THE APPLICABILITY OF LEAN SIX SIGMA IN DEVELOPING ECONOMIES: EXPLORATORY RESEARCH ON MANUFACTURING ENVIRONMENTS

UMUDE-IGBRU OVIRI CHARLES

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Umude-Igbru Oviri Charles

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Thesis Summary

Substantial literature has established the role of Lean Six Sigma (LSS) as a successful methodology for continuous improvement. Particularly in manufacturing environments, the synergetic approach between the individual techniques of Lean Production and Six Sigma has created an avenue for change in implementing organizations. However there exists a gap, as studies and implementation cases on the LSS subject are predominantly drawn from developed environments. Working culture and regional norms can affect the application of these techniques.

This research adopts a multiple case study approach to assess the applicability of the LSS initiative, providing a comparative overview of cases in manufacturing environments of developing and developed countries. Using Nigeria as the main unit of analysis for developing countries, a three-stage data collection process was employed for the realisation of the overall aim of developing an implementation framework suitable for organizations in this clime.

As the adopted research approach allows the researcher to be embedded in the implementation process of the case organizations, the need for a holistic approach for learning organizations' implementation of LSS cannot be overemphasized. The findings of the study uncovered the role of the documented Critical Success Factors (CSFs) for LSS implementation and their effect on failing organizational implementation of LSS. This study is among the very few that examines the interaction of the CSFs as they affect the overall implementation of the initiative, particularly for organizations in developing countries.

Based on the findings from the literature and the multiple-staged research process, this doctoral research presents an implementation framework for Lean Six Sigma, which provides a three-phase approach to the applicability of the initiative. The framework takes into cognizance the needs of learning organizations and provides a structured and practical approach to implementation, based on the identified CSFs. A Delphi study, employing expert views, was used to validate the proposed implementation framework.

Key words: Nigeria, Developing countries, Critical success factors (CSFs), Lean Six Sigma

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Dedication

This work is dedicated in loving memory of my beloved father, Sir Kiemute Umude-Igbru.

Contents

List of Tables

List of Figures

1.   Chapter One

Introduction

1.1.   Overview

There are different reasons why organizations are set up in various sectors of the economy. These reasons typically range from the need to meet an existing market demand or create a new market demand to profit-making. For any organization to be truly successful, it must devise a means to stay competitive, because there are usually other market forces competing for the same customers. Research has shown the capability of the Lean Six Sigma (LSS) initiative as a tool for maintaining competitive advantage (Antony et al., 2012a, Timans et al., 2012, Akbulut-Bailey et al., 2012). According to Enoch (2013), for organizations in Nigeria to be more competitive, the low level of awareness and implementation of the LSS initiative in the country should be addressed. To this effect, this thesis will develop a framework for the implementation of LSS in developing countries.

Slack et al. (2013) posit that there are various techniques typically employed by organizations to facilitate them in providing and maintaining a competitive edge and these include but are not limited to:

➢ Creation of ambitious goals and strategies
➢ Provision of low-cost products
➢ Reduction in lead time and speedy delivery of products
➢ Provision of high-quality goods and services

With the level of innovation and product development on the increase (Honarpour et al., 2012), coupled with the recent global economic downturns, competition among organizations has now become global. The role of quality improvement has been identified as a means to achieve competitive performance and organizational success (Dumitrescu and Dumitrache, 2011). However, empirical data to support this view has been drawn heavily from studies carried out in organizations in developed countries.

The evolution of quality management and continuous improvement programmes has had a significant effect on the performance of firms in the developed world (Jagdeep and Harwinder, 2012). This effect has provided benefits in product and services differentiation and organizational

cost reduction achieved through the elimination of waste and an increase in productivity (Agus, 2004, Arnheiter and Maleyeff, 2005).

Lean Six Sigma (LSS), as a major continuous improvement initiative, has received much attention in its relation to competitive advantage (Dumitrescu and Dumitrache, 2011, Ray and John, 2011, Antony et al., 2012b, Laureani, 2012). However, to retain such competitive advantage, organizations globally must employ best practices to continuously improve strategic performance objectives such as quality, cost, product delivery and flexibility (Slack et al., 2013). The competitive landscape requires both radical and incremental improvements within the organization's system, as they represent important components within the continuous improvement journey (Juergensen, 2000). The adoption of continuous improvement initiatives is driven by the increasing pressure for organizations to improve their performance and achieve business excellence. Questions like "to what extent does the adoption of these initiatives affect an organization?" provide the organization with the foresight to implement the right initiative to suit its corporate goals. However, "different strokes for different folks": the generalization of success stories to the implementation of continuous improvement initiatives raises questions as to their applicability to organizations with distinctive cultures and geography.

Focusing mainly on LSS, most literature has emphasized describing the methodology, implementation criteria, concept, tools and techniques of the approach. These studies also provide empirical data that highlight the tool's critical success factors as well as its strengths and weaknesses (Grant, 2008, Salah et al., 2010, Akbulut-Bailey et al., 2012, Antony et al., 2012b, Laureani, 2012). However, the level of implementation and awareness of the Lean Six Sigma approach, particularly in organizations in developing economies is recorded as being low (Zhang et al., 2012, Enoch, 2013). Most organizations in this category in developed countries have managed to exploit the benefits of LSS implementation successfully. However the level of penetration within organizations in developing economies is not as encouraging as it should be (Desai et al., 2012).

The application of the LSS approach as a driver for continuous improvement is increasing significantly and has become the norm approach for organizations (Timans et al., 2012). The need for organizations in developing economies to follow suit has become unavoidable, so as to compete globally effectively. Companies which have already tried to implement the LSS initiative in developing countries still want to know "how" and "when" the benefits accrued from the approach will be achieved. This quest poses a real concern, as the body of knowledge around

the LSS approach has not adequately addressed the receptivity of the initiative among organizations in developing economies. This research aims to fill the gap by focusing on the applicability of the Lean Six Sigma initiative in organizations within the Nigerian context. Key issues and problems are identified to create a learning culture, highlighting several alternatives and factors within the subject domain that could address implementation problems and hence proposing the need to develop an implementation framework to suit organizations in Nigeria.

1.2. Problem Statement

Previous research has highlighted the role of quality management and continuous improvement initiatives to maintain a competitive advantage. In the case of LSS, studies have recognized that its success depends heavily on creating a better fit between the organization and its environment (Grant, 2008, Dumitrescu and Dumitrache, 2011, Duarte, 2012). According to Antony et al. (2012b), the required change necessary for the deployment of the LSS initiative is represented in its critical success factors (CSFs). Fryer et al. (2007) defined CSFs as "the essential things that must be achieved by the company or which areas will produce the greatest competitive leverage". Management commitment, strategic and visionary leadership as well as developing organizational readiness are mentioned as top factors necessary for the successful implementation of the LSS initiative. Findings from Antony's research show consistency with previous Lean, Six Sigma and Lean Six Sigma methodologies (Coronado and Antony, 2002, Fryer et al., 2007, Antony, 2008, Desai et al., 2012). However, the current literature is characterized by studies carried out in organizations located in developed countries, and it is not clear whether these will translate to developing countries.

The question is, then, whether the guiding principles for successful implementation of the Lean Six Sigma initiative can apply to organizations in developing countries, using Nigeria as an exemplar country. Currently the body of knowledge around the Lean Six Sigma subject lacks research carried out within the Nigerian context. Due to this situation, organizations in Nigeria have tried to embrace the LSS methodology with a 'blind-eye' approach, hoping to achieve the benefits accrued from the successful implementation by their counterparts in the developed world. Therefore as a driver of this research, this study aims to explore the role of Lean Six Sigma in industries in Nigeria and the UK. Comparative case studies will be elucidated to address issues associated with the implementation of LSS in a developed culture versus a less mature culture, in national contexts.

1.3. Research Environment: The Nigerian Manufacturing Context

The manufacturing industry is regarded as one of the significant drivers of economic development. It is instrumental in the transformation of any national economy. In an era of rapid improvement in technology, the manufacturing sector offers valuable opportunities for developing countries to blossom and gain competitive advantage in global industrialization (Oparanma et al., 2009).

Nigeria is a developing country with a population of about 182 million, the largest economy in Africa, according to Euromonitor (2016), with its manufacturing industrial sector at the forefront of its growth and development (Iwuagwu, 2009). The manufacturing sector of Nigeria is still in an early stage of development, compared to other sectors in the country and to other countries (Iarossi et al., 2009). The manufacturing sector in recent times has accounted for 9% of the Gross Domestic Product (GDP) and currently employs about 5.2% of the workforce (Euromonitor, 2016). The measure of manufacturing efficiency, and capacity utilisation recorded in the CBN Statistical Bulletin (2015) indicates that the manufacturing sector has been performing poorly, as it is operating at only half of its capacity. This is related to the fact that high costs of production and a tough environment have resulted in both domestic and foreign plants producing below capacity (Kehl, 2009). Among the list of reasons for manufacturing sector decline, lack of growth and capacity utilization, power outages, poor transportation, a low level of technological know-how, and unrest in the Niger-Delta region are most prevalent; resulting in indirect costs of about 16% of sales (Iarossi et al., 2009; Euromonitor, 2016). The combination of these shortcomings raises the need for the rejuvenation of the manufacturing sector amidst the current economic instability. There is a current need for organizations within this sector to achieve more with less, applying best practices in manufacturing to curb the declining state of the sector.

As recorded by the Manufacturers Association of Nigeria (MAN), manufacturing industry in Nigeria is classified into the following groups;

- Pulp and Paper
- Food and Beverages
- Printing and Publishing

- Oil and Gas
- Wood Products
- Automotive and Assembly

- Electrical and Electronic
- Rubber and Plastic
- Metal products

- Chemical and Pharmaceutical
- Clothing and Textiles

These groups constitute the manufacturing establishment in the country, the practices of which are under review in this study. The next section discusses Nigeria as a case study research environment, particularly in its manufacturing sector through human resources, continuous improvement, organisational and economic contexts that are most relevant to this study.

1.3.1. Quality Management Practices in Nigeria

In Nigeria, manufacturing organisations are facing unforeseeable competition for both goods and services. This is usually the case in an environment where customers' expectations are continually changing. The recent deregulation in global market competition has offered customers the right to choose among many alternatives. In addition, customers continuously want value for money in the goods and services offered by manufacturers, demanding high quality at low prices. For this reason, many manufacturing organizations around the world have embraced the idea of Total Quality Management practices as a means of responding to competitive markets. One principle of this management philosophy commonly implemented among manufacturing establishments as a fundamental business strategy is the continuous improvement concept. A manufacturing organization cannot claim to be competitive when it is lagging behind in continuously improving its products and services, processes and employees. Hence, there is a need for manufacturing organizations' commitment to quality improvement. To maintain competitiveness, it is essential for quality improvement to be continuously practised. The realisation of this necessity led to the development of the Total Quality Management idea.

According to Nosakhare (2000), there are still many unanswered questions in the Nigerian manufacturing sector with regard to quality management practices. If the idea of continuously improved quality adds value to customers, why have Nigerian manufacturers shown a mediocre attitude to this philosophy? For some industries that have implemented the idea successfully, why have few improvements been felt as a result? In most cases, why have they not realised the significant benefit of quality management beside continuous improvement?

Ultimately, implementing the LSS initiative is known to play a important role in quality management practices in the manufacturing industry (Aized, 2012). Quality management can easily be integrated into LSS to facilitate manufacturing process improvement. Using LSS metrics, internal project comparisons ease resource allocation while external project comparisons allow for benchmarking. Therefore, the implementation of LSS makes quality management practices more successful in continually improving manufactured product quality. In the current highly competitive market environment, it is crucial for manufacturing organizations to integrate LSS and

quality management to gain the maximum benefits of these management performance improvement strategies.

1.3.2. Human Resources Relations in Nigeria

Human resources relations and practices in the Nigerian manufacturing sector could benefit substantially from LSS implementation. The Nigerian population is the largest in Africa, approximately 180 million people, constituting a huge percentage in terms of workforce. This record is one of the reasons why Nigeria is also the most attractive developing country for foreign investors, particularly in the manufacturing sector, which is the subject. For the LSS initiative to be successfully implemented, there is a need to engage the workforce in its implementation. Human resource management knowledge is an important factor that impacts manufacturing operations in Nigeria and has become increasingly critical for the way in which manufacturing business operations are carried out. The concept of human resources was introduced into the Nigeria workforce around 1940, and since then has been one of the drivers for tremendous growth in the manufacturing workforce in Nigeria. For this reason, the idea of LSS implementation in the Nigerian manufacturing sector cannot be an absolute success in the absence of consideration of human relations and employee engagement strategies.

Below are some facets of human resource management that should be taken into account within the Nigerian context as they provide the motivation of this study.

1.3.2.1. Staffing and Recruitment

The staffing and recruitment processes aim to ensure the appointment of reliable, competent and qualified workers. In today's Nigerian environment, there is a clear distinction between human resource practices in SMEs and large organizations, which are mostly multinational corporations. Selection and recruitment processes in Nigeria have been corrupted by local environmental factors (Nnadi, 2009) such as political pressure, theory and practice of "who you know", the federal character principle of representation, and common state of origin among staff in the same department. Staffing and recruitment processes in Nigerian organizations include sourcing potential employee by advertising or similar means, screening the candidates through assessment tests and interviews, appointing candidates based on the results of the tests or interviews, and on-boarding to ensure that the candidates are able to fulfil their new responsibilities efficiently (Ekwoaba et al., 2015).

The contribution of human resources is largely determined by the type of people recruited into the organization. In most cases, employers focus on the qualifications and experience of candidates being considered for vacant positions. However, it does not necessarily follow that the credentials make the employee. Research reveals that academic training alone might not adequately prepare a person for a job. Also, candidate experience might either be irrelevant or below standard. In fact, instead of focusing mainly on educational qualifications and experience, manufacturing HR needs to go further and explore further the aptitudes, attitudes and personal character of candidates for advertised jobs. In hiring Lean Six Sigma experts, most organizations target certification-based rather than competence-based employees (Enoch, 2013). There is a need to bridge this gap. This idea will really prepare a more favourable environment for production improvements that involve employees' commitment to the implementation of continuous improvement initiatives such as LSS.

The efficiency and effectiveness of productivity in the manufacturing sector largely depend on the quality of the workforce. The availability of a competent and effective workforce does not just happen by chance but through rigorous staffing and recruitment practices.

1.3.2.2. Employee Involvement

Nigerian values and norms have a considerable impact on the way employees carry out their job functions. According to Ovadje and Ankomah (2004), Nigerian managers have difficulty accepting the westernized concept of performance management, with its emphasis on goal setting, face-to-face feedback systems and peer and subordinate evaluation, as these practices are at variance with traditional values. The manner in which employees are involved with the improvement process is critical to the success and sustainability of the implementation of good management practices. Findings from Kuye and Sulaimon (2011) reveal that on average, the employee involvement in decision-making within Nigerian firms was low, attributable to their practice of a high power distance culture where employees are expected to be seen and not heard. This is in agreement with Hofstede's (1993) national culture dimensions for Nigeria of power distance, individualism versus collectivism, masculinity versus feminist, uncertainty avoidance, long-term orientation and indulgence (Hofstede, 2011). In detail, these factors provide a relative positioning of countries through a score on each dimension and are labelled in table 1.1.

Table 1:1 Hofstede's Dimensions of National Culture (Adapted from Hofstede (1993))

Hofstede's Cultural Dimensions	Descriptions
Power Distance	Is the extent to which power and authority is perceived to be unequally distributed by society
Individualism versus Collectivism	This dimension shows the degree of interdependence a society maintains among individuals
Masculinity versus Femininity	This dimensions shows the extent to which society allocates social role to the sexes
Uncertainty Avoidance	Demonstrates the degree to which members of the society feel uncomfortable with uncertainties. The uncertain reaction that the future is unknown
Long Term versus Short Term Orientation	This dimension shows the degree to a society programs its members to accept delayed satisfaction for emotional, social and material needs
Indulgence versus Restraint	This dimension is related to the gratification versus control of basic human desires related to enjoying life.
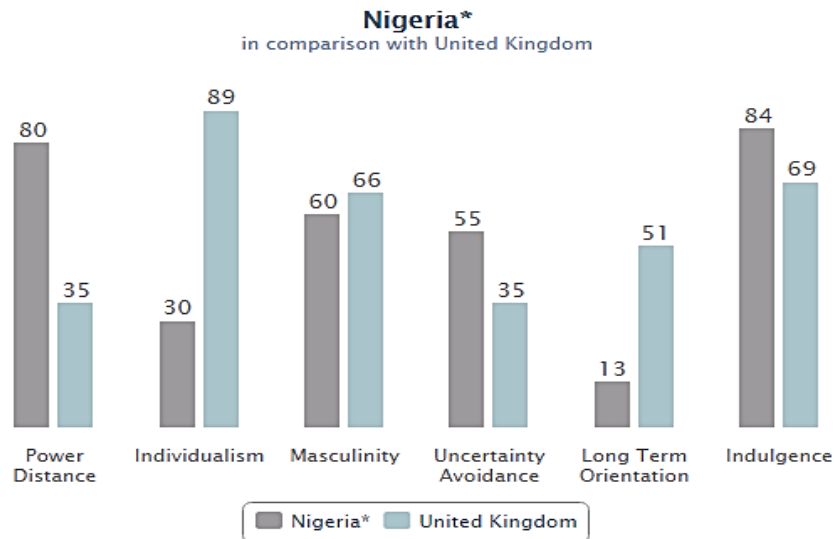
Figure 1:1 Hofstede's Dimensions of National Culture, Nigerian vs the UK (Hofstede, 2017)

As described in the figure above, Nigeria currently stands at a score of 80 and 30 for power distance and collectivism, compared to that of the United Kingdom with a score of 35 and 89 respectively (Hofstede, 2017). The former exposes a Nigerian environment characterized by a hierarchical structure where every employee has their place in a more centralized manner. The latter shows a context guided by strong employee relationships, where everyone takes responsibility for fellow members of their group. The balance provided by these two dimensions within the Nigerian context creates an opportunity for improved working relations. These cultural dimensions of power distance and collectivism seem to provide the rationale for top management and team involvement in making decisions in organizations, creating the need and enabling environment for the practice of management initiatives of which Lean Six Sigma forms a part. It is however unclear if the differences in the characteristics by both countries according to the study of Hofstede (1993) affects the national applicability of these management initiatives, an integral part to which this research is necessitated.

1.3.3.   Organizational and National Culture

According to Adegboye (2013), "*the applicability of modern management theories within the context of strongly defined African cultures has become the central focus of recent academic debates*". The organizational and cultural diversity of Nigeria influences management practices and hence is a significant consideration for LSS implementation. In recent times, a great deal of attention has been given to the importance of organizational culture in LSS implementation (Mi Dahlgaard Park and Näslund, 2013). It comprises the attitudes, beliefs, experience, and values of people and the organization (Hofstede, 1980). Hofstede (1980) has further contributed to the applicability of management philosophies across distinctive cultures by tackling the regional differences in relevance attributable to cultural differences. Adegboye (2013) identifies that the practice of management in Nigeria today is largely westernized. However, the local cultural influence within this environment is still evident and has made the applicability of such practices ineffective or challenging.

According to Aluko (2003), multinational organizations operating in a distinctive cultural context have become increasingly sensitive to the impact of the culture of the host country on their performance. An understanding of prevailing issues within the regional context is required to help mitigate the effects of failed management practices. The need for cultural insights into local conditions to understand the processes and philosophies in different countries has been further emphasised by Hofstede (1993) as highlighted in figure 1.1. As opportunities arise due to

investments in Nigeria's manufacturing sector, an interest in the role of national culture and its values as they affect the implementation of management practices has become even more critical.

1.4.   Rationale for Research

The justification for undertaking this study is based on the following three reasons;

- First is the need to promote continuous improvement initiatives as a tool for maintaining competitive advantage and improving organizational performance for companies globally (Caffyn, 1999, Juergensen, 2000, Coronado and Antony, 2002, Fryer et al., 2007, Oliver, 2009, Antony et al., 2012b).
- Second, empirical evidence to support the role of quality management and continuous improvement initiatives as a prerequisite of organizational growth are based on implementation stories from organizations in the western world (El-Feky, 2009).
- Third, despite the growing literature on LSS, there is still little or no awareness of LSS among organizations in Nigeria and other developing countries (Alsmadi et al., 2012b, Zhang et al., 2012, Enoch, 2013).

In order to promote Lean Six Sigma in Nigerian industries, an understanding of the practices and problems therein should be established. The above section detailing the Nigerian context explains the environment in which manufacturing companies operate. It is evident that some prevailing issues identified hinder opportunities for organizations to achieve more. The underlying principles of the Lean Six Sigma initiative aim to address issues organizations face in their continuous improvement journey, and the need to draw inferences to the Nigerian environment cannot be overemphasized. This study employs a comparative study between organizations in the UK and Nigeria. The former aims to draw experiences from organizations in the West. The latter provides an example of companies in a developing country. An understanding of the dealings of both worlds is required to present an overview of the environmental and industrial conditions required for the successful implementation of Lean Six Sigma in the context of organizations operating in Nigeria. This also highlights particular factors affecting the growing acceptance of LSS in organizations today.

1.5.   Research Aim and Objectives

In cognizance of the discussed research environment, this research aims to develop a framework for the implementation of Lean Six Sigma suitable for the Nigerian manufacturing industry. The

outcome of this study will provide an overview of the role of continuous improvement initiatives in Nigeria, in comparison to the UK. Further comparative studies, representing both developing and developed countries, generated from secondary data sources are presented as support for the main cases. The results will aid organizations to develop strategic goals to promote the LSS initiative. To this effect, the following research objectives are proposed;

1. To create an understanding of trends in and approaches towards the Lean Six Sigma methodology
2. To evaluate the Nigerian manufacturing industry's practice and beliefs concerning LSS
3. To review the implementation of LSS and its effects in organizations in Nigeria and the UK
4. To identify opportunities to sustain the LSS initiative in a developing economy

1.6.   Scope of the Research

The study focuses on the role of the Lean Six Sigma Initiative in organizations. Individual company priorities may affect how receptive they are to LSS initiatives. It is therefore not possible to develop an implementation framework to suit all industries in Nigeria. However, the multiple case study approach employed in this study will target similar industries in both countries. This approach aims to narrow the research to particular sectors to maintain the reliability and validity of the research findings.

The scope of this research is limited to the manufacturing industry of both countries. Although the finding may apply to other engineering sectors, further research, however, could create a valid argument for other sectors.

1.7.   Research Structure

The study is broken down in the following way:

➤ **Chapter one**: This section creates the background to the research. It highlights the research problems and provides justifications for undertaking the research. The aim and clear objectives of the research are also emphasized in this chapter. The overall structure of the thesis is presented.

➤ **Chapter Two**: This chapter explores the origin of continuous improvement initiatives. Drawing from the evolution of Quality Management, this section is designed to provide a historical flow of Lean Six Sigma, highlighting its role in competitive advantage. The chapter also creates a foundation for the realisation of the stated objectives.

- ➢ **Chapter Three**: Comprising 'Research methodology', this chapter highlights strategies employed by the author in undertaking the research. Justifications for each adopted method and procedure are also established with the aim of highlighting their reliability and validity. This section ensures the research adheres to the stipulated ethical guidelines.

- ➢ **Chapter Four**: For the purpose of generalizability of the research findings, this chapter further explains the acceptability of the Lean Six Sigma initiative in both developed and developing countries. Cases in this section are drawn from secondary data sources, aimed at offering comparable data in order to provide a broader context to the research problem.

- ➢ **Chapter Five**: This section provides an analysis of data generated through primary data collection methods. Combining the first and second phases of this research, this chapter explores cases created from Lean Six Sigma experts in Nigeria, participating manufacturing companies from the UK and Nigeria respectively. In-depth interviews from respondents from each clime aided the structuring of this chapter.

- ➢ **Chapter Six:** This chapter focuses on the development of a Lean Six Sigma implementation framework tailored to the Nigerian context. Factors considered for the success of the framework are also emphasized. This section concludes with the validation of the research framework by Lean Six Sigma experts and forms the last phase of the research.

- ➢ **Chapter Seven**: In the "Discussion, research findings and conclusion," this chapter provides a summary of the research, also presenting justifications of each of the research objectives presented in the first chapter.

- ➢ **Chapter Eight**: this section states the importance of the research. Strategic recommendations to promote the acceptability and implementation of the LSS initiative are also presented. The direction for future studies based on the research are also covered, providing researchers with a foundation for building future research in this field.

1.8. Chapter Summary

This chapter has highlighted the primary driver for undertaking this research. Through searches in the subject body of knowledge, areas lacking research were identified. Issues with Lean Six Sigma receptiveness have been discussed and the rationale for undertaking this research has been shown. This chapter further presented the aims and objectives of the research, acting as a guide to answer the questions resulting from conducting this study.

2.   Chapter Two

Literature Review

2.1.   Introduction

The previous chapter briefly explained the background to the research, as well as the stated objectives. This chapter aims to explore existing literature that underpins this study, describing the role of continuous improvement initiatives in manufacturing environments. The body of knowledge on quality management has increased over the years due to constant pressure on organizations to improve their operations. Related topics on the role of continuous improvement and the evolution of Lean Six Sigma form the basis of this chapter. It is divided into three sections, depicting the origin of the Lean Six Sigma initiative and its application to organizations.

The first section (2.2) provides an assessment of the role and impact of continuous improvement (CI) initiatives in relation to quality management. This encompasses the various definitions of continuous improvement as proposed by different researchers. A review and discussion of continuous improvement history, implementation methods/models and the impact of CI on both manufacturing organization operations and business activities are also presented.

The core of the chapter in Sections 2.3 and 2.4 provides an overview of Lean and Six Sigma, the advantages of the tools, a focal discussion, and review on the integration of Lean and Six Sigma. This section also discusses the critical success factors (CSFs) required for successful implementation of LSS. Various models and frameworks, implementation issues, and the impact on organizations' operations and business are also reviewed and discussed.

2.2.   Review of Continuous Improvement Initiatives

The increasing change in customer wants is the key reason why organizations continually aim to seek quality improvement within their products, processes, and services. In their report on the relationship between continuous improvement programmes and their effect on quality results, Tanco et al. (2012) suggest that for an organization to adapt to customer requirements changes, they must seek a continuous improvement programme that allows them to adapt easily to the competitive global environment. The report recognizes continuous improvement as a core component of TQM as used to achieve continuous quality performance and operational

improvement. In this automotive manufacturing-based case study research, the result reveals the significance influence of the continuous improvement programme regarding increasing the rate of defect-free production. However, it is imperative for an organization trying to adopt a continuous improvement programme to choose an adequate response, gather significant data, analyse several determining factors and draw appropriate conclusions as well as practical recommendations.

Ni and Sun (2009) buttress the point from Tanco et al. (2012), establishing the importance of continuous improvement in organizations seeking to continually improve on quality through the application of continuous improvement tools and techniques within their processes, leading to improved performance. From their perspective, continuous improvement must be fully aligned with the organization's strategic objectives and fully integrated into the structure and culture of the organization, with top management involvement geared towards an increase in product and service quality as well as meeting customer expectations. This argument has also been emphasized by Bessant et al. (2001), and Bhuiyan and Baghel (2005).

In this account, continuous improvement as presented by (Anand et al., 2009) is defined as an organization's strategic framework which is concerned with building a systematic mechanism within an organizational structure geared towards creating an innovative environment, proposing new ways of handling activities through undertaking a constant review of its processes. Ussahawanitchakit (2011) defines it as an organizational ability to seek new ways and methods aimed at providing enhancements and improvements in current organizational operations, thereby achieving optimum performance and efficiency within processes. Even though the two definitions view the concept of continuous improvement from different perspectives, the former believes it to be a framework towards creating an innovative environment while the latter thinks it is the ability of an organization to seek new ways and methods to provide efficient processes. However, the definition of continuous improvement is somewhat limited to the individual perspective and background. The researcher believes that key points that relate to the generic purposes of continuous improvement are lost in the process, which limits the meaning given to it.

2.2.1. Continuous Improvement Initiatives (CI)

Continuous improvement initiatives are implemented to ensure steady improvement gains within organizations' processes and activities, integrated into the organizational structure and culture for improved performance and customer satisfaction (Bhuiyan and Baghel, 2005, Anand et al., 2009). Since continuous improvement is a gradual process, and its strength lies in encouraging firms to

maintain existing operations performance, Bessant et al. (2001), in their evolutionary model of continuous improvement behaviour, state that CI seeks gradual improvements in the existing process leading to adjustments and transformation of the process by adopting new ways to improve process performance. According to Handel and Gittleman (2004), continuous improvement initiatives are development tools, techniques and practices that are inculcated and used to execute CI programmes and projects in an organization. To this effect, the balance or approach towards a continuous effective initiative required by an organization should be translated to its needs and requirements.

2.2.2. Rationale for CI Initiatives

The rationale behind the adoption of continuous improvement initiatives by organizations stems from the failure of previous quality frameworks in achieving competitive advantage through market adaptation and organization flexibility to change. Previous quality frameworks such as inspection, statistical quality control and quality assurance were primarily tailored towards the improvement of the organization's internal operations. The 1980s saw the introduction of continuous improvement initiatives, which integrated an organization's management as drivers of quality improvement programmes aligned with the organizational strategic framework and culture. This enabled organizations to adapt easily to changes in market and customer requirements with the production of high-quality goods at a reduced cost through waste elimination and improved operation efficiency, all geared towards improving competitive advantage and performance. Continuous Improvement gives organizations flexibility in processes and systems and promotes a structure that is easily adaptable to change (Jagdeep and Harwinder, 2012).

2.2.3. Timeline of Continuous Improvement Initiatives

The evolution of continuous improvement initiatives over the years is discussed in this section in order to provide a historic picture of Lean Six Sigma, based on the following areas: KAIZEN, TPM, TQM, Lean, Six Sigma and Lean Six Sigma. Lean Six Sigma is regarded as a hybrid methodology. The application of various types of CI initiatives in an organization has evolved over the years, as discussed.

I.   KAIZEN

KAIZEN is a CI initiative that integrates all organizational human resource functions to achieve continuous improvement within an organization's processes and activities. In Singh and Singh (2009) and Jagdeep and Harwinder (2012), KAIZEN is described as operating on the philosophy

of seeking small gradual improvements within an organization's activities and processes. Likewise, the paper released by Terry (2004) on the impact of productive maintenance argues that the core principles of KAIZEN are its maintenance and improvement of current standards, targeting waste reduction with a minimum cost of maintenance. The paper further confirms that KAIZEN operates on the Deming PDCA (Plan-DO-Check-Act) philosophy of quality.
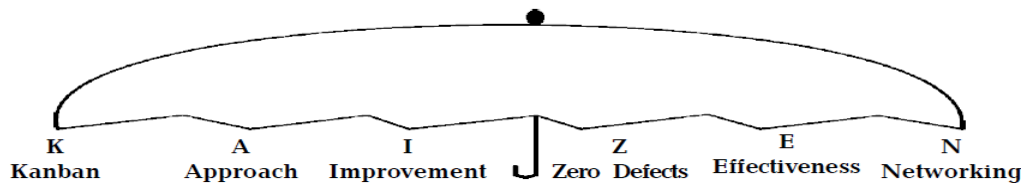
Figure 2:1 The KAIZEN Umbrella of Continuous Improvement (Terry, 2004)

II.   TPM (Total Production Maintenance)

In order to avoid production disruption, CI initiatives seek to improve production equipment. However, the evolution of TPM in 1951 was primarily targeted at preventive maintenance, which later evolved into total productive maintenance, as recorded in Terry (2004). According to Womack et al. (2007), TPM is a holistic system targeted at improvements within organizational production processes, quality systems and employees. Drawing from this evidence, it is relatively safe to argue that the primary objective of TPM is ensuring all production equipment is maintained in the best working condition to avoid disruption within the organization's manufacturing processes.

III. TQM (Total Quality Management)

In the era of organizations seeking to ensure quality standards in their products, processes and services, Total Quality Management (TQM) was introduced in organizational operations in the 1970s (Richards, 2012). Singh and Ahuja (2012) record that TQM was integrated into the TPM framework to ensure quality standards. The purpose of TQM was to achieve customer satisfaction through instilling quality standards across organizational functions. Regarding organizational culture, Siddiqui et al. (2009) discuss that TQM seeks to integrate quality as part of a corporate culture with the integration of an organization's supply chain

IV.   Lean

According to Corbett (2007), Lean is built on the ideology and concept of maintaining organizational competitive advantage through systematic reductions in waste during operational processes, streamlining activities to achieve efficiency in time and creating more customer value with the application of fewer resources at a reduced cost. Lean was formally identified by Womack et al. (2007) in 1970 and pioneered by Toyota with its application to its manufacturing processes.

V.   Six Sigma

Based on (Drake et al., 2008), CI initiatives' focus shifted to improvements in operational processes by seeking a reduction of errors and variations through the application of statistical methods and various quality management systems, an approach introduced by Motorola in 1986.

VI.   Lean Six Sigma (Hybrid Methodology)

Continuous Improvement initiatives targeted achieving high quality, efficient production, and waste reduction, which led to a synergetic approach that was a combination of both Lean and Six Sigma.

Table 2.1 below illustrates the evolution of CI initiatives with the corresponding timeline from the 1950s to the present day. In today's hybrid methodology, CI seeks to capture the improvements of both Lean and Six Sigma, aimed at waste elimination within production processes while maintaining the highest quality, as well as eliminating errors and production variation respectively. The applicability of the initiative listed above, regarding the geographical divide, is debatable. It is argued that the successful implementation of these initiatives are dependent heavily on organizational knowledge and an understanding of the proposed methodology (Juergensen, 2000, Ni and Sun, 2009, Oliver, 2009). This establishes a question about how organizations in developing countries, particularly characterized by low awareness and knowledge levels, fare in the implementation of these initiatives.

Table 2:1 Timeline for CI Initiatives (Umude-Igbru, 2014)

YEAR	CI TIMELINE	CI INITIATIVE
1950	First seed of CI planted by Deming and Juran adopted by Japanese management to seek improvement in processes, systems and employees.	KAIZEN
1951	CI initiative shifted to seek improvement in equipment to avoid production disruption.	TPM (Total Production Maintenance)
1970	CI initiatives transformed to seeking improvement in products, processes and services with attention to quality and customer satisfaction. Supply chain integration.	TQM (Total Quality Management)
1970	CI initiatives shifted focus to eliminating waste within production process while maintaining highest quality, reduction in production time and improved value. Formally identified by Womack in Toyota production plants.	Lean Manufacturing
1980	Focus shifted to improvements in operational process quality by seeking to reduce and eliminate errors (defects) and reduce production variation.	Six Sigma
Today	CI initiatives seek improvement in both product quality and production speed while reducing defects/variations in the production process.	Hybrid Methodology (Lean Six Sigma)

2.2.4. Successful Implementation of CI Initiatives

In an attempt to provide an answer to the question raised above, it is imperative to provide empirical evidence on the role of continuous improvement initiatives in both developed and developing countries, as well as highlighting key findings these research studies present. It can be argued that generalization of some of this evidence does not create a clear picture of implementation issues experienced by organizations in both regions. However, this approach aims to create an understanding of cases with organizations in these regions.

In Table 2:2 on continuous improvement cases, one similar purpose for which these studies were undertaken was to expose further how each of these initiatives affects the performance of the environment to which they are applied. The motivational factors for each case might be different, but the key message, irrespective of the geographical region, is to sustain and optimize manufacturing output. From the cases, it is evident that the success of the implementation of an initiative is dependent on a careful and structured approach to their application. Various issues are highlighted from the cases as well as the corresponding initiative to tackle such problems. In summary, the application of these initiatives has been proven to help organizations maintain a competitive advantage. These initiatives have been around for a long period, and the level of awareness and understanding could be the reason for their success in these cases. For new methodologies, such as the combined approach of Lean and Six Sigma, it is imperative to create an understanding of its approach first, before assessing its suitability for organizations in developing environments.

Table 2:2 Successful implementation of CI initiatives

CONTINUOUS IMPROVEMENT CASES				
Organization/ Division	**Source/ Country**	**CI Initiative**	**Research Purpose**	**Key Findings**
Company A • Petrochemical Plant	(Desai and Prasanna, 2011) India	KAIZEN	To illustrate the concept and principles of the KAIZEN methodology in a manufacturing environment, exposing its benefits as a continuous improvement tool.	Plant was characterized by problems: • Low material quality, lack of standardized processes, low product quality Structured introduction of KAIZEN sought out benefits in key areas: • Organizational processes, benchmarked measurement standards and overall organizational performance • 75% increase in the number of improvement processes per workforce
Lincoln Industries • Ceramic manufacturing company • Manufacturing SME	(Howell, 2011) USA	KAIZEN	To expose the usefulness of KAIZEN within its operations.	Achieved significant improvements through the application of KAIZEN: • Cost savings of about $1.6m • 70% inventory reduction • 50% productivity improvement • Lead-time reduction of about 60%
Multiple manufacturing environments	(Erlandson et al., 1998) USA	Poke-Yoke and KAIZEN	To establish the role of the application of KAIZEN and poke-yoke techniques as tools to create job opportunities and improve productivity.	Previous issues included: • High variation within operational assembly processes due to the use of old fixtures within the process Introduction of CI initiatives brought about: • Increase in production rate of about 80% • Reduction in process error rate of about 50% • Effective utilization of manpower
Company B • Electronics semi-conductor manufacturing firm	(Chan et al., 2005) China	Total Productive Maintenance (TPM)	To expose the effectiveness and implementation of the TPM initiative in a manufacturing setting.	Pre-CI implementation saw issues in: • Machine unreliability • Poor employee skillset Application of TPM saw: • Increase in employee skillset • Equipment productivity improvements of about 83%

CONTINUOUS IMPROVEMENT CASES				
Organization/ Division	Source/ Country	CI Initiative	Research Purpose	Key Findings
Multiple manufacturing environments	(Aspinwall and Elgharib, 2013) United Kingdom	Total Productive Maintenance (TPM)	To demonstrate the effectiveness of TPM in large and medium size manufacturing organizations.	Exposed organizational culture as a major impeding factor for the implementation of TPM. Other issues were in areas of: • High cost of production • Low employee skill levels • Low equipment efficiency levels. Saw benefits after a structured implementation of TPM across for companies in the areas of: • Improved plant availability and equipment performance • Increased in employee communication and job satisfaction • Overall financial improvements.
Multiple manufacturing environments	(Hernández Palomino et al., 2013) Mexico	LEAN	To explore the elements and practices of Lean management as they affect the performance of organizations.	Exposed differences between organizations practising the Lean methodology and non-practising ones. Benefits for the Lean organizations included: • Reduction in organizational cost of business • Increase manufacturing flexibility and volume • Market adaptability and increased organizational efficiency
Multiple manufacturing environments	(Mehta et al., 2012) India	LEAN	To investigate the implication of Lean manufacturing practices in automobile industries.	Exposed an integrated approach to Lean manufacturing and the organizational strategic objectives. Highlighted benefits in cost reduction and waste elimination. Exposed lack of top management commitment as a major impeding factor for the implementation of Lean methodology.
Multiple manufacturing environments	(Alsmadi et al., 2012b) Saudi Arabia	SIX SIGMA	To study Six Sigma implementation among Fortune 100 manufacturing and service firms	The rate of Six Sigma implementation is less than 32% • Exposed its rate in developing countries • Highlighted lack of knowledge and education as key impeding factors • Lack of top management commitment and insufficient communication were further impeding factors Among these impeding factors, benefits accrued from the implementation of Six Sigma included: • Overall reduction of customer complaints • Reduction of scrap rates and process variability

2.3.   Review of Lean and Six Sigma

The previous section analysed the role of CI in manufacturing environments, establishing an overview of events within cases in different geographical regions. This section digs further to discuss the concepts of Lean and Six Sigma, which are characterized to be the most popular continuous improvement methodologies used by organizations today (Albliwi et al., 2014). The benefits and limitations and the integration of both concepts are investigated and discussed. The guidelines as represented by the critical success factors for the implementation of the Lean Six Sigma methodology are discussed to help organizations in their journey

2.3.1. Lean Overview

The basic principles of a Lean management philosophy, although not referred to by that name at the time, were introduced around the time of Henry Ford's concept of mass production (Womack et al., 2007). The application of Lean techniques in industries has helped organizations to achieve production throughput and a reduced process cycle with a minimal amount of inventory (Alsmadi et al., 2012a). Womack et al. (2007) record that the philosophy was adopted by the Japanese, who modified and carried out systematic improvements to the philosophy called Lean production. The development of Lean production was a result of the influence of the Toyota Production System (TPS) aimed at achieving efficiency within the production process in a manufacturing system (Majed et al., 2012). (Majed et al., 2012) discuss a comparative analysis of Lean practices and performance. They state that Lean practice focused on ensuring continuous product flow within Toyota's production units in order to increase flexibility and adaptability to market demands, a point backed up in Holweg (2007).

To comprehend the concept of Lean philosophy, it is essential to understand the terminologies associated with Lean. Lean thinking can be defined as an organization-based philosophy targeted towards its operations, aimed at reducing waste in its processes (Hines et al., 2004), i.e. it is aimed at achieving organizational efficiency. Within a manufacturing context, Lean production is the integration of Lean thinking into an organization's manufacturing process in order to eliminate waste and improve effectiveness and efficiency (Holweg, 2007, Womack et al., 2007). In this context, waste can be defined as any task or activity within the organization's operations that requires resource inputs without value creation for the organization (Majed et al., 2012).

Lean, therefore, is concerned with the identification and elimination of all forms of waste within the operation process. Identified as a continuous improvement initiative (Bessant et al., 2001, Bhuiyan and Baghel, 2005, Anand et al., 2009), its overall aim is ensuring efficiency within an

35

organization's operations and production processes. This is achieved through the reduction of human activity, scrap and inventories, process flow time and product development time in order to meet market requirements and demand while ensuring high standards of quality at the lowest cost (Sanjay, 2013).

Majed et al. (2012) identify five key factors of Lean management in an organization:

- ➢ Identifying and eliminating waste
- ➢ Improving process flow
- ➢ Process objective is value creation
- ➢ Product based on customer pull (Kanban)
- ➢ CI approach focused on achieving perfection

According to (Atkinson and Nicholls, 2013, Martínez-Jurado et al., 2013, Packowski and Francas, 2013), for successful implementation of Lean management philosophy, there must be

- ➢ Management and leadership commitment
- ➢ Employee training, development, and commitment
- ➢ Integration of Lean practices into organization culture
- ➢ Supply chain integration

Table 2:3 Advantages and Disadvantages of Lean

S/N	Advantages	Disadvantages
1	**Waste Elimination** A major benefit linked with the implementation of Lean philosophy, principles and techniques is the elimination and reduction of waste within the organization's processes and activities (Osorno, 2013). Effective implementation of the Lean methodology leads to waste elimination within operations through inventory control and a leaner process (Kavanagh and Krings, 2011).	**Wrong Focus** Focus is primarily on process and product speed, which can lead to the neglect of quality (Gupta, 2009).
2	**Quality Improvements** Lean thinking, principles, and management are geared towards product quality. The implementation of Lean ensures the optimum quality of end-products, as errors, and non-value-added activities are eliminated in the process (Wee and Wu, 2009). The integration of Lean within the organization's supply chain also ensures quality standards are met within the value chain (Sanjay, 2013).	**Poor Decision-Making** Decision-making is not scientifically based (based on data), leading to errors.

S/N	Advantages	Disadvantages
3	**Reduction in Production and Operations Costs** The principles of Lean management focus on waste elimination, lead-time reduction, inventory control, balanced production processes and material flow (Seth and Gupta, 2005, Green et al., 2010): a corresponding effect of reductions in production and operating costs is achieved (Sanjay, 2013). This ensures a competitive edge for organizations in the marketplace, as price differentiation is predetermined (Yu-Lee, 2011, Simpson and Greenfield Jr, 2012).	**Poor Change Management Implementation** Requires change management, which not all employees might embrace.
4	**Flexibility in Meeting Market Demand and Customer Satisfaction** Implementation of Lean principles can enhance customer satisfaction, as the integration of customers within the product design stage ensures customer requirements are met and are of perceived quality (Gautam and Singh, 2008). Lean ensures faster process flow, ensuring products meet customers at the required time, achieved by aligning daily work activities to meet customer and organizational objectives. This ensures maximum customer satisfaction (Pejsa and Eng, 2011).	**Cost of Implementation** High cost of implementation.
5	**Maintenance of Competitive Advantage, Inventory Reduction, and Performance Improvement** A full implementation of the principles of Lean will lead to improved organizational performance (Ferdousi and Ahmed, 2010). Organizational performance improvement is achieved as a result of improvements in the organization's production process due to waste elimination, cost reduction and improved processes (Majed et al., 2012). The application of Lean leads to a reduction in inventory levels and an efficient inventory control system (Hofer et al., 2012).	**Loss of Autonomy** Task enlargement and loss of autonomy for workers (Stewart et al., 2010).

2.3.2.   Six Sigma Overview

The Six Sigma methodology was first conceptualized and introduced by Motorola in the 1980s by engineer Bill Smith (Coronado and Antony, 2002). The advent of Six Sigma was a response by Motorola to curb issues related to the production of low-quality goods which arose mostly in production design (Arnheiter and Maleyeff, 2005). This required Motorola to raise its design quality standard from a three sigma to a Six Sigma evaluation process in order to achieve high-quality conformance, achieved with a set benchmarked conformance probability ratio of 0.997 (Devore, 2012). This ensured high-quality products and a significant reduction in defects.

According to Bisgaard and Freiesleben (2004), Six Sigma was a continuance of the TQM initiative that focused primarily on the need for all stakeholders within the organization's functions to take full responsibility for processes, ensuring products and services are of high-quality standards as

interpreted by the voice of the customer. Other firms including Honeywell and General Electric sought to follow suit by implementing the Six Sigma improvement initiative in their organizational structure (Snee and Hoerl, 2003). Six Sigma operates on the customer approach by ensuring that decision-making processes within the organization's process are solely based on an in-depth analysis of customer data, with the emphasis on seeking continuous cost reduction. An excellent example of the positive result obtained from implementing Six Sigma in industries as highlighted in Schroeder (2000) was recorded for Motorola, who increased their sales figures and saved almost $16 billion, earning them organizational growth and quality awards.

Various attempts to define Six Sigma have been found in the related literature. Deshmukh and Chavan (2012) define Six Sigma as a quality continuous improvement initiative that seeks constant reduction within an organization's operations process to achieve high-quality conformance and reduced process costs. Schroeder et al. (2008), also define Six Sigma as a continuous improvement tool integrated into an organization's structure which ensures reductions in variations within the operation process through the inclusion of various improvement specialists, with benchmarked quality and performance standards towards the realisation of customer satisfaction and organizational objectives. However, in (Gitlow and Levine (2005), Gitlow et al., 2005), the primary objective of Six Sigma implementation is to ensure continuous improvement and variation reduction within the organization's processes through rigorous analysis in order to impact positively on organizational cost, quality and financial performance.

Likewise, in Pfeifer et al. (2004), the implementation of Six Sigma is aimed at improvements in product and service quality by promoting improvement goals within the organization's operations process, aligned with its strategic objectives. Contrarily, Hong and Goh (2003) state that a full implementation of Six Sigma must be an integration of tools which provides a support framework for undertaking data analysis and finding solutions. Six Sigma enhanced the Deming PDCA (Plan-DO-Check-Act) principle to create improvement processes such as DMAIC (Define-Measure-Analyse-Improve-Control), DMADV (Design-Measure-Analyse-Design-Verify), DFSS (Design for Six Sigma), etc. (Pande and Neuman, 2001, Brady and Allen, 2006).

The DMAIC methodology operates on the principle of seeking improvements to an already existing process, while DAMDV aims to create a new process, product or design (Gitlow and Levine, 2005). Design for Six Sigma (DFSS) is a strategy that enables innovation in the Six Sigma Process by ensuring effort and time is put into process and product design to meet customer requirements (Research, 2010). For successful implementation of Six Sigma, it is important that

these tools and methodologies are integrated into the organizational objectives in order to reap maximum benefits. For this to occur, the following factors should be considered:

- ➢ Employee training and knowing customer requirements all built into the organizational model (Chakravorty, 2009).
- ➢ Management commitment and employee training, as the implementation requires careful selection of employees who will monitor, develop and implement Six Sigma as well as conduct evaluation in order to ensure continuous improvement while the management ensures the adequate allocation of the required resources (Goh and Xie, 2004).
- ➢ Integrating Six Sigma into organizational culture to ensure employee motivation through a reward management system (Antony, 2004).
- ➢ Full integration of Six Sigma into organizational structure to ensure the continuity and absorption of Six Sigma principles and tools (Wyper and Harrison, 2000).

In conducting employee training in Six Sigma, there is a systematic approach to differentiating employees by level of knowledge attained in Six Sigma. These levels are grouped into belts (Han and Lee, 2002):

- ➢ Master Black Belt: Highest Six Sigma training responsible for training black and green belts. Ensures Six Sigma integration into organization's strategic objectives and continuous improvement of the programme. Full-time commitment (Shaked, 2010).
- ➢ Black Belt: Full-time commitment to Six Sigma implementation. Acts as project lead and seeks solutions for Six Sigma implementation (Jiju et al., 2007).
- ➢ Green Belt: Responsible for data analysis and collection. Ensures Six Sigma implementation techniques are successful. Roles includes leading small quality teams.
- ➢ Yellow Belt: Assists in supporting Six Sigma implementation and process reviews.
- ➢ White Belt: Lowest Six Sigma level. Has an understanding of the basic Six Sigma principles.

Miguel and Andrietta (2010) list three important aspects to be considered by organizations in adopting Six Sigma within their operations process or product development:

- ➢ Six Sigma's impact on business objectives i.e. financial impact, quality impact, and customer satisfaction
- ➢ Feasibility study to analyse the availability of resources and ability of the organization to implement Six Sigma effectively

➢ Organization's influence i.e. benefits organization stands to gain, e.g. employees, cost savings, etc.

Table 2:4 Advantages and Disadvantages of Six Sigma

Advantages	Disadvantages

To understand the full benefits of Six Sigma, there is a need to understand the attractions of organizations and to analyse data on achievements of Six Sigma implementation in these organizations (Klefsjö et al., 2001).These benefits are listed by (Henderson and Evans, 2000, Arnheiter and Maleyeff, 2005, Kwak and Anbari, 2006) as:
 	
  i.   Reduction in process variation
 	
  ii.   Increase in financial performance
 	
  iii.   Increase in customer satisfaction
 	
  iv.   Conformance to high quality standards
 	
  v.   Increase in productivity
 	
  vi.   Reductions in defect/scrap and rework
 	
  vii.   Reductions in cycle time
 	
  viii.   Cost savings
	The following as highlighted by (Dalgleish, 2003, Antony, 2004, Johannsen et al., 2011) are the disadvantages and challenges of the Six Sigma initiative:
	
	  i. Focus centred on the quality of process and product rather than the process flow velocity
	
	  ii. Cost of employee training: There is a high cost associated with bringing external consultants to train employees in order to obtain different levels of certification
	
	  iii. Difficulty of data collection: Relies heavily on data collection for decision-making, and data may not be readily available
	
	  iv. Costly for small business organizations
	
	  v. Primary focus on quality improvement: Associated cost to achieve quality is usually not considered
	
	  vi. Time constraint: Takes a long time to implement and achieve results

2.3.3. Lean and Six Sigma Integration

Having discussed Lean as well as Six Sigma, we now investigate the integration of both, which has become increasingly popular in today's business processes, hence it is important to the current research. The main driving force for Lean-Six Sigma integration is that organizations seek to enhance their competitive advantage leading to the adoption of several continuous improvement programmes, including the Lean management programme by Toyota and the Six Sigma concept by Motorola. These two management methodologies are integrated into an organizational culture for successful implementation, providing new perspectives and techniques for production processes and to achieve customer satisfaction (Arnheiter and Maleyeff, 2005,

Salah et al., 2010). They both require extensive training of employees and full commitment of all cadres of the organization's management. Both systems are targeted at achieving customer satisfaction, quality and employee commitment (Pepper and Spedding, 2010).

Organizations aim to increase high-quality products at a reduced cost while eliminating defects. The adoption of a CI initiative aids in improving operational efficiency and effectiveness within an organization. However, this may not help to solve all organizational issues. The two concepts of Lean and Six Sigma have had individual successes, with Toyota's enormous success in the application of Lean and GE's high success rate with Six Sigma. To solve the increasing levels of organizational issues, organizations today tend to seek ways of combining different CI initiatives geared towards creating a more profound effect on the organization (Shah et al., 2008).

One of the most often combined CI initiatives is the Lean and Six Sigma framework called Lean Six Sigma (Pepper and Spedding, 2010). The need for the combination of these initiatives can be seen from the shortcomings of each CI initiative, like the inability of Lean to have complete control of a process through statistical control, or Six Sigma' deficiency in improving process speed and seeking a reduction in capital invested. This has led to the combination of both concepts with the intention of deriving maximum benefits and providing a more in-depth solution to organizational problems (Bhuiyan and Baghel, 2005). The Lean and Six Sigma concepts have similar principles and frameworks with an underlying approach to improving quality (Majed et al., 2012).

The main question facing organizations in the adoption of the Lean Six Sigma initiative lies in "how to implement?" rather than the choice to adopt, as experienced by companies like Ford, Honeywell, Dow Chemicals, and organizations in diverse sectors such as finance and health (Majed et al., 2012), who have successfully implemented it. However, some organizations have not had much success in its adoption (Näslund, 2008). Ray and John (2011) state that one major challenge of the Lean Six Sigma concept arises in the need for organizations to be able to strike a balance between quality and speed in order not to cause improvements in one and neglect of the other. This is because the Lean Six Sigma concept targets improved speed and quality achieved through waste elimination and reduction in variations.

Antony (2004) states that the Six Sigma methodology needs to be improved upon in order to enable it to adapt to continuous market requirement and changes. In the same manner, Montgomery and Woodall (2008) state that the Lean methodology allows for the easy integration of other methods while maintaining focus on its priority, which is customer focus and elimination of waste. Both the Six Sigma and Lean methodologies adopted various tools borrowed from other

methodologies but successfully integrated and structured them into their methodologies. This makes it possible for these tools to be easily interchangeable amongst both methodologies (Montgomery and Woodall, 2008, Alessandro and Jiju, 2010).

The integration of LSS provides a wide variety and availability of tools to solve organizational problems, either by application in a fast manner and process like KAIZEN or by conducting a rigorous, detailed and gradual application, like the DMAIC process. The integration of LSS should be a holistic approach and not carried out in parallel within an organization's framework, as this could result in issues from problems in resource allocation, increase in cost implementation, prioritizing initiatives and indecision on which tool to apply. The integration of Lean into the Six Sigma framework is easily compatible, as it aids in the reduction of variation within the Lean framework (Montgomery and Woodall, 2008, Laureani, 2012). The implementation of LSS should be a holistic framework applied simultaneously in order to achieve organizational objectives.

2.3.3.1. Rationale for Lean and Six Sigma Integration

Organizations seek to improve their competitive advantage and increase performance in all aspects of their organizational functions. The Lean Six Sigma integration emerged in order to combine the efficiency, principles and framework of both individual initiatives to achieve faster improvement rates, ensure speed, higher quality, zero defects and reduced cost and to achieve customer satisfaction. The combination of both initiatives allows for a reduction in waste through the application of Lean and enabling easy identification of variations through the adoption of Six Sigma (Majed et al., 2012, Pamfilie et al., 2012).

Lean and Six Sigma are similar in their philosophy and principles, both being geared towards quality improvement and customer satisfaction, although with different approaches. The importance of integrating Lean and Six Sigma can be seen from the benefits derived from organizations implementing one of the initiatives and looking to incorporate another, but the differences in both approaches should be understood so as to have a better understanding of their combination (Arnheiter and Maleyeff, 2005, Mandal, 2012, Duarte, 2012).

- Benefits for Lean organizations considering the incorporation of Six Sigma: The necessity for a scientific-based approach to decision-making due to more data and data analysis techniques that leads to a focus on process and reduced variation.

- Benefits for Six Sigma organizations adopting Lean: Six Sigma organizations have the tendency to sacrifice quality for service delivery and process speed, which the merging of Lean will mitigate with the elimination of non-value-added activities within the system.

The differences between the philosophies concerning their approach as highlighted in Table 2:5 further creates a strong rationale for joint implementation.

Table 2:5 Difference in approach between Six Sigma and Lean. Adapted from Arnheiter and Maleyeff (2005), Salah et al. (2010)

LEAN	SIX SIGMA
Increasing speed of product flow	Ensuring end product conforms to quality
Elimination of waste and non-value activities	Removal of variations in the process
Shortening the process	Elimination of root causes in the process
Process flow	Process defects
Addresses visible issues like inventory	Addresses less visible issues like variations and measurements
Direct employee engagement	Use of specialists to implement

The need for organizations to eliminate the shortcomings and weaknesses of each methodology has led to the need to integrate these methods, their tools, and principles in order to derive maximum benefits.

2.3.4. Definition of Lean Six Sigma (LSS)

Lean Six Sigma is a continuous improvement initiative that seeks to enhance organizations' business and competitive advantage through a well-structured merger of both philosophies of Lean and Six Sigma (Antony et al., 2003). The former which focuses on process speed and the elimination of non-value-added activities works in synergy with the latter which centres on meeting the customer's quality requirements through the reduction of process variations (Alessandro and Jiju, 2010, Laureani, 2012). Montgomery and Woodall (2008) define it as a management system that seeks to integrate the principles, philosophies, and frameworks of both systems targeted towards performance enhancement and process improvement.

(Pamfilie et al., 2012, Corbett, 2011) define Lean Six Sigma as a methodology that is directed at the realisation of waste elimination and variation within an organization's activities and processes through the integration of the DMAIC tool. This is with the aim of ensuring organizations meet

customer satisfaction and market requirements within the constraints of quality, speed and cost. Lean Six Sigma's primary target is the realisation of improvements in processes, customer satisfaction, competitive advantage and financial performance.

The above definitions highlight the synergetic approach of the principles of both philosophies aimed at the improvement of the overall business performance. Its success is determined by the level of the merger, as seen in the above definitions. In other words, Lean Six Sigma can be defined as a CI approach that seeks full utilization of the benefits to be attained through the combination of both initiatives of Lean and Six Sigma, ensuring a bottom-line organizational competitive advantage in operations and financial performance. Organizations embrace Lean Six Sigma with the aim of improving their competitive advantage and still ensuring the aims of both approaches are fulfilled i.e. customer satisfaction, quality improvements and process efficiency. This ensures that the organization derives maximum benefit from the combination of the models.

(Arnheiter and Maleyeff, 2005, Laureani, 2012) stated that for effective implementation of Lean Six Sigma, organizations should clearly spell out their aims and objectives by aligning to its underlying principles. These aims should include:

- ➢ Creating goals based on a philosophy that ensures value creation within an organization's process
- ➢ Management commitment
- ➢ Creating a decision-making process that is science-based and customer-focused
- ➢ Seeking quality improvements through the reduction of variations
- ➢ Exploring the role of employee training and development
- ➢ Integrating the underlying principles into the organization's structure and culture
- ➢ Continuous improvement

2.3.4.1. Benefits of Lean Six Sigma (LSS) Integration

According to Salah et al. (2010) and Ray and John (2011), the integration of Six Sigma and Lean enables the organization to enhance their performance improvement, achieved through a well-structured approach to both methodologies. Salah et al. (2010) further explain that the importance of the integration can be seen in the organization's application of one methodology without knowing the benefit of applying the other, as an effective combination of both methodologies leads to continuous improvement.

Table 2:6 Benefits of Lean Six Sigma Integration

BENEFITS	SOURCE	SUMMARY
Business improvement	(Akbulut-Bailey et al., 2012) (Dumitrescu and Dumitrache, 2011) (Salah et al., 2010)	Integration of LSS will ensure business improvement through improvements in product quality and process speed leading to cost savings and increased competitive advantage
Process improvement i.e. quality and process accuracy measurement	(Chen and Lyu, 2009) (Grant, 2008) (Jenica et al., 2010) (Ray and John, 2011)	LSS creates improvement in quality and operations process
increased Customer focus	(Calzone and D'Marco, 2009)	Quality improvement and reduction in variation tailored to meet customer requirements
Increased employee empowerment	(Best, 2012)	Employee training leads to improved efficiency in work activities. This is controlled by the LSS methodology
Organizational flexibility	(Pillai et al., 2012) (Akbulut-Bailey et al., 2012)	Improved manufacturing organizations. Achieved by the restructuring of manufacturing activities and the elimination of non-value adds
Supply base optimization	(Blanchard, 2012) (Farhad and Alireza, 2009)	Reduced Inventory reduces delivery lead time and material flow

2.3.5. Critical Success Factors for Lean Six Sigma Implementation

Critical Success Factors (CSF) can be defined as those elements/factors which are vital and needed in order for successful implementation and execution of any programme, policy or technique (Rungasamy et al., 2002). In their paper published on the conceptual framework for critical success factors of Lean Six Sigma, Jeyaraman and Teo (2010) define CSFs as core functions and objectives that must be achieved successfully within an organization in order to benefit from certain programmes within the organization that will in effect, result in increased competitive advantage and enhance organization competitive leverage. They further state that CSFs are not organizational objectives but are important processes and elements that can be managed and influenced by the organization's management in order to attain organizational objectives. Achievement of CSF objectives will ensure improvements and success in organization-wide objectives and goals (Bandara, 2007).

2.3.5.1. Critical Success Factors for Lean Implementation

(Pius et al., 2006, Mann, 2009, Sanjay, 2013) identify four critical success factors needed for the successful implementation of Lean in a small and medium enterprise (SME) manufacturing organization:

➤ Leadership and Management: There is a need for full commitment by leadership and management to enable the effective implementation of Lean principles and tools through the allocation of resources, alignment with organization strategic objectives and leadership by example (Mann, 2009).

➤ Organization culture: For Lean effectiveness, the organizational culture must be suitable for implementation. An organizational culture that does not support waste reduction and streamlining of processes will not provide the necessary support framework for Lean integration. The organizational culture must be adapted and aligned with Lean, and Leanness seen as an attitude and way of undertaking activities (Sanjay, 2013).

➤ Skills, Training, and Expertise: Employee skills and training are necessary for effective implementation of Lean, as it will lead to improvements in task efficiency, innovation in activities and commitment to Lean practice.

➤ Financial Capability: The organization needs the financial capability to be able to allocate resources and ensure process streamlining.

(Dora et al., 2013) identify three critical factors needed for Lean implementation in food manufacturing industries:

➤ Employee skills
➤ In-house expertise
➤ Organizational culture

(Pedro and José, 2012) list three critical success factors for Lean implementation in aerospace industries:

➤ Leadership role
➤ Organizational culture and structure
➤ Employee Involvement

(Miina, 2013) identifies two CSF that must be achieved for Lean success in manufacturing companies in Estonia:

➢ In-house expertise in Lean techniques and implementation

➢ Organizational culture and structure that supports Leanness.

2.3.5.2. Critical Success Factors for Six Sigma Implementation

The table below depicts the critical success factors for Six Sigma implementation based on selected key performance indicators as highlighted in the literature.

Table 2:7 CSFs for Six Sigma Implementation

CSF	Article/Journal	Notes
Management commitment	(Pande and Neuman, 2001, Coronado and Antony, 2002, Henderson and Evans, 2000, Montgomery and Woodall, 2008)	Six Sigma Implementation requires full management commitment
Employee training	(Coronado and Antony, 2002, Brady and Allen, 2006, Kwak and Anbari, 2006)	For successful implementation, employees must be trained to achieve various Six Sigma levels and certifications
Change in organizational culture	(Coronado and Antony, 2002, Montgomery and Woodall, 2008)	Six Sigma must be integrated into the organizational culture, adopting it as a practice in all activities, decision-making and processes
Customer-focused approach	(Goh and Xie, 2004, Brady and Allen, 2006)	The main aim of the Six Sigma approach is customer satisfaction
Focus on process	(Montgomery and Woodall, 2008)	As Six Sigma entails the reduction of variation in processes, focus on organizational processes is key
Project management framework	(Coronado and Antony, 2002, Brady and Allen, 2006, Kwak and Anbari, 2006)	For effective and efficient project management through scientifically based decision-making
Integration into organization's strategic aims and quality	(Goh, 2002, Coronado and Antony, 2002)	Six Sigma should be integrated into the organization's strategic goals and objectives with a quality improvement approach
Tools for implementing change	(Coronado and Antony, 2002, Brady and Allen, 2006)	Six Sigma should be seen as a valuable tool for effective change management processes

The integrated approach to the Lean and Six Sigma methodologies has over the years received much attention. The preceding sections highlights the individual critical success factors (CSFs) of

both methodologies for implementation, and further research has explored the integrated approach in light of their CSFs.

In Table 2:8, nine authors have been selected to review CSFs for Lean Six Sigma implementation. Laureani and Jiju (2012) discuss the need for an organization to identify and correctly apply all of these CSFs for CI initiative success. Abu Bakar et al. (2015) and Habidin and Yusof (2013) identify fewer CSFs than other selected papers. A critical look at the presented table shows the following CSFs as commonly identified and accepted by all the selected papers as crucial in improving CI initiative implementation:

- Management commitment
- Organisational culture
- Communication
- LSS training

These CSFs are believed to have a significant impact on CI initiatives. However, every other factor has been listed based on the authors' perception and the CI approach for a given organization.

Table 2:8 presents findings from recent literature on the Lean Six Sigma subject area. Both methodologies individually present their implementation patterns. However, an integration of both methodologies does not fall short in the implementation of these CSFs. As identified by Laureani and Jiju (2012), the need for an organization to identify CSFs for any CI initiative is imperative because it enables organizations to channel their efforts towards achieving them. The Lean Six Sigma initiative is no different in this regard.

Table 2:8 CSFs for Lean Six Sigma Implementation

Critical Success Factors	Authors								
	Laureani and Jiju (2012)	Abu Bakar et al. (2015)	Zhang et al. (2012)	Antony et al. (2012c)	Mi Dahlgaard Park and Näslund (2013)	Jeyaraman and Kee Teo (2010)	Fadly Habidin and Mohd Yusof (2013)	Antony et al. (2012a)	Sharma and Chetiya (2012)
Management commitment	✓	✓	✓	✓	✓	✓	✓	✓	✓
Organizational culture	✓	✓	✓	✓	✓	✓	✓	✓	✓
Linking LSS to business strategy	✓	✓	✓	✓	✓			✓	✓
Leadership styles	✓		✓		✓	✓	✓	✓	
Communication	✓	✓	✓	✓	✓	✓	✓	✓	✓
Linking LSS to customers	✓	✓		✓	✓		✓		✓
Awareness	✓							✓	
Selection of LSS staff	✓	✓	✓		✓	✓		✓	✓
Data-based approach	✓					✓	✓	✓	
LSS projects selection/prioritization	✓		✓	✓		✓			
LSS projects tracking and review	✓					✓	✓		✓
Resources for LSS staff	✓			✓					
LSS training	✓	✓	✓	✓	✓	✓	✓	✓	✓
LSS tools and techniques	✓	✓	✓	✓	✓			✓	✓
Project management skills	✓			✓	✓			✓	
LSS financial accountability	✓		✓			✓			
Organization infrastructure	✓	✓	✓	✓		✓		✓	✓
Extending LSS to supply chain	✓				✓		✓		✓
Linking LSS to HR rewards	✓			✓		✓			

2.4. Lean and Six Sigma Implementation Frameworks: A Review

2.4.1. Introduction

The importance of the concept of Continuous Improvement (CI) in the manufacturing sector has been established in many researches. It is important for business performance improvement and sustainability. For this reason, the approach is said to be most widely recognized among industries seeking constant improvement in their organization (Albliwi et al., 2014{Albliwi, 2015 #752)}. From the manufacturing point of view, most of the available frameworks are not usually fit for purpose, in the sense that they are not easily adapted to manufacturing business activities (Alsmadi and Khan, 2010). This includes the way they do business, organizational culture and geographical location, among others.

This section presents selected relevant frameworks for review, discussion and analysis. Based on this analysis, the proposed framework of this current research is justified for its suitability, particularly in the case study country and sector.

2.4.2. Lean and Six Sigma Implementation Framework

The implementation of Lean Six Sigma in organizations is a challenging activity to embark upon; this is as a result of its direct involvement in peoples' behaviour and culture at the workplace (Mi Dahlgaard-Park et al., 2006). A successful CI initiative deployment is triggered by an appropriate implementation framework in any industry. As well as Lean Six Sigma, other CI initiative frameworks available, or rather those selected for the current project, are presented. This is to understand the overall view of each, their applicability, similarities and differences. Achieving this will allow the researcher to assess what works, particularly for manufacturing industries in Nigeria, and pave the way for an alternative to be proposed.

2.4.2.1. Framework Definitions

There is no standard definition of what a framework refers to. Many authors have been able to present it in a prescribed manner while others present a framework to be in the form of charts, diagrams and pictures. In some cases, there is a misconception in the meaning of a model and framework. A model is designed to answer the question "what?" while a framework is the "how to". A framework is a means of understanding a method of implementation and provides guidelines on how to go about it.

According to Mohd Yusof and Aspinwall (2000) a framework is "a structure for supporting, defining, or enclosing something, especially skeletal erections and supports as a basis for something to be constructed". Popper (1976) also defines a framework as a set of preliminary assumptions or ultimate ideologies of a logical basis in which discussions and actions can progress. In other words, if CI implementation were developed in theory, then it will be paramount to expect illustrative structures in terms of pictures, i.e. a framework to implement the already conceived theoretical activities.

2.4.2.2. Necessity of an Implementation Framework

One of the main reasons a framework is required is ultimately to transcribe or relate theoretical views into achievable processes in the form of guidelines. Byrne et al. (2007) state that organizations lack an accurate understanding of how complicated it can be to change organizational culture through innovation. Even though adopting a CI initiative within organizations is a new way of handling business operations, many organizations are unaware of the benefits accrued from an organization-wide implementation. It is a more challenging task to inculcate a new culture within an organization through CI with a good acceptability level than to build on the existing culture. The endeavour indeed requires a different perception. The following are the reasons why a framework is necessary, as adapted from Bessant et al. (2001):

- To illustrate an overview of Continuous Improvement initiatives for organizations to connect with a new idea
- To provide understanding of the organization's strengths and weaknesses
- To encourage company management to deal with an extensive list of the main concerns which otherwise might not be addressed
- To support implementation and enhance the likelihood of CI adoption success.

Based on Flynn et al. (1994), a rigorous framework fortifies relations between concepts and practical application. It is a means of interpreting CI initiative theory into practically organised conception. A well-developed implementation framework is a critical process not to be taken lightly in the quest for an organization's continuous improvement plan. A framework enables the organization to learn about CI measures and allow their adoption broadly and promptly in a measured way.

2.4.3. Selected Implementation Frameworks

In the past, various approaches have been developed, based on different perspectives and practices. This section presents three selected frameworks for review and discussion. The discussion of these frameworks will tend towards creating an understanding of what each was used to achieve and why they are or are not applicable in different respects. In addition, the selected frameworks are not a comprehensive list available for manufacturing organizations, but rather a representation sample of the common ones. The selected approaches are:

- Lean
- Six Sigma
- Lean Six Sigma

Each of these selected frameworks is related to manufacturing implementation, as that is the basis of this research.

2.4.3.1. Lean

The current rise in global competition has brought enormous challenges that prompt many manufacturing establishments to embrace new tools and techniques with the aim of enhancing their performance to remain competitive (Albliwi et al., 2015). Lean manufacturing has become popular with manufacturing organizations as Lean tools and techniques have been applied in diverse ways, with various tags. Across countries and industrial sectors, Lean manufacturing has gained much recognition as one of the best manufacturing practices.

Nordin et al. (2011) propose a framework for Lean manufacturing implementation. The proposed framework shown in Figure 2:2 was validated though the use of the Delphi technique.

Figure 2:2 depicts the expectation of the author to provide understanding and guidelines in the process of implementing Lean manufacturing to improve the chances of successful implementation.
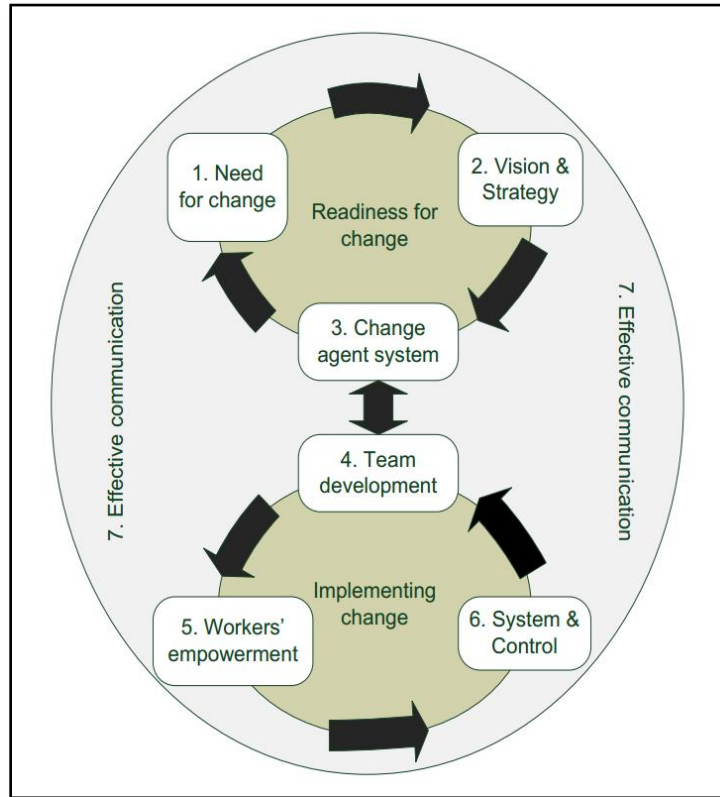
Figure 2:2 Proposed Lean Manufacturing Framework (Nordin Et Al., 2011)

However, the proposed Lean manufacturing framework was found to be limited in some respects, particularly within the scope of this study. The framework was developed with just the Lean component and as such cannot be adaptable for the implementation of Lean Six Sigma. Interestingly, the uniqueness of this framework lies in its focus on attitude change within the organization rather than a roll-out of certain Lean tools and techniques. As Antony et al. (2016a) highlights, the applicability of LSS has more to do with the change management process than the use of implementation tools. For this reason, the above framework from Nordin et al. (2011) could serve as a basis for future development. Another impeding factor for the framework can be seen from its validation with a small expert panel, which contradicts the larger sample suggested by Skulmoski et al. (2007). Therefore, the Lean manufacturing framework cannot be said to yield a sufficient outcome. Likewise, the framework has not been applied in a real working environment, not only for the geographical location for which it was proposed but especially for developing countries such as Nigeria.

2.4.3.2. Six Sigma

According to Chakrabarty and Kay Chuan (2009), Six Sigma "is a systematic approach for improving manufacturing or service processes". (Hahn et al. (1999), Inozu et al. (2006), Morgan and Lee-Mortimer (2006)) state that Six Sigma's strength relies on its framework to ease its application through tools and techniques in a well-organized manner. Six Sigma methodology relates to quality improvement and has gained substantial attention in recent years (Basu, 2004). Quite a lot of organizations have been recorded as adopting and applying Six Sigma in their quest to improve quality. These organizations are not limited to the USA, where Six Sigma was developed, but also apply across many other countries and all types of sectors (Morgan and Lee-Mortimer, 2006). Pheng and Hui (2004) and Inozu et al. (2006) cites the case for Singapore, where Six Sigma has been implemented in various organizations in healthcare, public services and the energy sector. In as much as Six Sigma implementation focuses on Critical Success Factors among other parameters, it is useful to review some of the works that justify this claim. Banuelas and Antony (2002) claim that CSFs are important measures needed for the successful implementation of Six Sigma in any organization. Critical Success Factors were studied by Antony and Banuelas (2002) who categorically state senior management commitment as the most common CSF among similar studies. Other CSFs identified include:

- Organisational readiness
- Customer focus
- Education and training
- Company-wide commitment
- Cultural change

Kumar et al. (2011) propose a Six Sigma framework for SMEs with the aim of managing and sustaining change. The proposed framework includes five phases for SME implementation as shown in Figure 2:3.
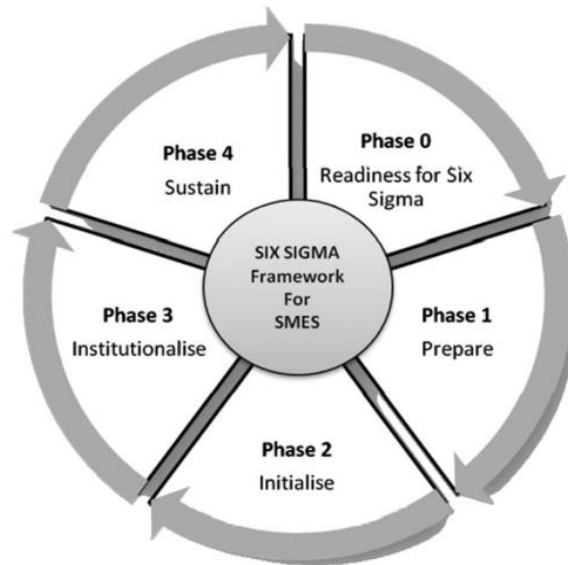
Figure 2:2 Five-Phase Six Sigma Implementation framework for SMEs (Kumar et al., 2011)

The Six Sigma framework for SMEs phases are:

➢ Phase 0: Readiness for Six Sigma

➢ Phase 1: Prepare

➢ Phase 2: Initialise

➢ Phase 3: Institutionalise

➢ Phase 4 Sustain

The step-by-step approach in the listed phases above is represented pictorially in Figure 2:3.
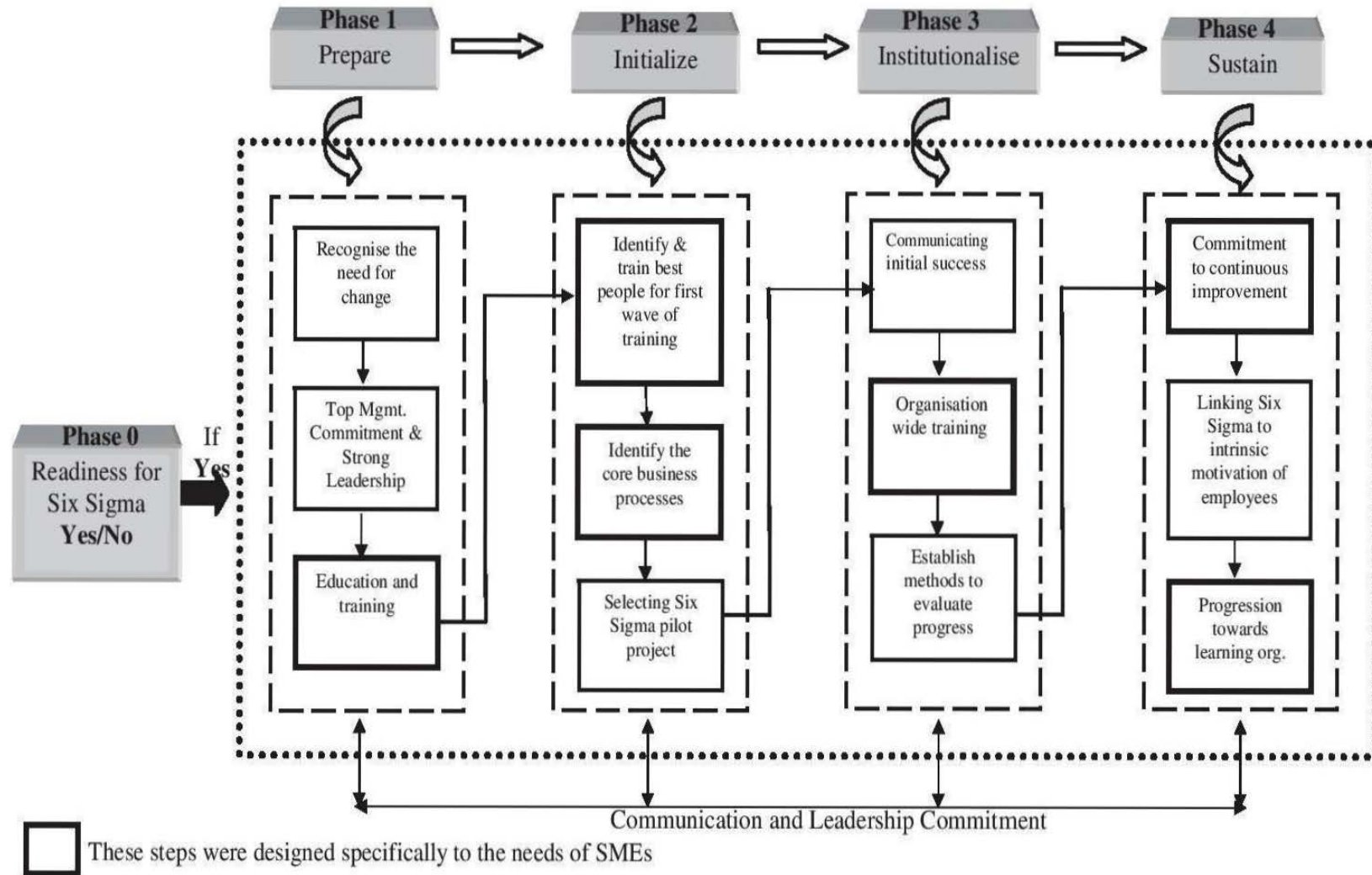
Figure 2:3 Twelve-Step Approach to Six Sigma Implementation (Kumar et al., 2011)

In some reviewed papers related to Six Sigma, the significance of applying Six Sigma in manufacturing organizations cannot be denied. However, the findings have established, for instance, in Chakravorty (2009) that there are limitations associated with case studies and generalizing survey outcome in a wider view. This is not sufficient to represent all organizations and business sectors. To this end, there is an important need to provide more cases, highlighting occurrences in organizations in different sectors and regions, as they aid to provide a bigger picture of implementation issues.

Kumar et al. (2011) confirm that no research project has been able to propose a generic six sigma implementation framework for an organization to use. For organizations, particularly SMEs, the decision on where to begin could be so challenging that the choice to proceed with a launch is abandoned. Most importantly, research has revealed that Six Sigma or other CI initiatives, according to Kumar et al. (2011) have failed because of inadequate understanding of how to embark on CI or failure to relate the CI initiative to strategic business goals and quantifiable objectives. To this end, a simplified approach towards implementation is needed.

2.4.3.3. Lean Six Sigma

The application of Lean Six Sigma in manufacturing environments relates to producing high-quality products at minimal cost and in the least time possible. Lean Six Sigma is widely known in industries to offer this possibility among other continuous improvement initiatives that are available. The strength of this framework is derived through the incorporation of both Lean and Six Sigma frameworks. Some related papers in the area of were found relevant for review and discussion in the next section.

Alsmadi and Khan (2010) proposed an integrative Lean Management and Six Sigma framework for SMEs. The proposed framework is based on a triangulation methodology that includes a Delphi survey, literature review and structured interviews. The paper reviews the evolution from TQM to Lean, through to Six Sigma. In their report, Six Sigma was created to cope with the external threat of losing market share in Motorola Company at the time. This was as a result of TQM's failure due to a lack of a universally accepted framework. Alsmadi and Khan (2010) further address the misconceptions about LM and SS and their integration. They utilized the Delphi method to validate the proposed framework. Figure 2:5 describes the implementation approach of their framework.

START

| STUDYING THE AS IS | UNDERSTANDING FACTS | QUANTIFYING ROOMS OF IMPROVEMENT | CHANGING THE SITUATION | MAINTAINING THE CHANGE |

BY   BY   BY   BY   BY

- Taking top management initiative
- Formation of Cross functional Team to Identify problems
- Mapping current state
- Hearing the Voice of the Customer
- Defining the Domain of the Problem

- Measuring the AS IS baseline
- Determining performance standards
- Confirming critical to quality issue
- Setting up process capability

- Determining Root Causes of Problems
- Identifying Variation Sources

- Carrying out a Designed Experiment
- Reduction of Setup time, congestion and delays
- Reengineering the Process to Achieve Single unit flow
- Implementing TPM
- Institutionalising Kaizen

- Standardising the Process Parameter settings
- Mistake Proofing the new process
- Integrating the change to company knowledge base

USING   USING   USING   USING   USING

- Brainstorming
- QFD
- VSM
- CTQ Tree
- Kano Model
- Project Charter

- C & E
- Time & Motion
- Process Capability Analysis

- Pareto Analysis
- C&E
- Brainstorming
- 5 Whys

- DoE
- 5S
- TPM
- BPR

- SPC
- Error proof
- Checklist
- Control Charts

TO ACHIEVE

COMPETITIVE ADVANTAGE

Figure 2:5 Lean Six Sigma Implementation Framework for SMEs (Alsmadi and Khan, 2010)

58

Even though the proposed framework was validated among SMEs from Jordan, a developing country similar to Nigeria, it is important to provide a framework that is easily adaptable within other environments. Using the logic of Antony et al. (2016a) on the "Attitude vs. Tools" approach for the applicability of the LSS programme, it could be deduced that the proposed framework might not address individual problems organizations in different regions may face. The framework focuses more on the application of tools and techniques to create a Change environment rather than a holistic view of organizational issues.

Jeyaraman and Kee Teo (2010) in their conceptual framework implementation of Lean Six Sigma focus on CSF analysis for manufacturing company performance. They adopted a pilot study approach to identify the top ten CSFs for Lean Six Sigma implementation. A practical guide to the implemented framework allows the case study manufacturing company to focus more on certain CSFs that will enhance the successful implementation of the framework. However, the success of the implemented framework is based on some identified CSFs relevant to achieving success. As it is known that there are many CSFs available for determining Lean Six Sigma success in a given organization, what happens if the CSFs identified in the case are different from those identified in another case study? This is an indication that the proposed framework can be argued to be case-study specific.

Garza-Reyes et al. (2016) in their research tagged "A Lean Six Sigma framework for the reduction of ship loading commercial time in the iron ore pelletizing industry" proposed a Lean Six Sigma implementation framework to improve key operations and performance indicators in an organization. The proposed framework was effective in helping the target business sector to enhance operations and improve performance-based indicators. However, the proposed framework has been tested in only one business sector and focuses on dealing with a single problem, and is therefore limited.

The application of Lean Six Sigma becomes a very broad approach as varieties of tools and techniques can be used. For example, George et al. (2005) list about 100 tools in their Lean Six Sigma Pocket tool book. This allows organisations to create a toolbox that specifies a focus on their products and services needs. With this flexibility, it can still be disputed that Lean Six Sigma application is more about attitude and culture than tools and techniques (Antony et al., 2016a).

2.4.4. Discussion

The selected frameworks used for continuous improvement implementation that have been discussed are believed to be important, even though the researcher realises that CI frameworks are not limited to those selected. However, these have been discussed because they were deemed crucial and appropriate in the current discussion to characterize the main subject matter of the research. The uniqueness of each framework reviewed helps to further expose ways to which they can be improved to suit other environments.

Most of the already developed frameworks are not sufficient to tackle the problems they are meant for. Due to this, a good number of enthusiasts, experts in the field, analysts and researchers have either redeveloped existing frameworks or proposed new ones.

From the generalization perspective, frameworks like Lean, Six Sigma and even Lean Six Sigma came about in response to different CI requirements. They all have their strengths and weaknesses in achieving their purposes.

As technology evolves with tremendous impact on manufacturing environments, the way and manner in which business operations are run becomes more demanding to keep up with current trends. Similarly, CI implementation frameworks become even more complex

However, their suitability for manufacturing in a developing country like Nigeria it not certain, as very little or no record of their implementation in a similar environment has been found.

2.4.5. Summary

Continuous Improvement implementation specifically for manufacturing organizations is a challenging task. Adopting a suitable framework for these organisations requires much effort. Lean, Six Sigma and Lean Six Sigma are three major frameworks reviewed in this study. In so doing, an understanding has been reached of the advantages, disadvantages, relative features and abstraction that make each of them unique. The Lean framework relates to high-quality products at minimal cost and time, whereas Six Sigma, focuses on quality improvement within an organization's business operations. The integration of the two, the Lean Six Sigma framework, however, encompasses the strengths of both. From the reviewed papers, it is evident that none of these selected frameworks can be considered entirely suitable in a manufacturing environment, especially in developing countries like Nigeria. Hence, a new framework that is fit for purpose is required, designed to respond to all unanswered questions in this respect. The framework will be developed through thorough and careful analysis of different options in major manufacturing

sectors in countries where they exist. It will also be based on significant facts obtained through primary source of data from identified key stakeholders such as senior management, employees, experts, suppliers and customers in the Nigerian manufacturing sector.

2.5.   Chapter Summary

This chapter started with an emphasis on CI initiatives, further narrowed down to Lean Six Sigma (LSS) implementation, and the importance of LSS as a continuous improvement initiative within the manufacturing sector was highlighted. The nature of these initiatives is such that organizations are tasked with the choice to implement methods to facilitate ways to which their jobs are carried out. The scant literature on LSS in developing countries indicated the need to raise awareness of the initiative. Continuous Improvement initiatives were also expounded on in this chapter by offering definitions, reviewing their various types, and successfully implemented cases of CI initiatives.

A major focus of this chapter was a detailed discussion of both Lean and Six Sigma and the integration of both concepts (Lean Six Sigma). This chapter further discusses the need for organizations to adhere to the critical success factor for implementation. A review of frameworks relating to the research area further provides support to the foundational objective of this study. The need develop a holistic and simplified framework for organizations in developing countries, characterised with low awareness levels has become more evident.

3.   Chapter Three

Research Methodology

3.1.   Introduction

This chapter covers the research method adopted, intended in order to elucidate the research topic. The review undertaken in the previous chapter formed the foundational framework for the research methodology, questions and objectives of this chapter, as it seeks to explore the implementation of Lean Six Sigma within the Nigeria manufacturing sector in comparison with that of the UK.

Williams and Remenyi (1998) reveal that research methodology is concerned with the way a research problem is tackled and usually includes the approach adopted towards theories, research designs, data collection and analysis methods. For Collis and Hussey (2009), research methodology encompasses the entire approach a researcher undertakes to achieve solutions for a research problem. The research method adopted typically has to provide correlation to the validity, reliability and generalizability of the research. It is also significant to note that the research methodology adopted by the researcher highly depends on the nature of the research problems and the answers the research seeks to provide.

This chapter will highlight the techniques and tools employed towards meeting the research objectives.

3.2.   Research Assumptions and Questions

This study was derived from the extensive literature review in the previous chapter, built on the assertion by Enoch (2013) that the effectiveness of the Nigerian manufacturing sector can be greatly enhanced by the implementation of the Lean Six Sigma.

In order to validate or disprove this assumption, the following research objectives will be achieved:

> ***Research Objective 1:*** To create an understanding of trends and approaches towards the Lean Six Sigma methodology

> ***Research Objective 2:*** To evaluate the Nigerian manufacturing industry's practice and beliefs concerning LSS

Research Objective 3: To review the implementation of LSS and its effects in organizations in Nigeria and the UK

Research Objective 4: To identify opportunities to sustain the LSS initiative in a developing economy

To meet the research objectives above, there are some fundamental questions raised by the research. The answers to these questions are linked to achieving the research objectives. The research questions are enumerated below:

Research Question 1: To what extent does the adoption and implementation of Lean Six Sigma affect an organization?

Research Question 2: How have current quality practices and continuous improvement initiatives been undertaken within the Nigerian manufacturing industry, particularly concerning LSS?

Research Question 3: What are the prerequisites for the successful implementation of LSS in Nigeria?

Research Question 4: How do manufacturing organizations in developed (UK) and developing (Nigeria) countries differ in their experience with LSS?

Table 3:1 Research Questions Linked to Research Objectives

S/N	Research Objective	Research Question
1	To investigate trends and approaches towards the Lean Six Sigma methodology	To what extent does the adoption and implementation of Lean Six Sigma affect an organization?
2	To carry out an evaluation of the Nigerian manufacturing industry's practice and beliefs	How have current quality practices and continuous improvement initiatives been undertaken within the Nigerian manufacturing industry, particularly concerning LSS?
3	To review the implementation of LSS and its effects in organizations in Nigeria and the UK	What are the prerequisites for the successful implementation of Lean Six Sigma in Nigeria
4	To identify opportunities to sustain the LSS initiative in a developing economy	How do manufacturing organizations in developed (UK) and developing (Nigeria) countries differ in their experience with LSS?

3.2.1. Process to Test Research Assumptions

The review of literature in the previous chapter revealed that LSS enhances an organization's performance as well as its operations. This result forms the basis of the argument that successful

LSS implementation in a developed economy is a consequence of an adoption of its critical success factors in line with the organization's key strategic objectives. This is, however, lacking within the Nigerian manufacturing sector, from the review conducted in the previous chapter.

Secondly, it can be seen that LSS or any other CI initiative can only be successfully implemented if the tenets, principles and pillars of quality management are fully accepted and enforced. While an awareness of quality management is inherent within the Nigerian manufacturing sector, these factors are not fully embraced or adopted, as a result of environmental, political and economic factors that pose difficulties to their full implementation (Enoch, 2013).

For the arguments above to be completely valid and acceptable, there is a need to assess the stated assumption. This can be conducted by developing an appropriate research methodology to test LSS implementation within the Nigerian manufacturing sector in comparison to the UK manufacturing industry.

3.3.   Research Paradigms (Philosophies)

Scientific research mostly occurs within a research paradigm that should include both theoretical and various methodologies aimed at generating solutions within the context of the research area (Qiu et al., 2012). It is also argued that most researchers conduct their research within a paradigm; this is facilitated by the manner in which the research is designed (Qiu et al., 2012).

In order to understand the research paradigm, there must be an understanding of the philosophical dimension within the research paradigms: ontology, epistemology, axiology and methodology (Wahyuni, 2012). The importance of the philosophical dimensions is highlighted by Easterby-Smith et al. (2012) who state that failure to carefully outline the philosophical issues inherent in the research could negatively affect the quality of the research and to a large extent the research design itself. This implies that a clear understanding of the philosophical issues inherent in a research paradigm can effectively aid the researcher to have a clear outlook and understanding of the research design (Saunders et al., 2011).

3.3.1. Attributes of Research Paradigms

A research paradigm can be defined as a framework based on a researcher's philosophy which acts as a guide on how a research study should be undertaken and implemented (Shepherd and Challenger, 2013). Collis et al. (2003) define a research paradigm as a researcher's beliefs or philosophy about society and world perceptions that are solely based on scientific knowledge. The attributes of the research paradigm needed for a successful study are discussed below;

Ontology can be defined in terms of social research, and deals mainly with the way and manner in which the researcher views reality and its dependence or independence on external social actors. Bryman and Bell (2015) posit that the essence of ontology is to lend support in investigating the nature of reality with regard to a particular phenomenon.

According to Creswell (2012), epistemology is a branch of philosophy interrelated with the nature and scope of knowledge. Epistemology can be defined as beliefs that serve as guidelines and aid in the full understanding of knowledge through the use of validity and acceptability. It enquires about what type of knowledge is required, how it can be gained and to what extent knowledge about the specific subject matter or discipline can be attained (Neergaard and Ulh_i, 2007). Epistemology states knowledge that is true in every context and does not differ from situation to situation. Blaxter (2010) argues that the concept of epistemology tends to find out the justification based on how we know versus what we know.

 Axiology in this context can be defined as ethics that ensures the researcher's values are enshrined within the research (Wahyuni, 2012). Axiology seeks to understand the role played by the researcher in respect of their value system and how it lends credibility to the research findings (Pathirage et al., 2008).

The methodological analysis in this scenario covers the steps, procedure, and process employed to conduct an inquiry, including the research design and framework. The methodology involves the application of a logical rationale and steps in undertaking a scientifically inclined research project (Mackenzie and Knipe, 2006), and could be undertaken through theory testing (deductive) or theory generation (inductive) (Saunders et al., 2009).

3.3.2. Types of Research Paradigm

The research paradigm from these definitions can be seen as not just a philosophical framework but as a guide to how the research should be undertaken. The research paradigm aids a researcher in building a research framework and design that enables adoption of the appropriate methodology and underlines the researcher's philosophy and research assumptions. In further expanding the research paradigm, (Collis et al., 2003) highlight three types of research paradigm interpretation:

- ➢ Philosophical: Solely highlights the researcher's beliefs and understanding of the world
- ➢ Technical: Enables the researcher to choose the appropriate type of methodology and technique for analysis of the research questions

➢ Social: Acts as a form of guide that aids the research

The research paradigms have expanded over the years as there have been significant changes in philosophies and beliefs as a result of increased knowledge. This aptly reflects the views of (Kuhn, 1963), in which he defines a paradigm as a globally recognized body of scientific knowledge which provides a generic framework for problem-solving by researchers but is time-constrained. This has given rise to two main perspectives in research, and these paradigms are based on the researcher's philosophy and approach to the research findings. These perspectives are Positivism and Interpretivism (McCutcheon and Meredith, 1993, Gill and Johnson, 2002, Collis et al., 2003, Thornhill et al., 2008)

I. **Positivism**: A research paradigm based on the natural sciences. Positivism relies on the assumption that the social reality is independent and is not based on the researcher's subjective nature but primarily on objective information obtained by scientific findings (Burrell and Morgan, 1994). If a concept or evidence cannot be scientifically quantified or proven, then it clearly is not objective (Hallebone and Priest, 2009). The research methodology and design should be independent of the researcher's views and beliefs, which should not be reflected in the research result. The positivism paradigm further states that the researcher should undertake their research objectively through the application of scientific investigation and logical reasoning (Smallbone and Quinton, 2004). The positivist employs a deductive process which is aimed at using objective scientific theories to explain social events and phenomena. In summary, in a positivist setting, the view of reality is seen as completely separate from the beliefs and perception of the researcher (Weber, 2004). However, the positivist paradigm has been highly criticized by researchers. It is argued that since science involves behaviour that arises from the researcher's beliefs and views, thereby showing the researcher's subjectivity, the positivism paradigm based on objectivity cannot be valid (Collins and Hussey, 2003, Yin, 2009, Lincoln et al., 2011)

II. **Interpretivism**: A research paradigm that operates on the philosophy that world events and social reality are based on the researcher's views, beliefs and opinions, thereby making it subjective. This means that as a result of interaction between the researcher and the phenomenon to which the study is involved, it is impossible for the researcher to separate their beliefs and views from the social event, therefore making it subject to the opinion of the researcher (Creswell and Clark, 2007). An interpretivist adheres to constructivism i.e. they view social reality as not objective but shaped by the actors' perceptions and views (Wahyuni, 2012). Interpretivism recognizes that researchers have

66

diverse beliefs and perceptions towards social reality as a result of different backgrounds which ultimately shape their beliefs and play an important subjective role in their research (Hennink et al., 2010). Interpretivism requires the researcher to interact fully with the subject to be researched, which involves the inclusion of their perception and beliefs about the researched subject. Interpretivism is based on the theory that a research activity is a form of social science that is affected by the thoughts, actions and behaviours of the researcher (Yin, 2003b). This clearly shows that the researcher and the research subject are not independent of each other, but interact with each other, which ultimately shapes the research work. In summary, Interpretivism is concerned with the research subject or work through understanding born out of the researcher's own beliefs and actions (Collins and Hussey, 2003).

3.3.3. Choice and Rationale for Research Paradigm

The interpretivism approach was adopted for this research. This approach was chosen because it allows the researcher to interact fully with the research and provide their research evidence and approach based on their beliefs, understanding and subjective evidence obtained from their interactions with the research subject and participants. Interpretivism, if fully integrated with a comprehensive research approach that employs relevant research standards through the adoption of an effective research design and methodology will ensure research legitimization (Kelliher, 2005).This has led to the adoption of the interpretivism paradigm within this research work. The interpretivism paradigm is based on qualitative analysis, and enables the researcher to understand the subject matter fully by integrating themselves into the subject.

A major drawback of the positivism paradigm is the high tendency to produce results that have a high degree of low validity and the fact it allows for generalization of results obtained from a limited sample. This has led to researchers focusing on the interpretivism paradigm that provides results with high validity and only allows generalization of results if the studies are similar and in the same setting. Another significant advantage of interpretivism is that it achieves validity of research by seeking to ensure a high level of research accuracy (Lin, 1998).

3.4. Research Approach

Research is aimed at relating theories to reality and a structured approach to creating this relationship is a prerequisite for successful research work (Burney, 2008, Saunders et al., 2011) state that for a researcher to completely relate theory to practice, two distinctive methods of either deductive or inductive research approaches can be adopted. The inductive research approach is

based on using observation of empirical evidence to establish generalizations or with a view to propose theory, while a deductive research approach is undertaken through the adoption of an already established theory to test a proposed hypothesis for an entirely different research topic (Hyde, 2000, Gregory and Muntermann, 2011).

3.4.1. Deductive Research Approach

The deductive approach requires the researcher to arrive at a research conclusion through testing a hypothesis or based on a known theory which is then generalized. In the deductive research approach, the researcher directly reaches a conclusion from an already established theory, on which a research hypothesis is developed, and then seeks to prove the research subject, relating back to an existing theory (Collis et al., 2003, Easterby-Smith et al., 2012). The deductive research approach is based on the positivism paradigm, as the researcher is not embedded into the research, but relies on established theories by which a relationship between theory and practice is drawn (Collis and Hussey, 2009). This approach is a top-to-bottom research design, as it requires the researcher to move from generic to specific ideas as they relate to the research topic.

3.4.2. Inductive Research Approach

The inductive approach requires the researcher to study the research subject from the information obtained. The results obtained after that promote the formulation of a new theory. This is aimed at linking reality to theory (Ary et al., 2010). The main aim of adopting the inductive research approach is to check whether the observed phenomenon is particular to a case study or can be generalized to other case studies, and if the observed phenomenon follows a particular pattern enabling the researcher to formulate a theory (Thomas, 2006). Inductive research requires the researcher first to observe phenomena related to the research subject and based on these observations arrive at a theory and state the observed conclusion.

In an inductive research setting, the researcher needs to adopt an open-minded approach to every observation and not rely on any pre-conceived logic or theory (Ghauri and Grønhaug, 2005). The inductive research approach is linked to interpretivism as it requires the researcher to be subjective, based on observed phenomena obtained by the direct involvement of the researcher in the real context and obtaining data through observation leading to theory formulation or generalization if the observed pattern is not particular to the research case study (Creswell, 2013).

3.4.3. Choice and Rationale for Research Approach

The primary approach adopted for this work is the inductive approach, as this approach is typically best suited for qualitative research work. An inductive approach is usually adopted where research questions are employed to narrow down the scope of study, as in the case of this study. It is also worth noting that the deductive approach is best suited when the research outcome is geared towards the propagation of new theory from the research, as opposed to a deductive approach which typically is aimed at testing an already existing theory.
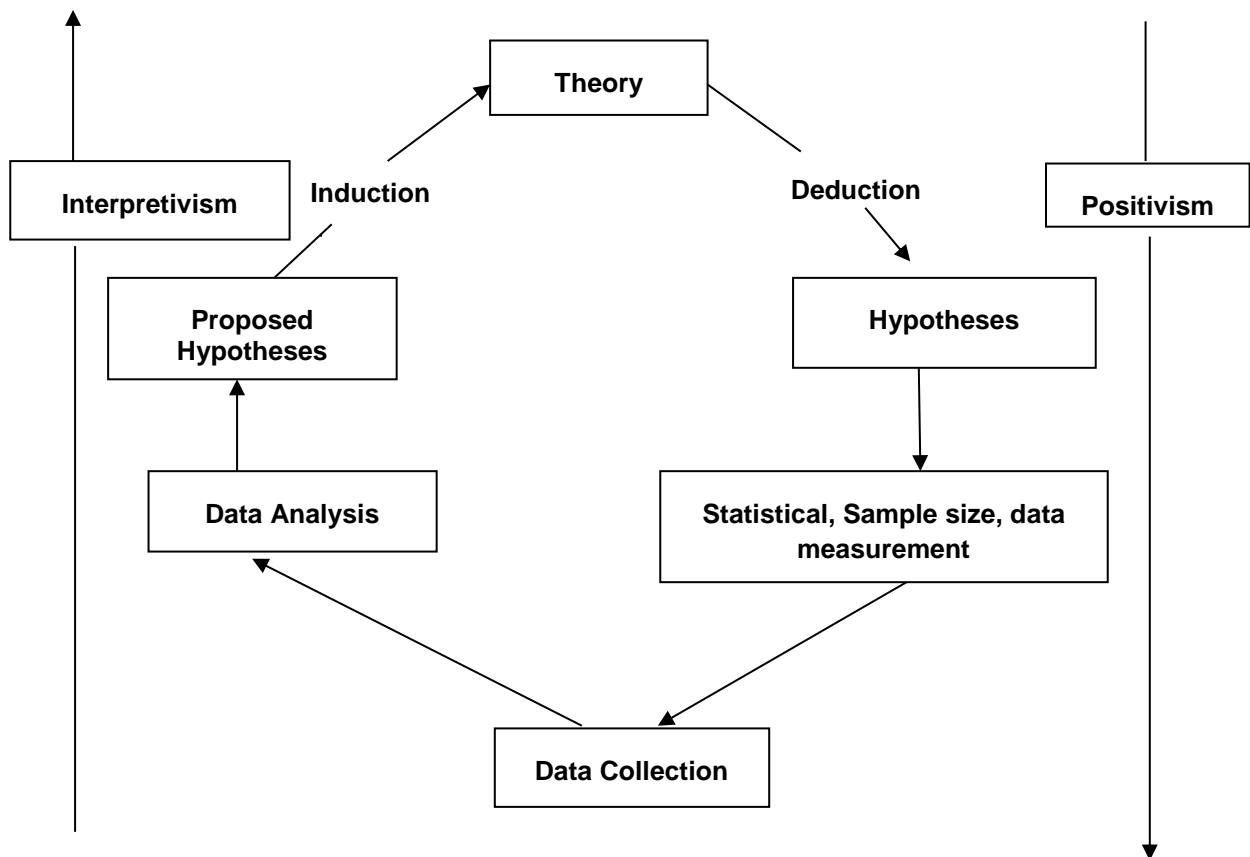
Figure 3:1 Research Philosophies, Paradigm and Approach (De Vaus, 2001)

3.5. Research Methods

Research methods are divided into qualitative and quantitative research methodologies (Scheurich, 2014). The method adopted in a piece of research is dependent on the approach taken by the researcher and its design. Research methods can be defined as the technique selected by the researcher to collect and analyse data or test hypotheses (Smith, 2007). Adopting

the research methodology suitable for the study will aid a researcher to conclude a research work successfully (Neuman, 2005). Researchers have been drawn into a long battle over the best research methodology to adopt, whether a quantitative or qualitative research methodology or a mixture of both approaches (Bryman, 2006). The best research method, to be adopted in a research work largely is dependent on the aims and objectives of the work, and the underlying research questions to be answered (Collis, Hussey et al., 2003). A discussion of the best approach/method to be adopted in this research work is discussed below.

3.5.1. Qualitative vs Quantitative Research

Quantitative research is built on the positivism philosophy and focuses on an objective research approach (Easterby-Smith et al., 2012). The quantitative research method seeks to measure data and variables in a structured way. In quantitative research, the focus is on quantitative data that can be measured and usually obtained from a large population sample to ensure reliability through data analysis (Wu and Little, 2011). In a quantitative research setting, the data obtained from a large observed population is tested and analysed based on empirically proven theory to ensure objectivity and high reliability. The method aims at seeking solutions to questions that concern relationships that occur among a measurable variable, with the researcher seeking to analyse and explain how the relationship affects the phenomenon through the use of an already established theory (Creswell, 2002).

Qualitative research is built on the interpretivism paradigm and can be described as a method of collecting data by the researcher during the research process, i.e. during learning (Cazan, 2012). It is based on looking beyond data; the researcher uses the available data during the research process to fully understand the research subject through thorough observation, conducting in-depth interviews thereby having a clear understanding of the subject matter. Qualitative research is mostly adapted towards the curious researcher who seeks to analyse data and generate theory through in-depth understanding and observation of a subject phenomenon (Chenail, 2011). Qualitative research is essential in ensuring in-depth understanding of individuals' and organizations' processes and how these processes affect the organization or individual through examining their experiences of the process (Bluhm et al., 2011). The qualitative research method is crucial to formulating and generating new theories and advancing new methods to test the theories. One major highlight of qualitative research is that it is a methodology that can be used to re-examine and retest an already established theory (Lee, 1999).

Table 3:2 Qualitative vs. Quantitative research (Bryman and Bell, 2007, Creswell and Clark, 2007)

Research Process	Qualitative Research	Quantitative Research
Aim of research	In-depth understanding and interpretation	Analyse, predict, and measure
Research approach	Inductive approach: Theory formulation	Deductive approach: Testing an empirically proven theory
Research paradigm	Interpretivism	Positivism
Research philosophy	Subjective	Objective
Involvement of researcher	High participation in process	Limited participation
Type of data	Explanatory: Mainly non-numerical data	Numerical data
Data analysis technique	Highly descriptive; relies more on understanding and interpretation of data	Strictly statistical analysis
Data validity	Based on participants' and researcher's study, understanding and observation	Based on proven theory, statistical tests and past research
Sample size	Small	Large
Research question and design	Generates theory based on observation and understanding of phenomenon	Hypotheses formulated based on existing theory
Aim of research question	Observe and explain any establish patterns	Uses statistical data to test relationship between variables

3.5.2. Choice and Rationale for Research Methodology

This research work adopts the qualitative research methodology based on the chosen research paradigm. The employment of the qualitative research methodology will enable the researcher to pursue an inductive research approach that allows a clear, descriptive analysis of generated theories and data with full inclusion of the researcher's views and understanding. It will also present a case study approach that allows real-time scenarios, explanation and understanding of the observed phenomenon by the participants. The use of qualitative design in this research also stems from the research questions, the research design and the understanding of the researcher of the observed phenomenon which will require an interpretive description and explanation (Edmondson and McManus, 2007). This research also aims at generating new theories, elaborating on theories and testing previous theories, which necessitates the employment of

qualitative research. This research will be undertaken in the natural setting of the case study companies and will duly include all views and perceptions of participants towards the observed phenomenon (Bluhm et al., 2011).

3.6.   Research Strategy

Having described the differences between the qualitative and quantitative research methods applicable to any given research, it is important to highlight appropriate strategies within both methodologies that can be used to achieve an in-depth review of the research phenomenon. According to Sanders et al. (2003), the relevant tools employed by the researcher to address specific research problems are called the research strategy. The choice of these strategies is subject to the philosophical dimension in which the research lies. In social sciences, research strategies such as experiments, surveys, grounded theory, ethnography, action research and case studies have been widely debated, providing room for the justification of their appropriateness within a given research study. For the purpose of this study, emphasis is given to the case study research strategy, providing justifications for its uniqueness within this research. However, other strategies are further discussed as they affect this research.

3.6.1. Grounded Theory

The grounded theory research strategy primarily focuses on extracting knowledge through academic literature. This approach, founded in 1967 by Glaser and Strauss, has been used for developing research theory from fieldwork and observation data (Saunders et al., 2007). Husey and Husey (1997) state that this approach is suitable for an inductive research approach which establishes research assumptions and suggestions. Even though the strategy satisfies the inductive approach, its selection for the current study is not regarded as appropriate due to the concepts associated with it. Grounded theory is more suitable for an investigative study of a real-world scenario where data are analysed without predetermined premises (Glaser and Strauss 1967). Ates (2005) further affirms that this strategy is focused on the researcher's interaction with the study concept, a suggestion which is out of the scope of this research.

3.6.2. Experimental Strategy

Another type of research strategy is the experimental strategy, which according to Bryman and Bell (2007), is used to realise causality in order to guarantee the validity of the positivist paradigm or quantitative research. Based on Dunn's (1997) assertion, an experimental research strategy is mostly adopted where timing is significant and there is consistency in the underlying relationship

pertaining to the research background. Ultimately, in the current exploratory study on LSS in the manufacturing environment, the adoption of an experimental research strategy is uncommon.

3.6.3. Ethnographic Research Strategy

The ethnographic strategy is an inductive research approach that originates from the field of anthropology (Saunders et al., 2007). In Hammersley and Atkinson (1995), the strategy is discussed as a method that focuses on the study of people's existence and where they live. The researcher's involvement in capturing research data includes extended observation, watching and listening in the given situation and asking relative questions. In many ethnographic research studies, the purpose is to understand people's culture under consideration in the manner in which it is being interpreted. Apart from the obvious reason highlighted in Hammersley and Atkinson (1995), the researcher found no purpose for selecting the ethnographic strategy as it is perceived as not relevant to the exploratory research context of LSS implementation in the manufacturing environment.

3.6.4. Action Research

The action research strategy was created in 1946 by Kurt Lewin (Saunders et al., 2007). It is referred to as "a comparative research on the conditions and effects of various forms of social action and research leading to social action" that uses "a spiral of steps, each of which is composed of a circle of planning, action and fact-finding about the result of the action" (Kumar 2010). The work of Eden and Huxham (1996) presents action research as a strategy for a theory-building process, through which theory develops based on the synthetic and analytic generation of data derived from a series of events as the designated issue is challenged. Saunders et al. (2007) state that action research as a strategy differs from others in that:

- It focuses on holistic and contextual understanding of phenomena
- It aims at contributing to solving scientific problems
- It enables incremental theory development.

Drawing from these insights, there is no evidence of the suitability of action research in exploratory research, which is the focus in the current research.

3.6.5. Survey Strategy

The use of a survey strategy is most common in social science research for obtaining relevant data about the subject of research interest. The survey can be in the form of interviews or

questionnaires, according to William (2006), who argues that analysing survey research data is best for forming descriptive or inferential conclusions. In Babbie (1990), the survey is described as a type of strategy that involves data collection from element samples of the subject matter, through the use of interviews and questionnaires. The priorities of the survey research strategy such as sampling can be misplaced and misleading considering the current study context of LSS implementation. However, interviews, a type of survey, were conducted by the researcher in order to obtain case study correspondence actual responses in an attempt to answer the research questions. However, the survey strategy on its own was not fully considered.

3.6.6. Case Study

One major research method involved in the qualitative method of data analysis and collection is the use of case studies. This approach is aimed at obtaining clear, precise knowledge and information on an organization and observed phenomena which aids in creating an understanding of the fundamental research issues and problems the research seeks to solve (Yin, 2009). The case study approach can be defined as an empirical inquiry that is aimed at conducting a thorough investigation within the real natural settings of an organization for an observed phenomenon, mostly where there is no clear-cut distinction between the observed phenomenon and the natural real setting context (Yin, 2003b). Case study research is defined by (Hartley, 2004) as 'the use of the natural setting of various entities and organizations aimed at investigating a contemporary phenomenon through a thorough method of data collection from participants within the entities without any set boundaries and controls, all under the supervision of a researcher'. The use of case studies in a research focuses on answering questions related to the 'how', 'who' and 'why' issues within the observed phenomenon (Yin, 2004).

Using a case study approach, the research involves direct observation by the researcher of the contemporary phenomenon in its natural setting, which the researcher has absolutely no control over and cannot influence (Voss et al., 2002). Case studies are mainly used when a researcher seeks to implement an inductive research approach that is aimed at obtaining qualitative data from the primary source used in generating or testing theories relevant to the contemporary phenomenon (Eisenhardt and Graebner, 2007). One major advantage of the case study research method is that it affords the researcher the ability to study various diverse aspects of the contemporary phenomenon and examine any potential relationship within the natural setting of the entire process while inculcating the full understanding offered by the researcher.

Case study research can involve either a single or multiple case studies. The former involves the researcher focusing their attention on a single organization, providing no basis for comparison, while the latter involves multiple organizations in the study, providing a basis for comparing more than one case scenario in order to generate an understanding of the contemporary phenomenon (Eisenhardt and Graebner, 2007). The use of multiple case studies according to Stake (2013) will ensure high research validity, reliability and theory-building. Ryan et al. (2002) list four types of case study:

> **Descriptive Case Studies**: Involves describing the contemporary phenomenon in its natural settings.

> **Experimental Case Studies**: Involves a critical examination of benefits and obstacles faced by organizations when implementing or undertaking a technique.

> **Illustrative Case Studies**: The focus is on clarifying a new contemporary phenomenon or practice which has been undertaken by organizations.

> **Explanatory Case Studies:** Involves the researcher understanding how an already existing theory affects an organization's practice and attempting to elaborate or generate new theories.

In a case study research method, the researcher has to consider not just the opinions and perception of the participants. Emphasis is placed on understand the interactions that occur within the natural setting of the organization in relation to the existing phenomena.

3.6.7. Choice and Rationale for Research Strategy

Selecting a suitable research strategy for the current study is not taken lightly, because of the significance of its impact on the outcome of this study. Approaches such as grounded theory, survey, action research and ethnographical and experimental strategies have been considered critically with the current research questions and the description of each of the highlighted strategies. In most cases, the choice of case study strategy is clear as it seems a more appropriate choice. Ethnography relates specifically to a group of people who share common culture (McCleverty, 1997); action research is more suitable for use when understanding and managing the relationship between theory and practice during problem diagnosis (Myers et al., 1999; Ottosson, 2003). Grounded theory is more appropriate for deriving a theory from a process, action or interaction, grounded in the views of participants in a study (Strauss and Corbin, 1990). However, the case study strategy has been developed to suit this research in that it details

continuous observation of a work practice at an appropriate organizational level, which is easily related with the implementation of LSS and CI initiatives in manufacturing establishments.

According to Yin (2003a), the rationales for adopting a case study research methodology are;

- ➢ The manner in which the research question is designed
- ➢ The level of control a researcher has over events and behaviour in understanding the phenomenon
- ➢ The research focus: if the research is solely focused on the contemporary as against the historical

In this study, a case study approach is adopted to benchmark and assess LSS and also to compare its practice in other developed countries such as Nigeria. The case study approach is particularly suitable for the research questions, focusing more on the "how" and "why", as evident in Yin (2003a). The following reasons are considered a viable justification for the case study approach being adopted in this study.

- • It allows the researcher to answer the research question "how" LSS has been or can be applied in developing economies, citing the Nigerian context as a factor for consideration.
- • It also answers the question "why"; that is, the reason LSS is applied especially in the Nigerian manufacturing environment.
- • Multiple case studies can be adopted in this study.
- • Most significantly, it provides a platform for comparison between developed and developing economies in terms of LSS implementation..

As multiple case studies are adopted, this paves the way for comparative case study of real-life organizations in selected countries, analysed in a qualitative manner (Dul and Hak, 2008).

3.7.   Data Collection Methods

For unbiased research, the researcher must ensure that the appropriate research method is used which includes appropriate research techniques to ensure high research validity, reliability, transparency and ensure the research aims and objectives are achieved (Johnson and Turner, 2003, Mack et al., 2005). Data collection methods are defined as the various techniques employed by a researcher aimed at data acquisition and analysis which will ensure research validity and reliability through knowledge enhancement and creation (Creswell, 2013). Application of the correct data collection methods in research is important as it aids the progression of the research

as a whole. The data collection methods and techniques to be employed in this research stem from the research paradigm, method, and approach which will ensure the research aims and objectives are fulfilled. The data collection method can also be seen as the research strategy which involves a systematic method employed to ensure there is an effective and efficient approach that ensures orderliness in the manner in which data is collected, reviewed and analysed, aimed at achieving the research aim and objectives (Jankowicz, 2005).

3.7.1. Interviews

According to (Boeije and Willis, 2013), interviews can be defined as a data collection method aimed at obtaining information, opinions, understanding and perspectives of actors within the natural setting of an organization in order to understand and explain a social phenomenon. The interview participants who have knowledge and experience about the social phenomenon will transmit such knowledge and experiences to the researcher by way of a conversation. The use of the interview research method aids in undertaking qualitative research, especially in relation to case studies (Dilley, 2004). The interview is a key part of qualitative research as it gives a researcher access to understand fully a social phenomenon from the views and perspectives of stakeholders who share their understanding, experiences and opinions within the natural setting of the organization (Seidman, 2012). (Wilson, 2013) defines three types of interview:

- ➢ Structured Interviews
- ➢ Semi-structured Interviews
- ➢ Unstructured interviews

I.   Structured Interview

A structured interview is defined as a limited interaction that occurs between the interviewer and participants and is based on a verbal questionnaire in which the questions are based on an already prepared script. A structured interview can be a one-to-one conversation or can be undertaken by telephone or email. In a structured interview process, the researcher cannot manipulate or deviate from the set questions, allowing little room for flexibility, as every participant regardless of role, position or understanding of the social phenomenon is asked the same questions. i.e. the researcher cannot fully observe and understand the opinions and perspectives of the participants in the natural setting of the organization due to its structured form (Wilson, 2014a). The structured interview does not align to the qualitative research method (Dipboye, 1997).

II.   Semi-structured Interview

A semi-structured interview process can be defined as an interview process in which some questions have already been fixed, i.e. predefined, but it also allows for some form of exploration by the researcher to enable them to gain understanding and insights into new topics and or areas (Wilson, 2014b). A semi-structured interview process is also defined as an interview process between the interviewer and participant(s) using a predetermined set of questions but also giving room for observation of the participants in their natural settings in order to gain more understanding of participants' perspectives on the contemporary phenomenon (Longhurst, 2003). The semi-structured interview allows the participants to proffer answers in their words and understanding, unlike a structured interview. It can be applied when the researcher has a background knowledge of the contemporary phenomenon and area been observed and understood and the number of predetermined questions is strictly at the researcher's discretion (Bennett, 2001).

Advantages of Semi-structured Interviews

  ➢ Allows for knowledge expansion and in-depth understanding not offered by structured interviews
  ➢ Enables a researcher to grasp fully and understand very complex issues by seeking more clarification and insight
  ➢ Gives a voice to the participants by allowing them to make further contributions and state answers according to their understanding and perspectives while also raising any further issues
  ➢ Increases focus and reduces digression from the topic to be addressed through the predetermined questions
  ➢ Unlike unstructured interviews that requires a great deal of time, the semi-structured interview requires less time

The semi-structured interview process is best suited for qualitative research approach and the interpretivism paradigm (Horton et al., 2004), and will be employed in this research work.

III.   Unstructured Interview

An unstructured interview process is defined as a general conversation between an interviewer and participant(s) without any form of predefined or predetermined questions. The aim of

undertaking an unstructured interview is to ensure that participants' perspectives, understanding and experiences are fully obtained without any restriction in the organization's natural setting. In conducting an unstructured interview, there has to be in-depth preparation by the researcher, which might include the use of pilot testing. It requires the researcher to listen and observe more to gain a full understanding of the perspectives and views of the participant(s) on the contemporary social phenomenon (Wilson, 2014c). The conversation should be guided by topics and issues that are relevant to the researched topic. The unstructured interview requires in-depth skill from the interviewer in order to steer the conversation from repetitive talk or ramblings while not upsetting the natural setting of the participants and phenomenon. One major area researchers fail to understand about the unstructured interview is that it does not connote an unprepared interview, as it should involve careful planning and clearly laid out objectives and goals (DiCicco-Bloom and Crabtree, 2006). A major strength of the unstructured interview is that it allows for great flexibility as the participant(s) can initiate various perspectives towards the researched phenomenon and bring out their in-depth understanding of it.

3.8.   Research Process

For an effective research process, the researcher must carefully identify all stages within the research and ensure they are fully tailored towards achieving the research objectives and aims. These include identification of the research topic, definition and acknowledgement of the research problem, choosing the right research philosophy and paradigm relevant to the research and the research method of data acquisition, analysis and interpretation that should be employed in the research work (Bordens and Abbott, 2002). The research process should be able to identify the right research paradigm and methodology suitable for the research. The research process adopted in this research covers all areas of the research study from project identification to analyses and observation down to the presentation of results.

The research process or design can be defined as a blueprint that aims at obtaining and analysing data in a coordinated manner which ensures all objectives are achieved; it also aims to ensure research validity and reliability (Selltiz et al., 1976). To ensure high data validity and reliability for this research, the research process is divided into three stages:

I.   Phase One: Pilot or Preliminary Case Study

II.   Phase Two: Main Case Study (Comparative analysis of multiple case studies)

III.   Phase Three: Framework development and validation using Delphi

3.8.1.   Phase One: Pilot or Preliminary Case Study

This phase involves the use of pilot test study of firms which will aid in determining the cases to participate in the research, and obtaining a tested variable pattern. The companies used in this phase are leading organizations offering consultancy services and training on LSS implementation within the Nigerian manufacturing industries. The consultants conduct LSS implementation and training for major Nigerian manufacturing firms and have considerable knowledge, experience, and understanding of LSS implementation, adoption, penetration and use within Nigerian industry. The use of the consultants for this research project is as a result of the following:

➢ In-depth knowledge and understanding of LSS implementation and adoption within Nigerian industry
➢ Access to data on LSS benefits, failures and level of penetration in the Nigerian manufacturing industry
➢ Knowledge of the effect of LSS implementation within the Nigerian manufacturing industry
➢ Knowledge of factors that inhibit and enhance LSS implementation in Nigerian industry
➢ Knowledge of level of training of workers and management in LSS

The collection method employed here involved the use of a semi-structured interview protocol with the consultants in order to gain an in-depth understanding of their perspectives, knowledge, and experience of LSS implementation, adoption, challenges and benefits within the Nigerian manufacturing industry.

A. Interviewee Selection Criteria

According to (Rabiee, 2004) interview selection criteria for a semi-structured interview should include:

➢ The interviewee being an expert with in-depth knowledge of the topic
➢ Ability to effectively communicate with the interviewer and communicate their perspectives
➢ Experience of the researched contemporary phenomenon

The interviewee selection criteria ensures the reliability and validity of the research. The interviewees selected for the pilot test study with the consultancy firms were senior management who were involved in LSS implementation and adoption and had in-depth knowledge of LSS implementation in Nigerian industry. They included:

➢ Managing Director (Consultant)

➢ LSS training and implementation team

B. Development of Research Instruments

To ensure the validity and reliability of research, a well-structured research instrument that provides valid and reliable measurements is important, as it aids in eliminating biased responses (Lloria and Moreno-Luzon, 2014). The research instrument employed in the pilot test study involved a semi-structured interview aimed at understanding and obtaining answers that focused on the research goal. The following were considered in designing the research instrument:

➢ Realisation of research objectives

➢ Data confidentiality

➢ Interview length

➢ Arrangement of predefined questions and agenda

➢ Employment of appropriate scaling method

The semi-structured research instrument for the pilot test study sought to cover the following areas in the achievement of the research objectives and obtaining variables:

THEME	INTERVIEW TOPICS
Organization background	History, achievements, services offered
Understanding LSS implementation and adoption in the Nigerian manufacturing industry	History of LSS implementation and adoption Level of LSS implementation and adoption Motivation for LSS implementation and adoption Model for LSS implementation Framework for LSS Implementation
Critical Success factors and barriers in LSS implementation in the Nigerian manufacturing industry	CSFs needed for successful implementation and adoption of LSS Barriers and challenges to LSS Factors to be considered before adopting LSS
Performance measurement of LSS implementation	Types of metrics and benchmarks used in measuring performance Improvement noticed after implementing LSS

Figure 3:2 Interview Topics for Phase One Study
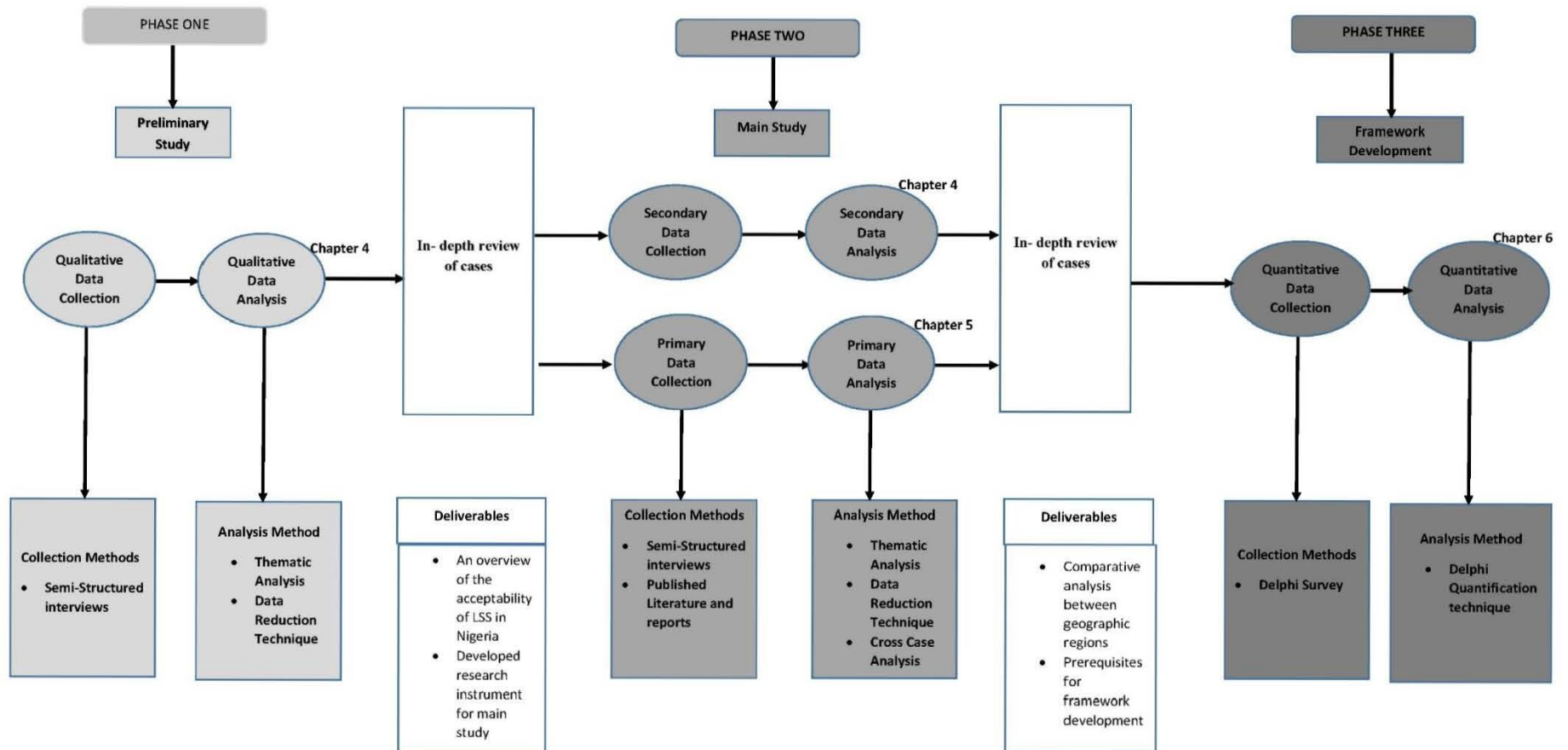
Figure 3:3 Research Process

3.8.2. Phase Two: Main Cases

This phase involved the use of multiple case studies in the Nigerian and UK manufacturing industries to ensure high result validity and reliability.

The data collection method involved the use of semi-structured interviews, which formed a basis for a multi-case approach within the selected manufacturing organizations, detailing the issues with implementation of LSS in Nigeria and the UK. The variables and research findings obtained from the pilot test study were used in developing a semi-structured interview within the main case studies. The use of semi-structured interviews is useful in the provision of a large amount of reliable qualitative data which can be easily compared to ensure validity (Cohen and Crabtree, 2006). The semi-structured interview enables the researcher to have greater insight into and understanding of the researched topic (Myers and Newman, 2007).

3.8.2.1. Rationale for Multiple Case Studies

A review of a national context exposes a unique phenomenon which the study aims to address. The analysis of implementation cases relating to LSS creates an avenue for companies in Nigeria to record the significant improvements the initiative brings. These improvements could be generated from conclusions drawn in the review of implementation journeys experienced by multiple cases covered in this research. The multiple case study approach examined the national context of Nigeria and the UK, focusing on implementation issues in both the cultural and institutional environments as they affect the adoption of LSS. This approach helps in ensuring high data validity and reliability as it enables the comparative review of cases and clarifies whether the findings are independent to a particular case or provide a generic outcome (Eisenhardt and Graebner, 2007).

The adoption of multiple case studies is naturally logical when the study is exploratory in nature (Collis and Hussey, 2003), as in the case of the current research. For this reason, multiple case studies are purposely significant for case comparison. As set out in the research objective to develop a framework that would be applicable for the selected case study, other case studies need to be considered in order to test and validate the developed framework. In other words, other case studies are used to benchmark the performance and the implementation of the developed LSS framework.

3.8.2.2. Unit of Analysis

For a detailed definition of the scope of study, the identification of the unit of analysis is important within case study research (Remenyi et al., 1998). For Collin and Hussey (2003), the unit of analysis is defined as the area or major entity that is being analysed within a given

study. It provides the definition of "who" and "what" is being analysed. For this study, the main focus is to assess the implementation of LSS within manufacturing environments, employing multiple case studies to provide a comparable overview about activities within the identified clusters of Nigerian and UK manufacturing organizations. In other words, the unit of analysis for the main cases are exposed as the two countries, as they influence the implementation of the LSS initiative.

3.8.2.3. Rationale for Case Study Sample

In defining the scope of the research, an important factor to note in the selection of cases is the selection of an appropriate sample strategy. One difference between the qualitative and quantitative research methods lies in the justification and reasoning employed to select samples (Collin and Hussey, 2003). A quantitative setting is characterized by randomly selected large samples, while the focus is centred on smaller samples, fit for purpose, in qualitative research. Irrespective of the research method, the choice of the sample method has been widely debated, particularly regarding issues of size and generalization (Patton, 1990).

In case study research, the goal is to develop and generalize theory. In terms of generalization, cases within a qualitative dimension are not termed as sampling units, as in the case of survey research where statistical generalization forms a basis of ensuring the validity of the research (Eisenhardt, 1989). Therefore, the adoption of a suitable sample strategy is dependent on the analytical generalization of the selected cases. According to Marshall (1996), the sampling methods for qualitative research are: convenience, theoretical and purposive sampling.

Convenience Sample: This method presents a less rigorous approach whereby the selection of participants are based on the most available participants. In this method, the researcher takes a flexible approach to deal with unforeseen opportunities during the course of the research. According to Marshall (1996), this option may provide poor quality data and lack intellectual credibility but it is found to be the least costly option to the researcher. However, the appropriateness of this method has been justified in qualitative research, employing a more attentive approach to its selection (Ritchie et al., 2013).

Theoretical Sample: this method presents a more structured approach to sampling, whereby participants are selected based on their potential contribution to development and generalization of the theoretical construct (Ritchie et al., 2013). It is identified as a principal strategy for grounded theory research (Marshall, 1996). The theoretical sampling process is iterative; the process requires the building of interpretative theories from emerging categories

or data, and selecting further samples to examine and refine identified theories until the researcher meets a data saturation point (Coyne, 1997, Ritchie et al., 2013). The appropriateness of its selection depends on the nature and objectives of the research as it is also used in most qualitative research requiring interpretation.

Purposive Sample: This is also known as criterion-based sample and it is the most common sampling technique. With this method, the participants are selected based on their identified characteristics or particular features that enables the detailed exploration of the research context (Ritchie et al., 2013). The selection of the appropriate sample lies in the judgement of the researcher to choose the most productive sample to answer the research questions (Marshall, 1996). This selection is based on an identified criteria, relatable to the research context. This allows for an in-depth study of cases, particularly in a multiple case approach.

A. Sample Criteria

The selection criteria used for the Multiple Case Study were based on the following

Table 3:3 Selection Criteria for Multiple Case Study Organizations

Criteria for Picking Case Study Organization	Criteria Description
Geographical location of firm	Nigeria/UK
Sector firm operates in	Manufacturing
Type of firm	Multinational, Independent, SME
Type of quality programme implemented	Lean Six Sigma
Size of firm	Large firm (more than 1000 employees), medium sized firm (500-1000 employees), small sized Firm (10-500 employees)

In the case of this research, a criterion based sampling approach allows for the selection of cases which highlight the characteristics for which the research is interested in. The selection criteria as presented in table 3.3 were established based on the research questions identified earlier in the research. The selection of cases for the Nigerian manufacturing industry were facilitated by contacts generated through the first phase of the research. The utilization of continuous improvement consultants in the first phase of this research created a list of Nigerian companies implementing lean six sigma. Based on the identified criteria of table 3.3 and possible access, only three (3) companies were eligible to participate in the study

As this research is focussed on generating comparable evidence on the implementation issues faced by both Nigerian and UK manufacturing companies, a selection of UK manufacturing companies was facilitated by a LinkedIn search of Key informants as they meet the selection criteria of the case organization. The utilization of this approach provided a long list of UK manufacturing firms meeting the selection criteria of table 3.3. However, negotiating access limited the participants to five (5) firms. This selection of the five firms provided means to build generalizable theories on the implementation of the lean six sigma initiative within UK manufacturing firms. This approach provided an avenue to benchmark their manufacturing counterparts in Nigeria.

According to Ritchie et al. (2013), there is no written rule for an acceptable number of cases within a case study research approach However, to ensure theoretical generalization, Eisenhardt and Graebner (2007) highlighted the need for 2 to 10 cases, that provides instances for both literal and theoretical replication.

B. Key Informants Criteria

The quality of case reviews depends largely on choosing the right informants. Arguably the most important factor to consider is that the informants possess knowledge of the subject on which they will be interviewed (Kumar et al., 1993). Such knowledge is usually based on their professional expertise, experience, social or academic positions. Therefore, the selection of key informants for case studies is usually very different from the typical respondent in sample studies. This is attributable to their depth of knowledge and experience. Depending on the nature of the research, academic scholars, industry experts, senior management and members of target populations are usually selected as good informants for the research (Mitchell, 1994).

For this research, the choice of the key informants was largely dependent on their role in the implementation of LSS within their organizations. A rigorous interview process was employed as situations are full of surprises. The goal was to seek out respondents with divergent opinions and perspectives. In selecting key informants, the main step is to identify the relevant groups from which they can be drawn. Table 3:4 illustrates how the key informants to this study were operationalized.

Table 3:4 Selection Criteria for Picking Interviewees in Multiple Case Studies Organizations

Criteria for Picking Interviewees	Criteria Description
Management level	Top management and middle Management
Management description	Managing Director, Quality Manager, Operations Manager, Production Manager, Senior Quality Engineer, Continuous Improvement Manager
Years of experience	6 years minimum

3.8.3. Phase Three: Delphi Method of Framework Validation

The Delphi method adopted in this research aims to assess the overall structure of the LSS implementation framework and its practicality within manufacturing environments. For the purpose of validation, the Delphi technique draws opinions from a selected panel of experts until a consensus is formed between them. As developed by Dalkey and Helmer (1963), this research method focuses on eliciting expert opinions, with the aim of validating the proposed framework of this study. According to Skulmoski et al. (2007), the Delphi research approach can be defined as a process which utilizes a repetitive survey approach among a panel of experts over a period of time aimed at achieving a consensus in opinions among the group of experts at the end of the review period. The approach is built on both the quality of the panel of experts utilized and the ability of the group of experts to align their opinions in such a way in which there is a consensus of views, also aiming at ensuring the accuracy of results (Baker et al., 2006).

To obtain the participation and ensure the accuracy of results from the panel of experts, engagement in the study requires undertaking a process which involves conducting the systematic distribution of questionnaires, which are subjected to a series of analyses. In this instance, a semi-structured survey was designed, with areas for suggestions by the panellists, repeated until consensus between the experts was reached. The approach within this research sought to validate the framework developed, using expert opinions to analyse each element as described in the framework, ensuring its fit within the structure.

3.8.3.1. Significance of the Delphi Method

While Delphi was first developed to estimate the effect of a nuclear bomb attack on the USA (Skulmoski et al., 2007), it has over the years been applied to forecasting for both technological and business improvement tools (Okoli and Pawlowski, 2004). The application of Delphi as a business development tool makes it significant, as it has been identified as an

efficiently structured approach that ensures communication among a selected group of individuals aimed at finding a solution to a complex problem (Linstone and Turoff, 2002). In this regard, a process to obtain feedback from each participant and accurately assess the views of the group must be created, with an opportunity for the panellists to reassess their contributions (Kuruppalil, 2007). The application of the Delphi research approach as opposed to, for example, focus groups, ensure participants freedom to express their views, as the condition is based on anonymity.

3.8.3.2. Justification of Method

As stated, the Delphi technique employed within this research is well suited to gather expert views and achieve consensus. The richness of data generated with this method shows its importance to the validity of the proposed framework. As compared to large sample surveys, information gathered through the iteration of rounds within the group of panellists provides a strong argument for data reliability. As the sample for the Delphi study is flexible, the information collected is easily controlled, and avenues for improvements are easily reviewed (Linstone and Turoff, 2002). The Delphi technique also eliminates issues regarding the dominance of one panellist, by removing intimidation and manipulation of output, as the confidentiality of each panellist participant is guaranteed (Day and Bobeva, 2005, Landeta, 2006).

This method is another way to generate reliable data in instances where respondents are geographically displaced, as the study is usually communicated electronically (Landeta, 2006).

3.8.3.3. The Delphi Process

An overview of the validation of the proposed implementation framework for LSS employed in this research is presented in Figure 3:4. The introduction of the Delphi research approach in this study stems from the fact of its effectiveness as compared to other statistical methods involving large samples (Rowe and Wright, 1999, von der Gracht et al., 2010). As explained in the course of this research, the elements of the framework are mainly drawn from the CSFs of LSS generated through the findings from all of the cases explored in this study.
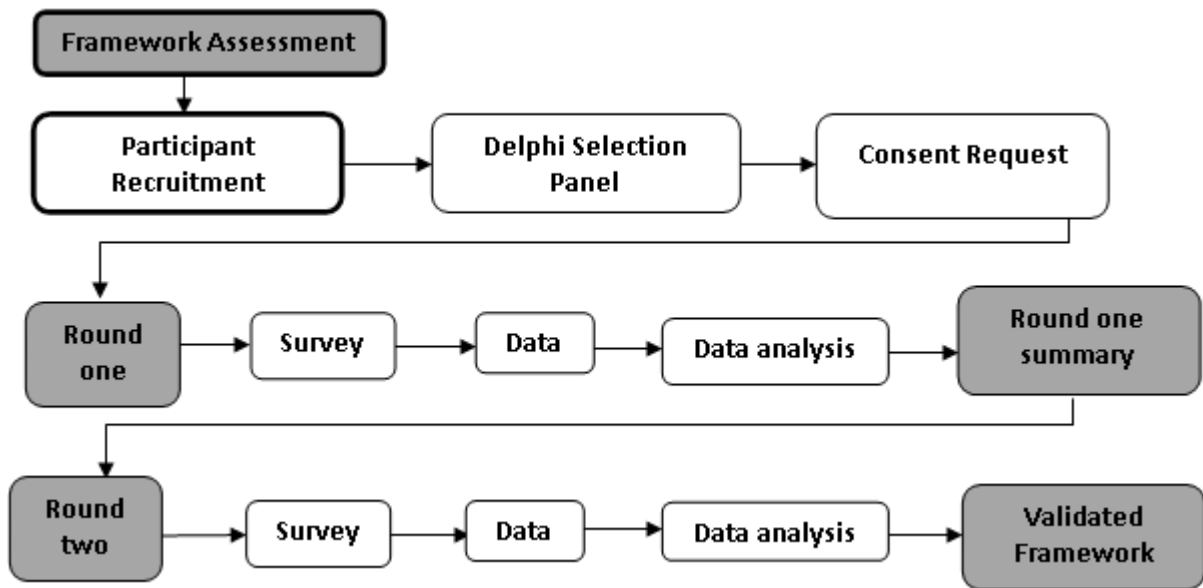
Figure 3:2 Delphi Research Process

The recruitment of participants for the Delphi process within this research focused on the reliability of data from the group of experts. To ensure the right selection of the panel of experts, the researcher employed search criteria to find experts with a high number of years of experience implementing LSS, academics within the subject domain, willingness and capacity to participate in the study, etc. According to Hasson and Keeney (2011), the selection of experts with sufficient experience within a particular research area is critical in the realisation of the aims and objectives of a Delphi study. For this study, the approach employed ensured a full representation of experts from countries/cases carried out in this research, with consent gained, and ethical considerations duly considered.

According to Okoli and Pawlowski (2004), the number of rounds adopted in the Delphi study is flexible and depends on the aim of the research. In most cases, a two- or three-round review is sufficient as long as consensus is met (Nordin et al., 2011). The first series involved distributing a semi-structured survey, giving room for open responses from the panellists. The experts' opinions were drawn to assess the validity of the overall framework structure (see Figure 6.3 and Table 6:2) using a five-point Likert scale (see Appendix D). The second round tended towards a more focused approach. A structured survey was distributed based on the findings from the first phase. In this step, experts were asked to rate their level of agreement and disagreement based on the revised issues raised in the first round. The results found in this round tended to merge towards a consensus of expert opinion.

3.8.3.4. Consensus-Building and Analysis

According to Nordin et al. (2011), the methods for analysing the data vary based on:

- Purpose of the Delphi study

- Structure of the Delphi survey

- Structure of rounds

- Number of participants.

Reaching consensus is based on an analysis of findings from each round. Employing a quantitative structure, the results gathered are analysed using rating techniques. In this study, an average of means from respondents with a minimum score of 75% was used to converge to a consensus. When analysing data from this approach, Hallowell and Gambatese (2010) state that the Delphi technique differs from traditional survey methods, as it employs only experts within its panel of participants.

3.9.   Data Analysis: Case Study Approach

Qualitative data analysis could be related to a jigsaw puzzle in which the pieces represent the data (Saunders et al., 2007). According to Yin (2003) and Eisenhardt (1989), in qualitative research, the biggest challenge is the analysis of large amount of data obtained through interviews. It is somewhat difficult for the researcher to condense the rich data in such a way that can be realistically understandable by the target audience (Easterby-Smith et al. 2002). Based on Eisenhardt (1989), "data analysis is the powerhouse in terms of building theorem through case studies; however, it is regarded as the most demanding and the least organised aspect of the process". Qualitative analysis logical procedures are presented by Miles and Huberman (1994), suggesting various techniques for presenting and analysing data. This method has been popular among researchers in analysing data.

Among the suggested techniques are grounded theory, content analysis, protocol analysis, cognitive mapping, critical incidence, pattern matching and repertory grid (Miles and Huberman, 1994, Easterby-Smith et al., 2002, Yin, 2003). Pattern matching is common for establishing causal connections between variables in descriptive or explanatory case studies in order to guarantee internal validity (Eisenhardt, 1989). Likewise, pattern matching and content analysis are broadly cited qualitative data analysis techniques (Saunders et al., 2007). Some software packages such as CAQDAS, NUD.IST and NVIVO are favoured for coding and generating patterns from large datasets such as interviews (Yin, 2003). Miles and Huberman (1994) propose one of the most commonly implemented techniques for qualitative data analysis, which comprises three steps: data reduction, data display and drawing conclusions. Another two-step process proposed by Eisenhardt (1989) involves within-case analysis and cross-case analysis.

3.9.1. Data Reduction

Data reduction is the first of the three steps proposed by Miles and Huberman (1994) for qualitative data analysis. In this step, the researcher is expected to sharpen, sort, focus, discard or organize the data gathered through data collecting means, in order to draw a conclusion and verify the outcome. This step involves summary writing of codes and cases and generating themes to make partitions or clusters, among other things.

In the current study, this technique was adopted and case study reports summaries were generated by the researcher based on themes acknowledged in the interview process. The individual case study documentation was kept reliable by being done after each company visit.

The process of data reduction provides an opportunity for the researcher to distil words into fewer understandable themes, providing an avenue to assess participant comments based on the identified codes. An example of the theme generation process is presented in Appendix C.

3.9.2. Data Display

Data display is referred to as an "organised compressed assembly of information that permits conclusion drawing and action" (Collis and Hussey, 2009). It enables the researcher to comprehend happenings within and across different cases, through which further action can be triggered. Mile and Huberman (1994) recommend data display methods such as matrices, grids, charts, networks and tables. In this study, tables, charts and matrices were adopted as data display techniques in order to present the qualitative data collected in the study second phase. For more information on data display techniques, refer to the bar chart examples in Chapter 5 (Figure 5:2 and Table 5:4).

3.9.3. Conclusion Drawing and Verification

After identifying the method of data display comes conclusion drawing and verification. The within-case analysis is followed by cross-case analysis of the participating case study organisations. Comprehensive case study reports are written in the within-case analysis stage to gain more knowledge of the key themes and distinctive outcomes evolving from individual cases with potential utilization in cross-case analysis in order to compare and contrast outcomes across cases. For a more reliable conclusion, a minimum of two samples is needed for cross-case comparison. Conclusions are drawn using the within-case and cross-case analysis in relation to the research questions.

The multiple case approach (discussed in Section 3.8.2.1) was adopted as the case study design and the primary unit of analysis was the UK and Nigerian manufacturing clusters

(discussed in Section 3.8.2.1). Based on the adopted design and the unit of analysis, a within-case analysis was conducted in the two clusters; the UK and Nigeria manufacturing clusters. Likewise, the cross-case analysis was conducted within each cluster across eight companies, five from the UK and three from Nigeria. Cross-case analysis was also conducted between individual clusters, and the outcomes are highlighted in Chapter 5.

The issues identified during the interview phases were synthesized in a matrix and tabulated, exposing participants' views on issues as they affect the research context. A pictorial representation of this matrix is given in Appendix C.

3.10. Validity and Reliability of Research

To fully understand the problems related to research validity and reliability, the study must be seen to answer the following:

> ➢ Has the research method employed provided solutions to the research objectives and questions?
> ➢ Were the appropriate research methods employed in obtaining these solutions?

The issue of research quality, especially in relation to qualitative studies, has been a recurring topic (Boeije, 2009). One major criticism of qualitative research is that it falls short in areas of validity, reliability and generalizability. Reliability is defined by Joppe (2010) as the extent to which results obtained from a research investigation are consistent over time and the sample population employed is representative of the entire population. Reliability can also be seen if a research result can be applied in a similar setting and methodology. Validity can be linked to research measurement, and is the degree to which a researcher has achieved an accurate measurement of what is intended to be measured within the research (Pyett, 2003). In quantitative research, issues of validity and reliability can be defined under these two headings:

> ➢ Is the result easily replicable?
> ➢ Are the measurements employed accurate and are they undertaking the required measurement?

This shows that to obtain validity and reliability in quantitative research the main responsibility is on instrument construction, but in qualitative research, the validity and reliability of the research lie with the researcher, who is the research tool (Golafshani, 2003) and whose efforts and ability will largely determine the research credibility.

Morse et al. (2002) state that validity and reliability are unknown to qualitative research, which relies more on result quality, the credibility of the results and knowledge, and the ability to

interpret and present data based on the researcher's ability and effort. This is reiterated by Kalof et al. (2008), who state that qualitative data does not rely on issues of validity and reliability but on the quality and credibility of the research. Various methods have been devised to ensure the quality of the qualitative research process (Guba and Lincoln, 1994, Bryman, 2006). They state that qualitative research quality and reliability can be obtained through the following proposed methods:

➢ Credibility in qualitative research represents internal validity
➢ Transferability in qualitative research is aimed at ensuring external validity
➢ The dependability of the research represents reliability
➢ The conformance of the research aptly describes objectivity

(Voss et al. (2002), Joppe (2010), Easterby-Smith et al. (2012)) list criteria in qualitative research that should be used to judge research quality, upon which this study was based. These include quality measurement, aimed at achieving reliability and validity of the research method employed in data collection. Reliability in this instance is based on how the resulting measurement obtained is valid over time, while validity is based on whether the right methodological approach is adopted to realise the research objectives.

To ensure high quality in this study, as well as achieving research validity and reliability, the use of a pilot test study and multiple case studies was introduced to ensure that the variables obtained could be tested for relationships, and measured, meaning it could be replicated in a similar setting. Also, a check was made as to whether factors observed in the contemporary phenomenon were generic to ensure construct validity and credibility. The use of semi-structured interviews employed in this study also ensured the validity and reliability of this research.

3.11. Limitations and Anticipated Problems

This research work has the following limitations and anticipated problems.

1. The research focus is on Lean Six Sigma implementation and adoption in the Nigerian manufacturing industry, with no consideration given to firm size, which will lead to problems with generalizability and generic theory generation and testing and might not potentially focus on inherent problems associated with company size.
2. Difficulties in data collection emanating from the research methods employed and time constraints related to the use of semi-structured interviews and multiple case studies.
3. Cost increase as the use of semi-structured interview method requires the researcher to travel to case study organizations and pilot test study firms.

3.12. Chapter Summary

To successfully relate reality to theory, this research work followed a subjective ontological and epistemological research approach. The research sought to adopt case studies and use observed patterns inherent within the case studies in Lean Six Sigma adoption and implementation to propose theories and arrive at conclusions. The researcher relied on his experience and knowledge which was instrumental during observations. The view of the author was established, with understanding of quality management and Lean Six Sigma shown in the previous chapter. The use of case studies to evaluate Lean Six Sigma implementation and adoption in organizations shows the adoption of an inductive approach in this research work

A well-developed research methodology is achieved if the prerequisites of the research approach, perspective, data collection and analysis techniques are carefully selected and easily justifiable. The outcome of this is linked to reliable and valid research findings. The choice of an appropriate research methodology forms an integral part of any research study. While this chapter dwelt on discussions on diverse research paradigms, strategies, and approaches, it also provided the rationale and justification for the selection of semi-structured interviews and case studies as an appropriate research strategy for the research. These justifications were designed to be consistent with the stated research objectives and questions. The adoption of the chosen methodology was in order to ensure the research constraints of validity, reliability, and credibility were taken into consideration.

4. Chapter Four

Review of the Acceptability of Lean Six Sigma in Various Countries

4.1. Introduction

The acceptability of continuous improvement initiatives differs by country, especially in relation to their distinctive cultures and modes of operation. Over the years, emphasis has been placed on the representation and understanding of LSS as a tool that aids competitive advantage in organizations. However, the continuous improvement journey can be seen as daunting. In the manufacturing context, there is substantial literature highlighting the need for an organization to integrate all its assets, such as human resources, processes, technology, etc., as a means to build organizational strength. To fully integrate these assets into manufacturing environments, companies are compelled to seek help by adopting certain initiatives such as LSS. The overall aim is to improve strategic operations and capability in areas of quality, production flexibility and performance, cost reduction, employee morale, workplace safety and customer service. The competitive landscape which organizations face provides the need to employ these best practices. Knowing the importance of LSS within manufacturing industries, it is important to align with the critical success factors required for LSS to be easily acceptable and implemented.

This chapter is broken down into two sections. The first examines LSS acceptability and implementation based on **secondary data,** obtained from literature published in the US, India, and Malaysia, representing countries across the developed and developing divide. This approach aims to provide comparable evidence of factors relating to the acceptability of LSS within these countries. The second section explores the acceptability of LSS based on **primary data** obtained from five major continuous improvement consulting firms in Nigeria. The choice to employ the latter technique emanated from the paucity of secondary data for the Nigerian environment, as highlighted in Figure 4.2. The findings presented in the second section are based on the report published by the author during this research journey.

4.2.   Applicability of LSS per Country

4.2.1. Review Methodology

This section explores the applicability of the LSS initiative by analysing common factors that organizations face in their unique working environments. A systematic review of implementation cases is carried out in order to highlight comparable factors from cases within these countries as they affect the acceptability of the LSS programme. It is important to note that the review of cases in this chapter does not serve as a means for generalizing occurrences within these countries, but provides an avenue for comparing implementation issues faced by most organizations, irrespective of their geographical location.

The foundation of this section was created using a structured selection approach to published cases regarding LSS implementation. Use of the Scopus database, regarded as one of the largest databases of peer-reviewed literature, helped to synthesize and analyse the results.

Search Criteria

TITLE-ABSTRACT-KEYWORDS (lean   six   sigma)   AND   TITLE-ABSTRACT-KEYWORDS (Implementation)   OR   TITLE-ABSTRACT-KEYWORDS (Acceptability) OR TITLE-ABSTRACT-KEYWORDS (Application)

Table 4:1 Search Criteria for Secondary Cases

Search criteria	
Inclusion	**Exclusion**
Articles published from the inception of the Lean Six Sigma integrated approach.	Papers published in cases outside the selected countries
Papers covering all data analysis methods (i.e. qualitative or quantitative or mixed analysis methods)	Papers that do not conform to the Lean Six Sigma integrated approach. (i.e. standalone Lean and Six Sigma implementation cases)
Articles from top journals on quality management-related topics	Publications on cases from non-academic databases
Articles highlighting factors aiding or impeding the implementation of LSS	Low-ranking journals

The search criteria listed above were used to narrow down the results generated. As emphasis was made on selected countries, Table 4.1 shows an overview of the selection process for

this section. The analytical tool from the Scopus database allows for a pictorial representation of the published articles for this section.

As depicted in Figure 4.1, publications regarding LSS gained popularity and progressed from the early 2000s. In 2007, there was a drop which later picked up drastically into the year 2008, advancing further in numbers and reaching a peak in 2014. The continuous increase within the subject area could be attributable to the conscious need to create awareness and build popularity for the LSS programme.

Aston University

Illustration removed for copyright restrictions

Figure 4:1 Lean Six Sigma Publications per Year (Scopus, 2016)

Similarly, the geographical location for which these cases are reported further validates the overall purpose of this research. The need for further research is evident in Figure 4.2. The disparity between implementation cases in developing and developed countries could be a reason for the low awareness levels in countries such as Nigeria. From figure 4.2 below, documented implementation cases for India and Malaysia alone are less than half of the evidence from their American counterparts. It could be argued that this figure does not depict a clear trend in implementation; however, in an attempt to promote the acceptability of such an initiative, the need to establish these patterns is imperative to form the basis for future research.

Figure 4:2 Lean Six Sigma Publications per Country (Scopus, 2016)

The charts above were generated based on the search criteria mentioned earlier. The selection of the countries, including the USA, India, and Malaysia was aimed to provide comparable evidence for cases representing developed and developing countries. The discussion in this section is therefore based on the acceptability of LSS in all selected countries, and cross-case findings from these countries are also presented. Most importantly, the secondary data analysis presented is applied to benchmark the acceptability of LSS in Nigeria, generated from the primary research conducted. This approach is aimed at creating an overview to expose the similarities and disparities which these countries experience in their journey.

4.2.2. Results per Case Country

4.2.2.1. Acceptability of LSS in the USA

Lean Six Sigma has been widely adopted in the USA and has become a common business practice. As evident from the Scopus search criteria chart shown in Figure 4.2, the USA possesses a large body of knowledge on LSS. The search criteria reveal 119 peer-reviewed journals highlighting LSS's level of acceptability and implementation within the USA, cutting across a diverse range of industries. Table 4.2 lists key case studies of LSS applicability in American companies, the purpose of research and their key findings. This enables the researcher to present key findings, such as cultural factors surrounding the reason for implementation and cultural and environmental factors driving both key success and failure factors.

While there is a high acceptability and awareness of LSS among American companies, there still exist some barriers to its implementation. These factors range from low employee morale as a result of fear of redundancy associated with the Lean practice to a lack of fully understanding the technical statistical data, which is a result of many firms cutting across industries implementing Lean but possessing a large number of non-technical (statistical) personnel. There is also a need to improve reward and recognition among SMEs adopting LSS in the USA.

American manufacturing companies can be said to be well-established in LSS implementation. This is supported by some of the key findings of the research. Krueger et al. (2013) explored the process of implementation of LSS in a manufacturing environment using the qualitative method. Their research reveals some of the key reasons for successful implementation of LSS. These include established project roles and responsibility and stakeholder involvement in LSS sustainability. Meanwhile, impeding factors affecting the implementation of LSS remain. Factors such as employee resistance to change, as well as poor project selection, remain worrisome. In Akbulut-Bailey et al. (2012) research, IT knowledge-sharing, the practice of change management, learning improvement and a synergetic approach to decision-making are factors discovered as important to LSS process implementation. This is related to an aerospace manufacturing establishment with approximately 500 employees.

In addition, Agarwal et al. (2016) have recently explored LSS process improvement of operational efficiency and patient throughput. This was carried out in healthcare services and was based on almost 50,000 employees with company turnover of around $7.2 billion. They highlight some key factors such as process prerequisites, implementation costs, training and communication requirements in the successful implementation of LSS in the selected business area.

In a military logistics and electrics depot with over 4,000 employees, Carstensen et al. (2015) analyse LSS acceptability and assess the impact of its implementation in this sector. The paper points out the lack of understanding of LSS statistical tools by employees. However, the successful implementation of this tool reveals a great impact regarding performance measurement and benchmarking, as well as the usage of LSS tools and techniques to obtain solutions.

Meza and Jeong (2013) who undertook an LSS implementation review in the aeronautics and aerospace industries, evaluated performance level. The study was carried out in a centre with

a workforce of over 17,000 and an approximately $19.3bn annual budget. This research highlights some success factors required for LSS implementation such as LSS framework establishment, performance benchmarking and project selection. A limitation was recorded in the low understanding in the principles of LSS. In most cases where there is some understanding of LSS implementation among employees, the fear of losing jobs remains a significant challenge for successful LSS implementation. This is evident in Liebtag (2013), who explored the planning and implementation of LSS in an accounting firm of around 200 employees in order to check the level of acceptability and its impact within the firm.

The range of company sectors using LSS shows its broad appeal and the universal nature of its benefits. However, implementation of LSS in these industries cannot be described as the ultimate standard capable of benchmarking organizational LSS processes in another geographical location. This is because the cultural background and way of life as well as business ethics, rules and regulations form major barriers in pinning down one specific approach for all.

Table 4:2 Applicability of Lean Six Sigma in American industries

AMERICAN CASES			
Organization/ division	Sources	Research purpose	Key findings
Company A • **Union manufacturing company** • **~1000 employees** • **~$20bn annual turnover**	(Krueger et al., 2013)	To explore the process of LSS implementation within a manufacturing environment (Employed a qualitative methodological approach)	• Highlights the need to establish project roles and responsibilities as a prerequisite for successful implementation • Highlights factors such as resistance to change (cultural), poor project selection, employee morale and motivation, data technicality, etc. as impeding factors to implementation • Exposes a synergetic approach of all stakeholders to sustain implementation

Johnson Technology Inc
• **Aerospace manufacturing company**
• **Subsidiary of GE**
• **~500 employees**
	(Akbulut-Bailey et al., 2012)	To expose the acceptability of LSS within its operations	• From the problems encountered, demonstrates the factors required for successful implementation:
			  o Learning capacity improvements
			  o Knowledge-sharing and IT
			  o Cultural readiness of the organization
			  o Change management practices
			  o Synergetic approach to decision-making.

Cleveland Clinic • **Healthcare services** • **49,166 employees** • **$7.2bn annual turnover**	(Agarwal et al. 2016)	To explore LSS process improvement on operational efficiency and patient throughput within the catheterization laboratory in a healthcare environment	Highlights the following factors: • Need for a process improvement team as a prerequisite for successful roll-out • Cost of implementation highlighted as a hindrance factor • Importance of healthcare personnel training on LSS tools to drive implementation • Establishes communication as a requirement for sustainability • Establishes that performance metrics should be a benchmark for setting goals and objectives for sustainability
Tobyhanna Army Depot • **Military logistics and electronics depot** • **4116 employees**	(Carstensen et al. 2015)	To analyse LSS acceptability and impact on US Army logistics and support (qualitative and quantitative approach employed)	Highlights factors required for acceptability and success: • Importance of team synergy in LSS design • Employment of LSS tools and techniques in obtaining solutions • Performance measurement and benchmarking Failure factors: • Lack of understanding of LSS statistical tools by employee
National Aeronautics and Space Administration (NASA)	(Meza and Jeong 2013)	A review of LSS implementation in Johnson Space Center to	Highlights the following critical factors required for LSS success: • Need for management commitment as a prerequisite for implementation and sustainability

• **Aeronautics and aerospace research** • **17,345 employees** • **$19.3bn annual budget**		evaluate performance levels, cost quality and variation reduction (Employed quantitative approach)	• Project selection (long term and short term) • Benchmarking results in performance • Importance of belt system • Establishment of LSS framework Failure factors highlighted in this research: • Reduced management understanding of LSS
Intel Corporation • **Chip manufacturing** • **$55.35bn 2016 revenue** • **95,000 employees**	(Panat* et al., 2014)	Highlights the acceptability of LSS in Intel's research and development unit	Highlights the following factors as important for LSS implementation in a manufacturing R&D firm • Involvement of all stakeholders including customers and employees • Short-term and long-term focus on LSS implementation should be set • Knowledge-sharing and change management essential to achieve implementation goals Major failure factor highlighted: • Time lag experienced in taking critical decisions as a result of technicality of project team
Company B	(Chakravorty and Shah, 2012)	To explore the implementation process of LSS in manufacturing operations	Highlights success and failure factors: • Need for external facilitator and company in-house team in LSS design • Need for LSS improvement team within the organization • Employee training on LSS tools, employee feedback, and ideas on improvement should be fully integrated • Top management training and involvement crucial • Involvement of suppliers and customers as factors for success • Low employee morale and setbacks encountered were impediments to LSS
Stark Logistical Process Company • **Multi-billion dollar asset management tracking technology company** • **150,000 employees**	(Burch V et al., 2016)	To analyse LSS implementation in the handheld technology services industry with emphasis on culture change and value-added activities	Highlights success factors: • Integration of employee views in LSS design • Management support • Project prioritization Failure factors: • Cost of training • Key decision-making delay • Lack of project champion • Competing initiatives

4.2.2.2. Acceptability of LSS in India

Implementation of LSS in India is still gradually gaining acceptance. This can be seen from the search undertaken in Figure 4.2 which results in 54 journals and articles and India ranking third in relation in the research search criteria. While the resulting journals and articles cover LSS implementation across diverse industries in India, ranging through manufacturing, health, small and medium enterprises (SME), services, etc., the lack of organization-wide global success stories of LSS implementation within India indicates the surface level of its acceptability and full adoption among Indian companies. LSS implementation and acceptability within India have been plagued by several factors:

➢ Cultural factors: Employee resistance to change management
➢ Inadequate knowledge of LSS tools and techniques by employees cutting across various sectors in India
➢ Poor management skills leading to lack of sustained top management commitment

The following factors are highlighted in Table 4:3, which provides a summary review of LSS implementation and level of acceptability within India:

➢ Substantial progress has been achieved in LSS design and deployment within Indian organizations, but cultural resistance hampers acceptability due to changing working ethics.
➢ Implementation of LSS suffers from poor management decisions which prefer production to quality.
➢ Financial cost of undertaking LSS.

Table 4:3 Applicability of Lean Six Sigma in Indian Industries

Indian CASES			
Organization/ division	Sources	Research purpose	Key findings
Company A (Automotive valve manufacturing company)	(Vinodh et al., 2011)	To implement LSS framework within an Indian automotive manufacturing environment (Employed a qualitative methodological approach)	• Management led the initiatives to drive LSS • Importance of LSS framework design before implementation Failure factors: • Lack of employee discipline and commitment • Resistance to change, particularly among employees
Company B Largest automotive parts manufacturer in India • **$6.5bn annual turnover** • **50,000 employees**	(Swarnakar et al., 2016)	To explore the deployment of an LSS framework aimed at reducing defect rates and increasing company performance in India's largest automotive parts manufacturer	Highlights the following key findings • Employment of external consultants working in tandem with in-house to design LSS framework plan • Top management commitment essential for LSS deployment • Roles and functions of project team members clearly stated • Lack of employee training and understanding of LSS tools and statistical tools was a major impediment
Company C (Rotary switch manufacturer)	(Vinodh et al., 2014)	To conduct a case study to show how LSS can be used to tackle defects and seek improvements in an Indian rotary switch manufacturer	Highlights the following success factors: • Importance of top management commitment as prerequisite for LSS deployment • Employment of in-house tem members to identify root causes • Importance of employee training and motivation Factors highlighted as impediments: • Employee resistance to change management initiatives • Lack of full top management support

Indian CASES			
Organization/ division	**Sources**	**Research purpose**	**Key findings**
Company D **150 employees**	(Kumar et al., 2006)	To study application of LSS to reduce defects within an Indian SME manufacturing die casting	Highlights success and impediment factors: • Initial top management commitment led to improvement • Lack of top management's sustained commitment • LSS design by external consultant and in-house improvement team • In-house improvement team employed to highlight areas of improvement • Employee resistance to change culture • High cost of implementation
Indian SME's	(Lande et al., 2016)	To explore critical success factors required for LSS in an Indian SME	• Highlights 17 critical success factors required for LSS deployment in Indian SMEs
Indian cylinder frame manufacturing SME • **$300,000 annual turnover**	(Gnanaraj et al., 2012)	To explore implementation of LSS in an SME engineering manufacturing company (Quantitative method employed)	Highlights the following findings as barriers to LSS acceptability in an Indian manufacturing SME • Inadequately trained employees • Lack of sustained management support • Poor management skills • Limited funds

Vinodh et al. (2011) based their study on the implementation of an LSS framework within automotive manufacturing in India. They discovered that automotive industry management is at the forefront of LSS initiatives, and the importance of LSS framework design is being encouraged before implementation. However, like the case of the accounting firm in the USA described in Liebtag (2013), resistance to change among employees is evident. In addition, there was inadequate commitment and employee discipline to make the initiative flourish. This is understandable, as the drive to embrace LSS initiatives could result in job losses. In another automotive environment, Swarnakar et al. (2016) explored the deployment of a LSS framework in order to minimize the rate at which defective products emerge and constantly increase company performance in India. It was discovered that top management involvement and commitment in the deployment of LSS are critical.

Vinodh et al. (2014) again conducted case study research to show how LSS can be used to tackle defects and improve manufacturing processes in India. In their report on an SME manufacturing company, Kumar et al. (2012) focus on the application of LSS to reduce defects in a die casting process. Talking of Indian SMEs, Lande et al. (2016) recently carried out an exploratory study of critical success factors required for LSS in this industry, for which a total of 17 critical success factors were identified as a requirement for LSS deployment in Indian SMEs. Interestingly, Gnanaraj et al. (2012) discovered limited funding as one of the problems encountered in the implementation of LSS. Without a doubt, it is safe to affirm that adequate funding is particularly significant in this process. Although funding alone cannot ensure successful deployment, adequate funding is required as a necessary resource to enable achieving LSS goals.

The reviewed papers clearly indicate that top management support to the implementation of LSS is a recurring problem among Indian industrial sectors. The effect of the lack of such involvement and commitment does not seem positive in a country where deployment of LSS awareness and acceptability is gradually gaining momentum. Top management commitment and support of LSS initiatives, in the researcher's view, can be regarded as a major milestone in successful LSS implement to improve the way an organization does business. Not ignoring the fact that employees in most of the selected industries have high resistance to change, it is believed that this problem can be dealt with through adequate training and understanding of LSS requirements. This however still boils down to management readiness to trigger employee readiness and reassurance of job security in the process.

4.2.2.3. Acceptability of LSS in Malaysia

LSS has low-level acceptability and implementation within Malaysia as shown in Figure 4.2, which yielded 11 journals and articles. The results show that LSS acceptability and implementation is limited mainly to manufacturing activities in the Malaysia automotive sector, electronics and healthcare. The implementation and acceptability level of LSS within Malaysia is hindered by several factors:

- ➢ Low awareness level of LSS tools and techniques
- ➢ Poor organizational readiness for change management
- ➢ Lack of highly skilled external consultants
- ➢ Poor resource allocation to LSS training and programmes by organizations
- ➢ Low employee understanding of LSS tools and techniques

Notwithstanding the factors highlighted above, LSS acceptability and implementation is on the gradual increase within Malaysia, as large Malaysian multinational firms gradually seek means to integrate it into their system and culture as they enter the global competitive landscape. This requires them to seek ways to improve their processes in order to enhance their bottom line and competitive advantage in the global marketplace. The following factors continue to spur LSS acceptability within Malaysia

- ➢ Management commitment
- ➢ Focus on customer requirements
- ➢ Need to achieve cost savings
- ➢ Improved financial performance

Table 4:4 Applicability of Lean Six Sigma in Malaysian Industries

Malaysian CASES			
Organization/ division	Sources	Research purpose	Key findings
Red Cross Hospital • **40 employees** **Canisius Wilhelmina Hospital** • **653-bed hospital**	(Ahmed et al., 2013)	Conduct a study to examine the effect of LSS on healthcare services (Employed qualitative method)	Highlights the following factors as problems for LSS implementation • Lack of project prioritization (projects adopted lacked business case) • Lack of funding of LSS training and programme inherent in smaller organizations but not large organizations • Poor training • Organization culture resistance to change management • Employee resistance
Six multinational electronics manufacturing services companies in Malaysia • **138 LSS practitioners utilized in survey**	(Jayaraman et al., 2012)	Evaluate acceptability and factors required for implementation of LSS in electronic manufacturing industry in Malaysia (Employed quantitative method)	Highlights from problems encountered the factors required for successful implementation: • Project prioritization (projects adopted lacked business case) • Management commitment and engagement • LSS training programme • Cultural readiness of the organization • Frequent and effective communication
Inno Biologics • **Protein expression, Bio process development, cGMP manufacturing and antibody production** • **$92,830 annual turnover** • **100 employees**	(Ismail et al., 2014)	Examine the challenges in applying LSS to achieve cycle time reduction in a bio-pharmaceutical company in Malaysia	Highlights the following factors as critical for LSS acceptability • Employee training • Employee involvement and engagement • Rewards and recognition • Utilization of highly skilled external consultants
Malaysian electronics and engineering sector	(Ali et al., 2016)	Explore relationship between LSS critical success factors and business and operation performance of Malaysia electronics sector (Employed quantitative study)	Highlights critical factors to include: • Management commitment • Organization's LSS awareness and deployment knowledge • LSS training • LSS resource allocation

Malaysian CASES			
Organization/ division	**Sources**	**Research purpose**	**Key findings**
Malaysia automotive sector • **161 companies**	(Habidin et al., 2012)	Explore critical success factors required for LSS acceptability and impact in Malaysia automotive industry (Employed quantitative study with structured questionnaire using Likert Scale)	Highlights the following factors as critical for LSS in Malaysian automotive industry: • Leadership commitment • LSS should be tailored to meet customer requirements Fails to highlight the following factors • Organizational culture change • Employee involvement

Research related to Malaysian companies' acceptability of LSS has been examined. Ahmed et al. (2013) conducted a study to examine the effect of LSS on healthcare services. The case study research was based on a Red Cross hospital with 653 beds and 40 employees. It was discovered that LSS project prioritization, funding, training and employee resistance, are among the key factors causing LSS problems. In Jayaraman et al. (2012), LSS acceptability and required factors for implementation were evaluated. Their evaluation is based on an electronics manufacturing company. In this specific business environment, management commitment and engagement, cultural readiness and communication are considered factors for the successful implementation of LSS initiatives. Also, in a bio-pharmaceutical manufacturing company in Malaysia, key research findings tended more towards employee training, involvement, and engagement as the main factors for LSS success (Ismail et al., 2014). Management commitment leads the way in seeing to successful completion of LSS implement in Ali et al. (2016), as for Jayaraman et al. (2012). However, LSS resource allocation and training are equally significant.

Although Malaysian companies' awareness and the acceptability of LSS implementation are gradually evolving, further top management commitment going forward is still an instrument to keep the trend going. Understandably, the limited number of employees in the named companies can be said to be one of the reasons why Malaysia is lacking in its quest to apply LSS initiatives, as wider coverage is paramount.

4.2.3. Cross-tabulation of Findings

Comparing the three selected countries under the themes of motivation for implementation, key success factors and key failure factors is critical to understanding the relationship between these environments, in order to analyse them correctly in view of those of Nigerian firms.

From the cross-tabulation Table 4:5 which summarizes these key variables from each country, it is safe to mention that process improvement is the main motivation for implementing LSS in the industrial sectors that adopt it. Most importantly, waste elimination is regarded as a means of improving performance, especially in manufacturing companies such as automotive in the USA and India. Financial growth and cost savings seem to be in the same context, as in the case of Malaysia and the USA. Product quality improvement is one of the reasons companies in India seek to deploy LSS in their business operations.

Table 4:5 Cross-case Findings on the Implementation of LSS among Countries

Country	Motivation for implementation	Key success factors	Key failure factors
USA	➢ System process improvement ➢ Financial growth ➢ Elimination of waste in operations ➢ Stakeholder integration ➢ Meet industry standards	➢ Top management drives initiative ➢ Employment of external consultants in LSS design and deployment ➢ Employee training on LSS tools and techniques ➢ Stakeholder integration ➢ Organizational readiness ➢ Knowledge-sharing	➢ Low employee morale due to fear of redundancy ➢ Lack of understanding of technical statistical data ➢ Poor project selection
India	➢ Process improvement ➢ Enhance organization's bottom line ➢ Improve product quality	➢ Top management support ➢ Employee engagement ➢ Employment of external LSS consultants ➢ Alignment of external consultant and internal improvement team in design and deployment	➢ Employee resistance to change ➢ Lack of long-term sustainable management support (quick-win management type) ➢ High cost of LSS programme ➢ Inadequate employee training ➢ Poor management skills leading to ineffective decision-making
Malaysia	➢ Cost savings ➢ Operations and process improvement ➢ Waste elimination	➢ Management commitment ➢ Employee involvement ➢ LSS training ➢ Customer focus ➢ Organization's LSS awareness level	➢ Poor project prioritization ➢ Lack of highly qualified external LSS consultants ➢ Resource allocation ➢ Low organizational LSS awareness ➢ Lack of organizational cultural readiness

The key success factors of LSS implementation cut across management's and employees' awareness and involvement.

On the other hand, employee resistance to change and poor project selection contribute to LSS implementation failure in these countries. Likewise, inadequate training contributes, particularly in India where a large number of employees are recorded.

Even though the outcome of this analysis cannot necessarily represent the view of most of the manufacturing companies in these countries, they have been utilized here to give an idea of what

LSS implementation, application, awareness or acceptability is all about in these sectors in their respective countries. These serve as benchmarking criteria for the Nigerian firms seeking to embark upon LSS implementation. In addition, the lessons learned from the key success and failure factors is significant enough to apply or avoid when engaging in the process to get better results.

4.3.   Acceptability of LSS in Nigerian Firms

In discussing the extent of the acceptability of LSS implementation within industries and the sparsity of data on LSS in Nigeria, the researcher interviewed top consultants in the field of LSS based on their level of experience, expertise and knowledge to assess the degree of awareness, acceptability, and implementation of LSS in Nigerian manufacturing firms (Umude-Igbru and Price, 2015).

The LSS consultants were engaged to help provide a clear picture of the acceptability of LSS within Nigerian industry. The interview process employed semi-structured interviews, as this ensured that the respondent consultants gave in-depth insights into the researched subject. The interview structure was divided into identifiable themes based on the respondent's response.

Drivers and Motivation as the first theme is concerned with the primary reasons why organizations adopt continuous improvement initiatives. This is important as it reveals what drives different sectors in adopting CI and the purpose of knowledge-sharing amongst the industry stakeholders. The second theme dwells on the current *Performance* of LSS within the Nigerian manufacturing industry to understand the opportunities that exist and areas for improvement. The third theme is the *Marketability* of LSS, which focuses on the roles played by consultants and LSS professionals in creating a high awareness of LSS within the Nigerian manufacturing sector. The final theme concentrates on the *Challenges* encountered within the Nigerian environment that limit LSS acceptability in the industry. A synthesis of the four listed themes will provide solutions to the research questions.

4.3.1. Drivers and Motivation for LSS

The influx of multinational companies into the Nigerian environment has led to many organizations looking for ways to enhance their competitive advantage. From the administered questionnaire, the primary drivers and motivators towards the establishment of LSS were outlined by the consultants and Table 4:6 details leading excerpts from their responses.

Table 4:6 LSS Drivers in Nigeria (Umude-Igbru and Price, 2015)

Open coding	Qualitative evidence
Industry sector drivers	"I will say the industries that patronise LSS most in Nigeria are the multinationals mainly in the area of manufacturing, oil and gas and telecommunications, but mostly the multinationals." (Accenture Global Consulting) "The manufacturing and production industry patronises the most." (Lean Sigma Concepts)
Multinational companies implementation	"Continuous improvement initiatives being employed within the Nigerian industries vary according to two class of companies: indigenous and multinational companies. Multinationals as a result of their foreign operations have mostly been operating LSS or some form of LSS within their international operations and now seek to implement them in their Nigeria operations." (Lean Sigma Concepts) "There has been a recent change especially with the influx of multinationals that are keen and seek to implement LSS in their organization's culture thereby rubbing off on indigenous firms who now strive to integrate it also based on success seen from multinationals' implementation." (Dew Insights Limited) "The Nigerian industry is still at infancy level regarding continuous improvement implementation, the ones that have matured in implementation are the multinationals such as Nestle, Cadbury, and Guinness, etc." (Process Improvement Consulting)
Process and productivity improvements	"Most organizations that implement LSS seek performance improvement in every facet of organization." (Opex Consulting) "these organizations seek value mainly in cost containment, streamlining their process making it easier for service provision, makes their process faster, leaner and cheaper and enables them to transact more volume." (Process Improvement Consulting) "Most organizations in Nigeria now seek to improve customer experience, perception and value." (Dew Insights Limited)

One major driver of LSS in the Nigerian environment is in the area of process and productivity, as highlighted by the respondents, which is a result of multinational companies adopting and embracing the LSS initiatives instituted by their parent company in a developed country. However, the improvements being sought by indigenous organizations are not always feasible due to the lack of adherence to LSS prerequisites. This is in contrast to multinational organizations that possess and control structures that make adaptation to change easy. Their approach towards LSS implementation is highly structured, taking into consideration the operating environment in which they find themselves.

4.3.2. LSS Performance within Nigerian Companies

The consultants noted that (on a scale of 1 to 10, with 1 being poor and 10 excellent), LSS performance within the Nigerian manufacturing sector was poorly rated, at about 3.5. The consultants asserted that LSS awareness and implementation within the Nigerian manufacturing sector is still in its infancy and any awareness created about LSS is predominantly by multinational companies. The sustainability of LSS initiatives cannot be ascertained within the Nigerian manufacturing sector at the moment, primarily because LSS sustainability depends heavily on core organizational values.

Any organization aiming at attaining the full value of LSS implementation must create an organizational environment that promotes CI and change management. The respondents noted that most manufacturing organizations in the Nigerian environment have a quick-fix culture which hinders LSS initiatives and the long-term sustainability of LSS initiatives. Another issue raised by the respondents on LSS sustainability within the Nigerian manufacturing sector was that some organizations view the LSS concept as just another 'management fad' that will come to an end in due course.

This perception lies mostly with indigenous companies. With multinational organizations operating within the Nigerian manufacturing sector, there is a high level of awareness of LSS due to dealings and affiliation with their parent companies.

The respondents noted that most indigenous companies seek quality improvements but are not able to align their organizational culture with quality initiatives. This shows that there is hope for LSS application within the Nigerian manufacturing organizations in the near future; it just requires Nigerian manufacturing organizations to integrate all of the prerequisites efficiently for the successful implementation of LSS.

Table 4:7 Lean Six Sigma Performance in Nigeria Manufacturing (Umude-Igbru and Price, 2015)

Open coding	Qualitative evidence
LSS Nigeria industry rating	"On a scale of 1 to 10 where 1 stands for poor and 10 excellent, I will rate it at a 4 because it's not grounded within the Nigerian industry but there is general improvement." (Dew Insights Limited) "The level of implementation is at its infancy level and on a scale of 1 to 10 with 1 being poor and 10 being excellent I will rate it 3." (Process Improvement Consulting) "On a scale of 10, I would rate the implementation as 4 because the application in Nigerian industries is poor. Employees who have acquired training experience difficulty applying it because the organization does not seek to integrate it fully." (Acceptance Consulting)
LSS sustainability	"There are always people and organizations that take LSS as a fad and feel it will fade over time." Also, "There have been situations in which professionals that have trained on LSS as green or black belts but have not been mentored on a project or implemented a project and now work within the organizations and are unable to deliver. This has a resulting effect with management disliking LSS implementation." (Dew Insights Limited) "Most organizations seek short turnaround investment times and are not bothered about the long-term improvement. In as much as there are quick wins associated with Lean Six Sigma, the major effect on the organization is long-term sustenance." (Lean Sigma Concepts)
LSS receptivity/ perception	"Most of them feel its main theories especially within the manufacturing industries particularly the SME's and the aviation industries who are supposed to be the drivers are mainly lagging behind." (Acceptance Consulting) "The industry's perception of LSS also is divided between multinationals and indigenous. The indigenous companies don't see the value and see it more just as a theory and most don't see how it adapts to their system." (Lean Sigma Concepts) "There is a high level of interest recently but understanding the LSS concept by organizations has been difficult with most organizations viewing it as a framework that can be used to achieve rapid improvement and cost reduction without seeing the underlying benefit of integrating it into organizational culture." (Dew Insights) Limited

Nigerian manufacturing companies are constantly looking for ways to cut costs to improve the financial bottom line, and quality initiatives like LSS are affected by these decisions. The concept of change management is new to the Nigerian business environment, mainly indigenous companies, consequently.

Rather than allocating resources to LSS improvement initiatives, they focus on employing individuals who have certificates in LSS to drive their initiatives. As state by the consultants, such persons have no real practical experience but only paper certification.

4.3.3. Marketability of LSS in Nigeria

The respondents noted that the marketability of LSS within Nigerian manufacturing companies is facilitated by their large size and also because they have significant resources to both drive the process and employ properly certified individuals to drive the process. Multinational organizations recognize that training for employees and management is critical to driving the process. Indigenous companies, on the other hand, are of a different view; as quoted, 'they believe that employee training is not an investment but an expenditure'. Indigenous companies do not regard LSS as a long-term investment; it is rather perceived as a management fad that will fade with time.

The respondents also noted that the in the Nigerian environment there is a high demand for certification. This notion has caused organizations to be more concerned about gaining employees possessing certifications rather than individuals who have practical knowledge to drive the process, the reason being that having certificates would appeal more and attract potential investors. To successfully drive LSS, organizations must integrate the belt scheme into the organizational culture and structure; this involves changing organizational behaviours, employee attitudes and job functions.

Table 4:8 LSS Marketability in Nigerian Manufacturing (Umude-Igbru and Price, 2015)

Open coding	Qualitative evidence
Organization's acceptability	"The major challenge stems from the perception of the people and the cultural differences between the organizations. Many think it's just a concept that cannot be translated to something realistic." (Lean Sigma Concepts) There are always people and organizations that take LSS as a fad and feel it will fade over time; also there are organizations who due to inability to sustain LSS, or financial constraints have completely ignored it." (Dew Insights Limited) "The LSS initiative often gets rejected primarily because of the level of awareness as organizations felt it sounded complicated and technical." (Opex Consulting)
Certification-driven market	"Our vision is for a company to adopt LSS as their continuous improvement platform instead of their workers obtaining certification but cannot practice or implement the initiative." (Process Improvement Consulting) "Organizations are mainly concerned with the certification process and improving organizational image and brand but not concerned with change management which LSS offers." (Lean Sigma Concepts) "We have so many people with LSS certifications, however, in terms of practical knowledge, these organizations are found lacking." (Dew Insights Limited)

4.3.4. Challenges to LSS Implementation in Nigeria

Various challenges are working against the acceptance and implementation of LSS within the Nigeria manufacturing context, and these are detailed below:

Organizational Culture: Inability to change existing culture and employee attitudes hinders LSS implementation. The Nigerian environment is prone to waste, and because of this, most organizations have become accustomed to the waste culture. This is supported by Tushman and O'Reilly (2013), who state that a significant barrier towards the adoption of change management in any environment or culture is one which supports waste.

Employee Commitment: Employees can act as a significant barrier to change within an organization. To ensure sustainability of LSS initiatives, employee involvement is a key factor. Yang et al. (2015) state that employee commitment aids the enhancement of innovation within an organization which will aid the sustainability of any CI initiatives.

Leadership Culture: Kotter and Schlesinger (2008) discuss four major factors that serve as barriers towards change in an organization: low tolerance for change, diverse opinions towards a reason to change, high level of lack of trust and parochial self-interest. The Nigerian manufacturing industries and business environment are typically reactive in nature as opposed to being proactive. This hinders the organizations from effectively driving initiatives that will enhance organizational objectives and competitive advantage. Consequently, the leadership culture will operate on a reactive philosophy and mind-set towards problem-solving which serves as a major barrier to CI sustainability and growth. A leadership culture that is proactive will adopt measures in advance while anticipating an event irrespective of the initial cost, but will reap the long-term benefit, which is a mark of continuous improvement. A proactive type of leadership culture is imperative for the enhancement of continuous improvement.

The respondents noted that LSS perception/acceptability within the Nigerian manufacturing industry is hindered by certain factors such as the certification-driven market, the reactive culture, the quick-win culture, and the lack of training. As a result of limited resources, organizations view LSS as a management fad leading to a lack of resource allocation to LSS. To enhance LSS receptivity and acceptability, there must be a paradigm shift in organizational culture, structure, leadership, culture and employee attitudes to change management. LSS must be viewed as a continuous improvement initiative by organizations in Nigeria to reap the maximum benefit.

The table below summarizes the challenges to LSS within the Nigerian manufacturing sector:

Table 4:9 Challenges to LSS Faced by Nigerian Manufacturing Organizations (Umude-Igbru and Price, 2015)

Open coding	Qualitative evidence
Low awareness level/ knowledge	"A general knowledge of LSS is inherent within the Nigerian industry. However, regarding implementation, there is little or no knowledge. It's mostly theoretical." (Acceltage Consulting) "LSS is still at its developmental stage. No high awareness of LSS within the past years." (Process Improvement Consulting)
Nigerian environment and culture	"One of the greatest challenges is change, change in mind-set, the paradigm shift. There is a need for a change in our culture; Nigeria practices a culture of waste." (Accenture Global Consulting) "The Nigerian environment deals with quick wins and quick fixes so the ability to pick the right projects that show visible benefits of LSS is crucial" (Dew Insights Limited) "The Nigerian culture substantially limits the ability of organizations to buy into the Lean Six Sigma concept as the culture encourages waste." (Lean Sigma Concepts)
Leadership culture	"It boils down to Leadership culture; the leadership culture really in Nigeria will rather spend money on public relations than on their internal process. There is a bad leadership culture in Nigeria." (Acceltage Consulting)
Employee commitment	"In an organization where I instituted LSS, ten (10) management staff were trained to green belt level and were given projects. Half did not complete their projects because other things were competing for their attention regarding workload so from the beginning they did not attach much importance to LSS and its benefit to even their work process." (Process Improvement Consulting)
Management buy-in	"The inability of owners of organization and top management to buy into LSS is a major problem in Nigeria." (Accenture Global Consulting)
Lack of quality-driven culture	"There are organizations dedicated to quality control and quality assurance, but organizations do not see quality as a way of life or as part of their organizational culture. Their quality knowledge does not spread throughout the organization and it's not integrated into an organization culture." (Opex Consulting) "Some organizations care more about certifications than integrating quality into their organizational culture." (Process Improvement Consulting)

4.3.5. Findings from LSS Consultants in Nigeria

The interview responses from LSS consultants representing six major LSS consultancy firms in Nigeria undertaken during the pilot study of this research work aided in giving an insight into LSS within the Nigerian manufacturing environment. The unique perspective offered by the LSS consultants gives a very clear understanding of levels of LSS penetration within the Nigerian context. The responses obtained from consultants within the pilot study of this research are summarized below.

In assessing LSS perception within the Nigeria manufacturing context, the responses obtained from the consultants indicated that implementation is prevalent in the manufacturing, telecommunications and financial sectors of the Nigerian economy. This is a result of the number of multinational companies operating in these sectors, as LSS implementation is embraced mainly by multinational firms who are aware of the programme due to foreign affiliations, compared to indigenous manufacturing companies who have limited knowledge seeking to implement based on their multinational counterparts doing the same. The responses revealed that LSS implementation is still at the infancy stage; most organizations who seek to adopt it do so in order to seek improvements in their processes and cost reduction. The responses also indicated that most organizations which seek to reap the benefits of LSS within the Nigerian manufacturing sector are not willing to adhere to the critical success factors, and indigenous firms are not willing to adapt to change.

The findings show that while the acceptability of LSS differs amongst the case countries, the findings from each country indicate a positive correlation between its acceptability, the socioeconomic conditions of the country and the understanding of the critical success factors for implementation in each case. These factors were reiterated by continuous improvement professionals/ consultants in Nigeria. Furthermore, their responses revealed that the performance of LSS within the Nigerian manufacturing sector is poor and implementation neither drives change management nor CI integration into organizational culture and alignment to business strategy. The consultants noted that the temporary success culture existing within Nigerian manufacturing firms hinders LSS sustainability, and most organizations do not invest in employee training and development due to cost, thus obstructing LSS acceptability. Most employees believe LSS to be another management fad which will fade away with time. The certification-driven culture in Nigeria is another hampering factor identified by consultants: organizations and employees are mainly concerned about being LSS or CI certified to boost their profile as opposed to aligning with organizational culture, business

strategy and change management. Most manufacturing organizations use their highly certified employee profile to attract investors and bid for contracts. The majority of indigenous manufacturing firms employ and perceive training as a major expenditure, not an investment. This shows a high lack of top management commitment and support towards LSS.

In general, the responses from the consultants indicated that awareness of LSS within the Nigerian manufacturing sector is very low, and most organizations implementing it lack knowledge of the required fundamentals and critical success factors that should be adhered to in order to reap the maximum benefit from its implementation.

4.4.   Chapter Summary

This chapter examined the level of LSS acceptance and implementation from two different data sources, secondary and primary. The secondary data was used to analyse the current level of LSS within the industries of three different countries, while the primary data, though published by the author, was used to supplement the limited number of publications on Nigeria as it regards the acceptability of LSS.

This chapter adds to the body of knowledge, in particular critically assessing the role of LSS with organizations in different regions. Despite distinctive national working cultures, the findings are not far-fetched. The motivation for implementation lies in the need to promote radical changes within organizations. Despite their different operational goals, the need to improve is an underlying factor.

As the second section highlights the current status in Nigeria based on views and perceptions from consultants within the field, arguments could be raised on the validity of the findings generated. To this effect, the next chapter aims to support the findings of this research further, employing qualitative research methods to investigate LSS in practice with the selected organizations in Nigeria and the UK, further representing developing and developed countries respectively.

5. Chapter Five

Lean Six Sigma: Case Review

5.1. Introduction

In the previous chapter, a comparative overview of the acceptability of LSS initiatives for companies in the USA, Malaysia and India were analysed utilizing data obtained from secondary sources. Analysis of these secondary data sources revealed the critical success and failure components for LSS implementation in these countries. The previous chapter also analysed the acceptability of the LSS initiative within the Nigerian environment, elucidating views from five major consulting firms in Nigeria.

In this chapter, a comparative analysis between manufacturing companies in the UK as a exemplar of developed nations and Nigeria as a subset of developing nations is carried out to establish the level of utilization of LSS initiatives, through qualitative data acquired from primary data. Findings are drawn from eight case study organizations consisting of twenty-three interviewees, with the primary unit of analysis based on two identified clusters; i.e. UK and Nigerian manufacturing companies.

As a result of the analysis of data collected through a rigorous interview process, a number of overarching themes have been identified. These themes are listed further in this chapter and were formed through a number of factors (codes) which in the opinion of the research participants affect the implementation of the LSS initiative. These factors/codes are further grouped into sub-themes.

5.2. Lean Six Sigma in Manufacturing Firms

This section provides an overview of the eight case organizations employed in this study. The first sub-section highlights the demographical standing of each firm. Generated from the primary data, the second and third sub-sections establish the relative positioning of the case study firms with respect to the critical success factors and the usability of the tools and techniques for LSS respectively.

5.2.1. Demographic Information for Firms

The demographic data for the organizations involved in the research was obtained to give a glimpse into the operations of the organization. As seen in Table 5:1, efforts were made to provide data for each organization based on the underlying factors. These data also provided the foundation of the comparative analysis of these organizations.

Table 5:1 Demographic Data for Participating Organizations

COUNTRIES	COMPANY	YOE	MANUFACTURING TYPE	COMPANY TYPE	ANNUAL TURNOVER	STAFF STRENGTH	KEY FEATURES
UNITED KINGDOM	1	1984	Electronics	Privately Held	Estimated £70-£350 million	Approximately 700 globally on six continents	Top management involvement, CI headed by CI lead manager and two facilitators
	2	1986	Packaging solutions	Public Company	Estimated £7 billion globally	Approximately 29,000 spread across 180 sites in 40 countries worldwide	CI headed by a global CI director, CI structure has CI plant managers and CI project leaders
	3	1968	Print manufacturing	Privately Held	Estimated £700 million	Approximately 3,000 workers across 4 manufacturing sites across Europe	CI headed by a Lean manager with an external LSS consultant to provide expertise
	4	1994	Chemical products	Public Company	Estimated £11.3 billion globally	Approximately 47,000 in 80 countries globally	CI headed by CI director with site-specific CI manager and facilitators
	5	1926	Chemical products	Privately Held	Estimated £24 million	Approximately 200 in three sites based in England, the USA and China	CI driven by company president through a global CI director and CI managers at various sites
NIGERIA	6	1948	Consumer products	Public Company	Estimated £255 million	Approximately 3,400 across 3 manufacturing sites locally	CI driven by CI managers and facilitators at all three manufacturing sites
	7	1950's	Pharmaceutical products	Public Company	Estimated £107 million	Approximately 96,575 globally. Local operations restricted to 2 manufacturing sites in Nigeria	CI headed by CI manager
	8	1912	Tobacco products and packaging	Public Company	Profit of $112 million in 2015	Approximately 750 locally at a single manufacturing site	

Exchange Rates (As at 09-02-2016). £1=286 Nigerian Naira, £1=1.26 Euro, £1=1.43 Dollar

5.2.2. Critical Success Factors and Challenges in UK and Nigerian Companies

Laureani and Jiju (2012) in their research place emphasis on identification of the critical success factors (CSF) required for the success of LSS in organisations. These CSFs are adopted and ranked according to their importance in order to ascertain implementation issues, and serve as supporting evidence to findings relating to each case. Participants in the case organizations were presented with a checklist to identify critical factors which were applicable to their organizations as well as corresponding challenges. The findings are presented in Table 5:2:

Table 5:2 Critical Success Factors for LSS (Adapted from Laureani and Jiju, 2012)

CRITICAL SUCCESS FACTORS FOR LEAN SIX SIGMA	CASE COMPANIES							
	UNITED KINGDOM					NIGERIA		
	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8
Management commitment	✓	✓		✓	✓		✓	
Organizational culture	✓	✓	✓	✓	✓		✓	
Linking LSS to business strategy	✓	✓		✓	✓		✓	
Leadership styles	✓	✓		✓	✓		✓	
Communication	✓	✓	✓	✓	✓	✓	✓	✓
Linking LSS to customers	✓	✓		✓				
Selection of LSS staff	✓	✓		✓	✓			
Data-based approach	✓			✓	✓		✓	
LSS projects selection/ prioritization	✓	✓		✓	✓			
LSS projects tracking and review	✓	✓		✓			✓	
Resources for LSS staff	✓	✓		✓	✓		✓	
LSS training	✓	✓	✓	✓	✓	✓	✓	✓
LSS tools and techniques	✓	✓	✓	✓	✓	✓	✓	✓
Project management skills	✓	✓	✓	✓	✓	✓	✓	✓
LSS financial accountability	✓	✓		✓	✓		✓	
Organization infrastructure	✓	✓		✓	✓	✓	✓	✓
Extending LSS to supply chain	✓	✓		✓	✓			
Linking LSS to HR rewards	✓			✓				

➢ **Management Commitment**

Top management commitment plays an important role in the successful implementation of LSS (Laureani and Jiju, 2012, Antony et al., 2012c). In order to show their commitment efforts, senior managers tend to dedicate time and resources and employ strategies for mishaps during the implementation process. In Companies 1, 2, 4, 5 and 7, the implementation process was predominantly driven by top managers. The leaders of the above-listed companies employed a persistent approach to LSS implementation. They acted as role models for the employees by involving them in business activities and operations, informing them about the benefits of the strategy, whether in terms of competitive advantage or improved performance, value and quality of goods and services. Top managers also provided initiatives such as training activities in order to facilitate and encourage employee participation in LSS.

With respect to Companies 3, 6 and 8, the respondents revealed that top management indicated little or no commitment in the implementation of LSS. This was highlighted in responses from participants, for example, a participant from Company 8 indicated the challenges faced, saying; "the role of senior executives in our journey to be sincere is not really recognized, a more passive role is played, leaving myself and my facilitators to bear some burden which primarily should be done by top management".

In the case of Companies 3 and 6, LSS processes were handled by the Continuous Improvement Manager and two members of his team. He took decisions with little or no interference from top management. The degree of support from top managers was therefore very low when contrasted with Companies 1, 2, 4, 5 and 7. In Company 8, on the other hand, top management saw the need to enforce LSS via training or certifying managers without involving the entire organization in the implementation process. It should be noted that LSS is not a temporary initiative but a continuous process in the value chain of the organization and thus its implementation should involve the entire organization.

➢ **Organizational Culture**

A number of studies have also highlighted organizational culture as a prerequisite for the success of LSS as the process involves adjustments within the organization, together with its employees (Jeyaraman and Kee Teo, 2010, Antony et al., 2012b). LSS implementation promoted substantial changes in the organizational culture of Companies 1 to 8, and the results of this change could be summarized to be either positive or negative.

From the responses gathered, one could deduce that the firms relied on fact-based decisions or data rather than instincts. Companies 1, 2, 4 and 5 showed tremendous improvement in data collection processes by involving employees and empowering them to develop their working strategies. Top management in Companies 1, 2 and 4 encouraged workers to collect data and develop their working processes with the use of continuous improvement, Value Stream Mapping and 5S. To support this point, a comment from Company 1 stated, "In order to follow the global alignment strategy for the needs of our business, we developed a grassroots approach, involving every top management to ensure the acceptance of new working ways and promote a buy-in culture".

LSS subsequently empowered the change from a reactive to a proactive method of operation. The involvement of employees in Companies 1 to 8 enabled the staff to comprehend the end results of processes, facilitated the identification of bottlenecks, and furthermore created consistency in working processes. It also led to the formation of cross-functional teams for business projects. Companies 1, 2, 4, 5 and 7 enjoyed the benefits generated from continuous improvement processes which were not experienced before the implementation of LSS, and this enabled commitment to organizational cultural change. On the other hand, remarks from Company 8, for example, indicated a negative effect of the change in organizational culture: "We faced a major challenge in tweaking the way we do things here to suit the Lean Six Sigma programme. When we tried rolling it out, immediately after the trainings, we could see interdepartmental friction, which was at first difficult to manage".

> **Linking LSS to Business Strategy**

Companies should be able to identify gaps or loopholes in their business processes and build sustainable plans in order to bridge these gaps. According to Cheng (2013), it is imperative for organizations to provide a bridge between their LSS process and the organization's overall strategy. George and George (2003) further highlight the need for project prioritization as an element of an effective business strategy, also citing project selection as a cardinal point for LSS implementation. Project selection and prioritization could be closely related to the implementation of LSS for better improvement of these business processes. Companies 1 to 8 were able to align all their business systems to LSS by following the global alignment strategy of business needs and demands.

➢ **Leadership Styles**

According to Antony et al. (2007), visionary leadership has generated a wide acceptance as one of the critical success factors for the successful initiation of continuous improvement initiatives, especially LSS. As indicated by Pamfilie et al. (2012), the success of the LSS initiative is heavily dependent on the vision of the topmost leaders, encompassing how they champion and properly align it to their business environment.

Relating this to the first factor of "management commitment", the role of participatory leadership cannot be overemphasised. From the case organizations, it was observed that only Companies 1, 2,4,5,7 show the presence of a strategy that links the selection of leaders to their LSS implementation process. An example provided by comments from Company 1 states, "We have a structure in place for our leaders, as we know, the weakest holds back others, and also an aggressive style negates benefits. It is our duty to select the right leaders to champion our implementation process".

➢ **Communication**

In the implementation of LSS, communication is an important concept. This helps create a platform of information-sharing between management and employees in order to demonstrate how LSS initiatives or processes work, how they relate to their tasks or responsibilities and their impact on organizational performance. This is reiterated by Jeyaraman and Kee Teo (2010) who state that communication feedback serves two very important roles in LSS implementation. First, it helps in seamless effective communication in an organization with its employees on the importance of LSS and how it should be undertaken. Second, it enables an organization to obtain an assessment of its LSS results, thus providing valuable insights into employees' views and perceptions on LSS and how to guide them effectively through the programme to achieve the set objectives and maintain competitive advantage. Communication from top managers helped solve resistance to change issues in Companies 1 to 8. In the sample companies, particularly Companies 1, 2, 4, 5 and 7, communication was established through meetings, emails and presentations by top managers. As a comment from Company 1 indicates, "Communication is crucial, there is no term as over communication; however lack of communication will definitely restrict the progress of your journey. We try our best to make communication here a top priority". Top managers involved all employees in these meetings and informed them on the progress of LSS initiatives in the firms. Other communication tools involved notice boards, newsletters and project review meetings.

Companies 3 and 8 mainly focused on production outputs and sales metrics rather than informing employees on the advantages of CI on processes.

> **Linking LSS to Customers**

An LSS strategy enables companies to identify customer needs and ways in which these needs can be satisfied. The ability of an organization to link its LSS programme to customers' needs and requirements is a critical factor towards successful deployment and implementation of LSS in an organization (Anthony Jiju et al., 2005). LSS operates on the philosophy and concept of knowing what the customer requires and how to fulfil these requirements efficiently and effectively (Pojasek, 2003). As observed in Companies 1, 2 and 4, there is evidence that they have created a link between LSS and customer needs, thus enabling them to be customer-focused. Interaction with participants from Companies 1and 4 indicated that linking LSS to their direct customers was initially a daunting task, but overall added great value to their journey in LSS. So far the strategy has facilitated a reduction in customer complaints and a significant increase in customer satisfaction. A comment from Company 1 stated, "We have adopted an LSS approach through customer complaint process as a tool for problem-solving and used it to increase product quality and reduce lead time," and for Company 4, "We have fostered the completion of 8D for issues and also encouraged customer awareness of strong improvement processes to enable us build customer confidence".

> **Selection of LSS Staff**

LSS staff are usually identified as champions. They facilitate the implementation of LSS with the use of their skills and expertise in LSS. Snee (2010) identifies project champions as a required critical infrastructure for the successful implementation of LSS. Their main focus encompasses process improvements and increase in overall output, while also maintaining standards in customer needs. Companies should be able to select and use them to facilitate the implementation process, as they provide the necessary expertise in the use of tools and techniques and also provide mentoring services to other employees (Pamfilie et al., 2012). Employees can look up to them for their knowledge and expertise in LSS strategy. The ability of a project champion to effectively select, prioritize and manage CI projects and resources has a direct correlation with project success (Lynch and Soloy, 2014). Companies 1, 2, 4 and 5 evidently had a selection of LSS staff with a high level of both practical and theoretical skills. These were their advantages, having the skillset and personality to suit the environment. Companies 3, 6, 7 and 8, on the other hand, had difficulties selecting the right LSS staff.

➢ **Data-Based Approach**

In regard to data-based approaches, Companies 1, 2, 4, 5 and 7 effectively engaged this approach in order to facilitate their change from a reactive to proactive means of operation. This data-driven method helped the measurement process in order to validate positive improvements. The importance of the data-based approach in LSS is that it supports organizations in their decision-making process as a result of constant data gathering, highlighting gaps and inconsistencies within processes and in so doing, aiding waste elimination and ensure process improvements (Snee, 2005, Andrew et al., 2008). Companies 3, 6 and 8 on the other hand, were not able to fully incorporate the data-based approach as it was difficult to show value added to their operations.

➢ **LSS Projects Selection/Prioritization**

LSS project selection and prioritization were carried out by Companies 1, 2, 4 and 5. Top managers in these companies considered LSS project selection as a critical approach to ensure global alignment was in place and the correct plant diagnostics were carried out to ensure all project opportunities were identified. This approach helped them handle critical business projects in order of importance. This process was done through regular meetings with Lean, operations and engineering champions as well as all employees, so as to encourage their involvement in the projects. Companies 3, 6, 7 and 8 struggled with the prioritization and selection of LSS projects due to a number of factors such as lack of expertise, resources and minimal effort and commitment from top management.

➢ **LSS Projects Tracking and Review**

Companies 1, 2, 4 and 7 put effort into implementing project tracking and review into their processes. In order to apply this method, meetings were organised for the purpose of project review and tracking. Project review and tracking were essential to the companies as they promoted progress and ensured a successful outcome and maximized benefits. The concept furthermore aided in identifying the support and resources needed for LSS projects, detecting loopholes or gaps in projects and enabling the continuous improvement of processes. In Companies 3, 5, 6 and 8, there was a need for ownership and accountability to drive the projects, thereby limiting project reviews and tracking.

➢ **Resources for LSS Staff**

In order to ensure the successful implementation of LSS, senior executives have an important role to play regarding the provision of resources for the execution of projects. Companies 3

and 6 experienced difficulties with LSS processes due to a lack of resource availability for project execution. In Companies 1, 4, 5 and 7, there was evidence portraying strong leadership and management commitment to the availability of resources to facilitate CI processes. Some companies rely on a lack of resources to justify the act of not integrating LSS initiatives into business processes. It should also be noted that the successful implementation of LSS requires heavy investments which are not easily afforded by all companies.

> **LSS Training**

The companies believed that in order to facilitate the implementation of LSS, it was necessary for training and development programmes for employees to be established. This initiative was to facilitate their involvement in continuous improvement projects and processes. Companies 3 and 6 had difficulties in executing LSS initiatives because of the nominal involvement of employees at the early stages of the implementation and lack of training programmes related to LSS. The purpose of training and development programmes is to empower employees to make informed decisions concerning LSS to improve their processes. In companies 1, 2, 4, 5 and 7, employees received training on LSS. A platform for the sharing of ideas and suggestions for process improvement was created. Additionally, training and development programmes in these companies facilitated organizational change. In company 8, senior executives saw fit to train and certify only their top managers without the involvement of the entire organisation.

> **LSS Tools and Techniques**

The use of LSS tools and techniques in companies is dependent on the implementation phase of LSS, be it from the Define or the Control phases. Companies 1 to 8 employed these tools and techniques, as this was an essential requirement and crucial to the organizational culture of the companies. The tools and techniques were to be integrated and implemented daily, teams with the appropriate training adopted these methods for LSS projects and these required persistent coaching and mentoring from top managers.

> **Project Management Skills**

The responses gathered proved that employees in Companies 1 to 8 were equipped with project management skills. These skills are usually enhanced by training and development programmes provided by top management in addition to their involvement in LSS projects. Looking at Companies 1, 2, 4 and 5, these project management skills were taught through Black Belt staff training which was considered to be a facilitation technique. In Companies 3,

6 and 8, top managers recognized that project management skills were not the typical skills for teams, therefore, the need arose to provide a structure that could easily be implemented.

> **LSS Financial Accountability**

It is imperative that companies align their business objectives and LSS strategy for long-term objectives in order to successfully implement LSS. Creating a sphere for LSS financial accountability is another step in the right direction to achieving this success. Companies 1, 2, 4, 5 and 7 effectively aligned LSS to their business objectives by using continuous improvement as a measurement tool in both PBIT (Profit Before Interest and Tax) and non-PBIT financial benefits against budget targets and this enabled them to evaluate project savings against the profit bridge. Companies 3, 6 and 8, on the other hand, did not adopt LSS financial accountability as a long-term view or link LSS to their business's financial needs. As identified by Company 6, "Developing an approach to track financial gains associated with our LSS process here is quite challenging because of our limited manpower".

> **Linking LSS to HR Rewards**

Regarding HR rewards, Companies 1 and 4 incorporated this into their LSS process. The companies used the link as a means to engage employees to participate and be empowered. HR rewards are often associated with employee recognition in financial or psychological terms. This invariably helps empower and motivate employees to participate in LSS processes.

In analysing the findings from the critical success factors mentioned above, it is apparent that of all the factors, only three were marked across all case firms: Training, Tools and techniques and Project management skills. The ranking for CSFs for the failure and success of the initiative could be pointed to the respective positioning of companies in the table above. As observed in Companies 3, 6 and 8, the difficulties experienced in perfecting their implementation programme could be made easier by creating an understanding of the role of the CSFs required.

5.2.3. LSS Tools and Techniques in UK and Nigerian Manufacturing Companies

During the interview process with the companies, questions were asked concerning the use of LSS tools and techniques. The questions were structured in relation to the DMAIC LSS process. Every company identified the tools and techniques they utilized in order to resolve quality issues in the company. The table below captures the responses obtained

Table 5:3 Use of LSS Tools and Techniques

	LEAN SIX SIGMA TOOLKIT	COMPANY							
		UNITED KINGDOM					NIGERIA		
		C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8
DEFINE PHASE	Affinity Diagram	✓	✓	✓	✓	✓	✓	✓	
	Failure Mode & Effects Analysis (FMEA)	✓	✓		✓			✓	
	Process Flow Chart	✓	✓	✓	✓	✓	✓	✓	✓
	Project Priority Calculator	✓	✓		✓	✓		✓	
	Value-added Flow Chart	✓	✓	✓	✓	✓	✓	✓	✓
	Value Stream Analysis	✓	✓		✓	✓		✓	
MEASURE PHASE	Histogram	✓	✓	✓	✓	✓	✓	✓	✓
	Measurement System Analysis (MSA)	✓	✓		✓				
	Pareto Chart	✓	✓	✓	✓	✓	✓	✓	✓
	Six Sigma Conversion Table	✓	✓		✓	✓		✓	
	Trend Chart	✓	✓		✓	✓	✓	✓	
ANALYSE PHASE	5-Why Analysis	✓	✓	✓	✓	✓		✓	
	Design of Experiments	✓	✓		✓				
	Fishbone (Ishikawa) Diagram	✓	✓	✓	✓	✓		✓	
	Regression Analysis	✓	✓		✓	✓			
IMPROVE PHASE	5S Tool	✓	✓	✓	✓	✓	✓	✓	
	A3 Report	✓	✓		✓	✓		✓	
	Brainstorming	✓	✓	✓	✓	✓	✓	✓	✓
	Corrective Action Matrix	✓	✓		✓				
	Error-Proofing	✓	✓		✓	✓		✓	
	KAIZEN	✓	✓		✓			✓	
	One Piece Flow	✓			✓		✓	✓	
	Pull Scheduling	✓	✓		✓	✓		✓	
	Quick Changeover (SMED)	✓	✓	✓	✓	✓		✓	
	System Diagrams	✓	✓		✓	✓		✓	
	Total Productive Maintenance	✓	✓	✓	✓	✓	✓	✓	✓
CONTROL PHASE	CHECK Process	✓	✓	✓	✓	✓	✓	✓	✓
	Control Plan	✓	✓	✓	✓			✓	
	Standardized Work	✓	✓	✓	✓	✓	✓	✓	✓
	Statistical Process Control (SPC)	✓	✓		✓	✓		✓	

> ➢ **Define Phase**

The Define Phase is considered the early stage of LSS implementation. A number of tools and techniques as elaborated above are used in this phase. With regard to the results obtained during the interviews, Companies 1, 2, 4, 5 and 7 used LSS tools and techniques in their daily business processes. These companies claimed that the use of the tools and techniques enabled employees to comprehend, evaluate and interpret data for continuous improvement. On the other hand, Companies 3, 6 and 8 had problems incorporating the tools and techniques during the early implementation stage to drive their continuous improvement efforts. This was due to lack of top management commitment or lack of resources.

> ➢ **Measure Phase**

The Measure Phase includes tools and techniques such as Trend chart, Histograms, Pareto charts and Six Sigma conversion tables. Companies 1 to 8 employed the use of Histograms and Pareto charts, as they are basic LSS tools and techniques. The companies confirmed that at least 50% of their quality issues were resolved using the basic tools of continuous improvement. They also confirmed that the basic tools were easier to implement especially by the teams, as they involved less statistics. Companies 1, 2, 4, 5 and 7 were more engaged in the usage of tools in the Measure Phase than Companies 3, 6 and 8.

> ➢ **Analyse Phase**

In the Analyse Phase, powerful LSS tools such as Regression Analysis, Design of Experiments and the Fishbone diagram were adopted by Companies 1, 2, 4, 5 and 7. Companies 3, 6 and 8, on the other hand, rarely used these tools to resolve their quality-related issues.

> ➢ **Improve Phase and Control Phase**

In relation to the Improve and Control Phases, Companies 1, 2, 4, 5 and 7 adapted all of the LSS tools and techniques for their continuous improvement process. They evaluated the VOC and applied it to the technical requirements of the goods and services provided. The successful implementation of these tools and techniques in Companies 1, 2, 4, 5 and 7 created a platform for an effective application of LSS in their organizational culture. It facilitated the companies' extensive involvement in the LSS process, whereas Companies 3, 6 and 8 were not conversant with the LSS tools and techniques as they had just started using advanced LSS tools. This was a result of the employees' poor understanding of the implementation of LSS tools; consequently, they were seldom employed for problem-solving.

5.3.   Lean Six Sigma in Practice

From the results generated, the practice of LSS is seen to be uniquely applied to each case company. However, it is observed that the underlying principles for which these organizations chase their continuous improvement journey aided the researcher in establishing relationships and patterns between them. Following the coding process, three major categories arranged in chronological order as experienced by the studied cases were established. These phases as realised from the participants indicated their step-by-step approach in the implementation of LSS. The phases, *Organizational Readiness, Organizational Roll-out* plan, and *Sustainability* of the Organization's LSS process respectively, formed the basis to assess the implementation of the LSS initiative within the studied cases (see Appendix C for an example of the coding process using the data reduction technique by Miles and Huberman (1994)).

To provide a basis for summarizing responses from participants in different organizations as well as countries, a qualitative 5-point scale was used to measure participants' comments as they influenced the defined themes above. These ratings employed and presented in charts were based on the researcher's analysis and comprehension of the qualitative data generated within the study. This approach was in accordance with the data analysis method highlighted in Section 3.9 by Miles and Huberman (1994). From a 5-point scale indicating level of influence (1 – not at all influential, 2 – slightly influential, 3 – somewhat influential, 4 – very influential, 5 – extremely influential), the views and comments from each respondent were captured, and relationships between groups established. For the purpose of data synthesis and analysis, this scale was further grouped into three categories (weak influence (1-2.49), moderate influence (2.5-3.49), strong influence (3.5-5)) as they represented the ratings per case organization. (See Appendix C for examples of data analysis and detailed participant rating.)

5.3.1. Organisational Readiness

Organizational readiness in this context describes the factors considered during the pre-implementation stage for LSS, highlighting what organizations require in creating an enabling environment.

The first identified overarching theme was related to the readiness of organizations in the LSS implementation process. This study identified several sub-themes, grouped into four categories as they influence the overall theme.

These included *strategic decisions* and their underlying *benefits*, the *role of top management*, *organizational culture,* and *employee relationship.* Figure 5:1 highlights the relationship between the central theme (organizational readiness), the sub-themes and the codes.
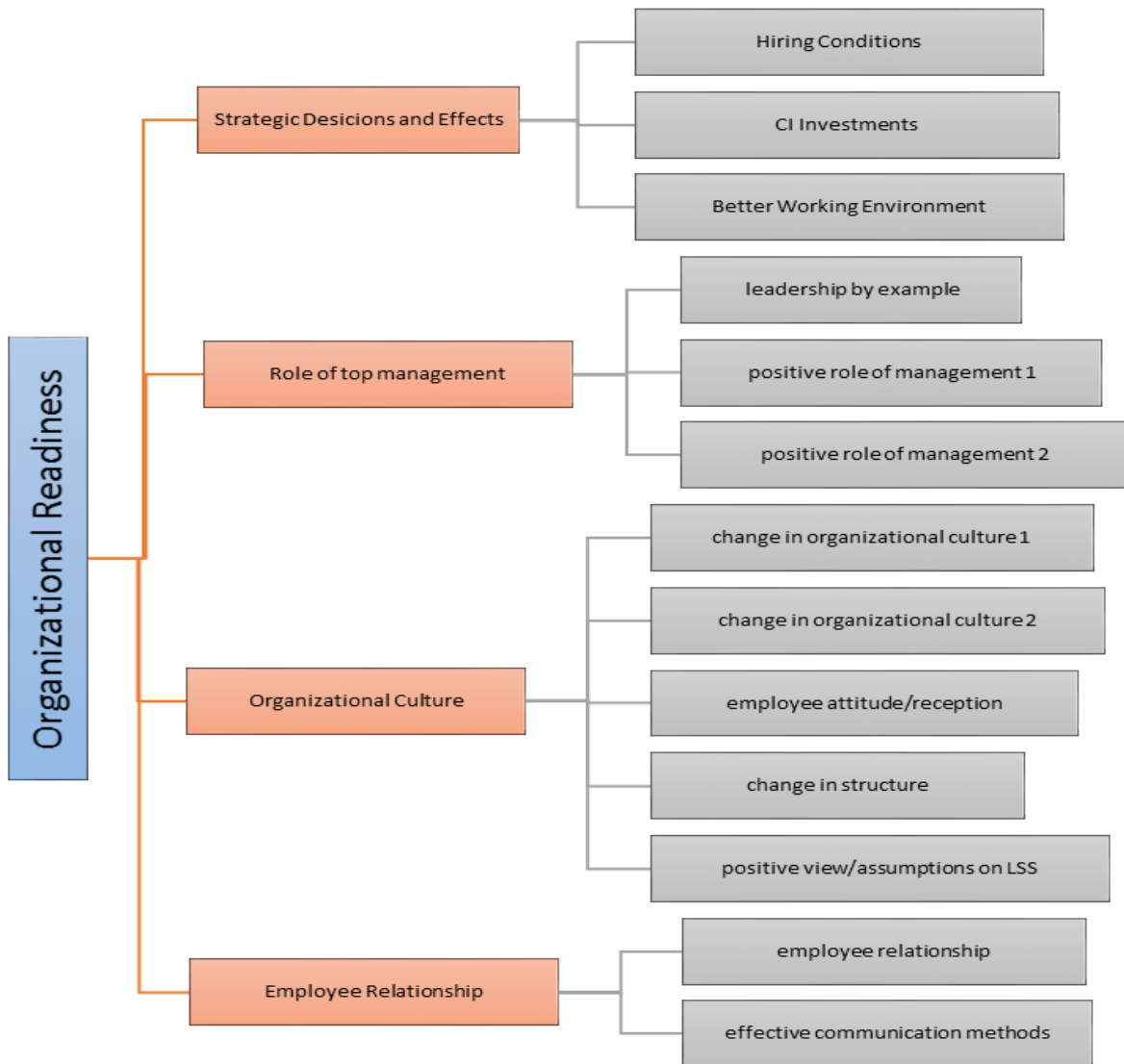
Figure 5:1 Organizational Readiness for LSS Implementation

The analysis of qualitative data collected through interview sessions within the case organizations was carried out in such a way that the researcher accurately assessed and measured each one against the identified themes. Using a qualitative rating technique, the classification tables within subsequent sections provide an avenue to compare aspects within the sample firms.

5.3.1.1. Strategic Decisions and their Effects

Emanating from the interview data were the strategic decisions considered by the case organizations in their LSS implementation process. Figure 5:2, rated qualitatively, shows factors as they influence the organizations within the research.
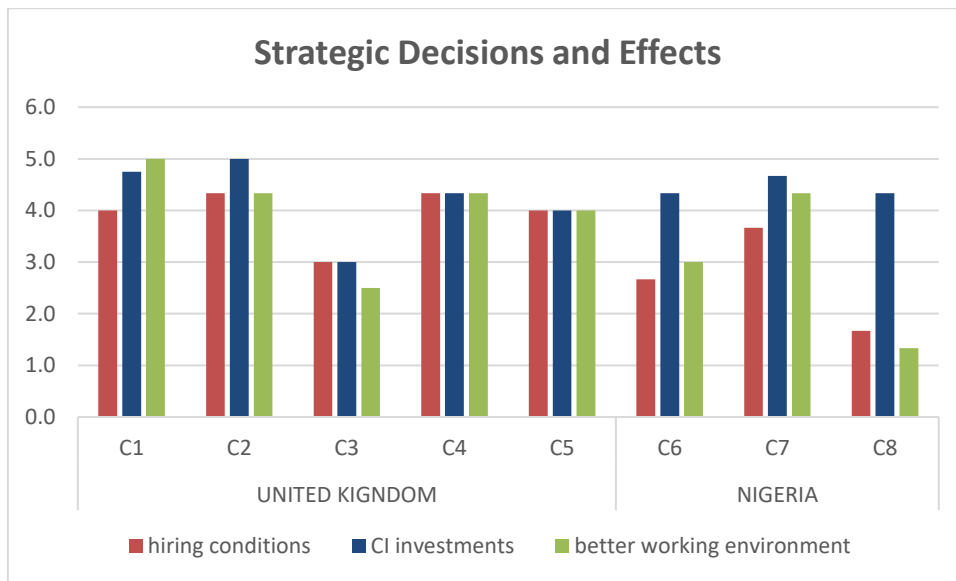
Figure 5:2 Role of Strategic Decisions and Their Effects

The decision by the UK organizations, especially Companies 1, 2 and 4, to build a comprehensive continuous improvement structure was made in order to recruit professionals with solid backgrounds in LSS to lead their CI process. The resolution helped in the growth of their structure and facilitated implementation within the companies. Lertwattanapongchai and William Swierczek (2014) highlight the importance of hiring LSS professionals and their impact on building an organization's CI structure, stating that one critical success factor required to help learning organizations is hiring stakeholders who support the development of a strong structure. Reiterating the importance of hiring LSS professionals, Timans et al. (2012) state that personal knowledge and experience of LSS by organization champions is one of the most important factors required to undertake a comprehensive CI programme.

The decision made by Company 1 to hire professionals was strategic, judging from their years of experience with continuous improvement and their personal drive for these initiatives is shown in Table 5:4. Their influence in the new organization could be for the long term, as implementation issues faced could easily be overcome based on their level of experience. El-Homsi (2007) discusses the link between LSS champions' level of experience and achieving the organizational strategy, asserting that for any organization to achieve high performance, the integration of LSS is crucial. The effect of this decision has produced an effective CI structure judging from the positioning of the majority of the UK companies and Company 7 listed in the chart above. Responses to this condition indicated a strong relationship between employing capable hands for LSS and facilitating change in the organization.

Participant views from companies 6 and 8 in Nigeria, in contrast, examined during the interview and observation process, failed to demonstrate the need to employ knowledgeable CI professionals to lead the change process. Remarks on follow-up questions from the researcher indicated that through the implementation stages of the initiative, there had been no employment of CI stakeholders. Both companies highlighted the need to develop in-house employees to drive their implementation, with the help of external LSS consultants, as indicated in the table. There are discrepancies between the results from both countries because the views of both groups have an effect on their level of implementation. Companies 1, 2, 4 and 5 in the UK and 7 in Nigeria reveal a strong influence of the necessity to hire CI professionals, as well as the positive impact of this decision on their working environments.

Companies 3 in the UK and 6, 8 in Nigeria demonstrated a weak to moderate influence of the effect of the decision on their working environment. In their research on LSS, Laureani and Jiju (2012) are of the view that the decision to engage professionals in a company has a great impact on organizational LSS readiness and growth. An organization that invests in hiring master black belts or black belts with years of experience as drivers of its LSS strategy will achieve more LSS integration into the organization objectives and readiness for CI. An example of these was revealed in the statements generated from Companies 1 and 8. In Company 1, the organization saw hiring the right people as a catalyst for change, while responses in Company 8 indicated that the effects of these decisions on the working environment were not properly enforced. Therein lies a question on the need to incorporate hiring needs in creating a "ready organizational environment".

Table 5:4 summarizes the views of the respondents regarding this sub-theme (Strategic decisions and effects)

Table 5:4 Qualitative Evidence for the Role of Strategic Decisions and their Effects

Open Coding	Qualitative Evidence	
	UK Companies	**Nigerian Companies**
Hiring conditions	"We looked at how the company was going, we could no longer maintain a business that was just ploughing along, we had to match our competitors, so we opened our gates and hired a managing director with a great Lean background that could act as a catalyst for change." (Company 1)	"We wanted an environment that won't focus just on meeting daily production targets; we targeted to do more with less, so we decided to equip our workforce with the right mind-set and tools to achieve this purpose. This was done initially through training and certifications through external consultants." (Company 8)
CI investments	"We had a goal to improve our overall figures, we had to go back to the drawing board and decided to invest heavily in continuous improvement. Decisions reached then were the need to bring on people with wealth of experience in CI, devise ways to improve our working culture and much more." (Company 4)	"It was part of a global roll-out programme by our parent company in the UK to ensure all sites get certified and enforce their CI program. We sought to get our employees trained and certified on LSS." (Company 8)
Better working environment	"These decisions have made our people more empowered, we have a much better and committed workforce, the environment is a much better place to work." (Company 1)	"It affected our organization, while we set out to implement the LSS programme; I believe the company did not properly enforce the change mantra. We now acknowledge it could have been done differently."(Company 8)

Taking into consideration strategic decision-making concerning resourceful CI investments, UK companies 1, 2 and 4 were committed to massive investments regarding the implementation of LSS. Investments were made in training, facilities and data management programmes, recruiting and selection of the right stakeholders, and most importantly, necessary investments in entrenching CI as part of the organization's culture. Lack of CI investment is a major failure factor in LSS. The failure of an organization to undertake investments in the areas of finance, technical and human resources can lead to failure in organizational LSS objectives (Albliwi et al., 2014). Jiju et al. (2007) state that the benefits obtainable by a company through LSS far outweigh its investment costs.

The critical success factors as experienced within the case organizations were indicated in Section 5.2.2. Although the majority of the respondents concurred that the need to embark on CI investments places a short-term financial burden on organizations, they also have short and long-term organizational and fiscal benefits if successfully incorporated. In most cases,

organizations fail to approach their choice of investments strategically. The consequences are apparent in the abandonment of such initiatives. Organizations that succeed in the implementation of LSS have to make initial CI investments as well as setting aside a particular budget to cater to their CI programme. According to Banuelas and Antony (2002), CI investments should be strategically made and projects carefully selected to obtain maximum benefits.

As an example from Company 3, a UK manufacturing firm did not undertake strategic CI investments but only embarked on it as a result of a decline in their profits and sales with the aim to achieve a quick success. Companies 6, 7 and 8 in Nigeria are also not left out, as they based their CI investment decisions on their affiliations with organizations in the developed world, particularly their parent companies. These parent companies, mostly located in the UK, had effective structures put in place for LSS to operate, therefore providing a direct replica to their subsidiaries in Nigeria might not deliver the desired results. In an attempt to drive CI programmes, the organizations in Nigeria resorted to unstructured training and providing a certification-driven workforce as part of their investments in LSS.

In line with the statements credited to Companies 6 and 8 in Nigeria, it is only logical that an effective approach to investment decisions is taken to suit these industries that are characterized by different working cultures. Strategic decisions relating to the implementation of LSS in organizations should be focused on embedding CI as part of the organizational working culture and integrating it into the corporate structure, as indicated in the CSFs by Laureani and Jiju (2012) listed in Section 5.2.2. Emphasis on investments such as LSS certifications, as in the case of Company 8, provides an organization with more certified employees and less LSS in practice.

From analysing the responses from different participants, its benefits can be appreciated in the differences in views amongst the companies and countries. Hiring conditions, clear CI investments and their corresponding effects on the working environment of organization are a prerequisite for organizational readiness for LSS.

5.3.1.2. Role of Top Management

Technical leadership attributes towards LSS are critical for organizational readiness. A leadership culture that understands LSS and its requirements, incorporating the right infrastructure for the initiative to operate, is a prerequisite for a successful implementing organization (Antony et al., 2012a).
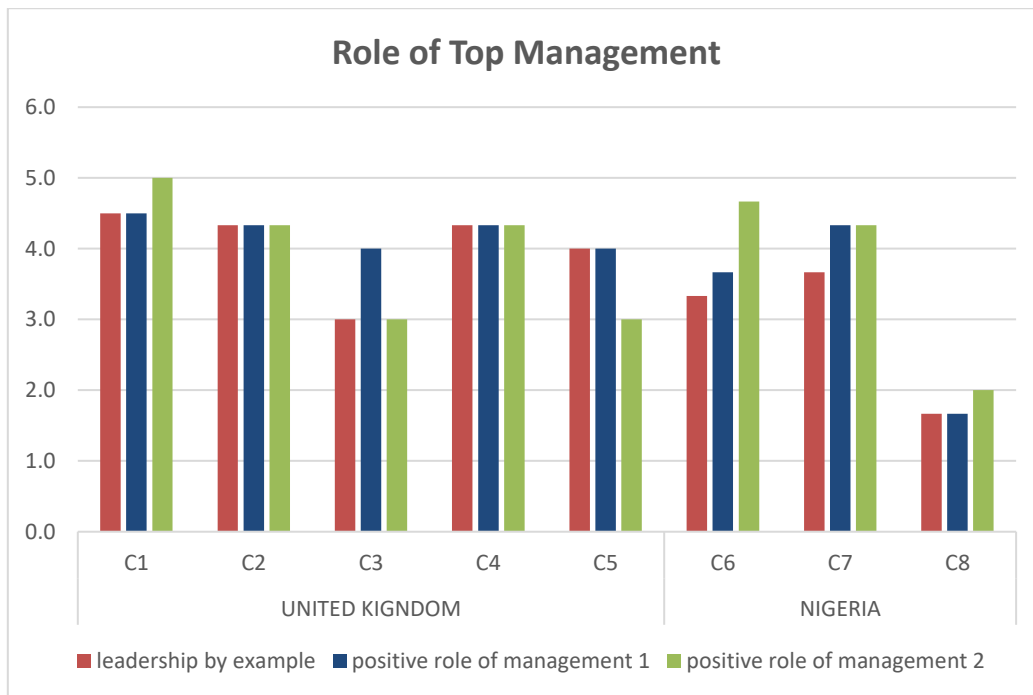
Figure 5:3 Role of Top Management in LSS Implementation

The responses obtained from UK Companies 1, 2, 4 and 5 and Nigerian Company 7 showed that most companies viewed leadership styles as a key element for creating an organization ready for LSS implementation. From Companies 1, 4 and 7, visionary leaders and mentors were fundamental for their CI application. The necessity of leading by example existing within an organization facilitates implementation. Through responses from UK Companies 1, 2, 4 and 5, it can be reasoned that leadership styles correlate with their LSS implementation, with an average score of 4 on a 5-point scale. Responses generated by these companies' indicated the presence of driven leaders. Pamfilie et al. (2012) in their research on the role of leadership in driving LSS from an analysis of 28 organizations, indicate that there exists a positive correlation between leadership by example and organizational LSS deployment. They further state that a leader acts as an efficient communicator of LSS objectives and requirements, which in turn encourage employees' motivation towards LSS. An increase in employee motivation will occur during LSS project implementation due to effective leadership (Pamfilie et al., 2012). Responses from participants of Company 8 in Nigeria revealed that there was an absence of leadership roles in LSS, evidently from the failure of top management to drive the CI process. Responses from Company 8 (see Table 5:5) indicated that the failure of management to lead by example disrupted their CI structure. Poor leadership was identified as a significant hampering factor towards organizational readiness for LSS in manufacturing

firms (Timans et al., 2012). The varying level of response from both countries as shown in the chart above has its effect on their implementation.

Table 5:5 captures the views of the respondents on the role of top management involvement in LSS within their organizations.

Table 5:5 Qualitative Evidence on the role of Top Management in LSS Implementation

Open Coding	Qualitative Evidence	
	UK Companies	**Nigerian Companies**
Leadership by example	"The site lead has excellent leadership and motivational skills; he has acted actively in the direction he wants the company to go and has driven from the top. Same applies to the senior management. The junior management like me has to align with the CI structure to drive it, as we are a direct link between top management and the workforce." (Company 1)	"There was no defined role as far as LSS is concerned because even the top management that brought the idea never really was there to see it grow and germinate." (Company 8)
Positive role of management 1 (Expectations)	"In reality, every stakeholder is important, no one is more important than the other, but you must have a full buy-in from senior management before LSS can even be successfully adopted, and I think that is where we got it right." (Company 4)	"The most important role for me is senior management. If you look at why we failed in our implementation in this site it was because senior management never had a clear policy and direction for LSS." (Company 8)
Positive role of management 2 (Driver/enforcer)	"Yes! Management is leading the drive, and they have set the foundation and structure on which our LSS programme stands. Top management commitment essential because the success of the programme depends on resources human, financial and material, which are required for effective take-off." (Company 5)	"Our initial plan was to have top management's role regarding the allocation of resources and provide backing, while we develop our people in-house to enforce it throughout the plant." (Company 8)

Examining the expectations from management in creating an organization ready for LSS to operate, responses obtained from the interviews in UK Companies 1 to 5 and Nigerian Companies 6 and 7 revealed the bulk of the responsibilities for implementation lay with senior management, and in their ability to drive from the top. Seen as a success factor as indicated by Company 4, the collective buy-in from management positively affected their implementation journey. According to Clegg et al. (2010), in incorporating CI initiatives, management must play an active role in all functions of organizations, particularly in employee training, and in

project selection. Academics recommend that CI professionals occupy leadership positions, as this will drive strategic leadership and improve organization performance, ensure continuous management commitment and support towards LSS (Antony et al., 2012a). Qualitative evidence from UK Companies 1, 2 and 4 revealed that the success of their LSS programme was a result of top management's commitment and acceptance, requiring management to drive the process totally from the top as well as leading from within. Respondents in Company 5 emphasized that the benefit of senior management driving the process allows the building of an active CI structure. Nigerian Company 8 demonstrated a failure in CI readiness due to a lack of clear policies relating to LSS from top management.

5.3.1.3. Organizational Culture

One aspect of organizations adopting LSS is to change their corporate culture from passive to active (Mi Dahlgaard-Park et al., 2006). It is imperative for a manufacturing organization to adopt the best organizational culture that will suit its LSS programme and enable the programme to effect change within its setting (Pakdil and Leonard, 2015). The importance of integrating LSS into organizational culture, creating readiness for LSS implementation was emphasized by the responses obtained from companies in this study.
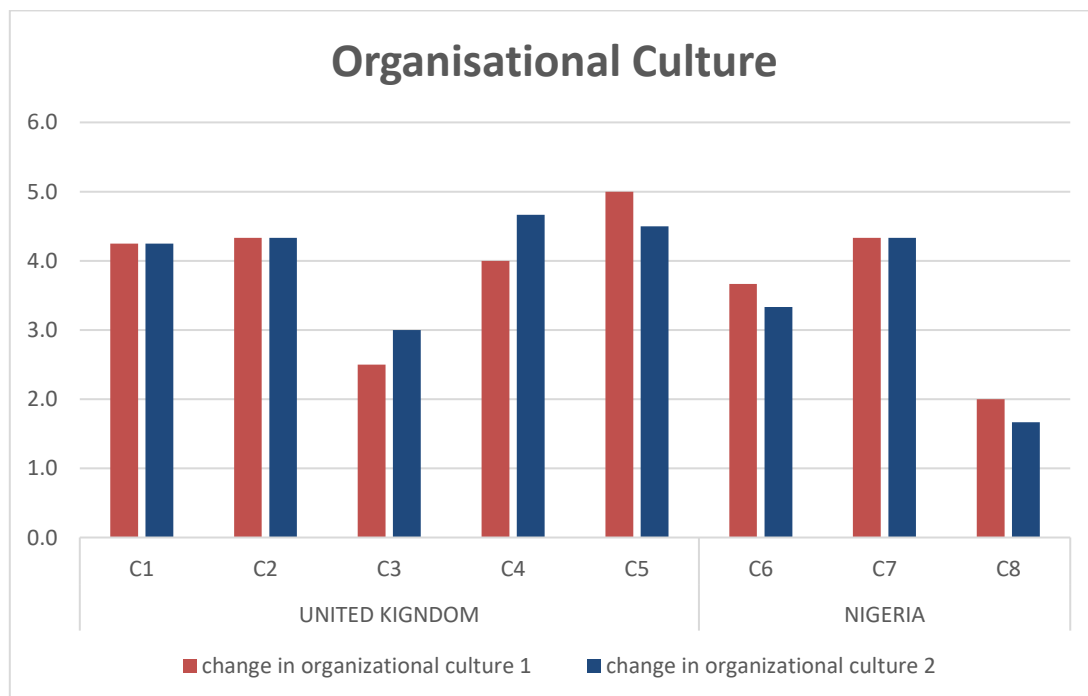
Figure 5:4 The role of Organizational Culture in LSS Implementation

As seen from Figure 5:4 above, most of the companies within this study highlighted the role of organizational culture in preparing an organization's readiness for LSS. In linking organizational culture to LSS, Fredendall and Robbins (2006) note that a culture which ensures every team member is inculcated into the LSS programme, encouraging development and flexibility, will help an organization improve its overall performance. The ability of employees to be fully integrated into the decision-making process shows the type of organizational culture in place. For practical readiness for LSS, corporate culture must match correctly with employees' requirements to ensure successful implementation of the LSS programme, as seen in the response from Company 2. Furthermore, it shows that for employees to engage effectively with their LSS change programme, the organization must first modify their culture to suit the employee working culture appropriately (Maroofi et al., 2012).

The qualitative evidence shown in Table 5:6 and Figure 5:4 above hinted at the cultural direction in participating organizations in this study. For Companies 1, 2, 4 and 5 from the UK, the findings highlighted the role organizations took to review their present culture and the applicability to the initiative. Evaluating the Nigerian companies, the cultural dimensions were also taken into account. Statements attributed to Companies 1 and 2 exposed the need to tweak the corporate culture if necessary to suit the implementation of the initiative. For Companies 3 and 8 from both countries, their cultural attributes negated their quest for improvement gains. These companies failed to understand the need to make radical adjustments to their culture during the preparatory phase. As Kwak and Anbari (2006) put it, LSS practice will only thrive in a company with a flexible, well-defined and creative culture that supports CI and encourages employee growth and training. The demonstration of this point reflects significantly on the overall implementation results of both Companies 3 and 8. It is evident from results of both companies that the change in organizational culture is not dependent on the country but rather on the ability of the organization to fully understand the cultural role necessary for LSS to operate.

Table 5:6 summarizes the views of the respondents on the impact of organizational culture on LSS within their organizations.

Table 5:6 Qualitative Evidence on the role of Organizational Culture in LSS Implementation

Open coding	Qualitative evidence	
	UK companies	**Nigerian Companies**
Change in organizational culture 1	"In a nutshell, I think we weren't in a bad state. We were just at a point where we could do things better, and we didn't believe that we could do it better. Our	"Regarding quality, compared to an unstructured approach, we now have employees getting to appreciate the need to do things right and provide

(Cultural direction)	culture was characterized by a phase of trials and errors, and also a different management style that didn't accommodate the employees in the thinking process. It was more senior management do the thinking and employees do the doing. But now, a new concept has emerged. Everyone has a sense of involvement." (Company 1)	results. A good reporting structure has been created." (Company 6)
Change In organizational culture 2 (Tweaks to suit LSS)	"Every organization is unique with its culture; we had to tailor our change programme to suit our needs and ensure it fits appropriately with our employees. However, necessary fundamental changes were made to create an enabling environment." (Company 2)	"That was one of the biggest problems; no one considered why we should implement LSS, what benefits do we hope to accrue from it, what do we intend to change. As the company was already doing well before LSS and even when the training was ongoing there was never a need to ascertain what tool will work better on this site and will help us improve." (Company 8)
Employee attitude / reception	"Well let me divide into three groups; we had some excellent employees that wanted to get involved and took it in their strides. We also had some that hovered around trying to understand what was going on; they thought an unknown plan was being arranged. Lastly, we had those that point blank refused to do anything. The last group, we had to let some go and incorporate the rest into our change programme." (Company 4)	"In reality, you have more employees who are not fully buying in than those who have accepted the programme." (Company 6)
Change In structure	"Yes, we had to change a lot. We needed everyone to be involved; we started by requesting quick and easy KAIZENS from everyone rather than just sitting around. People were encouraged to take ownership, which is the biggest thing to be fair." (Company 1)	"No real adjustments were made because we ended up doing the same thing we have been doing." (Company 8)
Positive view / assumptions on LSS	"Different levels of employees had their basic assumptions, for those of us in management; we reviewed our system and acknowledged the need to be better in all functions. We looked at the benefits of a structured implementation and the impact it could have on our financial sheets, and we went for it." (Company 1)	"I believe one assumption which turned out false, was that both top management and employees felt that implementing the programme through training and certifications would automatically make us compliant. I mean, we have almost 30 green belts today." (Company 8)

On employee attitudes and reception to LSS, responses obtained from Company 4 showed that there were three categories of employees, i.e. those who fully accepted the programme, those on the side-lines and those who rejected it. These categories indicate the importance of the voice of the employees in the implementation process. The results show that Company 4 let go of employees with negative attitudes to change, leading to their successful implementation of LSS. This action shows that employees who reject LSS and change management can be an obstruction to organizational readiness for LSS implementation. Rampersad and El-Homsi (2007), explain that it is more challenging to change an organization's culture than an individual. For instance, if an organization invests in improving its employees by engaging, empowering and integrating them into its LSS programme, it is easier to achieve organizational change and in turn the success of LSS. Employees with negative perceptions can also affect other employees, thus leading to a hostile environment within the organization towards LSS implementation. The responsibility is on the management to devise methods to engage its employees in LSS.
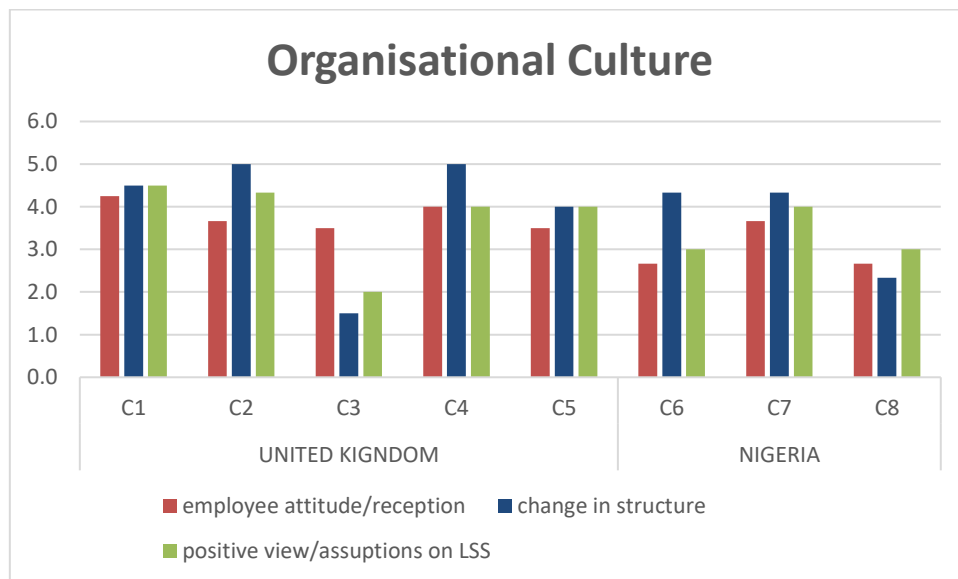
Figure 5:5 The role of Organizational Culture in LSS Implementation Contd.

The relative positioning of organizations in Figure 5:5 illustrates the role employees play in creating a ready organization. While success in implementation was recorded for most of the organizations, the task of removing negative attitudes to the change journey lies in the ability of organizations to mitigate reception issues and promote the understanding of employees. For Company 6, the management of negative attitudes towards implementation might have

had an effect on their overall success. While there were claims to being an implementing organizations, employee attitudes impeded the overall success of the programme substantially.

For an organization to ensure its readiness for LSS implementation, an important aspect, as highlighted in responses from Companies 1, 4 and 7, is the change in organizational structure. This change requires an organization to urge employees to be fully involved in the process, being aware of employees' needs and coaching them to take full ownership of LSS programme. As highlighted by Galloway (2008), the efficiency of the organization's structure is a critical success factor for successful LSS deployment and implementation. She further points out that a company with a robust organizational structure would ensure that employees receive proper training on LSS tools and techniques and modify its structure to guarantee its LSS programme effectively matches the organization's strategic objective. The LSS methodology offers an organizational structure which can realise improvements within its projects if manned by certified experts. The inability of an organization to effect adjustment to its structure in LSS implementation will impede organizational readiness, as shown in the response from Companies 3 and 8. Due to neglect of structure, there were no clear-cut policies on CI, leaving employees excluded from the entire process, preventing them from taking ownership of the process and resulting in these organizations undertaking tasks in the same way it was previously done. This factor is seen from the response in Company 1, which showed that while there must be different basic assumptions among employees, management will carry out a comprehensive analysis of the current organizational system to assess the necessity for CI and determine the best fit for the implementation structure.

On the assumptions about LSS in organizations, challenges were faced by most companies around employees who assumed that the LSS programme was a tool for management to increase their workload and downsize. Management was faced with the need to strike a balance between the efficiency levels of these employees and eliminating increased workload and downsizing. This was achieved by integrating the principles of LSS into their culture, creating awareness for employees to realise the need for a structured way of doing things. Examining the failure of CI in manufacturing organizations, companies who embark on LSS with incorrect objectives and approaches based on existing assumptions will fail (McLean et al., 2015). For Companies 6 and 8, a certification-driven culture affected their approach towards implementation. While the majority of the UK companies focused on an integrated approach towards the change programme, the Nigerian companies sought to employ a haphazard approach, characterized by an unstructured way of training most of their

employees, with the hope of championing the implementation process. This shows that a constructive approach by management on LSS is a very crucial factor, as a view channelled in the wrong direction will result in LSS failure and limit its implementation as observed from Company 8.

5.3.1.4. Employee Relationship

An organization that strategically involves its human resource functions into the Lean programme will achieve improved performance (Bamber et al., 2014). One major factor in ensuring organizational readiness for the LSS programme is the employee relationship, as it plays a crucial role in the LSS journey.
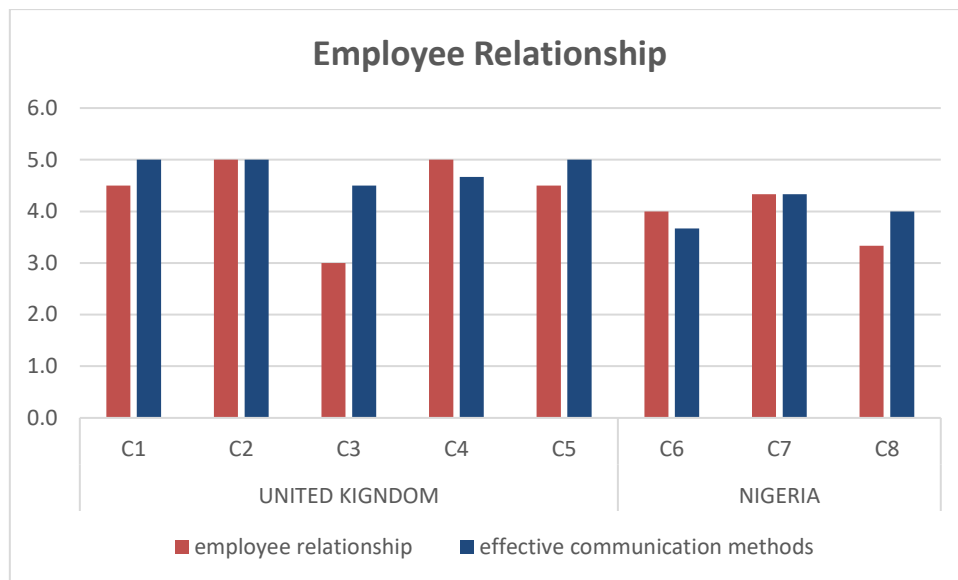
Figure 5:6 Employee Relationship and Its Effects on LSS Implementation

The findings from Company 3 highlighted that a poor employee relationship played its role in the failure of LSS. As a respondent put it when asked about employee relationship:

"*Truthfully now we are at a stalemate. You have employees who are so willing to implement LSS, but a management that is not open to their plans. We have situations of management still doing things the old way, and that creates a problem in their relationship with each other.*"

Company 6 also highlighted that due to a poor employee relationship, there was a period of disengagement between management and shop-floor employees, which caused both parties to drive in opposite directions. An organization's ability to develop strong relationships amongst staff while also maintaining a cordial working relationship between employees and

management will guarantee that its LSS and strategic business objectives are fulfilled (Mi Dahlgaard-Park et al., 2006, Byrne et al., 2007).

These responses showed the level of impact of the employee relationship in LSS implementation. Similarly, reactions from Company 1 demonstrated that for it to successfully develop its LSS programme, it had to manage and harness the employee relationship. Despite having some good and bad days, building and promoting teamwork characterized high-performance teams and helped workers in the construction of a cordial relationship, thus having a tremendous impact on the success of LSS implementation. Company 6's responses highlighted the importance of an effective employee relationship as it aimed at creating healthy competition to strengthen LSS among employees, while ensuring the relationship remained cordial, thus aiding organizational readiness.

Table 5:7 summarizes the respondents' views on the importance of the employee relationship to LSS acceptance and implementation.

Table 5:7 Qualitative Evidences on Employee Relationship

Open coding	Qualitative evidence	
	UK companies	**Nigerian Companies**
Employee relationship	"It's a developing process. We've had our good and bad days, but we tried to manage it by creating high-performance teams within different departments to promote an effective relationship." (Company 1)	"They relate well to each other, and as much as you might see competition about team targets, the relationship is very cordial." (Company 6)
Effective communication methods	"We have various communication means within the organization; from a more general monthly organization-wide meeting to a team or department-based weekly meeting. These are created to bridge communication between different levels." (Company 2)	"We have tried to implement a seamless reporting structure in order to eliminate bureaucracy within our system, and we have our mentor training programme that has helped in creating a direct communication method between employees." (Company 7)

On communication, for an organization to achieve and sustain gains made through CI, an active management-employee communication system must be in place, one that incorporates monitoring and performance appraisal (Creasy, 2009). The impact of effective communication methods in LSS implementation can be appreciated in the responses from all the companies in this study. It is observed that most organizations set up policies and systems that enabled effective communication, by bridging the communication gap between employees and

management, employing open-door policies and undertaking regular management/employees meetings. However, the disparity between the successes recorded by these companies exposes that the communication methods could be affected by the employee relationship. The manner in which employees interact would determine how information is disseminated. Wroblaski (2010) elucidates that there must be a continuous open line of communication between employees and management that embraces feedback processes that would lead to process efficiency and improvement.

The responses from Company 7 showed the importance placed on effective communication in developing organizational readiness and sustaining the success of the LSS implementation programme. It ensured a seamless reporting structure within the organizational structure and by this means, eliminated difficulties linked to bureaucracy. In addition, empowering employees to have direct communication systems to management as well as engaging employees in active mentorship and training programmes.

5.3.2. Organisational Roll-Out Plan

The results of this study indicate factors considered in rolling out the LSS initiative within participating organizations. The chronological timeline over which these organizations pursue their LSS journey are further broken down into three sub-themes: motivation for *implementation, deployment* and *implementation plan* for LSS. From the transcribed data as well, codes are further presented in Figure 5.7 as they influence the sub-themes as well as the overarching themes in general.
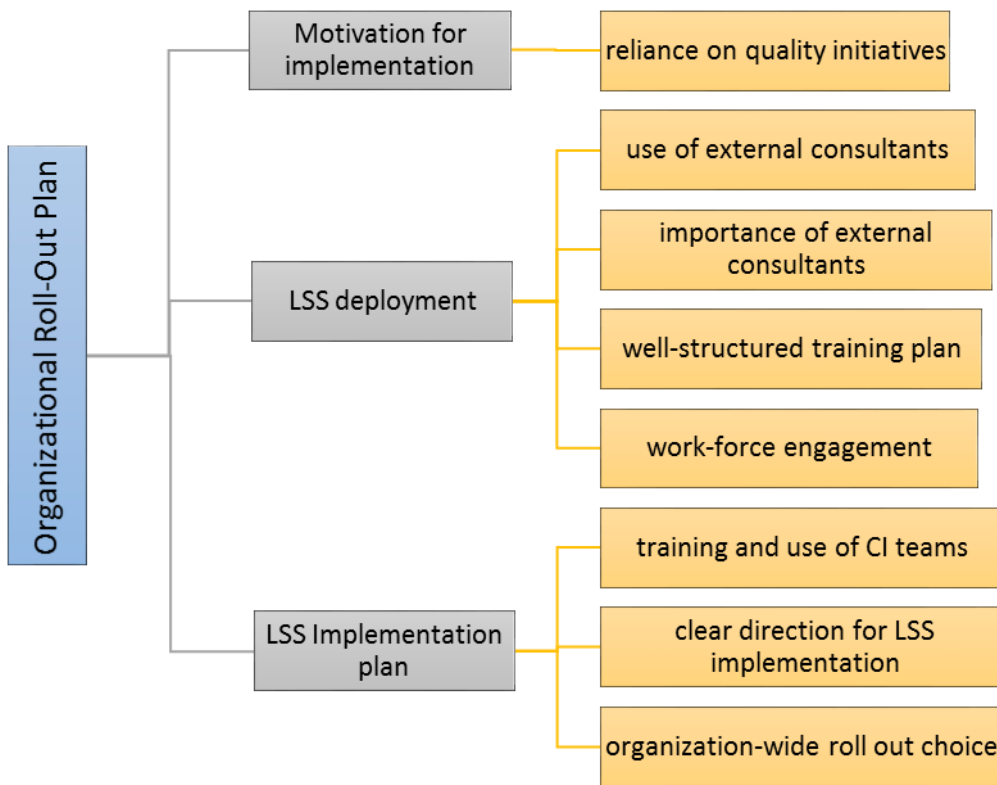
Figure 5:6 Organizational Roll-out Plan for LSS

5.3.2.1. Motivation for LSS Implementation

Understanding the reasons why organizations execute their CI programmes aids in designing the appropriate plan for implementation. For most organizations, their reliance on quality initiatives is matched to achieve the benefits which they bring. Outlined in various reactions, Company 4 (see Table 5.8) stated the major deciding factor that enabled them to assess and apply quality initiatives was to improve their customer feedback process. In so doing, customer quality complaints were efficiently managed and formed the basis of the organization's quality initiatives. Tailoring the initiative to customer needs gave the organization a firm grasp on customer quality complaints.

Table 5:8 shows the views of the respondents on the perceived motivation for LSS acceptance and implementation within their organizations.

Table 5:8 Motivation for Lean Six Sigma

Open coding	Qualitative evidence	
	UK companies	**Nigerian Companies**
Reliance on quality initiatives	"We had a product-specific approach to quality improvements. A more ad-hoc basis, as we relied on customer complaints to attend to our quality issues." (Company 4)	"We have internal QMS, and we still do TPM till date which has been very successful and that has led to an increase in production time, and also reduced machine breakdown period." (Company 8)

For Company 8, the motivation for their choice for LSS was to embrace a holistic and improved approach to quality improvement initiatives. As the responses showed, their dependency on their internal quality management systems and standalone periodic maintenance saw the need to seek further improvements.

For Company 1, the motivation for LSS implementation was to provide a benchmarking structure for quality that could easily be managed over time. As the Continuous Improvement Manager put it:

"*Previous quality measures have limited success in particular project delivery. Our reliance hindered us to define and measure improvements, making it difficult to attach value and recognition for our efforts.*"

For most manufacturing organizations, irrespective of the geographical region, the underlying factor for seeking improvement initiatives does not differ. The primary goal is to achieve measurable, significant improvements within their functions. From all participating organizations, the role of quality initiatives and their impact on organizational performance were understood.

5.3.2.2. LSS Deployment Design

One concern raised by participating organizations within this study came from the suitability of the use of external experts/consultants in the design and execution phase. In contending the importance or non-importance of these external experts, it is necessary to assess qualitative evidence obtained from the responses. Figure 5:8 gives pictorial evidence as to why each company deemed it necessary. It is, therefore, imperative to analyse the reasons for this belief as highlighted by the participating organizations
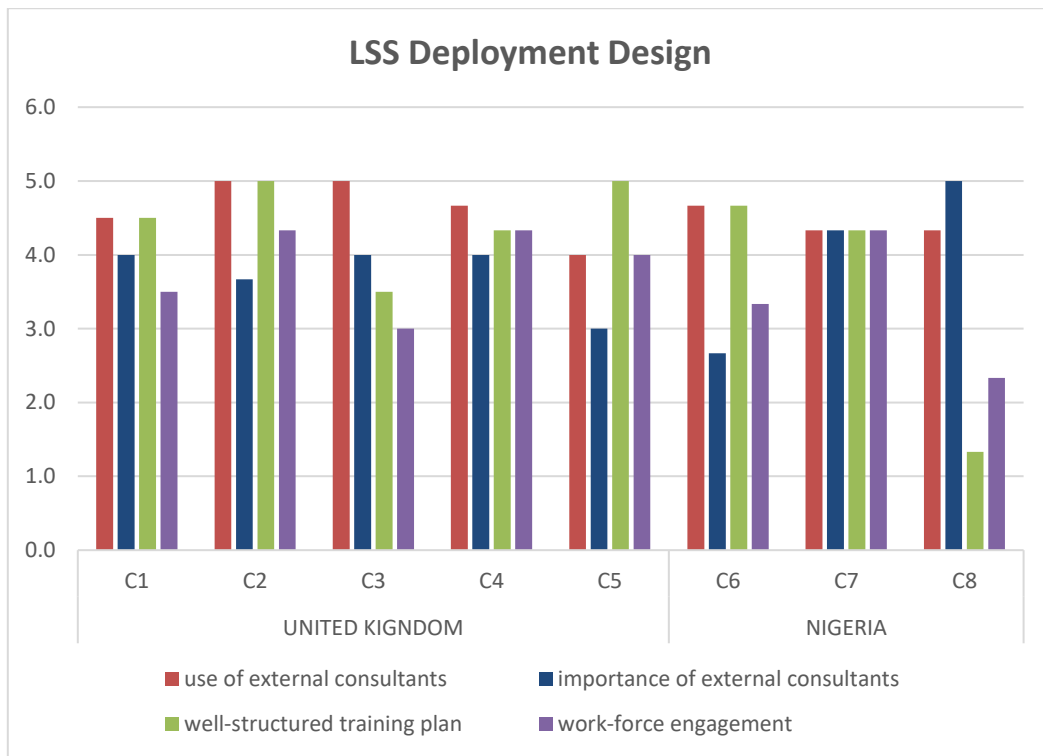
Figure 5:7 Lean Six Sigma Deployment Design

For most of the companies, while external consultants are very useful in the deployment design of the LSS programme, organizations are obligated to select the right external consultants with due consideration of the structure, working culture and environment in which they operate. Maleyeff and Campus (2007) are of the opinion that in undertaking LSS, skilled facilitators could be sourced internally or externally, but they should be sourced based on their ability to achieve project success. Responses attributed to Company 1 indicated that to successfully develop and roll-out their LSS implementation plan, an external consultant with flexibility in their approach was hired, one who tailored LSS tools and techniques towards the organization's requirements.

This choice indicates that the flexibility and adaptability of an external consultant to the organization are fundamental. For Company 2, the CI Manager stated:

"*We found the information coming from external experts to very useful, though they have lots of standards. In our case, we worked closely with them to provide that balance with are working culture.*"

Other companies indicated the need to incorporate the use of an external expert to run daily work on the site. For Company 3, the Lean Director pointed out:

"I am a consultant hired on a contract to launch LSS. In most cases, companies source the services of external experts for training purposes. I am on-site to make sure our effort is tailored to this site."

The findings across the cases suggested a careful selection of experts for the planning and execution of the initiative. Comparing responses from both countries, Table 5:9 indicates that while both countries acknowledge the use of external experts, the application of their expertise could be deemed to be different. For the UK firms, a clear understanding of their role is highlighted, as they provided guidance. For the Nigerian companies, as seen with Company 6, the consultants were given the bulk of the task of driving implementation. O'Rourke (2005) states that external consultants play key roles in the implementation of LSS, achieving the best approach in facilitating training, project selection and resource allocation. He adds that the experts create uniformity of training and LSS standards, but they should not be used solely to lead the CI initiative.

Table 5:9 highlights the views of the respondents on the LSS deployment design within their respective organizations.

Table 5:9 Qualitative Evidence on LSS Deployment Design

Open coding	Qualitative evidence	
	UK Companies	**Nigerian Companies**
Use of external consultants	"We tried a couple of consultants. We initially tried a more dictatorial type; that said, this is what you should do, how to do it and result in kind of training. We also had those that analysed our environment and tailored just to suit us. The latter helped in our journey." (Company 1)	"They played and are still playing a huge role. They have drawn up the entire training programme with input from my office HR and our CI department. They are involved in workshop training, training management levels, and shop floor. They have worked with organizations where LSS worked efficiently." (Company 6)
Importance of external consultants	"We employed the services of external consultants in the beginning, however, we subsequently created our in-house team to equip the workforce further and provide a clear structure. From my experience, the consultants are there to give a good foundation, but the real drive has to be done internally." (Company 2)	"We engaged the services of external consultants to help with training and certification of the employees." (Company 8)

Open coding	Qualitative evidence	
	UK Companies	**Nigerian Companies**
Well-structured training plan	"The organization decided to start from the bottom. Training all employees, creating awareness around the plant. They set out to train all team leaders, supervisors and mid-level staff to a white belt beginners level to promote ownership and accountability." (Company 4)	"We were told how the programme operates during the training, and then what we needed to do, going according to what was designed." (Company 8)
Workforce engagement	"We created a top-down approach in rolling out our initiative to the workforce. We identified each level of staff as a distinctive stakeholder and briefed them accordingly. We used training and workshops to communicate with each stakeholder." (Company 2)	"We took time to develop a road map for each of our pillars in our previous system in line with the LSS framework, handed it down to the factory and together we are enforcing around the plant." (Company 6)

On training needs for the organizations, the interviewees demonstrated the use of training schedules for their deployment plan. It was believed that employee training is a prerequisite for building and sustaining the LSS culture. As seen in Figure 5:8, most UK organizations expressed satisfaction with their training patterns as they encouraged employees to be more accountable and become owners of processes. For Company 4, training in batches was conducted first for low-level employees in order for them to fully understand the usability of the tools and techniques, and understand the philosophy behind LSS before proceeding to train middle and level employees. The findings from Company 8 exposed an unstructured approach towards employee training, as a more theoretical approach was employed. Emphasis was placed on certifications for team leaders, with tasks to enforce within their teams. Relating to the engagement of the workforce, it is important to train all employees on the basics of LSS, promoting employee involvement from the inception stages of the firm (Antony et al., 2012b).

Through the responses gathered from participants, it is evident that workforce engagement facilitated changing the working culture within most of the UK and Nigerian manufacturing firms. The transcripts, in Table 5:9, highlighted the value of the workforce in the design of the LSS initiative. According to Dalal (2010), the engagement of employees in the LSS journey should commence on the inception of the initiative. An understanding of the need for LSS must be created, ensuring employees are fully involved and participate in the decision-making

process. The responses from Company 2 showed that in engaging the organization's workforce, it is important to pay particular attention to the needs of employees, and tailor the training requirements to suit their distinctive roles and functions. For Company 1, to engage its workforce effectively, a hands-on approach was adopted, spearheaded by top management and controlled by the Managing Director, not only involving classroom lectures but using a method based on instilling improvement measures in everyday tasks. Similarly, the response from Company 6 also showed the importance of workforce engagement in the design of LSS, as they ensured their employees were committed to realising their strategic manufacturing objectives.

5.3.2.3. LSS Implementation Plan

The initiation of CI teams formed an integral part of the LSS implementation plan within the case organizations. Respondents in Company 2 indicated that to roll out an LSS plan effectively, there was a need to effect changes in the organizational structure to accommodate an LSS specialist whose obligation was to lead and drive the initiative. Anuar (2015) discusses the importance of cross-functional continuous improvement teams, noting that without such teams, efforts made towards an LSS programme and its projected results might fail. From the relative positioning of the case study firms on this factor as seen in Figure 5:9, it is evident that all companies demonstrated a moderate to strong influence of the use of CI teams. The applicability of these teams, however, could be questioned due to the individual performances of the firms.
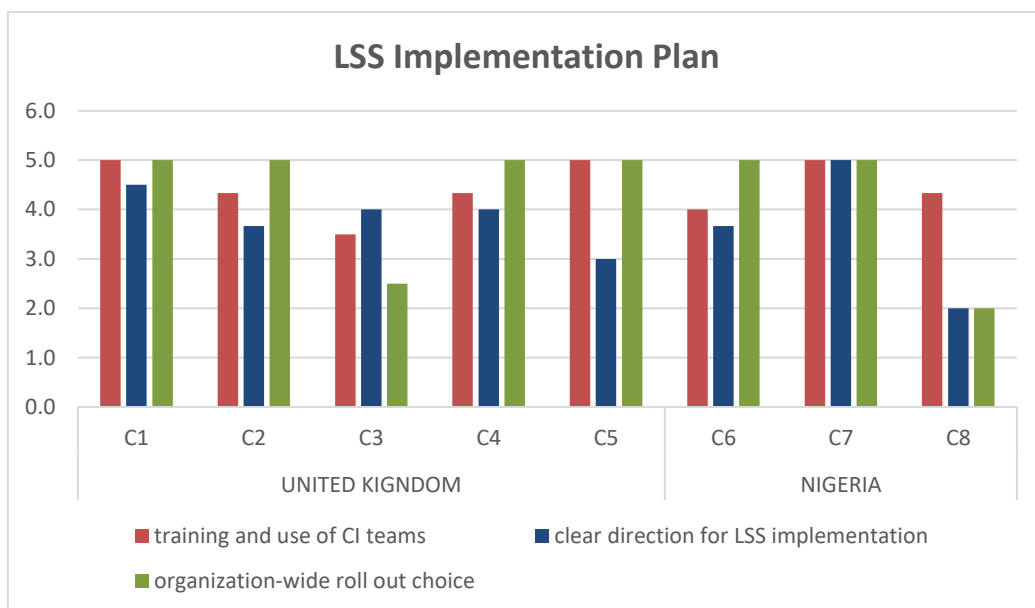
Figure 5:8 Lean Six Sigma Implementation Plan

In comparing practices in both countries, their understanding of the requirements and need for these teams could be judged differently. For UK Company 2, a more proactive approach was taken to restructuring as compared to a reactive approach for Nigerian Company 6. In a practical case of LSS implementation, functional CI teams were assigned to various facilities; these functional CI teams were responsible for incorporating LSS, training and laying down systems that ensured its success at Raytheon (O'Rourke Peter 2005). It is imperative for these requirements to be clearly set out in the planning and execution of the LSS programme.

Table 5:10 Qualitative Evidence on LSS implementation Plan

Open coding	Qualitative evidence	
	UK Companies	**Nigerian Companies**
Training and use of CI teams	"Changes were made in our organizational structure at first, to accommodate specialists such as myself to drive the initiative. Cross-sectional teams were also created to promote awareness within departments further." (Company 2)	"We are still trying to change things within the organization structure to fit into CI tools and techniques to ensure that our production processes and training are fully incorporated." (Company 6)
Clear direction for LSS implementation	"The journey is a continuous one; we are 8 years down the line, and we are experiencing improvements in all our functions." (Company 1)	"As I mentioned earlier, the consultants designed a 5 year plan but it was abandoned during the first. We are back to the drawing board to change things around." (Company 8)
Organization-wide roll-out choice	"It was an organization-wide implementation. We started with the easy bits such as 5S and then transcended into a more detailed data approach." (Company 1)	"Our initial plan was to roll it throughout the plant, but at the end, we started out based on pilot projects because there was need for quick wins." (Company 8)

On the need to assign a workable timeline for implementation, organizations within this study exposed distinctive directions for LSS implementation. This is attributable to the goals which they originally set out to achieve. In most cases, organizations adopt LSS as an operational strategy in a bid to reduce operational costs and improve competitive advantage while striving to achieve world-class production. However, this plan is often hampered by implementation issues faced. The inability of the drivers to undertake proper strategic planning will allow distinctive directions on the process and what an organization aspires to achieve through its implementation. To this end, a single direction or time plan to be used by every company is not feasible. According to Jeyaraman and Kee Teo (2010), organizations should have directions stating their expected goals and objectives on their LSS dashboard.

Responses from Company 1 identified the LSS programme as a continuous journey, one that requires improvements in all functions of the organization. Currently in their 8th year of implementation, the organization has experienced radical improvements across all departments; this is the result of clearly set directions. According to Jayaraman et al. (2012), LSS should not be seen as a standalone activity that involves the use of a few tools and techniques; it is to be targeted at achieving organization-wide process and product improvements while making a positive impact on financial performance. Similarly, Company 4's respondents stated that the success of their LSS execution was based primarily on having a clear LSS direction. As the HR manager said:

"We initially had a five years implementation plan to assess its use, but right now it's embedded within the organization. It's part of organizational culture and we more than 7 years down. We have a clear direction for our journey."

For Nigerian Company 8, the situation was somewhat different. The overdependence on external experts in creating an implementation plan to suit the culture of the organization could be held responsible for their implementation failure. As stated in Table 5:10, its 5 year plan was cut short at first, to allow for a review of the implementation plan. As part of the execution phase, it is therefore imperative to provide a clear direction for implementation, assigning deliverables to the implementation process. As stated by Albliwi et al. (2015), companies fail to obtain the maximum benefit from their LSS strategy as a result of the absence of clear guidelines for the direction of LSS during the implementation stage.

The choice for the pattern of execution was raised by participating companies in this study. For most firms, the choice to either roll-out in stages or an organization-wide approach affected the outcome of their implementation journey significantly. Different responses credited to interviewees revealed the reasons for their choice. For Company 1, as seen in Table 5:10, the selection of an organization-wide approach was preferred to imbue a general culture of continuous improvement. The engagement of easily implemented strategies such as 5S created an organization ready for a generalized approach. As further gathered from Company 1, a significant advantage of organization-wide execution is that it enables the firm to create a general awareness, achieved through training patterns, and to align all functions to the strategic objectives.

The case was slightly different for Company 2. As stated by the CI Manager:

"LSS was rolled out throughout the organization, but due to the financial pressure attached initially to CI, there was an initial focus on our production facilities with emphasis on improvements in our waste system, turnover time, quality improvements and process speed. This shift in focus affected other functions."

The financial burden of an organization-wide roll-out is a factor to be taken into account. The ability to identify the working criteria for the execution of the LSS programme per organization is critical for achieving success. The mismatch accredited to Company 8 as highlighted in Table 5:10 could have impeded their implementation plan. The hunger for quick wins saw a need to disrupt the already established plan. Again, the financial commitment to LSS could be responsible for this choice. As seen in Figure 5.9, Companies 3 and 8 saw the need to abandon their organization-wide execution approach, neglecting the role of an effective implementation plan as a prerequisite for a successful launch.

The interaction of these factors are required in the implementation journey. Judging from the findings of the cases, a link between the incorporation of cross-functional teams, the provision of guidelines for clear direction and the selection of an appropriate implementation strategy, shows its impact on the overall success of the initiative. According to Albliwi et al. (2015), an adaptable roadmap, depending on specific organizational needs, and a plan for sustaining results is required before the start of the implementation stage.

5.3.3. Sustainability of LSS

The outcome of this study reveals the third category as the last order in the LSS implementation journey. Opinions from participants highlighted two sub-themes: the *role of stakeholders* and *performance monitoring* for LSS, which are further broken down into six codes as they influence the sustainability of the LSS initiative within the participating organizations. Figure 5:10 illustrates the link between these codes, sub-themes and overarching themes for this research.
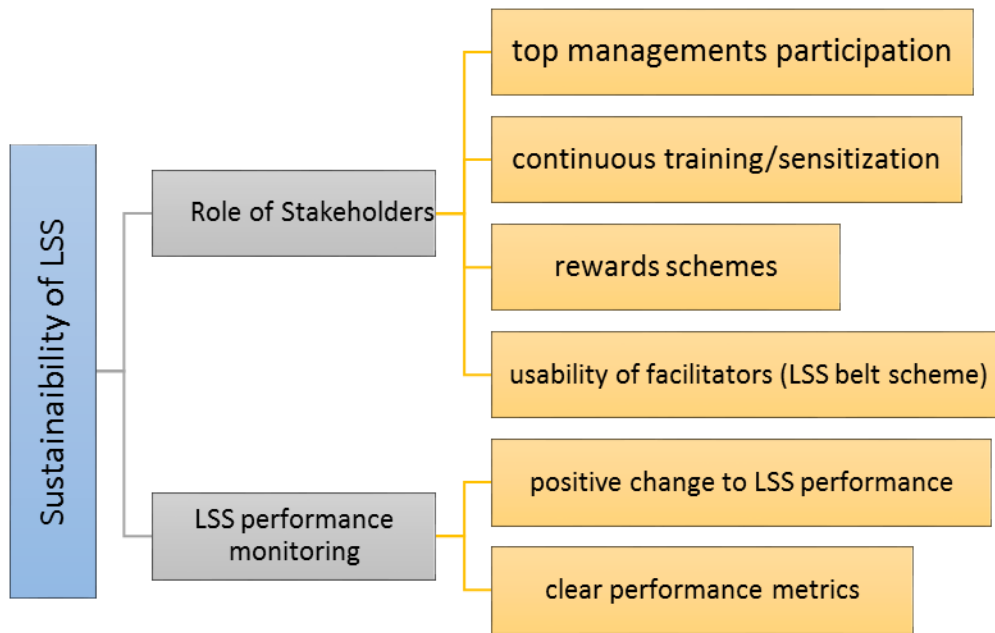
Figure 5:10 Sustainability of Lean Six Sigma within Organizations

5.3.3.1. Role of LSS Stakeholders

The responses obtained from UK Companies 1 and 2 confirmed that the direct involvement and participation from the organization's chief executives ensured that LSS was rooted into the organizational culture, and employees widely accepted and adopted LSS as a result of such involvement. This was restated by Nigerian Company 7, where top management involvement facilitated continuous training and capacity-building amongst other stakeholders within the organization. The most important factor for LSS implementation, especially in manufacturing companies in a developing country, is top management participation and involvement (David Muturi et al., 2015).
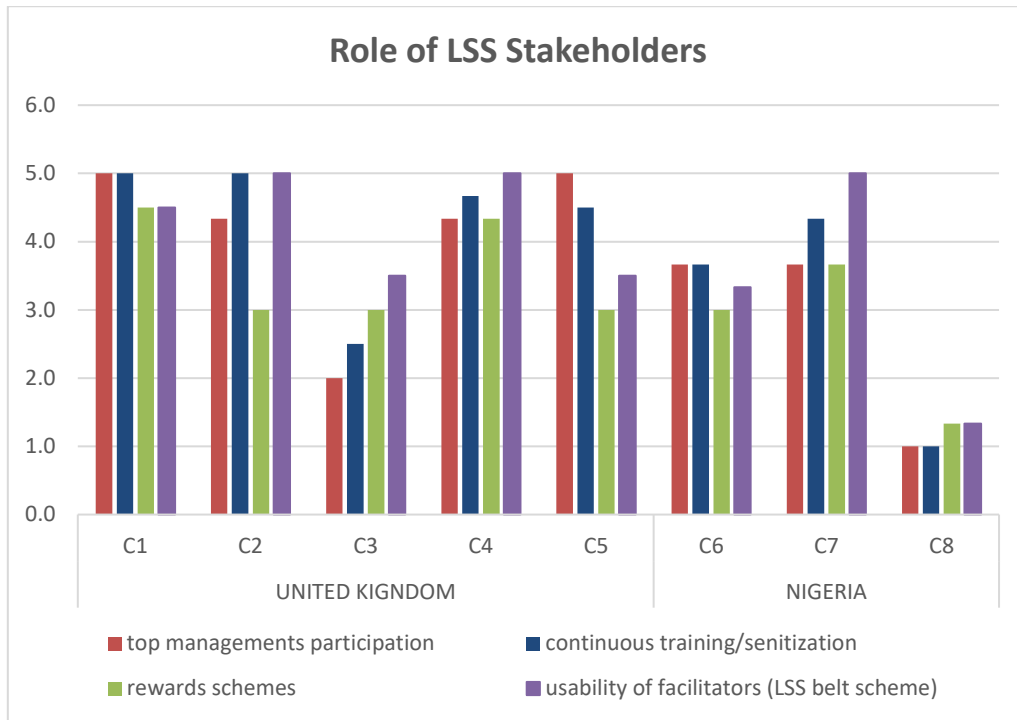
Figure 5:9 Role of Lean Six Sigma Stakeholders

Considering the failure of CI within manufacturing companies, Timans et al. (2012) and McLean et al. (2015) note that a lack of management involvement and participation, particularly during the implementation stages, would lead to the absence of CI as a culture imparted within the organization. Furthermore, the organization will experience low employee engagement in CI projects and lack of resource allocation, leading to CI failure.

Top management has to participate fully in LSS and set a good example for employees to adopt LSS, as management are regarded as leaders, the position that provides guidance and direction for projects within the organization (Mi Dahlgaard Park and Näslund, 2013). Manufacturing companies primarily must comprehend that LSS is a continuous activity, therefore requires constant learning and training by all involved parties, thus training should be ongoing, encouraged and integrated into company systems and cultures to ensure LSS is sustained (Antony et al., 2012a).

UK Companies 1, 2, 4 and 5 and Nigerian Companies 6 and 7 highlighted the role of continuous training as a CSF for implementation, as seen in Figure 5:11. Byrne et al. (2007) and Näslund (2008) suggest that an organization engaging in LSS must adopt training as part of its corporate culture to ensure that both management and employees are frequently refreshed on customer requirements.

There is a clear case for employee motivation and reward in driving LSS, as a 'reward scheme' is a supportive system used to motivate employees to strive continually in the organization's LSS methodology (Lertwattanapongchai and William Swierczek, 2014). The importance of rewards and recognition system was listed as a CSF in research on Malaysian automotive companies; it helped ensure employee commitment and CI (Fadly Habidin and Mohd Yusof, 2013). Responses obtained from UK Companies 1 and 4 and Nigerian Company 7 showed that reward had a strong influence on LSS. Company 1 further highlighted that a reward system was introduced to spur employee commitment towards LSS and drive innovation. An organization undertaking incentives and rewards needs to design a reward scheme to fit strategically into areas that will ensure it achieves CI within its systems and processes to avoid rewards and incentives being given to non-beneficial organizational CI (R. Jadhav et al., 2014).

Table 5:11 Qualitative Evidence on the role of LSS Stakeholders

Open coding	Qualitative evidence	
	UK Companies	**Nigerian Companies**
Top management's participation	"From my opinion, the continuous drive from top management has played a significant role in sustaining the programme. Our MD participates and reviews most of our improvement programmes and has ensured accountability across all departments." (Company 2)	"The commitment of top management has helped us over the period. Their role of continuous training and capacity-building cannot be overemphasized." (Company 7)
Continuous training / sensitization	"Continuous training of our employees and management staff has helped us tailor LSS tools into our organization and know what we require in other to sustain it." (Company 2)	"We appreciate that to sustain the programmes, we have to ensure continuous training of our employees while also trying to build systems that can sustain it." (Company 6)
Reward schemes	"Also as part of efforts to sustain the initiative, we introduced rewards and incentive schemes to employees that participate fully in our continuous improvement programme." (Company 1)	

Open coding	Qualitative evidence	
	UK Companies	**Nigerian Companies**
Use of facilitators (LSS belt scheme)	"The roles of these stakeholders are critical. We have two master black belts, me the MD and the CI Director. The level of training and experience to attain such status is tremendous. We act as the drivers here. We oversee everything and make sure we link continuous improvement to our financial sheets." (Company 4)	"I am the only Black Belt on site and my team helps in the use of problem-solving tools, providing enabling structures for us to grow, providing training and assigning of projects." (Company 6)

Regarding use of LSS facilitators, the role of LSS champions and their infrastructure among the case firms can be seen from Figure 5:11. An organizational infrastructure for LSS exposes the number of trained quality employees responsible for driving the LSS efforts in the company. According to Kumar et al. (2011) and Antony et al. (2012c), the sustainability of the LSS initiative is dependent on the ability of an organization to select the right employees to drive the change process. For Company 4, the organizational infrastructure, identifies the Managing Director as a Master Black Belt, shows the drive of the organization to sustain the initiative. For other organizations, the importance of an experienced professional to drive the initiative could be deduced from further comments. For Company 5, the HR manager stated,

"We have an in-house belt system. Currently we have just one Black Belt on site that drives. He provides the training plan for employees. He is basically in charge of the structure."

The case is no different for the practising organizations within the Nigerian environment. Both Companies 6 and 7 highlighted the importance of their LSS infrastructure.

In summary, the role of LSS stakeholders ranging from top management commitment to the individual selection of drivers provides an avenue for the sustainability of the LSS initiative. Responses to these sub-themes indicated differences in approach between organizations in this study. However, all participating organizations highlighted the need to inculcate the factors listed above in the LSS implementation process to ensure efforts are sustained.

5.3.3.2. LSS Performance Management System

The adoption of LSS leads to improvements in organizational processes and systems when benchmarked against internal company measures (Andrew et al., 2008). Organizations that holistically adopt LSS will achieve improved performance within their operations processes,

reduced waste, idle time and turnover time, and a smarter approach to work by employees (Näslund, 2008, Panat* et al., 2014, Corbett, 2011).
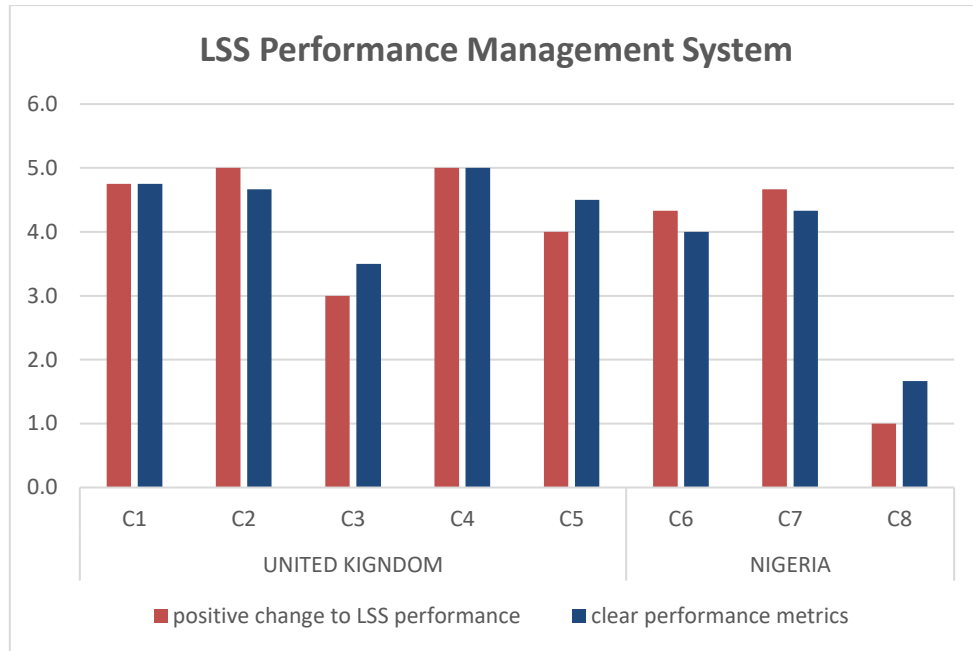
Figure 5:12 Lean Six Sigma Performance within Firms

The findings as seen above from UK Companies 1, 2, 4, 5 and Nigerian Companies 6 and 7 reveal that LSS brought about a positive change to their performance. Responses obtained from UK Company 1 highlighted that LSS implementation led to waste reduction, improved employee performance and increased profit. The application of LSS also leads to improved quality performance in a manufacturing company and enhances its competitive advantage (Gupta et al., 2012). Nigerian Company 7 also attested to LSS leading to improved employee performance and a more organized shop floor. Hassan (2013) in his research on LSS in a manufacturing environment states that LSS leads to an increase in shop-floor productivity, reducing costs by reducing waste and leading to an organized shop-floor.

Linking LSS with organizational performance metrics is important as its adoption is centred in its ability to resolve performance issues. In their research on the impact of LSS on organization performance metrics, Dumitrescu and Dumitrache (2011) point out that LSS provided financial benefits in five manufacturing companies through savings in costs, reduction in product defects and increased productivity. They further state that another method to benchmark LSS impact is against the organization's Key Performance Indicators (KPIs) such as lead time and quality. LSS had a strong influence on performance metrics in UK Companies 1, 2, 4 and 5

and Nigerian Companies 6 and 7. In UK Company 4, improvements in production, changeover time and waste reduction were experienced. Nigerian Company 6 recorded increased sales. In benchmarking LSS against the organization's KPIs. Andrew et al. (2008) note that LSS leads to improved organizational KPIs, especially in waste reduction, reduction of product rejects, increased productivity and reduced downtime.

Table 5:12 Qualitative Evidence on LSS Performance

Open coding	Qualitative evidence	
	UK companies	**Nigerian Companies**
Positive change to LSS performance	"We have had reduced changeover times, we have got better training facilities, we work smarter and get things done smarter, and our waste has reduced significantly. Performance, profits, and employee morale are all better." (Company 1)	"The bits and pieces learned by our employees as a result of the training are being used today, and we have seen some improvements to our working culture. The shop floor feels better to work in." (Company 7)
Clear performance metrics	"Overall, we assess the financial attribute of our LSS programme. In bits, we look at changeover times, manpower deployment, production output, waste output and so on." (Company 4)	"We track downtime, we track production output, we look at waste and daily output, and those at the sales team always look at sales figures. so we track all these and for the basis of our KPIs." (Company 6)

5.4. Summary of Key Findings from the UK and Nigerian Firms

In an attempt to synthesize comparable findings from Sections 5.2 and 5.3, this section highlights important factors deduced from both cases as they affect the implementation of the LSS initiative.

Table 5:13 Cross-case Findings for UK Firms

Key Factors	UNITED KINGDOM				
	1	2	3	4	5
Management commitment	High acceptability (CEO involved and CI Manager structure)	Top management involvement and acceptability	Lack of top management commitment (Management view LSS as fad)	Top management involvement and commitment	Top management support but LSS mostly driven by middle management
Employee training & engagement	Undertook employee training and actively engaged employees	Employees were trained on LSS tools and techniques and involved in decision-making process	Training was haphazard and no proper training plan	Well-structured training plan, full employee engagement	Employee training was good
Change in organization's culture	LSS was integrated into organization's culture	Experienced positive change in organization culture as a result of LSS implementation	No impact of LSS on organization culture as LSS programme not well-structured	Data-driven and data collection process integrated into the organization but still some minor hiccups	Positive entrenchment of LSS within the organization culture
Communication	Effective communication plan integrating all levels within the organization	Strong communication network involving all organization functions on a weekly and monthly basis aimed at bridging any communication gap within the organization	Horizontal reporting structure but not fully cascaded to integrate all employees	Easy communication accessibility among all staffs, open-door policy, unanimous reporting style to welcome contributions	Visual communication style to effectively convey information to all functions but still work in progress.

Key Factors	UNITED KINGDOM				
	1	2	3	4	5
Tools for implementing change	5S, SPC and KAIZEN were employed	Data collection and recording, 5S	Not data-driven	5S, PDCA, A3 and KAIZEN	SPC
Impact of LSS on organization	50% waste reduction, 300% profit increase, 25% increase in market share	Production increase, increase in KPIs	No significant effect with continuing dwindling organization finances but improved employee relationship and reduced customer complaints	80% cost savings, reduced downtime, increased profit, increased production	First year of deployment but savings of £2 million and increased profits, proper documentation

Table 5:14 Cross-case Findings for Nigerian Firms

Key Factors	NIGERIA		
	6	7	8
Management commitment	Top management main drivers of LSS	Top management commitment and support	Lack of top management commitment. Viewed LSS as a fad
Employee training & engagement	Continuous employee training in LSS tools and techniques	95% of employees trained to white belt level	Certification-based training not tied to improvement culture
Change in organization's culture	Not fully integrated and aligned with organization culture	Altered culture and structure to fit into LSS deployment	LSS not aligned to culture change but viewed as a fad and acquisition of certification
Linking LSS to customer focus	Limited customer focus	Customers fully integrated into LSS programme	No link to customer focus or improvement in product or quality
Communication	Poor communication medium within the organization	Fluid communication process encouraging idea sharing	Poor communication process. LSS design and implementation not communicated to organization's functions
Tools for implementing change	5S, TPM	5S	TQM, QMS
Impact of LSS on organization	Reduced downtime, improved data-driven	85% production optimization, 50% waste reduction, increased profit	No improvement impact

5.5.   Chapter Summary

To obtain an efficient implementation strategy for LSS, organizations must review the critical success factors (CSFs) required in undertaking LSS. The importance of these factors as highlighted in this chapter shows that the success or failure of any organization's LSS programme, irrespective of geographical location, hinges on its ability to undertake effectively and integrate these CSFs into its overall strategy and structure.

The disparity in the implementation of LSS across the various case countries as analysed highlights a glaring gap in the LSS literature between developed and developing economies. For effective LSS implementation in developing climes, there must be an attempt to absorb the principles and philosophy of CI. This can be achieved by entrenching it within the organization's culture and working systems, including rigorous training to enable organizations to maximize both short-term and long-term CI investment benefits, which will spur LSS growth within these case countries.

From this chapter, it is evident that a guiding implementation framework, highlighting important factors analysed, is needed for learning organizations to promote their implementation journey.

6. Chapter Six

Framework Development and Validation

6.1. Introduction

Findings from the previous chapters created a foundation for the development of the Lean Six Sigma implementation framework. This research critically reviewed literature in Chapter 2 on the Lean and Six Sigma subject domains and provided comparable cases in Chapter 4 on the acceptability of the Lean Six Sigma initiative in the USA, India, Malaysia, and Nigeria respectively. Chapter 5 analysed Lean Six Sigma in practice within manufacturing companies in the UK and Nigeria. This chapter presents the proposed framework based on the findings from these sources, and also presents the rationale for its development. The validation of the proposed framework is carried out in this chapter using the Delphi technique. The suitability and usability of the validated framework are also established to aid learning organizations in their continuous improvement journey.

6.2. Problem Statement

From the review of the literature, it is evident that the adoption and implementation of LSS have evolved through the manufacturing sector, creating benefits in organizational efficiency and effectiveness. However, the rate of success in implementation differs across economies, as seen in the cases analysed in this study. The differences experienced are attributable to the socioeconomic conditions and interaction of CSFs outlined in both the literature review and the case study analysis. While there is a body of research covering the implementation of LSS within developed economies (Antony 2012), as seen in the success stories leading to various frameworks and models (Chakrabarty and Kay Chuan, 2009, Kumar et al., 2011), there is a dearth of literature on emerging economies.

The framework for LSS implementation within the developing world is based on the systematic literature review conducted through this research and the two-stage case study approach using semi-structured interviews. The literature review aided in not only highlighting the subjects of Lean and Six Sigma but also their integration and CSFs necessary for implementation. The various case studies undertaken in this research exposed several performance improvements, failures in deploying and implementing LSS, and the role of these CSFs. From all of the findings within this research, the importance of the CSFs has been established at one stage or the other, and their effect on the overall success of the LSS initiative has been determined. However, all these cases and reviews, previous research, and implementing organizations

171

have failed to analyse the interaction of these crucial factors in the implementation stages for LSS. This chapter aims to bridge this knowledge gap, building a framework that integrates the factors presented by organizations in developing countries to aid in the implementation of LSS.

6.3. Necessity for a Lean Six Sigma Framework

As discussed earlier, and also from the review of existing Lean and Six Sigma implementation frameworks and models carried out in Chapter 2, the need to develop a framework that takes into account the peculiarities of factors the emerging economies undergo became evident. The limitations to the existing frameworks have been discussed, some of which created the need for this chapter. The limited scope and non-synergistic approach to implementation are among major factors that created the incentive for the proposed framework. This section presents the theoretical structure, objectives and critical findings for the development of the implementation framework for LSS.

6.3.1. Theoretical Base for Framework Development

This section is designed to look into the theoretical approaches that are useful in undertaking the design of an LSS framework for developing economies. It dwells on developing the framework based on critical success factors obtained from the findings from a combination of the literature review, pilot interview analysis and multiple case study analysis of this research work. In addition, an analysis of LSS frameworks and models from the literature and other research frameworks will be used, aimed at developing a comprehensive framework. The first phase of the research process (see Figure 3:2), involving a preliminary study of LSS specialists (consultants) as previously discussed in Section 4.2, assisted in identifying the level of adoption and implementation of LSS among companies within the Nigerian environment. This identification by the consultants supported in undertaking and selecting the multiple case studies across various case countries aimed at obtaining more in-depth knowledge of LSS practices within these countries. The experts, drawn from five major continuous improvement consulting firms in Nigeria, also chosen based on their relationships with the manufacturing sector, aided in suggesting the level of adoption and improvement measures required by respective organizations.

Additional surveys were administered to participating organizations in order to highlight general needs, relating particularly to the evaluation of CSFs and tools and techniques necessary for successful implementation of LSS and the personalization of the intending research framework. The methodological triangulation approach employed in the development stage provides a strong argument in ensuring the

validity and generalizability of the proposed framework. Figure 6:1 below illustrates the synergistic approach for which this chapter is created.
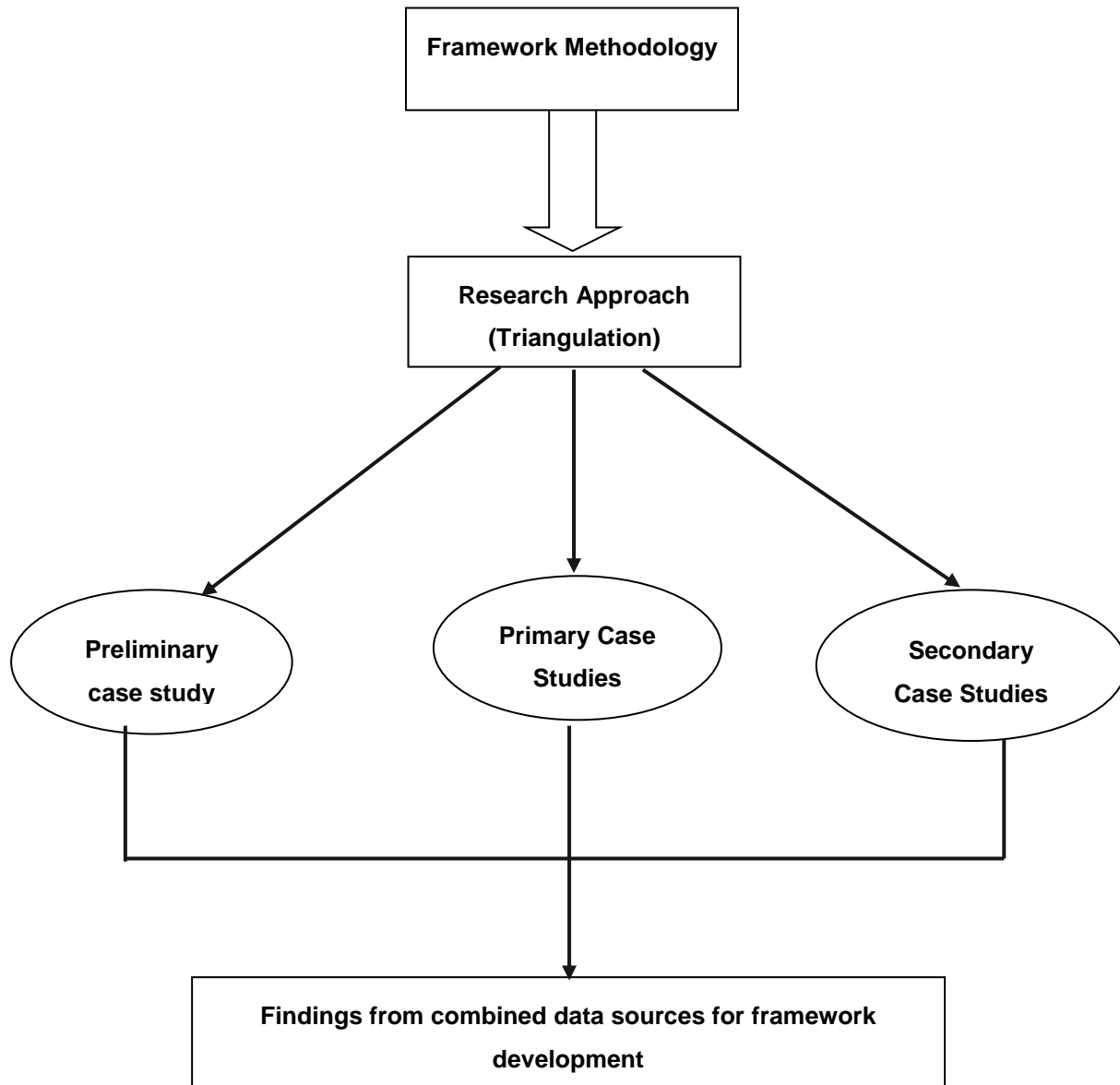
Figure 6:1 Paradigm for the Development of Lean Six Sigma Framework for Developing Economies

6.3.2. Objectives of the Lean Six Sigma Framework

The proposed LSS implementation framework aims to provide an effective approach to the implementation of the initiative, taking into account the problems which organizations in developing countries experience. These problems are particularly in areas of awareness and within the knowledge structure of the initiative. The novelty of this framework is in its application of the benefits accrued from an integrated Lean and Six Sigma approach. In detail, the objectives of the framework are to:

- Bridge the knowledge gap regarding the development of LSS frameworks for developing countries and learning organizations
- Provide an understanding of the role of the Critical Success Factors for the implementation of LSS as well as the interaction between them
- Establish a clear implementation structure for the execution of the LSS initiative
- Ensure the sustainability of the initiative
- Provide a systemic and continuous order for the stages required for the implementation of the initiative
- Provide a simplified implementation framework that could form the basis for the development of further studies

6.3.3. Critical Success Factors for the Framework

The specifics of the framework as indicated earlier emanated from a critical review of factors that affect organizations implementing LSS. These factors mainly representing CSFs for LSS, were obtained from four primary sources as they help to overcome challenges experienced by organizations in developing countries:

- Literature Review, undertaken in Chapter 2, which comprises a comprehensive review of studies on LSS, including already established frameworks.
- Multiple Case Studies, conducted through secondary research, comparing the acceptability of LSS between cases in developed and developing countries. This phase helped to establish the critical findings needed for the development of the framework.

- Analysis of primary data, comprising of five continuous improvement consultancy firms in Nigeria. This approach elucidated what is happening within the Nigerian environment, exposing factors as they affect the implementation of the initiative.
- Multiple Case Studies, conducted through primary research, comparing data from eight case companies, representing UK and Nigerian manufacturing organizations.

The role of the CSFs for LSS implementation is paramount, as stated by Setijono et al. (2012), as it helps to steer the direction of the implementation journey, providing room to accrue the benefits of the programme. The choice to draw findings from the sources listed above further increases the validity of each component of the framework. The parameters of the framework are further discussed in the findings presented in the following sections.

6.3.4. Critical Findings from Empirical Study

From the sources listed in Section 6.3.3., the findings gathered formed the basis of the development of the LSS implementation framework. The uniqueness of the framework comes from the structured approach with which the researcher undertook each phase of the research process. Reiterating the findings from each phase, each factor mentioned below influences each component of the proposed framework.

- **Literature Review**: Conducted in Chapter 2, findings from this section establishes the role of LSS in manufacturing environments. A clear understanding of the Lean and Six Sigma integration process was established in this section. A critical point established in this phase was the need for an implementation framework to suit individual environments (see Section 2.4)
- **Acceptability of LSS in various countries**: Conducted in Chapter 4, findings from this phase presented the implementation of LSS in different geographical locations. The uniqueness of this chapter lies in the further exploration of implementation issues as experienced by distinctive national working environments. For the purpose of the development of the framework, the following major factors were considered (see Section 4.2.3., Table 4:5):
  - The need for LSS project selection and prioritization
  - Employee training and knowledge transfer
  - The role of top management commitment
  - The use of external consultants.
- **Acceptability of LSS in Nigeria**: Conducted in Section 4.2, findings from this phase elucidated expert views on the implementation of LSS in Nigeria. Drawn from major consultancy firms in

Nigeria, the findings presented critical issues that affect the implementation of LSS, which also formed a basis for the development of the framework (see section 4.2). These issues include:

- o Management commitment and buy-in
- o A shift in organizational and national culture
- o Employee commitment and engagement
- o Leadership culture

- **Lean Six Sigma in Practice**: Conducted in Chapter 5, findings from this phase formed the main focus for the development of the framework. As the primary unit of analysis is based on the Nigerian and UK manufacturing environments, the findings from this section highlighted implementation issues as well as prerequisites for successful implementation of the LSS initiative. Critical findings drawn included:
  - o Usability of LSS tools and techniques
  - o Role of communication in the implementation process
  - o Top management commitment
  - o Shift in organizational culture and structure

From the above mentioned sources, it is evident that organizations irrespective of their location at times face similar issues with implementation. Although there still exist issues unique to environments like Nigeria, it is important to note that a structured approach, encompassing the above-listed issues is needed, not only to ease implementation but also raise awareness levels which the Nigerian business environment is lacking.

6.3.5. Theoretical Justifications for the Framework

6.3.5.1. Phase 1: Organizational Readiness

This phase entails an organization's preparation for initiation; it enables an organization to fully understand the importance of LSS within its system and highlight areas for radical improvement. The need for organizations to properly assess their level of CI investment, in terms of resource allocation, the level of management commitment, aligning LSS with organization culture and structure and ensuring full employee commitment is adequately captured in this phase. An assessment of the preparatory and readiness phase within the framework is required, as it will help manufacturing organizations within developing economies fully understand the need for change, using LSS as a focal point, and also serves as the foundation for the LSS implementation journey.

The elements listed below are steps required to link the implementation sequence, providing a description and justification of its need.

I.   CI Investment

One area in undertaking LSS is the level of investment required to attain successful LSS. LSS adoption requires considerable outlays and in developing climes where there is reduced LSS knowledge, requires an organization to consider LSS CI investment. One major drawback in LSS implementation across manufacturing organizations in developing economies is the associated cost of LSS, but a substantial investment in CI will lead to sustainable and profitable CI (Angell and Jeya, 2001). An organization with limited resources will experience failure in implementing LSS, therefore the management needs to make available resources for full LSS design, adoption and implementation (Albliwi et al., 2014).

II.   Working Environment

The choice of an appropriate CI strategy is dependent on the working conditions of the organization (Bolte, 2014). The importance of an improved working environment in LSS implementation is that it will aid an organization to develop a holistic approach which will stimulate innovation (Byrne et al., 2007). In order for best practices in LSS, there is a need for an organization to build a conducive working environment which integrates all organizational functions and offers 100% support to LSS deployment and implementation (Schonberger, 2008). The importance of the working environment was highlighted within all the analyses carried out in this research, as it ensures a more empowered and committed workforce.

III.   Hiring Conditions

Manufacturing organizations, especially in developing economies, need to recruit and hire employees and LSS experts who fit into their strategic decision-making process by ensuring talent acquisition and creating best practices in organization hiring in line with LSS practices (Sahay, 2015). An organization's focus on hiring conditions becomes imperative in LSS readiness and preparation, as it ensures an organization will get best-fit employees to suit its LSS strategic decision objectives. There is a need for an organization to bring in employees with a strong background and experience to drive its LSS programme.

IV.   Role of Management and Top Management Commitment

The level of commitment and management role has to be properly assessed before embarking on LSS, as it gives an indication of the level of organizational readiness and preparation towards LSS (Antony and Banuelas, 2002). LSS is more efficient and effective and yields better performance if a top-down approach

is adopted, where the senior management owns the process, supports the process and drives it down (Pande et al., 2000). From the research analysis undertaken, direct involvement of an organizations CEO in driving the initiative yields tremendous performance improvement. One major failure factor of LSS within organizations is a lack of strong leadership to lead and drive the initiative (Albliwi et al., 2014).

Top management's positive role in LSS readiness and preparation spurs other organizational functions to align with the organization's objectives properly. Top management has to be fully involved in the LSS design and roll-out plan, as management involvement will also ensure the incorporation of a proper measurement system and ensure that there exists a real-time reporting process (Haikonen et al., 2004).

V. Organizational Culture

Organizational culture plays an important role in LSS readiness and preparation, as an organization must adopt a culture which encourages LSS by understanding the best culture fit which encourages innovation, training, empowerment, effective communication and a clear definition of roles and functions (Knapp, 2015). In order for an organization to fully maximize the benefits obtainable from LSS, there must be adequate cultural changes which will provide the required climate necessary for LSS readiness, performance improvement and sustainability (Hess and Benjamin, 2015).

The findings in this research showed that organizations need to adopt and encourage a culture that allows flexibility, integrates employees into decision-making and promotes innovation. Organizational culture is a critical factor in building a sustainable LSS framework for manufacturing companies in developing economies, as socioeconomic activities prevalent in developing economies might lead to stagnation.

VI. Organizational Structure

To assess an organization's readiness for LSS, an organizational structure for LSS needs to ensure all employees and management are fully involved and take full ownership of the programme. An organization structure that encourages and promotes a transparent reporting culture will aid drive, creativity and innovation, as employees will be encouraged to share ideas and problems and seek creative solutions to issues surrounding their job roles and functions (Hoerl and Gardner, 2010).

The best type of organizational structure is one that can successfully link personal employee achievements within the organization's LSS framework to career path progress in order to enhance employees' motivation level and commitment (Brun, 2011).

VII.   Employee Relationship and Engagement

This is a major critical factor in LSS readiness, implementation and even sustainability. The role of the employee relationship and engagement within a manufacturing organization determines the level of employee commitment. Employee relationship entails an organization building an effective and efficient relationship and engagement with their employees by ensuring communication, which has a direct impact on employees' perception and understanding of LSS while clearly defining roles and working methods (Losonci et al., 2011).

Organizations should strive to develop an open relationship with employees in the areas of communication, support and empowerment to boost employee morale and ensure full employee commitment and engagement (Antony et al., 2012c). It is imperative for an organization to build a strong relationship and effectively engage its employees properly in order to develop the right mind-set for its employees towards LSS readiness and roll-out.

6.3.5.2. Phase 2: Roll-Out Plan

This is the roll-out and execution phase and it requires an organization to employ LSS initiatives within the organization system entirely, and also establish a training plan, put teams in place and decide the type of implementation plan, i.e. by project or function or an organization-wide roll-out. The roll-out phase is an important aspect, as it not only enables an organization to lay a sound basis for LSS but also inculcates it into the organization's culture and structure while ensuring sustainability and continuous improvement.

I.   LSS Tools and Techniques

The organization's approach to its LSS tools and techniques has a major effect on its decision-making process within its CI structure. It is important for an organization to employ the required LSS tools and techniques into its process and system, which will lead to improved performance within its system and operations (Douglas et al., 2015). LSS initiatives within LSS implementation will aid an organization in receiving customer feedback, thus leading to reduced customer quality complaints.

The organization's management's and employees' knowledge and understanding of LSS tools and techniques are vital within manufacturing organizations in developing economies, as this not only lead to reduced product defects and improved customer satisfaction. LSS tools and techniques employed within the organization's processes will ensure that an organization can tailor its training programmes to fit into the organization's processes adequately.

II.   Role of External Consultants

The importance of external consultants in LSS implementation was highlighted from the findings within this research. External consultants are vital as they aid in the design and undertake initial training for both management and employees, and also ensure that the organization's employees are properly trained on the LSS tools and techniques required for their respective job functions (George, 2010). External consultants aid the organization's personnel in having a firm understanding of LSS by introducing external knowledge which is useful for enhancing performance and continuous improvement (Boyle et al., 2011).

The external consultants should be flexible with LSS implementation and not rigid about models but should tailor them towards the organization's requirements and needs and should be able to expose internal weaknesses within organizational processes and systems (Voehl et al., 2013). External consultants should also help the organization in tailoring a training plan for individual employees to suit their needs and strengthen areas of weakness.

III.   Structured Training Plan

One critical factor in LSS implementation is the organization's training plan. The research findings indicated that in undertaking a structured training plan it is important for a top-down training structure where the organization's management is first trained on LSS tools and techniques in order to obtain a full understanding of LSS and then transmit this to subordinates, so that they might be trained (Antony et al., 2012a). This will not only ensure that the organization's management will drive LSS by example, but will also ensure that the organization's strategic goals and objectives are achieved.

A structured training plan undertaken within a manufacturing environment will ensure LSS success and will lead to improved employee morale and job satisfaction by aligning the training plan towards the organization's objectives (Pandey, 2007).

IV.   Project Prioritization and Selection

The findings obtained from the result of analysis in this research shows that the ability of an organization to get some quick wins by effectively and carefully selecting the right projects helps to not only obtaining top management commitment but also employee buy-in. It is imperative for external consultants and CI teams to select projects where they can get large financial returns, focused on major problem areas within the organization's operations and processes, while also targeting customer satisfaction and enhanced performance in both level of productivity and level of profitability (Mader, 2007).

The selection of projects with LSS is important during the early implementation stages as it not only determines early success achievement but also guarantees long-term buy-in and continued organizational support and acceptance. This means a manufacturing organization must select quick-win projects early which will guarantee savings, improvements and profits, and the project selection should be undertaken by LSS consultants in consultation with project and LSS champions (Ray and Das, 2010).

6.3.5.3. Phase 3: Sustainability of LSS

LSS sustainability requires stakeholders to take full roles and involvement in ensuring the LSS philosophy and practices are entrenched within the organization's culture, structure, processes and operations. It is important for an organization to properly manage all stakeholders involved in LSS for improved performance (Sunder M, 2016). Stakeholder management and clear definition of roles will ensure comprehensive continuous training, mentoring and management support towards LSS initiatives, leading to improved performance within the organization's benchmarked performance metrics. Stakeholders provide the support and strategy required to ensure the organization's LSS programme is properly sustained and continuously improved (Antony et al., 2012c).

I. Use of CI Teams and LSS Belt Scheme

The result findings within this research showed that for an organization to successfully sustain its LSS programme, it must develop an internal CI team who are very knowledgeable in LSS and can aid in mentoring and training other employees on inculcating CI culture and on LSS tools and techniques. CI teams plays its role, as they not only aid the creation of LSS awareness within the organization but also aid in driving the programme and aligning LSS with the organization's strategic objectives through proper organization structuring (Zou and Lee, 2010). One major importance of a CI team is that it allows for discussions and creative solutions towards problems instead of rigid models, while allowing team members to tailor LSS tools and techniques towards a coherent method, ensuring employee buy-in and creative solutions to problems (Cecilia Martinez Leon et al., 2012).

The importance of the LSS belt scheme was highlighted by the results findings in this research, as organizations which successfully undertook LSS had certified master black belts and black belts as the main drivers, mostly within top management and middle management positions, while they also trained employees to green belt level. The organization's focus should not just be on certification alone but in ensuring employees and management fully practice and integrate LSS tools and techniques within their roles and functions.

As reiterated by LSS consultants, a focus on just certification in order to boost the company profile will lead to a decline in the chances of LSS success. Therefore, the organization's focus should be on LSS practices and the integration of LSS into their roles and functions. A belt certification system properly integrated into the organization's processes will ensure the sustainability of the LSS programme and ensure the organization will achieve LSS success (Martin, 2008, Bangert, 2014). Technical and personal knowledge of master black belts and embedding black belts within teams aid to not only driving the process but obtaining success (Antony et al., 2012a).

II. Reward Schemes

It is important for an organization to provide incentives to obtain employee commitment and buy-in by introducing reward schemes for its employees. The introduction of a reward scheme not only ensures that an organization gets employee commitment and loyalty but also leads to employees seeking creative ways to solve problems with LSS tools and techniques as a result of the incentives attached to creative solutions (El-Homsi, 2007). Employees who get extrinsic rewards for their participation in LSS will lead to desired valued outcomes both for the employee and the organization, as they will put effort into implementing LSS tools and techniques within their job roles and functions (Buch and Tolentino, 2006).

Financial and career growth reward systems have the biggest impact on LSS sustainability and growth (Hajikordestani, 2010). A reward system has a direct positive impact on LSS success and sustainability, as an employee of an organization with a defined reward path that impacts on employee career growth and finance will be highly motivated towards undertaking LSS and integrating it into their job role and function (Hajikordestani, 2010). Reward systems differ within organizations according to the organization's ethics and values. Not only does a reward system ensure sustainability but it is also a critical factor for building an LSS foundation alongside the organization's training, communication and leadership commitment. Another importance of a reward system tied to LSS is that it will help an organization to attract and retain the best talent and experts in CI methodologies, tools and techniques (Alhuraish et al., 2016).

III. Performance Monitoring

To promote sustained LSS, and assess how successful the LSS implementation is within an organization, there must be clear performance measurement metrics system that benchmarks company returns using stated KPIs. This approach allows for the tracking and evaluation of the LSS programme, exposing benefits accrued, so as to ensure its sustainability. As characterized in organizations in developing countries, a shift

in focus is needed for both financial and non-financial results in order to ascertain the level of improvements within the organization.

IV. Communication

An effective communication method cuts across all phases of an LSS programme within a manufacturing organization as it serves as a bridge to properly integrate and harmonize all the organization's human and material resources into the achievement of organization strategic objectives (Goldsby and Martichenko, 2005). An effective open communication system inherent within a manufacturing organization will bridge the gap between management and employees by harmonizing them and constantly updating employee and all organizational functions on LSS performance measurement and organization's plans and goals.

Effective communication among the organization's top management and employees will enable the management to properly integrate employees into the organization's plans and strategic objectives, thus leading to improved trust, improved employee commitment, reduced disenfranchisement and increased buy-in by employees into the organization's LSS programme (Clegg et al., 2010, Radujković et al., 2014). A top-down communication plan should be adopted with a flexible hierarchical system allowing for communication feedback from employees and customers aimed at determining areas requiring continuous improvement. Results achieved through the implementation of LSS tools and techniques should constantly be communicated throughout the organization in order to get more buy-in and increase employee morale (Narasimhan, 2009).

6.4.   Overview of the Proposed LSS Framework

In synthesizing findings gathered through the course of this research, highlighting CSFs, challenges faced by organizations, and much more, it is imperative for the research to proffer solutions necessary to ease implementation, particularly for manufacturing organizations in developing countries. Based on the researchers' findings (see Section 6.3.4), the proposed framework below combines and provide links for elements essential for the implementation of LSS. These elements are categorized as indicators, key performance drivers and implementation process respectively. Indicators in this context refer to the elements that provide direction to the implementation of the initiative. Presented in stages, these elements of Organizational readiness, Roll-out plan, and LSS sustainability provide a structured approach, incorporating the needs of organizations at every step of the implementation journey. Highlighted in Figure 6:2, these elements would help organizations to track processes associated with each phase.

The indicators are the derivatives of the Key Performance Drivers. These elements, as indicated in Figure 6:2 could be classified as implementation aiders. As seen in Table 6:1, these items are crucial in the application of LSS. The success of the implementation of the initiative depends heavily on the role of these key performance drivers. As explained individually above, these elements provide a supporting role for the individual processes required for the implementation of the LSS initiative to materialize.

The third category as highlighted in Table 6.1 provides a step-wise approach for the organization-wide implementation of the initiative. Termed Implementation Processes, these elements, generated mostly from findings from this research, also relating to CSFs, serve as gateways for monitoring the overall implementation plan for the organization. Also explained individually above, these elements properly interwoven, provide an enabling environment for LSS to operate. The direction of the feedback loops as explained in Figure 6:2 further explains the interaction of the CSFs and all other elements required for implementation.

The role of an effective communication means for the implementation of the LSS initiative is highlighted in the framework below. As the framework aids to promote implementation, the communication loop therein can be seen to encompass all facets of the organization as well as each corresponding element.

184
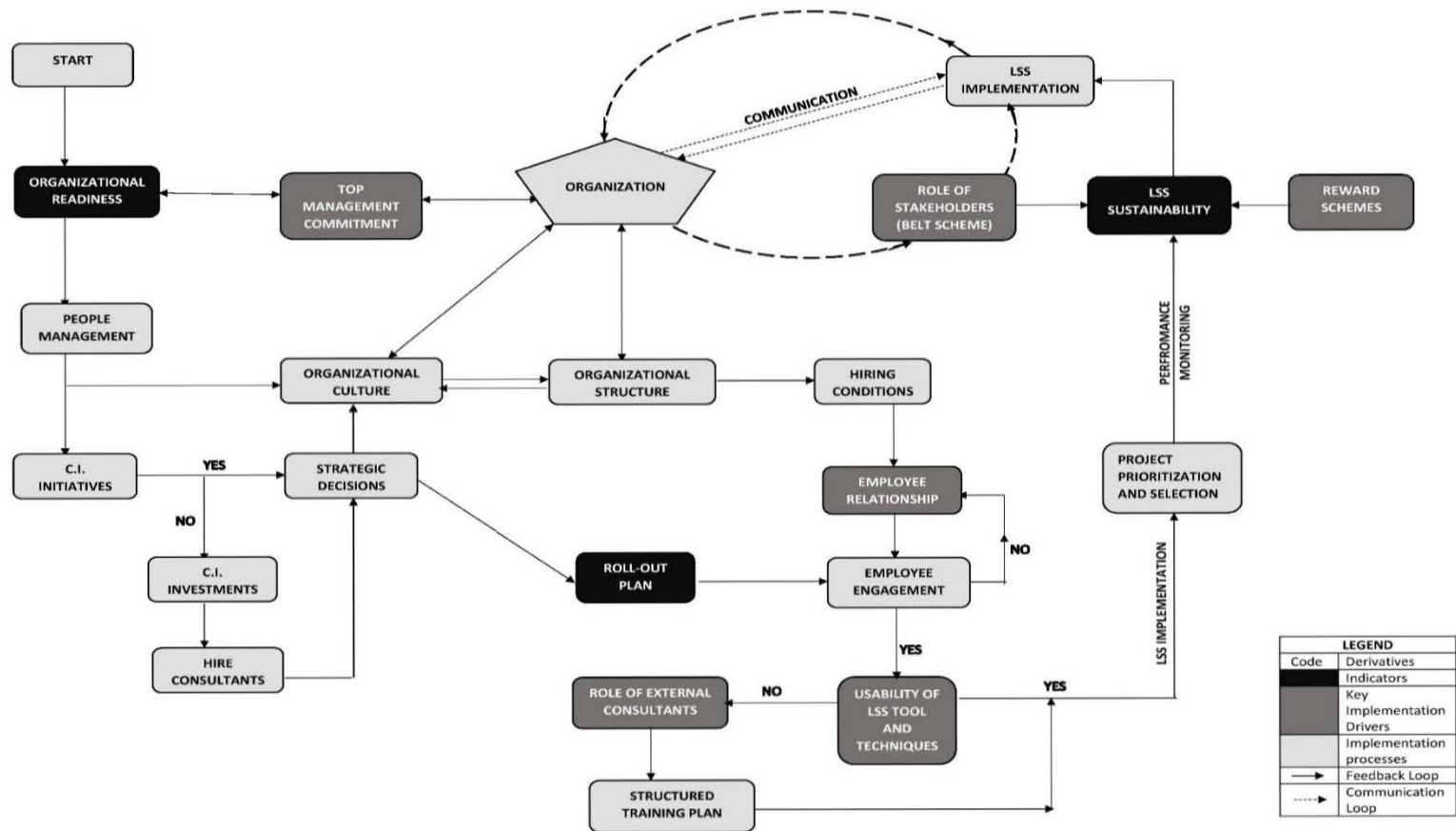
Figure 6:2 Proposed Lean Six Sigma Implementation Framework

Table 6:1 Interaction of Elements of the Framework

DERIVATIVES	ELEMENTS	INTERACTIONS
Indicators	Organizational readiness	This phase entails an organization's preparation for initiation; it enables an organization fully to understand the importance of LSS within its system and highlight areas for radical improvement.
	Roll-out plan	This phase exposes the prerequisites for deployment. It highlights areas for incremental growth and stakeholders required for successful launch.
	LSS sustainability	This phase highlights factors needed to achieve continuous growth within the LSS implementation cycle.
Loops	Communication	It encompasses all phases of the LSS implementation journey. This element assesses the role of communication methods in harmonizing all organizational requirements for the implementation programme.
	Feedback	The direction of the feedback loops exposes the interaction of the elements mentioned above. The relationship between each factor and how each is needed is addressed with the feedback loops.
Key performance drivers	Top management commitment	As a prerequisite for successful execution, this element provides an assessment of top management in relation to the organization's journey. Uniformity within top management is critical and required at the preparatory stage.
	Role of external consultants	Providing a support role, this element is required where in-house expertise is found lacking. It highlights the need for the creation of a deployment path.
	Employee relationship	The organization's communication balance is monitored with this element. This phase assesses the impact of employee and management rapport on the organization's journey.
	Usability of LSS tools and techniques	A review of appropriate and needed tools and techniques for LSS is assessed. Usability by employees is taken into account, with necessary steps for action in place to ensure its role is not surpassed.
	Role of LSS stakeholders (belt scheme)	The Lean Six Sigma infrastructure is monitored with this element. It assesses the required number of professionals (MBB, BB, GB, YB) needed during the implementation journey.
	Reward schemes	Especially within a developing economy context, rewards, and motivation schemes have proven to aid implementation. This element assesses their role in ensuring the sustainability of the LSS initiative.

DERIVATIVES	ELEMENTS	INTERACTIONS
Implementation processes	People management	
	Continuous improvement initiatives	Linked under the readiness phase, this process encompasses an assessment of an appropriate continuous improvement methodology, taking into account the knowledge gap in the current workforce.
	Continuous improvement investments	This process assesses organizational needs on the implementation of LSS. CI investments in this context represent the cost and value relationship for the implementing organization.
	Hire consultants	
	Strategic decisions	This process aims to link the organization's strategic objectives with the LSS application, taking into account the impact of strategic decisions on LSS
	Organizational culture	This process provides a link with the overall structure of the organization, as an assessment would expose the need to adopt a culture that allows for flexibility, employee integration and an improvement mind-set.
	Organizational structure	This process aims to assess the effectiveness of the organization's structure, regarding the involvement of employees, ownership of implementation programmes and efficient reporting structures.
	Hiring conditions	Establishes the need to employ the right minds for driving and implementing the initiative. The assessment of this process is required where there are no CI professionals within the organization.
	Employee engagement	This process highlights the need for an active employee relationship. This phase exposes the direct impact of employee strengths for the common goal (examples are assessed and achievable through KAIZENs).
	Structured training plans	This process assesses the training needs of an organization. Whether provided by in-house or external expertise, this process bridges the knowledge gap required throughout the implementation journey
	Project prioritization and selection	This process establishes the need for a clear direction for implementation, prioritizing projects as they are beneficial to the organization. This process ensures the sustainability of the initiative, as it gives management an avenue to monitor implementation performance.

6.5.   Framework Validation: A Delphi Technique

This section presents the validation means for the proposed framework.

6.5.1.   Overview of the Delphi Process

A Delphi study was conducted to gather expert opinion on the developed framework. This approach provided a structure whereby the wealth of experiences gained by the panellists over the years with LSS was included in the decision-making process on the validity of the framework. First, thirteen potential participants were invited for a two-round study on the validity of the proposed LSS implementation framework. Eight of the experts accepted the invitation and proceeded to the first round. An open-ended questionnaire was distributed at this stage to solicit expert judgements on the detailed structure of the framework. Figure 6:3 depicts an overview of the Delphi process in this research, explaining how the different elements of the framework were validated. Subsequent sections present the criteria for validation and the detailed results from the two-round study.
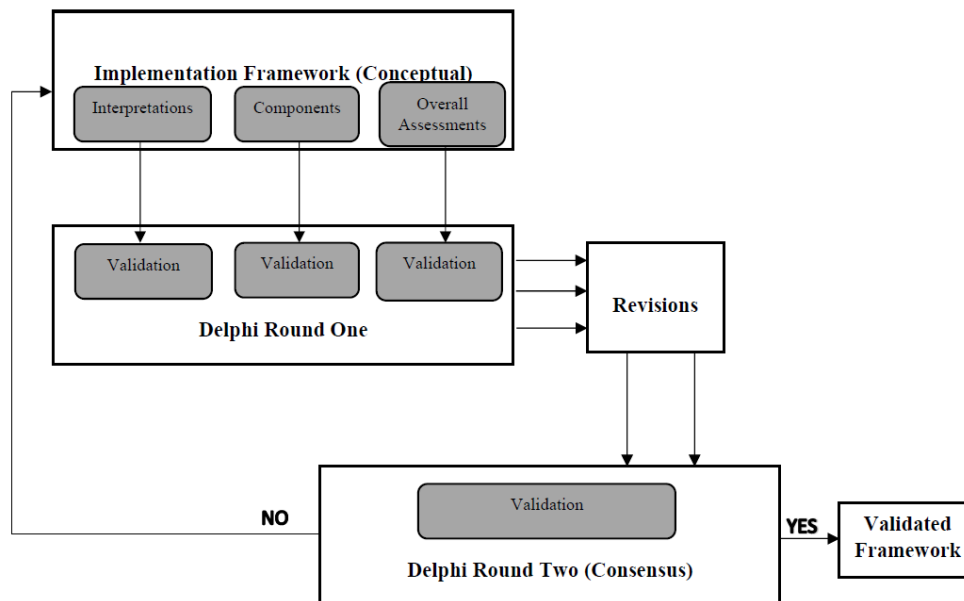
Figure 6:3 Delphi Process for Framework Validation

6.5.2. Criteria for Framework Validation

To ensure an easy synthesis of results, a five-point Likert scale detailing the level of agreement was used to validate the items of the framework. As seen in Figure 6:3, the interpretations (element definitions), components and the overall structure of the framework were assessed using the Likert structure (see Appendix D). The elements of the framework were further categorized into groups, with each group assessed based on the level of importance of each factor presented. This method exposed how each panellist graded each item and also provided an avenue for consensus-building among the experts. The framework was not validated if the items in the framework did not meet the average panel score. Also, as the distributed questionnaire provided room for comments, an element of the framework was not validated if the majority of the panellists recommended a significant change to the item. A mean score and validation range were used to approve the sections of the framework. A validation score of 75% was used as the criterion for consensus (i.e., an average of ≥ 3.75 on a five-point Likert scale). Table 6:2 further illustrates the criteria for validation.

Table 6:2 Criteria for Framework Validation

Scale (Level of Agreement)	Category	Items	Criteria for Validation	
			Measurement scale (Likert)	% Score for validation
A	Interpretations	Interpretations of terms	1-5	≥ 75%
B	Components	Key implementation drivers		
		Implementation processes		
		Indicators		
		Loops		
C	Overall Assessment	Feasibility of the framework		
		Usability for manufacturing companies		
		Sustainability of the framework		

6.5.3. Delphi Analysis: Round 1

In this phase, the panellists were given a detailed questionnaire, asking questions on whether they agreed to the structure of the proposed framework. The questionnaire structure also gave room for the experts to validate and further improve the framework by conveying their level of agreement to the given questions and also providing qualitative feedback. The composition of the panel, as described in Table 6:3, provided a strong base for the realisation of the objectives of this section. The responses generated were analysed and formed the basis of the succeeding sections.

Table 6:3 Demographic information for Delphi Panellists

Panellist	Designate	Organization	Area of Expertise	Years of Experience in Lean and Six Sigma Methodologies
P1	• Head of Department Lean Manufacturing • Ph.D. in Quality	University	• Teaching and consulting in Lean and Six Sigma • Quality management and improvement methodologies • LSS Master Black Belt	11 years
P2	• Director, Process Reengineering • Ph.D. Mechanical Engineering	Industry (Telecoms)	• Lead, innovation, and design for Lean Six Sigma • Operational excellence • LSS Coach and Master Black Belt	15 years
P3	• Director, Business Management • Ph.D. Engineering and Manufacturing Management	Industry (Consultancy services)	• Consulting in Lean and Six Sigma • Business development • LSS Master Black Belt	12 years
P4	• Managing Director, consultancy services • Visiting Professor • Ph.D. Engineering Technology	Industry (Consultancy services)/ University	• Quality management and improvement methodologies • Time compression and Lean systems • LSS Master Black Belt	22 years
P5	• Head of Change Management	Industry (Chemical Processing)	• Process improvement • LSS Coach and Master Black Belt	12 years
P6	• Senior Process Consultant	Industry (FCMG) Manufacturer / University	• Teaching and consulting in Lean and Six Sigma • Business improvement • LSS Master Black Belt	8 years
P7	• Head of Continuous Improvement	Industry (FCMG Manufacturer)	• Business improvement • LSS Master Black Belt	10 years
P8	• Lean Business Consultant	Industry (Consultancy services)	• Teaching and consulting in Lean and Six Sigma • LSS Master Black Belt	8 years

6.5.3.1. Assessment of Framework Interpretations and Definitions

The purpose of providing interpretations of the elements of the framework was to create an understanding of each item and how they are managed during the implementation journey. To this end, there was a need to validate the definitions. The table below shows the results from the first phase of the Delphi study. The average mean scores across the three factors indicate agreement with the developed definitions, with consensus established. Despite the fact that the panellists reached a consensus on the definitions, comments were made to improve the framework. Changes suggested include the need to establish clear roles for the Key Implementation Drivers, as they would help create a better understanding of the framework.

Table 6:4 Validation of Framework Terms

Interpretation of Terms				
Item	Number of respondents	Average Score	Validated Consensus	Changes Suggested
B1	8	4.375	87.5%	Simplify definitions to incorporate the roles of the drivers.
B2	8	4.25	85%	
B3	8	4	80%	

6.5.3.2. Assessment of Framework Components

Subsequent to the assessment of the definitions in the framework, the panellists were asked questions based on every component (i.e. factor) of the framework. This was done to increase the validity of the framework. The same five-point Likert scale was used to assess their agreement to the given statements. Divided into four sections, most of the components of the framework were validated, as they exceeded the validation threshold of 75%.

The first section, as seen in Table 6:5, assessed the Key Implementation Drivers. As stated earlier, these elements were summarized from top CSFs for LSS implementation. The developed framework established their role in the implementation stages of the initiative. For the purpose of the validation, the panellists were asked to show their level of agreement on how they affect the implementation phases. From Table 6:5, it is observed that all components exceeded the validation threshold. However, changes or considerations were recommended to improve the validity of the framework further. An omitted critical success factor, indicating Leadership Attributes, was recommended to be incorporated into the framework to strengthen the Top Management Commitment further.

Table 6:5 Validation of Key Implementation Drivers

Key Implementation drivers				
Item	Number of respondents	Average Score	Validated Consensus	Changes Suggested
C1	8	5	100%	Consider Leadership attributes in line with Top Management Commitment for the implementation sequence.
C2	8	3.75	75%	
C3	8	4.375	87.5%	
C4	8	4.375	87.5%	
C5	8	4.5	90%	

The second section highlighted the implementation processes of the framework. As seen in Table 6:6, four factors failed to meet the validation criterion. This resulted in the need to make significant changes to the framework. The main reason for a failed consensus was centred on the fit for purpose. For example, Item C7 (please see Appendix D for a detailed explanation) did not meet the criteria, as the majority of the panellists indicated a level of disagreement with the statement associated with the factor. As seen from the statement in Table 6:6, comments indicated that there is a choice for implementation, and the incorporation of the factor in the framework further complicates the implementation sequence.

Table 6:6 Validation of Implementation Processes

Implementation Processes				
Item	Number of respondents	Average Score	Validated Consensus	Changes Suggested
C6	8	3.5	70%	Does not fit the implementation process sequence.
C7	8	3	60%	Does not fit the implementation process sequence, as there is already a choice for CI implementation
C8	8	3.75	75%	
C9	8	3.25	65%	Duplicated factor.
C10	8	3	60%	Does not meet requirements for implementation processes. Consider as "Driver in phase 1"
C11	8	4.5	90%	
C12	8	4.375	87.5%	
C13	8	3.75	75%	
C14	8	4.5	90%	
C15	8	4	80%	
C16	8	4	80%	

The invalidated factors indicated above were areas to be revisited in the second round of the Delphi study.

The third section presented the indicators of the framework. In hindsight, these are the implementation phases of the framework. They demonstrate a chronological flow for the implementation of the LSS Initiative. As seen in Table 6:7, all eight panellists indicated a good level of agreement with the factors, with an average of 85% agreement. Again, as consensus was established, the experts provided suggestions for the improvement of the framework. Considered minor corrections, emphasis was laid on the factor of Organizational Readiness. The experts highlighted avenues to strengthen this implementation phase to increase its success.

Table 6:7 Validation of Framework Indicators

Indicators				
Item	Number of respondents	Average Score	Validated Consensus	Changes Suggested
C17	8	4.375	87.5%	Consider restructuring factors to reinforce this phase
C18	8	4.5	90%	
C19	8	4.375	87.5%	

The fourth section examined the feedback loops of the framework. This was designed to show the interaction of the factors required for the successful implementation of the initiative. Judging from Table 6:8, both factors failed to meet the validation criterion, as the experts indicated difficulties in the understanding of their purpose. As indicated, the experts provided suggestions, mainly regarding creating a clear structure for implementation.

Table 6:8 Validation of Feedback Loops

Loops				
Item	Number of respondents	Average Score	Validated Consensus	Changes Suggested
C20	8	2.5	50%	Implementation sequence not captured, consider simplifying implementation loops
C21	8	3.5	70%	"Communication" is important through the implementation journey. Consider establishing a clear direction

6.5.3.3. Overall Assessment of the Framework

In providing an assessment of the overall structure of the framework, the experts were asked questions based on the feasibility, usefulness and sustainability of the proposed framework. The different sections are presented in Table 6:9, provides an avenue to validate each of the previously stated factors, exposing their synergy and interaction, and providing a logical structure for implementation. As seen in the table, the areas of feasibility and the usefulness of the framework failed to meet the validation criteria. This is attributable to the previously failed factors mentioned.

Table 6:9 Overall Assessment of Framework

Overall Assessment					
Item		Number of respondents	Average Score	Validated Consensus	Changes Suggested
D1	Feasibility of the Framework	8	4	80%	
D2		8	3.25	65%	Clear steps not shown, consider restructuring and simplifying the framework to resolve the issue
D3	Usability for manufacturing companies	8	3.25	65%	Some of the processes are duplicated and as such difficult to provide logical understanding Considering your target user, the framework should be concise for easy flow
D4		8	4	80%	
D5		8	4	80%	
D6	Sustainability of the framework	8	5	100%	
D7		8	4.375	87.5%	
D8		8	4.5	90%	

The reasons for a failed consensus were considered and formed the basis of the revised implementation framework.

6.5.4. Revised LSS Implementation Framework

The results from the first round of the Delphi study were aimed at improving the applicability of the framework. The survey provided the means for gathering qualitative feedback from the panel of experts. After a detailed analysis of the first phase, the following changes were required;

- Provision of simplified definitions of elements, indicating how the factors interact with each other, and the corresponding roles and responsibilities for proper execution.
- Inclusion of Leadership styles to effectively check the element of Top Management Commitment.
- Exclusion of duplicated elements that complicate the implementation sequence.
- Simplification of the implementation sequence to provide a logical understanding of the proposed framework.

Given the issues raised above, Table 6:10 provides an overview of the key elements of the revised framework. The interaction of the CSFs is clearly stated, as well as the defined roles. The revised LSS implementation framework is presented afterwards.

Table 6:10 Revised Framework Definitions

Indicators	Key Performance Drivers		Implementation Processes	Interactions
Organizational Readiness	• Effective communication structure	• Clear strategic decisions	Readiness for CI investments	The framework initiates with providing clear strategies for investing in continuous improvement initiatives.
			Change in organizational culture	As characterized by organizations in developing countries, there is a need to effect changes to the organizational culture. With strong commitment from top management and a structured communication plan, this step follows through the stages for readiness.
			Create a flexible organizational structure	With the tweak to the organizational culture comes a need to reallocate resources. Strategic decisions are to be taken to create a clear reporting structure. The role of functional leaders in creating a ready organization is exposed by this stage.
			Hire CI professionals	Reallocation of manpower and resources may require the need for hiring. Employing the right minds to lead from within will promote the readiness of the organization.
Roll-Out Plan	• Top management commitment	• Effective employee relationship	Employee engagement in LSS	Sequel to all factors mentioned for organizational readiness, this stage is required for LSS execution. The engagement of the workforce is required for LSS deployment. Achievable through methodologies such as KAIZENS and other tools for continuous improvement. This stage creates an effective employee relationship.
		• Use of external consultants	Structured training plans	It is important to identify the training needs of the organization. The use of external consultants will help in the identification of training patterns as needed by organizational

	• Leadership attributes	• Sets of LSS tools and techniques		roles, and for the engagement and deployment of the workforce.
			Use of cross-functional teams	As part of the capacity-building process, the development of multi-function teams is required for LSS execution. The usability of the tools and techniques for successful implementation is achieved through the use of structured teams. Improvement results are measured at this stage.
Sustainability of LSS		• LSS belt structure	Selection of LSS projects and prioritization	The sustainability of the LSS programme is achievable through the prioritization of LSS projects. Using the required factors for the roll-out plan, this stage provides an avenue for continuous measureable growth in LSS.
		• LSS reward scheme	LSS performance monitoring and evaluation	Performance metrics are evaluated and monitored during this stage. LSS accountability is addressed by the stakeholders and means to motivate engaging employees are exposed here. The use of a reward scheme will act as a catalyst for job involvement and employee satisfaction.
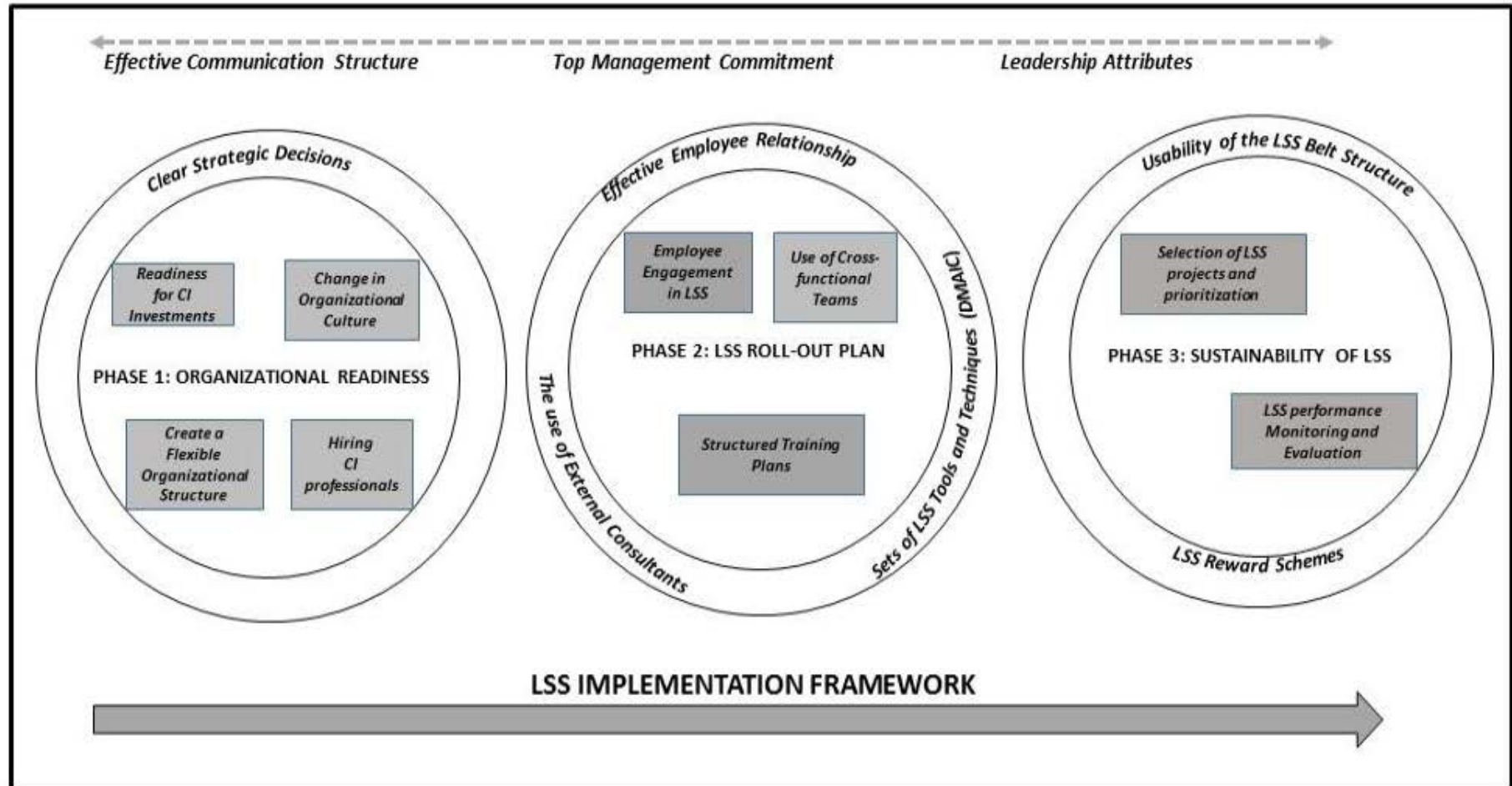
Figure 6:4 Revised Lean Six Sigma Implementation Framework

Table 6:11 Revised Roles and Responsibilities for LSS implementation

Key Implementation Drivers	Roles and Responsibilities / Deliverables
Top Management Commitment	This driver is required all through the implementation phases to • Provide an overall strategy for implementation • Allocate resources for CI investments • Channel the LSS initiative into organizational values • Be ready to resolve implementation issues as they arise • Provide a clear structure for the implementation journey, with tasks and responsibilities duly assigned
Leadership Attributes	In conjunction with the factor of Top Management Commitment, implementing organizations should develop senior management leaders to • Drive the implementation process from within and lead by example throughout the implementation journey • Motivate and provide support for employees throughout the implementation journey • Engage employees during training days to promote the awareness of the initiative

Communication Methods	This Key Implementation Driver is required throughout the implementation journey to
	• Indicate a clear direction for the implementation of LSS through all the organizational functions. Achievable through:
	   o LSS dashboard meetings
	   o Emails and periodicals
	• Provide a means to communicate regularly the success of the implementation process. This could be through visuals, monthly meetings or direct reporting.

Usability of LSS tools and Techniques	• DMAIC
	   o Employed for the management of daily operation improvements
	   o To be used for complex problem-solving and implementation of multifaceted projects, which may include variation monitoring and control
	• KAIZEN
	   o To be employed for the management of daily operation improvements, particularly relating to simple problems, projects, for the realisation of quick wins
	• General LSS tools to promote employee engagement and the execution of the LSS programme.

Key Implementation Drivers	Roles and Responsibilities / Deliverables
LSS Belt Structure	Training and development in the LSS infrastructure is important to set a structure in which LSS champions operate. The belt scheme provides an environment filled with the best hands for the execution of the initiative. Key deliverables from an effective LSS infrastructure include • Delivering on LSS projects by the best talents (Master Black and Black Belts) • Acting as motivational models for upcoming LSS enthusiasts within the organization • Developing talents for leadership roles, as they will automatically sustain the culture of continuous improvement.
LSS Reward Scheme	The need to carefully harness the capacity of the workforce is supported by this driver. As the employees are a source of idea generation and innovation, the key deliverables of this driver include • Motivating employees for the sustainability of the LSS initiative • Promoting knowledge transfer within the workforce.

6.5.5. Delphi Analysis Round 2

During the second round of the Delphi study, an additional survey was distributed to the eight initial expert panellists. Out of these, five participants responded, indicating their availability to proceed for the second round.

The descriptive information for the initial eight participants is listed in Table 6:3 above. The panel composition of the second round was made up of panellists P1, P3, P4, P6, and P7. The survey for the second round was designed to assess the overall effectiveness of the revised implementation framework. The survey structure, using the five-point Likert scale that assesses the level of agreement was reintroduced, as well as the criterion for validation consensus.

The panellists were asked questions based on the usability of the framework and its overall structure. The revised framework and the issues indicated in the first round formed the basis of the development of the survey used for the second phase. Table 6.12 shows results from the second round.

Table 6:12 Delphi Round Two Validation

Questions	Panellists					Mean	Validation Consensus
	P1	P3	P4	P6	P7		
Usability of the Framework							
1 The sequence of the framework is easily trackable and provides a clear direction for the implementation of LSS	5	5	4	4	4	4.4	88%
2 The revised framework provides detailed information on the interaction of the elements as they help in the implementation of LSS	4	4	5	5	4	4.4	88%
3 The components of the framework are clearly defined and easy to adopt	4	4	4	5	4	4.2	84%
4 The roles and responsibilities for implementation are easily captured in the revised framework	4	5	4	5	4	4.4	88%
Overall Structure of the Framework							
5 The overall structure of the framework addresses issues organizations may face in the implementation of LSS	5	4	5	4	5	4.6	92%
6 The revised framework provides a straightforward and simplified guide for new and learning organizations with the intent to implement LSS	4	4	4	5	4	4.2	84%

Questions		Panellists					Mean	Validation Consensus
		P1	P3	P4	P6	P7		
7	The revised framework provides an avenue for the independent assessment of each of the stated sequences	5	4	4	4	4	4.2	84%
8	The holistic approach of the framework covers the major areas of the critical success factors that could aid learning organizations in implementation	5	4	4	4	4	4.2	84%

The findings from the second round indicated an agreement with the developed framework by the panel of experts. With a validation range of above 80%, all errors from the initial framework had been captured and resolved by the author.

The revised framework was developed to provide a systematic approach to the implementation of the LSS initiative, particularly for industries in developing countries. Despite the fact that the unit of analysis was drawn from manufacturing organizations, the peculiarity of issues faced by organizations in the developing world allows for the general applicability of the proposed implementation framework

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6.6. Chapter Summary

The research highlighted the need for a systematic implementation framework to enable organizations facing challenges with the application of certain continuous improvement methodologies to realise the benefits accruable from them (Chakrabarty and Kay Chuan, 2009, Jeyaraman and Kee Teo, 2010, Kumar et al., 2011). This chapter provided a practical and comprehensive framework for the implementation of Lean Six Sigma, particularly for organizations in developing countries. The main aim of this thesis is realised from this chapter as the author employed the appropriate research methods in finding examples within organizations in manufacturing environments. These findings generated through the three years of the doctoral research provided the building blocks for the developed implementation framework.

To ensure the validity and generalizability of the developed framework, the author adopted the Delphi research technique for validation. The Delphi process created room for further improvements to the framework. The use of the panellists created room to solicit views from experts in the LSS field that ensured all important factors were adequately captured in the framework.

The revised implementation framework provides a phase-wise approach for the implementation of the LSS initiative. The originality of the framework is seen from the interaction of the critical success factors necessary for the implementation of the initiative, highlighting which are most important, and the distinctive roles as they affect the journey. The author developed and validated the proposed framework, with a future view of undergoing its practical application.

7.   Chapter Seven

Discussion, Research Findings and Conclusion

7.1.   Introduction

Lean Six Sigma has been shown to have a direct influence on manufacturing companies' financial, operational and process improvements. This has been achieved through enhancements in quality improvements processes, waste elimination and process streamlining (Antony et al., 2008). The level of implementation and acceptability of Lean Six Sigma among manufacturing companies within developing economies is imperative, as it enables them to not only improve survival within poorly planned systems and cultural practices but also efficiently allocate resources, ensure profitability and eliminate waste while offering customers the highest quality, efficient services.

This section seeks to discuss LSS implementation and acceptability within the UK, and some developed economies in comparison with Nigeria and other developing countries to gauge attributes, frameworks, the level of adoption and cultural factors that aid or inhibit LSS in developing economies, with Nigeria as a focal case study. The realisation of the research objectives is also shown in this chapter

7.2.   Discussion

Lean Six Sigma plays an important role within a manufacturing organization's operations, process, supply chain, culture and finance. However, the level of LSS implementation and acceptability within Nigeria manufacturing organizations is facing several issues and challenges (Umude-Igbru and Price 2015). The results obtained from the interviewees in the various case studies highlighted various discrepancies in frameworks, socioeconomic factors and culture in LSS implementation and acceptability between developed and developing economies. While numerous studies have shown a direct correlation between successful LSS implementation and an organization's performance enhancement within manufacturing companies (Shafer and Moeller, 2012, Albliwi et al., 2015, Swarnakar et al., 2016, Antony et al., 2016b), according to Fadly Habidin and Mohd Yusof (2013) and Albliwi et al. (2014), the level of LSS implementation critical factors within a manufacturing company will determine its performance improvement or failure level. Studies from Banuelas and Antony (2002) and Mi Dahlgaard Park and Näslund (2013), among others, have conclusively verified that for the efficient implementation and

management of LSS, there must be full commitment from top management and integration of employees within the programme.

In assessing the importance of LSS implementation and acceptability within Nigerian manufacturing companies, parallels can be drawn from other more developed economies and systems on how to implement the initiative within Nigerian manufacturing companies. Developed economies such as the UK and the USA with thriving frameworks and systems for LSS implementation (See Sections 4.2.2.1 and 5.4) were adopted within this research as they not only serve as a good reference point for the Nigerian manufacturing companies, but their level of production activities, process and operations are keenly adopted by Nigerian manufacturing companies. Pojasek (2003) and Hassan (2013) assert that LSS implementation within manufacturing companies aids in improving and streamlining operations while eliminating waste within their processes and facilities. According to El-Homsi (2007) and Antony et al. (2012a), the full involvement of top management and employee engagement enhances the acceptability of LSS while also aiding its implementation success. Similarly, Sunder M (2016) further reveals that the full participation and involvement of organization and project stakeholders within LSS planning and execution enhances project success. In drawing parallels between LSS design, planning, and implementation within the UK and the USA, Maleyeff and Campus (2007) state that strategies which include the engagement of experienced external consultants 'when employed', inculcating top management, outlining areas within operations that require improvement and ensuring prioritization of these areas. This synergistic strategy approach adopted by the stakeholders provides an enabling environment for the implementation of LSS to succeed.

To successfully implement LSS, it is critical for a manufacturing organization to have a thorough understanding of the CSFs required (Alhuraish et al., 2016). From the studies undertaken in this research, it is evident that the challenges faced by various manufacturing companies in the implementation of LSS were mainly due to their inability to implement one or more of the CSFs identified within this research (see Table 2:9). Further problems also emanated from their failure to adapt the LSS initiative to suit their organization's systems and structure. LSS in American manufacturing companies is highly efficient as a result of their LSS plan, design and implementation processes (see Section 4.2.2.1). There is a strong commitment from top management, they utilize external consultants, seeking the use of continuous training and engagement of employees, and also providing an efficient communication structure that extends to their customers. Most American manufacturing companies seek to adopt all of the LSS CSFs as a result of having established frameworks and systems (Lucier and Seshadri, 2001, Ronchi,

2004). The Indian manufacturing companies who have an excellent grasp of LSS continue to face some difficulties. These problems are attributed to both their socioeconomic situation and also cultural values, which include pressure on the return of LSS investment, and employee resistance due to a lack of effective integration of employees within the LSS process (Kumar et al., 2006). Most manufacturing companies in Malaysia seeking to implement LSS in spite of resource availability are constrained by a lack of top management commitment and involvement in the LSS programme, with a ripple effect on employee morale and level of commitment to the LSS programme. Malaysian manufacturing companies also face a lack of organizational cultural integration and poor communication methods (Naveen et al., 2013, Chay, 2014). These countries collectively have continually sought to increase their knowledge and the acceptability and implementation of LSS by exploring methods to improve on their areas of weakness.

7.2.1. Discussion of Findings

This research work is aimed at analysing the acceptability and the level of implementation of LSS within Nigerian and UK manufacturing companies. The results from the analysis as shown in Chapters 4 and 5 indicate that while businesses in the UK have greater acceptability and implementation success, there currently exists a gap between them and their Nigerian counterparts, highlighting the need to develop a systematic framework to encourage implementation. While Section 7.2 drew parallels between LSS application and the level of acceptability among secondary case study organizations/countries, it also clearly showed that organizations which adopt and fully integrate all the CSFs highlighted within this research achieve success in LSS design, roll-out and implementation (see Sections 4.2.2 and 5.3). This evidence provides an opportunity for Nigerian companies to be able to tailor their LSS programme to their local culture, conditions and constraints. Highlighted below are major issues which characterize the level of acceptability and implementation of LSS within Nigerian manufacturing companies in comparison with UK manufacturing companies, as obtained from the survey described in Section 5.2.2. Suggestions are made on how to improve LSS acceptability and implementation levels within Nigerian manufacturing companies by not only improving on these issues but also adapting and implementing the tweaked LSS framework (Chapter 6) within them.

- **The inability of Nigerian manufacturing organizations to properly integrate their culture into their LSS programme:** This resulted in the failure of the programme and a waste of resources as deduced from Company 8 (see Tables 5:2 and 5:6). The results from these sections also show that employees from most Nigerian manufacturing companies failed to execute LSS, as it is considered to be a fad or just another quality

tool. While these groups acknowledge that LSS can be utilized to seek improvements within their organizations, there has been little or no effort to embed it within its culture as a result of different perceptions between organizational stakeholders. The majority of the UK manufacturing organizations, on the other hand, as seen in Section 5.2.2, were focused on integrating LSS into their culture by incorporating all facets of the organization's processes and systems. This decision resulted in the significant success of LSS within UK manufacturing companies (Companies 1, 2, 4 and 5), as their focus was not just on the implementation of LSS but also on applying it as a tool to achieve continuous improvement (see Section 5.4). This shows a greater acceptability, understanding and application of LSS within UK manufacturing companies in comparison with their Nigerian counterparts.

- **The inability of Nigerian manufacturing companies to select LSS staff and appropriately utilize third-party consultants in LSS implementation** (Section 5.2.2). The results show that while Nigerian organizations readily employ the services of LSS experts in the design phase, their engagement through the journey is found lacking (Umude-Igbru and Price, 2015). Responses in table 5.9 showed that the Nigerian companies failed to align the role of experienced stakeholders in the LSS staff selection process. Engagement of third party consultants was on an on-site training basis only. The resultant effect was an undedicated workforce, nurturing a view of LSS being another management fad that may fade away with time. On the other hand, most manufacturing organizations in the UK adopted a framework which effectively integrated third-party consultants and the employment of highly skilled professionals who are highly knowledgeable in LSS, as can be seen from Section 5.2.2 and Table 5:9. The UK manufacturing firms involved external consultants not only in LSS design but also in early stage implementation and project selection for quick wins.

- **Project selection and prioritization** was one major area Nigerian manufacturing companies failed to implement and take into account in their Lean Six Sigma programme. This factor also has an active link to management's view of LSS, as can be seen from Section 5.2.2. The importance of project selection and prioritization not only aims at aiding organizations to achieve quick wins but also creates a sense of direction for implementing organizations to tie their journey to valuable returns for the company. As

this was found lacking within the Nigerian environment, companies still find it difficult to attribute the potential benefits of embarking on such a cost-driven initiative.

7.3. Summary of Findings

The research questions which formed the building blocks for this research work were instrumental in effectively gauging the level of LSS implementation within Nigerian and UK manufacturing companies and to effectively draw parallels between the acceptability and implementation of LSS in both countries and in developed and developing economies.

Research Question 1

To what extent does the adoption and implementation of Lean Six Sigma affect an organization?

Research Objective 1

To create an understanding of trends in and approaches towards the Lean Six Sigma methodology

It can be cogently argued from the results of the survey and interview findings in both the primary case study manufacturing companies, the research on the secondary case study manufacturing corporations and the literature review that the adoption and implementation of Lean and Six Sigma in an organization have a tremendous effect on the organization (See Sections 2.2.4, 4.2, and 5.4) From the secondary research findings in Chapter 4, organizations which effectively implemented LSS by inculcating all critical success factors as listed in Table 5:2, while ensuring the LSS tools, techniques and framework were tweaked towards the organization's requirements, experienced positive effects. It can also be observed that the effect of LSS adoption and implementation on an organization is largely dependent on both the organization's and its country's trends in and understanding of the LSS initiative (see Figure 4:2). These patterns can be obtained from both the assessments of the performance of organizations within developing economies, as while there were improvements within the organizations operating in developing countries, the majority of the gains were limited as a result of a low level of acceptability and lack of comprehensive framework. Organizations in developed economies within Chapter 4 had significant improvements within their operations and performance (see Section 4.2.) as a result of strong established trends and approaches within their countries and also established frameworks.

The findings from the primary research cases indicated that the trends and attitudes towards LSS implementation have a high correlation with the effect of LSS on the organization. It can be observed from Section 5.3 that the UK manufacturing firms who embarked on a comprehensive LSS approach had steady performance improvements and impact within their operations, recording financial improvements (see Table 5:13). Respondents within the UK manufacturing firms indicated that for an effective LSS structure, organizations should take an organization-wide approach, spearheaded by top management and fully tailored to fit the culture, systems and employees. This point is further argued by Banuelas and Antony (2002), who state that organizations that have an active approach towards the implementation of all CSFs within their LSS programme will experience significant improvements in their operational performance. The importance of an organization fully incorporating the CSFs while implementing LSS is seen to increase business performance and sustainability and improve competitive advantage (Jeyaraman and Kee Teo, 2010, Setijono et al., 2012, Abu Bakar et al., 2015).

Nigerian companies failed to commit fully to the implementation of LSS, possibly due to a lack of resources, as observed from the responses in Section 5.4. It was noted that LSS adoption is mainly limited to multinational manufacturing firms, and the level of their implementation is still low (see Section 4.2.1). Nigerian manufacturing companies' inability to adopt a standard approach and a low trend of LSS has led to reduced effects of LSS implementation within this environment, as the CSFs are not fully implemented or found lacking within the implementation phases, resulting in limited impact of LSS on organizational performance (see Table 5:14). Researchers state that a lack of implementation of CSFs while executing LSS will lead to failure of the LSS programme, with organizations failing to reap the potential benefits of LSS within their operations (Antony, 2004, Setijono et al., 2012, Albliwi et al., 2014). According to Clegg et al. (2010), failure to integrate these CSFs, especially within the organization's culture and beliefs, will lead to failure of the LSS programme. In Table 5:14, the respondents identified top management's attitude within the Nigerian manufacturing sector, who view LSS as a fad, promoting the trend towards obtaining certification without the proper implementation of LSS, indicates a major problem for the sustainability of the initiative. The certification-driven market fosters a scene where some black and green belts have limited practical experience and, as such, limited results within the organization in general. This trend towards obtaining LSS certification for employees creates a false impression of an organization's commitment to quality in the eyes of its clients and customers without recourse to actual implementation and integration into the organization's culture and operations. Rather than investing in LSS, most Nigerian manufacturing companies preferred to employ highly certified personnel without making any effort to carry out the implementation and integration of LSS within their operations and

processes. These findings of a lack of effective LSS within Nigerian manufacturing organizations tally with findings from Enoch (2013) but differ in that there is now a more concerted effort and increasing awareness driving LSS within Nigerian manufacturing organizations

It can be shown that the integration of all CSFs highlighted within this research is key to successful LSS implementation, as it ensures performance improvement and enhances the competitive advantage and sustainability of the organization's continuous improvement structure.

Research Question 2

How have current quality practices and continuous improvement initiatives been undertaken within the Nigerian manufacturing industry, particularly concerning LSS?

Research Objective 2

To evaluate the Nigerian manufacturing industry's practice and beliefs concerning LSS.

Summary of Findings

Quality practices and continuous improvement initiatives, practices and beliefs within the Nigerian manufacturing sector, especially about LSS, were identified and categorized, and framework was proposed. As can be seen from Section 4.2, the responses from noted experts within the Nigerian manufacturing industry pointed out that LSS awareness, acceptability, and level of implementation are still at an infancy stage, and performance levels are recording as low. Table 5:14 offered an in-depth explanation of LSS appraisal within Nigerian manufacturing companies. The experts highlighted that LSS has no proper implementation framework, as it is not properly grounded within the Nigerian environment, especially the production environment, even though they have seen general improvements.

The transcripts in Table 4:6 indicated that current quality practices and CI initiatives in respect of LSS tend towards more adoption by multinational companies, who place more value on its implementation and have a high level of acceptability. Nigerian indigenous businesses and SMEs, on the other hand, have a perception of LSS as theory, therefore do not place much value on its implementation. The communication structure within most Nigerian manufacturing companies could be summarized as effective, the bond between employees and top management is strong as a result of corporate cultural values (see Section 5.2.2 and Table 5:2). The presence of the highly skilled workforce and these communication attributes further

promotes an enabling environment for LSS to operate. Despite the presence of this skilled workforce, knowledge of the usability of the tools and techniques associated with the implementation of the LSS initiative still poses a huge barrier (see Table 5.3). It is therefore imperative to bridge this knowledge gap.

The attitude of top management towards CI initiatives such as LSS within Nigerian manufacturing organizations exposes restrictions towards their overall implementation plan. A clear sense of direction and drive from senior management is lacking, with resultant effects on the application of LSS (see Table 5.5). These effects are felt throughout the implementation journey, as human and material allocation to LSS is often viewed as a non-value-added activity for the company.

Views from the respondents (see Section 4.2) on LSS current practices within Nigerian manufacturing sector indicated that while there is evidence of a low level of implementation, there is an increase in the acceptability of the initiative, notably spearheaded by multinational firms and gradually being adopted by indigenous companies. It was believed that this influence on other organizations in the spectrum will further promote the general acceptability of LSS within the Nigerian environment. This view indicates a significant improvement for LSS regarding acceptability in comparison to Enoch (2013).

Research Question 3

What are the prerequisites for the successful implementation of LSS in Nigeria?

Research Objective 3

To review the implementation of LSS and its effects in organizations in Nigeria and the UK.

Summary of Findings

The findings obtained from the respondents showed that for manufacturing organizations both in the UK and Nigeria to be able to undertake LSS successfully, certain CSFs must exist within the organization structure, culture and LSS implementation framework. Table 5:2 listed all of the CSFs required for successful LSS implementation. It can be seen from the UK manufacturing companies (see Section 5.3.1.1 and Table 5:4), that the primary determinant of their success in implementation came from their ability to effectively tailor the LSS programme to their organization's strategic objectives, seeing LSS as a tool for overall improvement, and integrating the initiative within their culture and corporate structure. The integration process was collectively

due to their ability to involve external experts, employ highly skilled LSS professionals, build trust within the workforce and promote a change mind-set within the company.

The responses in Table 5:4 show that top management led the LSS drive and created a working environment and culture that not only integrated employees through open communication but also created a working culture that encouraged employee input and suggestions tied into HR rewards. From Section 5.3, one major CSF inherent within UK manufacturing companies is a mentoring programme which encourages all employees to be effectively trained by experienced fellow employees to achieve sustainability while also ensuring LSS is fully entrenched within the organizational culture. Extensions of LSS programme by UK manufacturing companies towards their organization's supply chain and its customers were also undertaken but there was no way of correlating this with the organization's performance improvement, even though it had some positive impact, as argued by Setijono et al. (2012). These views on CSFs are collaborated by Antony et al. (2005) and Antony et al. (2008), whose studies were limited to UK manufacturing SMEs but still showed a clear CSF requirement for LSS. The findings from the interviews (see Section 5.4) in UK manufacturing companies regarding the effects of successful implementation among the various cases saw improvements such as a 25% increase in market share, 50% reduction in waste, 200% profit increase, 80% increase in savings and greater employee commitment.

Nigerian manufacturing companies within this study made claims of adopting the CSFs in their LSS implementation (see Table 5:2). These adoptions, judging from the detailed analysis, were mainly in the areas of ensuring the provision of adequate training and certification of employees on LSS tools and techniques, ensuring effective communication within the LSS deployment and strong project management skills. While these have shown strength in LSS deployment within Nigerian manufacturing organizations, it can also be argued that the inability for them to correctly implement and integrate certain prerequisites have primarily led to failures and the minimal impact of LSS within the respective companies.

These requirements, as obtained from respondents and outlined in Section 5.4 include the inability of Nigerian manufacturing organizations to integrate LSS properly inside their organizational culture, thereby limiting CI and change within the employees' working culture and the organization as a whole. The other main hindrances to LSS within the Nigerian manufacturing sector (see Table 4.9), include a low awareness culture, employee training on LSS tools and techniques based on the certification-driven market, a reactive as opposed to a proactive culture, and perceptions of high cost implications for implementing LSS. The inability of Nigerian manufacturing organizations to accurately link their LSS initiatives to their supply chains further

impedes implementation. Lack of top management and employee involvement were seen as major inhibiting factors, as supported by Burtonshaw-Gunn et al. (2008) and Sadiq (2013). These limiting factors have significantly affected LSS implementation and acceptability, as corroborated by Dibia (2012), who listed these five critical success factors as being required for successful deployment of LSS.

Research Question 4

How do manufacturing organizations in developed (UK) and developing (Nigeria) countries differ in their experience with LSS?

Research Objective 4

To identify opportunities to sustain the LSS initiative in a developing economy

Summary of Findings

To ascertain means to sustain LSS initiatives successfully within a developing economy such as Nigeria, this research focused on a review of developed economies by assessing frameworks, methods of preparation and execution, employing both secondary and primary data sources to achieve the overall aim. The findings from the respondents in a developed economy (UK) showed that to sustain LSS, an organization must continuously involve all relevant stakeholders and continuously benchmark its LSS performance to undertake evaluation and monitoring, as seen in Section 5.3. The findings relating to the involvement of stakeholders (see Table 5:11), indicated that there must be a consistent effort from top management to lead LSS and participate fully in the programme, while ensuring continuous training of all employees, in particular on the use of the tools and techniques for improvement. This training should reflect the appropriate LSS infrastructure (belt scheme), promoting mentors for lower level employees on the LSS progression ladder. This view is supported by (Ingle and Roe, 2001). The findings from this study indicated that organizations should tie employee LSS performance to reward schemes within their job roles, to not only encourage other employees but to enable employees to adopt creative solutions to solving issues related to their job functions. One major area of sustaining LSS within developed countries (UK) manufacturing organizations as seen from the respondents in Section 5.3.3 is continuous benchmarking of LSS performance improvement within both the organization's operations and business finance to continually seek improvements and growth.

In developing economies (Nigeria) LSS differs from developed economies as a result of a lack of a structured framework and lack of full implementation of CSFs, as outlined by the respondents in Sections 5.2 and 5.3. It can be clearly observed that due to the low level of LSS knowledge (see Section 4.2), the Nigerian manufacturing industries also failed to undertake investments in CI adequately, and create an environment for employees which encourages idea sharing and innovation to aid LSS (see Table 5.2). While it can be seen from Table 4:6 that LSS has mainly been adopted by multinational companies within developing economies, as a result of their parent companies' persistence around LSS adoption, the Nigerian indigenous manufacturing companies are lagging behind. The sustainability of LSS is still significantly hampered by a lack of a comprehensive framework tailored towards LSS readiness, execution and sustainability in developing countries covered in this research. Other factors limiting LSS sustainability in a developing worlds manufacturing sector (Nigeria), as outlined by the respondents in Table 5:5, include lack of continuous management support and drive for the programme which leads to the disenfranchisement of employees and failure to link LSS to the organizational culture, thereby limiting growth and employee buy-in. Respondents' views from Section 5.3.3 and Table 5:11 also show a lack of employment of LSS belt schemes and mentoring programmes within developing economies and the certification-driven market culture as factors that limit LSS sustainability and growth within the developing economies.

7.4.   Conclusion

Lean Six Sigma, if properly implemented, plays a critical role in organizations, by aiding them to improve their operations, performance and competitive advantage. The integration of LSS within an organizational culture, processes and system in developed and developing economies plays an important role as it enables an organization to not only benchmark its improvement activities but also seek creative solutions to operational issues.

As stated in the introductory chapter, this research was undertaken to assess the acceptability of the LSS initiative within developing countries in comparison to developed countries, and thereby develop a practical framework to aid successful implementation of the initiative by companies within the developing economies. This research identified gaps regarding the applicability of the initiative within Nigerian companies (Burtonshaw-Gunn et al., 2008, Enoch, 2013, Sadiq, 2013). The limited amount of published material gave rise to a comprehensive research approach geared towards the realisation of the research objectives.

The findings from this study exposed discrepancies in the application of the LSS initiative, which hardly came as a surprise. The level of awareness and implementation differ significantly due to

the degree of understanding and approach of organizations in both worlds. In both cases analysed, it was evident that UK manufacturing companies employ a structured approach towards their implementation, in contrast with their Nigerian counterparts. While there have been improvements in LSS adoption over the years within Nigerian manufacturing companies, there exists a wide gap in actual implementation between the UK and Nigerian manufacturing sectors. This is the result of a lack of a comprehensive framework for LSS, tailored towards the Nigerian context, taking into account the cultural issues, organizational structure and understanding of the CSFs required for implementation. These major challenges within the Nigerian context as identified throughout the research highlight the need for a structure and a practical framework to determine the issues associated with implementation.

As a result of the problems within the Nigerian context, this study developed a practical implementation framework incorporating the issues found within the Nigerian environment as they affect the application of LSS. The uniqueness of the proposed implementation framework is seen from the interaction of the CSFs and the elements identified to aid successful implementation. As the LSS initiative is still at an infancy stage within Nigerian manufacturing organizations, a step-wise approach to implementation is required to promote awareness.

7.5. Limitations of the Research

This research focused mainly on the Nigerian manufacturing industry as a case study for developing countries. While secondary data sources were employed for countries such as Malaysia and India, to serve as support on developing countries, the richness of data from these countries could be argued as low compared to the primary data collected from the Nigerian sources. Nevertheless, the researcher ensured that the data generated from primary sources established a clear picture of the Nigerian manufacturing industry, generating responses from industry players including manufacturing companies and LSS consulting firms. This approach was made to eliminate bias and find balance within the industry.

The paucity of existing secondary data created an option to adopt primary means for data collection for Nigeria. Also, as the implementation of the LSS initiative is still at an infancy stage within the Nigerian manufacturing industry, efforts to measure the impact of LSS within the sector became a tremendous challenge. To this end, the researcher adopted means to assess the acceptability of the initiative rather than its impact. As the second phase detailed the collection of primary data from the UK and Nigerian manufacturing companies, the researcher employed

an exploratory research approach to find solutions to the research problem. The possibility of establishing casual relationships between factors in both cases was limited by this situation.

Due to time and financial constraints, this research is limited in two aspects. The first is the difficulty in visiting the participating firms more than once to conduct observations and provide means for data support. However, follow-up interviews were conducted via the telephone and email to limit the impact of this issue on the research. Secondly, efforts to validate the framework within companies in developing countries proved futile. To this effect, the researcher adopted the Delphi technique, employing expert opinions to assess the components of the framework for validation. The structure of the Delphi process created a basis for the measurement of each element of the framework as they affect the implementation of the LSS initiative. Also, as the development of the framework was based on findings from the primary and secondary data sources, with its validation based on the opinion of experts, the statistical generalization of the framework is limited, and could serve as an agenda for future research when tested over multiple cases.

8. Chapter Eight

Significance of the Research, Recommendations and Directions for Future Studies

8.1. Introduction

This chapter is focused on outlining the research significance as well as clearly stating the contribution of the study to knowledge while proposing steps required for improving Lean Six Sigma acceptability and implementation levels within manufacturing organizations in Nigeria, and developing economies in general.

The outlined significance of this research work and limitations will be used to indicate the future directions of this research work.

8.2. Significance of the Research

This research work has established the importance of the Lean Six Sigma initiative, backed up through findings from documented literature and analysed industry practices. It has added significantly to the body of knowledge on LSS, especially in relation to Nigerian manufacturing organizations, as it has been able to identify causes and areas of insufficiency in the acceptability and implementation of LSS within a developing economy. This research has discovered that while there are low acceptance and implementation levels of LSS within Nigerian manufacturing industry, mainly as a result of awareness levels, there has been a significant improvement recently. These improvements are primarily as a result of the influx of the choice to adopt continuous improvement initiatives by multinational organizations in line with their global strategies.

This research has also discovered that while there is no significant gap between theory and practice in the implementation of LSS in a developed economy, using the UK manufacturing sector as a case, there exists a substantial dearth of case study evidence on the applicability of LSS in Nigerian manufacturing organizations. To this end, this research developed a guiding LSS implementation framework tailored towards the Nigerian manufacturing sector. The development of this framework has helped to increase the awareness of the LSS initiative in the Nigerian environment, attributable to conference presentations and discussions with industry participants and consultants during this research journey. Arguably, it is evident that in building a sustainable implementation framework, future researchers and LSS practitioners are availed the opportunity to have a comparable base for future findings. In detail, this research proves significant in the following areas:

- The importance of LSS in aiding manufacturing organizations to achieve performance improvements and enhance competitive advantage was emphasized. The proper integration of LSS within a manufacturing organization's culture, structure and operations generates the desired benefits in areas of finance improvements, human resources and capacity developments, as well as an overall improvement in the working culture of the organization.

- Reasons for failures and the low acceptability of LSS within Nigerian manufacturing organizations have also been highlighted by listing critical success factors required for LSS implementation. Judging from the results of the Delphi study, this significantly aids practitioners and industry experts in understanding possible challenges faced in implementing LSS within the Nigerian manufacturing sector and how to combat and mitigate these problems efficiently.

- The developed framework for LSS implementation in the Nigerian manufacturing sector serves both theoretical and practical purposes. The theoretical significance is evident in the fact that while the Nigerian manufacturing sector acted as the primary focal point in developing the framework, it can be applied to the manufacturing sectors of other emerging economies or utilized as a foundation for developing other frameworks tailored specifically for their sectors. Its practical significance lies in the fact that it serves as a comprehensive, structured framework that could be applied by both indigenous and multinational manufacturing organizations in Nigeria to successfully implement LSS within their organizations.

- This research makes a significant addition to the limited body of knowledge on the application of LSS within Nigeria. It provides a comprehensive guide to the better understanding of challenges, issues and solutions to LSS implementation and adoption, while also serving as a reference point for other related topics on LSS in Nigeria by other academics.

This research has highlighted the significance of the role of external consultants for LSS in the awareness process. Peculiar to the Nigerian environment, this study exposes the joint effort between all stakeholders in the execution of the initiative, indicating their distinctive roles in the implementation journey.

8.3. Recommendations

The recommendations presented here aim at establishing ways in which the acceptability, knowledge levels and the success of implementation of LSS can be enhanced within the Nigerian

manufacturing sector. As the LSS programme is aimed at seeking improvements within an organization's operations, finances and strategic business objectives while also improving organizational competitive advantage, all of the recommendations proposed in this section are geared towards these goals.

The following are recommendations on how to successfully implement LSS within the Nigerian manufacturing sector. These recommendations are based on findings from the secondary findings in Chapter 4 on LSS implementation in developing and developed economies, the primary research results of Chapter 5 and the framework developed within Chapter 6.

8.3.1. Linking Lean Six Sigma to the Organization's Strategic Objectives

One significant difference between the implementation of LSS within the UK and Nigerian manufacturing organizations is the ability of the UK manufacturing organizations to link LSS to their organization's strategic objectives, as seen in Section 5.3.1.1. Nigerian manufacturing organizations before embarking on LSS should be able to align it to their organization's strategic objectives, to effectively apply the tools and techniques of LSS to their functions, operations and projects relevant to the achievement of their overall business goals. This decision will enable organizations to be able to benchmark effectively and track performance improvements, and find creative solutions to organizational issues.

To achieve these performance improvements, enhance competitive advantage and achieve the maximum benefits of implementing LSS, there must be a linkage between LSS and the organization's strategic objectives (Cheng, 2013, Gupta, 2015). Before the adoption of LSS within the Nigerian manufacturing context, organizations should adequately review and spell out areas requiring improvement and their strategic objectives to tailor the LSS tools, techniques and training patterns needed to ensure the long-term sustainability of the initiative effectively. Further evidence of the necessity of this link as experienced by UK and US manufacturing companies is seen in these cases (Antony et al., 2008, Albliwi et al., 2015).

8.3.2. Integrating Lean Six Sigma into the Organizational Culture

Another major factor which created problems in the implementation of LSS within Nigerian manufacturing organizations was the lack of its integration into the organizational culture. There is a high need for Nigerian manufacturing organizations to ensure their LSS programme and plans are fully embedded within their corporate culture. This integration will ensure the correct perceptions on the role of LSS, eliminating the thought of yet another management programme, as indicated by respondents, and also providing the desired results to ensure its long-term

sustainability. The justification of this recommendation can be seen in Table 5:14, indicating findings of poor cultural attributes for LSS within the Nigerian companies.

Another rationale for this recommendation can be seen from Section 5.3.1.3, Table 5:6, where the UK manufacturing organizations' ability to integrate LSS into their organizational culture ensured not only the success of the execution of their LSS programme but also its sustainability. According to Mi Dahlgaard-Park et al. (2006) and Zu et al. (2010), to ensure sustainability and achieve significant improvements through the application of LSS, an organization must endeavour to align fully and integrate LSS tools and techniques into its culture, working practices and employee behaviour. In this regard, the cultural dimensions for the applicability of the LSS initiative must be examined properly by implementing organizations.

8.3.3. Undertaking Substantial Investment in Lean Six Sigma

Nigerian manufacturing organizations in their quest to achieve quick wins fail to undertake substantial long-term investments in their organization's operations and resources, such as continuous training of employees and application of LSS tools and techniques within projects. The justification for this recommendation can be seen from Sections 5.3.1.1 and 5.3.1.3, where it was noted that there is a paucity of CI investment by Nigerian manufacturing organizations. This decision is attributable to perceptions of organizations' top management of the high cost of implementation. Reasons for this recommendation can be seen in Table 5.14, where the findings indicated that the existing leadership culture within Nigerian companies is more focused on investing substantially in public relations than in continuous improvement tools.

While UK manufacturing organizations are continuously undertaking substantial long-term investments within their LSS programmes (see Table 5:4), Nigerian manufacturing organizations limit the benefits obtainable from the implementation of LSS. Manufacturing organizations seeking to implement LSS successfully must undertake long-term investments in order to ensure its sustainability (Devane, 2004, Snee and Hoerl, 2007).

8.3.4. Involvement of External Consultants and Hiring Lean Six Sigma Experienced Professionals

The importance of the role of external experts and the hiring of experienced professionals for the implementation of LSS has been established in this research (see Sections 4.2.3, 4.3, 5.3.2 and 5.3.3). The sustainability of the LSS initiative is dependent on a synergistic approach by all stakeholders. The success of the initiative will be achieved by a combination of hiring

experienced employees, internal training and competency growth, supplemented by external consultants in the design and execution phases. The design of this approach should be effectively communicated, tailoring training plans towards the requirements of the organization

8.3.5. Elimination of the Certification-Driven Market

The problem of the certification-driven market is a major cultural challenge within the Nigerian environment. Again, this is attributed to the low awareness levels characterized by the industry. The haphazard approach towards obtaining certifications for LSS is created from the need to boost employability within the labour force. There is a direct correlation between this issue and the success of LSS implementation. The responses showed a negative trend in participating organizations, ensuring employees are trained and certified using the belt schemes and increasing the belt levels without any recourse towards actual implementation of LSS within operations.

In order to improve LSS's acceptance level and ensure success in its implementation, Nigerian manufacturing organizations must take a cue from their developed counterparts. A paradigm shift exists within organizations in the developed setting. Taking the UK as an example and as observed during interview sessions, the commitment of individual employees to their capacity growth is seen in their quest for an understanding of the LSS programme. The choice to become a certified professional should lie in the desire to drive from within, ensuring that the programme is sustained through the organization.

8.3.6. Elimination of the Waste Culture

This recommendation is due to the culture of waste as highlighted within this research (see Section 4.3.4). This problem has hindered the success of LSS within the Nigerian manufacturing sector, as both organizations and employees are tolerant with waste. The suitability of the proposed implementation framework is dependent on a paradigm shift. Organizations must develop and integrate a mind-set and culture of waste elimination within their processes, embracing the principles of LSS as an attitude and way of life in both their job functions and personal life, in order to accrue the benefits which the initiative provides.

Again, taking a cue from their UK manufacturing counterparts, an efficiency culture should be adopted. Measuring waste levels is a useful means to eliminate the culture of waste gradually.

8.3.7. Leadership Culture and Employee Commitment

A leadership culture which thrives on embarking on its LSS journey due to incessant pressures from parent companies or its competitors promotes a haphazard approach towards implementation. Top management should establish a clear motivation for implementation before it is implemented. Leadership attributes, especially from top management, is a determining factor for the success or failure of the initiative. As characterized by Nigerian companies, there is gap in communication between the stakeholders for implementation and top management. The success of the LSS initiative comes from the ability of top management to 'lead from within'. This problem as highlighted in this research impedes the acceptability of the initiative within the Nigerian manufacturing sector. Employee commitment towards implementation is stifled as a result.

A shift to a leadership culture which is fully committed to the strategic implementation of LSS within all facets of the organization ensures that maximum performance improvements from the LSS initiative are achieved (Pamfilie, Petcu and Draghici, 2012). This new leadership culture will also aid in spurring employee commitment to LSS initiatives, as its sustainability lies in the dedication and engagement of the workforce (Spasojevic Brkic et al., 2016).

8.4. Direction for Future Studies

This research has attempted to undertake a comprehensive analysis of the acceptability and implementation level of LSS in developing (Nigeria) and developed (UK) manufacturing organizations. However, this research also has its limitations, for reasons such as the paucity of information and lack of existing research within this field in the Nigerian manufacturing industry. Other limitations of this research could be attributed to the limited scope of this study. The timeframe for this research will naturally impede the further generalization of the study and as such areas for future research development and study can be categorized. The following are proposed suggestions for future exploration based on this research topic and the scope of this research.

[1]. The framework for LSS implementation developed within this study was tailored to the manufacturing industry in Nigeria, based on findings generated from this setting. The viability of testing the applicability of the framework within other sectors could form an agenda for future research. This will not only increase awareness of the initiative but also add to the limited body of knowledge of the subject area with developing economies.

[2]. There is a further need to increase the scope of this research to assess the barriers to implementation of the initiative in other national environments. Particularly in Africa, this

choice will increase the amount of literature, creating a better picture of the status of the implementation of the LSS initiative worldwide.

[3]. This research employed expert opinion to validate the proposed framework using the Delphi technique. Despite the fact that sufficient justifications were made for this approach, awareness, as well as further data for the Nigerian environment, could be created if further research was conducted to provide a practical validation of the proposed framework in an implementing organization.

[4]. This research has bridged a huge gap in LSS implementation within the Nigerian manufacturing sector. However, this research has been limited to organizations which have implemented or are in the process of implementing LSS, predominantly large corporations and multinationals. This raises questions on the awareness levels for SMEs within a developing setting. There is a need for future research to test the suitability of the framework within SMEs.

[5]. As this research focuses on the perceptions and acceptability of the initiative between the two clusters (i.e., developing and developed countries), further comparative research is needed to assess the impact of the implementation of LSS on organizational performance. This choice would provide a measurable overview of the factors that affect the application of the programme in distinctive settings.

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APPENDIX A

Sample Pilot Interview Request

Thank you for accepting my invitation on LinkedIn. I really do appreciate.

As my profile details, i am a PhD researcher working on developing an effective Lean Six Sigma (LSS) implementation model to suite the Nigerian industry, by means of analysing the constraints for adoption.

i am trying to build a contact base in the Nigerian industry to enable me carry out my research effectively, this led me to your profile which states you are a practising, experienced Lean Six Sigma champion.

i am to conduct a pilot study in April and I will appreciate your wealth of experience during the process.

I pray in future correspondence we will get to share ideas. And also, I will be grateful to you sir for your participation.

Kind Regards

Umude-Igbru, Oviri Charles
PhD Researcher
Engineering Systems & Management
Aston University
Birmingham
B4 7ET

PILOT STUDY

(LSS PRACTITIONERS/ CONSULTANTS)

INTERVIEW QUESTIONS

1. What continuous improvement initiatives are currently employed within Nigerian industries?

2. What is the industry's perception of Lean Six Sigma?

3. As a Certified LEAN SIX SIGMA consultant/ trainer, which industrial sector patronises the LEAN SIX SIGMA training programme in Nigeria the most? (give records for a period where applicable)

4. What are the perceived outputs or gains for which these organizations participate in your training programme?

5. How would you rate the status of LEAN SIX SIGMA implementation in the Nigerian industry?

6. What performance measurement methods are employed in the Lean Six Sigma implementation journey?

7. Is LEAN SIX SIGMA the solution to maintain competitive advantage and ensure continuous improvement among companies in Nigeria?

8. Have you ever marketed the LEAN SIX SIGMA initiative to an organization and got rejected?
   If yes. .why was it rejected?

9. Have you ever had a situation where the implementation of the LEAN SIX SIGMA initiative failed in an organization?
   If yes.. Give a brief account of your experience

10. To what extent do these organizations know about the tools and techniques of quality management?

11. What are the main CSF's for LEAN SIX SIGMA implementation in Nigeria?

12. What are the challenges faced by these organizations to LEAN SIX SIGMA Implementation?

APPENDIX B

Engineering Systems and Management Research Group

Department of Engineering and Applied Science

Aston University

Birmingham

<u>Doctoral Research Interview Invite: Exploring Lean Six Sigma Cases</u>

Dear

I would like to take this opportunity to thank you for accepting to participate in the research on exploring implementation issues associated with Lean Six Sigma within UK's manufacturing and production industries. A detailed analysis will be carried out based on responses from subsequent interviews.

The aim of this doctoral research is to develop a framework to assess the effectiveness of Lean Six Sigma implementation within organizations. A practical guideline is to be developed to enable learning organizations handle implementation issues within the Lean Six Sigma journey, and to ensure its sustainability.

In order to achieve this aim, it is essential that I gain a more detailed picture of Lean Six Sigma practices in your organization, achievable through interviews with Lean Six Sigma stakeholders like yourself. I am highly interested in hearing your experience and challenges faced in deploying the Lean Six Sigma initiative. The interview process forms not only an integral part of my research, but also a contribution to the field of Lean and Six Sigma.

Please note that all responses will be treated with the utmost confidence and no single set of responses will be readily identifiable.

Thank you in anticipation of your continued support.

Kind Regards

Umude-Igbru, Oviri Charles
PhD Researcher
Engineering Systems & Management
Aston University
Birmingham
B4 7ET
Umudeioc@aston.ac.uk

LEAN SIX SIGMA (LSS) INTERVIEW

Instructions: Please provide responses below each question as you go along.

Company overview

1. Please give a brief summary about your organization

2. What were the strategic decisions considered before the Lean Six Sigma implementation process

3. From your experience, how did these decisions affect the mode of operation of your organization? And why?

4. Judging from your current role, do you think swift decisions with implementing initiatives like the LSS should be made? And why?

5. Could you elaborate on your views of the role of different managerial levels in the LSS implementation journey

6. From your response to the last question, which role is most significant to successfully initiate the LSS implementation journey? And why?

7. In your organization, has top managements involvement facilitated the implementation process?

8. From your experience in this organization, how would you describe the way things are done, pre and post LSS implementation?

9. During the development of the LSS initiative, did your company consider if the LSS programme will fit in to the way things are done within your organization? Was there a need to change things? If yes, how important was the need? And why?

10. During the development stage of your LSS journey, how would you explain the behaviour of your employees towards the change programme

11. Were there any tweaks to your already set organizations rules and standards when creating the LSS environment? If yes, please give details

12. What were the basic assumptions within the organization during the development stage? And how were they managed?

13. How would you describe employee relationship in your organization?

14. What are the communication means between different levels of employees in your organization?

15. From your experience in this organization, how would you describe the situation from different aspects (eg facilities change, restructuring, etc), pre and post LSS implementation?

16. What quality or continuous improvement initiatives were employed in your organization prior to the deployment of LSS? How successful was that programme?

17. What role did consultants and LSS specialists play in deploying the LSS initiative in your company?

18. How was LSS deployment design developed?

19. How was the LSS implementation design communicated to all functions of your organization

20. What were the identified barriers during the implementation stage? And how were they managed?

21. What are the experiences gained as a result of managing the implementation barriers

22. What change in structure did your organization experience during the implementation of LSS

23. What was the training plan for employees who led and managed the effort of LSS deployment?

24. Indicate your timeline for the implementation of LSS in your organization?

25. How was the plan for LSS implementation proliferated? Was it broken down to pilot applications or rolled out organization-wide? And why.

26. How has your organization managed to sustain the LSS programme over the period?

27. What roles do LSS black belts and CI champions play to facilitate the sustainability of the LSS initiative in your organization?

28. Has the implementation of LSS facilitated change in organizational performance? If yes, in what way?

29. What are your organizations established performance metrics for LSS?

With respect to your identified performance metric, can you highlight the degree of change after the implementation of LSS? (provide evidence)

Lean Six Sigma Critical Success Factors

The table below highlights critical success factors as linked to the implementation of Lean Six Sigma (LSS) in your organization. Please tick as prioritised by your company and highlight corresponding challenges faced by each factor.

CRITICAL SUCCESS FACTORS	TICK AS APPROPRIATE	HIGHLIGHT CHALLENGES FACED IN YOUR ORGANIZATION
Management commitment		
Organizational culture		
Linking LSS to business strategy		
Leadership styles		
Communication		
Linking LSS to customers		
Awareness		
Selection of LSS staff		
Data-based approach		
LSS projects selection/prioritization		
LSS projects tracking and review		
Resources for LSS staff		
LSS training		
LSS tools and techniques		
Project management skills		
LSS financial accountability		
Organization infrastructure		
Extending LSS to supply chain		
Linking LSS to HR rewards		
Leadership styles		

Lean Six Sigma Tools and Techniques

The table below highlights the tools and techniques for Lean Six Sigma. Please tick as used by your company and highlight the frequency (On a 5 point scale).

LEAN SIX SIGMA TOOLKIT	TICK AS USED BY YOUR COMPANY	Degree of Use (5-Always, 4-Very Often, 3-Sometimes, 2-Rarely, 1- Never)
DEFINE PHASE		
Affinity Diagram		
Failure Mode & Effects Analysis (FMEA)		
Process Flow Chart		
Project Priority Calculator		
Value-added Flow Chart		
Value Stream Analysis		
Affinity Diagram		
MEASURE PHASE		
Histogram		
Measurement System Analysis (MSA)		
Pareto Chart		
Six Sigma Conversion Table		
Statistical Process Control (SPC)		
Trend Chart		
ANALYZE PHASE		
5-Why Analysis		
Design of Experiments		
Fishbone (Ishikawa) Diagram		
Regression Analysis		
IMPROVE PHASE		
5S Tool		
A3 Report		

Brainstorming		
Corrective Action Matrix		
Error-Proofing		
KAIZEN		
One Piece Flow		
Pull Scheduling		
Quick Changeover (SMED)		
System Diagrams		
Total Productive Maintenance		
CONTROL PHASE		
CHECK Process		
Control Plan		
Standardized Work		
Statistical Process Control (SPC)		

APPENDIX C

Example Showing Evolving Themes and Concepts

Questions: general questions were asked about the distinctive LSS implementation process for each organization. As seen in appendix II, these questions cover a range of topics as they affect the applicability of the initiative.		
Participant Response	Initial coding & Sub-theme	Themes
Company 3 (HR Manager) In a bid to remain competitive, we sought to review our strategies.one of which was to provide an effective structure for continuous improvement. We employed our CI director to create an enabling environment for us	strategic decisions for LSS implementation	
Company 5 (Managing Director) Some of these decisions made have improved our organization immensely, for example, ownership of projects and processes by middle management has improved due to the pressure from top management to get everyone involved.	Role of Top Management	
Company 1 (Site Lead) In a nutshell, I think we weren't in a bad state anyway. We were just at a point where we could do things better and we didn't think we could do it better. Our culture was characterized with a phase of trials and errors, and also a different management style that didn't accommodate the employees in the thinking process. It was more of senior management do the thinking and employees do the doing. But now, a new concept has emerged. Everyone has a sense of involvement.	change in organizational culture	Organizational Readiness
Company 3 (CI Manager) Several tweaks were made to our previous mode of operation. We had shift changes to accommodate high CI enforcers, and also	change in structure	

introduced CI talks in our weekly meetings. We were basically singing CI		
Company 1 (CI Manager) Everyone had the <u>training</u> though <u>consultants</u> and in addition, those in management and supervisors were given additional management training. We sought to develop our people management skills in order to <u>engage employees</u> effectively	well-structured training plan	
Company 7 (HR Manager) The <u>training plan</u> now is led fully by both the HR department and the <u>external consultants</u> in consortium with our CI department. We all work in tandem and clearly roles and training programmes are defined. We have a training system that we developed whereby we try to <u>indulge every employee</u> especially within the shop floor	use of external consultants workforce engagement	Roll-out plan
Company 5 (HR) The roles of these stakeholders are very important. We have two <u>master black belts,</u> myself and the <u>CI director</u>. The level of <u>training</u> and experience to attain such status is tremendous. We act as the drivers here. <u>We oversee everything</u> and make sure we link continuous improvement to <u>our financial sheets</u>	rewards schemes usability of facilitators (LSS belt scheme)	
Company 1 (MD) As part of <u>a hiring criteria</u>, we employ minds related to the LSS initiative in order to drive CI. Also as part of efforts to sustain the initiative, we introduced <u>rewards and incentive schemes</u>	top managements participation	LSS sustainability

to employees that participate fully in our continuous improvement programme. Company 6 (CI Lead) The ownership and supervision of projects are carried out by <u>Black belts</u> here. They align our LSS structure with <u>our KPIs</u>, in order to expose the <u>financial implications</u> of our programme	clear performance metrics	

Example of data synthesis and analysis per initial code

THEMES	Organizational Readiness	SCORE
SUBTHEMES	Role Of Top Management	
CODES	Positive Role Of Management 2 (Question 4)	
Participants Quotes		

			Participants Quotes	SCORE
PARTICIPATING ORGANIZATIONS	UNITED KINGDOM	1	In every C.I. journey, the role of each stakeholder is important. But the role of top management is very important. We have to drive and lead by example	5
			The site lead has an extremely good leadership and motivational skills, he has acted actively in the direction he wants the company to go and has driven from the top. Same goes for the senior management. The junior management like myself has to align themselves with the C.I. structure in order to drive it, as we are a direct link between top management and the workforce.	5
			The site Lead and senior management team as an entity, because if it is not driven from the top, the initiative is dead on arrival	5
			yes in the sense that top management has outlined a strategy to improve the organization through LSS	5
		2	We have a global director that expects returns from CI, to this effect every level of management has its role to play. As part of senior management, we all make efforts to align with our structure in order to expect results	5
			Here, the top managements drive is for LSS is led by our global director, and then when have our enforcer the CI director. All other management staff basically work with the laid out structure.	5
			Our success emanates from the drive of our global director. We basically have to do what the boss wants. In order words he has driven lss by example.	3
		3	We have examined the need to provide a clear direction for our LSS programme. A structure is being worked on	2
			Top management indicated an interest in LSS and made it its cardinal agenda, but a clear structure hasn't been laid out. To this effect we brought in the Lean manager to give us a clear direction	4
		4	Every managerial level is very important in the implementation journey, so it's important all levels of managers are aligned towards the same goal. Top management led the drive here which even required bringing in a master black belt as managing director to set the tone for implementation. Middle management here are tagged as enforcers to our CI initiative.	5
			In reality every stakeholder is important, no one is more important than the other, but you must have a full buy-in from senior management before LSS can even be successfully adopted, and I think that is where we got it right.	5

				3
		5	You going to have the doers, who are hands on with everyone, you going to have the middle managers people who are driving you also going to have the senior management that are developing strategies and its aligning their strategies to the middle managers that eases implementation and it comes to a point where you having to guide the people on the direction to take on the journey.	3
				3
	NIGERIA	6	It is within our senses to continuously look for ways to grow. For us in top management positions, we analyse on our needs and provide the right strategies to be executed. One of which is our choice for lean sigma	5
			Each level has its role to play, for our top management, they provide approval for such initiatives. Middle level management for which we have our CI manager helps to drive the initiative and mentor our shop floor employees	5
			I think the roles are adequately represented, our CI manager performs a good job in championing the initiative, but a boost from top management will make our work easier	4
		7	The way LSS is structured at ***, the main driver is our global management in the UK but every management at each site is responsible for driving it at their site with support from our **** team.	3
			Every level has an important role that cannot be over emphasised. In ***, our CI program is been implemented worldwide so it's driven from the top and you can see that top management plays an important role. At the middle management level we are tasked with ensuring that the management vision is implemented and building a system that can sustain the program	5
			Our *** programme is part of our global initiative. Top management is mandated to provide the necessary tools for lean six sigma to work for us. Our CI enforcers lead by example, translating it to lower employees	5
		8	Our initial plan was to have top managements role in terms of allocating resources and provide backing, while we develop our people in-house to enforce it throughout the plant.	2
			There was no defined role as far as LSS is concerned because even the top management that brought the idea never really was there to see it grow	2
			There was a mix match between the roles of management. A clear enforcement strategy wasn't put in place	2

1 Qualitative rating scale indicating level of influence per initial code namely; 1 – not at all influential, 2 – slightly influential, 3 – somewhat influential, 4 – very influential, 5 – extremely influential

Qualitative rating of codes per company

	LSS IN PRACTICE		COMPANIES																																	
			1					2				3			4				5			6				7				8			
Themes	subthemes	Codes	\multicolumn{5}{UNITED KINGDOM}																\multicolumn{NIGERIA}										
organizational readiness	strategic decisions & effects	hiring conditions	5	5	3	3	4	5	5	3	4.3333	3	3	3	5	3	5	4.333	5	3	4	3	3	2	2.667	3	3	5	3.667	2	2	1	1.6667
		CI investments	5	5	5	4	4.75	5	5	5	5	3	3	3	5	5	3	4.333	3	5	4	4	5	4	4.333	5	4	5	4.667	5	5	3	4.3333
		better working environment	5	5	5	5	5	3	5	5	4.3333	2	3	2.5	3	5	5	4.333	4	4	4	3	3	3	3	5	3	5	4.333	1	1	2	1.3333
	role of top management	leadership by example	5	3	5	5	4.5	5	3	5	4.3333	3	3	3	5	3	5	4.333	3	5	4	3	4	3	3.333	3	5	3	3.667	1	1	3	1.6667
		positive role of management 1	5	3	5	5	4.5	5	5	3	4.3333	4	4	4	5	5	3	4.333	5	3	4	3	3	5	3.667	5	3	5	4.333	2	1	2	1.6667
		positive role of management 2	5	5	5	5	5	5	5	3	4.3333	2	4	3	5	5	3	4.333	3	3	3	5	5	4	4.667	3	5	5	4.333	2	2	2	2
	organizational culture	change in organizational culture 1	4	4	5	4	4.25	3	5	5	4.3333	2	3	2.5	5	3	4	4	5	5	5	4	3	4	3.667	5	3	5	4.333	2	2	2	2
		change in organizational culture 2	4	5	5	3	4.25	5	3	5	4.3333	3	3	3	5	4	5	4.667	5	4	4.5	3	3	4	3.333	5	5	3	4.333	2	1	2	1.6667
		employee attitude/reception	4	4	4	5	4.25	4	3	4	3.6667	4	3	3.5	4	4	4	4	4	3	3.5	3	2	3	2.667	4	3	4	3.667	3	2	3	2.6667
		change in structure	5	5	3	5	4.5	5	5	5	5	1	2	1.5	5	5	5	5	4	4	4	5	3	5	4.333	3	5	5	4.333	2	3	2	2.3333
		positive view/assuptions on LSS	5	5	5	3	4.5	3	5	5	4.3333	3	1	2	4	3	5	4	3	5	4	3	3	3	3	3	4	5	4	3	3	3	3
	employee relationship	employee relationship	4	5	5	4	4.5	5	5	5	5	3	3	3	5	5	5	5	4	5	4.5	3	5	4	4	5	4	4	4.333	4	3	3	3.3333
		effective communication methods	5	5	5	5	5	5	5	5	5	4	5	4.5	5	4	5	4.667	5	5	5	4	3	4	3.667	4	5	4	4.333	4	4	4	4
organizational roll-out plan	motivation for implementation	reliance on quality initiatives	5	5	3	4	4.25	5	5	5	5	4	4	4	5	3	5	4.333	5	5	5	3	4	3	3.333	5	3	5	4.333	5	3	4	4
	LSS deployment	use of external consultants	5	5	5	3	4.5	5	5	5	5	5	5	5	4	5	5	4.667	3	5	4	5	4	5	4.667	5	3	5	4.333	5	5	3	4.3333
		importance of external consultants	4	4	4	4	4	3	5	3	3.6667	5	3	4	4	4	4	4	3	3	3	2	3	3	2.667	4	4	5	4.333	5	5	5	5
		well-structured training plan	5	5	5	3	4.5	5	5	5	5	3	4	3.5	5	3	5	4.333	5	5	5	5	4	5	4.667	5	5	3	4.333	1	2	1	1.3333
		work-force engagement	4	4	3	3	3.5	5	5	3	4.3333	3	3	3	3	5	5	4.333	3	5	4	4	3	3	3.333	4	5	4	4.333	2	3	2	2.3333
	LSS Implementation plan	training and use of CI teams	5	5	5	5	5	5	3	5	4.3333	3	4	3.5	3	5	5	4.333	5	5	5	4	5	3	4	5	5	5	5	3	5	5	4.3333
		clear direction for LSS implementation	5	5	5	3	4.5	4	4	3	3.6667	4	4	4	5	4	3	4	3	3	3	3	4	4	3.667	5	5	5	5	2	2	2	2
		organization-wide roll out choice	5	5	5	5	5	5	5	5	5	2	3	2.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	2	2	2
sustainability	role of stakeholders	top managements participation	5	5	5	5	5	5	5	3	4.3333	2	2	2	4	5	4	4.333	5	5	5	3	4	4	3.667	4	3	4	3.667	1	1	1	1
		continuous training/senitization	5	5	5	5	5	5	5	5	5	2	3	2.5	5	5	4	4.667	4	5	4.5	4	4	3	3.667	4	5	4	4.333	1	1	1	1
		rewards schemes	5	5	5	3	4.5	3	3	3	3	3	3	3	4	5	4	4.333	3	3	3	3	3	3	3	3	3	5	3.667	1	2	1	1.3333
		usability of facilitators (LSS belt scheme)	5	5	5	3	4.5	5	5	5	5	4	3	3.5	5	5	5	5	4	3	3.5	4	3	3	3.333	5	5	5	5	2	1	1	1.3333
	LSS performance monitoring	positive change to LSS performance	4	5	5	5	4.75	5	5	5	5	3	3	3	5	5	5	5	4	4	4	4	4	5	4.333	5	5	4	4.667	1	1	1	1
		clear performance metrics	5	5	4	5	4.75	5	5	4	4.6667	3	4	3.5	5	5	5	5	4	5	4.5	4	4	4	4	5	4	4	4.333	2	2	1	1.6667

APPENDIX D

DELPHI ROUND ONE

Introduction: A Delphi survey for the validation of a proposed Lean Six Sigma (LSS) implementation framework.

The purpose of this investigation is to assess the interaction of critical success factors and determinants for the implementation of Lean Six Sigma within manufacturing environments. As the figure below details, this framework was created from a detailed analysis of cases borne from both developing and developed countries. (Manufacturing implementation cases from Nigeria, United Kingdom, USA, Malaysia, and India. Collected through both Primary and Secondary data collection methods.). The result of this comprehensive study highlighted the elements found in the framework.

Please feel free to provide brief answers as they relate to the subject matter. This survey can be completed as your schedule permits.

Problem Statement

Research conducted over the years have exposed issues with the implementation of different continuous improvement methodologies. As in the case of Lean Six Sigma, further studies highlights discrepancies in matters relating to understanding, application as well as the sustainability of the initiative. This poses a threat to organizations that are willing to embark on their unique continuous improvement journey. The cost and time implications of a failed improvement journey cannot be overemphasized.

The key to a successful implementation of Lean Six Sigma lies in creating awareness and a sense of direction for organizations to follow. The purpose of this validation procedure is to identify whether the essential factors needed in engaging the Lean Six Sigma initiative are being applied and communicated appropriately.

Delphi Study Approach

Researchers characterize Delphi as a technique for structuring a group communication development to allow a group of participants to tackle difficult problems through a disciplined

communication approach that provides participants with individual feedback on group judgements.

This study focuses on experts under the Lean and Six Sigma subject domain within distinctive geographical settings, representing both developing and developed economies. Practising Lean Six Sigma Master Black Belts, Black Belts, Academics in the area of Lean and Six Sigma are included in this study.

The goal of this method is to reach a consensus among members of these groups by the end of a multiple-round questionnaire process. The uniqueness of Delphi lies in its reliability, given the variableness of human opinion, and in its ability to be administered remotely and without direct participant interaction.

The Delphi technique allows a disciplined communication approach that provides participants with individual feedback on group judgements. This provision allows participants the opportunity to revise their personal position and affords them anonymity throughout the process.

Responses from this first survey will be collated and will form the basis for subsequent phases until a consensus is reached among participants.

Thank you for your willingness to participate in this Delphi study.

Yours Sincerely,

Oviri Umude-Igbru

Ph.D. Candidate, Aston University.

umudeioc@aston.ac.uk

LEGEND

Code	Derivatives
	Indicators
	Key Implementation Drivers
	Implementation processes
→	Feedback Loop
----►	Communication Loop

DERIVATIVES	ELEMENTS	INTERACTIONS
Indicators	Organizational Readiness	This phase entails an organization's preparation for initiation; it enables an organization fully to understand the importance of LSS within its system, and highlight areas for radical improvements.
	Roll-out plan	This phase exposes the prerequisites for deployment. Highlights areas for incremental growth and stakeholders required for successful launch.
	LSS Sustainability	This phase highlights factors needed to achieve continuous growth within the LSS implementation cycle.
Key performance drivers	Top management commitment	As a prerequisite for successful execution, this element provides an assessment of top management in relation to the organization's journey. Uniformity within top management is critical and required at the preparatory stage.
	Role of External Consultants	Providing a support role, this element is required where in-house expertise is found lacking. It highlights the need for the creation of a deployment path.
	Employee relationship	Organization communication balance is monitored with this element. This phase assesses the impact of employee and management rapport on organization journey.
	Usability of LSS tools and techniques	A review of appropriate and needed tools and techniques for LSS is assessed here. The usability by employees is taken into account, with necessary steps for action in place to ensure its role is not surpassed.
	Role of LSS stakeholders (Belt Scheme)	The Lean Six Sigma infrastructure is monitored with this element. It assesses the required number of professionals (MBB, BB, GB, YB) needed during the implementation journey.

	Reward schemes	Especially within a developing economy context, rewards, and motivation schemes have proven to aid implementation. This element assesses it role in ensuring the sustainability of the LSS initiative.
Implementation processes	People management	
	Continuous improvement initiatives	Linked under the readiness phase, this process encompasses an assessment of an appropriate continuous improvement methodology, taking into cognisance the knowledge gap in the current workforce.
	Continuous improvement investments	This process assesses organizational needs on the implementation of LSS. CI investments in this contexts represent Cost and value relationship for the implementing organization.
	Hire consultants	
	Strategic Decisions	This process aims to link the organizations strategic objectives with LSS application taking into cognisance the impact of strategic decision on LSS.
	Organizational culture	This process provides a link with the overall structure of the organization, as an assessment would expose the need to adopt a culture that allows for flexibility, employee integration, and an improvement mind-set.
	Organizational structure	This process aims to assess the effectiveness of structure of the organization, about the involvement of employees, ownership of implementation programmes and an efficient reporting structure.
	Hiring conditions	It establishes the need to employ the right minds for driving and implementing the initiative. The assessment of this process is required where the presence of continuous improvement professionals lack within the organization.

	Employee engagement	This process highlights the need for an active employee relationship. This phase exposes the direct impact of employee strengths for the common goal. (Examples are assessed and achievable through KAIZENs).
	Structured training plans	This process assesses the training needs of an organization. Whether provided by in-house or external expertise, this process bridges the knowledge gap required all-around the implementation journey.
	Project prioritization and selection	This process establishes the need for a clear direction for implementation, prioritizing projects as it is beneficial to the organization. This process ensures the sustainability of the initiative as it gives management an avenue to monitor implementation performance.
Loops	Communication	The importance of this element cannot be overemphasized. It encompasses all phases of the Lean Six Sigma implementation journey. This element assesses the role of communication methods in harmonizing all organizational requirements for the implementation programme.
	Feedback	The direction of the feedback loops exposes the interaction of the elements mentioned above. The relationship between factor, and how each is needed is addressed with the feedback loops.

Survey Questions

Please provide answers below each question

Section A- Background Information

1) Name of Participant:

2) Name of Organization:

3) Current Position:

4) Work Experience (Years):

5) Experience in Lean and Six Sigma (provide specifics):

Rating Scale

1 = Strongly Disagree

2 = Disagree

3 = neither agree nor disagree

4 = Agree

5 = strongly agree

Section B- Interpretation of Terms

Validation Criteria		Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly Agree (5)	Comments
Interpretation of Terms							
B-1	The descriptions highlighted in the table above adequately describes the role of the KEY PERFORMANCE DRIVERS within the Lean Six Sigma implementation context						
B-2	The interpretations of the INDICATORS highlighted						

	in the table above adequately describes the direction for Lean Six Sigma to succeed						
B-3	The descriptions of the IMPLEMENTATION PROCESSES highlighted in the table above adequately describes actions needed for Lean Six Sigma to operate						
B-4	**Suggestions for improvement:**						

Section C- Components of framework

This section aims to describe phases and processes constituting the Lean Six Sigma framework illustrated in the figure above. Please familiarize yourself with the components and rate its relevance to the framework.

As illustrated in the figure above, the proposed Lean Six Sigma framework is composed of three main indicators; *Organizational readiness* to LSS, LSS *Roll-Out* Phase and the *Sustainability* of LSS. These phases provide a chronological direction for Lean Six Sigma to operate. Activities and drivers were borne out from the Indicators above to highlight important factors required for the phases. These are tagged *Implementation Processes* and *Key Implementation Drivers* respectively.

As the name implies, the first two Indicators provides the prerequisites to launch the change initiative successfully, with the third indicator providing means to sustain efforts from the previous. The relation of these requirements is further broken down as required by implementing organizations. The interaction between these activities and drivers are duly represented by the direction of the feedback loops as highlighted in the figure above

A holistic communication approach is adopted to the framework as shown, as it is seen as a major determinant for organizations to succeed. Its link is drawn from all facets of the organization as seen in the figure above, to the actual implementation process, and assigned its enforcement role to the Lean Six Sigma stakeholders.

The table above further clarifies the interaction between the components of the framework

Validation Criteria		Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly Agree (5)	Comments
Key Implementation drivers							
C-1	Given the information provided, the ***commitment from top management*** is necessary all through the implementation journey as highlighted in the framework						
C-2	the role of experienced professionals ***(External LSS Consultants)*** acts as a driver for change as was emphasized in the implementation process						
C-3	An organization-wide understanding and ***usability of the tools and technique*** for LSS provides an overall drive for the company						
C-4	the role of experienced in-house professionals ***(stakeholders, Master black belts, black belts, etc.)*** acts as a driver for change as highlighted in the implementation process						
C-5	The use of ***reward schemes*** provides motivation to employees and enhances their drive to achieve results						
Suggestions for Improvements							

Validation Criteria		Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly Agree (5)	Comments
Implementation Processes							
C-6	Given the information provided, the management of the workforce *(People Management)* is important in creating a ready organization						
C-7	the review of appropriate *Continuous improvement initiatives* is critical in creating a ready organization						
C-8	the need to embark on Value-added *Continuous improvement investments* are critical in creating a ready organization						
C-9	the role of appropriate *Continuous Improvement Consultants/Experts* is essential in creating a ready organization						
C-10	*Strategic Decisions* are important when building an enabling environment						
C-11	the review of the *Organizational culture* is important for Lean Six Sigma to operate						
C-12	the review of the *Organizational Structure* is necessary for Lean Six Sigma to operate						
C-13	*Hiring* employees with the continuous improvement mind-set is important when employing Lean Six Sigma drivers						
C-14	the need to *engage employees* on procedures and requirements are essential in creating a ready organization						
C-15	*Structured training plans* are important when building an enabling environment for Lean Six Sigma to operate						

	Validation Criteria	Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly Agree (5)	Comments
C-16	***Project prioritization and selection*** is required for Lean Six Sigma to operate						
Suggestions for improvement							

	Validation Criteria	Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly Agree (5)	Comments
Indicators							
C-17	Given the information provided, the phase of ***Organizational Readiness*** provides an appropriate description to create an enabling environment for Lean Six Sigma, and it's also relevant to the framework						
C-18	the phase of ***Roll-Out Plan*** provides an appropriate description to create a launch point for Lean Six Sigma, and it's also essential to the framework						
C-19	the phase of ***Sustainability of LSS*** provides an appropriate description to sustain the Lean Six Sigma initiative, and it's also critical to the framework						
Suggestions for Improvements							

273

Validation Criteria		Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly Agree (5)	Comments
Loops							
C-20	As highlighted in the Framework, the interaction of all elements (Indicators, Key implementation drivers, and Implementation process) are adequately captured by the feedback loops						
C-21	The communication loop is adequately captured and establishes its presence in the implementation journey/						
Suggestions for improvement							

Section D- Overall Assessment of the framework

Criteria for framework validation will be assessed on the following:

1. **Feasibility of the framework**: Feasibility in this context refers to how the factors highlighted herein are possible to follow, judging from distinctive organizational cultures.

2. **Usability for manufacturing companies**: Usability assesses the appropriateness of the framework with manufacturing environments.
   - Clarity
   - Ease of use the process/step is easy to follow and use
   - Appropriateness – the process and technique are appropriate

3. **Utility/Sustainability of the framework**: Assesses the impact of the framework on the viability of the LSS Initiative.
   - Usefulness
   - Facilitation
   - Confidence

4. **Overall**

- Strengths of the framework

- Weaknesses

- Suggestions for improvements

Validation Criteria		Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly Agree (5)	Comments
Feasibility of the framework							
D-1	The linking and interaction between critical success factors are important for Lean Six Sigma to succeed.						
D-2	The framework provides clear steps for organizations to follow in their journey, judging from the highlighted factors						
D-3							

Validation Criteria		Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly Agree (5)	Comments
Usability for manufacturing companies							
D-4	The flow and processes highlighted in the framework are easy to use, after a detailed study by me.						
D-5	As a Lean Six Sigma professional, I feel the factors captured in the framework are appropriate						
D-6	The proposed set of interpretations above is comprehensive and meaningful to the manufacturing sector						

Validation Criteria		Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly Agree (5)	Comments
Utility/Sustainability of the framework							
D-7	The LSS implementation framework will be useful in implementing a Change environment by providing a structured approach to organizational-wide implementation						
D-8	The framework provides an avenue for the independent assessment of highlighted implementation processes.						
D-9	Elements of the framework aid the organizational-wide learning process						

Overall
D-10 Strengths of the framework
D-11 Weaknesses
D-12 Suggestions for improvement

DELPHI ROUND TWO

Engineering Systems and Management Research Group

Department of Engineering and Applied Science

Aston University

Birmingham

<u>**Delphi Study: Round 2**</u>

Dear *****,

I would like to take this opportunity to thank you for participating in the first phase of this study. Sequel to your general comments made, I have attached a revised framework.

In the same manner as the first phase, please take your time to go through the detailed explanations and fill the attached questionnaire accordingly.

Thank you in anticipation of your continued support.

Kind Regards

Umude-Igbru, Oviri Charles

PhD Researcher
Engineering Systems & Management
Aston University
Birmingham
B4 7ET

Main Building MB110
<u>Umudeioc@aston.ac.uk</u>
+44 (0) 7990079053

Questions	Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly Agree (5)	Comments
Usability of the Framework						
1	The sequence of the framework are easily trackable and provides a clear direction for the implementation of LSS						
2	The revised framework provides detailed information on the interaction of the elements as they help in the implementation of LSS						
3	The components of the framework are clearly defined and easy to adopt						
4	The roles and responsibilities for implementation are easily captured in the revised framework						
Overall Structure of the Framework						
5	The overall structure of the framework addresses implementation issues organizations may face in the implementation of LSS						
6	The revised framework provides a straightforward and simplified guide for new and learning organization with an intent to implement LSS						
7	The revised framework provides and avenue for the independent assessment of each of the stated sequence						
8	The holistic approach of the framework covers the major areas on the critical success factors that could aid learning organizations for implementation.						
Overall Comments						

APPENDIX E

RESEARCH PUBLICATIONS

Conference Papers

Umude-Igbru, O.C. and Price, B. (2015) Acceptability of Lean Six Sigma in a Developing Economy: Results from Exploratory Research in Nigerian Consulting Companies. Paper presented at IEOM 2015 (April), Dubai

Workshop/ Seminar

Seminar on "Exploring Manufacturing Effectiveness: Pre and Post Lean Six Sigma Implementation Cases" *Future Factory Series: Lean Manufacturing conference* 19th March 2015, Aston University, Birmingham.