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Integrating Lean Six Sigma with Knowledge Management within Service Organisations

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Abstract

Lean Six Sigma (LSS) programs aim to minimise variance in organisational processes, deliver predictable financial outcomes, lower the expenses associated with poor quality, enhance bottom-line results, and provide value for both customers and shareholders. LSS efforts are an effective method of enhancing manufacturing quality. However, for over two decades, LSS has been used in organisations in Western countries. However, it has only begun to be used in Middle Eastern countries. Additionally, there is a dearth of empirical studies examining the current state of LSS in these nations.

Knowledge management is concerned with the collection, distribution, and responsiveness of information from the standpoint of a decision support system. Similarly, the importance of knowledge management has increased significantly in recent years, emerging as a significant source of competitive advantage for businesses. Little study has been conducted on implementing knowledge management and LSS concurrently. This study will examine the state of Lean Six Sigma (LSS) and knowledge management in Jordanian service organisations. Additionally, this dissertation will examine the value of knowledge management in ensuring the effective deployment of LSS in service companies. This research aims to develop a synergistic approach for integrating knowledge management and Lean Six Sigma tools through the DMAIC problem-solving method to strengthen and ensure the quality of services provided by Jordanian organisations, both public and private.

The study relied on the inferential (analytical) approach, which is concerned with procedures that infer the existence of findings in the statistical population through representative samples and, subsequently, the generation of quantitative data. The interpretation task primarily concerns inferential analysis (inferring and concluding). The regression analysis findings indicate that knowledge management contributes to the success of Lean Six Sigma projects. The implications of these findings for existing theory and managers of LSS and knowledge management projects were examined. This study offers value for academics and practitioners working in LSS in Jordan by conducting an in-depth examination of the present state of LSS deployment and knowledge management in the country.

Keywords: Lean Manufacturing, Six Sigma, Lean Six Sigma, Knowledge Management. The service sector, Jordan.

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1- Introduction

1.1 Introduction

In the current business environment, various companies and organisations strive to adopt comprehensive management methodologies to enhance their overall performance (Melton, 2005), satisfy their customers, decrease the processes' costs, and have a niche in the market (Tenera & Pinto, 2014). As quality improvement (QI) and continuous improvement (CI) are vital factors for success in manufacturing organisations, several contemporary service organisations (for instance, healthcare and financial organisations) implement QI or CI in their works (Antony, Snee, & Hoerl, 2017). While techniques for business improvement come and go, boosting the bottom line never goes out of style. Business improvement methodologies have evolved last century (Snee, 2004a). Each approach builds on prior ways by incorporating the most valuable features of past approaches and supplementing them with new concepts, techniques, and instruments to overcome identified limits. Snee (2010) argues that development techniques are not fads but rather stages in the growth of business development methodology.

Many companies worldwide apply the Lean Six Sigma (LSS) methodology to reduce product or service defects and eliminate waste in the process (Alhuraish et al., 2017). Lean Six Sigma initially emerged from Lean Manufacturing and Six Sigma methodologies. Integrating both methods compensates for each method's limitations (Arnheiter & Maleyeff, 2005). By implementing LSS, the organisation gains many advantages, including competitive advantages and improving financial and operational performance (Alhuraish et al., 2017). However, many service organisations faced challenges while implementing LSS, and maybe they did not know how to implement LSS successfully (Kalashnikov, Benita, López-Ramos, & Hernández-Luna, 2017). Top management commitment, appropriate skills and training (Montgomery, 2016), excellent communication, and evolving employees in

the LSS implementation (Antony et al., 2017) are primary factors out of several factors essential to implementing LSS successfully.

Lean manufacturing and Six Sigma are required methods in the present-day business environment to ensure that today's business/organisation has a competitive advantage. A competitive advantage is achieved by maintaining the practice of sustainable development strategies (Pfeffer, 2010). Whether used in conjunction or alone, Lean and Six Sigma are strategies for optimising processes that generate and deliver high-quality services and products (Nave, 2002). Any reference in modern business to the quality of services and goods reflects how companies prioritise production and outcomes. Six Sigma and Lean are two of the most common approaches corporations use to effectively enhance service and product operations (Alhuraish et al., 2016a; Pacheco et al., 2015). Continuous efficiency and quality improvement of products and services are critical for meeting production targets (Indrawati & Ridwansyah, 2015). Numerous contemporary businesses are systematically using Lean and Six Sigma to reduce waste and increase efficiency (Alhuraish et al., 2015; Mousa, 2013; Tjahjono et al., 2010).

Lean thinking (LT) is based on the Toyota Production System (TPS). It is a concept that involves the determination of the value of any process through the distinction between value-added activities or steps from non-value-added activities or steps and the elimination of waste to add value to the whole process (Kovács, Kő, & Demeter, 2020). The Lean strategy provides established tools and techniques to reduce lead times, inventories, setup times, and downtimes for equipment, scrap, repair and other hidden plant waste (Sharma, 2003). Lean focuses on efficiency to produce products and services as cheaply and quickly as possible (Antony, 2011).

An engineer named Bill Smith developed Six Sigma at Motorola in the mid-1980s. Six Sigma is a process improvement methodology that focuses on identifying and eliminating the sources of faults and mistakes by concentrating on essential process outputs from the customer's perspective. Six Sigma concepts may improve a mean process, develop resilient products and processes, and eliminate excessive process variation that results in poor quality (Shah, Chandrasekaran, & Linderman, 2008). Six Sigma is a statistically based problem-solving approach that generates data to drive solutions and produces remarkable ultimate outcomes (Snee & Hoerl, 2007).

Over the last two decades, Lean Six Sigma (LSS) has evolved into one of the most frequently utilized and verified techniques for business process improvement ever experienced by enterprises (Antony et al., 2017). Since then, the popularity and implementation of LSS in the industrial sector have risen significantly (Shahin & Alinavaz, 2008), Especially prevalent among big western organizations such as Motorola, Honeywell, and General Electric (Laureani & Antony, 2012). Snee (2010) defines LSS as a business strategy and methodology that improves process performance, leading to increased customer satisfaction and bottom-line results. The LSS technique increases an organisation's capabilities, lowers production costs (Chen & Lyu, 2009), and maximises shareholder value (Laureani & Antony, 2012).

Knowledge is a blend of information and practice. Knowledge is one of the organisation’s crucial resources and primary assets (Grant, 1996). Knowledge has value once employed practically; otherwise, it is useless to organise data. Effective Knowledge management (KM) is required to achieve the necessary results (Essawi & Tilchin, 2013). Knowledge management aims to provide the right people with exact knowledge at the right time (O’Dell & Hubert, 2011). KM is the process of creating, distributing, sharing, and saving staff knowledge (Dalkir, 2005). Consequently, one of the KM objectives is to take advantage of the expertise and old employees' experiences by storing it and educating new employees.

1.2 Problem statement

The current era's main features are high-intensity competition and the service provided at pace. Consequently, excellent customer services require organisations to eliminate defects in the service provided to the customers. At the same time, the company endeavours to maximise profit through these services. Consequently, high resource utilisation, continuous improvement, and reducing the waste of the process as much as possible should be considered to achieve the company’s goals. As a result, companies are forced to adopt quality management methods

In the last two decades, Lean Six Sigma (LSS) methodology has been embraced by various service organisations in the different services sector to enhance the performance of their services by eliminating the defect in the services and reducing waste. Although LSS is a helpful quality and management methodology, not all organisations successfully benefit from applying Lean Six Sigma (Glasgow et al.,

2010; Kumar & Antony, 2008). Lack of proper skills and training- which are parts of knowledge- and lack of top management support are the main factors that cause the failure of implementation of LSS (Montgomery, 2016).

1.3 Research aims and objectives

This research aims to assess the level of Lean Six Sigma adopted by the service organisations and the level of knowledge management employed by the organisations concurrent with Lean Six Sigma. Investigating the interaction between Lean Six Sigma and the Knowledge management phenomenon is one of this research aims. Therefore, the services organisations can fill the gap in using LSS, enhance the services provided to their customers, and improve the process within the organisation.

The research objectives below emerged Based on the research aims:

1- Evaluate the current level of Lean Six Sigma adopted by the services organisations in Jordan.
2- Evaluate the current level of Knowledge management technique adopted by the services organisation.
3- Investigate the significant association of KM with the implementation of LSS by integrating the LSS approach with KM.

1.4 Research questions

This research will try to answer the following questions based on the research objective.

1- What is the current level of LSS adoption in the services organization in Jordan?
2- What is the current level of KM concept adoption in the services organization in Jordan?
3- What are the obstacles and failure factors facing the Jordanian services organization during the implementation of LSS?
4- Is there a significant role of the KM in the success of LSS in the services organization in Jordan?

1.5 Research model

Figure 1 depicts the research problem, objectives, questions, and the projected relationship between the study variables. The created knowledge should be identified

in every step of DMAIC and stored while the breakthrough is performed. The identified knowledge should be adequately managed through the four steps of the KM procedure in every phase of DMAIC, and available required knowledge should be reused immediately to enhance the service performance. In each step of the DMAIC phases, several tools may be used. The hypotheses have been built between KM management as one element and each phase of DMAIC.

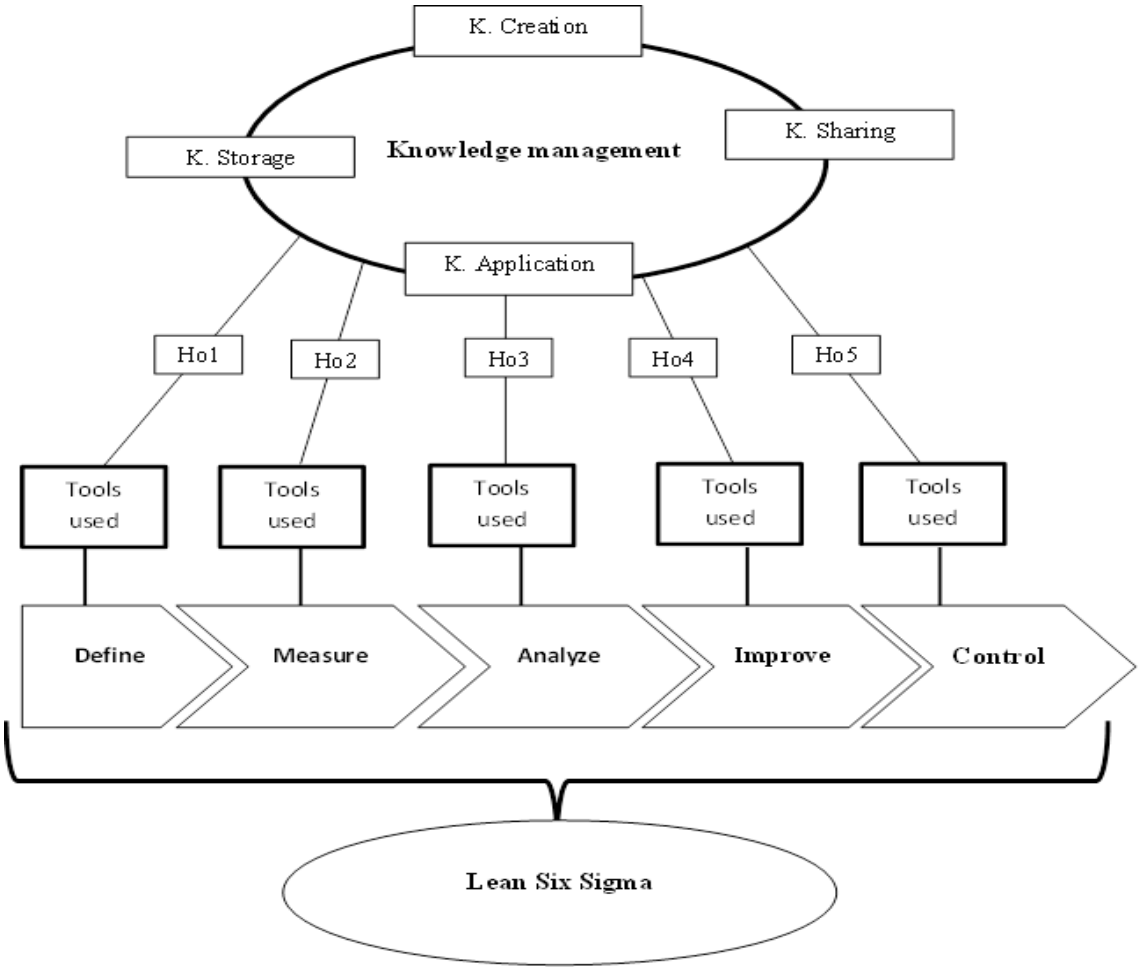

Figure 1. The conceptual framework

According to the conceptual framework, the five phases of the LSS are as follows: define, measure, analyze, improve, and control. The following conceptual and procedural definitions were established for each phase (more details are provided in chapter 2):

- Define: Specify the problem, the customer set, the desired outcomes, and the target process.

- Measure: Identify the parameters that need to be quantified, choose the optimal method for measuring them, gather the necessary data, and conduct the measurements experimentally.
- Analyze: Identify gaps between actual and desired performance, analyze their reasons, understand how inputs affect outputs, and rate improvement prospects.
- Improve, determine which options are the simplest to execute, evaluate hypothetical solutions, and implement genuine changes.
- Control: Develop a thorough solution monitoring strategy, watch implemented changes for success, regularly update plan records, and maintain a functional staff training routine.

1.6 Research Hypotheses

Based on the research problem, objectives, questions, the theoretical models of Knowledge Management and Lean Six Sigma, the experimental evidence examined in the literature review provided the framework for the following research hypotheses:

HO 1: There is a significant relationship at the level of ($\alpha = 0.05$) between knowledge management practice, and LSS define phase.

HO 2: There is a significant relationship at the level of ($\alpha = 0.05$) between knowledge management practice and the LSS measure phase.

HO 3: There is a significant relationship at the level of ($\alpha = 0.05$) between knowledge management practice and the LSS analysis phase.

HO 4: There is a significant relationship at the level of ($\alpha = 0.05$) between knowledge management practice and the LSS improvement phase.

HO 5: There is a significant relationship at the level of ($\alpha = 0.05$) between knowledge management practice and the LSS control phase.

1.7 Research context

Service excellence is not a catchphrase but a long-term commitment to satisfying the customers' ever-increasing demands and desires. It is the duty of the organisation's administration and employees (Alolayyan, Al-Hawary, Mohammad, & Al-Nady, 2018). In Jordan, Few pieces of research deal with improving quality in various

sectors, including financial and bank sectors (Ali & Omar, 2016; Mualla, 2011), accommodations and hotels sector (Al-Rousan & Mohamed, 2010), and telecommunications (AL-Nawafleh, ALSheikh, Abdulllah, & Tambi, 2019). It is noticeable that the health sector is the most concerned with the quality of services provided (Al-Mhasnah, Salleh, Afthanorhan, & Ghazali, 2018; Mandahawi, Al-Araidah, Boran, & Khasawneh, 2011). However, the research on the LSS methodology in Jordan is very limited (Al-Refaie & Hanayneh, 2014; Alomari, Mansour, Almohtaseb, Salah, & Alshaketheep, 2020). Therefore, the lacking of research tackled with LSS motivates the researcher to conduct this study. Furthermore, the researcher is looking to increase their knowledge about LSS and its implementation's success factors.

2- Research Methodology

2.1 Research Methods

The research methodology effectively organizes a group of diverse ideas to reveal that this phenomenon is formed (Anderson & Poole, 2019). The study employed an inferential (analytical) approach, concerned with procedures that infer the existence of findings in the statistical population through representative samples and, subsequently, the generation of quantitative data. This strategy seeks to create a database from which it can infer attributes or connections. It is included in the sample, and its features are inferred to be similar to the original population. The interpretation task primarily concerns the inferential analysis, " inferring and concluding." (Cooper et al., 2014).

Moreover, this study took an exploratory approach. This technique is beneficial for clarifying and analyzing the nature of a problem by defining its conditions, components, and dimensions, describing their interactions, doing data analysis, measuring, comprehending, and accurately describing the phenomena or problem holistically. As a result, it assists in generalizing the facts or knowledge retrieved and gives ideas and recommendations for resolving the issue (Sekaran & Bougie, 2016). The study also used the descriptive approach. This approach is concerned with collecting data through a sample and then organizing it, and it was described quantitatively and then presented in recursive tables. This approach summarizes and

analyses the data by measuring the central tendency and dispersion (Cooper et al., 2014).

2.2 Population & Sample

The study population is defined as the complete enumeration of all the elements in any field of research. In many cases, it is impossible to study all members of the study population. Still, it is possible to obtain sufficiently accurate results by examining a part of the study population (a sample), considering time and cost. The participants selected should represent the entire study population to obtain a reduced cross-section (Saunders et al., 2009).

The primary purpose of sampling, which represents a small number of units, is to be representative of the study population and that events or facts are prevalent in this population (Kumar, 2019). The accuracy of the results depends mainly on how the sample is chosen. Therefore, sampling is the process of selecting a small number (sample) from a larger group to become a basis for estimating the result related to the larger group.

The study population consisted of government institutions counted 110 according to the Prime Minister's report 2020 (Prime Minister, 2020), and service institutions in the private sector. Their number is 1653 (Department of Statistics, 2020), and their registered capital with the Jordanian Ministry of Industry and Trade is 100,000 Jordanian dinars, representing medium-sized and large-sized organizations (CBJ, 2020). The researcher prepared an electronic questionnaire (Online Questionnaire) and published it via (Google forms) using the random sampling method. Only one employee in the upper and middle management within the available positions (managers and their assistants, heads of departments, and supervisors) can answer the questionnaire on behalf of their organization. Each company received only one questionnaire. After 60 days, 207 thoroughly answered electronic questionnaires were received. After checking and reviewing the questionnaires, the number of questionnaires represented by the study sample was 207, which constituted 11.7% of the study population.

2.3 Data Sources:

1) **Secondary Data:**

The researcher consulted books and scientific research on the subject of the study and the World Wide Web (Internet), and numerous publication databases to gather the most recent and suitable worldwide research on the subject.

2) **Primary Data** :

A questionnaire designed in proportion to the study's factors served as the primary source. The questions for the study instrument were developed uniquely for the current research following an intensive review of Knowledge management and Lean Six Sigma literature and brainstorming sessions with my supervisor and academics. The questionnaire's design was based on previous research published by practitioners and academics in the field of quality improvement and KM

3- Results

3.1 Descriptive statistics for the organization's continuous improvement methodologies.

Table 4. Descriptive statistics of continuous improvement methodologies used in the organization

Variable	No	Category	Frequency	Percentage
Continuous improvement methodologies	1	Lean Management	27	%13
	2	Six Sigma	5	%2.4
	3	Lean Six Sigma	6	%2.9
	4	Total Quality Management (TQM)	58	%28
	5	Business Process Management (BPM)	14	%6.8
	6	Business Process Re-engineering (BPR)	8	%3.9
	7	PDCA	6	%2.9
	8	TQM+BPR	42	%20.3
	9	Six Sigma + TQM + BPR	33	%15.9
	10	BPM + BPR	2	%1
	11	LM + TQM+BPR	1	%0.5
	12	TQM+BPM+BPR	5	%2.4
	Total		**207**	**%100**

Source: Own Research 2022

Table 4 shows that 28% of the sample respondents chose TQM as their preferred technique for ongoing improvement. Where 20.3% chose TQM and process re-engineering. 15.9% chose Six Sigma, TQM, and process re-engineering, and 13% chose Lean management. 3.9% of the sample used process re-engineering, and 6.8% used business process management. On the other hand, 2.9% were equally distributed between the LSS and PDCA, and their number was only 6. Followed by 2.4% of answers were for TQM, business process management, and process re-engineering as an approach to continuous improvement. The same percentage and number were for Six Sigma, followed by 1% for managing work processes. The process re-engineering number was 2, while 0.5% of its answer was towards Lean management, TQM, and process re-engineering as an approach for continuous improvement.

If we look at the above result differently, we will find that the LSS methodology use is very little. In comparison, TQM was the most used tool among 139 organizations. This is due to a weakness in keeping pace with and researching the various new quality methodologies, as TQM was adopted early in Jordan as an integrated methodology for developing services.

3.2 Descriptive, inferential statistics for knowledge management.

This part aims to indicate the arithmetic means, standard deviations, the degree of agreement, the paragraphs rank at the arithmetic means, and the (T) value to describe the trends of the study sample towards knowledge management, which were measured based on ten questions.

The KM has achieved an arithmetic mean of 3.69 with a relative weight of 73.8% of the total index and a standard deviation of 0.754. This indicates that the level of knowledge management came within the high level from the sample point of view. The T value at the total indicator 13.234 is higher than its tabular value of 1.960 and statistically significant at the level ($\alpha \leq 0.05$). The results showed that item 2 states: The Organization classifies data and then converts it into information to support decisions. It ranked first with a mean of 3.95 and a high level of approval. Its relative weight was 79% with a standard deviation value is 0.840, where it achieved the value of (T) in this paragraph 16.291, which is higher than its tabular value of 1.960 and is statistically significant at the level ($\alpha \leq 0.05$).

On the other hand, item 9, which states: The Organization's strategic plan promotes the application of knowledge management, obtained the lowest arithmetic means, which reached 3.56, with an average level of approval and a standard deviation of 0.983, and the relative weight reached 71.2%, where the value of (T) at this item 8.310, which is greater than its tabular value 1.96 and is statistically significant at the level ($\alpha \leq 0.05$). Hence, most organisations classify data and convert it into information to support decisions, meaning that they are wired for implementation as indicated by rank. At the same time, a significant emphasis should be set on the initial organizational strategic plan in order to reflect on the different company functions by aligning their goals towards promoting the application of knowledge management within the workflow.

- **3.3 Descriptive, inferential statistics for the CSFs.**

This part aims to indicate the arithmetic averages, standard deviations, degree of agreement, the rank of items at the arithmetic averages, and the (T) value to describe the study sample's trends towards CSF, which were measured based on ten questions.

The CSF has an arithmetic mean of 3.92, a relative weight of 78.4% of the overall indicator, and a standard deviation of 0.487. This shows that the CSF level was excessive among the sample participants. The T value at the total indicator 27,071 is statistically significant at level (0.05) and greater than its tabular value of 1.960. The results showed that item 7, adequate knowledge of quality development tools, occupied the first rank with an arithmetic mean of 4.04 and a high approval level. The relative weight then reached 80.8% with a standard deviation of 0.891, where it achieved the (T) value at this item 16.764, which is greater than its tabular value of 1.960 and is statistically significant at the level ($\alpha \leq 0.05$). On the other hand, item 9, which states: Sufficient Organizational infrastructure, obtained the lowest arithmetic mean, which reached 3.67, with a high level of approval, with a standard deviation of 0.954, and the relative weight reached 73.4%. The value of (T) was at this item 10.122, which is greater than its tabular value of 1.96 and statistically significant at the level ($\alpha \leq 0.05$). All the CSF in the success of the LSS implementation are very important. However, we find that the sample focus on knowledge of the tools used in applying the LSS methodology confirms the questions of the study

3.4 The relationship between KM and the LSS phases.

The correlation coefficient (Pearson Correlation) was extracted to identify the relationship between knowledge management and the LSS phases. The results of which are shown in Table 5.

Table 5. The correlation between KM and the LSS phases

		Define	measure	Analysis	Improve	Control
KM	Pearson Correlation	**0.287	*0.154	**0.300	**0.286	**0.288
	Sig	0.00	0.026	0.00	0.00	0.00
	N	207				
****Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).**						

Source: Own Research 2022

Zikmund et al. (2013) indicated that if the correlation coefficient value ranged between (0.30 - less than 0.60), the correlation strength is medium. While if it is less than 0.30, the correlation strength is low, and if it ranges between (0.60 - 0.80), the correlation is high. Table 28 indicate a medium significant correlation between knowledge management and the analysis phase through the value of the Pearson correlation coefficient, which is 0.3 and is statistically significant at the level ($\alpha \leq 0.01$). It was also found that there is a low considerable correlation between knowledge management and the define phase, which appears through the value of the Pearson correlation coefficient, which is 0.287 and is statistically significant at the level ($\alpha \leq 0.01$). We note a considerably low correlation between knowledge management and the measurement phase. The value of the Pearson correlation coefficient is 0.154 and is statistically significant at the level ($\alpha \leq 0.05$). It was found that there is a low considerable correlation between knowledge management and the improvement phase, which appears through the value of the Pearson correlation coefficient, which is 0.286 and is statistically significant at the level ($\alpha \leq 0.01$). It was found that there is a low considerable correlation between knowledge management and the control phase, which appears through the value of the Pearson correlation coefficient, which is 0.288 and is statistically significant at the level ($\alpha \leq 0.01$).

3.5 The relationship between CSFs and the LSS phases.

The Pearson Correlation coefficient was extracted to identify the correlation between the CSF and LSS phases. The results of which are shown in Table 6.

Table 6. The correlation between CSF and LSS phases

		Define	Measure	Analysis	Improve	Control
CSF	Pearson Correlation	**0.439	**0.314	**0.403	**0.519	**0.366
	Sig	0.00	0.00	0.00	0.00	0.00
	N	207				
****Correlation is significant at the 0.01 level (2-tailed).**						

Source: Own Research 2022

The results of Table 6 indicate a medium significant correlation between the CSF and the define phase through the value of the Pearson correlation coefficient of 0.439, and it is statistically significant at the level ($\alpha \leq 0.01$). It was also found that there is a considerable medium correlation between the CSF and the measurement phase, which appears through the value of the Pearson correlation coefficient, which is 0.314 and is statistically significant at the level ($\alpha \leq 0.01$). We note that there is a medium considerable correlation relationship between the CSF and the analysis phase, which appears through the value of Pearson's correlation coefficient of 0.403 and is statistically significant at the level ($\alpha \leq 0.01$). It was found that there is a considerable medium correlation between the CSFs and the improvement phase, which appears through the value of the Pearson correlation coefficient of 0.519 and a statistical function at the level ($\alpha \leq 0.01$). It was found that there is a medium significant correlation between the CSFs and the control phase, which appears through the value of the Pearson correlation coefficient, which is 0.366 and is statistically significant at the level ($\alpha \leq 0.01$).

3.6 The role of KM in the LSS phases.

To identify the role of knowledge management in LSS phases in service organizations. In this part, knowledge management and LSS phases were subjected to simple linear regression analysis, and the following results were reached:

Table 7. Simple Regression of KM and the LSS phases

KM	R	R^2	Adj R^2	DF	F Calculated	F. Sig	Constant	B	Std. Error	T calculated	T Tabulated	T. Sig
Define	0.287	0.082	0.078	206	18.336	0.00	3.150	0.221	0.052	4.282	1.96	0.00
Measurement	0.154	0.024	0.019	206	4.996	0.026	3.394	0.127	0.057	2.235	1.96	0.026
Analysis	0.300	0.090	0.085	206	20.230	0.00	2.859	0.268	0.059	4.498	1.96	0.00
Improvement	0.286	0.082	0.078	206	18.325	0.00	2.966	0.269	0.063	4.281	1.96	0.00
Control	0.288	0.083	0.078	206	18.514	0.00	3.126	0.243	0.056	4.303	1.96	0.00

Source: Own Research 2022

It is clear from the results of Table 7 that there is a statistically significant role for knowledge management in the define, measure, analysis, improve and control phase through the value of T is greater than its tabular value and significant at the significance level ($\alpha \leq 0.05$).

4- Discussion, Conclusion and Recommendations

This chapter concludes this investigation by proposing answers to the primary research questions raised in Chapter 1. This chapter addresses the research's quality and highlights the study's primary contribution to theory, knowledge, and practice. Additionally, the study's shortcomings are discussed, followed by an agenda for future research that might assist other researchers in focusing their efforts on narrowing the gaps in the current literature. Finally, a critical assessment of the research trip is offered to demonstrate the techniques and personal experiences obtained by the researcher and the problems and barriers encountered along the way.

4.1 Judging the hypothesis

To identify the role of knowledge management in LSS phases in service organizations. Knowledge management and LSS phases were subjected to simple linear regression analysis, and the following decisions were reached:

Hypothesis 1: There is a significant relationship at the level of ($\alpha \leq 0.05$) between knowledge management practice and LSS define phase.

Data analysis points out a significant positive correlation between knowledge management and the define phase at the significant level of $\alpha \leq 0.05$. Therefore, we **accept** the hypothesis. It is noted that the value of the correlation coefficient R =

0.287 indicates a low relationship between the two variables. The value of the coefficient of determination (R^2 = 0.082) indicates that knowledge management explained 8.2% of the variance in the define phase. From the previous, the form of the prediction equation is as follows: define phase = 3.150 + 0.221 x KM. The value of Beta = 0. 287 indicates that an increase in KM by one degree is accompanied by the defined phase's rise of 0.287.

Hypothesis 2: There is a significant relationship at the level of (α≤0.05) between knowledge management practice and the LSS measure phase.

Data analysis points out a significant positive correlation between knowledge management and the measure phase at the significant level of α≤0.05. Therefore, we **accept** the hypothesis. It is noted that the value of the correlation coefficient R = 0.154 indicates a low relationship between the two variables. The value of the coefficient of determination (R^2 = 0.024) indicates that knowledge management explained (2.4%) of the variance in the measurement phase. From the previous, the form of the prediction equation is as follows: Measure phase = 3.394 + 0.127 x KM. The Beta value = 0.154 indicates that the increase in KM by one degree is accompanied by an increase in the measure phase by 0.154.

Hypothesis 3: There is a significant relationship at the level of (α≤0.05) between knowledge management practice and the LSS analysis phase.

Data analysis points out a significant positive correlation between knowledge management and the analysis phase at the significant level of α≤0.05. Therefore, we **accept** the hypothesis. It is noted that the value of the correlation coefficient R = 0.30 indicates that there is a medium relationship between the two variables. The value of the coefficient of determination (R^2 = 0.090) indicates that knowledge management has explained 9% of the variance in the analysis phase. Therefore, the form of the prediction equation is as follows: Analysis phase = 2.859 + 0.268 x KM. The Beta value of 0.30 indicates that the increase in KM by one degree is accompanied by a 0.30 rise in the analysis phase.

Hypothesis 4: There is a significant relationship at the level of (α≤0.05) between knowledge management practice and the LSS improve phase.

Data analysis points out a significant positive correlation between knowledge management and the improve phase at the significant level of $\alpha \leq 0.05$. Therefore, we **accept** the hypothesis. It is noted that the value of the correlation coefficient R = 0.286 indicates a low relationship between the two variables. The value of the coefficient of determination (R^2 = 0.082) indicates that knowledge management explained 8.2% of the variance in the improvement stage. Therefore, the form of the prediction equation is as follows: Improvement phase = 2.966 + 0.269 x KM. The Beta value of 0. 286 indicates that the increase in KM by one degree is accompanied by an increase in the improve phase 0.286.

Hypothesis 5: There is a significant relationship at the level of ($\alpha \leq 0.05$) between knowledge management practice and the LSS control phase.

Data analysis points out a significant positive correlation between knowledge management and the control phase at the significant level of $\alpha \leq 0.05$. Therefore, we **accept** the hypothesis. It is noted that the value of the correlation coefficient R = 0.288 indicates a low relationship between the two variables. The value of the coefficient of determination (R^2 = 0.083) indicates that KM has explained 8.3% of the variance in the control phase. From the above, the form of the prediction equation is as follows: Control phase = 3.126 + 0.243 x KM. The Beta value of 0.288 indicates that the increase in KM by one degree is accompanied by an increase in the control phase by 0.288.

4.2 Discussion

The systematic use of LSS was a specific question that was put to the respondents. Some gave a positive answer; however, the straightforward implementation of LSS in Jordan might be uncommon. Therefore, the researcher relied on the LSS tools, and the respondents were questioned about these tools' usage and the phase at which it occurs. As a result, these organizations only partially use the LSS methodology.

Moreover, This study's results agree with (Pinjari & Teli, 2018), which confirms that KM is crucial in this heavily based knowledge information sector. Consequently, the organisation requires the maintenance of employees' specialised technical knowledge and problem-solving skills to maintain the organisation's smooth operation. Technical expertise must be mastered, and tacit knowledge must be improved through

continuous training and experience. Specialist expertise includes performing procedural knowledge, such as LSS problem-solving procedural knowledge training (Albliwi et al., 2014).

One crucial practice for KM implementation in LSS is proper knowledge implementation as providing interactive module notations and training manuals, having top executives deliver an opening speech, and teaching using innovative theoretical approaches. While for best practices of KM in LSS, the idea revolves around knowledge creation through brainstorming and daily performance reviews. Furthermore, utilizing LSS knowledge enables the creation of new knowledge for problem-solving and continuous improvement (Sin, Zailani, Iranmanesh, & Ramayah, 2015; Zhang & Chen, 2016). Additionally, knowledge storage is essential in indexing knowledge in easily usable forms and standardized formats, leveraging the utility of stored knowledge to employees (Muhammad & Chin, 2020). Moreover, human capital's acquired skills would be lost within months without proper, regular application of the human capital knowledge, skills, and experience during the LSS training.

Employee capabilities and attitudes are critical to the success of Lean efforts (Worley & Doolen, 2006). The most crucial necessity for LSS is proper employee training and communication (Laureani & Antony, 2016). Additionally, employees must sufficiently understand their responsibilities and tasks' what, how, and proper order (Pepper & Spedding, 2010). Although six Sigma training is critical to its success, it is considered prohibitively expensive and time-consuming (Ranjan Senapati, 2004). This can be attributed to the fact it is not yet standardised, leading to its efficacy being questioned. Similarly, employee responsibilities play a part in the success of LSS (Spasojevic Brkic & Tomic, 2016). Without a general framework for implementing LSS (Pepper & Spedding, 2010), employee roles become even more crucial. Additionally, the installation of LSS dynamically changes the duties of individual employees, their assignments, work organizations, employment relationships, tasks, and activities (Drotz & Poksinska, 2014).

4.3 Conclusion

Lean Six Sigma (LSS) methodology has been used in many organisations worldwide to reduce product or service defects and eliminate waste in the process. By implementing LSS, the organisation gains many advantages, including competitive advantages and improving financial and operational performance. Knowledge is one of the organisation's crucial resources and primary assets. Knowledge is a blend of information and practice. Knowledge management aims to provide the right people with exact knowledge at the right time. KM is the process of creating, distributing, sharing, and saving staff knowledge.

This research aims to assess the level of Lean Six Sigma adopted by the services organisations and the level of knowledge management employed by the organisations concurrent with Lean Six Sigma. Through the developed model, the services organisations can fill the gap in using LSS, enhance the services provided to their customers, and improve the process within the organisation. Investigating the interaction between Lean Six Sigma and the Knowledge management phenomenon is one of this research aims. Knowledge management and Lean Six Sigma reduce defects and adapt to new possibilities. Both KM and LSS are pretty effective in boosting organizational performance. Any organization's objective is to enhance customer satisfaction by adjusting services and goods to new standards that align with customers' desires. To achieve this objective, organizations must rely on the synergy of KM and LSS. The research confirms that Knowledge Management is an important factor in implementing Lean Six Sigma performance improvement initiatives.

4.4 Recommendations

According to the results obtained from the theoretical framework and the statistical data analysis, the following recommendations were made:

1- Paying attention to the concept of Lean Six Sigma and emphasizing the possibility of using it in service organizations because of its scientific importance in reducing errors and improving the quality of services commensurate with customer expectations.

2- Working on investing in training and providing workers with knowledge in the field of Lean Six Sigma, the basics on which Lean Six Sigma is based, and its importance and benefit for service organisations.

3- The organizations' managers should emphasize to quality authorities the necessity to concentrate on Knowledge of the LSS methodology's tools, with a stronger emphasis on the measurement stage tools.

4- Adopting the concept of workers' participation in the decision-making process through good suggestions made by organizations workers. Therefore, this avoids their resistance to new management ideas, including Lean Six Sigma.

5- Confirm the support and commitment of senior management regarding implementing projects related to improving services and increasing the satisfaction of service recipients.

6- That service organizations have to support the participation of workers in making decisions related to improving services and the satisfaction of workers as they are in direct contact with service recipients, in addition to improving communication processes between administrative levels

4.5 Research limitation

1- One restriction is that the research is limited to Jordanian organizations. However, because this country has a significant number of organizations, a higher depth of information may be used for this study. As a result, similar research will need to be undertaken in other Middle Eastern nations.

2- Another limitation during the implementation of this study is that data were obtained via the internet (google forms), and hence no deeper insights could be gained.

3- Another difficulty is that this study was conducted during the pandemic period. Where preventive measures were imposed by the state, including the disruption of institutions, this caused delays in data collection and made the international comparison impossible.

4.6 Future Research

This study gives us a foundation for understanding Lean Six Sigma and the elements that make it effective. However, no information or support in this research body can be used to decide whether or not to apply Lean Six Sigma. Future research may focus on the ongoing evaluation of Lean Six Sigma conditions. Based on performance metrics, service applications can do an ongoing assessment of the current situation. This evaluation may take the shape of an intuitive application. A database of the performance metrics and a set of analysis tools could make up this application. The presence of such a system would increase Lean Six Sigma's advantages. However, this line of inquiry is only pertinent if Lean Six Sigma is necessary.

The training methods would be another area for exploration. Typically, classroom instruction is the preferred training technique for Lean Six Sigma. The recent training versions have given the learners meaningful face time with instructors and practitioners. Assessing the effectiveness and performance of a novel idea is an intriguing study topic (Antony et al., 2007). The training approach and its efficacy are crucial because they will enable service organizations to identify the areas in which the training should be concentrated. Any additional investigation into efficient training techniques and creating such a mechanism would be beneficial in this regard. Future research is required to overcome the limitations revealed in this study and to allow for the generalization of the research findings. Among these are the following points:

1- The researcher intends to expand this study to include more MENA nations to determine the present degree of LSS deployment and to compare the findings to Jordanian organizations and Western countries. This will facilitate the exchange of knowledge and best practices across countries.

2- Further study will determine the critical performance differences between LSS and non-LSS organizations.

This agenda is a significant research result that will assist other field researchers in directing their future studies in the following areas:

1- LSS and its impact on organisational performance (financial performance, operational performance)

2- Comparison between LSS and TQM.

3- Change Management and Lean Six Sigma in Today's Business

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A. Journal publications

1- Aljazzazen, S. and Schmuck, R., 2022. Critical Success Factors for Successful Lean Six Sigma Implementation in the Service Organizations. CALITATEA / QUALITY: ACCES LA SUCCES / ACCESS TO SUCCESS 23 (188): 76 - 85.

2- Aljazzazen, S., & Balawi, A. (2022). Risk and Uncertainty in Consumer Decision-Making: An Overview of Principles and Perspectives. Modern Management Review, 27(1), 7-19.

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B. **Conference Publications**

1- Aljazzazen, S. (2021). Factors Affecting the Banks' Profitability in Jordan between 2015 and 2020. In Proceedings of FIKUSZ Symposium for Young Researchers (pp. 21-33). Óbuda University Keleti Károly Faculty of Economics.

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