organisational Learning

Among the elements of LSS, one of the most popular marks of LSS is continuous improvement. According to Sony & Naik (2012), continuous improvement cannot be made without organisational learning. They also insisted that any training will not succeed unless regular training and follow-up sessions are conducted. Since LSS is not merely a toolbox but a holistic philosophy, it is impossible to grasp the core concepts and implement them in everyday activities without consistent learning and mutual sharing. To understand their relationship, literature on the topics were studied.

2.7.1 Lean Culture and Organisational Learning

One of the core concepts of successful Lean philosophy implementation is cultural shaping. Lean culture maintains the philosophy of continuous improvement and teamwork to ensure both customers and employees receive the greatest benefits. Lee et al. (2015) have conducted a study to identify the relationship between organisational culture and organisational learning. Their results showed that organisational culture is significantly associated with organisational learning (Aghakhani et al., 2016). In other words, the stronger the lean culture and values instilled in an organisation, the more significant the impact it has on the behaviour of an organisation's members (Aghakhani et al., 2016). Qorbani Zade and Aspadpour (2010) stated that organisational learning occurs when organisations produce, complete, and organise the knowledge, normalise their activities, and apply it to their culture. If the knowledge and behaviour of the employees are closely tied with culture, then the way an organisation learn is also impacted by the culture.

H1. Lean Culture is positively related to organisational learning.

2.7.2 Lean Leadership and Organisational Learning

Leadership is expected as one of the vital factors for LSS implementation that cannot be ignored. Leaders are proved to be a positive and influential factor in overall organisational performance (Nath Dhakal et al., 2019). Leadership can be regarded as a source of beliefs and values influencing participation in achieving set goals (Pamfilie

et al., 2012). Much research shows the importance of leadership in the field of LSS (Laureani & Antony, 2017). As LSS is not a cost-reduction initiative but a philosophy that is embedded into an organisation's way of doing things like Toyota, it certainly involves the learning of an organisation. Besides, several researchers have conducted various extensive literature reviews to determine the relationship between leadership and organisational learning and concluded that leadership styles impact the overall performance of an organisation as leaders affect how a team learns, especially transformational leadership (Xie, 2019; Do & Mai, 2020). While the study by Poksinska et al. (2013) found many leadership behaviours exhibited by Lean managers can be classified as transformational leadership behaviours.

H2. Lean Leadership has a positive correlation with organisational learning.

2.7.3 Lean Management and Organisational Learning

Lean Management not only promotes standardisation but also invites participation and learning. According to Stimec (2020), continuous improvement in LSS is a concrete process of learning from experience, a key feature of organisational learning. Like LSS philosophy, organisational learning focuses on "the process by which organisations change or modify their mental models, rules, processes or knowledge, maintaining or improving their performance." (Basten & Haamann, 2018b). Alagaraja & Herd (2022) has shown how Lean thinking can relate to the characteristics of a learning organisation from the three primary levels. For instance, Lean philosophy promotes collaborative especially cross-functional learning at the team level because Lean views a team-based working environment as an important mechanism for enhancing learning and performance. Besides, Lean Management encourages the people's empowerment toward a collective vision by cultivating the mindset of continuous improvement. When a team has a shared vision and mindset, organisational learning will be developed so that the desired state of the organisation can be achieved. Hence, Lean Management provides the opportunity for organisational learning at every level.

H3. Lean Management is positively related to organisational learning.

2.7.4 Change Management and Organisational Learning

Organisational learning is a change in the organisation to acquire a new experience. Every organisational learning involves beliefs, cognitions, actions or behaviour (Argote, 2011). Freitas et al. (2018) mentioned that organisational learning is a change that happens as a function of gaining experience. New knowledge is created and manifested as changes occur in routines, cognition, and behaviours. Hence, it is inevitable that change management is required, especially a huge change is required in an organisation. Pamfilie et al. (2012) stated that resistance to change in an organisation surrounding LSS improvement projects is extremely high. It is because an LSS implementation requires a lot of changes, including the organisational culture. If a change includes improvement from one phase to another, there can be no improvement without learning.

H4. Change management has a positive relationship to organisational learning.

2.7.5 Employee Engagement and Organisational Learning

Employee engagement is one of the significant concepts in organisational behaviour as it concerns the level of involvement, interaction, intimacy, and influence an employee has over time (Hanaysha, 2016b). For an employee to engage in their work, they need to connect through various communication methods, including sharing knowledge. The distribution and sharing of learning that reinforces and support continuous learning will occur when organisational learning culture is developed. This will lead to nurturing of employee's job satisfaction and organisational commitment and ensure a stable employee workforce in the long term (Hanaysha, 2016b). Besides, an opportunity for career development is important as it enhances the working knowledge and ability of an employee, which leads to commitment and engagement (Hussain et al., 2016). Employees will feel valued and respected when they find that the organisation cares for their continuous growth. Since organisational learning is impacted by the culture and all human resource management activities, an organisation must manage its culture and activities to enhance employee engagement (Danish et al., 2014).

H5. Employee engagement has a positive correlation with organisational learning.

2.8 LSS Training in Service Sector

While it is crucial to understand the fundamental concepts of LSS and organisational learning, it is more vital to transform the knowledge into systematic training that develops the skills of every employee in an organization. For training to conduct effectively, well-revised and structured modules are necessary as the modules will guide the practitioners and employees throughout the process of LSS implementation. Therefore, it is important to understand the module development model and the importance of LSS training in service sector.

2.8.1 Module Development

Sreedharan V et al. (2020) discovered an emergence of literature that presents the successful model and application of LSS. Most of the studies on LSS are concerned with the CSFs, practices, awareness, conceptual model development, LSS frameworks development, and implementations (Sreedharan V & Sunder M, 2018). Although there are fruitful discussions regarding the LSS, the implementation of LSS is still a challenging endeavour. The failure to deploy LSS impacts the ROI of an organisation and creates waste along the process. One of the most significant factors that lead to the low interest in LSS implementation is the inadequate opportunities for LSS training. Without well-trained personnel, it will be extremely difficult to upbringing and establish new forms of organisational culture, which is an essential factor for employee engagement and quality improvement (S. A. Albliwi et al., 2015). However, there is a lack of discussion on the development of LSS training modules in the service sector (Sreedharan V et al., 2020). Hence, there is a compelling need for module development to train workers before LSS implementation in an organisation.

There are various types of instructional design models to assist practitioners in making their learning effective. One of the most popular types of models is Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model. Several reasons for using this model include its flexibility in customisation as it provides a framework for practical design, enables high-quality content that turns up from iterative refinements, and improves workplace performance (Sreedharan V et al., 2020).

The five steps of the ADDIE model are:

- Analyse: Understand the problem statement and current level of understanding
- Design: Outline the learning objectives, type of content, and method of delivery
- Development: Process of creating the module or instructional material
- Implementation: Delivery of the module to the identified target audience
- Evaluation: Assess the effectiveness of the module

2.8.2 Training and Development in Lean Six Sigma

From Table 2, it is undeniable that training is one of the CSFs of LSS implementation. Sreedharan V et al. (2020) insisted on adequate training among employees to implement LSS efficiently. S. A. Albliwi et al. (2015) highlighted training as a crucial factor in obtaining successful results from LSS implementation. Raja Sreedharan & Raju (2016) conducted a literature review of LSS in various industries and identified most organisations use LSS as a tool or technique rather than a holistic approach. A structured review from Singh & Rathi (2019) found that many LSS research focuses on LSS tools and techniques instead of the philosophy of LSS. Besides, the challenge in deploying LSS in the service sector is lacking an in-depth understanding of LSS methodology. LSS should be a holistic approach. LSS is not applying a toolkit for improvement but a culture-building vehicle for imbibing quality excellence (Sunder M & Antony, 2018). A team needs a correct understanding of LSS philosophy and knowledge in applying the LSS tools, especially in the service sector context.

Therefore, this study aims to investigate the impact of the key aspects of LSS on organisational learning. The study is conducted by developing relevant LSS modules for the service sector and providing training in LSS to a company in the service sector. Then, an evaluation of LSS's impact on organisational learning will be conducted by determining its relationship with three key organisational learning measures: commitment, knowledge, and performance.