Sustaining Lean Six Sigma Implementation in Higher Education Institutions

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Declaration of Authenticity and Author Rights

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Date: *25/02/2022…*

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Dedication

This Thesis, with great respect, is dedicated to my late Mother, Mrs Ehiwhantie EDAKI, who was the cornerstone of my aspiration and success.

Acknowledgement

I sincerely give thanks to the Almighty GOD, first and foremost, for the Grace, knowledge and strength and ability HE has given me to complete the thesis, none of which would have been possible without the Grace of GOD. The Thesis would not have been possible without other individuals' help and support. I express my deep gratitude to my first supervisor Dr Daba Chowdhury and other supervision team members for their support, encouragement, and motivation. I want to express my thanks and appreciation to the academics and administrative staff of the University of the West of Scotland and the Institute of Continuous Improvement in Public Service UK. I want to express my humble gratitude to all my family members for their years of understanding and patience, especially my wife, Mrs Augustina Edaki, and my children, Chika, Abraham, Destiny, David and Precious. Finally, my gratitude goes to my friends and relatives, who have provided emotional and moral support and encouragement. The journey would not have been possible without the support and understanding of you all, and I am highly grateful to every one of you.

Abstract

Lean Six Sigma (LSS) methodology has been implemented as a business improvement strategy across industries and service sectors. Nevertheless, organisations that have been able to sustain the gains of their continuous improvement (CI) initiatives appeared limited, with considerable variation in the level of sustainability. Also, the application of the LSS improvement strategy in HE sectors has not been widely adopted, and successful implementation and sustainability of LSS programmes in HEIs remain a challenge and lack empirical studies. Therefore, the primary purpose of this study is to explore the status of LSS implementation in Higher Education Institutions (HEIs) as Public Service organisations (PSOs) to identify the key factors that enable effective implementation and sustainability of LSS programmes in HEIs and make a recommendation.

Related literature was reviewed, focusing on the status of Lean, Six Sigma, LSS and CI applications in HEIs. The research methodology employs a qualitative data collection approach and a semi-structured telephone interview method. Interviews were conducted with heterogeneously selected 14 CI practitioners involved in implementing CI projects and programmes in HE sectors in the UK. The data collected was analysed using Template Analysis techniques. The research finding reveals the critical success factor (CSFs) and barriers to LSS project implementation, the benefits based on the LSS initiative's impact, including the adopted performance measurement systems, sustainability enabling factors (SEFs) and barriers to sustainable improvement in HEIs, through which LSS Sustainability Framework was developed. Based on the findings, the research recommends the following unique elements for sustainable improvement in HEIs: creating capacity for the CI programme; securing buy-in from management and employees; embedding CI as part of the organisational strategy; system approach to CI implementation; effective performance measurement; managing and sustaining change behaviour and attitude.

This research has contributed to knowledge in both theory and practice. Previous studies in LSS and CI are widespread in the manufacturing and service sector; however, this research has contributed to the LSS and CI Body of Knowledge in the HE and Public Service Sector. The study has also added to the limited literature on LSS and CI sustainability in the service sectors and identified a gap in the literature on LSS and CI sustainability in the HE sectors. The research further identifies novel key SEFs to develop a framework and make recommendations for sustainable CI programmes in HEIs.

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Abbreviations

BI:	Business Improvement
BIM:	Business Improvement Methodology
BoK:	Body of Knowledge
BSC:	Balanced Score Card
CAQDAS:	Computer-Assisted Qualitative Data Analysis Software
CCA	Constant comparison analysis
CI	Continuous Improvement
CIMs:	Continuous Improvement Methodologies
CQI:	Continuous Quality Improvement
CSFs:	Critical Success Factors
DFSS:	Design For Six Sigma divided
DMADV:	Define, Measure, Analyze, Design and Verify
DMAIC:	Define, Measure, Analyze, Improve, Control
DPMO:	Defects Per Million Opportunities
GEC:	General Electric Company
HE:	Higher Education
HECFE:	Higher Education Council for England
HEIs:	Higher Education Institutions
JIT:	Just-in-Time
LM:	Lean Management
LSS:	Lean Six Sigma (Integrated)
PDSA:	Plan, Do, Study, and Act
PSOs:	Public Service Organisations
QA:	Quality Assessment
QAA:	Quality Assurance Agency
QM:	Quality Management
RQ:	Research Question
SEFs:	Sustainability Enabling Factors
SS:	Six Sigma
SSM:	Soft Systems Methodology
TPS:	Toyota Production System
TQM:	Total Quality Management
VOC:	Voice of Customers

Chapter 1:

Introduction

1.0 Background of Study

The shifting dynamics of the global economy are forcing Higher Education institutions (HEIs) to re-examine the models applied in public service administration. Societies have become more knowledge-based, increasing the need to improve access to higher education. Given the uncertain economic conditions, increasingly, governments across the globe are retreating to efforts, such as budget cuts to Higher Education Institutions (HEIs). With the cost of Higher Education (HE) increasing faster than inflation, the question of value is becoming sharper among HE stakeholders (Barber et al., 2013; Kowang et al., 2022). Among the consequences of these changes is that HE is facing reductions in national and local funding, increases in labour and other costs, changes in demographics, increased global competition and a rise in student expectations (Davidson et al., 2020; Hess and Benjamin, 2015; Nadeau, 2017), demands to improve accountability (Brookes and Becket, 2007; Svensson et al., 2015), striving of institutions toward a higher standard, and demand for higher quality and productivity under the pressure of public scrutiny (Sunder and Mahalingam, 2018)

Between 2010/11 and 2020/21, in the US, HEIs tuition fees, room and board at public and private institutions rose by 18 per cent, from $21,990 - $25,910 (US-NCES, 2022), with total student debt up 53 per cent from 2013 – 2022 and now totals nearly $1.76 trillion (Hanson, 2023). Similar trends are evident in the UK and other countries. The high cost of HE pressures on public universities in England was a significant reason the British government created the new student fee regime in 2010, with a 200% increase, from £3,000 - £9,000, as introduced in 2012, which saw tuition fees rise to £9,250 per year with the inflation rate. The value of outstanding loans at the end of March 2023 reached £206 billion (Bolton, 2023).

In addition, HEIs globally are awakening to radical and transformational change, competition intensifying not just because of the competition between the institutions but also because of a range of new players in the educational sector, with technology transforming how the global economy works. Advancements in technology have significantly increased student choice and flexibility options. HEIs are increasingly competing with each other to offer students a quality education, flexible course delivery, and user-friendly online student services. Students and parents, on the other hand, are

demanding a quality educational experience, and at the same time, they insist that yearly tuition fee increases do not outpace the inflation rate (Kokkinou and Kollenburg, 2022; Sunder and Mahalingam, 2018)

These issues have placed HEIs in a precarious position where the sector should spend less for more and, at the same time, cannot cut back on the resources and quality they offer to their students. Therefore, HEIs are being challenged now more than ever to become more flexible, responsive, efficient, and focused on students' needs to better serve their students and others. They must act in the same way businesses are finding to serve their customers' needs better (Mulyana et al. 2021). However, against the background of HEIs still been run like seasonal businesses with escalating costs and low productivity. HEIs in the UK and across the globe remain under pressure to adopt Lean Six Sigma (LSS) as a continuous improvement methodology (CIMs) with a proven track record in manufacturing and other service industries to efficiently and effectively enhance their performance (Antony et al., 2017b; Sunder and Mahalingam, 2018). The key is to maintain high quality and performance improvement of the education system while reducing costs, although something often contradicts the usual logic of Educational Institutions. However, this is the route that many successful businesses have taken using business improvement methodologies to break the rigid link in people's perceptions – between cost and quality (Thomas et al., 2017; Kokkinou and Kollenburg, 2022).

1.1 Conceptual Background of LSS

Over the years, many organisations have resorted to continuous improvement (CI) methodologies, such as Lean and Six Sigma, to streamline their processes and circumvent defects caused by increased process complexity, – to achieve the triple improvement goals: Quality; Speed; and Cost (Gorge, 2003). The history of these improvement methodologies has been well documented, and the fundamentals established by the early practitioners were the building blocks for Quality Control, Toyota Production System (TPS), Total Quality Management (TQM), Lean, Six Sigma and a recent combination of Lean Six Sigma (LSS) methodologies (Gorge, 2003; Basu, 2009; Anthony et al., 2017b).

Lean Principles: Lean is a CI methodology, with its origins in the Toyota Production System and commonly used in manufacturing that seeks to improve speed by continuous elimination of non-added value activities from a process in order to improve its efficiency through the application of the five basic principles and tools (Womack and Jones, 2004).

Six Sigma Methodology: Six Sigma (SS) is a methodology that uses statistical tools to focus on reducing defects and variation and increasing the performance and reliability of business-process to meet customer satisfaction. SS involves the use of structured methodology DMAIC (Define, Measure, Analyse, Improve, and Control) for existing process and DFSS (Design for Six Sigma) approach for a new process (Pande et al., 2000; Stamatis, 2004; Gontijo et al., 2015). ***Lean Six Sigma (LSS):*** Lean Six Sigma methodologies have recently been integrated to maximax the strengths of both methodologies to overcome the respective weaknesses of the standalone methodology. LSS theoretical framework is a combination of the Lean principles and tools and SS statistical tools within a structured DMAIC approach (George, 2003; Anthony et al., 2017b; Thomas, 2017) for effective implementation and sustainability of CI gains.

LSS and CI Sustainability: Different definitions of CI sustainability/sustainable CI have been provided by various practitioners based on their views, with some using different phrases – holding on to the gains of improvement (Hayes, 2022); embedding new processes (Buchanan et al., 2005). CI sustainability focuses on maintaining improvements within a particular setting and translating initial gains into continuous improvement (Hayes, 2022). CI sustainability can be viewed as a new way of working where improved outcomes become the norm, thinking and attitudes are fundamentally altered, and the surrounding systems are transformed in support (NHS Modernisation Agency, 2002).

1.2 Problem Statement

Although LSS has continued to gain wider acceptance across various industries, with success stories well documented across manufacturing, healthcare, and financial sectors and retail (e.g., Antony et al., 2019; Chung, 2013; Sunder, 2014; Singh and Rathi, 2019; Sunder et al., 2020; Antony et al., 2022). However, evidence suggests that organisations struggle to successfully implement the LSS approach (Antony et al., 2019; McLean et al., 2017), and no specific industry-wide accepted approach or roadmap for LSS implementation (Salah et al., 2010; Leon, 2013; Antony et al., 2016). Research also suggests that organisations across industries and sectors that have been able to sustain the gains of their LSS and CI initiatives over an extended period are limited (Chung, 2015; Duarte, 2012; Matteo et al., 2011; Silver et al., 2016; Hayes, 2022). LSS projects have consistently failed or not achieved their desired purpose (McLean et al., 2017; Antony et al., 2019b, and sustainability of improvement gains is difficult to achieve (Antony et al., 2019b).

LSS BoK in the HE environment has yet to be thoroughly researched (Antony et al., 2017b; Sunder, 2016a; 2016b; Sunder and Antony, 2018), and the application of LSS methodology in the HEIs domain is relatively in its infancy, with a limited empirical and comprehensive study on the effective applicability of the LSS approach as a sustainable business improvement solution in HEIs (Antony et al., 2016; Sunder, 2016a; Thomas et al., 2017; Kokkinou and Kollenburg, 2022; Mulyana et al., 2021). Current academic papers around LSS in HEIs are rather conceptual viewpoints centred around understanding the basis on which LSS is to be applied, characterising the nature of the LSS journey in HEI and highlighting the typical readiness, critical success factors (CSFs), barriers to successful application in HEIs (Adeinat el at., 2022; Svensson et al., 2015; Sunder, 2016b; Kokkinou and Kollenburg, 2022; Mulyana et al., 2021; Sunder and Mahalingam, 2018).

Therefore, literature and studies on LSS in the HE domain lacked the rigour of empirical and comprehensive investigation. Research shows that part of the challenges of LSS implementation is the difficulty in measuring and quantifying the benefits and performance of CI initiatives (Kumar et al., 2010; Pacheco, 2014; Svensson et al., 2016; Shokri, 2017; Sunder et al., 2020). HEIs being a complex organisation (Svensson et al., 2016), with the intangible nature of the business process, makes measuring benefit and output vastly difficult (Antony et al., 2016; Sunder, 2016b; Thomas et al., 2017; Sunder et al., 2020). Therefore additional work is required to evidence the benefits further and return on investment that can be delivered in applying LSS in HEIs (Antony et al., 2019; Sunder et al., 2020).

Thomas et al. (2017) also revealed that the major reason why LSS has not been widely adopted in HEIs was due to the institutions failing to see the benefits and return on investment. Therefore, it can be argued at present that there is a precocity of an academic and empirical investigation on the sustainability of Lean Six Sigma as a CI initiative in HEIs (Antony et al., 2019; Kokkinou and Kollenburg, 2022; Mulyana et al., 2021; Sunder, 2016a; Thomas et al., 2017). That Highlights the need for a broader study based on a holistic approach to the application and sustainability of LSS improvement initiatives within the HE sector to create a culture of change and CI rather than borrowing and replicating tools and methods from concepts that have been developed in a different industry.

1.3 Significance of Study

The rationale for this study can be classified as multi-fold: Firstly, given the escalating costs and declining revenue streams currently facing both public and private HEIs and the public service sector in general, coupled with the growing demand for higher quality and productivity and speedy processes of service by the sector's stakeholders. As the first of its kind, this study will propose critical enabling factors and a framework for the sustainable implementation of LSS as CI methodology in the HE sector, which can also be applied in other public service organisations. Secondly, as research reveals that the LSS Body of Knowledge (BoK) has not been thoroughly researched, this study will conceptually and empirically make a new contribution as the first to identify LSS and CI sustainability enabling factors (SEFs) and develop LSS improvement Sustainability Framework in HEIs and PSOs. Thirdly, following the cultural and organisational dynamics within HEIs, this study will further provide LSS project leaders, researchers, and professionals in HEIs and public sectors with excellent resources with additional insights towards assessing the benefit and impact of the LSS programme. Finally, the study will further demonstrate the applicability and effectiveness of LSS methodology in HEIs and the public service sector structural domain.

1.4 Purpose of Study

This study aims to explore the status of LSS and CI methodologies in HEIs and identify the elements that are key enablers to sustainable implementation of LSS initiatives in HEIs as Public Service organisations (PSOs). Towards creating a framework for a broader culture of CI and change for excellent performance in the sector. In the first part of the study, the researcher’s thorough review of the existing literature explored the status of LSS and CI methodologies that have been practised in HEIs, to identify: the critical success factors (CSFs) and barriers to the successful implementation of LSS projects; the measures to quantify the benefits and performance of LSS projects; and enabling factors and barriers to the sustainability of LSS programme. Through a constructivist stance and qualitative research design, the researcher conducted a semi-structured telephone interview with CI practitioners with years of experience implementing LSS methodologies within HEIs to explore the research questions based on the research objectives.

1.5 Research Objectives

Four objectives are designed to explore the implementation and sustainability of LSS and CI in HEIs in the UK. The research objectives and questions were identified based on the review of existing literature, from which a research gap on the sustainability of LSS in HEIs and the measures to quantify the benefits and performance of CI methodologies were identified.

The research objectives are as follows:

1. To identify the CSFs and the challenging factors to LSS project implementation in HEIs
2. To examine the benefits of LSS initiatives in HEIs and how CI benefits can be best measured and quantified
3. To identify critical enabling factors and the barriers to sustainable CI initiatives in HEIs
4. To develop LSS Sustainability Framework and recommend how best to sustain the LSS programme in HEIs

1.6 Research Questions

The above research objectives were investigated to address and answer the following research questions:

RQ1: What are the CSFs to implement LSS projects in HEIs?
RQ2: What are the challenges to LSS/CI project implementation from HEIs' perspective?
RQ3: How can LSS initiatives in HEIs be best measured to quantify the benefits?
RQ4: What are the key enabling factors and barriers to LSS improvement initiatives sustainability in HEIs?

1.7 Research Scope:

The main aim of this study is to assess the enabling factors to sustain the gains of LSS and CI initiatives in HEIs. The scope of research will be centred on CI Methodology theory and its applications and sustainability within the HE environment. The research literature review will be covered in two parts, focusing on literature from HEI and related public and service sectors due to the limited studies of LSS in HEIs. The first part will be an overview of the status of the HE sector in the UK and other parts of the globe, which will include the development of CI applications in the HE environment, the early cases of quality

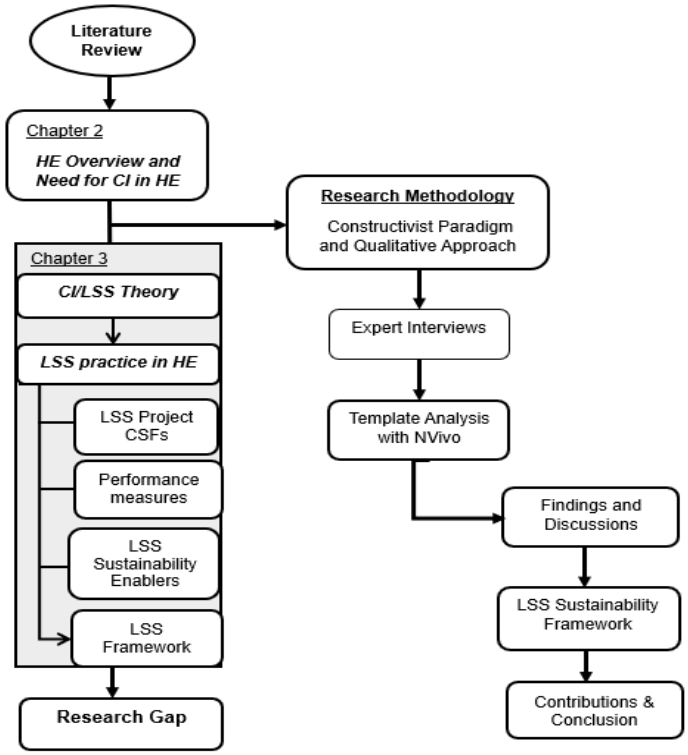
management and CI efforts in HE, and an understanding of the need for CI initiatives in the HE environment. Based on the view that stems from the global issues facing HEI in the global competitive environment and the need for HEI to adopt CI methodology and operate as other business sectors. It became necessary to understand some characteristic differences between HEIs and other industries regarding the challenges of HEIs adopting CI methodology. The Researcher, following previous studies (Sunder, 2016a; 2016b, Antony et al., 2017), considered the characteristic of HEI in terms of its uniqueness in understanding the need of customers, the definition of customers and HE products, performance measurement, process defect and the principles of academic freedom in the HE environment. Finally, the difference between quality assurance and CI in the UK HE will be reviewed in the first part of the review.

The Theory of CI Methodologies formed the basis of the second part of the review in Chapter 3, focusing on the integrated LSS framework and its applications in HEIs. The review will begin with the evolution of CI methodologies to the present Lean, Six Sigma and the integrated LSS and their applications. LSS has been regarded as a modern BIM. However, it was necessary to understand the origin of Six Sigma and Total Quality Management, their difference and how SS has emerged as the most accepted CI methodology and how TQM has been relegated to become a fad CI methodology. Lean and SS as stand-alone methodologies, their differences, the argument for the integration of LSS based on their strengths and weaknesses, the LSS application approach and framework, and their application and benefits across the service sector will be considered in the review to form the basis of LSS theoretical framework leading to the identification of the research gap. In order to focus on the research objectives and research questions, the review was narrowed down to the status of CI methodologies applications in HEIs, to identify the CSFs, the performance measurement and metrics, the CI sustainability concept and review of existing literature on CI and change sustainability in service and public sectors to identify the SEFs and understand the argument to sustain the gain of improvement initiatives in HEIs. Finally, the existing LSS application framework in the HEI literature will be reviewed, and a conceptual framework will be proposed.

1.8 Research Process

The research map in Figure 1.1 illustrates how the research process. The literature reviews were presented in Chapters 2 & 3, leading to the identification of research gaps. Constructivism paradigm assumption and qualitative approach were employed as a research methodology to design a semi-structured interview. Data collected was analysed using Template Analysis Techniques, and findings were analysed and discussed, leading to a framework's development. Finally was the presentation of the research conclusion and recommendations.

Figure 1.1 Research Process Map



Source: (The Author)

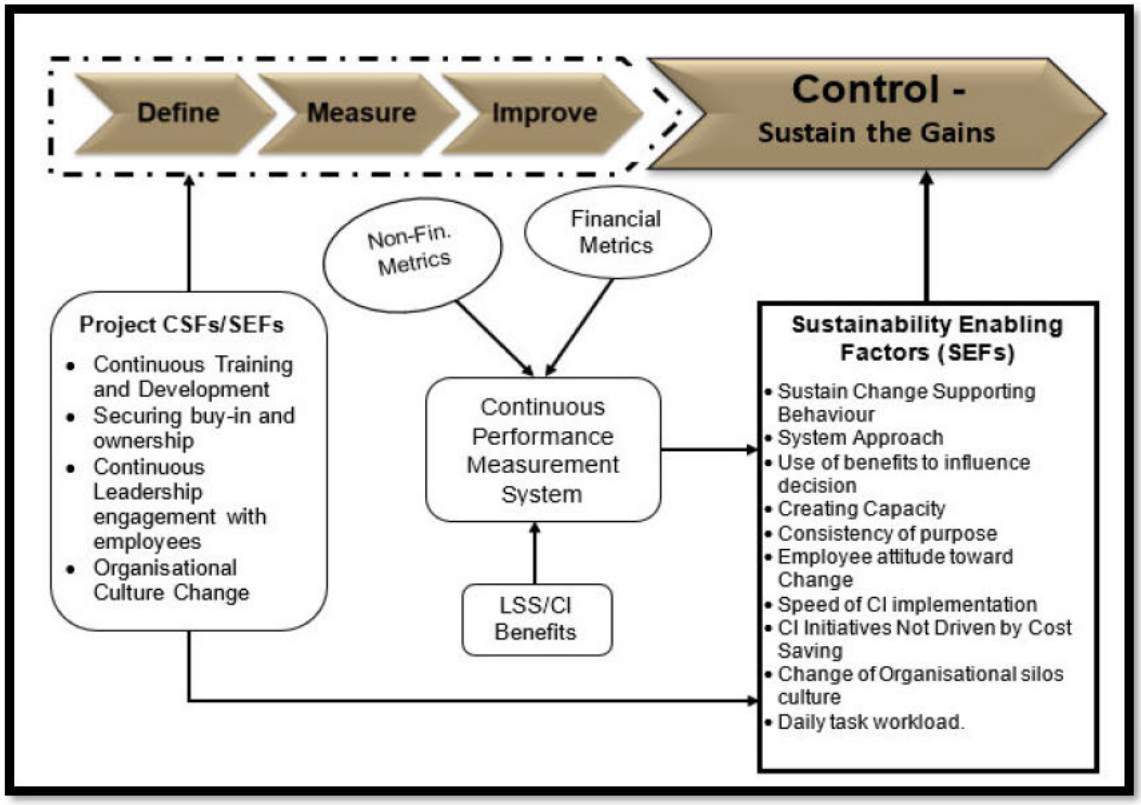
1.9 Summary of the Main Findings and Framework

From the exploratory research on the sustainability of LSS programme in HEIs through literature review and semi-structured interviews, the following findings thus emerge, leading to the development of LSS improvement sustainability framework that focuses on the Control phase of the DMAIC cycle as illustrated in Figure 1.2

- The research finding shows distinctive elements, such as – Continuous Training and Development; Securing buy-in and ownership from management and employees; Continuous Leadership engagement; and Change of organisational Culture, to be critical to LSS project's success and to sustaining the improvement gains.

- Findings also show continuous performance measurement systems – using financial and non-financial metrics to clarify the benefits of LSS improvement initiatives in HEIs during and after the improvement project completion.
- The study especially revealed the Key enabling factors illustrated in the framework (Figure 1.2) to sustain the gains of LSS and CI programmes in the broader HE environment.

Figure 1. 2: LSS and CI Sustainability Framework



Source: (The Author)

1.10 Summary of Research Contributions

Based on the research gap identified from the literature, the findings show contributions to theory and practice in the area of study in terms of adding to the existing knowledge and novelty of the research findings.

- Firstly, the researcher has employed a constructivist stance which has not been thoroughly researched in CI methodology management research, to explore participants' subjective views on their historical experience in implementing LSS as CI methodology. The Researcher has therefore demonstrated an alternative epistemological position in the field of quality and CI management.

- Secondly, research gaps indicate the limitations of empirical studies in the subject areas of the LSS and CI sustainability across sectors. No literature was found to have studied LSS and CI sustainability in the HE environment. Therefore, the study has made new theoretical contributions by identifying novel LSS improvement sustainability enabling factors in the HE environment and developing an LSS improvement Sustainability Framework focusing on the Control phase of the LSS-DMAIC theoretical framework.
- Thirdly, following the limited empirical studies on the CSFs and the challenging factors of LSS project implementation in HEIs, the researcher has made a further and new contribution in identifying the CSFs and the challenging factors for effective implementation of LSS projects with new emerging themes.
- Finally, the studies have contributed to the practice of LSS and CI to the wider HEIs, as it provides CI practitioners and HEIs the resources and additional insight through the framework into embedding the culture of sustainable improvement and change in the broader HEIs context.

1.7 Structure of the Thesis

This Thesis consists of 7 chapters as follows:

Chapter One, which is usually the introduction of studies, focuses on the background of the studies, the brief concept of Lean, Six Sigma, LSS methodology and the fundamental definitions of the CI sustainability concept. Other sections in the introduction are the problem statement and the study's rationale, the significance of the study, the purpose of the study, the research objectives, research questions, the scope of the study, the research process summary, the summary of the research findings and the contributions.

Chapter 2 includes a literature review of HE Sectors and the antecedent of CI in HE. The chapter begins with an overview of the higher education sector, the development of CI in HE sectors and the need for CI HEIs. The characteristics of HEIs were reviewed and compared with industry organisations, followed by the comparison of quality assessment and CI methodology in HEIs.

Chapter 3 is the literature review of CI Theory, where CI methodologies concept and their applications in HEIs were explored. First was the evolution of CI methodologies leading to the integration of LSS. A case for an integrated LSS approach was also reviewed, including

the benefits of LSS application across the service sector, including LSS application theories and limitations. Further is CI methodologies application – TQM, Lean, Six Sigma and LSS in HEIs. Followed by the CSFs and challenges of LSS project implementation, the impact of LSS and the performance measurement system. More also was the LSS and CI sustainability concept, the SEFs and Barriers, and a summary of the SEFs. Finally, is a review of the existing LSS implementation frameworks, their limitations, and the research gap. Finally, is a diagrammatic conceptual framework based on the literature review's findings.

Chapter 4 – the research methodology chapter, is designed to clarify the research philosophy and strategies appropriate to this research and the discussion and rationale for the choice of constructivist philosophy, qualitative approach, semi-structured interviews data collection methods and the data analysis techniques adopted in the study. The chapters also included a discussion on trustworthiness and authenticity as criteria adopted to evaluate the quality of the research, including the ethical consideration adopted by the researcher.

Chapter 5. This chapter begins with the analysis of the interview participants' characteristics and further presents the key findings of the semi-structured interview questions based on the interview protocol. The interview analysis was categorised into main themes and subthemes using template analysis techniques. Detailed thematic analysis of selected themes were presented.

Chapter 6 discusses the key findings based on the research questions. The discussion highlighted the CSFs and challenges to LSS and CI project implementation, performance measurement and quantification of LSS performance and benefits, the determination of the LSS programme sustainability enabler and barriers and the LSS improvement framework.

Chapter 7 finally presents the conclusion and the recommendation of the research. The chapter presents the research process, the research summaries of key findings, the research recommendation for best practice, the area of further research, and the research limitations.

Chapter 2:

Overview of the Higher Education Sector

2.0 Introduction

This chapter is the first part of the literature review, which presents an overview of the Higher Education (HE) sector and the antecedent of CI application in education institutions, the background of HEIs in the UK and the development of CI initiatives in HEIs and the need for the application of CI methodology in HEIs in the UK was also explored. The characteristics of the HE sector was also presented based on its uniqueness and compared with other industry and sector. The difference between quality assurance (QA) and CI in the HEI environment was clarified.

2.1 Higher Education Institution – An Overview

Education institutions have been a part of our society since pre-historic days. However, formal education took shape in the middle-aged (500 AD – 1600 AD), with the Roman Catholic Church acting as the centre of education and literacy before spreading to various cultures around the world and has continually evolved into different higher institutions of learning from generations (Reddy, 2013). As the church encouraged these old inward-looking institutions to become more outward-looking and more 'modern' in their approaches, new institutions, called universities, were born (Anthony and Antony, 2022). Wiseman and Wolhuter (2013) argued that the global revolution of Higher Education (HE) had been advanced by the rise and the legitimisation of the knowledge economy, where the national competition in a globalised world underscores the centrality of HE projects in national and international affairs. The Truman Commission report advanced the early expansion of HE in the USA upon establishing the community college system in the 1950s (Bloom et al., 2007). The commission report underscores that the purpose of HE was to promote equal opportunities and enables individual citizens to understand their responsibility as members of a free society (Bloom et al., 2007).

Thus, the great economist (Adam Smith) in the inquiry into the cause of The Wealth of a Nation, viewed the benefits of education as a public good that could drive societal progress – through the development of human capital, where the public may enjoy those benefits as a by-product from the individuals (Bloom et al., 2007; Soares, 2007). Similarly, the public good of HE is linked to promoting social justice through increasing social mobility and

exposure to human values (Williams, 2014). Bebedelis (2008. p. 5), analysing the teaching of Aristotle and Sai Baba, stated that “education is a process of eliciting and rearing the human values latent in every individual”. That underpins the additional responsibility for HEIs to prepare students from a broader perspective and make them readily acceptable for the good of society (Sunder, 2016b). HEIs, therefore, have a higher responsibility to prepare students for lifelong journeys and not merely for income (Sai-Baba and Nilayam, 2008). Thus, the purpose of HE goes beyond the private and public good; instead, it is a means to self-actualise through human values.

HE is defined in this study as education beyond the secondary level, with courses usually studied at universities and certain further education institutions, including vocational studies and career institutions that award academic degrees or professional qualifications (Callender et al., 2012). HE industry combines a dominant public sector of state universities – known as Higher Education Institutions (HEIs). Today the Higher Education industry has evolved with the flourishing of world-class universities and colleges (public and private) and hundreds of other educational institutions, many of which are competitively oriented (Sunder, 2016b; Sunder and Antony, 2020). The HE system has been characterised by researchers as a complex and diverse unique system and culture, compared to manufacturing and other services sectors (Dew and Nearing, 2004; Svensson et al., 2015; Sunder, 2016b; Sunder and Antony, 2020).

There are about 163 universities in the UK that provide higher education qualifications. HE is a major UK service sector and export earner, attracting about £41.9 billion of export earnings, contributing £95 billion to the England economy, and generating significant 815,000 jobs and employment opportunities in England (University UK, 2023). Evidence suggests that a considerable variation exists among HE systems worldwide. These differences include the types and nature of the public and private HEIs and the ranking, relative weight, and reputation in the overall HE system (Sunder, 2016b; Sunder and Antony, 2020). In a modern and developed country like the UK, HEIs are part of the public sector, except for a few privately owned ones. Higher Education (HE) has been used exclusively to distinguish programmes that are mostly in theory and open to those with post-secondary education, awarding level or sets of levels from diploma or first degree to doctorates.

2.2 Development of HE Continuous Improvement

HEIs are well acquainted with continuous quality and process improvement methodologies. Improvement initiatives in HEIs have grown from a unique combination of circumstances from the late 1980s and early 1990s (Baldwin, 2002). There are many enthusiastic early examples of different Institutions that utilised CQI initiatives in the USA (Baldwin, 2002; Dew and Nearing, 2004; Waterbury, 2008) following the creation of the Malcolm Baldrige National Quality Award (MBNQA) in the late 1980s in the USA to give recognition to institutions that exhibit high standards and quality. Including the growing interest of community colleges and private and public universities experimenting with continuous quality improvement (CQI) principles and designing quality initiatives for various reasons to improve all levels of education (Dew and Nearing, 2004; Waterbury, 2008).

For example, Fox Valley Technical College (FVTC), a further education college in the US, was one of the early leaders in CQI, utilising TQM tools for planning new academic programmes. As a result, FVTC became more efficient in various areas (Narasimhan, 1997; Dew and Nearing, 2004). Stamford University in Alabama began its student-first Quality quest and applied CI methodology to its academic and administrative activities. It was the first to produce a broad account of CI initiatives for campus (Lozier and Teeter, 1996; Dew and Nearing, 2004). Another excellent example of early application of the HEI CI/TQM initiative was Oregon State University (OSU), where OSU created a model that identifies critical processes and analysis to improve academic and administrative challenges, such as frustrated students, faculty and staff, and dwindling finical resource (Dew and Nearing, 2004, Waterbury, 2008).

In the UK HEIs, although early CQI effort was relatively slow, with early case studies examples represented by few universities, such as South Bank University (Geddes, 1993), Aston University (Clayton, 1993), Wolverhampton University (Doherty, 1993), and East London University (Ahmed, 2008). For example, Aston University implemented a TQM system to facilitate changes in integrating the Staff Development Unit (SDU) within the University's Human Resources function and to enhance support services for overseas students (Clayton, 1993). East London University applied Quality Improvement in Learning and Teaching as part of the university strategy for quality improvement and dissemination of good practice after being criticized by the UK Quality Assurance Agency (QAA) for neglecting staff development and training (Ahmed, 2008). However, UK institutions have benefited from a CQI initiatives process similar to their counterparts in the US in the form

of improved student performance, better services, reduced costs and student satisfaction (Kanji and Tambi, 1999; Geddes, 1993).

HEIs are diverse in their selection and adoption of CI methodologies. To date, studies have identified various CI methodologies that HEIs have adopted in HEIs, such as Total Quality Management (TQM), Lean Management, Six Sigma, integrated Lean Six Sigma, Kaizen event, Benchmarking, Plan-Do-Study-Act (Deming wheel), and Balanced Scorecard (Thalner, 2005; Taylor, 2009; Jordan, and Carruth 2012; Francis, 2014; Emiliani, 2015; Antony et al., 2017, 2019; Cudney and Furterer, 2020; Mulyana et al., 2021; Kollenburg, 2022). Also identified are quality and standard assurance frameworks explicitly created for quality assessment in higher education institutions to ensure the quality of academic programs (Quality Assurance Agency, 2022). For example, the Baldrige Quality Award Criteria in the US (Thalner, 2005); EFQM (European Foundation for Quality Management) excellence model (Arjomandi et al., 2009), CDIO (Conceiving-Designing-Implementation-Operating) – a framework design specifically for engineering education mostly adopted in Sweden and UK (Shokraiefard, 2011), and QA framework (Quality Assurance) commonly adopted in the UK and International HEIs in other countries that have gained UK QAA accreditation (Ahmed, 2008).

2.3 Need for Continuous Improvement in HEIs

HEIs are regarded as complex systems – thus composed of subsystems that allow a change in one part of the system to impact other parts of the system (Dew and Nearing, 2004; Taylor, 2004; Svensson et al., 2015; Anthony and Antony, 2022). In the early argument for CI in HEIs, Dew and Nearing (2004) described HEIs as an open and closed system – as information is allowed to enter and leave the institution. CI Body of Knowledge thus promotes an open system and the study of the co-varying process to optimise the system's performance as a whole. Hence, the need to introduce CI into HEIs settings as diagnostic concept and tools that will help subsystems improve the performance and overall health of the education institutions (Dew and Nearing, 2004).

HEIs adopt CIMs for various reasons, as the challenges between institutions vary. Barber et al. (2013), analysing the global challenges of Higher Education, argued that the forces of technology and globalisation are transforming the HE sector like every other sector, with competitive intensity emerging and the concept of the traditional university under pressure because of a range of new players - open online courses (Barber et al., 2013). The authors further argued that, as the cost of HE increased faster than inflation, the questions of value

became sharper. Therefore, academic leaders need to have a keen eye toward creating value for their students as the question of breaking the link between cost and quality becomes more apparent.

In addition to the significant challenge of the HEIs competitive environment, Adcroft et al. (2010. p. 580) argued that HE "is different to many other areas in the public sector because it offers the prospect of real competition and that competition is likely to deliver significant changes in how" institutions "are organised, managed and regulated". Therefore, offering a real challenge to all HE sector leaders to become more efficient and effective (Adcroft et al., 2010; Universities UK, 2011). Blazer (2011), outlining the challenges of HEIs, pointed out that in HEIs, processes are failing to meet the needs of those they serve as it perceived to be extremely slow, with delays in responding to complaints, poor documentation, and often viewed as a process characterised with non-value-added activities.

The U.S. Secretary of Education, A. Duncan, in 2012 at the Time Summit, opined that HE is at a crossroads and identified key challenges facing the education system as the high price of tuition, low completion rates, and little accountability on improving attainment and achievement (Duncan, 2012). Duncan (2012) expressed a huge US government funding of more than $150 billion yearly to HEIs and students through grants, loans, and direct school support. The author emphasised that the US government is shifting toward performance-based funding, and as such HE system must get dramatically better and drive transformational change to scale and deliver a world-class system of education (Duncan, 2012).

More also, in the UK (Universities UK, 2011) University UK Efficiency and Modernisation Task Group report emphasised that effectiveness, efficiency and value for money have become central concerns for the higher education sector due to decisions made by the current Government in England to effect a radical change, with the reduction in public funding for teaching. The report highlighted the pressure for HEIs to proactively manage costs and demonstrate value for money and further suggested that HEIs should view efficiency management as part of the strategic organisational objectives to enhance the effectiveness of the institution to ensure continued delivery of high-quality teaching and research, with more focus on identifying those areas where sector-wide approaches to improvement might be necessary (Universities UK, 2011). From the above analysis, it can be revealed that the characterisation of the HE organisations as a complex system and the enumeration of HEIs' key challenges supported early and recent reports on the need for CI and quality improvement initiatives in HEIs. An earlier report on the reasons for the

adoption of the CQI approach in HEIs suggested a series of complaints from various sectors of the economy, including business, industry and the government, over the decline in the quality of graduates (Kanji and Tambi, 1999), pressure for public concern for accountability and responsibility of HEIs (Kanji and Tambi, 1999; Albert, 2002). Some institutions reported that their deep and genuine concern for their students led to quality improvement strategies (Chambliss, 2003). Downey (2000) suggested that increased costs and a rise in competition are leading reasons institutions seek out quality improvement initiatives.

Anthony and Antony (2022) recently argued that several structural changes in society, such as globalisation, the information age and the rise of the knowledge-based economy, significantly transform how we acquire, disseminate and transform knowledge. The structural changes have become more closely linked to a country's economic competitiveness. HEIs are being forced to change their paradigm regarding their role in society and the value they bring (Anthony and Antony, 2022) and be more focused on overcoming unprecedented financial pressures and high demand for efficient and effective process and systems performance improvement (Svensson et al., 2015; Kanakana et al., 2015; Antony and Cudney, 2016; Antony et al., 2018; Cudney and Furterer, 2020; Mulyana et al., 2021; Anthony and Antony, 2022). However, the reasons indicated for the adoption of quality improvement or CI methodology in HEIs, remain similar in the UK and across the globe, given the pressure on HEIs to conduct their activities in a more business-like-fashion and the call for efficient and effective performance improvement and quality excellence in HEIs remained on the increase.

2.4 Higher Education Characteristics in Comparison with Industry

There are notable differences between HEIs, manufacturing industries and other transactional sectors (Anthony and Antony, 2022). HEI is a complex system with unique characteristics compared to other organisations. At the same time must adopt the CI methodology that other organisations have widely applied to succeed in the increasingly competitive environment (Svensson et al., 2015; Sunder, 2016b; Thomas et al., 2018; Sunder and Antony, 2020; Cudney and Furterer, 2020; Anthony and Antony, 2022). From the perspective competitive environment, however, some elements are reported to be challenging to HE in deploying CI methodology when compared to the sector, factors such as the difficulties in understanding customers' needs, the definition of customers and HE

products, performance measurement, process defects and the principles of academic freedom in the HE environment (Sunder, 2016a; 2016b, Antony et al., 2017).

2.4.1 The Difficulty of Understanding Customers Needs

Defining and understanding customers' needs and the target audience in the transactional and manufacturing sector is a straightforward journey. Anthony and Antony (2022) and Sunder (2016a), in their comparison of HEI and other organisations, argued that understanding customer need in the same way is challenging in HEI. Developing a customer focus driven strategy to meet and exceed customer satisfaction in the HE organisation is complex, contrary to the CI methodology's primary purpose. The increased competition in HEIs (Sunder, 2016a), and the growing need and difficulties for HEIs to incorporate greater market strategy into their strategic planning process (Mizikaci, 2003; Bayraktar et al., 2008; Koris et al., 2015), further make this task more challenging. Therefore, it cannot be suitable to view HEIs as the same as other transactional and manufacturing industries (Anthony and Antony, 2022; Sunder, 2016a).

2.4.2 Definition of Customers

Studies viewed HEIs customers as the students and their parents, the government that, in most cases, pays the bills, and employers of labour (Koris et al., 2015; Guilbault, 2016). At the same time, Cao and Li (2014) viewed the entire society as HEIs' customers. However, no research-based concrete definition for HEIs customers is available in the literature, though many authors have expressed different opinions. This poses a challenge for HEIs to define and identify the needs and expectations of different customers groups (Sunder, 2016a; Sunder and Antony, 2020

2.4.3 Defining Products

Inspecting tangible finished products in the manufacturing industry is customary, although the product is intangible in all service industries. However, in HEIs, students are sometimes viewed as a product in the process, and customers for campus facilities and course material and graduates as a completed product (Brewer et al., 2002). The finished product of the HEIs is defined as an educated student or a student's knowledge level (Sunder, 2016; Sunder and Antony, 2020). However, Venkatraman et al. (2007) argued that students are non-standard human beings with a range of experiences, emotions and

characteristics, and treating them as products misses the complexities of the learning process as a unique learner.

2.4.4 Measurement System

Performance measurement system in education institutions similar to service organisation is vastly different from the manufacturing industry because of the intangible nature of the educational process (Does et al., 2002). Performance indicators are more numerous and complex in HE and challenging to assess (Roffe, 1998). As Cao and Li (2014) argued, education product outcomes are often lifelong but may not be as tangible or measurable. Therefore, Sahney et al. (2003) suggest that the education sector as a service industry needs to adopt a similar method to other sectors in measuring the performance and quality of their services and the satisfaction of their customers. However, an effective improvement measurement system for HEIs is lacking (Bayraktar et al., 2008; Hilton and Sohal, 2012; Holmes et al., 2015; Antony et al., 2017; Davidson et al., 2020).

2.4.5 Defect Detection

The tangible product of the manufacturing process is what customers consume immediately or later when needed. The product's characteristics could be well-felt by the customer when the product is being used (Sunder, 2016). But this is not so easy in the case of services (George, 2003) and also within the higher education sector (Sunder, 2016a). Six Sigma quality level is said to have 3.4 defects per million opportunities (DPMO), which helps to determine what defect means from the customer perspective (George, 2003). Although the Sigma level for HEIs is estimated to be 3.0 DPMO (Kanakana et al., 2015), what constitutes a defect from a customer perspective and how to detect it in the education sector is still an indefinable area (Sunder, 2016a; Sunder and Antony, 2020)

2.4.6 The Principle of Academic Freedom

One unique operating model of the HE sector is academic freedom (Koch, 2003; Holme et al., 2015; Yorkstone, 2016). A principle that allows academic staff members the freedom to teach and research without fearing losing their job or benefits, even when such activities are contrary to existing conventions (Yorkstone, 2016). However, such a culture is often not receptive to developing and adopting quality and process improvements in higher education (Koch, 2003; Antony et al., 2012; Holme et al., 2015; Anthony and Antony, 2022).

2.5 Quality Assessment Versus Continuous Improvement in HEIs

The UK remains a provider of high-quality HE in all its many modern forms. The UK Education Reform Act 1988 provided a framework for pursuing a quality education. Various HEIs stakeholders have their interest vested in quality, e.g. the public-sector organisations are interested in quality to make the best possible use of limited resources (Ahmed, 2008). The UK government spends over 4.7 billion pounds annually supporting the direct costs of the HE sector (Higher Education Council for England, 2022). As a major stakeholder in HE, the UK government is concerned with value-for-money and ensuring the economy's competitiveness by encouraging a highly educated workforce (Ahmed, 2008; Universities UK, 2017; QAA, 2017). Other external stakeholders, students and their families, and prospective employers in the industry, commerce and the professions have their interests protected as part of the course assessment and institution audit process (QAA, 2017; 2022).

The Quality Assurance Agency (QAA) are responsible for conducting Quality Assessment in UK HEIs. The QAA is a UK-wide semi-public body established in 1997 to replace the Higher Education Quality Council. QAA examines the university's quality strategy, annual quality monitoring process, and quality enhancement and collaboration provision to safeguard HE standards; and promote the continual enhancement of the quality of teaching, learning opportunities, and related student support services (QAA, 2017; 2022). QAA, in collaboration with other governments, established quangos: Higher Education Funding Council for England, Scotland, Wales, and Northern Ireland (bodies that distribute government funding to HEIs), conduct quality assessment in HEIs, to ensure implementation of HE quality code and quality assurance (QA) frameworks (Ahmed, 2008; QAA, 2017; 2022).

However, Dew and Nearing (2004), in their text, argued that there is undoubtedly a current convergence of interest concerning Quality Assurance (QA) and Continuous Improvement (CI) in HEIs. The authors opined that there appears to be a strong interest in QA; though it may sound similar to CI, QA and CI are designed to address different issues. Emphasizing the differences, Dew and Nearing stated that CI in HE focuses on understanding the importance of statistical variation in the work process and organisational dynamics in fostering change. In contrast, QA in HE focuses on ensuring academic programmes meet a common standard rather than continuously improving performance. As such, QA often appears to promote conformity to external requirements and may appear

to be more about maintaining control rather than seeking excellence (Dew and Nearing, 2004). Morley (2003) offered a critical view of the QA effort in the UK HE as an attempt by the state to gain control and surveillance over the education system and concluded that the controversial QA activities in the UK HEIs had created a culture of compliance rather than improvement initiatives.

In contrast to Morley's (2003) view, James (2006), although acknowledged that some CQI is being conducted under the practice of QA, James (p. 25) however, critiqued Morley's study as "unsatisfying and ultimately unconvincing" as it seems to leave no room for the concepts of quality improvement and assurance in HEIs and offered no suggestions. Therefore, James (2006) concluded that more needs to be learned about how to pursue the objective of quality improvement in policies and programs in HEIs. James emphasises the need for a highly distinctive paradigm for QA and the development of strategies for improving performance in HEIs (James, 2006; Krause et al., 2005). Therefore, it can be argued that the challenges of the 21st century in HEIs are beyond an authoritative guide to quality assurance procedures (University of Aberdeen, 2015). Instead, as studies suggest (e.g., Antony and Cudney, 2016; Sunder, 2016a; 2016b; Thomas et al., 2017; Sunder and Antony, 2020; Adeinat et al., 2022), there is a need to develop sustainable programs for continuous performance improvement in HEIs, in support of the purpose of this study.

2.6 Summary

This chapter presented the antecedent of HE as it was traced back to the Middle age, from where formal education spread into different cultures across the globe. The need for HE became apparent due to advancing a knowledge economy, developing human capital, and promoting equal opportunity among citizens for a better society. As HE evolved into various world-class universities and institutions, HEIs have become one of the dominant public sectors with a unique system, contributing to the country's GDP. At the time of this study, 163 Universities offering different courses were identified.

Another aspect presented is the development of continuous improvement in HEIs, which began in the US in the late 1980s and early 1990s. It was revealed that CI initiatives started with the National Excellence Award in the US to ensure high standards and quality in HEIs. This led to the adoption of CQI, which was designed to improve quality across all levels of education, including the UK. Early cases of CQI application in HEIs in the US and UK with success stories and evidence of good practice were presented. However, the adoption of

CQI in the UK HEIs was slower. It was evident that HEIs have adopted CI methodologies such as TQM, Lean, and Lean Six Sigma.

The need for the application of CI in HEIs was argued based on the complexity of the HE system and CI as a diagnostic concept and tool that will help HEI improve their processes and performance. However, the challenges of CIMs application in HEIs were identified because of their unique characteristics. Therefore, it became necessary to identify these unique characteristics of HEIs compared with other service sectors. These unique factors would need to be considered when implementing CI initiatives in the HE environment. Finally, was the difference between Quality Assurance, a mechanism designed to assess the quality of the HEIs programme and CI methodology – a technique designed to continuously improve HEI performance.

Chapter 3:

Literature Review

3.0 Introduction

Following the overview of the HE sector in Chapter 2, In this Chapter (Chapter 3), as the second part of the literature review, the researcher extensively explores related secondary data based on the purpose of the studies to identify the research gap, develop research questions based on the research objectives, and explore the research questions to build a conceptual framework. This Chapter started with the evolution of CI methodologies with an understanding of their origin over the years. The concepts of CI methodologies – Lean, SS, and TQM, and the differences and similarities in their strengths and weaknesses were reviewed, focusing on the Lean and SS integration approach, the justification and benefits for integration, then LSS theory and the criticism of LSS applications. The following section reviews the application of Lean, SS and TQM as a stand-alone approach in HEIs, followed by the review of LSS approach practice in HEIs and the identification of CSFs and the challenging factors of LSS application in HEIs environment. Further in this chapter is the assessment of LSS impact and performance measurement system in the HE, review of LSS and CI sustainability concept, leading to the identification of Sustainability Enabling Factors (SEFs) and barriers to sustainable LSS programmes in HEIs as PSOs. This chapter also attempts to review the existing LSS framework in the HEI environment, present the framework's limitations and research gaps, and finally develop a conceptual framework based on the reviews' findings.

3.1 Evolution of Continuous Improvement Methodologies

This is the historical development of continuous improvement methodologies theories. Before the concepts of Continuous Improvement (CI) and Quality Initiatives were formalised, much work has taken place over the centuries with the history well documented in the literature. CI and Quality initiatives that have roots in improving and maintaining the quality system can be dated back to the late 1700s, from E. Whitney’s development of the standardised part principle to mass-produce guns to F. W. Taylor – the father of scientific management who investigated workplace efficiency in the late 1800s (Deming, 1982; Dale, 2003; Brophy, 2013; Aartsengel and Kurtoglu, 2013). Both works influenced Henry Ford in 1910 in the design of the ground-breaking assembly line leading to the mass production of the Ford cars’ Model T (Womack et al., 1990).

In the 1920s, a significant contribution was made in the progressive manufacturing management practice to the British auto industry by F. G. Woollard as the first to develop automatic transfer machines (Brophy, 2013) and followed by successive phases of changes in Quality Management (QM) and CI concept (Deming, 1982; Ishikawa, 1985). This successive phase was first championed by W. Shewhart's idea in the 1920s in American industry when statistical theory began to be applied effectively to quality control. W. Shewhart made the first sketch of a modern control chart in 1924, and currently, it is one of the most widely discussed statistical techniques in quality management (Deming, 1986).

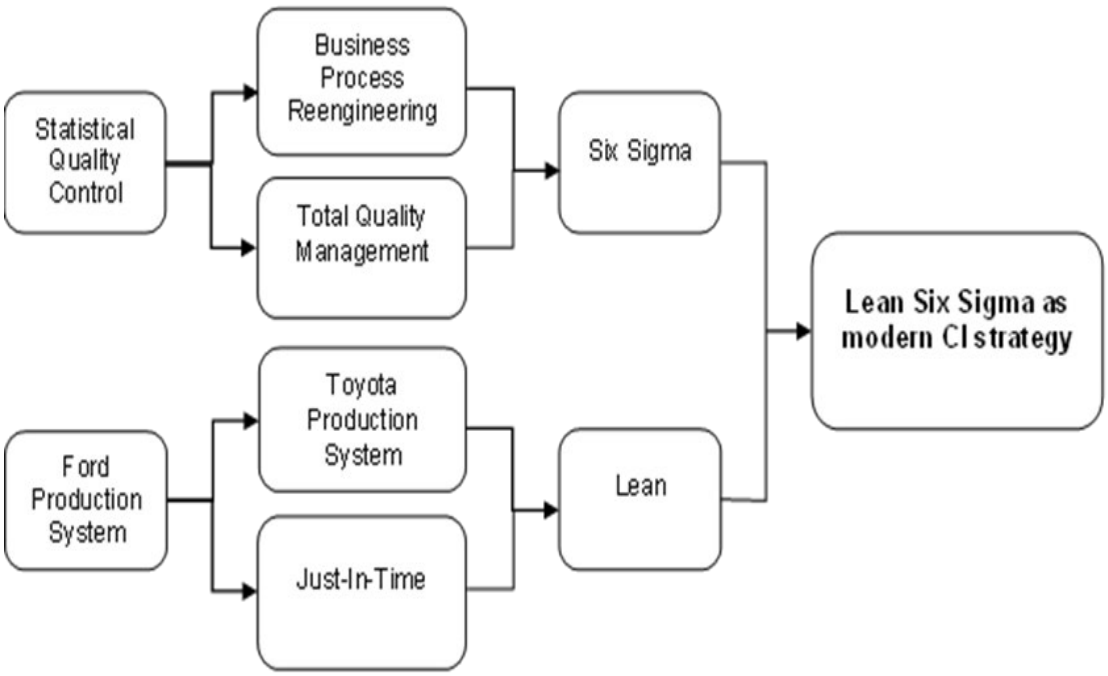
In the early 1950s, QM was introduced to the Japanese with the help of some notable American scholars – Deming and Juran, where Deming encouraged the Japanese to adopt a systematic problem-solving technique (Deming, 1986). Based on the influence of Deming and Henry Ford on the leaders of Toyota (a Japanese car manufacturer) - Eiji Toyoda and Taiichi Ohno, Toyoda and Ohno after World War II, developed the Toyota Production System (TPS) between 1948 and 1970 (Ohno, 1988). TPS comprises two major components – the Just-In-Time (JIT) Production System and Respect-for-Human System (Sugimori et al., 1977; Ohno, 1988). The spread of TPS in the late 1980s propagated the development of Lean thinking. Lean is still enhanced today and often refers to activities used in Kaizen, the Japanese word for Continuous Improvement (Liker, 2004), value stream mapping, and waste elimination (Womack et al., 1990; Womack and Jones, 2005).

Shigeo Shingo (Toyota external consultant) also, in the 1960s, developed the method of SMED (Single-Minute Exchange of Dies) and Poka-Yoke (mistake proofing). At the same time, Professor Ishikawa at the University of Tokyo formulated the concept of quality circles (Ishikawa, 1985; Liker, 2004; Brophy, 2013). However, the quality and efficiency revolution in the West was slow to follow. It did not begin until the early 1980s when it became apparent that there was something unique about Japanese management practice (Deming, 1986; Liker, 2004; Womack et al., 1990). A modified form of total quality control was exported to the USA from Japan and was later renamed – Total Quality Management (TQM) – a process designed to meet and exceed the needs and expectations of customers (Dale, 2003).

Following in the 1980s was the development of Motorola's Six Sigma quality improvement methodology, which has evolved into three generations and recently has gradually been

deployed to replace TQM (Pande et al., 2000). In 1987 the ISO 9000 series became the internationally recognised standard for QM systems (Dale and Shaw, 1999). While in the early 1990s, Business Excellence or Excellence Model was widely adopted and promoted by the European Foundation for Quality Management (EFQM) and British Quality Foundation (BQF) (Kumar et al., 2010). From the time W. Shewhart used a variety of tools to achieve process improvement in his studies, and the fundamentals established by various early scholars and practitioners moving into the twenty-first century were the building blocks for CI efforts such as TQM, Lean thinking, Six Sigma, and the present combination of Lean Six Sigma (Bodek, 2004; Antony, 2009; Brophy, 2013; Aartsengel and Kurtoglu, 2013) as indicated in figure 3.1. Researchers and practitioners across various industries have viewed Lean Six Sigma as the modern business improvement and continuous improvement methodologies of all time.

Figure 3.1: Evolution of CI and LSS Methodologies



Source: Adapted by the Author from (Ohno, 1988; Deming, 1986; Liker, 2004; Womack et al., 1990; Aartsengel and Kurtoglu, 2013)

3.2 Continuous Improvement Methodologies Theories

The evolution of CI Methodologies presented how Lean and Six Sigma and the integrated LSS have evolved into the present-day most accepted CI methodology. The section presents the concept of these methodologies, their principles and their differences and similarities, their applications and approach, evidence of success stories, and the criticism of their applications.

3.2.1 Lean Management

The term “Lean” was initially coined by J. Krafcik, of the Massachusetts Institute of Technology, in a project focused on bridging the significant performance gap between Western manufacturing and Japanese automotive industries (Krafcik, 1988; Bhamu and Sangwan, 2013). In the extension of that project, Womack et al. (1990), in their publication *“The Machine that Changed the World”,* and Womack and Jones (2004) in “*Lean Thinking”,* popularised the Lean concept following a visit to Japanese firms in 1982, in attempt to understand the Japanese post-war economic miracles and the discovery of Toyota Production System – TPS (Womack and Jones, 2004).

Lean philosophy – used to focus on cycle time reduction and waste elimination in work process improvement (Womack et al., 1990; Womack and Jones, 2004), originally from the TPS concept, was initially embraced by manufacturing sectors globally. The Lean movement has spread to service industries (Staats et al., 2011; Hasle et al., 2012) and has evolved into a management system, philosophy and methodology (Barraza et al., 2009; Gupta et al., 2016). Various researchers and practitioners have commented upon the Lean concept, and there appear to be different views on which characteristics have been associated with the idea (Bhamu and Sangwan, 2014; Gupta et al., 2016; Palange and Dhatrak, 2012; Bicheno and Holweg, 2023). Lean thinking was used by the pioneers (Womack et al., 1990; Womack and Jones, 2004) to mean doing more with less as they viewed it as a way of reducing waste and identifying non-value-adding activities in a process. A more embracing and workable definition was provided by Gupta et al. (2016. p.1027) in determining the necessity to standardise the Lean service definition:

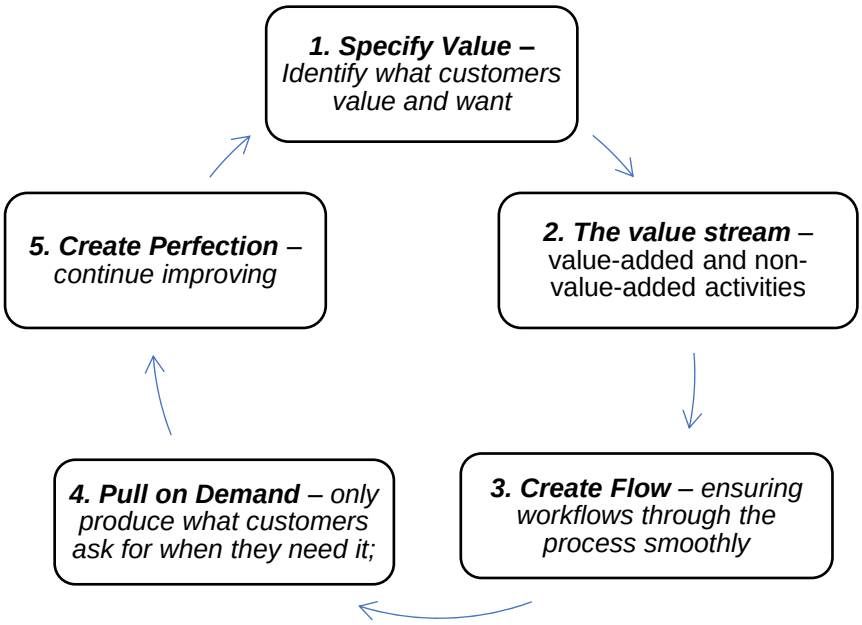
“……an integrated multi-dimensional approach encompassing a wide variety of management practices based on the philosophy of eliminating waste through continuous improvement….”(p. 1027)

Thus, Lean is a culture, a way of thinking, a practical philosophy and a methodology, and more than just a toolbox for process improvement (Gupta et al., 2016). A tool employs to move business processes ever closer to uninterrupted flow in the sequence of operations that deliver perfect quality and becoming more of a time-based competitor (Bicheno and Holweg, 2023).

3.2.1.1 Lean Principles

Lean can be described as a philosophy with guiding principles (Womack and Jones, 2004) and a set of management practices, tools, and techniques (Shah and Ward, 2003). The widely adopted Womack and Jones (2004) Lean Thinking has five principles, as shown in Figure 3.2.

Figure 3.2: Lean Principles.



Adapted from Womack and Jones (2004)

These five principles of Lean Management were to reduce cost and enhance the organisation's speed by minimizing seven types of waste as identified by Ohno (1988) Overproduction; Motion; Transportation; Inventory; Extra processing; and Waiting. Through employee involvement and Kaizen event (Kaizen – Japanese translation of continuous improvement), by employing Lean tools and techniques such as 5S workplace organisations, Visual Management, A3 Problem solving, Standard work, Just-in-Time (JIT),

Total Productive Maintenance (TPM), Kanban, Mistake Proofing and others (Womack et al., 1990; Kumar et al., 2006; Brophy, 2013; Bicheno and Holweg, 2023).

Although there are successful applications of Lean principles in various organisations, however, research has shown that there are difficulties in the implementation of the concept to achieve profitability and benefits (Antony et al., 2017; Achanga et al., 2006), with a lack of Lean culture development to support the concept in the organisations (Liker and Hoseus, 2008). Research also shows that organisations are abandoning Lean tools and techniques due to the highly changing business environment, and implementing Lean principles as a single business improvement initiative has become inadequate.

3.2.2 Six Sigma (SS) Concept

Six Sigma (SS) was originally invented by the Motorola company in the 1980s and has dramatically evolved into the present General Electric (GE) 5 steps approach – DMAIC (Define, Measure, Analyse, Improve, and Control) (Pande et al., 2000; Stamatis, 2004; Harry and Crawford, 2005), and – DFSS (Design for Six Sigma) approach (Stamatis, 2004). SS has also evolved from a statistical tool to a company-wide strategy for business process improvement (Antony and Banuelas, 2002; Kumar et al., 2008). SS was developed to reduce unwanted variation and increase the performance and reliability of business processes to meet customer satisfaction (Stamartis, 2004; Antony et al., 2007; Antony et al., 2018b Akinlabi et al., 2022). Researchers have argued that SS philosophy and its tools are similar to the TQM approach and have replaced TQM and become the focus of quality management and business excellence (Pande et al., 2000; Stamatis, 2004). However, in contrast with TQM in the application, SS represents a new organisational structural approach to quality improvement (Stamatis, 2004; Kumar and Bauer, 2010; Antony et al., 2018b)

Although, there appears to be little consensus on the definition of Six Sigma (SS). In the early studies of the concept, Pande et al. (2000) define SS as a sweeping cultural-change effort to position an organisation for more excellent customer satisfaction, profitability and competitiveness. Thus, This definition accentuates a holistic approach to driving change throughout an organisation (Pande et al., 2000). SS has further been understood and defined to reflect different perspectives and characteristics, as shown in Table 3.1.

Table 3.1: Six Sigma definition based on the Characteristics

Characteristics	Definition
Performance metric and statistical tool	The quality level metric of 3.4 defects per million opportunities (DPMO)
Methodology for problem-solving	Provide DMAIC and DFSS methodology – where other tools and techniques are deployed along
Philosophy	Aim at reducing variation based on customer critical to quality (CTQ) issues and data-driven decisions.
Business improvement Strategy	SS is defined as a "business improvement strategy" for the effectiveness and efficient performance of business operations to meet and exceed customer satisfaction.
Focus on Customers	Customer-centric, measuring and mapping voice of customers (VOC) based on CTQ
Leadership engagement, team-based approach	SS application is championed from the Top-down, involving a team-based approach and cross-functional team.
Improvement specialist belt-system	Emphasizes training and certification of improvement specialists that result in Black Belts, Green Belts, and Yellow belts before embarking on any project
Project-based organisation	SS accentuates a project-by-project feature of its implementation and focuses on project management skills and approach.

Sources: Adapted from (Bendell, 2006; Naslund, 2008; Kumar et al., 2008; Akinlabi et al., 2022; Antony et al., 2018b).

3.2.2.1 Six Sigma DMAIC and DFSS Methodologies

SS involves learning the basic principle behind the two-major project-based improvement methodologies, DMAIC (Define, Measure, Analyze, Improve, Control) and the five-phase DFSS (Design for Six Sigma) – DMADV - define, measure, analyze, design and verify (Pande et al., 2000; Antony and Fergusson, 2004). The SS-DMAIC problem-solving strategy is used to improve existing processes that do not involve changing or redesigning the fundamental structure of the underlining process. In contrast, DFSS–DMADV is used to design a new technique or redesign existing processes when it fails to meet its objectives (Snee, 2004; Samartis, 2004). However, not just the methodologies (DMAIC and DMADV) make SS methodology applications successful in organisations. Instead, the collection of tools and techniques integrated into the structured methods sequentially and rigorously also makes SS applications successful (Kumar et al., 2010; Antony et al., 2018b).

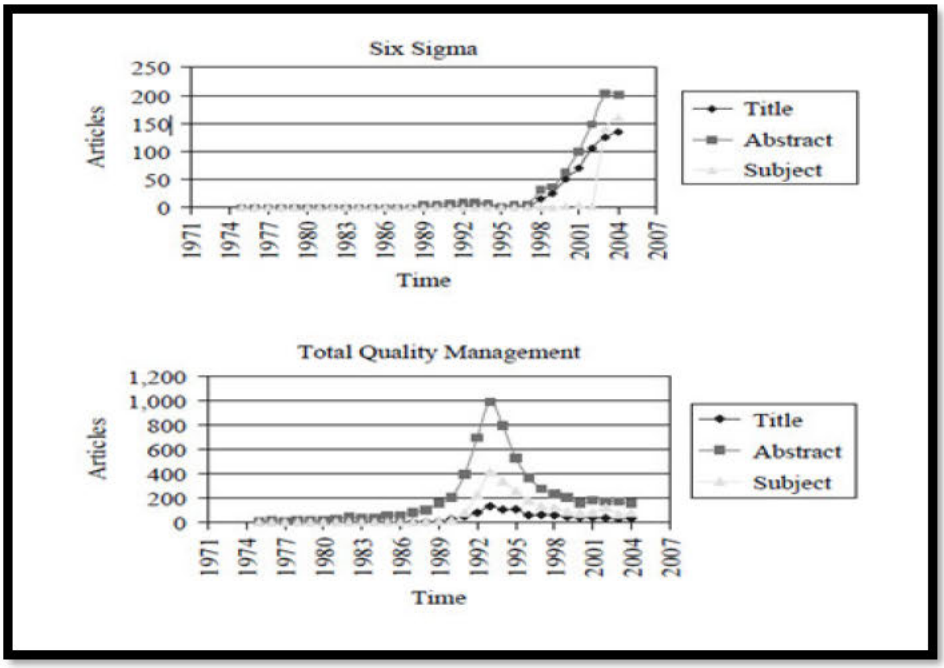
The original focus of SS methodology was on manufacturing industries, but has now been exploited across other industries and service sectors (Antony et al., 2018b; Alsmadi et al., 2012; Antony and Kumar, 2007; Sony et al., 2020), with significant contribution of savings and bottom-line benefit to various organisations, such as GE; Motorola; Honeywell; Bombardier; Boeing; Caterpillar (Antony et al., 2018b; Gijo et al., 2014; Kumar et al., 2008; Gutierrez et al., 2009). However, Linderman et al. (2003) argued that SS's focus has been too narrow to descriptions of practice rather than on theory development. In support of Gupta's (2004) view of SS, Kumar et al. (2012) concur that SS initiatives have failed due to organisations' failure to link their initial strategic business goal with their business improvement measurable objectives. Kwak and Anbari (2004), in their study on the future of SS, stated that the primary aim of SS should be focused on improving the overall management performance rather than pinpointing and counting defects. The Authors suggest that SS should be integrated with other CI methodologies for effective performance. A recent study on the criticism of SS (Sony et al., 2022) shows that a significant number of companies have failed to gain any benefits from Six Sigma, with respondent satisfaction with Six Sigma less than 50 per cent. That suggests that the effectiveness of SS may depend on integration with other methodologies with similar principles and assumptions, such as the Lean principle.

3.2.2.2 Six Sigma Vs Total Quality Management

SS and TQM concepts have many similarities, especially concerning origin, methodologies, tools, and effects (Stamatis, 2004; Antony & Fergusson, 2004; Andersson et al., 2006). Some traits of TQM found in SS are a work process view, customer-centric approach, CI mindset, decision-making based on data and improvement in all aspects and functions of the organisation (Anderson et al., 2006; Antony, 2009). Both methodologies rely on a plethora of statistical tools (Naslun, 2008), emphasising the relevance of top-management commitment and employee involvement (Antony, 2009). When compared with TQM, SS has some differentiated characteristics. While TQM allows employee participation and self-managed teams, SS is driven by the organisation’s champions using belt systems such as black, green, and yellow belts). TQM is more about department-based projects, and SS are more of a cross-functional team-based project with five steps structured DMAIC process (Snee, 2004; Antony, 2009). SS's advantages over TQM have been identified as a structured method, focus on business and financial outcomes, and the use of belt system specialists (Schroeder et al., 2008).

Studies have shown that SS has replaced TQM to become the focus of quality management and business excellence in the past decade (Naslund, 2008; Antony, 2009; Alsmadi et al., 2012; Mosadeghrad, 2014). Organisations that have embraced Six Sigma within their working culture had previously adopted TQM (Walters, 2005). Naslund's (2008) analysis of the academic publications of Six Sigma versus TQM clearly shows that the number of published TQM articles dropped significantly compared with the growing publication of Six Sigma literature, as indicated in Figure 3.3. One could argue that the nature of the transitions from TQM to Six Sigma is a fad phenomenon (Pande and Holp, 2002; Taylor, 2004; Antony, 2009; Waterbury, 2008; Naslund, 2008; Mosadeghrad, 2014). Basu (2009), a renowned scholar in quality management, stated that TQM was the buzzword of the 1980s. The author argued that many viewed TQM, especially in the USA, as an embarrassing failure (Basu, 2009). Against this background, the scene for Six Sigma appeared to establish itself (Basu, 2009).

Figure 3.3: Popularity of Six Sigma and TQM



(*Source:* Naslund, 2008)

3.3 Emergence of Lean Six Sigma (LSS) Concept

Lean Six Sigma (LSS) was first coined to describe a management system combining Lean and SS methodologies, tools and techniques in 2000 (Sheridan, 2000). However, the combination of Lean principles and tools in addition to Six Sigma (SS) methodology was born following the shortfall of SS methodology in the General Electric company (GEC) improvement project (GEC report, 2000); and the criticism from academics and

practitioners on the deployment of Lean or Six Sigma in isolation in most cases where organisations need to reduce waste in the process and same time reducing variations (George, 2002). Smith (2003) noted that Lean and Six Sigma methodologies have often been used separately or sequentially. However, the separate use of both methods create two subcultures within the organisation (Harrison, 2006); conflicting outcome and ineffective use of resources (Bendell, 2006).

These instituted a debate between experts on whether Lean and SS methodologies should be combined (e.g., George, 2002; 2003; Smith, 2003; Harrison, 2006; Bendell, 2006; Arnheiter and Maleyeff, 2005). How to merge these two methodologies was first analysed by an American consultant, M. L. George, in 2002 (George, 2002; 2003; Anthony et al., 2003, Chiarini and Enrico, 2013). According to George (2002, 2003), Six Sigma does not directly address process speed resulting in a lack of improvement in lead time in companies applying SS methods alone. Similarly, as George (2002) argued, those companies engaged in Lean methodology alone show limited improvements across the organisation due to the absence of a SS cultural infrastructure. George further argued that combining Lean and Sigma is a prerequisite for rapid improvement rates, and organisations are driven to invent or learn the other half of the equation (George, 2002). Lean Six Sigma (LSS) combination was developed to complement each other's strengths to overcome their respective disadvantages (Anthony et al., 2012; Ranjan and Vora, 2014), at the same time, addressing specific problems that are identified along the CI journey (Pepper and Spedding, 2010), to achieve the triple goal of business improvement initiatives – high quality; high speed; and low cost (George, 2003).

3.3.1 Definition of Lean Six Sigma (LSS)

Various researchers and practitioners have defined LSS to explain the applications and expected benefits of the combined methodology. George (2002) described LSS as a methodology used to achieve the fastest rate of improvement, customer satisfaction, quality, cost, process and investment to maximise shareholder value. Snee (2010), on a broader contribution, defined LSS as a business improvement strategy and methodology that increases performance resulting in an improved bottom line. LSS methodology (Salah et al., 2010) and philosophy (Hilton and Sohal, 2012) focus on the elimination of waste and variation (Salah et al., 2010) by integrating both tools and techniques within the DMAIC structure of SS (George, 2003; Leon et al., 2013; Hilton and Sohal, 2012; Salah et al., 2010), and prescribes actions to improve operational efficiency and effectiveness (Leon et al., 2013; De-Koning et al., 2008). Although the definitions have commonalities, there is no

well-known acceptable definition of LSS. The implication is that these researchers' integrated LSS approach/model is typically aligned with their respective definitions (Leon et al., 2013).

3.3.2 Differences Between Lean and Six Sigma

Lean and SS have become the two most popular and successful programs espoused by various industries. Researchers have attempted to comprehensively analyse the difference between the two concepts (e.g. Anderson et al., 2006; Marsh et al., 2011; Rathilall and Singh, 2018; Akinlabi et al., 2022). However, the fundamental differences between the two methodologies lie in their strength and weakness are presented in Table 3.2. Lean provides the tools and techniques used to reduce the lead time of any process and eliminate non-value-adding activities. Six Sigma is closely associated with defects and quality and does not contain any tools to control lead time or tools specific to reducing lead time (Kumar et al., 2010; Marsh et al., 2011; Rathilall and Singh, 2018; Akinlabi et al., 2022).

Table 3:2 Strengths and Weakness of Lean and Six Sigma

Strength

Lean	Six Sigma
• Eliminate waste	• No defects
• Decrease lead time	• Save money
• Cycle time reduction	• Uniform process output
• Work-in-progress reduction	• Defect reduction
• Shorten delivery time	• Culture change
• Space saving	• Customer satisfaction
• Less equipment needed	• Detailed statistical analysis for improvements
• Driven for efficiency	• Driven for Excellence
• Improve flow in processes.	• Reduce variation and improve processes.
• Visual workplace and clean environment	• Structured problem-solving methodology

Weaknesses

Lean	Six Sigma
• Statistical or system analysis not valued	• The process is not improved, thought the streamline.
• Process incapability and instability	• Lack of specific speed tools
• There is no systematic problem-solving approach.	• SS does not question existing methods of operation and if it is adding value as long as it does not produce variation.
• No focus on reducing variation and maintaining uniform process output	• No focus on process improvement throughout the entire value stream
• Does not concentrate on dramatic improvements through innovation	• Does not see the importance of a visual workplace and clean work environment

(Adapted from Rathilall and Singh, 2018; Ikumapayi et al., 2020)

The Lean strategy brings a set of proven tools and techniques to reduce cycle times, inventories, set-up times, and other wastes, focusing on value from a customer perspective through the entire organisation's supply chain (George, 2002; Antony et al., 2003). The statistically-based problem-solving plethora of tools and techniques SS methodology delivers data to drive solutions by identifying root causes of the problem, developing metrics, analysing process, and evaluating capability, with various solutions designed to provide dramatic bottom-line results (Antony et al., 2003; Kumar et al., 2010; Marsh et al., 2011; Rathilall and Singh, 2018; Ikumapayi et al., 2020)

3.3.3 Integration of Lean Six Sigma Methodology

The combination of Lean and SS into LSS has been widely acknowledged as the modern business improvement and CI philosophy of all time and broadly adopted to replace the individual approaches of Lean and Six Sigma methodologies in both manufacturing and service contexts (George, 2002; 2003; Arnheiter and Maleyeff, 2005; Pepper and Spedding, 2010; Marsh et al., 2011; Anthony et al., 2012; Duarte, 2012; Ranjan and Vora, 2014; Thomas, 2017; Antony et al., 2017). As generally inferred, LSS consists of an integration of independent tools and techniques of both methodologies, which according to Arnheiter and Maleyeff (2005) and Corbett (2011), are being used to institute a culture of change and CI at every level of the organisation. The advantages of both approaches lie in SS's scientific and quantitative approach in relation to the technical approach of Lean principles (Arnheiter & Maleyeff, 2005).

Although, Nave (2002) argued that the exclusive use of either Lean or Six Sigma would facilitate most process improvements. However, Six Sigma projects often focus on reducing variation and cost-cutting with less attention paid to customer requirements (Okhovat et al., 2012). Therefore, Bendell (2006) suggests the simultaneous adoption of Six Sigma's problem-solving methodology and the flow view of Lean management. In their studies, Arnheiter & Maleyeff (2005) concluded that both Lean and SS represent the state-of-the-art methodology, where each system prioritises certain facets of organisational performance. Therefore, diminishing returns may result when either approach is implemented in isolation in a highly-competitive environment (Arnheiter & Maleyeff, 2005). Pepper and Spedding (2010), in their evolution of Lean and SS, stated that the two paradigms are catalysts of change and, if integrated, can be a powerful tool for cultural alignment that will provide enormous potential for sustainable organisational change and process improvement.

Antony et al. (2003) analysis of the synergy of integrated LSS supported the view of George (2002). Antony et al. (2003.p.40) further argued that, while the main principle of SS is “to take an organisation to an improved level of Sigma capability through the application of statistical tools and techniques”, Lean principles have a role in “eliminating waste and non-value-adding activities”. In the combined LSS approach, Lean helps to eliminate noise, establish standards and maintain customer focus in the business processes, and prevent a single SS approach from becoming a cost-saving exercise (Bendell, 2006). Pepper and Spedding (2010) argued that SS methodology should complement Lean in addressing specific problems in the Lean journey. Snee (2010) contends that the discussions on which approach (either Lean or SS) to apply are unproductive if the organisation's main issue is to improve the business. The author stated that the body of knowledge (BoK) of combined LSS is needed to solve the problems organisations encounter rather than focusing on using integrated approaches (Snee, 2010).

To capitalise on the strengths of both Lean and Six Sigma, as shown in Table 3.2 above, Pepper and Spedding (2010) anticipate that the ultimate balance lies in creating sufficient value from the customers’ perspective and reducing variation to acceptable levels. Therefore combining the efficient approach to problem-solving through Lean with the innovative approach to problem-solving through Six Sigma enables an organisation to gain advantages from both types of improvement (Akinlabi et al., 2022; Rathilall and Singh, 2018; Ikumapayi et al., 2020). Therefore, the concept of integrating LSS was favoured over the years within organisations that chose Lean and Six Sigma to work in unity rather than independently.

3.3.5 Benefits of Lean Six Sigma in the Service Sector

The implementation of integrated LSS as a business improvement methodology has increased significantly over the last decade due to successful results and outcome benefits. Arnheiter and Maleyeff (2005) refer to LSS as an integrated entity that exploits the benefits of both methodologies. As reported, combining Lean and SS leads to achieving CI at every level of an organisation (Smith, 2003; Arnheiter and Maleyeff, 2005; Baven, 2005; Corbett, 2011; Salah et al.,2010) and helps companies achieve zero defects and fast delivery at low cost (Salah, 2010). Outlining the benefits of the LSS approach, Arnheiter and Maleyeff (2005) noted that SS's scientific and measurements perspective keeps Lean processes on track and eliminates waste in more accurate methods.

Integrated LSS methodologies in organisations create superior improvement (Thomas et al., 2008; Snee, 2010), improve performance, effective leadership, customer satisfaction and bottom line. Pepper and Spedding (2010) provided a critical thought on LSS integration. They noted that LSS "should be seen as the platform for cultural and operational change initiation"(p. 142). Similar to Arnheiter and Maleyeff (2005), Pepper and Spedding (2010) concluded that combined LSS provides a more integrated, coherent and holistic approach to CI (Arnheiter and Maleyeff, 2005; Rarjan and Vora, 2014).

Higgins (2005) argued that integrating LSS methodologies attempts to empower employees at the higher level of process analysis, allowing employees to take ownership of the processes. One of the critical success factors (CSFs) of CI initiatives at any organisation is the availability of a set of problem-solving tools (Jeyaraman and Teo, 2010; Antony et al., 2018), and LSS integration success can be effectively achieved through the use of LSS toolkit (Salah et al., 2010). To George (2002), as the pioneer, LSS is a critical factor of corporate strategy, driven by customer and business needs to achieve competitive advantage and faster improvement at less cost.

From early examples, British Aerospace (BAE) Systems implementation of LSS in 1999 shows 97 per cent improvement in productivity and 112 per cent value-added productivity in five years, 90 per cent improvement in customer lead time, 70 per cent reduction in work in process, 300 per cent improvement in product reliability and zero lost workdays (Furterer and Elshennawy, 2005; George, 2002). The savings achieved by Motorola as one of the pioneers of the LSS methodology reached over $16 billion in 2005 (Brett and Queen, 2005). Also, GE Capital – the financial division of GEC, was one of the first financial institutions to apply the LSS methodology to increase profitability and customer satisfaction (Antony, 2006). Other financial institutions implementing LSS with optimal benefits were Bank of America, Citicorp, American Express, Lloyds TSB, HSBC, Zurich Financial, and Bank One (George, 2003).

A similar case study report of LSS benefits in healthcare (Huang et al., 2012) indicated - 30 per cent reduction at the call centre, 31 per cent increase in patient throughput, 30 per cent reduction in total Takt-time, 33 per cent reduction in patient experience-time, 91 per cent reduction in travel time for technicians, and 50 per cent reduction in travel-time for preparation personnel. The report also shows that the business improvement initiative translated into 3,000 city scan patient cases handled annually, including an approximately $750,000 increase in net revenue (Huang et al., 2012). Another example of LSS

application in a healthcare case study in an Irish Hospital thus concluded that LSS projects yielded considerable organisational benefit (Laureani et al., 2013).

Thomas et al. (2008) case study of the application of LSS in a small engineering company shows significant cost savings – with 55 per cent in project rate reduction, 31 per cent increase in production system throughput and an energy usage reduction of 12 per cent per annum. Another application of LSS in a business process outsourced organisation was found to have worked very well for reducing process cycle time by carrying out process changes (Ray and John (2011). As reported by Stoiljkovi et al. (2011), implementing the LSS process for a sample analysis process in a microbiological laboratory helped remove most of the dispersions in the process, reduce variation, and reduce the duration of analysis and opportunities for the appearance of defects. Albliwi et al. (2017) and Iyede et al. (2018) assessment of the impact of LSS implementation across organisations highlighted similar improvements with previous reports. The above examples indicated that LSS methodologies can be successfully implemented in various sectors of the economy, both in the manufacturing and the service sector, with accrued benefits (See Table 3.3).

Table 3.3: Benefits of LSS Applications

• Uniform process output	• Flexible organisation
• Cycle time reduction	• Shorten delivery time
• Defect reduction	• Customer satisfaction
• Work in progress reduction	• Space-saving
• Cost reduction	• Market share growth
• Productivity improvement	• Less equipment needed
• Culture change	• Product/service development
• Customer-focused	• Less human effort
• Employee empowered	• Faster improvement at less cost

Adopted by the Author (*Sources:* George, 2002; 2003; Furterer and Elshennawy, 2005; Brett and Queen, 2005; Antony, 2006; Thomas et al., 2008; Stoiljkovi et al., 2011; Ray and John, 2011; Huang, 2012; Albliwi, et al., 2017; Iyede, et al, 2018;).

3.4 Lean Six Sigma Theory

LSS methodology has been applied in various manufacturing and service sectors with great success stories (George, 2002; 2003, Furterer and Elshennawy, 2005; Thomas et al., 2014). Most well-known LSS programmes come from larger companies like Motorola,

GEC, Honeywell and many other consulting firms (Sheridan, 2000; Smith, 2003). However, research has shown that there are numerous ways in which the LSS integration has been modelled by researchers and applied in various organisations (Bendell, 2006; Salah, 2010; Pepper and Spedding, 2010; Corbett, 2011, Leon et al., 2013; Taylor, 2014). There appears to be no consensus on how LSS is defined (Gershton and Rajashekharaiah, 2011, Leon et al., 2013) with implications of various approaches of LSS methodology (Bendell, 2006; Pepper & Spedding, 2010; Salah et al., 2010; Corbett, 2011; Leon et al., 2013; Taylor, 2014).

Early developers of the LSS approach (e.g. George, 2002; Hines et al., 2004; Ferng and Price, 2005; Snee, 2005) seemed to concentrate on a simple connection between Lean and SS and proposed that business be Leaned-up first, followed by the introduction of SS to reduce-variation in a business process. Snee (2005) suggested that where the CI project aims to eliminate waste and simplify business processes. Lean tools can be more effective at the first improvement stage before tackling the complex problem with SS process optimization and control. Pepper and Spedding (2010) proposed a Lean dominant model where SS is used in a subordinate role. This model presents Lean principles as the most dominant approach - to eliminate waste) and uses Six Sigma as a tool within the model to reduce variation and improve quality (Furterer and Elshennawy, 2005; Salah, 2010; Corbett, 2011; Akbulut-Bailey, 2012). This approach uses Six Sigma only as a tool within Lean, which undermines the DMAIC approach's power (Taylor, 2014; Thomas et al., 2014).

Other researchers have proposed a Six Sigma Dominant Model, infusing some Lean tools into the Six Sigma-DMAIC structure (Sallah, 2010; Gershon and Rajashekharaiah, 2011; Taylor, 2014). Gershon and Rajashekharaiah (2011) argued that SS has evolved to incorporate Lean principles. Some researchers inferred that SS and LSS are the same, and most literature refers to LSS as SS reformed, incorporating Lean tools (Dumitrecu and Dumitrache, 2011; Duarte et al., 2012). For example, Snee (2010) used LSS and SS interchangeably. Gershon and Rajashekharaiah (2011) argued that the essence of LSS remains in the DMAIC methodology of SS.

Another approach applied Lean and SS in parallel – even when applied to the same problem (Salah, 2010). Mader (2008) gives an example of a model where a traditional Six Sigma approach can be used in parallel with the LSS light approach, which mainly uses a Lean tool (Kaizen event) to reduce process lead time. Researchers also proposed an approach where Lean and SS are deployed separately to a different project based on the complexity of the problem (e.g., Antony et al., 2009; Bevan et al., 2005). Bevan et al.

(2005) argued that it is very rare that two business improvement approaches be used in a complementary rather than in a competing way. However, the authors agreed that a pragmatic approach is required and recommended using either Lean or Six Sigma as a separate model where necessary or both be adopted in series (Bevan et al., 2005).

The LSS model proposed by Crawford (2004) presented how Six Sigma can be applied at first to improve the process effectiveness, followed by the application of Lean tools and techniques to improve the system efficiency in a sequential approach. Bevan et al. (2005) application of combined LSS in the Healthcare sector adopted these proposed approaches, where the best Lean tools as part of LSS were brought in at the improved stage of the SS DMAIC process, thus, relegating Lean to a secondary function. However, it can be argued that these dominant/subordinate approaches do not achieve the intended integration of LSS tools and techniques. That led to an increase in the argument for a more balanced and integrated approach that draws on LSS tools and techniques simultaneously to achieve the most benefits (Bendell, 2006, Thomas et al., 2008; Thomas et al., 2009; Corbett, 2010; Salah et al., 2010; Leon, 2013; Pepper and Spedding, 2010; Taylor, 2014; Furterer, 2016, Thomas, et al, 2017; Antony et al., 2018).

3.4.1 Criticism of Lean Six Sigma Application

Combined Lean Six Sigma approach has been widely publicised as the most favoured hybrid CI methodology, and many applications are being cited for its popularity in practice (Thomas et al., 2009, 2017; Leon et al., 2013; Taylor, 2014; Rarjan and Vora, 2014; Antony et al., 2017, 2018, 2019). Despite the practical success and similarities between Lean and Six Sigma tools and methodology, the guiding philosophy and overall approach differ (Bjurstrom, 2012), and organisations struggle to implement LSS (Leon et al., 2013). For these organisations, the question is not whether they should use Lean or SS but how to use both bodies of knowledge to solve problems effectively (Snee, 2010; Salah et al., 2010).

On this development, Gershon and Rajashekharaiah (2011) have argued that the proponents of Lean Six Sigma have failed to develop a process to prescribe how to apply Lean Six Sigma. Therefore, it can be inferred that early attempts to integrate the two concepts (George, 2002) have failed to achieve a single coherent framework effectively. The actual effect of the LSS combined approach remains somewhat ambiguous (Thomas et al., 2009; Marsh et al., 2011). There is no specific industry-wide accepted approach or roadmap for the implementation of LSS tools and techniques, with various models being

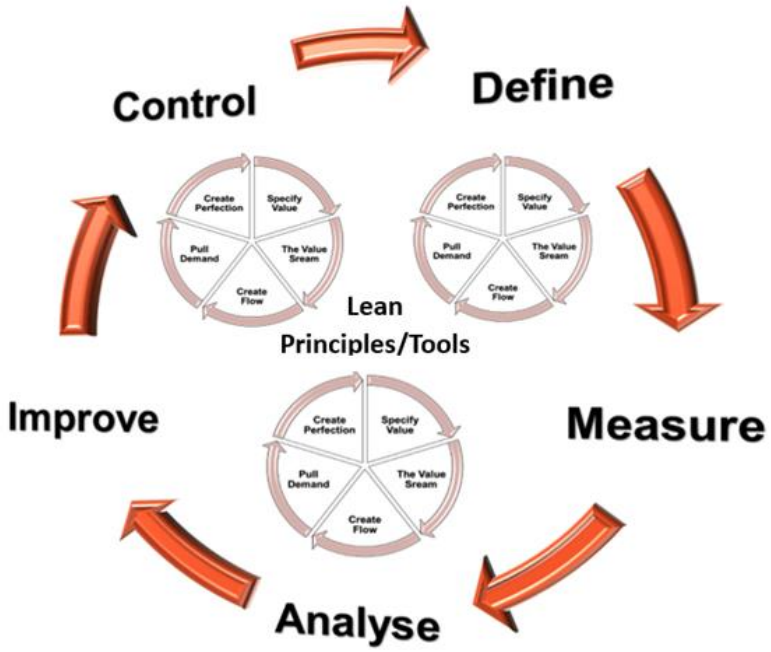
proposed for a combined LSS approach and a mix of tailored strategies developed by researchers, organisations, and consultancy companies or in-house based on the complexity of the project (Bendell, 2006; Kumar et al., 2006; Proudlove et al. 2008; Salah et al., 2010; Corbett, 2011; Marsha et al., 2011; Antony et al., 2012; 2017; Leon; 2013; Sunder and Mahalingam, 2018)

Bendell (2006) has argued that the dominant/subordinate combination of LSS may be questionable because complete integration of the model is not being achieved. The author, therefore, suggests that it would be desirable for a holistic approach to effectively integrate the two methodologies into one system (Bendell, 2006). Despite its wide acceptance as the most notable business improvement methodology, Spector (2006) stated that the LSS concept has not worked for every organisation. The author argues that many firms still struggle to achieve the desired results of LSS. They (firms) lack a holistic framework and effort to focus on achieving an overall organisational goal (Spector, 2006). In support, Pepper and Spedding (2010) and Snee (2010), in their studies, concluded that a systematic approach is required to optimise the whole system and focus the right strategies in the right places to drive CI. It can be argued that there is a lack of a holistic approach to sustainable LSS and CI change programmes due to the identified flaws as studies suggest (Bendell, 2006; Pepper and Spedding, 2010; Salah et al., 2010; Snee, 2010; Leon, 2013; Rathilall and Singh, 2018; Anotony et al., 2018; Sunder and Anthony, 2018).

3.4.2 LSS Theoretical Framework

The integrated LSS framework, as proposed by researchers (Salah et al., 2010; Leon, 2013; Pepper and Spedding, 2010; Taylor, 2014; Furterer, 2016; Thomas et al., 2017; Antony et al., 2018), involves the integration of Lean principles and tools (Womack and Jones, 2007) and Six Sigma statistical tools and techniques (Pander et al., 2000) within different phases of DMAIC structure as when they are needed in each and any of the stages as illustrated in Figure 3.4.

Figure 3.4: LSS Theoretical Framework



Source: Adapted from (Salah et al. 2010; Leon, 2013; Pepper and Spedding, 2010; Taylor, 2014; Furterer, 2016; Thomas et al., 2017; Antony et al., 2018).

Define – This phase aims to delineate the LSS project's team, scope, objectives, voice of customers and process details (Salah et al., 2010). It consists of clarifying the project's scope and defining the goals, identifying external factors that can burden the organisation, and narrowing down the problem (Thomas et al., 2017; Antony et al., 2018). This phase is crucial since the projects selected objectively are more successful than those chosen subjectively.

Measure – The objective of this phase is to provide a structure to evaluate the actual performance of a process by statistically assessing, monitoring and comparing its current performance to its output (Furterer, 2016). The current situation or problem is documented in this stage, and milestones, risks, corrective measures created, and metrics are established to help to monitor key process characteristics towards the objectives set in the Define phase (Leon, 2013; Thomas et al., 2017).

Analyze – The objective of the LSS project team is to identify, organise and validate the potential root cause of poor performance and problems (Thomas et al., 2017; Pepper and Spedding, 2010). This phase is characterised by collating all the information obtained in the measure phase and identifying the root cause of the problem the project has established to resolve. It involves analysing the system to identify ways to reduce the gap

between the current performance and the desired goals (Pepper and Spedding, 2010; Taylor, 2014; Furterer, 2016).

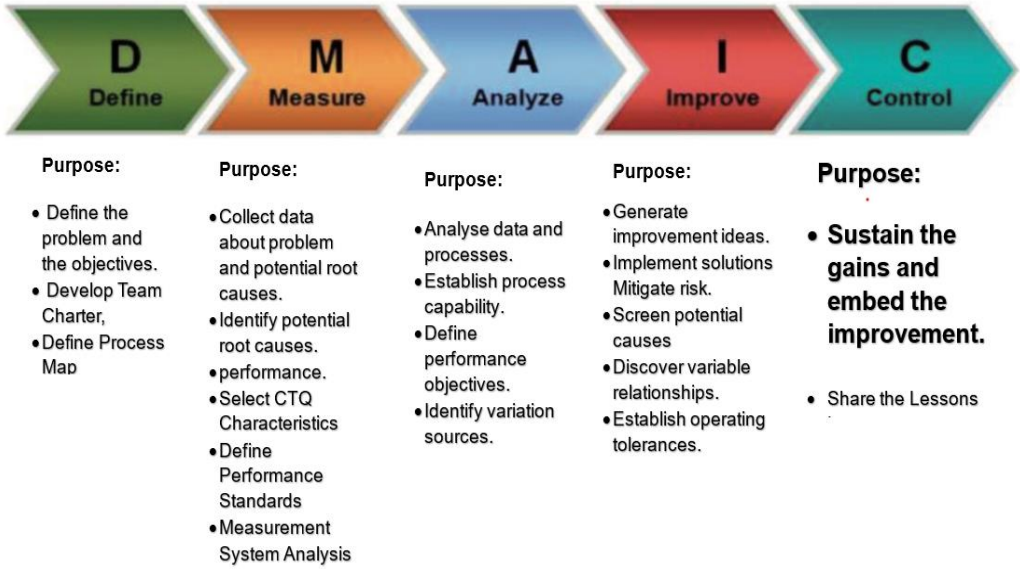
Improve – The Improve phase aims to build solutions that improve process performance (Furterer, 2016). How do we remove the causes of the defects? The improvement or implementation phase is when the selected solution during the analysis stage is implemented (Salah et al., 2010; Leon, 2013). As the result of the new solution implemented, the first output will be measured towards objectives settled initially.

Control – The Control phase aims to sustain the improvements achieved through various tools and techniques. It is an important stage in the LSS lifecycle as it ensures the sustainability of the results(Furterer, 2016; Pepper and Spedding, 2010; Taylor, 2014). How can we sustain and embed the improvements? This phase aims to lock in the benefits achieved by doing the previous stages and report any deviations from the goals established in the defined phase (Thomas et al., 2017; Antony et al., 2018). Also, to share lessons learned (Kumar et al., 2011).

3.4.3 LSS Framework Limitation and Research Gap

Although this systematic DMAIC structure LSS framework is one characteristic which makes LSS application effective with reported benefits (Oko and Kang, 2015; Thomas, 2017, 2018; Antony et al., 2019; Ikumapayi et al., 2020), however, the review of extant literature (See Section 3.9) reveals limitation from the Control (C) phase of the LSS DIMAC framework, with a report showing that the Control phase of DMAIC cycle has not been properly conducted (Murphree, 2011), to achieve it purpose where the improvement and the benefits are expected to be sustained and embedded in the organisation as indicated in Figure 3.5. More recently, LSS practitioners reported that sustaining improvements for extended periods is difficult and has become a common challenge in many organisations (Ali et al., 2023; Antony et al., 2018; 2019). Evidence also suggests that LSS efforts failed to drive the anticipated value and generate long-lasting gains (CBIS, 2017; Chakravorty, 2010). Most studies concluded that organisations that have sustained the gains of their LSS and CI effort are very limited (Chung, 2015; Duarte, 2012; Matteo et al., 2011). CI and LSS practitioners in their views argue that LSS program that is not sustained is considered to be a failed endeavour (Antony et a., (2019), nevertheless LSS efforts are consistently reported to have failed or not achieved their desired purpose (McLean et al., 2017; Antony et al., 2019; DeSanctis et al., 2018; Mohaghegh et al., 2021).

Figure 3.5: Summary of Purpose of each Phase of LSS-DMAIC Framework



(The Author)

Several researchers have investigated the CSFs of LSS project implementation in the service sector (Psychogios et al., 2012; Sfakianaki and Kakouris, 2019; Sreedhara et al., 2018; Tsironis and Psychogios, 2016; Kokkinou and Kollenburg, 2022), but very limited study has attempted to investigate the factors that enable sustainable improvement across service sectors and public service sectors despite the generally reported failures of sustainable improvement. Also, studies that have examined the CSFs and challenges factors of LSS project implementation in HEIs and public service are very limited. Following the literature review and to the best of the researcher's knowledge in the concerned field, no study has attempted to identify subject-enabling factors for deploying a sustainable LSS and CI initiative in HEIs and other public services organisations except for the healthcare sector. Evidence also shows that the LSS body of knowledge has not been thoroughly researched in the area of LSS and CI sustainability (Matteo et al., 2011; Ali et al., 2013; Antony et al., 2016; 2017, 2018, 2019b), which necessitated the need for further study on sustainable LSS as CI methodologies to embed the culture of CI.

Empirical studies assessing the benefit and impact of LSS in service and public sectors appear limited (Shokri, 2017). Most studies identified were merely conceptual and single case reports (Uluskan et al., 2016, Freitas et al., 2017; Shokri, 2017). A study assessing LSS application in the UK public sector by Antony et al. (2016) and Rodgers and Antony (2019), including HEIs, concluded that additional work is required to evidence the benefits better and return on investment that can be delivered as well as considering more holistic

approaches of LSS (Antony et al., 2016). Rodgers and Antony's (2019) review concluded that although the public service sector shows individual case studies of savings and benefits, no evidence is presented of the embracing of Lean or Six Sigma or Lean Six Sigma as a business process improvement strategy integrated into the working practices of a business model.

Studies show that steps to sustainable implementation of CI are dependent on the application of an effective performance and benefit measurement system (Kumar et al., 2010; Svensson et al., 2015; Sunder, 2016b, Thomas et al., 2017; Antony, 2017; 2018). However, Kumar et al. (2010) reveal that part of the challenges of LSS implementation is the difficulty experienced in measuring and quantifying the benefits flowing from LSS projects. Svensson et al. (2015), Sunder (2016b), and Thomas et al. (2017) also emphasise similar challenges and a lack of academic publications on how to quantify and measure improved performance in HEIs. Another criticism of the LSS approach is that, despite the success stories, some organisations that strived to emulate the success stories that have been reported often find out that it is not always as easy to achieve as others may have claimed (Sunder, 2016b). These gaps and discrepancies in the existing literature and theoretical framework are the motivating factors for this study. The assessment of research gaps in the literature review has motivated the Researcher to initiate this research.

3.5 Continuous Improvement Practice in HEIs

This section assesses the status of CI methodologies - Lean and Six Sigma applications in HEIs. Due to the limited literature on combined Lean Six Sigma in HEIs, and for a better understanding of the status of the CIMs practised within HEIs, the researcher decided to begin this section with the exploration of publications on the implementation of TQM, Lean, and Six Sigma within HE environments. Various papers that used TQM, Lean, Six Sigma and LSS methodologies for solving problems in HEIs environments were selected and reviewed to explore the status of LSS application in HEIs and to gauge whether LSS methodology has been deployed as a strategic change for sustainable improvement in HEIs or used as an operational tool for improving process efficiency.

3.5.1 Total Quality Management (TQM) in HEIs

Literature published in the 90s shows that TQM was the preferred methodology adopted in the HE community for meeting their improvement challenges (Quinn et al., 2009; Suarez-Barraza et al., 2012; Emiliani, 2015). However, a search of contemporary publications and

text on the implementation of TQM in HEIs appears limited, thus, indicating that the TQM framework is no longer the preferred choice of quality initiatives in HEIs. The adoption of TQM has been relegated and regarded as a fad methodology in the HE environment (Taylor, 2004; Antony, 2009; Waterbury, 2008; Naslund, 2008; Buccino, 2011; Emiliani, 2015; Sunder, 2016b; Nadeau; 2017). The lack of precise contexts for the strategic aims of HEIs adopting TQM has become apparent (Naslund, 2008, Sunder, 2016b).

In evidence, Aly and Akpovi (2001) investigated the extent of TQM implementation at California State University (CSU) and the University of California (UC), an institution with 32 state-wide campuses, playing host to half a million students and 27,000 faculties. From the 134 survey questionnaires sent out to senior administrative and academic personnel of both universities, 64 responses were received, with a response rate of 47 per cent. Based on the survey results, 55 per cent of the universities indicated they had adopted the TQM concept in one form or another. However, the findings show that 76% of universities reported implementing TQM for business administrative services. In comparison, only 18 per cent reported implementing TQM at a broader school level, and another 18 per cent on a campus-wide basis (Aly and Akpovi, 2001).

Aly and Akpovi's (2001) result also indicated that 53 per cent of the universities had made some improvement in managing their business processes, and 24 per cent indicated improved morale. Unfortunately, only 12 per cent reported some improvement in academic quality. The study further shows that 41 per cent of the universities discontinued their TQM programme, with 57 per cent identifying unsatisfactory results as a reason for discontinuation of the TQM programme. The authors concluded, in general, that the character of TQM implementation in HEIs is still limited to business-type operations of the universities, such as – business and finance and administrative services, and that the academic side of the institutions has not yet received significant attention of TQM implementation – therefore, TQM has not been widely implemented in HEIs (Aly and Akpovi, 2001).

3.5.2 Lean Management in HEIs

A search on references on the application of Lean as a business improvement technique in HEIs environment has appeared with greater frequency. Literature published since the year 2000 reveals a greater interest in the application and adoption of Lean principles as a stand-alone methodology in HEIs (e.g. Emiliani, 2005, Doman, 2011; Radnor and Bucci, 2011; Francis, 2014; Waterbury, 2015; Balzer et al., 2015; Thomas et al., 2015; Balzer et

al., 2016; Hofer and Naeve, 2017; LeMahieu et al., 2017; Narayanamurthy et al., 2017; Hargaden et al., 2018; Kregel, 2019; Zighan and EL-Qasem, 2020; Allaoui and Benmoussa, 2020; Kokkinou and Kollenburg, 2022; Simonyte et al., 2022). Studies revealed that Lean principles, with their original application from the manufacturing industry, have spread rapidly into the service sector and have been widely accepted and implemented in HEIs across multiple countries, with a substantial positive impact recorded in the sector by the advocates of the philosophy in HEIs (Balzer et al., 2015, Emiliani, 2004; 2015; 2005; Radnor and Bucci, 2011).

Thomas et al. (2015) comparatively investigated HE and Further Education Institutions' approaches to deploying Lean principles. In a sequential two-phase study, the Authors conducted a focus group of 25 participants followed by face-to-face interviews as feedback in 92 academic institutions in the UK. Thomas and colleagues reported that the infrastructure to embed Lean principles into the culture of the respective institutions was less developed. Although, the findings show that the institutions had experience implementing Lean tools driven by a consultancy-based approach with a tool-driven mentality. The project focuses on student improvement and cost-saving without a workable and coherent purpose-built HEI Lean operating model (Thomas et al., 2015).

Balzer et al. (2016) reviewed 64 publications on Lean in HE across various databases published between 2000 – 2015. They (Balzer et al., 2016) concluded that applying Lean tools and techniques can have a significant and measurable value in improving academic and administrative operations processes at the department level and the institution-wide approach. The report identifies the challenges Lean practitioners faced in HEIs as organisational culture, lack of communication, and lack of top management support, thus diminishing the achieved improvements (Balzer et al., 2016)

Analysing multiple cases of Lean implementation in HEIs, Waterbury (2015) captured the challenges and the lessons learned from implementing Lean in HEIs. Through semi-structured interviews with the administrators from seven HEIs in the USA who initially sought training opportunities and coordinated Lean projects, the author presented multiple cases with analysis of the critical success factors, challenges and barriers as insights from the institutions with experience implementing Lean. Based on experience, the author further outlines some critical reflective questions to consider before implementing Lean (Waterbury, 2015).

From indicative examples of success stories of Lean implementation in HEIs: The case of the University of Central Oklahoma's adoption of Lean principles and tools to address the institution's campus needs in facilities and other administrative areas indicated that: the university physical plant work order system per month reduced from 3,000 to 300, reduction on lead times for routine work order response calls from 24 days to 2 days, tracking system developed to monitor open work orders, savings secured and reallocated to address other needs, and Lean team were formed to streamline the processes and to achieve desired value-added (Kusler, 2009).

In the case of St Andrew University in the UK, the institution was introduced to Lean in 2006. The University trained and resourced a Lean team to lead Lean change initiatives, focusing on administrative functions with three main goals: culture change, effectiveness, and efficiency. The university's critical areas of Lean activity have been finance, library, registry and estates. However, the report indicated early difficulties and shortcomings, such as middle manager resistance to change, poor scoping of projects, and failure to deliver the project outcomes due to inadequate project management skills. However, the University made some significant gains in savings: a digital student attendance system that was estimated to have recouped efficiency savings of over £130,000 yearly; staff recruitment process and advertising saving £150,000 each year; streamlining of student debt management and the matriculation process saved £100,000 each year; a review of the casual staff payment process resulted in significant efficiencies savings of £24,000 each year (University UK, 2011; Robinson, and Yorkstone, 2014). Honken and Janz (2011) analysed the utilisation of Lean principles in Winona State University IT process improvement project. The report indicated that the IT department took a unique approach to resolve improvement issues by adopting a kaizen event (application of Lean tools and principles by the Lean team) to streamline the IT project life cycle, resulting in a significant increase in the number of completed IT projects in the university and an increase in customers and stakeholders satisfaction (Honken and Janz, 2011).

Klein et al. (2021) applied a Lean implementation framework to compare and prioritise waste reduction using Analytical Hierarchy Process (AHP) methodology in a Brazilian HEI. The seven original wastes plus the loss of knowledge waste were identified and evaluated as the main criteria. The proposed framework resulted in an arrangement of 24 wastes. Waste prioritisation allows universities to organise their activities and select tools or practices to optimize their efforts to create value for final users. Through a questionnaire with the administrative and technical staff of HE at five public universities in Morocco,

Allaoui and Benmoussa (2020) studied the attitudes of HE employees to the change with Lean at public universities to determine the factors of resistance to change and to look for the motivating factors that encourage HE employees to participate in change project with Lean. The findings show that individual, organisational and group factors positively impact employees' attitudes toward change with Lean, but individual factors are more important than other factors.

Ahmed EL-Qasem, (2020), through a semi-structured interview, explores the applications of Lean thinking in re-evaluating the business school curriculum by identifying and eliminating non–value-added activities in public universities in Jordan. The study finds that applying Lean thinking in the business school helps the school curriculum developer eliminate many superfluous and non–value-added activities. Value stream mapping is a valuable tool for developing an employability-focused curriculum.

Kokkinou and Kollenburg (2022) examine the CSFs of continuous improvement HE using online surveys and interviews with an international network of Lean practitioners in HE. Findings indicate that Lean implementation in HEI is characterised by a bottom-up approach involving supporting processes. The Author concluded that the role of management in implementing Lean in HE is limited and suggested that attention should be directed to employee empowerment and customer focus. The findings also showed that HE organizational culture is more influential than national culture.

The result of quantitative survey research by Petrusch et al., 2019, which investigated the degree of Lean thinking adoption in administrative services of Brazilian private HEIs, shows that no evidence of broad implementation of Lean thinking in administrative processes of Brazilian private HEIs was found, with the adoption being incipient. When compared to studies from USA and UK, highlighting the maturity of enablers, principles, tools and performance measures related to Lean. According to the Authors (Petrusch et al., 2019), the results were convergent to those presented by other USA and UK studies.

Regardless of the reported success stories of Lean in HEIs, the application of Lean as a stand-alone methodology is becoming limited. Research suggests that most HEIs' Lean projects focused on cost reduction, as the institutions had resorted to business process improvement mainly in the wake of the global financial crisis (Waterbury, 2008; 2015; Thomas et al., 2015; Balzer, 2016). The study has shown that Lean as a standalone methodology cannot achieve the triple goal of quality and process improvement (Cost,

Quality and Speed) for sustainable change and continuous improvement (George, 2002; 2003; Bendell, 2006; Arnheiter and Maleyeff, 2005; 2010; Snee, 2010).

3.5.3 Six Sigma in HEI

On the other hand, Six Sigma (SS) has witnessed popularity in the service and public sectors. Still, a search of academic references on the application of SS in HEIs indicates that SS adoption in the HE sector is minimal. The number of SS implementations is significantly lower than those of Lean (Thomas et al., 2015; 2017; Nadeau, 2017). In their recent study, Thomas et al. (2017) argued that Lean had taken hold in the psyche of many HEIs managers due to the number of success stories recorded, thus making Lean an increasingly utilized methodology than Six Sigma in HEIs.

It can be argued that HEIs journey within the formalised application of business improvement methodologies – Lean, Six Sigma, and Lean Six Sigma is still being developed. As evidence, Nadeau (2017) suggests that there have not been any conclusive and compelling findings concerning the use of Six Sigma and Lean Six Sigma (as new managerial approaches) in the HEI environment in general, as many HEIs are still in their first experiences with the use of the methods. Therefore, a predominance choice of applying the Lean tool over the statistically oriented Six Sigma and Lean Six Sigma approach is expected (Sunder, 2016a; Thomas et al., 2017; Nadeau, 2017).

3.5 Lean Six Sigma Practice in HEIs

Despite the success of LSS implementation recorded in other sectors, studies show that many HEIs are not keen on integrating LSS principles to understand and analyse variation within the HEIs business processes (Antony et al., 2016; 2017; 2018; Thomas et al., 2017; Sunder and Mahalingam, 2018; Sunder et al., 2020). For example, Psomas and Antony (2017), in an attempt to assess their awareness of LSS methodology in HEIs, interviewed 15 CEOs of HEIs in a sample of 40, and the result shows that only 26.7 per cent of participants knew about LSS practices in HEIs. In their studies, Antony et al. (2017) concluded that several universities worldwide have only begun to integrate both methodologies to achieve operational excellence. However, there is some documented evidence of LSS implementation in HEIs, with limited empirical investigation.

Xerox, a global company, was one of the early firms to apply LSS to their document management services in a HE environment with successful stores, as recorded in their white paper (Raifsnider and Kurt, 2004). At Ohio University, Murphy (2009) presented a

report on applying LSS tools and principles in an actual virtual reference improvement project of an academic research library. According to the report, LSS tools such as SIPOC maps (suppliers, inputs, process, outputs, customers) and Pareto Charts were adopted in the improvement project. Further, they discussed the benefits and limitations of deploying the LSS initiative within library settings in the HEI environment. The author suggests that the project can be executed as a one-off but argues that adopting LSS methodology and cultural change would require institutional support. Murphy (2009) concluded that adopting the LSS approach enables the academic library to respond swiftly to changing student needs and develop infrastructure that supports and sustains a culture of assessment and change in the institution.

In a study, Weber (2013) attempted to determine if LSS methods could help technical college instructors maintain or improve learner outcomes when applied to significantly shortened course duration from 17 weeks to 15 weeks semester period. The author quantitatively examined the difference in learner performance data between the two groups using LSS approaches to Cohort 1 (intervention group) to shorten their course duration from 17 weeks to 15 weeks. While cohort 2 had the same course delivered without applying LSS methods. The findings indicated that the LSS methodology's effectiveness as learner assessment performance measures was not significantly different between Cohort 1 and 2 despite having a 12 per cent reduction in usual coursework duration (Weber, 2013).

Kanakana et al. (2015) presented the application of LSS in a single case study in addressing a longstanding problem of low throughput rate (higher rate of student dropout) in the University of Technology – South Africa engineering faculty. The authors employed a Voice of Customers (VOC) - students' voice sample through a survey to estimate the current throughput rate and the Sigma level. Findings indicated that 42.8 per cent of students failed to graduate within six years of enrolling, with a low throughput rate of ≤ 23 per cent and a low sigma level at 1.3 compared with 3 Sigma levels attainable at other international HEIs. The low throughput rate and defect level variables were identified and analysed, based on which LSS improvement solutions were developed and deployed to reduce the variation in the process. Which consequently led to an increase in throughput rate from 38% to 71% in the following year. Although Kanakana et al. (2015) presented a success story of LSS, their proposed approach was merely selecting a few LSS tools in a one-off improvement project.

In a case study, Isa and Usmen (2015) explored whether LSS concepts and tools could be applied to analyse and improve facility management services (FMS) at Wayne State University. During the study, the authors actively engaged with the department and collected qualitative and quantitative data from the faculty, the students and members of staff to evaluate and rank the quality of services provided. Findings show that applying LSS within the DMAIC framework can effectively analyse and improve business processes, eliminate non-value-added activities, reduce bureaucratic reviews and approvals, and improve operational efficiency and effectiveness (Isa and Usman, 2015).

Oko and Kang (2015) illustrated the application of the LSS–DMAIC model in providing effective improvement to the student admission process at the State Polytechnic in Nigeria. Through a qualitative study, the authors highlight a poor and inappropriate admission process, accompanied by various wastes (Muda) in the process – resulting in a high process lead time, higher cycle time, and high defect process causing rework and repetitions of functions. The Authors applied LSS methodology to improve the efficiency and the effectiveness of the student admission process, which helped to reduce: the process lead-time, cycle time, and idle times minimise variation in the process with fewer reworks and increase the process utilization time and the process cycle efficiency (Oko and Kang, 2015).

Svensson et al. (2015) presented evidence of the LSS approach, utilized as a core CI philosophy at King Abdullah University of Science and Technology (KAUST) in Saudi Arabia, to create a platform of business process and quality improvement across the administrative functions within the University. According to the authors, the LSS programme was executed alongside training 350 staff members on LSS awareness, including certification of 50 yellow belts, 150 green belts, and seven black belts to facilitate and promote LSS initiatives across the institution. The results show improvement in business processes and efficiency and provide staff members with a platform to initiate process improvements in the entire institution and help streamline the support functions in delivering smooth and efficient service to students, faculty, and staff members (Svensson et al., 2015). However, the authors (Svensson et al., 2015) highlighted a lack of patience from the business owners, as they often push for the systems' immediate rollout without a detailed understanding of the improvements required. Secondly, there were concerns about how the program will progress into the maturity phase for sustainability and continuous improvement. In addition, Svensson et al. (2015) expressed a lack of a mechanism to continually monitor (lack of control plan) the improvement project following

completion and a call for the process owner to take responsibility for measuring and continuously improving process performance. Although the Authors (Svensson et al., 2015) also indicated that the project was successfully implemented, but highlighted concerns about how the LSS improvement project will be sustained over a long period. The same gap this researcher proposed to address through this study.

In their study, Bargerstock and Richards (2015) demonstrated an application of combined LSS methodologies and tools in an academic assessment process improvement project for business courses at Maharishi University of Management, USA. Through a cross-functional team, a Kaizen event was deployed with SS DMAIC to streamline the efficiency of the academic processes and boost faculty compliance. The Authors reported a two-third reduction in cycle time, eliminating non-value-added activities, creating additional customer value, and significantly increasing compliance rates (Bargerstock and Richards, 2015). Although the single case study cannot be generalised, it thus revealed that LSS methodology could be substantially applied to improve academic processes in HEIs. (Bargerstock and Richards, 2015).

Antony and Cudney (2016) evaluated the development of LSS for efficient and effective process and systems improvement in a Scottish HEI as part of the institution's LSS journey. The authors illustrated a list of LSS projects the institution's improvement team (staff members) completed. From the example of the improvement project presented, the focus was on the institution's administrative, finance, human resources, and estate management aspect. Antony and Cudney (2016) outlined key Lean and Sigma tools used in the project in a more serial approach, where Lean tools were deployed at the initial phase, followed by the application of the SS toolkit. Through lessons learned, the authors (Antony and Cudney, 2016) explored the challenges and CSFs encountered. They concluded that the LSS methodology application had not been widely adopted in HEIs due to some misconceptions. However, Antony and Cudney (2016) further noted that LSS methodology can be deployed to tackle the efficiency and effectiveness of business improvement across the HE sector.

Sunder (2016a), in a real-time case study, presented an analysis of how LSS was leveraged to improve a university library process in HEI in India, with the objectives to improve library utilisation and save 83 man-hours per day. The author highlighted academics' and practitioners' views of success stories of LSS methodology adopted by several HEIs around the globe, including the uniqueness of a higher education system

(HES) for adopting improvement initiatives. Upon implementation, the case shows that the time taken by students to search for library books was reduced from 15 minutes to less than 5 minutes on average. According to Sunder, the case study helps reveal insight into the future application of LSS and its benefits to HEIs (Sunder, 2016a).

An empirical study by Thomas et al. (2017) attempted to develop and implement an integrated LSS framework within UK HEI in the academic curriculum design and delivery of a new undergraduate programme. To identify critical issues regarding the strategy and the type of improvement programme employed, the authors surveyed eight HEIs, collected observational and verbal data through semi-structured interviews, and selected one case study to test the design HEIs LSS framework. The survey findings show little widespread adoption of LSS in HEIs and identified Lean as the strategy of choice within the eight HEIs. According to the authors, there was little evidence of the application of advanced LSS. The approach was merely a selection of tools in a simplistic manner without any attempt by the respective institutions to integrate LSS into a coherent system. Their findings also reveal that HEIs implemented Lean principles because they failed to articulate the benefit of both (LSS) methodologies. SS tools were viewed as too statistical and thus required a considerable investment in statistical training (Thomas et al., 2017). Thomas and colleagues concluded that applying a balanced LSS framework shows that LSS can effectively be deployed for curriculum development and enhancement in HEIs, improving stakeholder (student) engagement. Although the authors further suggested that it was too early to determine whether the curriculum design changes have taken effect. However, the project was vital in initiating and driving change in the academic curriculum by the university leaders (Thomas et al., 2017).

In another study, Antony et al. (2017) attempted to explore the fundamental challenges and CSFs in developing a Lean Six Sigma (LSS) initiative within UK HEI. Following an initial review of related literature, the authors presented a case study on how a UK HEI named University “X”, with five campuses and home to over 10,000 students, has implemented various LSS projects to improve core efficiency and effectiveness and support business processes. The paper shows that University X adopted a sequential LSS model in two phases by initially focusing on Lean principles and tools to reduce waste and sequentially applied SS methodology to tackle ineffectiveness in business processes (Antony et al., 2017). The authors reported success at the institutional level and outlined the outcome. Based on the project experience and lessons learned, the authors further shared CSFs and barriers to LSS project completion (Antony et al., 2017). Although the

LSS projects were executed across other departments within the HEI, there were no projects to improve academic processes such as teaching effectiveness. Most of the evidence presented was based on perspectives of lessons learned. A simple sequential combination of Lean and SS tools and techniques lacked an integrated and coherent approach as proposed.

Antony et al. (2012) presented the key challenges and CSFs essential to introducing and developing LSS in HEIs. Following their experience, the authors noted that selecting LSS tools and techniques in HEI depends on the organisation's needs. They also presented some LSS tools and techniques for implementing LSS methodology in HEIs. They (Antony et al., 2012) concluded that LSS applications in HEIs are still embryonic, including an apparent misconception by many PSOs that LSS cannot be transferred to the HE sector because of its origin from the manufacturing industry.

Simon (2013) presented a practitioner view paper on the business case for LSS in HEIs.The author argued that the HE system grapples with delivering top-performing students in a cost-efficient manner. Simon outlined a comprehensive list of benefits of LSS application in HEIs. Simon noted that the business case for LSS in HEIs includes academic programs, operations process improvement, and cost reduction (Simon, 2013). Antony (2014), in a review, identifies the readiness factors (RFs) to introduce and develop LSS methodology within HEIs as – visionary leadership, management involvement and commitment, linking the improvement initiative (LSS) to the institution's strategy and the selection and retaining of the right business improvement project team and leader. However, the author recommended that HEIs start their improvement initiatives by tackling administrative process problems before embarking on colossal investments in strategic-oriented projects. Finally, Antony (2014) suggested a sequential approach to applying Lean and Six Sigma.

Hess and Benjamin (2015), in their review of the historical development of LSS, identify the relevant opportunities for its application within the HEIs setting and discusses the challenges of LSS implementation and the cultural changes necessary to provide an appropriate climate for its long-term success with HEIs. The authors further discuss the potential impact of LSS on the various HEI departments. In conclusion, the authors stated that LSS methodology could facilitate vast improvements in HE sectors, serve as a catalyst to change needed to ensure continued improvement in the HEIs and serve as an agent of cultural change for public and private institutions. Nelson (2015) reviewed various cases

of LSS tools and techniques applications within HEI libraries. The Author identified Value Stream Mapping (VSM) and Failure Mode and Effects Analysis (FMEA) control plans to be used within the existing culture to maintain quality processes and services for HEI library users. However, the author augured the need for an LSS framework at the institution's broader level to create continuous and sustainable improvement (Nelson, 2015). Nelson's study also supports the objectives of this study.

Wiegel and Brouwer-Hadzialic (2015) explored the case for applying LSS in HEIs in review to explain a set of structural variable differences between HEIs and manufacturing domains. The authors argued that the impact of LSS fell short of expectations and performance in the education sector and grouped the reasons for failure as structural domain-specific and change management issues. They presented six variables framework - co-production, interdependency, technology, input variation, and informational nature. In describing their structural differences and relationship in LSS application in HE domains, Wiegel and Brouwer-Hadzialic, (2015), argued that it makes the generic application of LSS less plausible, naive and likely to decrease the methodology's effectiveness. Therefore, supporting the view for sector and industries specific approach to LSS application.

Sunder (2016b) provided a good contrast review of the TQM, Kaizen, Lean, Six Sigma and combined Lean Six Sigma applicable in HEIs. In the study, the author attempts to compare the value and shortcomings of these CI initiatives with combined LSS in imbibing quality into HEIs. The Author viewed LSS as a recognised organisation strategy and leadership that aims to target every opportunity for improvement within an organisation to imbibe a quality culture. Conclusively, Sunder (2016a), similar to Antony et al. (2017), concurs that LSS deployment in HEIs is in its introductory phase and accentuates various opportunities for future research for the effective application of LSS in HEIs.

In their study, Lacher and Staudacher (2016) adopted the LSS approach of the DMAIC cycle to evaluate the difference in understanding the University student dropout phenomenon, the factors leading to the dropout, and the flexibility of such elements. The authors, through expert interviews, attempt to understand how LSS tools and techniques can be used as business improvement methodology to provide a remedy to reduce dropout rates among HEIs students. Although Lacher and Staudacher (2016) observed no common agreement on the factors leading to student dropout among the interviewees, there was rigidity in some crucial factors identified. The Authors argued that identifying the real reasons for dropout posed a barrier to any dropout reduction strategy. However, Lacher

and Staudacher (2016) concluded that LSS could be deployed to unify ambiguous databases to understand the underlying reasons for student dropout, thereby reducing dropout rates (Lacher and Staudacher, 2016). Lu et al. (2017) attempted to develop a theoretical leadership model to address current impediments and challenges associated with LSS application in the HE environment. In discussing the characteristics of Leadership that can be adopted in the HE environment, the Authors presented the differences between conventional leadership (industrial Leadership) and leadership in HEIs. They argued for the need for LSS leadership that is better suited for HEIs and proposed the LSS leadership theoretical model, which can help improve the quality of education, reduce non-value-add processes and costs, and enhance the operational efficiency of HEIs (Lu et al., 2017).

In reviewing related literature published over the past 16 years, from 2000 to 2016, Nadeau (2017) attempted to provide a worldwide report of the documented experience of Lean management, SS, and combined LSS approaches in HEIs communities. The author highlighted the targeted outcome and the actual result obtained, the preferred tools, the challenges and the improvement opportunities. Nadeau (2017) findings revealed that the combined LSS approach had been applied primarily on a highly localised basis to teaching-related processes or services such as finance process, data processing and building maintenance within HEIs. The finding also shows that some challenges are unique to the HEIs setting. The author highlighted that the complexity of HEIs, in interpreting who their clients are, the notion of added value, and the connections between teaching and research, thus makes the LSS implementation approach even more difficult. Nadeau (2017) concluded that although the few measured results suggest that the methodology holds promise, the impact of LSS application in HEIs remains to be determined and highlighted the need for a broader study, which, thus, supports the purpose of this study.

Using multiple case-study methods, Sunder and Mahalingam (2018) explore the implementation of LSS in two select international University colleges. The Author adopted the LSS toolkit of the DMAIC structure in the execution of the projects, featuring student teams in the selection and implementation of the LSS project. Sunder and Mahalingam's (2018) empirical study helped validate the application of LSS methodology in HEIs, highlighted various challenges and benefits of LSS in the HEI environment, and emphasised collaboration between practitioners, academia, and students in project management. In a paper to further expand the applicability of LSS in the HEI setting, Sunder and Antony (2018), through review, suggested a six-step conceptual framework for deploying LSS methodology in HEIs: HEIs LSS readiness, aligning of LSS approach with

the organisational vision, LSS deployment strategy, educating the appropriate stakeholders (students) and formation of CI team. The Authors further noted that the LSS initiative should not be seen as anyone's job but as a crucial part of the leadership agenda (Sunder and Antony, 2018)

O'Reilly et al. (2019, presented the key learning points arising from the early steps in the journey of LSS CI initiatives in an Irish university with over 2,800 staff and over 21,000 students. The findings show the introduction of LSS in a structure DMAIC rather than Lean alone to support the institution's administrative processes with a successful outcome such as improved cycle time, cost-reduction, customer and employee satisfaction, and reduction in rework and error. The authors (O'Reilly et al., 2019) emphasised the importance of LSS readiness factors, as Antony (2014) previously identified.

Furterer et al. (2019), through mixed-methods participatory action research, applied LSS methodology to improve the tutoring processes at the university. The process improvement project outcome shows an outstanding balance between tutor utilisation and student waiting time, including improved efficient and effective utilisation of resources within the institution. The Authors noted that the LSS approach could help to: minimise the risk of implementing solutions that are costly or ineffective; help to improve the university's commitment to tutors and tutoring; enhance relationships, and improve utilisation and the overall culture and work environment. Furterer et al. (2019) concluded that combined tools of LSS could be deployed to effectively and efficiently improve other repetitive processes within the university.

Haerizadeh and Sunder (2019) paper demonstrated the applicability and impact of LSS for improving the HE system at Iranian University, given the global challenges facing HEIs, as presented by the Authors. Using a single case study approach, the Authors (Haerizadeh and Sunder, 2019) illustrated the implementation LSS-DMAIC cycle in HEIs and highlighted the implementation challenges based on lessons learned. During implementation, a baseline goal was set by the LSS team to achieve an overall improvement of 10 per cent level of student satisfaction, decrease student advising wait times by 15 per cent, and increase enrolment by 5 per cent. The study shows that the LSS methodology implementation delivered the set goals, including student-facing benefits of improved quality in the education system. Like Antony et al. (2017), the Authors (Haerizadeh and Sunder, 2019) remarked that applying LSS in HEIs is at the infancy stage.

Wheeler-Webb and Furterer (2019) illustrate the application of LSS to improve the quoting, scheduling, invoice and payment to vendors for a university's campus office move process. The project shows a significant improvement in the campus move process, with a 27 per cent improvement in average project delivery time and a 38 per cent reduction in the invoice processing time. The Authors noted that the project's success was based on the effective engagement of project sponsors and owners from the beginning, including all stakeholders' project approval. Li et al., 2019 use a practical case study approach to demonstrate the power of using LSS to improve an HEI's service process. From the case study, the LSS team found HEI service process contains a sizeable human behaviour component, which dramatically increases the unpredictability of the entire service delivery process and increases the complexity of the process and the ability of the improvement team to identify the root cause. The paper also illustrated the challenges met and lessons learnt for the LSS application (Li et al., 2019).

In another study, Furterer and Key (2019) implemented LSS methods and tools to improve the Office of Learning Resource's student employment hiring processes at the University of Dayton. LSS methodology was applied to engage the multiple stakeholder groups in the Office of Learning Resources to improve their processes. The LSS team developed sixteen major process improvement ideas. The tutoring coordinator implemented several of the ideas, which reduced the time to hire students, and will measure the results after the end of the semester. Some of the other team managers struggled with implementing the improvements, demonstrating that the change management elements are some of the most difficult to execute within LSS. This case study effectively highlighted the value of applying LSS process improvement tools in higher educational administrative processes. It also highlighted the variability between stakeholders in engagement and their ability to successfully implement process change.

In recent literature, several case studies have been conducted to implement or utilise LSS in higher education. LSS was applied in higher education to reduce student dropout rates by Gupta et al. (2020). A qualitative study with semi-structured interviews to analyse student dropout causes was conducted. LSS tools were employed; however, the lack of detailed records hindered analysis. Adeinat et al., 2022) presented a case study using the LSS process to manage the Assurance of Learning (AoL) to improve the curricula process of the Faculty of Economics and Administration (FEA) at King Abdulaziz University in Saudi Arabia. The case study highlights the value that LSS can bring to the HE context concerning making the AoL process more efficient and effective. It emphasises LSS use

in developing the project charter, mapping the process using the SIPOC model and various LSS tools and techniques to measure and control the assessment (Adeinat et al., 2020). The Author also highlighted lessons learned based on experience.

After an extensive literature review, Gastelum-Acosta et al. (2023) surveyed Mexican public HEIs to identify the existing relationships among the CSFs and their impact on the benefits of implementing LSS projects. The authors applied a structural equation modelling (SEM) technique, and findings suggest that the success of LSS projects in HEIs is highly bound to a serious commitment from top management and several interrelated factors. In a case study, Shamsuzzaman et al. (2023) implemented the LSS methodology to improve the admission process of an HEI. The adopted DMAIC and Lean framework preliminary investigation showed that completing the whole admission process of a new student takes an average of 88min, equivalent to a sigma level of about 0.71 based on the targeted admission cycle time of 60min. Implementing the proposed LSS approach increased the sigma level from 0.71 to 2.57, which indicates a reduction in the mean admission cycle time by around 55 per cent. Substantial improvement was also expected to provide an efficient admission process, enhance the satisfaction of students and employees and increase the reputation of the HEI to a significant level.

3.5.1 Criticism of LSS in HEIs

The literature review on the application of LSS in HEIs (See Appendix A2 – LSS application in HEIs) suggests that the application and adoption of integrated LSS in HEIs generally are still in their infancy (Antony et al., 2017; Nadeau, 2017; Thomas et al., 2017; Haerizadeh and Sunder, 2019 Adeinat, et al., 2020). Most of the case studies reported centred on a single case approach. Others were practitioner reports of case studies based on lessons learned. Therefore, it can be argued that these studies lack replication and generalisability (Yin, 2013). The review shows that LSS has only been applied in resolving departmental issues separately. Evidence also suggests that LSS implementation approaches adopted in HEIs often depend on selecting a few Lean and Six Sigma tools and techniques. There has been no attempt to create the underlying culture needed to launch LSS concepts as integrated principals across the institutions. Therefore, LSS has not been rooted at the institution-wide level to embed a change and continuous improvement culture. As such, the real benefit of LSS implementation in HEIs has not been fully realised across the Institutions. A further review of publications on LSS methodology in HEIs shows several anecdotal reports, conceptual studies on reviews, and practitioners' viewpoints, where

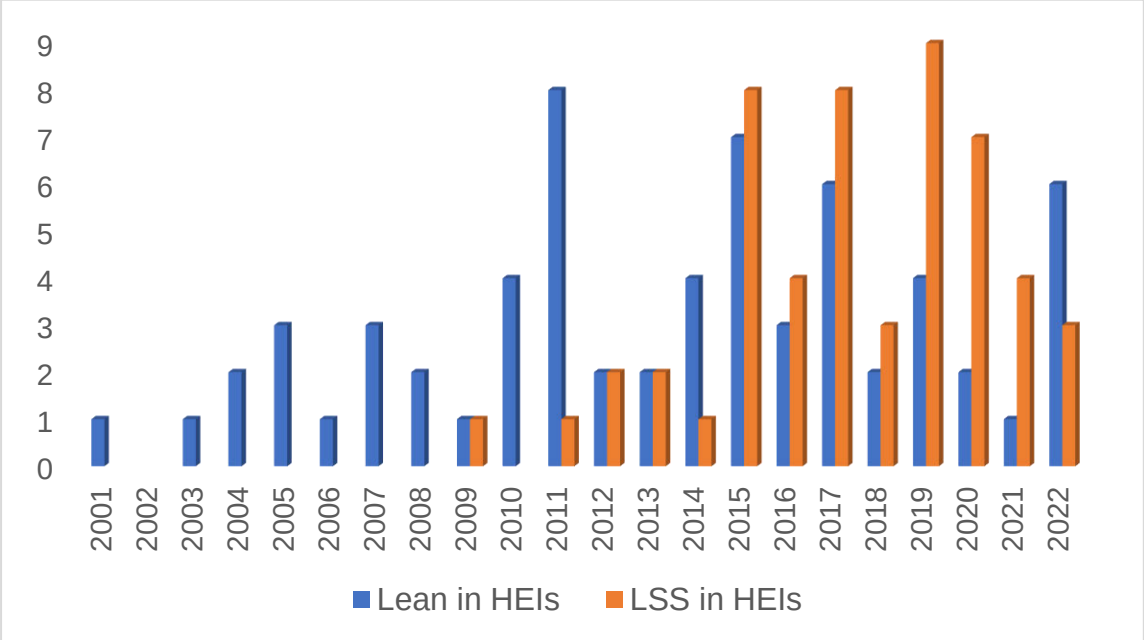
researchers and practitioners have only provided their views based on their experience and lesson learned. Therefore, it lacked demonstration of research conducted through the rigour of empirical investigation in HEIs environment.

3.5.2 Analysis of Lean Versus Combine LSS Publications in HEIs

To understand the most adopted CI methodology (Lean and Lean Six Sigma) in the HE environment, the researcher attempts to compare the academic publication of Lean methodology in HE as a standalone tool and the publication of Lean Six Sigma as an integrated approach in the HE environment. An extensive search of different databases was conducted on the literature on Lean in HE and LSS in HE, which was published between 2001 and 2022. From the extensive search, 198 articles and academic publications on Lean and Lean Six Sigma in the HE environment were found, out of which 65 were Lean as a stand-alone publication. In contrast, LSS in HEIs publication found was 53 as outlined in Appendix A1 and A2.

The findings analysis (See Figure 3.6) shows that only Lean methodology academic literature was published between 2001 and 2008. The combined Lean Six Sigma publications in the HEI environment did not begin until 2009. However, the Lean methodology was the preferred approach until 2014. The analysis further clearly shows that in 2015, the number of published Lean literature in the HE environment has dropped compared with the growing publication of LSS literature. Therefore, one could argue that the combined LSS approach LSS has become the dominant and more acceptable CI methodology in the HEI environment, as indicated in Figure 3.4. This was also shown in Gomez-Molina and Moyano-Fuentes's (2022) recent search of Lean and LSS literature publications between 2003 – mid-2020, where they identified only 68 articles on both Lean and LSS in the HE environment.

Figure 3.6: Lean V. LSS publication in HEIs: Between 2001 – 2022



Source: The Author

3.6 Success and Challenges Factor to LSS Project Implementation in HEIs

Based on the research objectives to identify the critical success factors (CSFs) and the impeding factors of LSS implementation from a HEIs perspective. This section has attempted to identify those CSFs and the challenges that underpin the effective implementation of the LSS project in the HE sector. This section begins with a discussion of the concept of CSFs and the relevance of CSFs to the effective and efficient management of business change and CI. The findings and analysis of the CSFs of LSS in the HE sector were presented following reviews of related literature.

3.6.1 Critical Success Factors (CSFs)

Identifying and applying critical success factors (CSFs) to solving business and management problems is not a new approach to the field of studies (Rockart, 1979; Kumar et al., 2010; Oprime et al., 2011). CSFs with origin and popularisation of application from information system discipline can be dated back as a basis for determining managers' information needs in a clear and meaningful way critical to the success of any organisation (Rockart, 1979; Bullen and Rockart, 1981). Brotherton and Shaw (1996) also defined CSFs as essential aspects an organisation must identify to achieve a competitive advantage.

In the context of LSS and CI implementation, CSFs can be considered major starting points (Tsironis and Psychogios, 2016) and represents the essential elements without which any CI and change initiatives stand little chance of success (Jeyaraman and Teo, 2010; Antony et al., 2012; Antony and Cudney, 2016). Therefore CI CSFs must give careful and constant attention for any organisation to succeed in their CI journey (Antony et al., 2012; Antony and Cudney, 2016; Antony et al., 2017). There was no doubt early researchers of quality management (e.g., Ahire, 1996) highlighted the increasing number of quality management project failures and called for researchers to develop a consistent and validated set of principles to implement and sustain quality improvement initiatives.

Although several studies have investigated CSFs of quality management initiatives, early studies much focused on TQM programs (Owlia and Aspinwall, 1997; Yusof and Aspinwall, 1999; Sila and Ebrahimpour, 2003), Lean principles (Achanga et al., 2006) and SS (Antony and Banuelas, 2002). Some studies refer to CSFs of LSS but mainly emphasise manufacturing industries (e.g., Coronado and Antony, 2002; Arnheiter and Maleyeff, 2005) and other service industries (e.g., Psychogios et al., 2012). However, HE sectors, which culturally have a complex organisational system, seem to be neglected. Research shows limited academic and empirical investigation identifying the CSFs of LSS implementation in HEIs (Sunder, 2016b, Antony et al., 2017; Sunder and Mahalingam, 2018; Antony et al.,2018). Sunder (2016b), acknowledging such limitations, concluded that further studies are needed to understand the success and failure elements of LSS application in the HE sector. It could be argued that there are similarities in CSFs across organisations and industries in the implementation of CI and quality management initiatives (Youssef and Zairi, 1995; Sila and Ebrahimpour, 2003; Fryer, 2009; Antony et al., 2002; Nashund, 2013; Buccino, 2011; Sreedhara et al., 2018; Sfakianaki and Kakouris, 2019Sunder et al., 2020; Kokkinou and Kollenburg, 2022). Earlier studies, Youssef and Zairi (1995) and Sila and Ebrahimpour (2003) comparative analysis of quality management CSFs in organisations worldwide shows similarity in universally important CSFs.

Nashund (2013), in a study reflecting on the analysis of CSFs for Lean and SS methodologies, compared the CSFs of TQM, JIT, TPS and Re-engineering and opined that the CSFs listed in academic journals consulting reports are similar. Nashund argued that although the level of detail of the CSFs varies, the content appeared comparable with only slight variations. According to the report, the CSFs of Lean and SS are similar to all other improvement initiatives and relatively constant over time. The Author concluded that CSFs

relate more to how an organisation approaches the CI initiatives versus specific factors. Even though certain authors bring up some aspects of CSFs for the specific CI methodology, most CSFs are relatively general.

Following the view of strong similarities between CSFs of CI methodologies, the researcher reviewed literature focusing on CSFs for effective implementation of TQM, Lean, Six Sigma, and combined LSS as CI methodologies in service sectors, public sectors and HEIs. A total of 183 CSFs was identified from 40 sources (see Appendix B), the 183 CSFs identified were collapsed into 25, and the most prevalent CSFs were presented in Figure 3.5 and Table 3.4 (Abu-Bakar et al., 2015; Antony and Cudney, 2016; Antony et al., 2007; Antony et al., 2012; Antony et al., 2018; Bayraktar et al., 2008; Buccino, 2011; Coronado and Antony, 2002; Francis, 2014; Fryer, 2009; Fryer et al., 2007; Gonzalez-Aleu et al., 2018; Heckl et al., 2010; Hilton and Sohal, 201; Isa, 2013; Jeyaraman and Teo, 2010; Kim, 2010; Laureani and Antony, 2012; Matteo et al., 2015; Pederson and Hunchi, 2011; Psychogios and Tsironis, 2012; Psychogios et al., 2012; Sfakianaki and Kakouris, 2019; Sila and Ebrahimpour, 2003; Sreedhara et al., 2018; Tsironis, and Psychogios, 2016; Kokkinou and Kollenburg, 2022; Francescatto et al., 2023; Kowang et al., 2022; Gastelum-Acosta et al., 2023). As identified, categories were found to be similar or strongly related, but the factors were consolidated to reflect the group and placed in a category of best fit.

From the review, leadership and top management commitment were identified as the most important core factors of LSS implementation (Owlia and Aspinwall, 1997; Sila and Ebrahimpour, 2003; Antony et al., 2007; Bayraktar et al., 2008; Fryer, 2009; Jeyaraman and Teo, 2010; Buccino, 2011; Antony et al., 2012; Matteo et al., 2011; Hilton and Sohal, 2012; Holmes et al., 2015; Tsironis, and Psychogios, 2016; Antony and Cudney, 2016; Antony et al., 2017). Studies outline leadership's role in LSS implementation (e.g. Antony and Snee, 2010). As noted in the context of LSS, leadership should be rooted in an organisation's elements instead of just one person and extended from top management in any LSS project (McCarty et al., 2005). However, Lu et al. (2017), in their study, drew on the uniqueness of leadership in HEIs, distinguished between traditional leadership in HEIs and LSS leadership in HEIs and criticized the traditional path to leadership within HEIs as inadequate for leading HEIs in today’s business environment. The authors suggest that to understand and implement LSS in HEI, LSS leadership is better suited than conventional leadership (Lu et al., 2017), leaving a gap for researchers to further develop the HEIs LSS leadership model.

Beyond leadership, other prevalent factors identified were training and development, organisational culture, and project selection and prioritisation (Owlia and Aspinwall, 1997; Sila and Ebrahimpour, 2003; Antony et al., 2007; Bayraktar et al., 2008; Holmes et al., 2015; Fryer, 2009; Jeyaraman and Teo, 2010; Kim, 2010; Buccino, 2011; Antony et al., 2012; Matteo et al., 2011; Psychogios, and Tsironis, 2012; Hilton and Sohal, 2012; Isa, 2013; Sahu et al., 2013; Francis, 2014; Abu-Bakar et al., 2015; Tsironis, and Psychogios, 2016; Antony and Cudney, 2016; Antony et al., 2017). However, in some cases, the factors cited were particular and isolated to a specific source. For example, Kim (2010) identified change management as a factor, while Matteo et al. (2011), in their survey, also focused on specific steps of Kolter's (2008) change model, such as – the creation of a sense of urgency, creation of vision/goal, removal of obstacles for change, and creating quick wins.

Further identified is Knowledge management development (Francis, 2014), best practice sharing (Jeyaraman and Teo, 2010), benchmarking (Sila and Ebrahimpour, 2003; Jeyaraman and Teo, 2010), and performance measurement and evaluation (Bayraktar et al., 2008; Holmes et al., 2015; Hilton and Sohal, 2012), were also identified as specific and isolated factors. Recent studies on the CSFs of Lean and Lean Six Sigma application in HE, Kokkinou and Kollenburg (2022), Francescatto et al. (2023), Kowang et al. (2022), and Gastelum-Acosta, et al. (2023) also identified similar CFSs with previous studies. It is noteworthy that the key findings on CSFs from the literature, as summarised in Figure 3.7 and Table 3.4, have a universal application to help successfully implement any business improvement initiatives, not just the LSS project. Identification of CSFs is encouraged when organisations and institutions are considering developing an appropriate CI and change implementation plan (Antony and Banuelas, 2002).

Figure 3.7: CSFs of LSS Project in HEIs - from Literature Review

Source: The Author

Table 3.4: Critical Success Factors of Lean Six Sigma in HEIs

	Abu-Bakar et al. (2015)	Antony and Cudney (2016)	Antony et al. (2007)	Antony et al. (2012)	Antony et al. (2018)	Bayraktar. et al., (2008)	Buccino (2011)	Coronado and Antony (2002)	Francis (2014)	Fryer (2009)	Fryer et al. (2007)	Gonzalez-Aleu et al., 2018	Heckl et al., 2010	Hilton and Sohal (2012	Isa, (2013)	Jeyaraman and Teo (2010)	Kim (2010)	Laureani and Antony (2012)	Matteo et al. (2015)	Pederson and Hunchi, 2011	Psychogios and Tsironis, (2012)	Psychogios et al. (2012)	Sfakianaki and Kakouris, (2019)	Sila, I. & Ebrahimpour, M. (2003)	Sreedhara et al. (2018)	Tsironis, and Psychogios, (2016)	**Total Frequency**
Top management commitment and support			X	X			X	X		X	X	X	X	X	X	X	X	X		X		X	X		X	X	**18**
Effective communication		X		X	X			X		X	X		X	X		X			X	X					X	X	**13**
Visionary Leadership	X	X		X	X	X	X	X	X	X	X			X		X		X	X		X			X			**16**
Developing readiness		X		X	X																						**3**
LSS/CI skills and competence	X		X	X		X		X				X			X	X	X					X			X		**11**
Project selection and prioritisation		X	X	X	X		X			X					X	X	X					X					**10**
Organisational culture			X	X	X		X			X			X		X	X	X	X			X	X	X		X	X	**15**
Training and development	X		X				X			X	X	X	X	X		X	X		X	X	X		X	X	X	X	**17**
IT and System	X								X			X					X				X	X		X		X	**8**
Best practices sharing and benchmarking																X								X			**2**

Project Management Skills	X		X					X	X				X	X	X		X								X	**9**
Reward/incentive and Recognition system			X			X							X		X	X				X						**6**
Financial capability and accountability			X				X								X	X										**4**
Data Management – report/dashboard							X			X						X	X									**4**
Organisational Structure			X				X			X	X			X			X			X						**7**
Customers Management/focus						X		X		X	X		X		X						X	X	X	X	X	**12**
Teamwork /Employee involvement and empowerment						X		X		X	X	X								X	X		X	X	X	**11**
Supplier Management								X		X	X												X	X	X	**6**
Linking improvement methods to strategy	X							X			X		X		X			X		X					X	**8**
Company-wide participation			X														X									**2**
Framework - specifying tools & techniques						X									X		X									**3**
Change management								X							X				X	X						**4**
Performance measurement and evaluation						X		X			X		X	X									X			**6**
Process Management											X		X							X						**3**
Developing Knowledge Management									X																	**1**

(*Adapted by* the Author)

3.6.2 Challenges of LSS application in HEIs

Although evidence suggests that the application of LSS methodology to the HE environment presents some impediments that are similar to those found in the industry, such as resistance to change, inadequate resources, training and development (Antony et al., 2012; Tari and Dick, 2016; Holmes et al., 2015); lack of communication, lack of visionary leadership, and lack of management commitment (Antony, 2015; Antony et al., 2017). However, studies also identify specific challenges and barriers not found in manufacturing industries and other service sector settings due to the typical nature and characteristics of HEIs specified in section 2.6. These unique challenges are:

- The difficulty of determining products and identifying customers in HEI (Antony et al., 2012; Holmes et al., 2015; Sunder, 2016a; Sunder et al., 2020). LSS focuses on the voice of the customer (VOC), and determining VOC customers may prove difficult if not specified.
- The difficulties of the measurable outcome, as the intangible nature of the educational process, make HE performance measurement vastly difficult (Does et al., 2002; Holmes et al., 2015; Antony, 2014; Sunder, 2016a; Antony et al., 2017; Sunder et al., 2020)
- Lack of appropriate data availability or accessibility from the existing infrastructure (Antony et al., 2017). Based on lessons learned, Antony et al. (2017) noted that in some projects, the identification of Critical Quality (CTQ) is very problematic
- HE culture - is not often receptive to implementing CI initiatives, including academic freedom (Holmes et al., 2015; Yorkstone, 2016), (Antony et al., 2017b; Sunder and Mahalingam, 2018).
- Complex HE organisational structure - the multifaceted organisational structure of HEIs (Svensson et al., 2015, Sunder and Antony, 2018; Mulyana et al., 2021
- Lack of managerial responsibility for quality improvement and lack of employee empowerment for quality improvement (Holmes et al., 2015; Antony, 2014; Kokkinou and Kollenburg, 2022)
- A misconception that the terminologies of LSS tools and techniques are only made for the manufacturing sector. Therefore, LSS does not work very well in the HE (Antony et al., 2012; 2017; Antony, 2015).
- Other challenges are a lack of stakeholder management and project governance (Holmes et al., 2016) and a Lack of clarity of LSS implementation strategy (Antony, 2015; Antony et al., 2017; 2018).

3.7 Assessing the Impact of LSS and Performance Metrics in HEIs

This section emphasises understanding the relationship between LSS and the organisational performance of HEIs, through a review of scant literature that examines the impact and benefits of LSS initiatives in HEIs performance and how the performance is measured. Organisational performance is commonly referred to as the outcome derived from an organisation's activities and operation or achieving the organisation's goals (Uluskan et al., 2016). According to Bates (1999), overall organisational performance is the bottom-line measurement of the effectiveness of any improvement initiative. Therefore CI efforts such as the LSS programme performance need to identify and measured at a particular level in the process to ensure changes are producing the intended benefits (Bates, 1999; Waterbury, 2008; Gupta et al., 2014; 2020; Antony et al., 2017).

3.7.1 Impact of Lean Six Sigma on HEIs Performance

Few studies attempted to assess the impact and benefits of Six Sigma and LSS initiatives in organisations' performance (e.g., Arnheiter and Maleyeff, 2005; Corbett, 2011; Douglas et al., 2015; Uluskan et al., 2016). These studies were conceptual and single case reports (Uluskan et al., 2016; Shokri, 2017). Studies suggest that empirical studies found assessing the benefit and impact of SS and LSS were more related to manufacturing industries and the healthcare sector (Shokri, 2017), while studies assessing the benefits and impact of the application of LSS and CI in HEIs appear very limited (Nadeau, 2017). For example, Douglas et al. (2015) attempted to assess the usefulness of LSS across manufacturing and service organisations as part of a pilot study in East Africa in a survey of 23 organisations employees who had attended belts training. The studies show huge benefits of LSS in cost reduction, increase in productivity, and reduction in scrap and delivery time. Douglass and colleagues concluded that the respondents perceive LSS to have benefited their organisations (Douglas et al., 2015). Similarly, Zhang et al. (2016) surveyed 410 logistics companies in Singapore to assess the impact of LSS in improving logistics operations. Although there was a low response rate of 7.8 per cent (32 out of 410), findings indicated that 37.5 per cent of participants had implemented the Lean approach and LSS, with varying degrees of cost savings and increased productivity (Zhang et al., 2016)

Nevertheless, there are few studies on the impact of TQM in the HE sector. Kanji et al. (1999) compare TQM practices in HEIs in the US and Malaysia and their contribution to the respective HEIs' performance and business excellence. The study surveyed 60 Malaysian

and 72 US HEIs, with a response rate of 27.8% and 24.5% for Malaysian US institutions, respectively (Kanji et al., 1999). The author analysed the difference in the performance of HEI that practice TQM and non-TQM HEIs. The findings indicated that TQM institutions outperform non-TQM institutions (Kanji et al.,1999). Psomas and Antony (2017) attempt to determine the impact of adopting main TQM elements in Greece HEIs, through interviews of 15 CEOs of HEIs from a sample of 40 HEIs – indicating a 37.5 per cent response rate. Their findings show significant improvement in quality, operational process improvement, teaching staff and other employee satisfaction (Psomas and Antony, 2017).

As studies reveal in section 3.6, there appear to be anecdotal reports and conceptual studies that tend to provide a general conclusion on the potential benefits of these improvement initiatives in HEIs (e.g., Simon, 2013; Hess and Benjamin, 2015; Antony et al., 2018; 2019a), with case studies presentation of success stories (e.g., Murphy, 2009; Thomas et al., 2017; Sunder and Antony, 2018; Furterer and Key; 2019; Adeinat et al., 2022; Sunder and Mahalingam, 2018; Gastelum-Acosta et al., 2023). These case-studies type research do not go beyond providing reports on specific benefits of LSS implementation with departments in HEIs as shown in LSS application in HEIs (see section 3.6). Therefore, it could be argued that rigorous and empirical investigation attempting to assess the direct impact of Lean, SS, and LSS initiatives in the HE sector's overall performance is lacking (Thomas et al., 2017; Nadeau, 2017; Shokri, 2017). In evidencing this claim, Nadeau (2017), in a review of Lean, SS, and LSS experience in the HE sector worldwide, noted that although few measured results available suggest that LSS methodologies do hold promise. The author concurred that their impact remains to be determined. Therefore, part of the objective of this study is to extend similar studies into assessing the impact of LSS application on HEIs performance and determine how the benefit can be best measured.

3.7.2 LSS Improvement Measurement Metrics in HEIs

Business managers hope to improve ways of measuring corporate performance when employing business improvement methodologies. Surprisingly, despite organisations, long design and improvement methodology implementation, such as Lean and Six Sigma, measurements of the effectiveness of their performance have not been directly related to the methodologies' purposes (Gupta, 2004; Tyagi and Gupta, 2008). Studies emphasised that Six-Sigma and LSS performance improvement measurement challenges are more prominent in the service sectors (Tyagi and Gupta, 2008), including the HE sectors, because of their unique characteristics (Holmes et al., 2015; Antony, 2014; Sunder, 2016a; Antony et al.,

2017). Although not restricted to the service sector, the difficulties of measuring and quantifying the benefits flowing from SS implementation were also reported in the manufacturing industries (e.g., Kumar et al., 2010).

In a paper presentation, Burton (2006) argued that organisations deploying LSS begin with the right intention. Still, they eventually hit performance measurement walls, as the bottom-line results from their improvement initiatives are often illusionary lack of business improvement strategy with the right performance metrics. The author further asserts that many organisations' LSS projects risk becoming the next lost opportunity, like previous improvement initiatives, without understanding their critical elements and event-driven metrics – leading to disappointing results and a rapid loss of organisational interest (Burton, 2006). Supporting Burton's view, Summers (2011) argued that an effective strategic plan must contain performance measures chosen for their ability to quantify information about the CSFs that enable leaders to make informed decisions. The author further emphasised that an effective performance measurement system is useful for understanding, aligning, and improving performance at all parts of the organisation (Summers, 2011).

Metrics in the context of LSS initiatives are performance attributes that assess organisations' improvement (Comm and Mathaisel, 2003). Comm and Mathaisel (2003.p.315) state that "good metrics must be easily developed to answer the questions and produce the right results". The following are a few examples of quantifiable metrics for HEIs: administrative cycle times, cost-saving, waste reduction and improved quality (Comm and Mathaisel, 2003). Levinson and Rerick (2002) discussed three distinct standards to be considered when developing performance metrics: be objective, must be clearly defined, quantifiable, designed to control the initiatives and programme that it measures, and must be aligned with the organisation's goals. Performance metrics must be linked to the strategic plan and used by leaders to communicate important activities (Summers, 2011) and keep the organisation focused on its overall performance (Waterbury, 2008). However, academic and empirical discussion on performance measurement metrics to quantify the benefits and performance of LSS projects at organisational levels appeals to be limited (Kemper and De Mast, 2013).

Simon (2015), Sunder (2016a; 2016b), and Thomas et al. (2017), in their articles, emphasised the need for performance measurement metrics to quantify the benefit of LSS projects in HEIs. Sunder (2016b) also highlight the lack of literature about the key metrics for measuring LSS project in HEIs. The author, therefore, suggests LSS case study-based research for opportunities to identify the key performance indicators of the LSS project in the HE sector (Sunder, 2016b). Simon (2015) highlights the need for leading indicators in LSS improvement

initiatives – metrics that report the current performance of CI in the HEI business process rather than lagging indicators – report on historical performance. The author argued that although data exist in education, its use is not clearly understood. In some instances, Simon (2015) contends that the data only reflect the institution's performance, usually historical (Simon, 2015).

Waterbury (2008), in a thesis study – Lean in Higher Education, interviewed seventeen members of experts (Delphi technique) to identify metrics that can be used to measure success in HEIs processes such as – student satisfaction, amount of rework, waiting time, the steps in a process, cycle time, and efficiency saving. However, the metrics Waterbury (2008) identified are inadequate for Lean and SS projects. In a review, Kemper and De Mast (2013) discussed how to measure current performance in terms of operational performance metrics in the service and healthcare sectors. The authors distinguish between process flow metrics – throughput time and resource utilisation; and improvement initiative metrics such as Lean and Six Sigma. Kemper and De Mast (2013) further presented a list of common process flow performance metrics for the service sector.

Similarly, Summers (2011) categorised LSS performance measures into process measures and results measures. Process measures monitor operational activities, while result measures relate to the organisation's outcomes and customers' results. The author presented LSS performance measures for products and services (Summers, 2011). From the reviews, the researcher extracted a list of process and organisational performance metrics related to the service and HE sector, as depicted in Table 3.5.

Table 3.5: LSS Performance Improvement metric for service and HEIs Sectors

Process and organisational performance metrics	
• Amount of rework • Number of steps in a process • Cycle time • Capacity –Maximum throughput • Throughput –Actual amount processed • Throughput time – Processing time • Workload • Total resource time • Rework • First time right • Waiting/Idle time	• Expediting costs • Waste Minimize • Employee satisfaction, growth, and development • Customer/Student satisfaction • Number of completed improvement projects • Cost to quality (CTQ) • Sigma Level • Quality rating • Return on process improvement investment

Adapter from (Kemper and De Mast, 2013; Comm and Mathaisel, 2003; Summers, 2011; Waterbury, 2008).

3.8: Sustainability of LSS Improvement in HEIs

To better understand and identify practical approaches and key elements as enablers and barriers to a sustainable LSS programme, the researcher in this section has reviewed extant literature on sustainable LSS improvement programmes. However, the existing literature lacks any study on the sustainability of CIMs programmes in the HE sector (SEFs) within the HE domain. As such, the researcher decided to review existing but limited literature on sustainability and sustainable LSS and CI projects in other service sectors.

3.8.1 LSS and CI Sustainability - Concept and Definitions

Within the CI and Change management context, sustainability has assumed several meanings. Hayes (2022. P.381) coined sustaining CI and change as – "Stickability – holding on to the gains". Buchanan et al. (2005) definitions focus on embedding new processes. CI sustainability focuses on maintaining improvements within a particular setting and is concerned with translating initial gains into continuous improvement (Hayes, 2022). Dale (1996) also defines sustainability in terms of increasing the pace of improvement while holding the gains made. The more notable definition was provided by The NHS Modernisation Agency (2002, p. 12), which defines CI sustainability as the state where "new ways of working and improved outcomes become the norm" and where "the thinking and attitudes behind them are fundamentally altered, and the systems surrounding them are transformed in support". In other words, according to the Modernisation Agency, change is sustained when it becomes an integrated or mainstream way of working rather than something added on. The researcher adopted a working definition (The NHS Modernisation Agency, 2002; Buchanan et al., 2005; Hayes, 2022) and defined LSS and CI sustainability as a new state of working that fundamentally altered the norms and the systems surrounding being transformed into supporting and translating improvement gains, into embedding CI culture.

Although LSS has been used to improve business processes and quality performance, with reported organisational benefits and success stories as indicated in section 3.4.5. A successful LSS implementation can generate significant economic benefits for organisations (Vallejo et al., 2020). Despite glowing success stories of LSS applications, It has been argued that whether LSS methodology can help to achieve sustainable improvement and performance in a disruptive, innovative, and constant change environment has been questioned (Chung, 2015; Maleyeff, 2014; Murphree et al., 2011; Matteo et al., 2011). Sustainability of CI is critical besides implementing the concept, and according to Ali et al.

(2023), sustaining the CI culture, which is more toward changing the employee behaviour and mindset about improvement as a part of their daily functions, is very difficult. In developing a famous change model, Lewin (1951, cited in Hayes, 2022) argued that change is often short-lived, and after a short while, life tends to return to the way it was before the change. In Lewin's view, it is not enough to think of the change process as simply reaching a new state; instead, deliberate attention and a plan is required to develop to maintain this new state for as long as relevant to the organisation. The sustainability of the CI programme, irrespective of its focus, remains the same in increasing the pace of improvement and change while holding on to the gains over a long time as relevant (Hayes, 2022).

Antony et al. (2019b. p. 89) assert that an “LSS program that is not sustained is considered a failure”. However, several studies revealed that most CI (Lean, Lean Six Sigma) initiatives have consistently failed or not achieved their desired purpose (McLean et al., 2017; Antony et al., 2019; DeSanctis et al., 2018; Mohaghegh et al., 2021). Kotter's (1995 cited in Hayes, 2022) earlier report on the sustainability of re-engineering CIM projects shows that gains achieved in 10 out of 12 projects are not sustained. Similarly, a study on NHS found that 33 per cent of CI projects are not sustained upon one year of evaluation after completion (Maher et al., 2010). Pedersen and Huniche (2011) contend that approximately 70 per cent of companies who have used LSS as a CI initiative have either not achieved the expected results and/or not been able to sustain improvements over time. Confirming Beer and Nohria's (2000) early report that up to 70 per cent of organisational change and improvement initiatives are not sustained. Furthermore, in a Comprehensive Business Improvement Solution report, a consultancy firm conducted a global-based survey on Lean Six Sigma adoption and its benefits in the year 2008 and reported that 80 per cent of respondent organisations claimed that they were failing to achieve the intended performance and 74 per cent participants claimed that they were not getting the expected benefits (CBIS, 2017). Chakravorty's (2010) report from an aerospace organisation that implemented more than 100 CI initiatives indicated 50 per cent of the improvement project failed to achieve the desired or intended performance as stated in the project charter.

In recent years, the need for sustainability of CI initiatives has gained wider attention among CI practitioners (Institute of Continuous Improvement in Public Services, 2017, Antony and Gerald, 2017; America Society of Quality, 2023) and the limitation of empirical studies on the subject area remains an issue (section 3.10). Due to the lack of literature on LSS/CI sustainability in HEIs, the Researcher has reviewed related literature in other service sectors, including the Healthcare sector. However, one of the most challenging and contemporary

problems among the LSS community is ensuring improvement projects' sustainability in a rapidly innovative and changing business environment. Most debates and studies around LSS across sectors are centred around coherently integrating Lean and Six Sigma tools and techniques during implementation (e.g. Antony et al., 2014; Sunder, 2016a). But the main challenging issue confronting LSS organisations on the sustainability of LSS improvement has not been given much attention. In evidence, Guarraia et al. (2008) reported a survey conducted by Bain & Company Management to assess the effectiveness of LSS improvement programmes in 84 service industries shows that 80 per cent of LSS efforts have failed to drive the anticipated value, while 74 per cent responded that the expected competitive edge and saving target was not achieved.

In their studies of LSS sustainability in the Healthcare sector in the UK, Matteo et al. (2011) and Matteo (2012) affirmed that it is not clear whether LSS projects have led to sustainable improvements. Although, DelliFraine et al. (2010), and Maleyeff (2014), claimed that some organisations have been able to sustain LSS and CI programs over the long term without a report on evidence. However, DelliFraine et al. (2010) contend that LSS projects in healthcare have failed to show measurable improvements over time. Reports suggest that organisational barriers diminish the potential for LSS to provide lasting breakthrough improvements (Chung, 2015; DelliFraine et al., 2010). Consequently, some organisations abandoned their improvement efforts after some time (Maleyeff, 2014), while others struggled with their implementation process (Leon et al., 2013). A review of articles on LSS projects in HEIs and the service sector has shown a lack of evidence of sustainable LSS improvement initiatives. The key elements and construct to sustainable LSS improvement have not been thoroughly researched.

Ordinarily, the control stage of the LSS - DMAIC cycle is expected to have control methods to sustain the LSS improvement programme. In their article, Murphree et al. (2011), reporting on practical steps to sustaining LSS projects in healthcare, argue that when improvement is achieved in a project, many leaders declare victory and close the project rather than moving into the control phase to directly or indirectly monitor for the foreseeable future. Conclusively, the authors presented three practitioners' views on enabling factors for sustainable LSS improvement performance (Murphree et al., 2011) (See Table 3.6). Buestan et al. (2016) concur that the control phase of LSS is not further developed to sustain the improvement gain achieved. The Authors further argued that CI projects are usually considered closed by the CI team immediately after the first evidence of improvement has been achieved. The success story at the Improve phase of DIMAC is being allowed to overshadow the need to implement

procedures that guarantee long-term gains. Buestan et al. (2016) concluded that for organisations to sustain their LSS improvement; they must maintain their CI culture through the application of an appropriate training system; apply Visual Controls and Poka-Yoke systems, and establishment of an audit process to guarantee that the improvement effort will be maintained in the long term in the event of a change of leadership (Buestan et al., (2016).

Without realising the need for a change management effort, process improvement approaches are unsustainable, Campbell (2008) warned. Radnor et al. (2012) argued that, because of the narrow-minded practitioners focusing on tools and techniques, sustainable improvement activities, such as creating a culture of CI and structured problem-solving approach, have so far been neglected. In a pilot study, Matteo et al. (2011) attempted to identify underlying causes that have hindered the sustainability of LSS in the Healthcare environment. The authors noted that one of the barriers to sustainable process improvement programmes was inconsistency in management philosophy. The pilot study finding also shows a lack of support for staff to speak up, violation of standards or ethics, and ignoring CSFs that do not suit the organisation's culture (Matteo et al., 2011). Surprisingly, Matteo et al. (2011) study also indicated that 58 per cent of team members had no clear understanding of the improvement project goals, and 10 per cent had no knowledge of CI. Langabeer's (2009) earlier survey shows that over 80 per cent of participants did not specify project goals before their improvement project initiation, which is also a contributing factor. Matteo et al. (2011.p.9), however, postulated that all efforts are meaningless without a transformation of organisational culture from „fire-fighting" to „fire-prevention". The authors concluded that no sustainable solution could be embedded unless organisations are able to empower their staff through continuous training and measure the improvement programme effectiveness (Matteo et al., 2011).

Maleyeff (2014), in an interviews study, attempted to identify the characteristics that can sustain process improvement efforts in the public sector in North America. The author generated a list of factors that drove both success and failure in implementing short-term and long-term process improvement. Findings show a set of practices such as deploying a sound, consistent, and robust methodology, building trust by removing fear, long-term cultural change and communicating CI vision to all stakeholders (Maleyeff, 2014). Chung (2015), through focus interviews with seven experts, identified six common themes categorised into two key barriers that impact the sustainability of LSS improvements in the healthcare sector environment. The barriers were related to leadership commitment and inadequate LSS Skills personnel (See Table 3.6 below). Chung (2015) concluded that for LSS projects to offer

lasting benefits, organisations need to have committed CI initiative leadership and a well-developed governance structure to support process improvement projects.

Bigelow et al. (2010) presented a case study of sustaining an LSS project in a hospital laboratory in Canada. The authors explain how Lab-Service introduced LSS to increase staff satisfaction, meet and exceed contractual turnaround time targets (TATs), and increase productivity. According to the Authors, the programme slipped within a year, and the causes of project variability and unsustainable were not apparent. Therefore, a project was initiated to determine the reasons and find a solution to implement a sustainable improvement that could maintain the long-term performance of the lab service. The Hospital Lab-service process was re-design, and changes were implemented to ensure sustainability (Bigelow et al., 2010). The Authors noted that the journey to process excellence is iterative and outlined five essential elements of LSS improvement sustainability based on lessons learned (Bigelow et al., 2010).

Elshennawy et al. (2012), in their studies, identified two sets of factors - process factors and organisational factors to develop a framework to assess the level of Lean implementation and sustainability in the US hospital. The process factors (process stability, process standardisation, patient flow streamlining, mistake proofing, continuous improvement) are for process performance, and the organisational factors (leadership, culture and involvement, respect for employees, change management) enhance organisational capabilities (Elshennawy et al., 2012). To assess the degree to adopting various processes and organisational factors critical for successful Lean implementation, the Authors surveyed 13 departments, with a sample size of 55 per cent and 25.5 per cent response rate. The finding indicates that sustainable Lean implementation processes and organisational factors were variably adopted within the departments surveyed.

In an attempt to identify issues that affect the long-term success of quality improvement projects, Silver et al. (2016) review of the NHS CI sustainability Model outlines the following CI sustainability enabling factors: process control boards, performance boards, standard work, and improvement huddles meeting to review performance. Holweg et al. (2018) examined 204 Lean projects in a large European bank to investigate why some improvements were sustained and others were not. Overall, the projects produced some impressive efficiency gains – 20 per cent by the end of the first year and 31 per cent by the end of the second year. Yet despite these aggregate gains, 21 per cent of the projects failed to yield any improvements and of the 79 per cent that did show some improvement, only 44 per cent continued to sustain any improvement by the end of the second year. Managers reported that

one of the main reasons new practices were not maintained was the lack of visible support from board members and senior leadership. Antony et al. (2022) attempted to identify failure factors to sustainable CI initiatives in manufacturing and service organisations. They surveyed 106 experts from different countries involved in implementing CI initiatives, such as Lean, Six Sigma, Lean Six Sigma and Agile. The findings from the service organisations show a lack of reward and recognition system, poor alignment between CI and organizational learning, lack of training and education to employees, lack of top management commitment and support, lack of employee engagement, lack of communication and resistance to change.

Antony and colleagues, an expert in CI (Antony et al., 2019b), and John Hayes, an expert in change management (Hayes, 2022), in their book chapters, presented their general view on “LSS Sustainability” (Antony et al., 2019b.p.83-89), and “Sustaining Change” (Hayes, 2022.p.381-387). Antony et al. (2019) presented ten frequently occurring challenges of LSS sustainability and associated strategies to overcome them, while Hayes (2022 also suggested some key elements to sustainable change but categorised them into actions to promote buy-in from the start and activities to promote sustainability after implementation (See Table 3.6). Although Antony et a. (2019b) and Hayes, 2022) presented their anecdotal expert views, the difference between previously presented CSFs to CI and change implementation is not clear and thus requires empirical investigation.

Following the Researcher's analysis of the extant literature on this topic area, several unique elements and constructs as enablers to sustaining LSS improvement initiatives were identified, as depicted in Table 3.6 (Campbell, 2008; Bigelow et al., 2010; Murphree et al., 2011; Matteo et al., 2011; Maleyeff, 2014; Matteo and Perera, 2011; Buestan et al., 2016 Silver et al., 2016; Antony et al., 2019b; Hayes, 2022), key barriers and failure factor to sustaining the LSS programme also in Table 3.6. (Chung, 2015; Matteo et al., 2011; Buestan et al., 2016; Chung, 2015; Murphree et al., 2011; Radnor et al., 2012; Holweg et al., 2018; Antony, et al., 2019; 2022). Similarities exist between the sustainability enabling factors and implementation CSFs. However, the researcher will attempt to identify elements that are unique in the context of sustaining the LSS improvement programme.

3.8.2 LSS Sustainability Enabling Factors and Barriers – Findings from Reviews

Table 3.6: LSS Improvement Sustainability Enablers and Barriers

S/n	Authors and Date		Sustainability Enablers (Es) and Barriers (Bs)
1	*Bigelow et al. (2010)*	E	Development of LSS Leaders; Standard work at all levels of an organisation; Visual management; Frequent celebration of successes; Education and training programme of all staff in the value stream
2	*Murphree et al. (2011)*	E	Apply learning and integration as a formal checklist approach; Integration of process changes into the organisation; Defined control plan; Ongoing metrics monitoring to detect performance declines; Continuous measurement of programme effectiveness.
		B	Declaring victory too early; Failure to properly conduct the Control phase of the LSS-DMAIC cycle.
3	*Matteo et al. (2011)*	E	Transformational organisational culture; Employee empowerment; Continuous measurement of programme effectiveness; Education and training programme of all staff in the value stream.
		B	Consistency of management philosophy; Lack of support to staff to speak up; Violating of standards or ethics; Lack of understanding of the improvement project goals
4	*Matteo and Perera (2011)*	E	Continuous measurement of programme effectiveness; Change management effort
5	*Elshennawy et al. (2012)*	E	Process stability, process standardisation, workflow streamlining; Mistake proofing for process performance; Leadership, culture and involvement, respect for employees; Change management effort
6	*Radnor et al. (2012)*	B	A narrow focus on tools and techniques.
7	*Maleyeff, (2014)*	E	Deployment of a sound, consistent, and robust; methodology; Building trust by removing fear; Long-term cultural change; Communication of vision to all stakeholders
8	*Chung (2015)*	B	Lack of leadership engagement and commitment; Lack of appropriate investments in LSS Solutions; Lack of a centralised; LSS program and project alignment with business strategy; Lack of sector-specific business knowledge; Lack of data analysis and study design rigour in LSS projects; Declaring victory too early; Failure to properly conduct the Control phase of the LSS-DMAIC cycle.
9	*Buestan et al. (2016)*	E	Application of an appropriate training system; Application of Visual Controls and Poka-Yoke systems; Establishment of an audit process.
		B	Declaring victory too early; Failure to properly conduct the Control phase of the LSS-DMAIC cycle.
10	*Holweg et al. (2018)*	B	Lack of visible support from board members and senior leadership
11	*Silver et al. (2016)*	E	Visual management board; Standardised work; Improvement huddle meetings to review performance constantly

12	*Antony et al., (2019)*	E	Consistent management commitment; Link LSS to the business strategy and periodically upgrade; Effective rewards system to retain staff; Create a sense of urgency in purpose; Promote total employee participation, agility and customer-centricity approach; Ensure robust governance and ownership of improvements; invest in appropriate organisational infrastructure for LSS; Ensure knowledge management of LSS projects; Focus on sustaining the improvement gains all through the course of implementation; and Institutionalisation of LSS.
		B	Focusing on project metrics and neglecting the overall system metrics; Change in leadership at the top-management level; Organisations' failure to achieve real benefits; The inability to retain LSS-trained staff members of the volatile labour market; Understanding the nature of the sector in which LSS is applied; Lack of continuous top-management commitment; Lack of understanding of the true purpose and position in relation to other technologies; Lack of ownership makes it unsuccessful many times; Lack of wiliness to continue - **I** have done enough' attitude.
13	*Vallejo, et al, 2020*	E	Communicate the result of the project, Document lessons learned, Share best practices and lessons learned, and integrate LSS with the business plan.
14	*Antony et al., (2022)*	B	Lack of reward and recognition system; Poor alignment between CI and organisational learning, Lack of training and education to employees; Lack of top management commitment and support, Lack of employee engagement, Lack of communication; Resistance to change
15	*Hayes, (2022)*	E	Actions to promote buy-in from the start – Effective change strategy; Communicating an inspiring vision; Managing stakeholders to win support for the change; Rewarding new behaviours. Actions to promote sustainability after implementation – Dealing with leadership issues; Politics – Power and Influence of stakeholders; Churn - strengthening the induction and training regime for new recruits; Priorities and resources - setting new priorities divert resources and attention; and Motivation
16	*Bhat et al., 2023*	E	Top management engagement and commitment; Empirical evaluation in every phase; Organizational belief, vision and Culture; LSS success celebration; Benchmarking and best practice sharing; Data through IT; Effective HRM practice; Project KPIs; Deployment plans; Project selection; Crossfunctional collaboration; Understanding the tools and techniques; Right person for the right project; Balance between work and project; Involvement of scientific staff; Knowledge management; Customer focus; LSS program team; Effective communication; Structured approach; Customized LSS strategy; Cross-functional team; Clearly defined roles, responsibilities; Rapid project completion; Continuous improvement.

E = Enabler, B= Barriers

(Adopted by The Author)

3.8.3 Summary of Key Findings

From the limited literature reviewed on Sustainability/Sustainable LSS, CI and Change, which includes – conceptual reports from books, chapters and articles with very limited empirical studies, factors that enable sustainable improvement and factors that assume to be barriers and challenges to sustaining the gains of CI programme were identified from 15 pieces of literature as shown in Table 3.6 above. Most of the factors identified were linked to implementation and sustaining CI but not specific to sustainable improvement, and it is difficult

to differentiate the LSS/CI project CSFs and the stainability enabling factors (SEFs). Some of the sustainability enablers factors and barriers (Table 3.6) identified are pretty much the opposite factors to each other. The SEFs from Table 3.6 were further analysed, and the top 14 SEFs from the literature were identified, as shown in Figure 3.8.

Figure: 3.8: LSS Sustainability Enabling Factors – Findings from Review

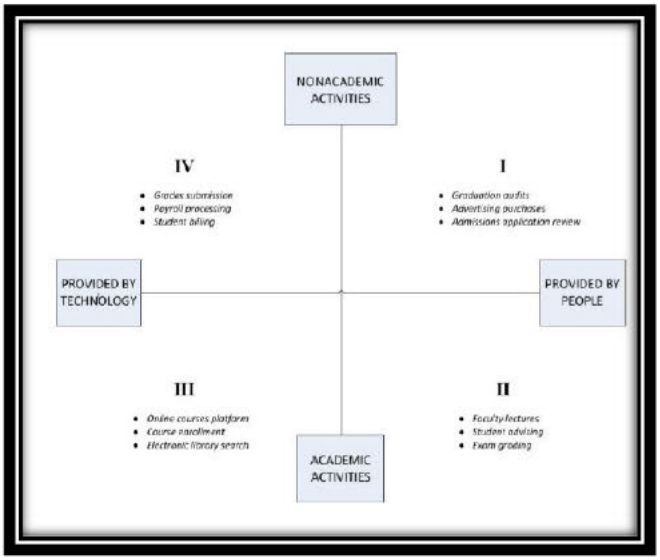
Source: (The Author)

3.9 A Review of Existing LSS Framework in HEIs

The purpose of this section is to review existing frameworks for LSS application in HEIs and to reveal their weaknesses and limitations in the context of their adequacy for the implementation of LSS programmes HEIs. However, as research suggests in section 3.4, Lean, SS, and LSS implementation framework in the HEIs domain appears limited (Sunder, 2016b, Antony et al., 2017, Thomas et al., 2017), and few studies found seem to be limited in their context and scope (e.g. Buccino, 2013; Thomas et al., 2017; Weber, 2013). Hence, practitioners of LSS in HEIs (e.g. Sunder, 2016, Anthony et al., 2017; Thomas et al., 2017) advocate developing a framework for effective implementation of LSS in HEIs. A framework thus offers a mechanism that links various elements, construct tools, drivers and indicators – termed as structural blocks, within a system that is connected to others to create an outcome (Thomas et al., 2016, Kumar et al., 2006).

Holmes et al. (2015) developed a SS framework for project selection in HEIs, using a weighted scorecard approach, as shown in Figure 3.9. The framework establishes a continuum of academic or non-academic activities based on technology or people in quadrants for efficient use of resources. According to the Authors, the weighted scorecard SS framework was effective in assessing academic delivery and student feedback in the project selection process. However, the framework only focused on project selection – the pre-implementation stage.

Figure 3.9: Framework for SS project selection



(Source: Holmes et al., 2015)

Jenicke et al. (2008) proposed a three-tiered conceptual framework to apply SS across HEIs. The framework organised the SS DMAIC cycle into a hierarchy of university, college/school, and department levels related to academic performance indicators (PI) based on institutional reputation and fiscal position. According to the Author, the framework aims to provide transparency in SS improvement projects in HEIs. Jenicke et al. (2008) further accentuate the role of top management, openness and involvement of the stakeholders and top-manager training as the elements of the successful implementation of the framework. However, the model lacks an implementation roadmap and is narrowly focused on lag indicators of performance assessment in HEIs.

Buccino (2011) proposed a culturally-feasible framework for LSS implementation to achieve performance excellence in K-12 educational organisations in the USA, using Soft Systems Methodology (SSM) and the worldviews of education experts in a Delphi Panel. The Author proposed a framework to integrate critical subsystems representing various elements in

Figure 3.10. Nevertheless, the model is practitioner-based, presented in a single case study within K-12 secondary school education setting, and is yet to be validated. There was immediate concern from practitioners and experts regarding the complexity and ability of the school community members to understand the model, leading to the questioning of the clarity of the model (Buccino, 2011).

Figure 3.10: A System Framework to Apply LSS in K-12 Education

Source: Buccino (2011) Content redacted due to copyright restrictions

Waterbury (2008), in a thesis study, presented the Education Lean Improvement Model (ELIM) based on five Lean principles (Value; Value Stream; Flow; Pull; Perfection) and conducted a Delphi study that defined performance metrics for academic environments. As in Figure 3.11, the resulting ELIM uses W Edwards Deming's PDSA (Plan, Do, Study, and Act) framework for continuous improvement to guide Lean projects' implementation in HEIs (Waterbury, 2008). Although the Waterbury model appears to be one of the early works on Lean in HE, Lean tools alone cannot achieve the triple goal of CI, as indicated in section 3.4. In addition, ELIM lacks elements, constructs and programmes of implementation while narrowly focused on HEI's improvement metrics.

Figure 3.11: Education Lean Improvement model (ELIM)

(Source: Waterbury, 2008) Content redacted due to copyright restrictions

Weber (2013), expanding on Waterbury's (2008) ELIM, proposed the education LSS improvement model (ELSSIM) for course application in a technical college to maintain learner outcomes and deliver a course within significantly less time. The model combines Waterbury's ELIM - PDSA, the five principles of Lean and the SS DMAIC cycle process. ELIM becomes ELSSIM with the addition of the DMAIC problem-solving process, as illustrated in Figure 3.12, to serve as a visual framework for a two days kaizen event and subsequent improvement activities in the institution (Weber, 2013). ELSSIM (Weber, 2013) was proposed to over the weakness of ELIM (Waterbury, 2008). Weber's study and model were practitioner-based and only focused on two cohorts of students in a single case study. The ELSSIM model only specified the combined methodology and lacked an implementation roadmap and construct.

Figure: 3.12: Education LSS improvement model (ELSSIM)

Source: Weber (2013) Content redacted due to copyright restrictions

Sunder (2014), considering the need for practical knowledge for students and HEIs to improve academic processes parallelly, proposed a SS student engagement model that involves student teams in deploying SS projects for academic quality improvement. The framework comprises ten steps integrated within the SS cycle that incorporate multiple variations, suiting the education sector as depicted in Figure 3.13. The model focuses on the student team playing an active role in the implementation process and continuous training of the student team to a Green Belt level. The Author, though, outlines the unvalidated benefits of the model. However, students playing an active role in the implementation process and continuous training is unachievable and unsustainable. In addition, the model's applicability is limited in scope and not scalable and lacks the value of combining Lean and SS approaches.

Figure 3.13: Six Sigma – Student engagement model

Source: Sunder, (2014) Content redacted due to copyright restrictions

Thomas et al. (2017) in a study assessing the effectiveness of LSS methodology in designing academic curricula and programmes in HEI. Authors extending their LSS framework (Thomas et al. 2016) employ the DMAIC cycle as the key driver in the implementation process to create a more balanced and integrated approach for applying Lean tools and techniques within the SS DMAIC cycle in an interactive process. Thomas and colleagues heavily rely on robust VOC (voice of student) in redesigning an academic programme and proposed vital information on integrating LSS in HEI, emphasising toolkit application (See figure 3.14). The authors focus more on the use LSS toolkit in designing an academic curriculum in a single case study without validation. The model is also limited in scope as it focuses only on academic programme development. The application to a wider HEIs improvement initiative is limited and lacks the critical elements and constructs to implement and sustain the LSS initiative.

Figure 3.14: LSS Implementation Model for HEIs

Six Sigma Cycle	Lean Cycle						
		(0) Train& Prepare	(1) Specify Value	(2) Synchronise Internal Value Stream	(3) Create Flow	(4) Pull on Demand	(5) Create Perfection
	Define	Institute departmental wide training in LSS ensuring full preparation in both tools, techniques and management development of LSS leaders. Set goals and expectations and establish roles and duties for staff Routinely monitor key business parameters in order to identify early issues which can be worked upon at stage 1 project start.	Workshop held with existing students & Employers to identify the key value adding issues around the course.	Key Variables identified from stage 1	Identify conflicting processes causing bottlenecks.	Define client expectations around delivery method. Determine volume of students	Identify the areas causing variation from client value perspectives
	Measure		Competitor performance analysis undertaken (recruitment figures, results profiles, product range, employability profiles etc). QFD analysis performed to identify Wants and Hows.	Set up Quality Improvement Group (QIG) and focus on the design of the value stream and implementation plan	Measure conflicts to see if the issues adversely affect the improvements and undertake action planning	Measure existing teaching delivery capabilities and analyse against client requirements	Measure existing levels of variation through constantly measuring against student focus groups
	Analyse		Using Shainin's KVST to identify the key variables that impact on providing an improved course programme.	Develop strategies towards implementing solutions	Drive the implementation of the course development programme flow through the system	Identify the features capable of rapid delivery of course. Identify all constraints affecting delivery capabilities	Identify the delivery and client recruitment issues that affect variation. Pinpoint causes and set up improvement teams
	Improve		Implementation group set up to consider the key customer variables and to build an effective new BSc degree programme.	QIG to implement the recommended improvements (shown in conclusions section)	Identify and remove bottlenecks from system as implementation is undertaken	Establish and embed new technology enhanced learning systems to ensure 24/7 delivery of programme and asynchronous delivery	Establish improvement blitz teams to systematically improve course delivery and manage client expectation
	Control		Lock in new course features with validation documentation. QA to update quality procedures and validation protocols.	Lock in process optima through new VSM as implementation progresses.	Determine new flow system and ensure adherence to new flow paths	Manage new order and embed practices to ensure consistent delivery to standard	Set new process specifications and manage the new process order.

Source: Thomas et al., (2017).

Sunder and Antony, 2018, developed a six-stage conceptual framework for deploying LSS in the HEIs based on their practitioner experience, as in Figure 3.15. In their model, the authors describe that LSS readiness is the foremost step in the LSS deployment journey in HEIs. The strategic perspectives of aligning the organisational vision for quality excellence need to be achieved by establishing a need for LSS through leadership. Then, developing an LSS deployment strategy becomes the next step. Educating the appropriate stakeholders (students) and team formation becomes the next important steps in the LSS deployment. Once the above steps are implemented in the right way, identifying and implementing LSS projects becomes critical. The execution and closure of the LSS projects lead to quality excellence in HEIs (Sunder and Antony, 2018).

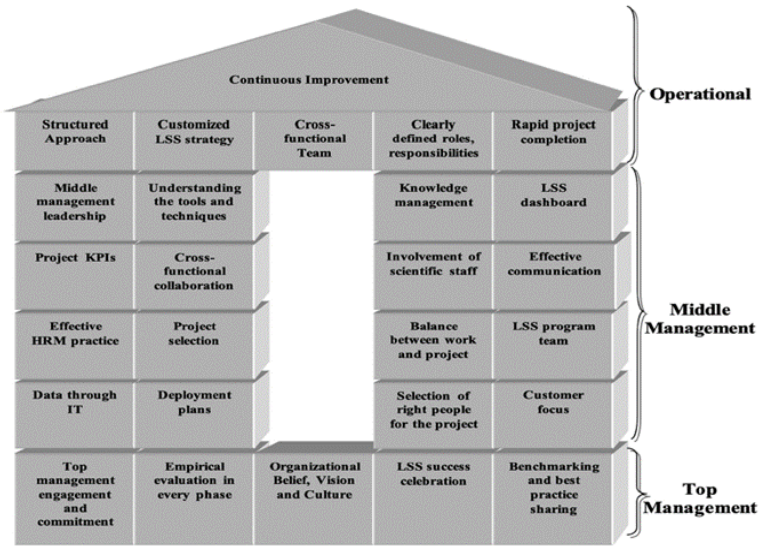
Figure 3.15: Six-step Model of LSS Implementation in HEIs

Source: Sunder and Antony, (2018). Content redacted due to copyright restrictions

Bhat et al., 2023 presented LSS deployment and sustainment strategies for the healthcare sector from a multi-level perspective through a multi-method research design involving literature review, action research and Delphi study. The action research part of the study involved more than ten years of projects focused on deploying LSS in the healthcare sector.

The Authors identified 27 strategies across the three levels of management for the effective deployment of LSS. Further, they presented a customised LSS framework for deployment strategy from the healthcare perspective (see Figure 3.16). Although the Author reported 27 strategies for the deployment of LSS, there was no difference from the already identified CSFs of LSS in section 3.6.1.

Figure: 3.16: Strategy for Deploying LSS in Healthcare



Source: Bhat et al., (2023)

Vallejo et al., 2020, through a survey instrument, developed a road map for implementing and sustaining LSS improvement over time. The authors analyse the existing literature on Lean and Six Sigma that, included road maps and critical success factors (CSFs) to design a survey. The road map adopts successful road maps from the literature into consideration and then adapts them to fulfil the company's perspective on CI. The Authors identify CSFs for LSS implementation and sustaining LSS, as shown in Figure 3.17. The limitation was reported on using the survey method, and the authors emphasised interviews with employees to enhance the understanding of the organisational culture and further improve road map development.

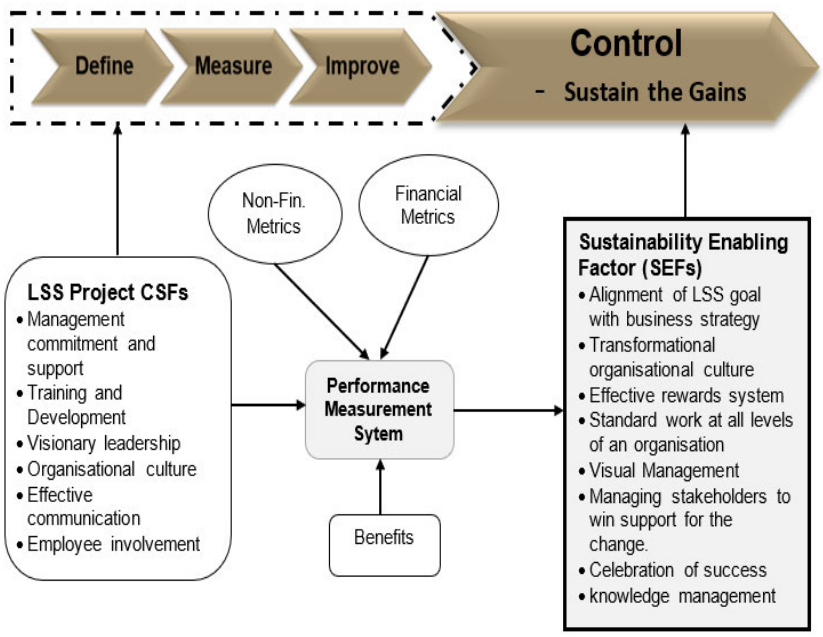
Figure 3.17: A road map for implementing and sustaining LSS improvement

Source: Vallejo, et al, (2020) Content redacted due to copyright restrictions

3.10 Conceptual Framework from the Review

Many researchers proposed various models and frameworks of LSS in service and HE environments. In consideration of the limitation and the research gap identified from the control stage of the LSS theoretical framework in section 3.4.2 and reviewing the existing and limited LSS frameworks and models in HESs, it can be argued that the existing framework has failed to reap the best results of a sustainable LSS improvement. Therefore, Researcher has proposed a conceptual framework for LSS improvement sustainability based on findings from the literature review, as shown in Figure 3.18. The proposed framework is based on the limitation of the control phase of the LSS DMAIC framework, as the first of its kind, focusing on the C – Control stage of the methodology. According to Hayes (2022), sustainability can be affected by factors critical to project implementation and actions that promote sustainability after project implementation. Following Hayes's view, the framework, as illustrated in Figure 3.18, includes LSS project CSFs to ensure project completion, a performance measurement system using financial and non-financial metrics with clear benefits from the project, and sustainability-enabling factors to promote sustainable improvement. However, the framework will be compared with interview findings, reversed based on interview findings, and further discussed in Chapter 6.

Figure 3.18: LSS Improvement Sustainability Conceptual Framework



(The Author)

3.11 Summary

This chapter presents a literature review based on the research objectives upon which a research gap was identified. The studies begin with the evolution of CI methodologies, and as revealed, Lean and SS evolutions can be traced back to the late 1700s. Lean takes its roots from Ford Production System, TPS and JIT, while SS evolved from SQC, BPR and TQM. Review shows that Lean and SS have been used and accepted across industries and sectors, including HEIs and PSOs. Lean is a philosophy with five basic principles that are used to eliminate waste in business processes. SS is similar to TQM tools and is used to reduce variation in business processes. Similarities and differences were found between SS and TQM. While recent applications show TQM as a fade methodology, SS methodology has become dominant in organisations.

Lean and SS methodology was applied as a standalone approach to focus on different improvement issues, problems, and objectives. Lean and SS methodology presents their strengths and weaknesses, leading to the argument for an integrated approach of LSS tools to complement each other strengths. As illustrated, the cases reviewed show evidence of benefits and success stories from LSS applications across sectors. Practitioners and researchers have proposed different approaches to combining LSS applications, lacking widely accepted approach models. A predominant integrated LSS DMAIC theoretical framework, which simultaneously integrates Lean and Six Sigma tools and techniques, has

been proposed and applied. However, the DMAIC cycle of the LSS theoretical framework shows limitations on the controls phase – which focuses on sustaining improvement gain, from which a research gap was identified. Also identified are various criticism and limitations, identified are the lack of studies and applications of LSS and CI in the HE environment.

The assessment of the status of CI and LSS in HEIs through a search of existing literature began with the application of TQM, Lean, and SS in HEIs, which revealed the early applications of CI methodologies in HEIs, including the analysis of the limitations of their applications, therefore justifying the need for an integrated LSS approach in HEIs. There were early applications of TQM in HEIs, but TQM is no longer the preferred methodology in HEIs. Only a few cases of SS application in HEIs were found. At the same time, cases of Lean applications were recorded as the most dominant CI methodology adopted in the HE environment in the early years until 2014. Although LSS has become dominant in the HE environment, the literature on LSS practice in HEI remains limited, with a lack of empirical studies. Although cases reviewed show successful applications, LSS was introduced into HEIs in 2009 but was not the dominant methodology until 2015. The adoption of integrated LSS in HEI is still in its infancy in the HEIs. The review conducted was based on the research objectives. The CSFs and the challenges to implementing the LSS project were identified from publications on LSS in service sectors because of limited literature focusing on CSFs and barriers of LSS in HEIs.

Also, the impact of LSS and CI application in HEIs, and the performance measurement system with the use of financial and non-financial in the qualification of the improvement benefits were identified in the review of related literature in service and HE sectors. Some studies documented the benefits of LSS application, but they were limited. A balanced Scorecard system and financial and non-financial metrics are used to qualify CI performance and benefits. Based on the research gap, the concept and definition of LSS and CI sustainability were explored. Although studies on the subject area appeared limited, studies on LSS and CI sustainability in services sectors were analysed through which SEFs and the barriers to sustainable LSS improvement in HEI were identified, and further analysis presented top SEFs. The existing framework and model for applying LSS in HEIs were reviewed. Similarly, very few conceptual frameworks were identified, and the few frameworks identified fall short of any elements of the LSS sustainability concept. Following the limitation and the review findings, the researcher proposed LSS Sustainability Framework that focuses on the control phase of the DMAIC structure.

Chapter 4:

Research Methodology

4.0 Introduction

Following the review of related literature on the concept and application of CI and LSS methodologies in Chapter 3, a research gap was identified based on the purpose of the research. This chapter was designed to explain and describe the research methodology and research method employed by the researcher to explore the research questions. This Chapter outlined different research philosophies and presented a constructivist paradigm as the researcher's underlying worldview of the study in section 4.1. The purpose and objectives of the research were presented in the preceding section (section 4.2), followed by the explanation of the research approach and research design used to explore the research questions based on the purpose of the study in sections 4.3 and 4.4). Section 4.5 describe the data collection method – a semi-structured expert interview. The following section (section 4.6) presents the sampling method, the sample size of interview participants, and the justification for the sample size. Data analysis, including techniques and tools, was presented in section 4.7. The chapter also considered the validity and reliability of the research procedure, followed by considerable ethical issues and measures to overcome the ethical problems (section 4.8).

4.1 Research Philosophy

Research philosophy interaction is referred to as a basic belief system – paradigm or worldview and assumption about the development of knowledge (Crotty, 1998; Creswell, 2014; Creswell and Plano Clark, 2011; Saunders et al., 2016). Paradigmatic viewpoint (Crotty, 1998) can be explained in terms of the researcher’s philosophical beliefs on the nature of reality – ontology, nature of knowledge – epistemology, ethics and values – axiology and the research process - methodology. Every aspect of these philosophical assumptions underlies all research paradigms that underpin the research design and specific method that turn the approach into practice (Onwuegbuzie et al., 2009; Saunders et al., 2016; Creswell and Plano Clark, 2011; Christ, 2013). Philosophical paradigms (Lincoln et al., 2011; Mertens, 2010; Collis and Hussey, 2014) or worldview (Guba and Lincoln, 2005; Creswell, 2014), as coined, is a basic set of orientation (belief) about the world (Denzin and Lincoln, 2000; Creswell, 2014), a shared belief system that influences the knowledge researchers seeking and how the evidence collected is interpreted (Morgan, 2007; Christ, 2010).

The understanding of how the researcher's worldview impacts this study is considered highly important (Amaratunga et al., 2001; Easterby-Smith et al., 2018; Collis and Hussey, 2014; Gray, 2014) to clarify the research design, the research evidence and how it can be gathered and interpreted. Also, to recognise the suitability of designs and their choices based on research questions, avoid possible difficulties and identify and apply a design that may be outside the researcher's experience of the subject area (Easterby-Smith et al., 2018). That will enable the researcher to understand their role (Wilson, 2014), which thus helps to improve research quality and the researcher's creativity (Easterby-Smith et al., 2018). There exist several classifications of research paradigms and assumptions in the literature. The most recent highlighted paradigm is post-positivism which emerged from positivism, phenomenological interpretivism, pragmatism, critical realism and constructivism – a subcategory of interpretivism (Easterby-Smith et al., 2018; Bryan, 2016; Sunder et al., 2016; Collis and Hussey, 2014; Wilson, 2104).

Although, there is a lack of verbalization of the epistemological position in the field of quality management and CI management and methodology, as evident in the work of Biedenbach and Muller (2011). In more general, scholars who explore the epistemological foundations of quality management (QM) tend to rely heavily on the pragmatic paradigm as a standalone paradigm (e.g. Mauleon and Bergman, 2009; Phelps et at., 2008), systemic paradigm (Barouch, 2011; Conti, 2010; Roth, 2013) and the pragmatic paradigm, positivist and interpretive phenomenology (e.g. Kumar, et al., 2010). Although the constructivist paradigm has been suggested to be a useful concept of QM (Kelemen, 2003; Manjunath, 2008; Priebe, 2000), this contention has not been further explored in QM and CI research (Barouch and Ponsignon, 2016). Therefore, to embrace the worldview that best fits this study's context, the researcher will engage in a constructivist stance (Avenier and Cajaiba, 2012; Barouch and Ponsignon, 2016) to explore practitioners' views through qualitative research design.

4.1.1. Constructivist paradigm

The constructivist paradigm stems from phenomenology and the study of interpretivism (Mertens, 2005). As a subcategory of interpretivism, constructivism is typically viewed as an approach to qualitative research (Biedenbach and Muller, 2011; Easterby-Smith et al., 2018; Creswell, 2014; Onwuegbuzie et al., 2009). The constructivist stance was chosen for this study because it reflects on one of the basic tenets of the theoretical paradigm that reality is socially constructed by those that engage with the world they are interpreting as they seek to

understand and develop subjective meanings based on their historical and social experiences (Onwuegbuzie et al., 2009; Easterby-Smith et al., 2012; Creswell, 2014). Therefore, the researcher attempts to gain an understanding of the lived experience from the point of view of those that are involved in the process (Schwandt, 2000), with the intention of understanding "the world of human experience" (Cohen et al., 2000. p.36).

Constructivists do not usually start with theory compared with postpositivists. Instead, they "generate or inductively develop a theory or pattern of meanings" (Creswell, 2004, p.38) throughout the research process. Creswell (2014) argued these meanings are diverse and manifold, leading the researcher to look for complex views rather than narrowing meanings into a few understandings. Constructivist researchers also believe that multiple contradictory but equally valid accounts of the same phenomenon can exist (Onwuegbuzie et al., 2009). Lincoln and Guba (2011.p.197), elucidating as a constructivist, argued that "a good part of social phenomena consists of the meaning-making activities of groups and individuals around those phenomena." Therefore, supporting the assumption that the whole meaning generation is always social, arising from interaction with individuals or groups (Crotty, 1998). That justifies the researcher's attempt to engage the LSS experts and practitioners within HEIs to construct a consensus meaning of the research questions from the CI based on their social experience and their interaction in implementing the LSS and CI methodology.

The goal of this paradigm in this research is to rely as much as possible on the participants' views of the research questions through broader and more general open-ended questions to enable participants to construct their meaning of a given situation, typically built-in discussions. It also focuses on the specific contexts in which people live and work to understand participants' historical and cultural settings (Creswell, 2014). The researcher intends to make sense of (or interpret) the chosen participants' meanings based on their experiences. The constructivist researcher could rely on a qualitative or combination of qualitative and quantitative methods collection and analysis to build patterns, themes, and general concepts (Christ, 2013; Onwuegbuzie et al., 2009) for the purpose of generalisation (Onwuegbuzie et al., 2009). The researcher believes that a constructivist view of the CI experts – the CI managers and team leaders, who are the main participants/actors in the CI implementation process, can foster a positive approach to determining the key enabling factors for sustainable implementation of LSS improvement initiative.

4.2 Research Purpose and Objectives

Research purpose must be clear in a study, as the statement of purpose conveys to the researcher what the result of the research is likely to achieve (Creswell and Plano Clark, 2011; Marshall and Rossman, 2011; Newman et al., 2003; Yin, 2013). Newman et al. (2003.p.192) stated that the “purpose of social science research is rooted in the distinctive conceptualisation in researcher's rationale about the study”. There is an iterative process between considering the research purpose and the research question, during which decisions about the research methods are made (Newman et al., 2003). They also noted that the apparent purpose of research from any epistemological perspective is to answer questions. What the researcher wants to learn (purpose of study) helps shape the research questions. Therefore, the research purpose should focus on the study's reasons and keep connected with the research questions and the methods (Newman et al., 2003). The researcher, as such, has clarified the research purpose and the research question in section 1.5 and section 1.7, respectively.

However, the purpose of a research study could be descriptive, explanatory, and exploratory (Creswell and Plano Clark, 2011; 2018; Yin, 2013; Marshall and Rossman, 2016; Saunders *et al*., 2016). The researcher has defined the research questions based on the exploratory research as per Marshall and Rossman (2011) and Yin (2013) general guidelines (see table 4.1). Therefore, the main purpose of this exploratory research is to assess the applicability and sustainability of LSS projects in HEIs in the UK and to identify and recommend LSS sustainability enabling factors (SEFs) to embed a culture of CI and change in the organisation. Following the research purpose, research questions were developed from the literature review (chapter 3) to focus on the research objectives (see section 1.6).

Table 4.1: Matching research questions and purpose

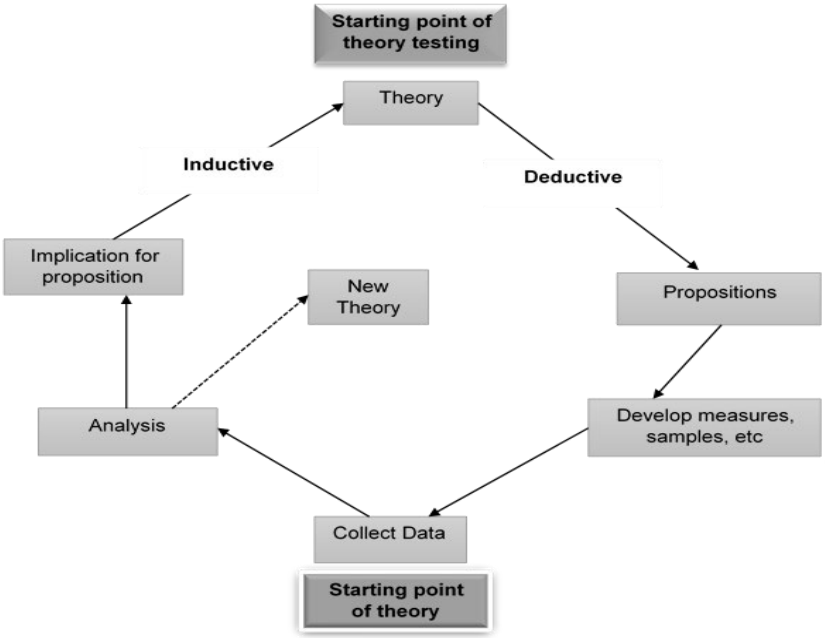
Purpose of study	General Research Questions
Descriptive	
To document and describe the phenomenon of interest	What are the salient actions, events, beliefs, attitudes, and social structures and processes occurring in this phenomenon
Exploratory	
To investigate little-understood phenomena To identify or discover essential categories of meaning To generate hypotheses for further research	What is happening in this social program? What are the salient themes, patterns, or categories of meaning for participants? How are these patterns linked with one another?
Explanatory	
To explain the patterns related to the phenomenon in question To identify plausible relationships shaping the phenomenon	What events, beliefs, attitudes, or policies shape this phenomenon? How do these forces interact to result in the phenomenon?

Adapted: Sources: (Marshall and Rossman, 2011; Yin, 2013)

4.3 Research Approach

The two main research approaches are deductive (more quantitative) and inductive (more qualitative). Every part of empirical knowledge, not only the theoretical ideas (deductive knowledge) but also the basic sentence formulated based on direct empirical observation (inductive knowledge) – is verifiable and thus a potential starting point of any investigation (Ebenezer and Kelle, 2003). Therefore, the role of theory in empirical research is to make explicit the two alternative ways of working, whereby theory is constructed - either inductively or deductively (De Vaus, 2009; Ghauri and Gronhaug, 2010; Wilson, 2014; Patton, 2002; Saunders et al., 2016; Denzin and Lincoln, 2000) in two ways to establish what is true or false and draw a conclusion (Ghauri and Gronhaug, 2010), as shown in figure 4.1.

Figure 4.1: The logic of the research process



(Adapted from De Vaus, 2009*)*

The *deductive approach* begins with the general and ends with the specific and underpins the style of study in which the researcher starts from the theoretical position where the researcher has to, first of all, formulate a theoretical concept and explanation from the phenomena under investigation (Ebenezer and Kelle, 2003; Gray, 2014; Ghauri and Gronhaug, 2010; Saunders et al., 2016). Theory and hypothesis built on existing knowledge (literature) are subject to empirical scrutiny to confirm, refute, or modify the theory (Davies and Hughes, 2014; Wilson, 2104; de Vaus, 2009). Deductive research is usually associated with the quantitative type of research. Deduction – concluding logical reasoning "need not be true in reality, but logical" (Ghauri and Gronhaug, 2010., p.15).

The inductive approach is a theory-building process – moving from the specific to the general, starting with the observation of a particular instance, seeking to establish generalisation out of the patterns or structure found about the phenomenon under investigation (Bryman and Bell, 2015; Ebenezer and Kelle, 2003; Davies and Hughes, 2014; Ghauri and Gronhaug, 2010). In an inductive approach study, the researcher deploys the principles of curiosity to gather data from a planned subject area. Thereafter, the data are analysed to determine if any patterns and themes could emerge (Ebenezer and Kelle, 2003). From these observations, it may be possible to construct generalisations, relationships and even theoretical conclusions (Bryman and Bell, 2015). The inductive approach is not designed to corroborate or forge a theory; instead, through gathering data process, the approach attempts

to develop patterns, consistencies, and meaning of the data (Gray, 2014). This type of research is associated with the qualitative technique, which is the main focus of this study.

Although the discussion on inductive and deductive research approaches presents an alternative way of building theories, both approaches are not entirely exclusive of each other. Inductive includes an element of deductive and vice versa (Ghauri and Gronhaug, 2010, Gray, 2014) and can be integrated into mixed-method research to overcome the weakness presented by each approach (Ebenezer and Kelle, 2003). However, the researcher has focused on the inductive approach, following the purpose of this research and the research questions in a qualitative study that focuses on participants' subjective experiences in the interpretations of the phenomenon under investigation.

4.4 Research Design

Understanding research design is imperative as it provides a logical and rational plan to address the research questions. Researchers have used different terms to define research design (e.g., Ghauri and Gronhaug, 2009; Bryman and Bell, 2015; Yin, 2013). Simply put, a research design is a means of providing specific direction for procedures for data collection, analysis, interpretation, and data reporting in research studies (Creswell and Plano Clark, 2011; Creswell, 2014). It helps to reveal the type of research and the priority of the researcher (Ghauri and Gronhaug, 2009), guide the methods and decisions the researcher must make during their studies and set the logic by which the researcher makes interpretations of the studies (Plano Clark, 2011). Therefore, following the research design, the researcher adopted a qualitative approach based on the research purpose and objective.

4.4.1 Qualitative Research

Qualitative research is assumed to revolve around the socially constructed nature of lived realities (Denzin and Lincoln, 2005), centred on the interactional creation of meaning(Holstein and Gubrium, 2011.p.341). Qualitative research focuses on interpretation in data collection and analysis, with a predominant emphasis on the inductive approach in the generation of theory, including a preference for how individuals interpret their social world (Bell et al., 2018; Easterby-Smith et al., 2012). The qualitative research approach adopted in this study is commonly associated with the constructivist paradigm - as exemplified by phenomenologists with the conviction that the individual's subjective experience is of crucial importance (Guba and Lincoln, 2005; Holstein and Gubrium, 2011). The approach allows the researcher to

analyse a phenomenon using individual experiences and perceptions of the phenomena under investigation (Creswell, 2014). Qualitative study is associated with the case study, action research, grounded theory, and narrative research strategies and utilises data collection methods such as in-depth interviews, focus group interviews, and participant observation in a small sample of participants (Gray, 2014; Saunders et al., 2016).

The construction of social reality has been made possible in the study through a qualitative approach in semi-structured interviews as adopted in this study. In line with this study, the researcher takes a more exploratory approach and begins the process without preconceptions about the nature of the phenomena under investigation. Qualitative researchers make no notions about reality as it does not exist independently outside of individual perception (Trochim, 2015), including the researcher's work. Therefore, qualitative researchers have the underlying premise that research participants and the social environment in which they operate cannot be separated (Trochim, 2015). Based on the epistemological level of this study, influenced by the researcher's constructivist view, the researcher believes that the social world must be interpreted from the perspective of the actors being studied (Bryman and Bell, 2015).

In contrast, quantitative research is classified into experimental and non-experimental – such as surveys (Lomax, 2004). It utilises a large sample size, often translating into statistical analysis to make the connection between what is known and what can be learned through research. Researchers who adopt a quantitative strategy are independent of what is being studied and value-free (Morrison, 2002). Quantitative researchers seek to investigate general laws to describe the reality that is being observed. These have been challenging for those operating from a qualitative research perspective (Easton, 2010; Robson, 2011). Qualitative researchers have argued against the notion of objectivity, claiming that the best way to discover and explain social phenomena is when the researcher is completely immersed in the process and views the phenomena in context (Trochim, 2015; Wynn and Williams, 2008). Qualitative researchers also criticised the quantitative approach, as it cannot be used to produce deeper and more detailed aspects of research phenomena that can be lost in an attempt to explore sets of statistical data (Creswell, 2014; Bell et al., 2018).

The quantitative approach's primary strategy is to appropriate the data into established categories rather than providing a thick description of the account. On the other hand, qualitative data provided richness and holism in data, with full potential to reveal complexity and interpretations nested in a natural context (Miles and Huberman, 1994). Based on these justifications and the fact that the researcher is much interested in understanding the meaning

that the actors socially construct, the researcher has focused on a qualitative approach and use of a semi-structured interview method to probe into the mind qualitatively, experience qualitatively, and knowledge of LSS professional and experts (participants) to ascribe subjective meaning into their respective organisation's environment (Bryman and Bell, 2015), to identify the key enablers to sustainable implementation of LSS programmes in HE as a PSOs.

4.5 Data Collection Method

Data collection, either secondary data or primary data, is fundamental to research studies (Gray, 2014; Ghauri and Gronhaug, 2010; Wilson, 2014; Saunders et al., 2016). The researcher considered secondary and primary data suitable to address the research phenomenon in sustaining LSS implementation as management science, based on the purpose of the studies. The researcher begins by collecting secondary data in the form of articles and journals from various database publications, from which research gaps were identified and served as the background for developing the research questions for collecting primary data (Easterby-Smith et al., 2018; Ghauri and Gronhaug, 2010; Saunders et al., 2016; Wilson et al., 2014). That enables the researcher to understand better and explain the research questions and other useful ideas around the topic under investigation (Ghauri and Gronhaug, 2010); and develop the theoretical framework of the research to support the findings of the primary data.

4.5.1 Data Collection Method – Interview

In consideration of the research questions, the objectives, the purpose, the research strategy (Saunders et al., 2016) and the type of data needed to answer the research questions (Ghauri and Gronhaug, 2010), the researcher has employed a semi-structured interview in the collection of primary data from chosen individual CI experts and professionals (interview participants) that are involved in the implementation of CI in HEIs in the UK. The interview research instrument is a process of interaction that consists of the possible joint construction of knowledge and meanings about people's experiences of activities and events. It offers the researcher direct access to understanding the participants' accounts and experiences (Smith and Elger, 2012). Interviews, as commonly associated with qualitative studies, allow the researcher to gain insight into participants' beliefs and attitudes toward applying LSS and CI (Wilson, 2014) in their respective organisations. Employing interviews will enable the researcher to obtain first-hand data reflecting practitioners' and expert views on practical experience in applying CI and LSS methodologies in HEIs as PSOs.

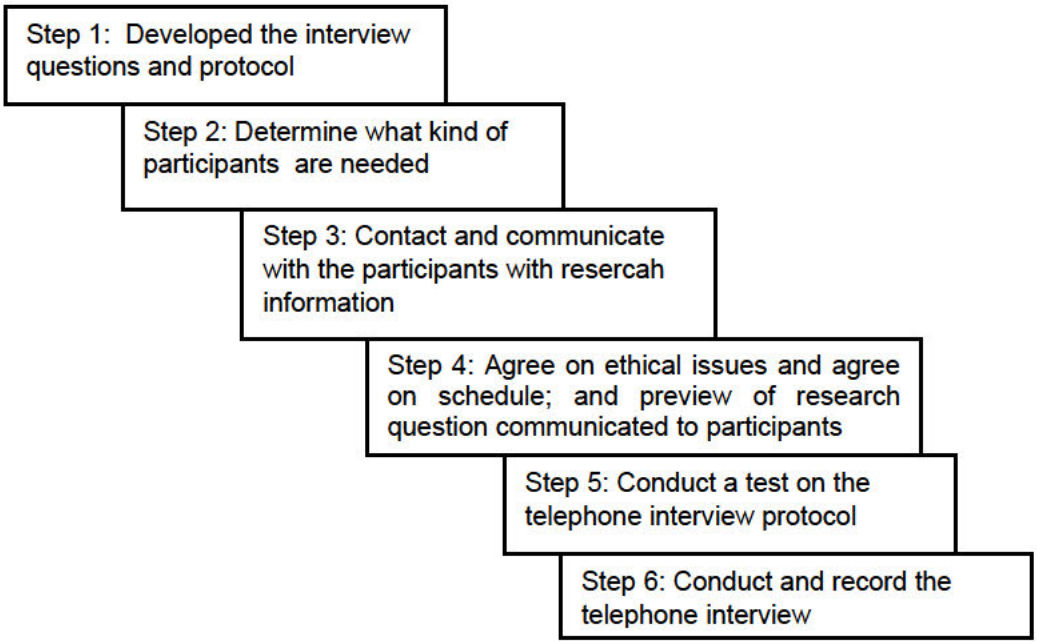
The most common type of interview involves individual and group/focus group interviews (Saunders et al., 2016). Depending on the purpose of the research, the interview could be structured, semi-structured or structured. Semi-structured may contain a list of themes and some key questions (interview protocol) designed to be covered during the interview, possibly with open-ended questions that allows the interviewees to explore further the topic they consider as critical and to structure those issues in their own terms to open new lines of enquiry (Bryman, 2016; Barnes, 2001; Yin, 2013; Saunders et al., 2016). Semi-structured interviews in this study were used in relation to exploratory research (Saunders et al., 2016) and allowed the researcher to explore in-depth individual CI professional experience on the LSS projects CSFs, the measures to quantify CI benefits and the key enabling factors to sustainable LSS and CI programme.

4.5.2 Expert Semi-Structured Interviews

In exploring the research questions based on the research purpose, the researcher has focused on expert experience and knowledge in applying CI methodologies in HEIs as PSOs. The rationale for focusing on LSS expert knowledge by the researcher in exploring the researcher questions is that they (CI experts) are equipped with explicit specialist knowledge. This knowledge includes an in-depth understanding of CI methodologies gained through specific CI training and years of experience in the application CI programme in HEIs, which enable them (participants) to provide clarification or resolve specific issues within the phenomenon under investigation. Collins and Evans (2002) maintain that the expert view is characterised by social constructivism in its prime, focusing on demystifying a particular knowledge, where knowledge is interpreted into a social activity. Expert knowledge in this study is viewed as a construction through negotiation, cooperation, networking, and teamwork in an open-ended process (Meuser and Nagel, 2009) between the participants and the researcher.

Interviews can be administered through telephone interviews, face-to-face and internet-based. However, these methods of administering interviews mentioned present individual strengths and weaknesses as documented in the literature (e.g., Bryman, 2016; Johnson and Turner, 2003; Onwuegbuzie et al., 2010; Stewart and Shamdasani, 2017; Saunders et al., 2016). Considering the overarching advantages of each method, the researcher chose a telephone interview. Telephone interviews are the most convenient and efficient method with very busy individual professionals and experts within their own space. The researcher has outlined six interview steps process of the telephone interview (as shown in Figure 4.2)

Figure 4.2: Six Steps Expert Interview Process



Author: The Researcher

The semi-structured interview questions were developed, which formed the interview guide following the research questions, research objectives, and study purpose (See Appendix C). In determining what kind of expert participants were needed based on the research objectives, homogeneous participants (CI Experts) with different years of experience and levels of responsibilities for varying views were recruited in the respect that they are actively involved in implementing CI/LSS in HEIs and PSOs. The participant was purposefully identified and selected based on their profile on the internet domain via LinkedIn, which is linked to their respective organisations and Institutions. The researcher's choice was related to the recognition of the participants' role as CI practitioners, with different levels of professional certification and extensive experience in implementing CI/LSS projects and programmes in HEIs and PSOs, including their ability to construct factual knowledge to clarify the research questions.

The participants were initially contacted through phone calls, emails and LinkedIn messenger, followed by a formal invitation email with a participant information sheet (See Appendix D), providing more information about the research and explaining the research purpose. Trust, confidentiality and ethical issues were established with the participant using a consent form (See Appendix E). Interview dates were scheduled and agreed upon between the researcher and the participants. As researchers suggested, a preview of the interview questions was communicated to the participants ahead of time (Burke and Miller, 2001; Christmann, 2009)

to give participants more time to reflect and think about their responses before the interview to yield thick and rich descriptive data (Burke and Miller, 2001). A pre-test of the interview protocol was also conducted with two CI practitioners that were not part of the main research. This helped determine the most logical and smooth-flowing order of the questions and resolve issues around structuring the questions and follow-up questions. The audio recording process and transcribing were also tested.

The interview was conducted following a pretest of the interview guide. The researcher acted courteously during the telephone interview and tried asking questions in a conversational tone to elicit a response to avoid awkward pauses between questions and, at the same time, maintained the interview protocol professionally. For the researcher to maintain data reliability and integrity, all questions during the interview were asked with the exact wording and in the prescribed order (Burke and Miller, 2001). In some cases, experts were asked a follow-up question for participants to elaborate on their construct based on their response to an early question. The interview lasted 45 minutes - 1 hour, depending on the following-up questions. The telephone interviews were recorded with Mp3 software, allowing repeated play and enhancing the transcription process's accuracy. The recorded interview was transcribed and transformed into a more formal writing style (Bryman and Bell, 2015; Kvale, 2007).

The purpose of conducting interviews includes gaining insights into the research questions (Saunder et al., 2016; Bryman and Bell, 2015). The researcher seeks to understand the view of CI practitioners and experts within a specific set of contextual opinions and perceptions based on their cognitive feelings and professional experiences, with the intent to offer potential insights into the research questions. The dialogue from the respondents provides insight and rich contextual information about the research questions. An expert interview is an effective way to conduct research when the researcher seeks to gain the knowledge and experiences of experts and factual information (Bogner and Menz, 2009).

A telephone interview with the use of a question catalogue is a very efficient and economical kind of collecting qualitative data, as neither travelling is necessary nor are there any expenses incurred in conducting the interview (Bogner et al., 2009; Bryman and Bell, 2015; Gray, 2014; Creswell, 2014). The length of an interview allows a participant time to develop their ideas fully, and the researcher used probing follow-up questions to elicit clarity from the participant. The fact that the interviewer and the interviewee share a common knowledge background help to increase the level of motivation on the part of the expert to participate in the interview, as observed in this study. A shared understanding between the participants and

the researcher of the social relevance of the study, thus basically eradicating the need for further justification (Bogner et al., 2009). Additional advantages of telephone interviews over face-to-face interviews, Helmer (1983 cited in Bogner and Menz, 2009), suggested that expert participants are more likely to generate reasoned, independent, and well-thought-out opinions in the absence of exposure to persuasive views of others. Other strengths of telephone interviews include the ability to collect information from participants regardless of their geographical location and their efficiency and flexibility due to technological advancements, especially the availability of recording and transcribing software.

4.6 Sampling of Interview Participants

Sampling designs represent the framework within which the sampling procedures occur, including the sample size and Unit of Analysis (Onwuegbuzie et al., 2007). There are two main sampling methods - probability and non-probability sampling. The choice between these two sampling methods depends on the purpose of the study, the type of questions and the type of data needed to answer the research questions. Within qualitative research, suitable participants are chosen on the basis that the data they provide will be sufficient to enable the research questions to be answered (Saunders and Townsend, 2019). As the research focuses on gaining insights that facilitate rich data rather than statistical description (Patton, 2015; Saunders and Townsend, 2018), a non-probability sampling technique was employed as required in this study. There is a wide range of non-probability sampling techniques (Miles et al., 2013; Patton, 2015) with predetermined participant selection criteria (Miles et al., 2013; Patton, 2015). The non-probability techniques often used in qualitative research are purposive, volunteer, and haphazard (Saunders and Townsend, 2018). The researcher's choice for purposive sampling to select participants was based on their relevance to answering the research questions, to enable the researcher to gain new insights into the phenomena under investigation and support the development of new understandings from which new theories may be developed (Miles et al., 2013).

At the planning of the semi-structured interview-based qualitative research, individuals working at different hierarchical levels and job roles as CI Consultants, Coordinators, Managers, and CI Leaders that are actively involved in the implementation of CI/LSS were purposefully chosen to provide the requisite information about CI/LSS initiatives practices in their respective institutions and organisations (Forza, 2002, Malhotra and Grover, 1998). Although the participants in this study are individuals, the unit they represent is the Higher Education Institutions (HEIs) in the UK, as reviewed in Chapter 2. The researcher employed

the heterogeneous technique to purposefully identify CI practitioners (participants) with diversity in characteristics, such as years of experience, level of education, level of professional certification and job role in the application of CI methodologies in HEIs and PSOs, in-order to provide maximum variation in the data collected. These variations arguably represent the strength of this technique, as any patterns that emerge from the data are likely to represent the key themes (Patton, 2015).

4.6.1 Participant Sample Size and Justification

Initially, a sample size of 24 heterogeneous participants was selected and deemed sufficient to answer the research questions. The selected participants were contacted with an invitation letter and participants information sheet, out of which 15 participants agreed to participate and consented to be interviewed. However, only 14 interviews were conducted, and one of the participants could not participate, due to a busy schedule, though the interview was rescheduled but was later cancelled (See section 5.1 for analysis of interview participants).

However, there are challenges in determining the sufficiency of participants and how many participants are needed for a qualitative interview study (Onwuegbuzie and Leech, 2005; Adler and Adler, 2012; Baker and Edwards, 2012; Saunders and Townsend, 2018). These challenges, according to Saunders and Townsend (2018), are two folds: the proposed number of participants in the planning of the qualitative research that are needed to answer the research questions; and the actual number that participated in the study being sufficient to provide the depth and breadth of relevant data required to answer the research questions and same be regarded as credible (Saunders and Townsend, 2018). Bryman (2012) attempted to provide an answer to how many qualitative interviews are enough in a study. They identified five factors influencing the sample size of interview-based qualitative studies, such as – saturation; the minimum requirements for qualitative studies in terms of numbers; the style or theory that underpinned the study; the heterogeneity of the population; and the breadth and scope of the research questions. Based on qualitative research's open-ended and often exploratory nature, some researchers argue that data collection should continue from further participants until saturation is achieved (e.g., Morse, 1994; Guest et al., 2006) or information redundancy is reached (Lincoln & Guba, 1985). At the same time, others argued for numerical guidance (e.g., Adler and Adler, 2012; Bryman, 2012; Saunders & Townsend, 2018).

Although, researchers have argued that empirically-based advice regarding when saturation is likely to be reached are limited (e.g., Baker and Edwards, 2012; Saunders and Townsend, 2018). Nevertheless, Guest et al. (2006), in their studies, comment that 6 to 12 interviews should be sufficient to reach saturation. Similar numbers ranging from 13 to 15 were reported by Francis et al. (2010) and Marshall (1996). Onwuegbuzie and Leech (2005) generally advised that the number should not be too small, otherwise, it will be difficult to obtain data saturation. On the other hand, the number should not be too large to make an in-depth analysis difficult (Onwuegbuzie and Leech, 2005). However, Kuzel (1992) argued that the number required for saturation would likely depend on whether chosen participants are homogenous or heterogeneous. Saunders (2012), drawing on experience, advised that between 4 and 12 participants will be sufficient for a homogenous group and between 12 and 30 for heterogeneous groups. In the case of this study, 14 heterogeneous participants can be considered sufficient (Saunder, 2022).

Similarly, Baker and Edwards (2012) answer to how many interviews are enough suggested 15 participants. However, the authors noted that the quota of their expert voices interview ended up at 14 participants, which is similar to this study. Adler and Adler (2012) also advise between 12 and 60 for qualitative research, but they noted that the number of participants could vary from 1 to 100. Mason's (2010) review of 560 Thesis relating to interview-based qualitative studies in Britain and Ireland shows that the sample size range was between 1 and 95. To concur with the above qualitative research expert's advice and reports on the sample size of an interview-based qualitative study, the researcher considers the sample size of 14 participants in this study sufficient to answer the research questions.

4.7 Data analysis

Several methods for qualitative data analysis have been proposed to date, including grounded theory – constant comparison analysis, template analysis, content analysis, and pattern matching, to name but a few (Bazeley, 2009; Easterby-Smith et al., 2018; Yin, 2013; Leech and Onwuegbuzie, 2007). Qualitative data collected from the interview was transcribed and transformed into the literal style of conversation and analysed with a combination of Constant Comparison Analysis and Template Analysis, with the help of a Computer-Assisted Qualitative Data Analysis Software (CAQDAS) – Nvivo, which allows numbers of themes to be created as it emerges.

4.7.1 NVivo – CAQDAS

The researcher employed NVivo, a CAQDAS, to analyse the transcribed data (Bazeley and Jackson, 2013). NVivo software allows the emerged themes to be coded and organised into themes and sub-themes. The software helps the researcher to manage a large amount of text into a limited number of categories based on explicit coding rules (Ryan & Bernard, 2000; Leech and Onwuegbuzie, 2007; Bazeley and Jackson, 2013) and help to visualise the content data at various stages of the interpretive process and visualise the relationship among the themes (Bazeley and Jackson, 2013). The NVivo software enables the researcher to sort segments, get all similar text in one place, read the segments, and make the connection that was “subsequently corroborated and legitimised” (Waring and Wainwright, 2008. P.90) during the discussion.

4.7.2 Constant Comparison Analysis

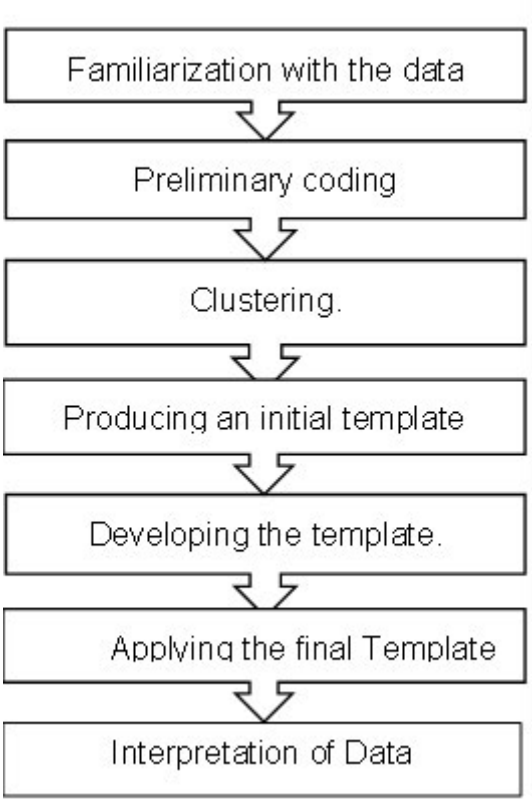
Constant comparison analysis (CCA) was developed by Glaser and Strauss (1967), the fathers of grounded theory (Ryan & Bernard, 2000; Lincoln and Guba, 2000; Lincoln et al., 2011; Leech and Onwuegbuzie, 2007), as a technique to compare themes and concepts in grounded theory (Ryan & Bernard, 2000). This method was adopted at the first stage of the template analysis to establish familiarity with the data. The data collected are subject to constant comparison analysis to develop data familiarity by the researcher in the process of identifying key themes and subthemes with the frequency of concept recorded (Lincoln et al., 2011). The themes were even noted based on the fact that they have been mentioned (Onwuegbuzie and Teddlie, 2003), thus allowing the researcher to identify unusual expressions or hidden meaning for a new construct in the coding process.

4.7.3 Template Analysis:

Template analysis (TA) is a form of thematic analysis that emphasises the application of hierarchical coding, with a high level of structure in the qualitative data analysis process — focusing on the development of a coding template based on a subset of data that is further applied for revision and refinement (Brooks et al., 2015; King and Brooks, 2017). Template analysis enables the researcher to record and code the qualitative data transcribed to help establish useful themes for the study, with a clear focus and emphasis on similarities across the included material (Brooks et al., 2015).

The researcher conducted template analysis in this study according to the six stages process (Brooks et al., 2015; Saunders et al., 2016; King and Brooks, 2017; Anderson-Ingstrup and Ridder, 2020) (See Figure 4.3). CCA was employed to establish familiarisation with the transcribed data based on the first step of the template analysis. The researcher further employed NVivo to conduct the other four subsequent stages of the template analysis process. The researcher carried out preliminary coding and organised the emerging themes into meaningful clusters; established a template of categories based on the research objectives and themes; developed a hierarchical structure of themes and defined how the categories, the themes and sub-themes are related. Following that, an initial template showing the hierarchical organisation of themes was produced. The initial template was further reviewed with the selection of the most relevant themes and sub-themes, leading to the development of the final template with the complete data set (See Appendix G for the final Template Analysis).

Figure 4.3: Template Analysis Techniques Steps:



Sources: Adopted from (Waring and Wainwright, 2008; Brooks et al., 2015; Saunders et al., 2016; King and Brooks, 2017; Anderson-Ingstrup and Ridder, 2020)

Finally, was the examination of the pattern and frequency of the themes in the data. The themes and subthemes were listed based on categories and headings of the research questions and objectives to determine their frequencies of themes and subthemes. However, the frequency and pattern of themes alone are not able to reveal anything meaningful (King and Brooks, 2017). The researcher selected themes discussed in detail based on their relevance and link to the research questions and aims (King and Brooks, 2017). As expected, according to King and Brooks (2017), template analysis, even in a modest scale qualitative research, is likely to generate more themes than what could be analysed in detail.

The researcher employed template Analysis because of easy adaptability. As a style of thematic analysis and the coding structure, the researcher can visualise the key themes and sub-themes required to answer the research questions. TA allows the researcher to organise the emerging themes into meaningful groups and define how the themes are related within and between the clusters in hierarchical relationships, with subthemes nested within the main themes (Brooks et al., 2015). The flexibility of TA, especially the TA design, helps the technique achieve a balance between openness and structure in coding. In addition, the relatively non-prescriptive approach to TA design and organised encourages the researcher to retain an open-minded approach to the analysis.

4.8 Reliability and Validity

Reliability and validity are essential criteria in the process of establishing and assessing research quality. It can be argued that rigour is needed in both quantitative and qualitative research. This rigour necessitated that the researcher ensures high quality in its reliability and validity (Easterby-Smith et al., 2018; Gray, 2014; Collins and Hussey, 2013; Saunders et al., 2016; Bryman and Bell, 2015). However, the extent of its application in quantitative research rendered it inapplicable in qualitative research (Mason, 2002; Bryman and Bell, 2015; Lincoln and Guba, 2000), as such the concept of validity and reliability have been assimilated into qualitative with different connotations (Lincoln and Guba, 2000; Bryman, 2016; Creswell, 2014).

Several alternative and general criteria have been aimed to be relevant to evaluating the quality of qualitative research, although with variations, different models and more suitable terms (e.g., Lincoln and Guab, 2000; Spencer et al., 2003; Yardley, 2000). Lincoln and Guba (2011) proposed trustworthiness and authenticity as alternative criteria to evaluate qualitative research. Spencer et al. (2003) use commitment, rigour, transparency, impact, and importance. Similarly, Yardley's (2008) studies produce a criteria checklist to assess

qualitative research quality. The researcher, however, evaluated the quality of this research based on the Lincoln and Guba (2010) trustworthiness and authenticity criteria and Yardley's (2000) commitment and rigour, transparency and impact criteria. As these criteria are well rooted in the axioms and assumption of the constructivist view in line with the paradigm of this study (Lincoln and Guba, 2000), including the relevant to the research approach (Symon and Cassell 2012) such as coding and thematic analysis style of template analysis of semi-structured interviews.

Denzin and Lincoln (2011) posit that trustworthiness and authenticity must be accounted for research results to be deemed valid and reliable. Therefore, to overcome the threats of validity and reliability (Creswell and Plano Clark, 2018; Saunders et al., 2016; Johnson and Turner, 2003), the researcher has widely considered these issues and performed several procedures to ensure the quality of the research findings. In qualitative research, multiple accounts of social reality (i.e., respondent validation) are significant in establishing credibility (Denzin and Lincoln, 2011; Bryman and Bell, 2015). As a measure to internally validate the study and establish the credibility of the finding: the account of the final report (the themes) was sent to the research participants as part of “member validation” (Bryman, 2011.p.396) to seek corroboration and accuracy of the findings and as a mean of confirming individual accounts (Denzin and Lincoln, 2011; Bryman and Bell, 2015; Cresswell, 2014). Secondly, the researcher is total commitment and substantially grounded on research skills development, including contemporary knowledge of the subject area of study (Yardley, 2000) and ensured good practice in the process and rigour of data collection and analysis (as indicated in sections 4.6 and 4.7). This procedure helps establish trustworthiness in the findings (Denzin and Lincoln, 2011).

Guba and Lincoln (2005) argued that a thick description of findings provides others with a database for making judgements about the possible transferability of findings to another context. Based on the in-depth interview study of a small group of CI professionals as participants in this study, the research has similarly used detailed and thick descriptions to report the research findings. Detailed descriptions of findings may help convey a more meaningful interpretation to the reader with an element of shared experiences, offer many perspectives about a theme, and make the results more realistic and richer, thereby adding to the validity of the findings (Creswell, 2014).

It is recognised that complete objectivity is impossible in business research (Bryman, 2011), as social researchers are unconsciously influenced by their values. Maxwell (2006) signified

that researcher bias, or the researcher's influence, is the main threat to validity in qualitative research. Guba and Lincoln (2011) proposed confirmability to establish trustworthiness. This expects the researcher to act in good faith and not allow personal value to sway the conduct of the research and findings (Bryman, 2011). The risk may be due to the researchers' influence in only seeking evidence that supports their research questions and ignoring other contradictory evidence (Sullivan, 2009). To avoid this bias, the researcher has designed an open-ended interview question to seek more explanations of the research questions, allow the interviewees to share their experience in-depth and freedom to express their thought on the research question. Using a semi-structured interview protocol enables the researcher to avoid asking different questions to different interviewees, treat all participants and their answers equally and avoid asking probing questions that may sway the interviewee to answer differently rather than for clarification.

In addition, to avoid the researcher's influence on the participant's views, participants were informed of their choice to respond to any question/questions during the interview. The participants were given access to the recorded Mp3 to check their answers before transcribing. Access to the recorded material allows participants to confirm whether they have adequately answered the research questions or verify whether the answers they have provided as recorded were what they meant. On a general note, there was no feedback on the recorded material. The recorded interview was transformed into a literary style based on the research purpose, thus helping to highlight nuances of the conversation and facilitating communication of the meaning of the research topic to ascertain the transcript's validity (Flick, 2007). Following Gibbs (2007) suggested qualitative research reliability procedures, and the researcher employed constant comparison analysis to check the transcripts to ensure they did not contain obvious mistakes made during transcription, ensure that there was no shift in the meaning of the codes during the process of coding (Creswell, 2014).

Finally, the authenticity of the research was established through the fair representation of the participant sample (Guba and Lincoln, 2011). Different viewpoints among the studied sample members were ensured (see sampling method in section 4.6). The sample being studied widely represent the individual CI professionals with different job roles and responsibilities (such as - Consultants, Managers, Coordinators and Leaders) in the field of CI, also with varying experience, level of professional certification and educational qualifications (See chapter 5.1 section for participant analysis).

4.9 Ethical Considerations

Ethical issues must be considered in any research, especially research involving human beings. The closer the research is to individuals in real-world settings, the more likely ethical questions will be raised. The nature of business and management research is such that the researcher will depend on other people for access to data Research ethics is referred to as the appropriateness of the researcher's behaviour in connection to the rights of research participants, either became the subjects of the study or are impacted upon by the study (Saunders et al., 2016). Ghauri and Gronhaug (2005) viewed research ethics as moral principles and values that influence researcher conduct and research activities.

There are different aspects of ethical issues in this research related to research participants and the organisation they represent in the data collection process. Such issues include seeking participant consent, the possibility of causing harm to participants and maintaining confidentiality. Considering the ethical issues of this research, the researcher has ensured working within the UWS Ethics Committee guideline upon the approval of the ethics application made to the committee. Following the ethics committee guideline, the researcher formally contacted participants with a research participant information sheet that provides information about the research (See Appendix D). The participants were briefed about ethical issues regarding the General Data Protection Regulation (GDPR) and confidentiality concerning the research, after which a consent form was sent to the participants for attestation (see Appendix E for a sample of the consent form).

The respondents were **NOT** pressured into participating in the research, as participation was voluntary. The research purpose was communicated to all participants taking part through the participant information sheet. The anonymity and confidentiality of respondents were assured and maintained during and after the interview and in the report. Information collected during the research has been kept strictly confidential. Participants and their institutions are known to the researcher in the data collection process and were **NOT** in any form reported and published. Participants were identified with a unique ID known to the researcher in data collection and analysis. All documents and reports containing participants and their institution information have been secured based on GDPR and saved in computer cloud drives with a password that is only known to the researcher. In addition, the researcher will always request participants to review the report to agree on the content and secure participants' consent before publication in any journal in the future with undisclosed identities.

4.10 Summary

This chapter describes the overall research process, specifically the research methodologies and methods adapted to investigate the research problems. The general research philosophy employed a constructivist paradigm to demonstrate an alternative paradigm in the field of CI management to explore expert historical experience. Constructivists inductively develop a theory or pattern of meanings. The researcher has focused on the inductive approach, following the purpose of this research and the research questions in a qualitative study that focuses on participants' subjective experiences in the interpretations of the phenomenon under investigation. Therefore this study relies on a qualitative approach to explore the research questions and provide rich data with the full potential to reveal the complexity of the phenomenon under investigation.

The data collection method will begin with collecting secondary data articles and journals from various database publications, from which research gaps were identified and served as the background for developing the research questions. Primary data was collected using semi-structured telephone interviews, following the interview protocol designed with an open-ended question. The interview with 14 heterogeneously selected experts was conducted to explore in-depth CI professional experience on LSS and CI implementation. The data collected were transcribed and analysed with Constant Comparison Analysis and Template Analysis, with the help of Nvivo software which allows several themes to emerge. The validity and credibility of findings were considered through detailed and thick descriptions of the research findings, helping to convey a more meaningful interpretation. An open-ended question allows the interviewees to share their experiences in-depth and express their thoughts on the research questions to avoid bias. Finally were the ethical issues, and in this case, the ethics committee guideline was followed to ensure participants were brief about ethical issues regarding confidentiality and participant consent was taken, and agreement was reached with the participants.

Chapter 5: Data Analysis - Template Analysis

5.0 Introduction

Following the conduct of the primary study based on the research process and procedures described in the previous Chater, this chapter focused on the analysis and interpretation of key findings of the semi-structured interview conducted to explore the research questions and objectives. A sequential process of Template Analysis was used to identify and display the themes and subthemes based on codes generated using Nvivo. The final Template (Appendix G) was categorised into six headings, analysed, and compared with the literature findings. Qualitative data were collected from fourteen practitioners with different characteristics, as analysed in section 5.1. Section 5.2 and the subsequent subsections (section 5.2.1 – 5.2.6) present each category of the templates analysis with an in-depth analysis of the CSFs and challenges of LSS projects implementation, the benefits of LSS projects, the measures to quantify the benefits and performance, the sustainability enabling factors and the barriers to LSS sustainability.

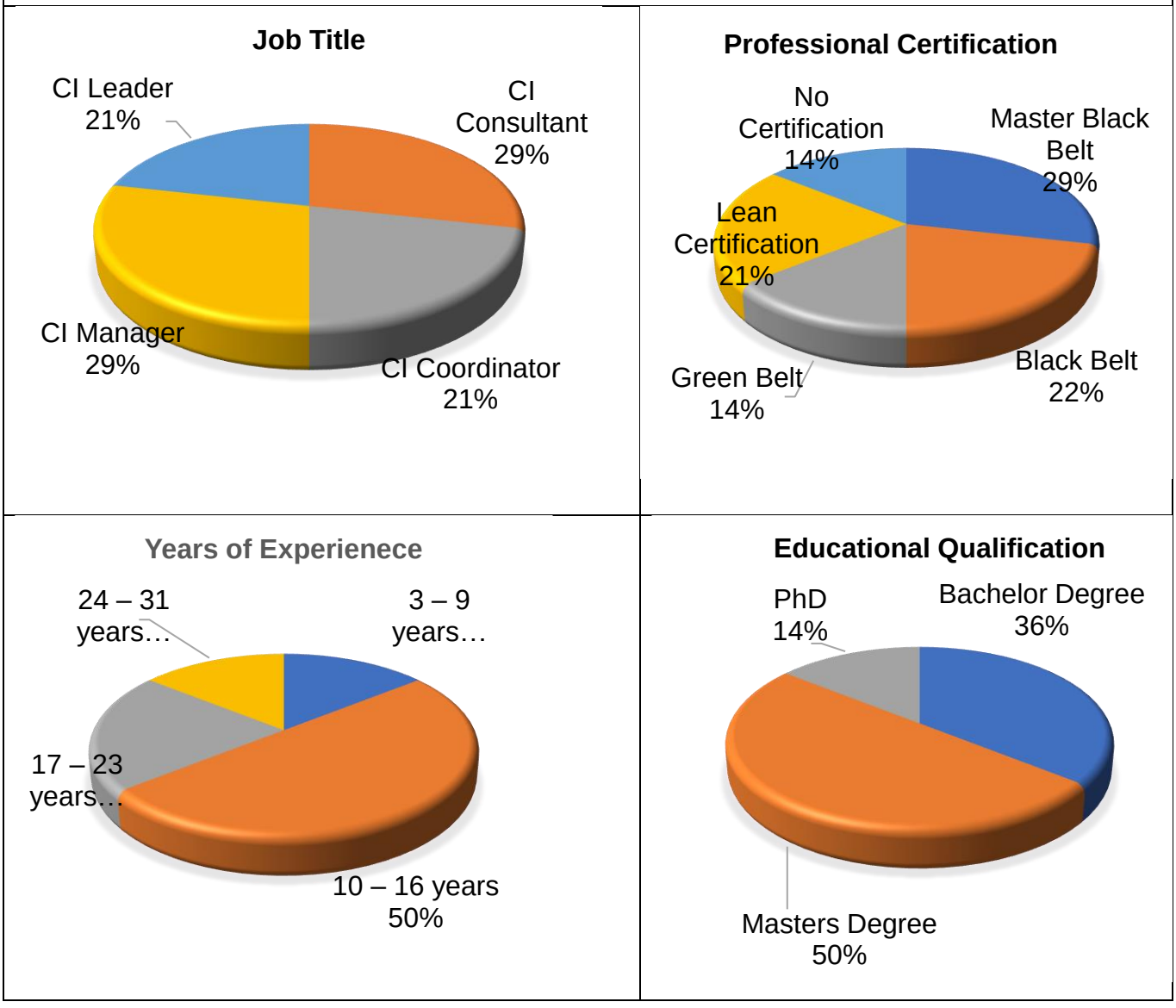
5.1 Characteristics of the Interviewees

The semi-structured interviews were conducted with 14 participants that are heterogeneous in their characteristics (see table 5.10), each participant represented with an ID (See Appendix F). The participants are CI practitioners with different educational qualifications, job titles, and years of experience implementing CI methodology in HEIs. Based on the analysis of participants' characteristics (See Figure 5.1), the job title of the 14 interview participants shows that 29% were CI consultants, 21% were CI Coordinators, 29% were CI Managers, and 21% were CI Leaders. The professional certification chart indicates that 21% of the participants hold Lean Certification, 29% hold LSS Master Black Belt (LSS-MBB), 22% hold Black Belt, 14% hold Green Belt certification, and 14% of the participants have no professional certification. The analysis also indicates that the participants are highly educated, with 36% bagged a Bachelor's degree, 50% with a Masters's degree, and 14% holding a PhD degree. The analysis further indicates that selected participants have spent between 3 – 31 years practising CI as a profession. The participants' characteristics thus qualified them to provide an expert view in response to the research questions.

Table 5.1 Interview Participant Characteristics

Job Title		Professional Certification		Years of Experience		Educational Qualification	
CI Consultants	4	Master Black Belt	4	3 – 9 years	2	Bachelor Degree	5
CI Coordinators	3	Black Belt	3	10 – 16 years	7	Masters Degree	7
CI Managers	4	Green Belt	2	17 – 23 years	3	PhD	2
CI Leaders	3	Lean Certification	3	24 – 31 years	2		
		No Certification	2				

Figure 5.1: Participant Characteristics Analysis



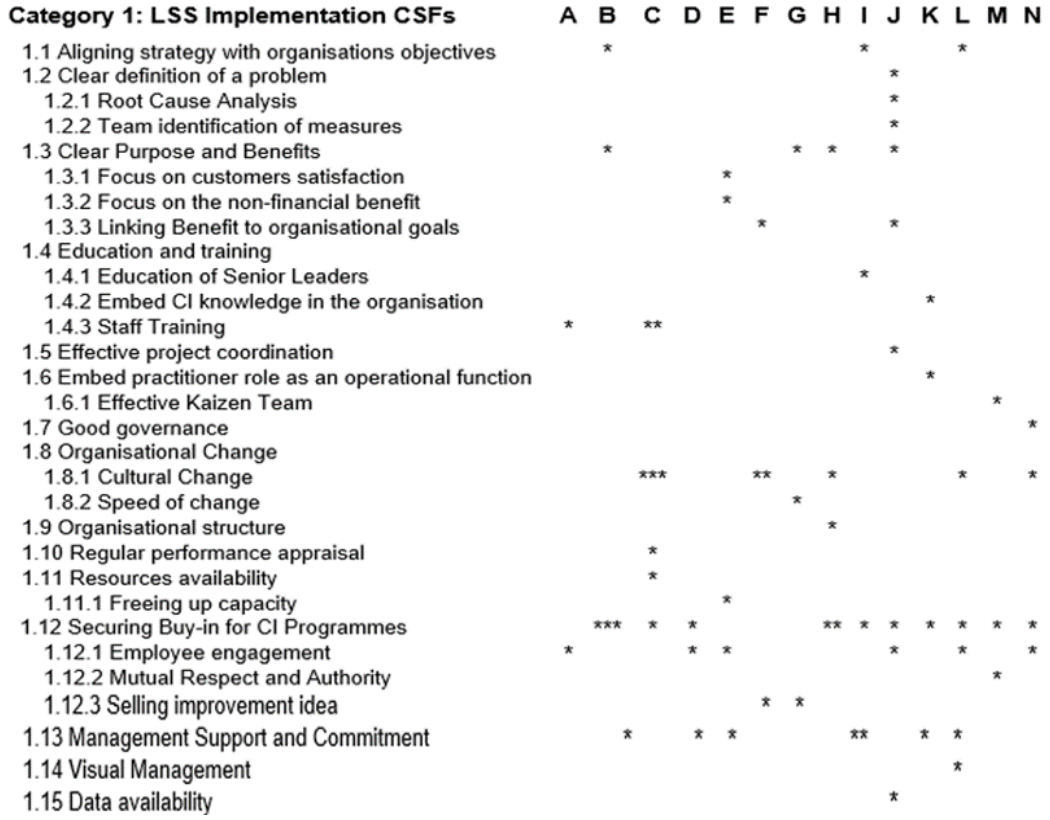
5.2. Key Findings from Semi-Structured Interview:

Following the final template analysis, six categories template was developed in light of the interview questions and further subcategorised into hierarchies of themes and codes (See final TA in Appendix G). The researcher used the categories and themes to reflect the research questions and objectives designed to make sense of the interviewee's experiences. The following subheadings are the analysis of each of the categories of the final template analysis:

5.2.1. CSFs to LSS Project Implantation in HEIs

This category identifies the CSFs of implementing LSS projects within HEIs from the interview. In the exploratory interviews, the experts were asked to identify the factors that have proven useful to the successful implementation of LSS projects over the years of their experience as CI practitioners in HEIs. The template analysis of the interview identified 29 CSFs, categorised into 14 main themes and subdivided into different hierarchies (Table 5.2). From the template above (figure 5.2), the most cited CSF theme in aggregate was "*securing buy-in for CI project".* Other frequently mentioned themes were organisational change; Senior management support and commitment; Clear purpose and benefit, education and training. Although most of the cited CSFs appeared to be similar to previous studies (See section 3.8), however, new themes appeared to emerge from the interview, such as: *getting buying-in for the CI project; Cultural change; the speed of change; the clear purpose of project and benefits; and, a clear definition of the problem.* The majority of the interviewees cited these new themes. However, five themes were selected and further analysed based on their relevance to the research questions and aim and the new emerging themes (kings et al., 2017).

Figure 5.2: LSS Project CSFs Template Analysis Category



Category 1: LSS Implementation CSFs	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1.1 Aligning strategy with organisations objectives		*							*			*		
1.2 Clear definition of a problem										*				
1.2.1 Root Cause Analysis										*				
1.2.2 Team identification of measures										*				
1.3 Clear Purpose and Benefits		*					*	*		*				
1.3.1 Focus on customers satisfaction					*									
1.3.2 Focus on the non-financial benefit					*									
1.3.3 Linking Benefit to organisational goals						*				*				
1.4 Education and training														
1.4.1 Education of Senior Leaders									*					
1.4.2 Embed CI knowledge in the organisation											*			
1.4.3 Staff Training	*		**											
1.5 Effective project coordination										*				
1.6 Embed practitioner role as an operational function											*			
1.6.1 Effective Kaizen Team													*	
1.7 Good governance														*
1.8 Organisational Change														
1.8.1 Cultural Change			***			**		*				*		*
1.8.2 Speed of change							*							
1.9 Organisational structure								*						
1.10 Regular performance appraisal			*											
1.11 Resources availability			*											
1.11.1 Freeing up capacity					*									
1.12 Securing Buy-in for CI Programmes		***	*	*				**	*	*	*	*	*	*
1.12.1 Employee engagement	*			*	*					*		*		*
1.12.2 Mutual Respect and Authority													*	
1.12.3 Selling improvement idea						*	*							
1.13 Management Support and Commitment		*		*	*				**		*	*		
1.14 Visual Management												*		
1.15 Data availability										*				

Source: The Author

Securing buying-in for CI Project:

The theme *"securing buying-in"* appears to be a new theme identified by the researcher when compared with previous studies (see section 3.8) and took the position of the main theme in the hierarchy in subcategorising the template. The theme "securing buy-in" for the CI project was widely observed among the consultants and the manager's interview response (e.g. Interviewees B, C, D, G, H and N). They subscribe that the major factor in the successful implementation of LSS project rests on the ability of the CI manager and team to secure project support from senior management and employees.

> *"One of my main CSF is having a buying-in from senior management because, without their support, CI cannot be implemented within the business. CI has to be promoted from the top down. If you got agreement, interest and enthusiasm, you are in a much stronger position to train and implement Lean methodology and culture throughout the business"* (Interviewee C).

> *"Buy-in from senior management – help to gain high leadership on board, chief executive and all senior management need to be brought into the programme.*

Focus on staff and take them on the journey – high employee engagement, understanding employee roles and the difficulties they are experiencing and trying to provide an improvement, working alongside with employees rather than doing it for them" (Interviewee D).

"Another factor is selling improvement ideas, which may sometimes be a difficult change in expectation and aspiration. After implementation, providing LSS training will be good to try and sell the idea and reset their expectation and aspiration differently" (Interviewee G).

"Leadership buying-in not just at the most senior but throughout the organisation, especially where we have very high-ranking staff. "Employee engagement – a very successful engagement with staffs around CI such implementation can get the whole organisation buying into it." (interviewee N).

As cited by Interviewee C, getting agreement from senior leadership and management is a requisite to a successful LSS project. However, practitioners' views on this theme appear to be contrary to previous studies (e.g., Tsironis and Psychogios, 2016; Antony and Cudney, 2016; Antony et al., 2012), which highlighted senior management support and employee engagement. On the contrary, the secure buy-in theme, as used by interviewees based on their expert experience, placed responsibility on CI practitioners to "secure buy-in" from all stakeholders by "*selling continuous improvement project ideals"* (Interviewee G) to the whole organisation (interview N), secure – project ownership with the opportunity to "*engage with of all employees"* and understand the role of all employees (Interview D and G) that will be involved and impacted upon by the project. Interview J emphasise *"a clear identification and engagement with all managers and employees in that business that are going to be impacted with the end to end of the project."*

Management commitment and support:

Top management's support and commitment are major CSF in CI projects, as revealed across the literature (e.g. Jeyaraman and Teo, 2010). This study indicated a similar view as 43 per cent of respondents cited management commitment and support (Interviewee, C, E, H, J, L, and M). As argued by interviewee C, "*Without commitment and support of leadership, CI cannot be implemented within the business".* A strong commitment and project ownership are required from the senior management with a position of authority for successful CI project management. "*The CI project must have clear ownership with a position of authority.*

However, they do not necessarily need to be skilled in LSS/CI but must be committed to improvement and change initiatives (Interviewee J).

Organisational Cultural Change

This theme indicated the need for a shift in the organisational culture of HEIs to adopt change and improvement initiatives. Like any other PSO, the organisation culture of HEIs is complex and often not receptive to change and continuous improvement initiatives. The response from the expert interviews indicated a "*cultural change"* and "*speed of change"* as notable factors in the change management process of LSS project implementation (Interviewee C, F, G, H, L, N). As identified (Interviewee C and F), cultural buy-in from top management is a key factor that requires consensus (interviewee F) and wiliness (Interviewee C) for cultural change and a behavioural shift among all stakeholders, which includes top management and employees for successful implementation of improvement and change project (Interviewee C, F, G, N).

> *"The key thing is cultural buying from the top. It will be very difficult to implement Lean and CI without culturing buying. The process may be great, cultural change, change management is required to slowly change behaviour. Otherwise, the output will remain the same in productivity* (Interviewee F*).*

Interviewee F argued that the CI initiative in HEIs and PSOs has been regarded as a "*tickbox exercise"* and advocate for *"the wiliness to adopt a new culture and seek a better way of doing things"* (Interviewee F). Interviewee C called for *"they need to stabilise CI and establish it in the culture of the organisation… …invest in new culture and methodology and to see it through"* (Interviewee C). Interviewee (L) indicated the need to *"develop LSS/CI behaviour for cultural change". At the same time,* Interviewee (N) cited a "*good culture that enables you to have an honest conversation on the things that are not working that need to be improved*".

The Speed of Change:

In addition to being open to cultural change, the organisational change subtheme shows that the speed at which the change occurs is another factor (Interviewee F, G). The respondent indicated the "slower *speed of change*" – a slow change process that will allow management to slowly change their behaviour (Interviewee F) and a methodology that gradually introduces and deliver CI project over a period (interviewee G).

Interviewee G argued that *"change needs to be done in slow steps"* based on experience.

"I find out that we have to do things in slow steps. Very few areas we jump into an opportunity or change then go into slow thinking training with the opportunity to deliver the change. Only occasional people get it and go with it straight away. In trying to change from one track to another – either you have to delay the change or work out a methodological process, push and pull strategy to introduce the concept, work out how to introduce the change in the future may be between 3 -6 months wait. Slow steps in introducing the concept, Sell the ideas and deliver the unique expectation" (interviewee G)

Clear definition of Problems:

This theme is one of the new themes identified as CSFs. Interviewee J emphasised the need for a clear definition of CI problems in the process of initiating a project.

"A clear definition of the problem statement…. a clear acceptance of all parties involved that they dedicate resources to solving the problem that has been identified. The entire team can clearly define the specific and main issues contributing to the problem. The team can identify the root cause of the problem by conducting a proper root cause analysis. The CI facilitator having the skill to conduct Root Cause Analysis brings openness of business to chase down the roots cause" (Interviewee, J).

Although, implementation of LSS methodology at a stage thus involves the definition of the problem in the defined stage of applying LSS technique and tools, such as using the Fishbone tool in conducting root cause analysis with a clear problem statement as cited. Nevertheless, similar to this study (See barrier to CI project), previous studies suggest that lack of data challenges a clear definition of CI problems (e.g. Albliwi et al., 2014). Interviewee J indicated the need for the involvement and engagement of the entire team, both manager and employees, in identifying the problems. The CI practitioner's skills and knowledge of conducting root cause analysis were also identified as a success factor in problem definition.

Clear Purpose and Benefits:

This theme indicated that the purpose and benefit of CI and change projects should be clarified to all stakeholders. Although, research suggested a lack of awareness of the benefit and the need for CI initiatives in the service sector, including HEIs (Albliwi et al., 2014). To ensure a successful implementation of the CI project, respondents cited that: *"there should be understanding of the benefit of the improvement project"* (Interviewee B) and the need to *"develop a clear purpose of the department of the organisation and the improvement that is*

trying to be achieved" (Interviewee H). As such, the purpose and benefit of the LSS project should be communicated to management and employees alike (Interview B, H).

Interviewee E advocates for benefits that "*focus on customer satisfaction and other non-financial benefits"* (Interviewee E). *"Proof of the results and benefits that need to be delivered"* (Interviewee G) which could be "*in the form of a quick win to celebrate early success"* and secure buy-in (Interviewee G).

> *"…proof of the CI project results and benefits that need to be delivered. I always have to prove that CI initiatives can deliver the outcome they want, e.g., cost savings, engagement of workers and improved customer satisfaction. Sometimes, the result may be specified, for example, 10% saving.. the result may sometimes not be what is expected, and the benefit could come in a different form. For an example of an improvement where we proposed to save 10%, in the end, there was an increase in spending by 10 per cent, but we earned 20 per cent more revenue, and the result was delivered differently, which sometimes does not fit with people thinking* (Interview G).

Although, a quick win is important to *secure buy-in and convince stakeholders of the benefit of Lean and CI"* Interviewee F indicated. However, finding a quick win could be difficult, respondents argued. Respondents argued that a long-term mindset is required to identify benefits linked and aligned with organisational goals and strategy (Interviewee F, J).

> *"In most cases, organisations are not able to find quick-win benefit to justify the CI project" …. rather than looking for quick-win" "benefits need to be linked to the organisation high-level goal and business strategy to identify how Lean and CI initiative can support the organisation"* (Interviewee F).
>
> *"CI project and benefits need to be aligned with the business goal"* (Interviewee J)

5.2.2. Challenges to LSS Project Implementation in HEIs

In this (second) category, the interviewees were asked to identify their challenges in implementing LSS and CI projects in HEIs. Following the interview, a total of 28 themes were identified and categorised into 11 main themes, including subthemes and categories, as shown in Figure 5.3. Based on the density of the interviewee statement, the most mentioned themes as challenges were *Lack of Leadership commitment and support, followed by Organisational Culture, Difficulties in getting buy-in from employees, Lack of capacity and*

Lack of employee engagement. Although, the factors identified in this category show similarity with previous literature (e.g., Tari and Dick, 2016; Antony et al., 2012). However, some new themes seem to emerge from the expert view relating to HEIs as PSO, which include *lack of capacity*, the *unwillingness of management to free up existing capacity* to support LSS projects, and *lack of a culture of the lesson learned.* The following are further analyses of selected main challenges of CI/LSS project implementation in HEIs.

Figure 5.3: *Template Analysis of the Challenges of the LSS Project*

Category 2: Challenges to LSS Project	A	B	C	D	E	F	G	H	I	J	K	L	M	N
2.1 Choice of Tools and Methodology												*		
2.2 Difficulties in identifying customers												**		
2.2.1 Difficulties of identifying public value												*		
2.2.2 Difficulties of measuring customers Value												*		
2.3 Focus on Cost savings					*						*	*		
2.3.1 Focusing on Headcount					*									
2.3.2 Quick win mindset						**								
2.4 Lack of visible performance measures													*	
2.5 Lack of accurate and reliable data		*												
2.5.1 Huge cost of gathering data		*												
2.6 Lack of capacity					*		*		*					
2.6.1 Management unwilling to free up capacity									*					
2.7 Lack of employee engagement						**		*						
2.7.1 Disconnection between functional roles							*							
2.7.2 Lack of CI Manager responsibility to encourage staff									*					
2.8 Lack of Financial Resources			*											
2.9 Lack of knowledge and skills	*						*							*
2.9.1 Lack of Effective CI Team													*	
2.9.2 Lack of Trained Staff and Practitioners			*									*		
2.10 Lack of Leadership Commitment and Support	**		*		*			***			*	*	*	
2.10.1 Difficulties of getting buy-in from employees		*		*		*						*		
2.10.2 Lack of top management involvement	*				*									*
2.11 Organisational Culture					*	*	*	*		*				*
2.11.1 lack of a Culture of a lesson learned														*
2.11.3 Negative Perception of LSS and CI Methodology											*	*		
2.11.4 Resistance to change									*					

Source: The Author

Lack of Leadership and top-management commitment and support:

The difficulties of securing commitment and support from the top management and leadership in the process of implementing CI initiatives as a change project was cited by 50% per cent of the respondent (e.g. Interview, A, C E, H, K, L, and M). Although this factor shows similarity with literature, however, in the case of HEIs in the PSO environment, respondents argued that top management "continuously *delegate responsibility top-down"* (Interview A) rather than*…." getting involved and helping to develop cultural change"* (Interview E). This indicated the difference between the commercial service sector environment and the PSOs

environment, as further emphasised by CI consultant respondent with 15 years experience of working across HEIs and other PSOs.

> *" What you find is that the improvement project has been handled by someone that doesn't have the commitment required from the senior management. Although we have delivered some good pockets of CI projects due to the commitment of some individuals that were involved in the projects. However, there is a frustration of work in trying to deliver improvement. Generally speaking, the top management is paying lip service, ..insincerity of support. There is no real commitment to change and improvement in the spirit of CI*" (Interviewee H).

Challenges of Organisational Culture:

The respondents cited the challenges of developing a culture to support continuous organisational improvement and change. The difficulties of the rigid organisational culture of HEIs, have also been indicated in previous studies. As cited, the top management in the public service environment is always very receptive to change and continuous improvement initiatives.

> *"….it is a very strong culture that is quite difficult to drive through change, and you can't be up against that culture that doesn't want change to be entrenched in the organisation. They don't have high culture turnover. It is a culture that has been entrenched over the years and is very difficult to penetrate... this is the way we do things here" Trying to push forward change and improvement can be quite difficult, if not impossible, although there are lots of success stories"* (Interview N).
>
> *"The baseline data sometimes shows that the problem is not usually the process but the cultural behaviour. Changing cultural behaviour could take a long time and be difficult.. ..you need top management to get involved in helping to develop cultural change"* (Interviewee F).

Unfortunately,

"The senior and middle management don't want the answers to be what it turns out to be. Rather, they want answers that fit their personal or political ideology" (Interview J).

This challenging factor is similar to Matteo et al. (2011) view, as they argue for the need to transform organisational culture. As subcategorised in the template, other cultural change issues identified are the negative perception of LSS and CI methodology and resistance to change. Although CI methodology applications originate from the manufacturing sector and

are widely accepted. However, the concept and the terminology are yet to be widely accepted in the HEIs and PSOs environment (Antony et al., 2017).

> *"Strange culture in the public service sector where they view LSS as concept and approach for manufacturing" …..despite many articles of success stories of LSS/CI in public service, without a mini-project to demonstrate the success, they still reject the methodology* (Interview G).

Lack of capacity:

Capacity in the form of resource – employee time and effort input, especially human resources that are required to implement change and improvement projects from initiation to completion. Respondents cited "*lack of capacity for the organisation to be fully engaged in the CI programme"* (Interviewee E); *and "lack of management support to free up capacity"* (Interviewee I) as the main challenges to LSS project implementation. The challenge of capacity resulted from the employees being preoccupied with daily tasks, "*Lack of capacity to improve because the employees are so busy fire-fighting"* (Interviewee G), and most often, management's unwillingness to free up capacity.

Focus on Cost savings:

Cost reduction and efficiency saving are part of CI initiatives' benefits, as it has been used by the organisation to illustrate success stories of CI projects. However, too much focus on cost-saving by the organisation has become a challenging factor in the wide acceptance of CI implantation. CI initiative has been viewed as a cost-saving and a head-count-driven initiative, as argued by respondents (Interviewee E, L)

> *"Focus on cost reduction and saving and focus on headcount. The organisation focuses on reducing the previous year's cost, leading to decreased employee morale. CI initiative is better achieved when focusing on eliminating waste from the business processes"* (Interviewee E).
>
> *"Although the positive understanding of Lean is to create capacity to grow, the dilemma for the public sector is that Lean is about cutting costs. The public sector view on CI, as cost savings exercise, is an inherent contradiction of its core principles in the private sector"* (Interviewee L).

In most cases, Organisations pursuing their quick-win mindset as a business case to justify their CI project benefits result in head-count exercise – leading to job losses. As argued (Interviewee F, J), CI benefits should be linked to organisational strategy rather than seeking quick-win.

Lack of knowledge and skills:

Training and education of employees and top management have long been highlighted as CSF to LSS project implementation. Nevertheless, the lack of CI methodologies knowledge and skills among the employees and top management still impedes CI project implementation across HEIs and PSOs (Interviewee A, C G, L, M).

> *"Lack of overall CI skills in the team. The team skill seems to vary uniquely. E.g. business analysis, financial manager, or customer service, but the required overall skills for budgeting, costing and putting together simple data analysis and measures needed to develop metrics and effectively deliver LSS/CI projects are lacking—for example, using spreadsheets and creating graphs. There is a huge gap in overall skills. The organisation needs to develop skills across all areas, which could be very difficult"* (Interviewee G).

As indicated, there is a "*Lack of Lean practitioners at the senior management level"* Interviewee A) and a *Lack of effective kaizen team, including CI managers* (Interviewee M). Interviewee C argued that "*although we have senior LSS champion staff, there are no trained LSS employees in the organisation".* Thus, the organisation is having challenges implementing the CI project. Respondent emphasises employee training and support, ensuring their line manager supports the initiative (Interviewee M).

5.2.3 The Benefits of LSS as CI Initiatives in HEIs

This category attempts to identify the benefits of LSS projects. The interviewee was asked to highlight the benefits of CI initiatives in the respective projects they have embarked upon over the years. The benefits cited by respondents are summarised in Table 5.4, and the most cited were "*cost-saving"* (interviewee A, B, D, E, G, J, K, M), *"capacity building"* (Interviewee A, B, E, F, G), "*customer satisfaction"* (Interviewee A, E, F, I, J), "*employee engagement"* (Interviewee A, C, E, F, K), and *"improvement in cultural change"* (Interviewee C, N).

Figure 5.4 Template Analysis of the Key Benefit of LSS in Initiatives

Category 3. Benefits of the LSS Programme	A	B	C	D	E	F	G	H	I	J	K	L	M	N
3.1 Capacity building	*	**			**	*	*							
3.2 Cost Savings	*	*		*	*		*			*	*		*	
3.3 Customers Satisfaction	*				*	*			**	*				
3.4 Employee engagement	*		*		*	*			*					
3.4.1 Developed capability						*								
3.4.2 Employee empowerment					*									
3.4.3 Improved CI awareness			*											
3.4.4 Increase employee involvement and morale					*	*		*						
3.5 Evidence-based Data to influence decision-making														*
3.6 Higher productivity										*				
3.7 Improved Culture of Change and CI			***											*
3.8 Increase in Lead time					*								*	
3.9 Increase in speed of delivery										*				
3.10 Local community engagement				*										
3.11 More responsive to customer value									*					
3.12 Waste Reduction					*									

Source: The Author

Although most CI project was said to have been driven by efficiency saving, hence cost reduction was hugely reported. *"The organisation that I have worked for has been able to deliver a benefit in terms of efficiency savings"* (interviewee B). Interviewee G cited an example of £300,000 savings from CI projects. Interviewee B indicated 66 per cent of cost reduction in CI efficiency projects, while Interviewee K indicated "*workforce efficiency that translated into savings, but not necessarily headcount".*

> *"Benefit should not focus on cost savings, but rather on the number of complaints, employee morale, and the amount of rework done. Simplifying complex processes and bringing in better working conditions, work satisfaction, and, in the end, reducing cost. Even though cost saving may not be initially revealing"* (Interview E).

Despite the project being driven by efficiency saving, other benefits were also reported. *"we implanted the methodology and achieved a full capacity – increase in capacity in a very short"* (Interviewee A). Respondent cited *"increase in capacity*" as a benefit which thus enables the organisation to build broad CI knowledge and acceptance of CI methodology.

"Most departments lack the capacity to change and improve because they are always firefighting. The first pact of the process was to work with employees to build their capacity and give them a chance to learn about LSS and perform as CI term. Free up some capacity from the non-value-added activities. That capacity open-up the opportunity for them to think of change differently. The capacity is used for change and thinking, encouraging them to network and share knowledge and develop focus groups, leading to a change in culture and developing skills to improve their work (Interviewee G) independently.

Another benefit reported was a "*10 per cent reduction in customer journey"* (Interviewee F*) ", increased focus on the customer and more responsive to the value and service delivered to customer and student"* (Interviewee I), leading to an increase in customer and student satisfaction. Respondents also indicated employee empowerment due to high employee involvement and buy-in into the CI implementation process.

"*employees having the authority to make changes improve their morale and sense of belonging for creating value in the organisation, feeling of having a say in their work and how it is being done. Employee commitment and involvement, rather than being told what to do, increase employee's morale"* (Interviewee E).

"…shift in people's attitude as they feel been engaged been listened to, and their contribution is being taken on board" (Interviewee F)
"….staff has been involved in the process of identifying improvement project. Higher degree of buying-in, improvement in the change management process" (Interviewee K)

5.2.4 Measures for Quantifying the Benefits of LSS Initiatives in HEIs

In exploring expert views on this category, firstly, respondents were asked to identify an established CI performance measurement system used in their organisation. Predictably, as shown in Table 5.5, the interviewee cited the adoption of *performance metrics*, *Key Performance Indicator management,* and the *Balanced Score Card* (BSC) system. Secondly, respondents were asked how best their CI benefits and performance should be measured to quantify in their organisations. Respondents cited: *financial metrics (Interviewee A, D) and non-financial* metrics (A, B, D, E, L). However, the majority of respondents emphasise the use of non-financial metrics (see Table 5.5). Measuring and quantifying the benefits of the CI project has been cited as a critical success factor. However, the difficulties of measuring and

quantifying CI benefits and performance was also widely cited by the respondents (Interviewee A, B, F, G, I), similar to previous studies (Sunder, 2016a,b; Kumar et al., 2010)

Figure 5.5: Performance Measurement and Quantification

Category 4: Performance Measurement and Metrics	A	B	C	D	E	F	G	H	I	J	K	L	M	N
4.1 Align with strategic direction									*					
4.2 Balanced ScoreCard System										*		*		
4.2.1 Financial metrics	*			*										
4.2.1.1 Cost saving		*		*										
4.2.2 Non-Financial Metrics														
4.2.2.1 Cultural Change Metrics												**		
4.2.2.2 Customer Satisfaction Score	*	**		*	*		*		*				*	
4.2.2.3 Employee engagement level	*											*		
4.2.2.4 Employee Morals level					*					*		*		
4.2.2.5 Lead time					**	*			*				*	
4.2.2.6 Resources utilised		*												
4.2.2.7 Services delivered					*									
4.2.2.8 Staff competency												*		
4.2.2.9 Strategic metrics							*							
4.2.2.10 Transaction Throughputs					*									
4.2.2.11 Waiting time					**									
4.2.2.12 Waste reduction rate				*								*	*	
4.3 Capability Chart							*	**						
4.3.1 Control Chart								**						
4.4 Customer Survey								*				*		
4.5 Key Performance Indicator (KPI) Management			**	*				*			*			
4.6 Monitoring metrics														
4.7 Performance Measurement System	**	*		*	*	*	*			*				
4.8 Visual management board							*		*					

Source: The Author

Balance Score Card (BSC):

BSC is a performance measurement management system used to measure organisations' financial and non-financial performance indicators (Kaplan and Norton, 1996). The system was originally developed with a focus on financial metrics until more recently when the nonfinancial indication was included, as financial statements alone cannot correctly capture the measurements that companies need today. Respondents cited the use of BSC as a measurement system (Interviewee, J, L) *"at the strategic level*" (Interviewee, L) and the use of "*permanent and temporal metrics,* a situation where *…permanent data should be collected with temporary measures to solves a specific problem"* (Interviewee, J).

Key performance indicator (KPI):

KPIs are financial and non-financial indicators that organisations use to attest to how successful they were in achieving their long-lasting goals as part of the Balanced Score Card management system.

"KPI is a way in which the auditor assesses the business to ensure we are working toward an agreed and approach business-standard. We have a Key Performance indicator (KPI) set by the external and internal auditor and senior management" (Interviewee C).

"The senior management has two levels of KPI—the functional level KPI and top management level KPI by which CI impact is measured. Senior management receives those high-level KPIs monthly to determine if they are going well and to be held accountable if not achieved. Also, to achieve improvement in an outgoing basis in the areas that are not doing well" (Interviewee D).

5.2.4.1 Difficulties of Measuring and Quantifying Benefit

The difficulties of measuring and qualifying non-financial indicators and other metrics, as indicated in previous studies (e.g. Sunder, 2016a,b; Kumar et al., 2010), remain an issue in the process. The same was cited by respondents (e.g. Interviewee A, B, F, G, I). Based on their experience, they emphasise the difficulties of quantifying and measuring CI project benefits and performance and some issues that underpin these difficulties. Interviewees argued that these problems were underpinned by a "*lack of clear understanding of the problem facing the organisation"* (Interviewee A), "*inconsistencies within the process"* (Interviewee B), "*lack of clarity of organisation overall benefit" (*Interviewee F), Interviewee G *argued that "corporate measures are still pointing to the wrong direction",* and Interview I opined that "*Quality measures are being avoided because we are not asking the right question when measuring performance".*

".. there is difficulty in quantifying and measuring benefit. Sometimes due to a lack of understanding of the problem. There is a need to understand the client problem that needs be solved, identify the potential benefit based on the problem right from the onset and track them all through" (Interviewee A).

".. there are performance metrics but are difficulties. I find inconsistency in performance metrics, which is very tricky - how people measure and record turnout differently. ….most organisations resume work without and never plan to go back and remeasure the process so that they can quantify the benefit that has been delivered and simply stop the moment they go live with another project… to me, that process of measuring benefits is not going well" (Interviewee B).

"Organisation overall benefit not clear, although each department has different metrics to measure their productivity level. But at the overall organisation level, it is difficult and unclear where they want to go" (Interviewee F).

"…in the Lean University project executed, performance metrics were a big challenge. We do not have enough metrics to prove we made a massive difference. Performance metrics for the public sector is very difficult, and there really has to be data from the top for people to adhere and work with" (Interviewee I).

Nevertheless, to mitigate against these difficulties, respondents suggested the need to *"aligned CI benefit measures with organisational strategy*" (interviewee B, I), the use of a *"visual management board"* as part of the performance measurement system to ensure employees understanding of the process and measure (Interviewee G, I).

"Measuring CI performance should include visual management. Sometimes there is a change in the processes, but employees don't notice whether it gets better or not" (Interviewee G).

"…. best measurement must be aligned to the organisation's strategic direction and team engagement to ensure alignment to the organisation's overall objective. Visual Management Board and metric management board to show the improvement journey and the achievement. Clear improvement strategy that aligns with the corporate goal. For measurement to work, it has to be demanded and supported by the top management" (Interviewee I).

Furthermore, Interviewee G indicated the use of operational metrics and strategic metrics, as quoted, *"appropriate monitoring metrics, the establishment of a successful transaction form of performance metrics and operational metrics" and the development of strategic metrics as part of corporate policy strategy, which is more to do with the aspiration of the organisation"* (Interviewee G).

Interviewee K suggested the development of "*Corporate KPIs and Unit KPIs"* at the different levels within the organisation. While Interviewee L suggested *"the use of a Balance Score Card at the strategic level".* Interviewee L argued that *"measures have to be directed to the purpose to make an impact"*.

5.2.5 Sustainability Enabling Factors (SEFs) of LSS Initiatives in HEIs

This category explores expert views on the key factors that enable a new way of working and improving outcomes that translate the initial gains of the LSS programme into a sustainable CI across the entire organisation – sustainability enabling factors (SEFs). From the template analysis, 36 codes were identified and categorised into 16 main themes and further subcategorised into different hierarchies of themes, as indicated in Table 5.6.

Figure 5.6: LSS Sustainability Enabling Factors

Category 5: LSS Sustainability Enablers	A	B	C	D	E	F	G	H	I	J	K	L	M	N
5.1 Availability of quality data				*						*				
5.1.1 Knowledge of data analysis				*								*		
5.2 Continuous Training and Development			*		**				*					
5.4.1 Increase CI Knowledge and practitioners			*		*		*							
5.4 2 Leadership and top management training									***					
5.4.3 Mandatory staff training on Kaizen					*									
5.4.4 Refresher training			*	*										
5.3 Create an Understanding of CI Methodology						*								
5.3.1 Wider Acceptance of CI Methodology							*							
5.3.2 View of LSS as a problem-solving tool										*				
5.3.3 Modification of Concept Language								*						
5.3.4 Less focus on Toolkit level of LSS and CI											*			
5.3.5 Choice of the right tools and Methodology												*		
5.4 Creating Capacity					*									
5.4.1 CI specialist team				*										
5.4.1 Professionalisation of CI function in PSOs											*			
5.5 Embed CI as part of the organisation's strategy						*								
5.5.1 Consistency of Purpose					*			*		*				
5.5.2 Formal Approach to CI across PSOs							*							
5.5.3 Strategic sets principles for CI Application												**		
5.5.3.1 Contingent approach												*		
5.5.3.2 Coordination of CI programme							*							
5.6 Identifying the right performance measures			*					*						
5.6.1 Set CI as part of staff performance appraisal			*											
5.7 Leadership Engagement with Employees	*			*	**									
5.7.1 Effective Leadership Communication						*								
5.7.2 Top management involvement					**								*	
5.8 Lesson Learn mechanism				*										*
5.9 More commercial-minded PSOs		*												
5.10 Organisational Culture		*				*		*						
5.11 Senior Management Buy-in and Ownership			*	*				*	*	*	*			
5.11.1 Leadership Support and Advocacy	*						*				*			
5.11.2 Leadership accountability	*													
5.11.3 Leadership long-term focus		**			*	*								
5.11.4 CI practitioner at senior management	*													
5.12 Service user-oriented approach						*		*						
5.13 Share of best practice			*											
5.14 Stakeholders' Engagement														*
5.14.1 Employee Engagement and Empowerment				*		*				*				
5.14.2 Top Management Engagement						*					*			*
5.15 System Approach to CI									**					
5.15.1 Process Thinking										**		*		
5.15 Using Benefits to influence decision														*
5.15.1 Sharing and celebrating success						**								
5.16 Visibility Management														*
5.17.1 Publication of CI KPI in an annual report													*	

Source: The Author

The template analysis (Table 5.6) demonstrated the density of the sustainability enabling elements cited by respondents, of which *Continuous Training and Development, Leadership engagement with employees, Senior Management buy-in and ownership, Organisational Culture and Change, use of benefits to influence decisions, Long-term focus and Leadership support and advocacy appeared to be the topmost cited themes*. Very scanty pieces of literature have attempted to study SEFs of LSS as CI and change initiatives (see Table 3.10). Consequently, out of the 36 main themes and subthemes cited by the interviewees, as SEFs, only visual management, organisational culture and change and employee empowerment were found to be similar to the limited literature reviewed. Although most of the factors cited factor share similarities with CSFs in section 5.2.1, most factors cited appeared to be unique to SEFs. Below is the analysis of some of the identified SEFs themes.

Coordination of CI programme:

Coordination as part of the management element synchronises organisation functional areas and integrates individual responsibilities and departmental activities efficiently in harmony towards the common objective. Interviewee G indicated that *some departments have implemented LSS with little knowledge within the organisation but lack a formal approach.* Therefore, *"the need for a better coordination"* of these programmes and individual activities *across the organisation's department and unit* (Interviewee G).

Sustaining individual behaviour:

One of the unique factors cited is sustaining individual employee behaviour in the change process. Based on the respondent's view, managing organisation change from its present state to a desired future state and sustaining the future state over a long period thus requires sustainability of individual employee's behaviour (Interviewee L). *"sustainability is more about sustaining individual behaviour rather than corporate performance"* (Interviewee L).

Standard Operating Procedure:

The need for a standard operating procedure was also cited as a sustainability enabler (SE), steaming from the coordination of activities. Interviewee G called for a formal approach to implementing CI and LSS in PSOs, *"there are lots of pockets of work but no formal approach (Interviewee G).* Interviewee M suggested *"incorporating the changes and CI in standard operating procedures and ensuring the operating procedures are followed and more visible"* (Interviewee M)

Consistency of purpose:

Respondents (Interview E, J, and H) cited consistency of purpose as key sustainability enabling factor. Similar to Matteo et al. (2011) study that reported inconsistency of management philosophy as a barrier to sustainable improvement programmes in the healthcare environment. For CI initiatives to be sustainable,

> "…*there has to be the consistency of purpose with a focus on quality rather than cost-cutting"* (Interviewee J)

> "….*depends on the consistency of purpose, consistency of message, training and mindset over the years* (Interviewee E)

> "…..a *clear purpose of service, knowing what to deliver and identifying the right service to be provided* (Interviewee H).

Develop sets of LSS and CI principles:

Research suggests that the lack of broader acceptance of LSS and CI methodology and its principles may be due to the CI language being used and the misconception of the origin of Lean and SS methodology – the manufacturing industry. The interviewee cited the development of a much more acceptable set of strategic principles for the effective and sustainable implementation of CI.

> *"There is a need for a set of principles for applying Lean/CI in the public sector, compared to the private sector. There has to be a strategic set of Lean principles that suit the public sector"* (Interviewee L).

Data analysis capability:

Although lack of data has been cited as a barrier to LSS project implementation, availability of data is one issue, and lack of knowledge to analyse available data has been viewed as a long-term issue to sustainability. The interviewees indicated the development of data analysis knowledge within the organisation's CI and functional team. "*There is a need for stronger knowledge of data analysis within the organisation and use of data to drive CI in the organisation"* (Interviewee D). While Interviewee J opined the need to "*ensure the operation manager in each of the business areas are skilled on how to read and run data so that CI can be embedded into the operations".*

Creation of CI specialist team:

CI team within an organisation thus provides the much-needed skills and capacity needed for successful implementation and sustainability of change and improvement initiatives over time.

> *"Having a specialist team responsible for delivering the change and service improvement across the organisation rather than being left to functional managers. In cases where change and CI implementation are left to functional areas, they tend to struggle. Having a team of CI specialists can help other functional areas sustain the improvement required"* (Interviewee D).

The professionalisation of CI functions:

Respondent cited the formalisation of CI functions as a profession to create the individual's CI expertise and capability needed for improvement and change solutions.

> *"I have been advocating for the professionalisation of CI functional in public services, like HR and Accounting. The right level of investment to create CI professionals to improve change management and the CI soft skills that are required"* (Interviewee K)

Embed CI as part of daily task and organisation strategy:

Conventionally, CI initiatives are implemented as a project structure with a beginning and an end. In most cases, the end of the project brings the initiative to an end. Therefore, to sustain the CI initiative, respondents argued for *embedding CI as part of the organisation's day-to-day activities and strategy* (Interviewees J, F and I). Interviewee J emphasises that organisations need to "*build a momentum of CI as part of daily work rather than waiting for specific intervention*".

System Approach and Process Thinking:

Respondents argued for interrelationships and interdependencies among the entire organisation as a system and the need to view the entire organisation's business as a set of processes with documentation of the evidence. System approach and process thinking, leading to collaboration across the department to identify solutions and leverage process improvement throughout the system for sustainability.

"Managers need to stop seeing LSS/CI as a project, LSS/CI initiatives to be viewed as a system and the way organisation operate. … organisations need to incorporate CI as part of the leading team" (Interviewee I).

"There has to process thinking and evidence and data-based thinking" (Interviewee L), and *"getting the improved process properly documented*" (Interview J).

5.2.6 Barriers to LSS/CI Sustainability

The barriers to sustainability template analysis in Table 5.6 shows 35 themes and subthemes categorised into 14 main headings of themes. Respondents cited various impending factors that contributed to their LSS projects not being sustainable or not sustaining the improvement gains over a long period. The comparison of the barriers to sustainability in this category with the challenging factors to LSS/CI project implementation in section 5.2.2 shows new emerging themes. Nevertheless, both categories – the challenging factors to implementation and sustainability enablers (figure 5.2 and figure 5.6) also show some similarity which suggests reoccurring of the impediment to CI initiatives despite the practitioner's effort to over the challenges in the respective projects.

Figure 5.6: Template Analysis of Barriers to LSS/CI Sustainability

Barriers to Sustainability	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1 Attitude to change			*	*										
1.1 Fear of complete automation							*	*						
1.2 Perception CI concept and Language									*					
1.3 Lack of wider acceptance of CI methodology							*							
2 CI initiatives are driven by cost savings		**					*		*	*				
2.1 Headcount									*					
3 Difficulties of measuring benefits	*	**						*				*	*	
3.1 Lack of CI performance measures													*	
3.2 Lack of clear benefit											*			
4 Failure to develop Culture of CI and Change		*				*								
4.1 Difficulties of getting buy-in		*				*								
4.2 Philosophical thinking											*			
5 Focus on individual performance						**								
5.1 Employees working in silos						*								
5.2 Speed of change						*								
6 Lack of CI knowledge and skill at the top management level	*													
6.1 Lack of CI practitioner at the top management level	*													
6.2 Lack of accountability	*													
7 Lack of engagement with service users				*										
8 Lack of resources			**									*		*
8.1 Lack of CI specialist				**							*			
9 Lack of senior leadership commitment	*	*			*			*		*	*	*		
9.1 Delegation of responsibilities	**	*											*	
9.2 Lack of effective communication top-down			*											
9.3 Lack of wiliness to invest time and effort	*													
10 Lack quality data				*										
10.1 Original data accessibility	*													
11 Proliferation of different methodology									*					
12 Short term focus		**			*	*								
12.1 Focus on quick win						*	*							
13 Unstable policies and environment		*	**	*	*									
13.1 Change in political leadership				*										
13.2 High management and staff turnover			*	***	*					*	*			

Source: The Author

Attitude toward change:

This refers to an employee's response to change, whether positive or negative. In this case, interviewees indicated employees' negative attitude to change as a barrier to CI sustainability. Attitude to change in the form of employee complacency to change, *"a feeling of we already know it and we don't need to know anymore, such attitude thereby putting pressure on daily work"* (Interviewee C). Another form of attitude cited is "*lack of dedicated employee to a change programme"* (interviewee D).

Fear of process automation:

As argued by Interviewee G, "*Although automation is inevitable in LSS/CI programme and will be a target, we can never automate every process*. However, the respondent cited that "*fear of complete automation of work process makes lots group of people fear that they may lose control and power over the process as there a lot of check and balances, authorisation, delegation, and sign off procedures were built around the process which about power and control* (Interviewee G).

Lack of Wider Acceptance:

Similar to previous studies on the challenges of CI implementation (e.g. Antony et al., 2017), "*lack of wider acceptance of CI programme"* was also cited as a barrier to sustainability (Interviewee G, H). Interviewee G opined "*that there is still a lack of wider acceptance of LSS in the UK public sector compared to the US".*

Perception of LSS and CI concept Language:

LSS and CI methodology concept language has its root in the manufacturing industry. Therefore, the negative perception of LSS and CI concept Language in the public service environment hiders wider acceptance of methodology (interviewee H). A similar view was also reported in previous research (Thomas et al., 2017; Antony et al., 2017)

> *"LSS language is uncomfortably fit for many in the public sector. Because the root of LSS lies in the manufacturing environment, it is difficult for some people to make that relationship and how it can help them to improve in the public service sector". Too much discussion about the origin is turning people off. There is a need to modify the language and the way it talks about waste. Most of the language of LSS is in the deficit with negative mindset and concepts – e.g., what is the problem, identify the problem, how big is the problem. The danger of using*

such language is that – the people, the service and everything become a problem with the negative mindset" (Interviewee H).

Cost-Saving Driven CI Initiatives:

LSS and CI projects have been widely regarded as cost-saving driven initiatives in the public sector following the UK government's adoption of LSS as CI methodology for the efficient saving programme across the public service sector in the aftermath of the 2008 global economic recession. The respondent (Interviewees B, G, I and J) accorded that the *cost-saving driving initiative* created a barrier to sustainable CI programmes. Such terms of reference associated with a CI programme created a "*wrong perception toward CI programme as cost-saving and service cut initiatives*" (Interviewee G), and focusing on cost-saving resulted in "*headcount"* (Interviewee I).

> *"CI in PSOs is very much driven by cost-saving. That was where it all started. It is relatively new to the public sector. People started to get involved in a more commercial way of doing business and non-businesses. But the public sector has jumped on the bandwagon to meet their target, driven by cost savings even now" (Interviewee B).*

> *"Pursuing a cost-saving initiative through headcount – getting rid of people. Organisations going into LSS looking for a huge amount of savings…have no understating of the fundamental principles of Lean. CI is a much better endeavour if senior management understands that and not looking for a quick win. But to develop a better way of cost savings as an alternative to headcount" (Interviewee I).*

Failure to Develop a Culture of CI and Change:

This refers to the inability of organisations to develop a culture of change needed to sustain CI initiatives. Although previous studies suggested a change management approach to sustained LSS (Campbell, 2008; Matteo and Perera, 2011) and thus lacked specifics. However, respondents cited the failure of organisations to develop the culture of CI (Interviewee B, F). "*Failure to consider the wider aspect that they need so the organisation develops a sort of culture where LSS/CI is almost the way of doing business that will come naturally"* (Interviewee B). Interviewees further cited some reasons why organisations are unable to develop a culture of CI:

- ***Organisational silos culture –*** that is deeply rooted in the organisation (Interviewee F). "…. *People think more of individual performance rather than organisation performance. They are more engaged in how they move forward as individuals, therefore doing anything to achieve individual performance rather than seeing a collective performance. . employees see the CI programme as a barrier to individual performance" (Interviewee F).*

- ***Daily task workload_***– employees are too busy with daily routines. Therefore securing employee buy-in becomes difficult (Interview, B and F).

  "People don't buy into CI,.. they feel doing CI/ Lean will impact their daily job activities as they are too occupied with everyday tasks. They don't step back from their daily task (Interviewee F).

  "Employees consider LSS/CI programme as additional to their daily job, and it is very difficult to get buy-in at any level consistently" (Interviewee B)

- ***Speed of Change*** – the speed at which the change management programme is being implemented is crucial to the change initiative's success, as studies suggest. Interviewee F indicated the speed at which organisations implement CI programmes. "*Employees are not given dispensation during CI and change implementation. …. the impact it may have in daily task and performance in the short term are not being considered".* The respondent further argued that *"organisations should allow more time for employees to buy-in and at the same time manage their workload"* (Interviewee F).

Lack of CI practitioners at the top management level

Training and education have been widely argued as a success factor for LSS implementation, emphasising employee training to increase CI knowledge and skill within the organisation. Although this remains a challenging factor, as the study suggests, Interviewee A cited *"lack of CI knowledge and skill at the senior management level and lack of senior management wiliness to invest time and effort.* Thus, leading to *"…..continuous delegation of responsibility top-down and practitioners in the organisation are too young and junior to hold the leaders accountable" (*Interviewee A).

5.3. Summary:

This chapter presented the data analysis based on the research design and the data collected from the semi-structured interviews. The first part was the analysis of the participants' characteristics based on educational and professional qualifications, job titles, and years of experience implementing CI methodology in HEIs. Template analysis techniques were employed with the help of Nvivo. The data analysis was categorised into six headings based on the interview questions and presented in aggregate. The heading covered is the CSFs of LSS project implementation, the challenges of LSS project implementation, the benefits of LSS and CI initiatives in HEIs, the measures to quantify the benefits and the difficulties performance measurement in HEI, the LSS sustainability enabling factors and the barriers sustainability.

The first category was the analysis of the CSFs, where respondents identified 29 CSFs. The 29 CSFs were categorised into 14 main themes and subdivided, from which new themes emerged. On the challenging factors of the LSS project, 28 themes were identified and categorised into 11 main themes and subthemes, and new themes also emerged as challenging factors. From the analysis, the respondents identify several benefits from different LSS projects that they have completed. Although most CI project was said to have been driven by efficiency saving, hence cost reduction was hugely reported. Respondents identified Balance Scorecard as a CI performance measurement system and identified the use of organisation KPIs and financial and non-financial metrics.

From the sustainable CI category, the respondent identifies 36 themes as sustainability enabling factors (SEFs). The SEFs identified were categorised into 16 main themes with further subcategories, and most of the themes identified were new when compared with the literature reviews. Finally, from the barriers to the LSS sustainability template, 35 themes and categorised into 14 main themes, and new themes also emerged from the identified barriers. Across the six categories, some themes were selected and thematically analysed based on their relevance to research questions and aims and the new emerging themes. Some of the literature reviewed has reported the CSFs for deploying and sustaining LSS. However, there are huge similarities with elements they reported as sustainability enablers when compared with project implementation CSFs

Chapter 6:

Discussion of Key Findings and Framework

6.0 Introduction:

Following the analysis of the interview data and thematic description in Chapter 5, this chapter report further discusses key findings from the interview based on the research questions. Retrospectively, the key findings from the literature review proposed into a conceptual framework in Figure 3.15 (Section 3.10) were compared with the interview findings. This chapter discussed the CSFs and the challenging factors of LSS project implementation, the performance measurement and metric and the difficulties of measuring and quantifying LSS performance and benefits. Further discussed are the sustainability enabling factors and the barriers to LSS and CI sustainability. The researcher also compares LSS project CSFs and the SEFs from the findings to identify the factors unique to SEFs and those that apply to both LSS project CSFs and SEFs. The final results from the literature review and interviews were combined to reverse and develop a new framework illustrated in Figure 6.1. Finally, is the presentation of the LSS Improvement Sustainability Framework and further discussion of the LSS and CI sustainability enabling factors.

6.1 CSFs and Challenging Factors to LSS Project Implementation

CSFs, as a major starting point in the implementation of LSS and CI projects, require careful attention from LSS practitioners. The analysis of the expert interviews shows a considerable consensus on eleven commonly cited CSFs of LSS in HEIs and PSOs. Securing buy-in for the CI project, employee engagement, senior management support and commitment, clear purpose and benefit, education and training, changes in organisational culture, speed of change, clear purpose and benefit of the project, a clear definition of the problem with the application of root cause analysis and free-up of capacity were considered the topmost CSFs and the new emerged CSFs in driving change and improvement within HEIs as a PSO. Although, most of the cited CSFs for the implementation of CI projects by the experts were similar to previous studies reviewed (e.g., Psychogios and Tsironis, 2012; Psychogios et al., 2012; Sfakianaki and Kakouris, 2019; Sreedhara et al., 2018; Tsironis, and Psychogios, 2016; Kokkinou and Kollenburg, 2022) (See section 3.8). Nevertheless, eight new CSFs emerged from the expert interview processes that were least indicated in previous literature, as shown

in Table 6.1. Such as securing buy-in for CI initiative, Clear purpose and benefit, Focus on non-financial benefits, Speed of change, Increased capacity, clear definition of the problem, Embed CI role as a functional area, and freeing up capacity.

Securing buy-in was not only a newly emerged CSFs but also a reoccurring theme as a challenging factor to CI project implementation. Securing buy-in for LSS project success was tied to the ability of the practitioners to sell the CI initiatives and garner support and commitment from top management and employees through effective engagement. Early gains and quick wins as CSF are also crucial and necessary to secure Top-management buy-in and company-wide commitment to a CI initiative. That could be in the form of a pilot project (Kumar et al., 2009). Similar to the challenges of securing buy-in for a CI project, lack of management commitment and support was also cited as the most common challenging factor to CI projects across respondents, followed by lack of change in organisational culture, Lack of capacity, focus on cost-saving and headcount and negative perception of CI methodology. The literature review on the challenges of LSS implementation in HEIs (section 3.6.2) identified similar impediments to the LSS project (e.g., Antony et al., 2012, Antony, 2015; Holmes et al., 2015; Sunder, 2016a). The template analysis of the expert views on LSS project challenges in HEIs (figure 5.3) reveals emerging challenges to LSS initiatives in HEIs, as shown in Table 6.1 below).

Table 6.1: CSFs and Challenging Factors of LSS/CI Project in HEIs

LSS Project CSFs and Challenging Factors	CSFs	Challenging Factors	Newly emerged factors
1. Securing buy-in for CI initiative	✓	✓	✓
2. Management support and commitment	✓	✓	
3. Organisational Culture change	✓	✓	
4. Employee engagement and empowerment	✓	✓	
5. Clear purpose and benefit		✓	✓
6. Education and training	✓	✓	
7. Free up capacity	✓	✓	✓
8. Focus on cost-saving and headcount.		✓	✓
9. Focus on non-financial benefits.	✓		✓
10. Speed of change	✓		✓
11. Clear definition of the problem	✓		✓
12. Embed CI role as a functional area	✓		✓

Source: The Author

6.2 Measuring and quantifying CI project benefits and performance in HEIs

Benefits are the bottom-line test for the effectiveness of any improvement initiatives. Therefore, to ensure the improvement and change programmes produce the intended benefits and performance, the project benefits must be identified, measured, and quantified. Based on RQ3 (How can LSS initiatives in HEIs be best measured to quantify the benefits?), the response from the experts on NVivo analysis indicated 43 references from 86 per cent of the respondent. The template analysis (Figure 5.5) shows an agreement among interviewees on the methods and methodology for measuring and quantifying benefits and performance based on their experience, which is similar to previous studies (Neely et al., 2005).

Performance Measurement System was cited by 50 per cent of the respondents. A system that uses a set of metrics to measure and quantify the efficiency and effectiveness of CI initiatives (Neely et al., 2005). The respondent also indicated using a Balanced ScoreCard (BSC) system – a performance management system as a methodology adopted to measure and quantify financial and non-financial metrics of CI projects. However, respondents emphasise the use of non-financial metrics. Cost-saving was cited as a financial metric, while twelve non-financial metrics were identified (Table 6.2). Comparison of the non-financial metrics identified by the respondent with the metrics identified from the literature (Kemper and De Mast, 2013; Comm and Mathaisel, 2003; Summers, 2011; Waterbury, 2008) (Table 3.5), although shows some similarity, but with new emerged metrics to best measure and quantify CI projects in HEIs and PSOs.

Table 6.2: Non-Financial Metrics for Measuring LSS Performance

Non-Financial Metrics	
• Cultural Change metrics	• Services delivered
• Customer Satisfaction score	• Staff competency
• Employee engagement level	• Strategic metrics
• Employee morals level	• Transaction Throughputs
• Lead time	• Waiting time
• Resources utilise	• Waste reduction rate

Sources: The Author

Non-financial metrics:

Respondents emphasise non-financial measures, including operational and strategic measures, in quantifying the efficiency and effectiveness of CI initiatives. Similar views were identified in the literature (Chow and Stede, 2006). As argued, non-financial measures help

managers better understand the root causes of performance problems, initiate timely corrective actions, encourage cross-functional decision-making, and focus on strategic issues. On the other hand, financial metrics have been criticised for being too backwards-looking and too late in the performance measurement system (Chow and Stede, 2006).

6.2.1 Difficulties of Measuring and Quantifying Benefits and Performance:

Despite the interviewees' articulation of various benefit and performance measurement systems and metrics, the expert did not hesitate to acknowledge the difficulties of measuring and quantifying CI project benefits and outcomes based on their experience (Interviewee, A, B, F, G, and I) as earlier discussed in section 5.2.4.1. There is a correlation with previous studies as literature review identifies the difficulties of measuring and quantifying benefits and performance as a challenge to LSS implementation both in education sectors and other service sectors, especially due to the intangible nature of HEIs and PSOs service (Does et al., 2002; 2004; Jenicke et al., 2008; Holmes et al., 2015; Antony, 2014; Sunder, 2016a; Antony et al., 2017).

The respondents further outline some issues that underpin why organisations are having difficulties measuring and quantifying CI performance measurement and the best approach to reduce these difficulties (See Section 5.2.4.1). Respondent cited the lack of understanding and clear definitions of the organisation's improvement issues, inconsistency of the CI process and lack of clarity of the organisation's overall CI benefit (Interviewee, A, B, and F). These issues identified by the respondents correlate with the CI project implementation CSFs identified in the study (Section 5.2.1).

6.3 LSS Sustainability Enabling Factors and Barriers

In determining how best to sustain the LSS improvement programme in HEIs, the respondent was presented with two interview questions to identify essential LSS sustainability enabling factors (SEFs) and the barrier to LSS sustainability. As previous studies mainly focus on the CSFs of LSS project implementation, the Researcher attempt to identify distinguishable elements that enable the long-term sustainability of CI and LSS programmes (LSS-SEFs) in HEIs. The analysis of practitioners' views on LSS SEFs and barriers in section 5.2.5 and section 5.2.3, respectively, shows some agreement among respondents. The most notable SEFs on the list, as shown in Table 6.3, are Continuous training and development, Leadership engagement and coordination; Management ownership of the CI programme; Change in organisational Culture; Sustaining individual change supporting behaviour and System

approach and Process thinking. On the other hand, the barriers and challenging factors to sustainable improvement identified by the respondent were Attitudes toward change and the speed of change, Fear of process automation, Lack of wider acceptance, Cost Saving Driven CI Initiatives, Failure to develop a culture of CI and Change, Organisational silos culture, Daily task workload, Lack of CI professional at the top management level.

The LSS sustainability Enabling and Challenging factors identified by interview respondents were more newly emerged themes when compared with the top findings from the literature review (Table 6.3 and Figure 3.6). Although there were newly emerging themes from the literature review, however, the top 14 SEFs from the literature review share similarity with projects CSFs (Murphree et al., 2011, Matteo et al., 2011; Matteo and Perera, 2011; Silver et al., 2016; Campbell, 2008; Elshennawy et al. 2012; Maleyeff, 2014; Chung, 2015; Holweg et al. 2018; Chung, 2015; Vallejo et al., 2020; Buestan et al. 2016; Bigelow et al. 2010; Matteo et al. 2011; Antony et al., 2019b; Hayes, 2022; Bhat et al., 2023). The newly emerging sustainability enabling factors and barriers from the interview (sections 5.2.5 and 5.2.6) were least cited in the literature in section 3.9.2. For example, sustaining change-supporting behaviour, system approach and Process thinking, Creating Capacity and professionalisation of CI functional area, attitude toward change and the speed of change, which enabling and challenging factor, Lack of wider acceptance; Cost Saving Driven CI Initiatives; failure to develop Culture of CI and Change; and Daily task workload and Lack of CI Professional at the top management level (See Table 6.3 and 6.4).

Table 6.3: Key LSS Sustainability Enabling Factors (SEFs)

- Continuous Training and Development
- Create knowledge of data analysis within the CI team.
- Leadership engagement and coordination
- Management ownership of the CI programme
- Change of organisational Culture.
- Sustaining change-supporting behaviour
- System Approach and Process Thinking
- Use of Benefits to influence decision
- Creating Capacity
- The professionalisation of the CI function
- Creation of CI team
- Embed CI as part of the organisations' daily tasks and strategy

- Consistency of purpose
- Standard Operating Procedures
- A Strategic Set of Principles for CI Application
- Long term focus

Source: The Author

Table 6.4: Barriers to LSS Sustainability

Attitude toward change and the speed of change
Fear of process automation
Lack of wider acceptance
Cost-Saving Driven CI Initiatives
Failure to Develop a Culture of CI and Change
Organisational silos culture
Daily task workload
Lack of CI Professionals at the top management level

Sources: The Author

6.3.1 Comparison of LSS Project CSFs and Sustainability Enabling Factors:

As research indicates, more literature was found to have studied the CSFs of LSS implementation in the service sector and HE environment than those that attempted to investigate the sustainability enabling factors. Some of the literature reviewed has reported the CSFs for deploying and sustaining LSS. However, there are huge similarities with elements they reported as sustainability enablers when compared with project implementation CSFs (e.g., Murphree et al., 2011, Matteo et al., 2011; Silver et al. 2016; Campbell, 2008; Chung, 2015; Holweg et al. 2018; Chung, 2015; Buestan et al. 2016; Antony et al. 2019b; Vallejo et al, 2020; Hayes, 2022). Hayes (2022) provides two categories to sustainable change elements and suggests that sustainable improvement and change are about what the CI and Change managers do during project implementation and after implementation, which centre on actions promoting buy-in from the start and actions promoting sustainability after implementation. Therefore, to understand the differences between LSS project CSFs and SEFs, and the distinguishable factors unique to sustainable improvement. The researcher compares the LSS project CSFs and the SEFs identified from the interviews and literature reviews (Section 3.6.2 Figure 3.4; Section 3.9.3 Figure 3.6; Section 6.1 Table 6.1 and 6.3 Table 6.3 and 6.4).

The comparison of findings (See Table 6.5) shows that there are factors that were reported both as CSFs to LSS project completion and sustainability enablers, such as Continuous Training and Development; continuous Leadership engagement with employees; Organisational Culture and Change; Securing buy-in of the project; Communication of vision to all stakeholders; Continuous Performance Measurement, Effective change management process, employee participation and empowerment, and knowledge management. More importantly, other factors were identified that are unique to SEFs from the literature and the interview response, most of which are two or more references or standalone factors that were either identified by individual respondents or found in one literature reference. Such includes but is not limited to coordination of the CI programme, the use of benefits to influence a decision, knowledge of data analysis within the CI team, system approach and process thinking, embedding CI as part of the organisations' daily task and strategy, consistency of purpose, standard operating procedures and strategic set of principles to CI application and Ownership of the CI programme.

Table 6.5: Comparison between Project CSFs and Sustainability Enablers (SEs)

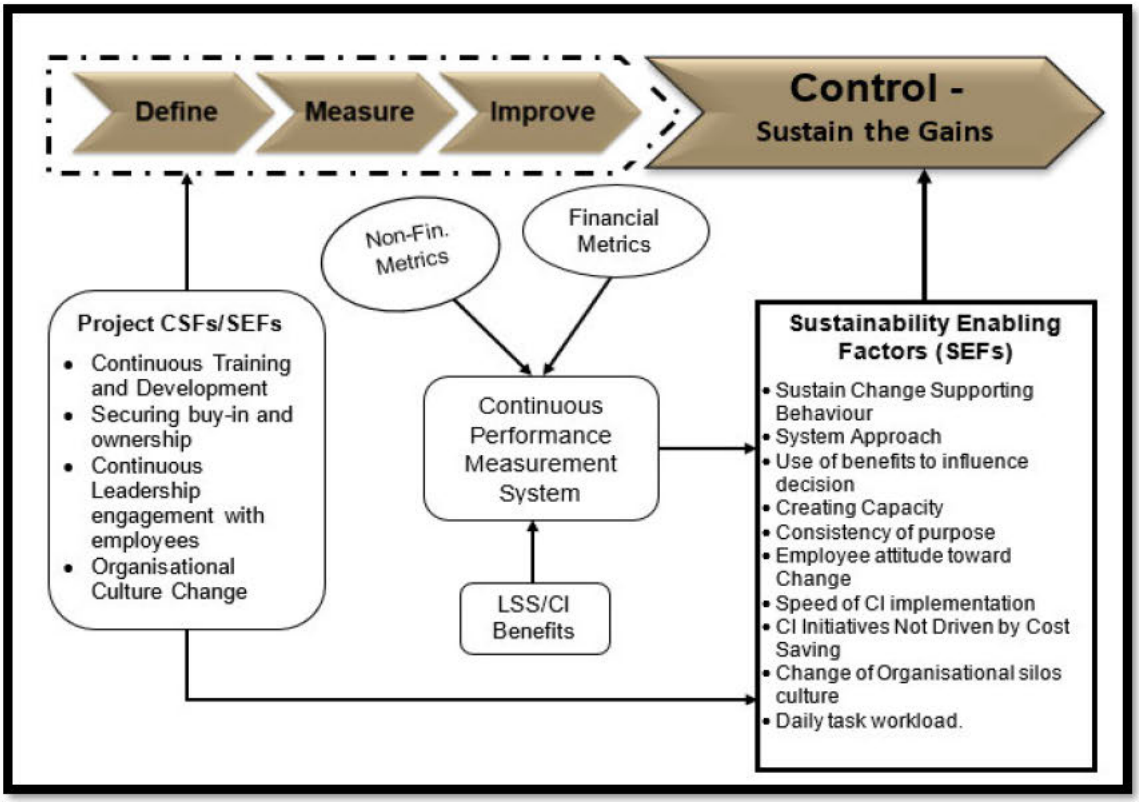
CSFs/SEFs – Literature and Interviews Findings	**CSFs**	**SEFs**
• Continuous Training and Development	√	√
• Leadership engagement with employees	√	√
• Securing buy-in of the project	√	√
• Organisational Culture and Change	√	√
• Ownership of the CI programme		√
• Use of Benefits to influence decision		√
• Long-term focus		√
• Knowledge of data analysis within the CI team		√
• System Approach and Process Thinking		√
• The professionalisation of CI functions		√
• Embed CI as part of daily tasks and strategy		√
• Consistency of purpose		√
• Standard Operating Procedures and strategic set of Principles for CI Application		√
• Effective rewards system to retain staff		√

Source: The Author

6.4: LSS Improvement Sustainability Framework

Following the comparison and combination of conceptual framework in Figure 3.1, section 3.10, with the interview key findings, a reverse LSS improvement Sustainability Framework was developed for sustainable implementation of LSS and CI initiatives in HEIs. Lean Six Sigma methodology builds upon many successful elements of previous CI initiatives. The dynamics in the global economy, the increased competition, increased inflation, increased running costs, the cost of HE and the rise in stakeholders' expectations are luring many HEIs to embark on the CI journey. However, HEIs need to ensure sustainability and long-term benefits from their CI initiatives. Following the limitation of the existing LSS-DMAIC framework and the research gap identified, the Author has developed LSS Sustainability Framework, as shown in Figure 6.1, that will act as key guidelines for HEI to follow in their effort to improve continuously and sustain the gain of their LSS improvement programme and embed the culture of Change and CI in the broader organisational context.

Figure 6.1: Reverse LSS Improvement Sustainability Framework



Source: (The Author)

No known research projects or literature have proposed the LSS Sustainability Framework focussing on the Control Phase of the LSS-DMAIC framework, and studies are also void of LSS Sustainability Framework in HEIs and the public sector. This framework was developed by critically analysing the LSS frameworks/models and the SEFs proposed by researchers and matching these with the findings from the expert interviews. The LSS-DMAIC framework is the predominant LSS framework that researchers have proposed to integrate Lean and Six Sigma implementation (Pepper and Spedding, 2010; Taylor, 2014; Furterer, 2016, Thomas et al., 2017; Antony et al., 2018). See sections 3.5.1 and 3.5.2. A sustainable improvement is expected to be achieve at the Control Phase of DMAIC of the LSS framework, which focuses on sustaining the benefits after project implementation. The framework consists of SEFs – factors critical to sustaining the gains of the improvement initiative over time; Barriers to Sustainability – challenging factors to sustainability that must be resolved during and after implementation; LSS project CSFs/SEFs – factors considered critical to the successful implementation of the LSS project and simultaneously vital in promoting CI sustainability; and Continous performance measurement system and financial and non-financial metrics to measure and quality the benefits that flow from the CI initiatives during and after implementation. These factors are further discussed below.

- *Continuous Training and Development:*
  Although training and development have been frequently identified as a CSF in LSS application in previous studies (see table 3.4) (e.g., Abu-Bakar et al., 2015; Heckl et al., 2010), however, for a sustainable LSS and CI programme, organisations need to make resources available to continuously provide adequate training to its workforce to support and sustain CI initiatives, which includes the development of data analysis capability among the CI team, LSS training through a Belt Based System" that involves learning the principles behind CI methodology, problem-solving skills and the use of LSS tool and technique to implement, refresher training and modification of CI concept and language. Similar to expert views, the few literature reviewed on LSS and CI sustainability also reveal the same training and development construct (see section 3.6). Such as the application of learning and integration as a formal check-list approach (Murphree et al., 2011), the Application of an appropriate training system education and training programme for all staff (Buestan et al., 20216) and the development of LSS Leaders (Bigelow et al., 2010).

- *Leadership Engagement and Coordination:* LSS sustainability requires leaders to coordinate and engage with all employees, support organisational harmony and encourage cross-functional leaders to propose improvement solutions. LSS Leaders

need to recognise and embrace the importance of developing strategies to increase the significant numbers of the workforce involved in the CI programme. Similarly, a previous study (Lu et al., 2017) argued for the LSS leadership model that better suits HEIs to provide the leadership needed to fully engage the employees and close the engagement gap. Thus, effective CI leadership must motivate their subordinates to do their best and exploit all their potential to contribute to implementing and sustaining CI initiatives across the organisation.

- *Senior Management Ownership:* Leaders must be responsible for their everyday behaviours, actions, and interactions. To sustain LSS and CI programmes, Leaders must demonstrate ownership of the initiative by identifying and taking opportunities and responsibility and being accountable for their and their team's decisions. Building trusting relationships with all colleagues, delegating appropriately, and taking a positive approach to mistakes rather than apportioning blame. Management can also improve their ownership by reflecting critically on events around them and their role.

- *Organisational Culture:* This provides a perspective on change management and insight into organisations' nature and behaviour (Maull et al., 2001). The experts have identified change in an organisational culture in the study as a CSF and challenging factor to CI project implementation, similar to literature reviews (e.g. Antony et al., 2018; Isa, 2013; Jeyaraman and Teo, 2010; Kim, 2010; Psychogios et al., 2012, Sfakianaki and Kakouris, 2019). Change in organisational culture was also cited as a LSS sustainability enabler. One major impediment to CI goals in HEI is driving cultural change among employees, and HE with PSO corporate culture are not often willing to accept change and CI initiatives (Holmes et al., 2015; Yorkstone, 2016). LSS leaders must be trained in change management and CI strategy to develop a cultural analysis model for their CI programmes.

- *Sustain Change Supporting Behaviour:* Employee support has been identified as a factor for the success of CI quality initiatives. Change supporting behaviour (CSB) includes actions employees engaged in upon participating and facilitating a planned change and CI project initiated for long-term gain across the organisation. Various constructs have been developed to address this issue, including openness to change, readiness for change, attitudes toward organisational change, and commitment to change (Kim et al., 2010).

- *System Approach:* Most CI efforts are often focused on solving immediate problems rather than engaging in systemic change, thereby missing the opportunity to build a

sustainable CI programme. HEI and PSO managers must think differently and invoke a paradigm shift in how HEI businesses are conducted using system thinking. There is a need for HEIs to develop an increasingly deep understanding of the underlying structure and see wholes and a framework for interrelationships and modifications that amount to a cultural shift.

- *Using benefits to influence decision* – adopting a focused deployment strategy of CI and change initiatives to create quick gains to influence employees and management support and commitment. Although the focus on quick wins could be a barrier if not integrated with the organisation's wider approach.
- *Creating Capacity* – HEIs, as PSOs, lack the capacity to deploy CI initiatives across the broader organisation. Therefore, PSOs need to professionalise CI as a functional area (such as the Accounting department and HR department) and create a CI Team within the organisation that will facilitate and embed CI applications as part of the organisation's daily tasks and strategy.
- *Consistency of purpose* – HEIs need to create the highest priority toward CI initiatives, not only when convenient. This could be achieved through staff training and development, reducing delivery time, increasing customer satisfaction and value, and becoming more proactive (Deming, 2000). In addition, consistency of purpose could be achieved if organisations can embed CI application as part of organisations daily tasks and strategy by setting out standard operating procedures and strategic principles for CI application and focusing on the long-term application of CI.
- *Attitude toward:* CI change determines how the change programme is perceived and the feelings towards the issues relating to the CI and LSS programme. The CI programme is either accepted or perceived as a threat by the stakeholders based on trust. Attention needs to be given to the attitude and priorities of those affected by the change, ensuring that the employees and managers – are prepared to adapt through stakeholder engagement, communication, and development of a change process that promotes contribution, trust, and buy-in to overcome lack of trust and fear of process automation, for wider acceptance of the CI programme.

- *Speed of CI project implementation:* Most CI change programmes are rushed, leading to employees feeling that they have not been involved in the improvement process, and successive initiatives may lead to initiative fatigue. Researchers have also argued

the CI and change programme's timing, sequencing and pacing (e.g., Hayes, 2014). HEIs need to develop timely and extensive communication plans that identify when what, and how to convey CI programme information to all stakeholders during the project life-cycle.

- *CI Initiatives Driven by Cost Saving:* CI and LSS models are classified as – efficiency models that help drive cost and expense reduction. However, the CI manager should ensure the deployment of the CI programme is not primarily focused on cost reduction. HEIs must develop a CI strategy as part of their long-term corporate strategy.

- *Organisational silos culture:* Silos based approach barrier is a narrow focus deployment of LSS strategy to address a specific problem with an immediate result – quick win advantage. The narrow focus strategy prevents end-to-end process improvement and change in the organisational mindset (Duarte, 2011), which could scuffle sustainability. Three LSS/CI deployment strategies have been identified – the Top-Down Approach (organisations Wide approach), Partial Deployment – functional business unit, and Focused Deployment – silos-based approach (Duarte, 2010). Although, each strategy with its respective advantages and disadvantages. Nevertheless, HEIs must adopt a more comprehensive organisational approach for broader acceptance, management commitment, and buy-in.

- *Daily task workload:* Barriers to the sustainability of the CI programme relate to daily task workload as employees are busy firefighting with their routine tasks. As argued, an excessively high workload correlate to low performance (Asamani et al., 2015). Employee high workload is likely to create a sense of helplessness and a feeling of burnout, which could make employees give up on the CI efforts, as managers try to maximax productivity from existing workers by increasing their daily workload (Asamani et al., 2015). HEIs managers must develop strategies to improve organisational procedures and processes to ensure a smooth workflow that minimises work interruptions, which needlessly compound workload and undermines the organisation's more comprehensive application of long-term CI and change programmes.

- *Continuous Performance Measurement System:* Performance measurement and monitoring are fundamental to continuous improvement. Performance measurement Systems (PMS) – a group of metrics used to quantify the effectiveness and efficiency of actions (Neely et al., 2005), must be developed to monitor and maintain

organisational control during and after LSS project execution and presented to the organisation as feedback on the outcome of actions. CI Performance measurement requires vital data types to drive and manage performance improvement. The creation and implementation PMS process involves: defining the targets, developing a set of performance metrics, and collecting, analysing, reporting, interpreting and acting on performance data (Bititci, 2015). Effective measurement must be an integral part of the management process, using the Balanced Scorecard approach integrated financial and non-financial metrics to quantify the benefits. The Benefits must be identified and communicated to continually secure buy-in into the CI programme.

6.5 Summary

The discussion of key findings from the interviews, as presented in the chapter, based on the research questions, was compared with the result of the literature reviews. This led to the discussion on the CSFs, the challenging factors, the performance measurement and metric, and the difficulties of measuring and quantifying CI benefits. Further discussion was on SEFs and the barriers to sustainable CI, a comparison of the LSS project CSFs and the SEFs to identify unique SEFs and those that apply to both LSS project CSFs and SEFs. The CSFs and Challengings factors from the interviews show considerable agreement and some similarities with the literature review result. However, the interview response identified newly emerged elements as LSS project CSFs and challenging factors. Similar to the review, the respondents suggested using a performance measurement system and KPIs, including adopting financial and non-financial metrics to qualify the CI benefits and the sustained gains. Although the importance of measuring CI performance and benefits was expressed, however, similar to the review, respondents emphasised the difficulties of measuring and quantifying the benefits of CI projects and identified some key challenges.

Based on the findings, SEFs and barrier/challenging factors to sustainable improvement were discussed to identify distinguishable elements that enable the long-term sustainability of CI programmes in HEIs. The LSS SEFs and challenging factors identified by interview respondents were more newly emerged themes when compared with the top findings from the literature review. However, some similarities were identified with differences in aggregates. In an attempt to identify factors that are unique to LSS and CI sustainability, a comparison of the LSS project CSFs and SEFs from secondary and primary data was conducted. Significant similarities exist between elements reported as LSS project CSFs and SEFs.

Nevertheless, factors unique to sustainable improvement – SEFs, were also identified. Based on the research gap, the conceptual framework was developed, which was compared and integrated into creating a new framework based on the findings from the interview. The LSS sustainability framework focuses on the Control Phase of the DMAIC cycle as the first of its kind in HEIs and the public service sector. The element in the framework consists of SEFs; Barriers to Sustainability; LSS project CSFs/SEFs; Performance measurement system metrics, and the included benefits. These factors are further discussed based on the framework.

Chapter 7:

Conclusion and Recommendation

7.0 Introduction:

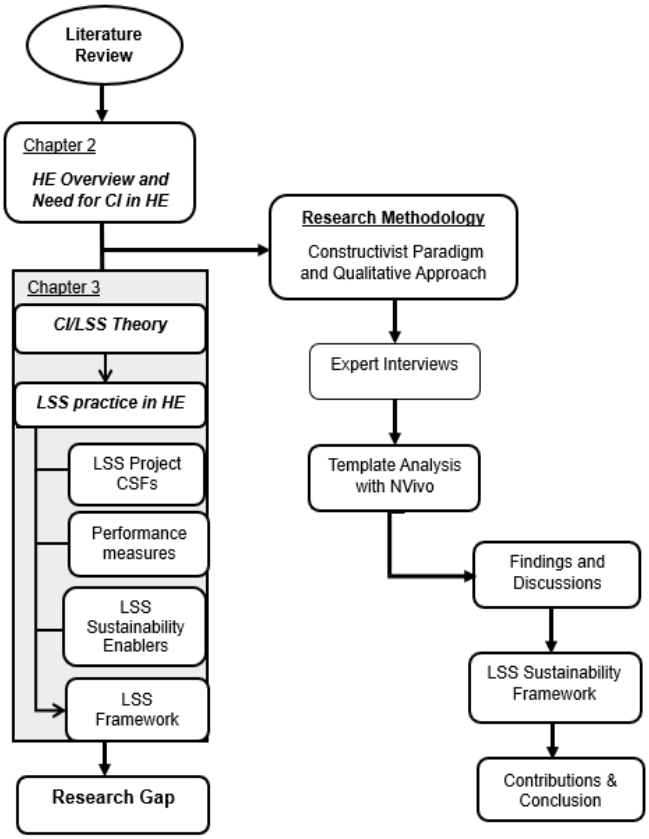
The main focus of this research is to explore practitioners' views to identify the factors that enable the successful implementation and sustainability of LSS as a CI methodology in HEIs as PSO for long-term effective and efficient performance. Lean and Six Sigma are contemporary CI methodologies integrated to drive change and business process improvement in the Higher Education sector with accredited benefits. However, studies suggest that a limited number of organisations have been able to achieve long-term gains from their CI initiatives, including the difficulty of measuring and qualifying CI benefits. Although the wider acceptance and application of CI methodologies in HEIs and PSOs are still in the embryonic stage, nevertheless, as competition intensifies with an increasing demand for accountability and value for money by HEIs stakeholders, the need for HEIs to implement sustainable CI strategies that have been widely used in the business environment to improve performance is increasing.

This exploratory research identified a research gap in implementing and sustaining the gains and measures to qualify the benefits of the CI methodologies (LSS) application as a business improvement strategy in HEIs towards driving an effective change and performance in the sector. Research on the implementation of LSS and CI in HEIs has much focus on conceptual views of the application, the CSFs and the barriers (e.g., Hess and Benjamin, 2015; Antony et al., 2017; Thomas, 2017). The researcher was inspired by the work of Svensson et al. (2015), where the Authors express concern about the sustainability of their LSS project; the work of Antony and Cudney (2016) and Sunder (2016 a) on the LSS implementation in HEIs; including a further call for a conference paper during the third international conference for LSS in Higher Education by Antony and Gerrard, (2016) specifically on how to sustain LSS and CI initiatives in HE sectors. This chapter briefly summarises the research process, the key answers to the research questions and how the research aim and objective were addressed. The study's significance and implications were summarised, including the contribution to theory and practice. The chapter also outlines this research's limitations and future research agenda.

7.1 Summary of the Research Process

Despite the limited articles published on LSS and CI in HEIs, the Researcher reviews related literature on CI methodologies in HE and other public service sectors. Following the findings provided in the literature review (Chapters 2 and 3), the next steps in this research were planned and designed. At the onset, it was clear that this research would benefit from a qualitative approach to provide rich data to create a meaning that is nested in the participant experience and socially constructed by actors – LSS practitioners that are directly involved in the CI implementation process, through a semi-structured interview as presented in chapter 4, to answering the research questions (section 1.6), discussed in the next section to contribute to the theory and practice of the LSS body of knowledge. The data collected were analysed using constant comparative analysis and thematic template analysis. The researcher established the evaluation of the quality of the qualitative research by ensuring trustiness and authenticity in the data collection and analysis process, including a commitment to the research rigour and ensuring transparency in the research process, as presented in section 4.8 of chapter 4.

Figure: 7.1 Research Process Map



Source: (The Author)

7.2 Conclusion of Key Findings

The section presents the summary of the key findings based on the following research objectives: to identify the CSFs and the challenging factors to LSS project implementation in HEIs; to examine the benefits of LSS initiative in HEIs and how CI benefits can be best measured and quantify; to identify keys enabling factors and the barriers to sustainable CI initiative in HEIs as a PSOs; finally to make a recommendation on how best to sustain LSS programme in HEIs for excellence performance.

RQ 1: What are the CSFs for effective implementation of LSS projects in HEIs?

The CSFs for implementing the LSS project in HEIs identified by respondents are – changing the organisational culture, senior management support and commitment, education and training, employee engagement and empowerment. Other newly emerge factors from the practitioner interview which has not been cited in previous studies include: aligning CI strategy with organisational objectives, securing buy-in for CI initiative from the management and employee alike, slowing down the speed of change process, freeing up capacity for the employee to be able to engage in the CI process, having a clear purpose and benefit by focusing on customer satisfaction focusing on non-financial benefits and linking of benefit to organisational goal and having a clear definition of the problem - through the use of root cause analysis tools and identification of measures emerge as a new CSFs from practitioner interview which was not mentioned in previous studies.

RQ2: What are the challenges to LSS/CI project implementation from HEIs' perspective?

The interviewees identified similar factors as both CSFs and challenging factors to CI project implementation. The identified CSFs can become challenging factors when failed to be considered during LSS project implementation. Challenging factors include difficulty securing buy-in for CI initiatives, lack of management support and commitment, organisational culture change, lack of employee engagement and empowerment, lack of clear purpose and benefit, and lack of knowledge and training. Other challenging factors are the unwillingness of management to free up capacity, focus on cost-saving and headcount, and negative perception of CI methodology in HEIs emerge as new themes.

RQ3: What are the benefits of LSS in HEIs, and How can LSS/CI project be best measured to qualify the benefits?

This question was designed to identify the benefits of LSS and CI initiatives in HEIs and to examine how CI benefits can be measured and quantified to overcome the difficulties of measuring CI benefits, as research suggests. Similar to previous studies, the Interviewees,

based on the outcome of their respective CI projects, identified various benefits they have achieved in the implementation of their LSS projects (see section), such as capacity building, cost savings, customers satisfaction, employee engagement, developed capability, employee empowerment, improved ci awareness in the organisation, increase in employee involvement and morale, evidence-based data to influence decision-making, higher productivity improved in the culture of change and CI, increase in lead time, increase in speed of delivery, local community engagement, more responsive to customer value, and waste reduction.

Although studies show that measuring and quantifying CI initiative performance and benefits can be cumbersome, especially in HEIs as PSOs, however, interview responses on how CI project performance and benefits are measured and qualified based on interviewee practical experience revealed the use of a developed performance measurement system in their organisations such as performance metrics, key performance indicators and a balanced scorecard system and the use of visual management board. The interviewees also cited the cost-saving as a financial metric and non-financial metrics – such as cultural change metrics, customer satisfaction score, employee engagement level, employee morals level, lead time, resources utilised, services delivered, staff competency, strategic metrics, transaction throughputs, waiting time, waste reduction rate.

Nevertheless, the interviewees cited the difficulties of measuring and qualifying CI project performance and benefits. They argued that the measurement difficulty was because of a lack of clear understanding of the organisation's problem, inconsistencies within the process, lack of clarity of the overall organisation's benefit, and the use of wrong corporate measures. The respondents further suggested that CI benefit and performance measures and metrics should be aligned with organisational strategy and the use of a visual management board as part of the performance measurement system to minimise the difficulties.

RQ4: What are the key enabling factors and barriers to LSS improvement initiatives sustainability in HEIs?

Response to the fourth question in an attempt to identify the key factors that enable sustainable gains improvement initiative over time and the key barriers that could hinder sustainable CI initiatives in HEIs. This study's first and second questions focused on LSS CSFs and the challenges of LSS project implementation. This last question also attempts to identify SEFs and barriers to LSS implementation that can be distinguished from the project CSFs and challenging factors. From the interview analysis, the most cited sustainability enabling factors identified by the practitioners based on their years of experience are continuous training and development, leadership engagement with employees, senior

management buy-in and ownership, organisational culture and change, use of benefits to influence decisions, long-term focus and leadership support and advocacy. However, other SEFs (see figure 5.6 and table 6:4) that emerged from the interview are: creating knowledge of data analysis within the CI team, leadership coordination, management ownership of CI programme, change of organisational culture, sustaining individual change supporting behaviour, system approach and process thinking, use of benefits to influence decisions, creating capacity, professionalisation of CI function, creation of CI team, embed CI as part of organisations daily task and strategy, consistency of purpose, standard operating procedures, strategic set of principles to CI application and long term focus.

On the other hand, the barriers to LSS and CI sustainability from the template analysis (figure 5.6) show a wide range of impediments to LSS sustainability. However, there were similarities between the barriers to sustainability and challenging factors to LSS project implementation. That indicates some reoccurring factors that the interviewees (practitioners) have been unable to resolve despite their experience, factors such as – cost-saving driven initiative leading to headcount, lack of leadership involvement and participation, lack of resources, and the difficulties of measuring performance and benefits that interviewees (practitioners) are unable to resolve based on their experience. Other factors that are unique to barriers to sustainability are attitude toward change and the speed of change, fear of process automation, lack of wider acceptance of CI methodology, lack of clear project benefit, failure to develop CI and change culture, organisational silos culture, daily task workload, lack of CI professional at the top management level.

7.3 Research Recommendations

Although HEIs are set up to provide a public good, however, with the cost of higher education is rising, and the quest for value by stakeholders is increasing. Consequently, the HE sector globally is beginning to respond to changes and demand by adopting CI methodologies to improve performance in the education system. Evidence suggests a low rate of sustainable LSS and CI initiatives in organisations, including HEIs. To ensure successful implementation and sustainable business improvement and create a broader culture of CI and change in HEIs for excellent performance. The researcher, through practitioner views, conducted an empirical investigation and made the following recommendation:

- ***Creating Capacity for CI Programme***

  The Researcher recommends the need for HEIs to create capacity across the organisations through staff empowerment and training and reduce employee daily workload to create space within the staff's busy daily schedule to engage in the CI

application process. At the same time, include CI responsibilities as part of employee daily tasks and performance appraisal. HEIs must also create a CI specialist team responsible for driving business improvement initiatives across the organisation for long-term gains. There is also the need for professionalising CI functional areas within HEIs like other functional areas for more recognition of the CI role within the business and at the top management level as a champion.

- ***Securing buy-in from management and employee:***

Even though management and employee support and commitment have been widely reported as a success factor to CI projects over the years, the findings show that practitioners still have difficulties securing buy-in. Therefore, the researcher recommends securing buy-in from management and employees to gain continuous commitment. To effectively gain buy-in from different levels of management and employees, the Author suggests a complete disclosure, honesty and openness be infused into the decision-making of the CI implementation process for broader acceptance and continuous support to create a culture of CI in HEIs.

- ***Embedding CI as part of organisational strategy:***

For the long-term sustainability of CI and change initiatives, HEIs leadership must focus on long-term CI goals and develop and embed CI strategy as part of the organisation's overall strategy. HEIs must ensure consistency of purpose with standard operating procedures in their CI management process. The Author suggested that developing and embedding a long-term CI strategy as part of the business strategy will enable HEIs to develop a strategic set of principles and standard operating procedures for a long-term application of CI, thereby maintaining consistency of purpose in the application process for sustainability.

- ***System approach to CI implementation:***

System thinking is another approach to achieving sustainable CI implementation. HEI managers require a paradigm shift in how public sector businesses are conducted using system thinking to develop an understanding of the fundamental structure. HEIs and PSOs need to recognise the interconnectivity and the dynamic behaviours of different individuals and departments as a system to form a unified whole in the application process. A system approach to implementing business improvement will promote collaboration across all departments for a clear definition of improvement problems and

develop collaborative solutions to leverage improvement throughout the system to build a sustainable CI programme.

- ***Effective performance measurement:***

The study suggests that no sustainable CI solution can be embedded in an organisation without an effective performance measurement system (PMS). Therefore CI managers in HEIs need to develop a robust performance measurement system, such as a Balanced Scorecard System, CI KPI system and financial and non-financial metrics to measure and quantify CI programme performance and benefits. However, PMS cannot be effective without quality data. Therefore, the CI team must make quality data available and easily accessible. Also, to address the lack of quality data in PMS, HEIs must provide the required training to develop data analysis knowledge and skills within the organisation. The PMS should include a visual management board to effectively communicate the improvement journey and the alignment of PMS with strategic direction and the organisation's objectives.

- ***Managing and sustaining change behaviour and attitude:***

Managing organisation change from its present state to a desired future state and sustaining the future state thus requires sustainability of individual employees' behaviour. These behaviours and attitudes are employees' actions in participating, facilitating, contributing, and continually supporting a planned CI initiative. CI managers in HEI should clearly define and communicate the anticipated benefits to motivate employees and develop a quality relationship between employees and the organisation. Considering the speed of the change process, support the CI initiative as it progresses from the implementation stage to higher levels of institutionalisation for a broader culture of CI and change.

7.4 Research Contribution and Implication

A researcher is expected to contribute to the theory and/or practice in their research area regarding the novelty of the research findings and/or adding to existing knowledge. This study, therefore, has attempted to address multiple gaps as identified and makes contributions to both theory and practice and further demonstrated several areas where this research can impact practice and policymaking within HEI:

1. Predominantly, continuous improvement management researchers tend to rely heavily on research philosophies such as the pragmatic paradigm, positivist, and interpretive

phenomenology. The constructivist paradigm as an epistemological position in the field of quality and CI methodology management research has been suggested but has not been thoroughly explored. The Author, embracing the constructivist worldview to explore practitioners' views through qualitative research, has demonstrated an alternative epistemological position in the field of CI methodology management research.

2. Research gaps indicate empirical studies from the LSS Body of Knowledge in the subject areas of the LSS and CI sustainability across sectors are limited. To the best knowledge of the researcher, no study was found to have studied LSS and CI sustainability in the HE environment. Extend literature lacks any framework design for sustainable LSS and CI in HEIs and PSOs. Studies also lack any LSS framework that focuses on the Control phase of the DMAIC cycle. The findings, as the first of its kind, have made new theoretical contributions to the use of CI methodologies in the HE sectors in the theory of LSS sustainability, in the identification of novel LSS improvement sustainability enabling factors and barriers to sustainable improvement, and development of new LSS improvement Sustainability Framework that focus of the Control phase of the LSS-DMAIC theoretical framework.

3. Empirical studies exploring the CSFs and Challenging factors of LSS and CI project implementation, and the impact of LSS projects and the performance measurement in HEIs and Public Service Environments were also limited. This study has conceptually and empirically made a further and new contribution to the existing research in identifying the CSFs and Challenging factors to LSS and CI project implementation. Where factors such as Securing buy-in for CI initiative; Clear purpose and benefit; Free up capacity; Focus on cost-saving and headcount; Focus on non-financial benefits; Speed of change; Clear definition of the problem; Embed CI role as a functional area, newly emerged as theoretical LSS project CSFs. A further contribution to LSS-BoK was made through an empirical investigation in exploring the benefits and performance metrics to quantify and measure the benefits of the improvement programme in HEIs.

4. Finally, the practitioner and policy-making implications are identified as the study's potential benefits. At the practice level, the study has provided CI leaders, practitioners, and researchers in HEIs and PSOs domain excellent resources and additional insight into understanding the LSS project CSFs and the elements and framework to sustainable LSS and CI practice within the HE domain. At the university level, there is a benefit of HEIs using the Author's framework to develop and sustain CI and change culture, to effectively

engage employees in changing their attitudes and behaviour toward CI programmes, to overcome the CI sustainability barriers and embrace the enabling factors and overtime become centres of best practice to deliver change within a larger university institution ecosystem.

7.5 Limitations of the Research

It was important for the researcher to recognise and acknowledge the limitations of this research to better understand the successions of events throughout its completion. This study presented the advantage of understanding the subjective views of LSS experts' lived experiences through semi-structured interviews to assess the status of CI methodology applications in the HE environment. However, the study also presented some limitations.

The study was initially proposed to conduct an extensive survey of all HEIs in the UK to assess the current status of their CI methodologies implementation. Unfortunately, the response rate from the initial online survey of HEIs in the UK was not enough to provide statistical data. As such, the researcher had to rely on a review of existing literature.

This study has only focused on practitioners' views as the only sources of data in the CI and LSS application in HEIs due to the possibility of access to data to HEI management and employees. There was also a lack of academic literature that focuses on the application of LSS and CI in the HE Sector, and empirical study on the theory of sustainability of CI methodology and change initiatives in HEI and other service sectors was another limitation. The researcher has to rely on the literature on sustainable LSS from other service sectors.

Another major limitation of this study was the financial constraints experienced by the researcher, leading to the interruption of the study for a year. Also, the outbreak of COVID-19 and the impact of the lockdown on the researcher's well-being lead to the delay and missing deadline even with a year extension.

7.6 Further Research Direction

As a result of the limitations experience, the Researcher has recommended the following further research: For future research, a wider survey study is required to assess the status of LSS and CI application CI in HEIs in the UK to provide a better understanding of the level of CI methodologies that have been adopted by UK HEIs, the type of CI methodology and the type of tool and techniques that have been widely used and practice. A research survey study on the status of LSS and CI in HEIs in the UK is required to draw up cases of success stories to conduct further case comparison analysis for best practices and lessons learned. This

study has only focused on practitioners' views. Therefore, future research may focus on a wider qualitative and quantitative study of LSS in HEIs, including the CI management and employees' views on the same research questions.

Based on the finding of this study and the developed framework, as a future study, the researcher suggested action research using multiple case studies and surveys to extend this study and further validate LSS/CI sustainability framework for HEI and PSOs. Empirical research on LSS and CI Body of Knowledge in the subject area of sustainability/Sustainable improvement and change are still very limited. Therefore, further studies are recommended to develop the theory and practice. Another future area recommended to extend this study is to conduct a wider survey using Interpretive Structural Modeling to asses the hierarchy of the CSFs and SEFs that have been identified in this study.

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Appendix A: Lean and LSS Publications in HEIs 2001 – 2022

Appendix A1: Lean Methodology in HEIs publications 2001 – 2022

Authors	**CI Approach**	**Research Methods**	**Research Contribution**	**Location**
Alagaraja, (2010)	Lean	Literature Reviews	Conceptual	Other
Alp, 2001	Lean	Literature Reviews	Conceptual	US
Balzer, et al., (2015)	Lean	Literature Reviews	Conceptual	US
Balzer, et al., (2016)	Lean	Literature Reviews	Conceptual	US
Barton and Yazdani (2013)	Lean	Single Case Study	Case	UK
Buster-Williams (2009)	Lean	Single Case Study	Case	
Clayton, M. (1995),	Lean	Literature Reviews	Conceptual	US
Comm and Mathaisel (2003)	Lean	Literature Reviews	Conceptual	US
Comm and Mathaisel, (2005a)	Lean	Single Case Study	Case	US
Comm and Mthaisel, (2005b)	Lean	Open-End Survey	Empirical	US
Cristina and Felicia (2012)	Lean	Single Case Study	Case	
Dey (2007)	Lean	Single Case Study	Case	
Doman (2011)	Lean	Single Case Study	Case	
Doman, M. (2011),	Lean	Single case	Case	
Douglas et al., (2015)	Lean	Literature Reviews	Conceptual	
Dragomir and Surugiu, (2016)	Lean	Multiple case Studies	Case	UK and US
El-Sayed et al. 2011	Lean	Single Case Study	Case	
Emiliani 2004a	Lean	Single Case Study	Case	USA

Emiliani 2004b	Lean	Single Case Study	Case	USA
Emiliani 2005a	Lean	Single Case Study	Case	USA
Emiliani 2015b	Lean	Literature Reviews	Conceptual	USA
Emiliani, 2006	Lean	Literature Reviews	Conceptual	USA
Fearn 2010	Lean	Single Case Study	Case	
Finn and Geraci 2012	Lean	Single Case Study	Case	
Fisher et al. 2011	Lean	Single Case Study	Case	
Francis, 2014	Lean	Literature Reviews	Conceptual	UK
Hargaden et al, 2017	Lean	Case Report	Case	Europe
Hines and Lethbridge, 2008	Lean	Action Research, Semi-Structured Interviews and collection of Secondary data on a single case study	Case	UK and US
Holm and Waterbury 2010	Lean	Single Case Study	Case	US
Honken and Janz (2011)	Lean	Action Research	Case	US
Kazancoglu and Ozkan-Ozen, (2019)	Lean	Single Case Study	Case Study	Other
Kregel, (2019),	Lean	Action Research	Action Research	
Krehbiel *et al.* 2015	Lean		Case	US
Kress 2008	Lean		Case	
Langer, (2011),	Lean		Case	UK
Lawn, 2011	Lean		Case	
LeMahieu, et al, (2017),	Lean	Single case	Case	
Tay and Low (2017),	Lean	Semi-Structure interview on Single case	Case	Others
Lorenzetti, 2014	Lean		Case	
Moore, et al, 2007	Lean		Case	US
Narayanamurthy, et al., (2017),	Lean	Action Research	Action Research	
O'Reilly, et al., (2018)	Lean	Single Case Document and Archives	Case Study	Other
Pedersen et al. 2015	Lean		Case	US
Radnor and Bucci 2011	Lean	Semi-Structured Interviews on Multiple Case studies	Case	UK
Robinson and Yorkstone, 2014	Lean	Single Case Study	Case	
Sfakianaki and Kakouris, 2019	Lean	Focus group review and Survey of expert	Empirical	Others
Sinha and Mishra 2013	Lean		Case	India
Hofer and Naeve, 2017	Lean	Single Case Study	Case	
Tatikonda, 2007	Lean		Conceptual	

Thirkell and Ashman, 2014	Lean	interviews in two UK universities	Empirical	UK
Thomas *et al.* 2015	Lean	Focus Group In Higher and Further Education	Empirical	UK
Valickiene and Valickas, 2016	Lean	Literature Reviews	Case	Spain
Hargaden, et al., 2017	Lean	Action Research	Action Research	
Hargaden, et al., (2018)	Lean	Literature Reviews	Conceptual	
Waterbury, 2008	Lean	PhD Thesis - Expert Statement	Empirical	US
Waterbury, 2015	Lean	Literature Reviews	Conceptual	US

Appendix A 2: Combined LSS approach publications 2001 - 2022

Author(s)/Date	**CI Approach**	**Research Methods**	**Contribution**	**Location**
Anthony and Antony, (2017)	LSS	Survey	Empirical (Survey)	UK and Rest of the World
Antony et al., (2012)	LSS	Literature Review	Conceptual	UK
Antony, (2014)	LSS	Literature Review	Conceptual	UK
Antony, (2017)	LSS	Literature Review	Conceptual	
Antony, and Cudney, (2016)	LSS	Case report	Case	UK
Antony, et al., (2018)	LSS	Case report	Case	UK
Antony, J. (2015),	LSS	Academics Views/Conceptual	Conceptual	
Bargerstock and Richards (2015)	LSS	Singe case study	Case	USA.
Buccino, (2011)	LSS	PhD research - Delphi panel (statement from an expert		USA
Cudney et al, (2017)	LSS	Literature Review	Conceptual	UK
Furterer, et al., (2019),		Literature Review	Conceptual	USA
Haerizadeh and Sunder (2019),	LSS	Case report	Case	

Hess and Benjamin, (2015)	LSS	Literature Review	Conceptual	UK
Isa and Usmen, (2015)	LSS	Single case study report	case	USA
Kanakana, et al., (2012)	LSS	Survey and historical data in a single case study	Case	South Africa
Lacher and Staudacher (2016)	LSS	Expert Views	Expert Views	
Lu, et al., 2017	LSS	Literature Review	Conceptual	
Montgomery, D. (2017).	LSS	Editorial Review	Conceptual	Conceptual
Murphy, (2009)	LSS	A case study report	Case	USA
Nadeau, 2017	LSS	Literature Review	Conceptual	USA.
Nelson, 2015	LSS	Literature Review	Conceptual	
O'Reilly, et al., (2019),	LSS	Single Case study	Case	Irish
Oko and Kang, (2015)	LSS	Interview and Single Case Study	Case	Nigeria
Simon, (2013)	LSS	Conceptual	Conceptual	USA
Sunder and Antony, (2018),	LSS	Conceptual	Conceptual	UK
Sunder and Mahalingam, (2018),	LSS	Empirical - Multiple case-study	Case	Other
Sunder, (2016a)	LSS	Case report	Case	Indian.
Sunder,2016b)	LSS	Literature Review	Conceptual	UK
Svensson, et al., (2015)	LSS	Survey questionnaire and single case study illustration	Case	Saudi Arabia
Thomas, et al, (2017),	LSS	Semi-structure interview and a single case study	Case	UK
Venuthurumilli, et al, (2017)	LSS	Literature Review/Conceptual	Conceptual	
Weber, (2013)	LSS	Survey and single case study	Case	USA
Wheeler-Webb, and Furterer, (2019),	LSS	Case - Act Research	Case	
Wiegel and Brouwer-Hadzialic (2015)	LSS	Case Study	Case	

Appendix B: Critical Success Factors of LSS in Service, and HE Sector

Antony, et al., (2017)	Francis, (2014)	Jeyaraman and Teo, (2010)	Fryer, (2009)
• Strategic visionary Leadership • Developing organisational readiness • Organisational Culture • Project selection and prioritisation • Effective communication at all levels vertically and Horizontally	• Strong executive leadership • Training and development • Developing knowledge management • Harnessing information technology and ensuring good project governance.	• Management engagement and commitment • Reward and recognition system • Competency of master belt/black belt • Company financial capability • Frequent communication and assessment on LSS results • Project prioritization, selection, reviews and tracking • Project success stories, best practices sharing and benchmarking • Effective training programme • Established Lean Six Sigma dashboard • Organisational belief and culture	• Planning • Culture • Management commitment • Communication • Empowerment • Service Design • Results • Ongoing evaluation • Customer Management, • Organisational structure • Process management • Supplier management • Training • Teamwork • Quality data and reporting

Manville, et al., (2012)	Buccino, (2011)	Abu Bakar, et al., (2015)
• Senior management commitment, Support and enthusiasm • Linking LSS to business strategy • Linking LSS to the customer • Understanding the tools and techniques • Project selection and prioritisation • Training and education.	• Leadership commitment • School district culture • Organisational learning • Strategic planning (and project selection) • Organisational structure • Data management; quality tools • Financial resources (and decisions)	• Organisational infrastructure and project management • Management commitment and leadership • Lean Six Sigma competency • Training and education • Linking LSS to business strategy

Antony, et al., (2012) LSS CSFs in HEIs	Matteo, et al., (2011) LSS CSFs in Healthcare	Holmes, et al., (2015) SS CSFs in HE	Hilton and Sohal, (2012) LSS in Service
• Top management support and commitment • Effective communication at all levels vertically and horizontally • Strategic and visionary leadership • Developing organisational readiness • Resources and skills to facilitate implementation • Project selection and prioritisation • Organisational culture	• Top management commitment • Creation of Sense of urgency • Communication • Creation of vision/goal • Removal of obstacles for change (e.g. empower/motivate employees) • Look for Quick wins • Training	• Trained personnel, management commitment • Measurable performance • Alignment with organizational strategy • Project management structure • Careful selection of projects.	• Leadership • Communication • Behaviour and awareness • Policies culture • Organizational support and strategy • Education and training • Project teams and project management • Performance evaluations

Kim, (2010)	Isa, (2013)	(Antony, et al., 2007).
• Strong leadership of the top management • The driving organisation of Six Sigma • Education and training for Six Sigma • Reward for project result • Producing and securing high Black belt • Efficient activities to improve projects • Rational selection of project theme • Computational operational system Enough preparation time • Experience with quality control activities • Accurate data management • Company-wide participation of members • Standardisation of SS Improvement • Organisational culture	• Top management commitment and support • Linking Six-Sigma to business strategy • Customer focus • Project management skills; Understanding of Six-Sigma methodology • Project selection and prioritization • Management of cultural change; Well train personnel on how to use the tools and techniques • A framework to specify tool or technique • Cooperative personnel in contact to the improvement processes • Project tracking and reviews • Incentive program; Availability of resources.	• Customer focus • Project management skills • Management commitment and involvement • Organisational infrastructure • Understanding of Six Sigma methodology • Project selection and prioritisation • Integration of six sigma with financial accountability • Management of cultural change • Training and education; Project tracking and reviews • Incentive program • Company-wide commitment

Owlia and Aspinwall (1997) TQM CSFs in HEIs	Sahu, et al., (2013) TQM CSFs in Technical Education	Psychogios, and Tsironis, (2012) LSS CSFs for airline-serv. S	Bayraktar. et al., (2008) TQM in HE
• Top management commitment • Strategic planning • Organisations for quality • Employee involvement and team working • Training for quality • Design management • Process management • Supplier QM • Information and analysis.	• Infrastructure; • Training • development and placement; • Research and development and consultancy; • Administration • Promoting institute's initiatives • Technical institute's excellence measures	• Leadership • Strategic orientation • Quality-driven organisational culture • Continuous training • Teamwork • Customer satisfaction Technical systems	• Leadership • Vision • Measurement and evaluation • Process control and improvement • Program design • Quality system improvement • Employee involvement • Recognition and reward • Education and training • Student / other stakeholders' focus

Tsironis, and Psychogios, (2016)	Psychogios, et al., (2012)	Sila and Ebrahimpour (2003) QM CSFs worldwide
• Management involvement and support • Committed leadership • Quality-driven culture • Quality-driven training • Teamwork • Link L6σ targets and customer satisfaction • Binding strategy with LSS targets • Supportive technical systems • Clear targets of LSS projects • Prior experience in implementing similar quality • Initiatives • Link performance management system with LSS	• Top Management Involvement & Support, Quality-driven • Organizational Culture • Quality-driven Training • Top-Down & Bottom-Up Project Selection • Customer Satisfaction • Prior implementation of other quality improvement programs and Supportive • Performance Management • IT Systems	• Leadership • customer focus • Information and analysis • Training • Supplier management • Strategic management • Employee involvement • Human resource management • Process management • Teamwork • Product and service design • Process control • Benchmarking • Continuous improvement • Employee empowerment • Quality assurance • Social responsibility • Employee satisfaction

Appendix C: Semi-Structured Interview Questions

Research Title: **Sustaining Lean Six Sigma as Continuous Improvement Initiatives for performance excellence in HEIs**

Introduction:

The interview questionnaire therein is designed as part of a study to assess the status of Lean, Lean Six Sigma (LSS) and Continuous Improvement (CI) methodologies implementation within Public/Service sectors, toward the identification of key elements that are enablers of sustaining improvement programme in the sector. The telephone interview will be recorded through call recorder equipment for transcription and analysis purposes. The data collected will be analysed as per the research objectives established. I would be happy to share the results of my study. Your assistance will be highly appreciated. Thanks.

Part A. Participants Information

1. What is your position in your organisation?

2. How many years of experience do you have implementing Lean/LSS/Continuous Improvement/Quality Improvement methodologies?

3. Which area of the Public/Service sector has been involved in implementing any Continuous Improvement Methodologies?

4. Do you have current LSS/CI certification? If yes, what is your level of certification?

Part B: Main Research Questions

- **Critical Success Factors and challenges to LSS/CI Implementation**

1. What has been the critical success factors to LSS/CI implementation in your organisation?

2. What do you see as the biggest challenges to LSS/CI project implementation?

- **LSS/CI Benefit and Performance Measurement**

3. What has been the benefits of LSS/CI initiatives in your/client organisation overall performance?

4. What are the established performance metrics in your organisation?

5. How do you think your organisation should best measure and quantify it benefit and overall performance base on it Lean, LSS/CI initiatives?

- **LSS/Continuous Improvement Sustainability**

6. Based on your experience what will you consider as key elements/factors to sustaining LSS/CI as an organisation wide programme?
7. What do you think are key barriers to sustaining LSS/CI programme?

8. In your most top wish, how will you wish to improve the current state of LSS/CI in your organisations?

Appendix D: Interview Participant Information

Research Title:

Sustaining Lean Six Sigma Implementation as a continuous improvement methodology for performance excellence in Public Sector

Dear Participant,

As a practitioner that is actively involved in the implementation of Continuous Improvement and operational excellence projects in organisations/Institutions, you are hereby invited to participate in a doctoral research interview, with the purpose to explore the status of Lean Six Sigma and other Continuous Improvement methodologies implementation in the UK Public Sector, toward the development of a framework for sustaining Continuous Improvement initiatives for excellence performance. I believe your knowledge, leadership, practical views and years of experience in the field of continuous improvement will help to provide valuable insight into this study. This research is being conducted by **Louis** Edaki, in affiliation with The University of the West of Scotland, UK, in partial fulfilment of the requirement for Doctor of Business Administration – DBA.

Participation in this Research Study

Individual participants are invited to a 30-minute interview based on the research questions and objectives. The interview could be either conducted through telephone or face-to-face depending on the suitability of the participant There are no other commitments or lifestyle restrictions associated in participating. Please note that participation in this research study is voluntary, participants can withdraw at any time and don't have to give any reason. Participants may choose not to answer any questions and may refuse to complete any part of the research question they do not wish to for any reason.

Risks and Benefits of Participation

We do not anticipate any risk to participants in this study. The potential physical and/or psychological harm or distress will be the same as any experienced in everyday life. Whilst there are no immediate benefits for those participating in the interview, it is hoped that this research will have a beneficial impact and contribution to the best practice of Continuous Improvement both in public service and transactional sectors in general. The research outcome will be shared with participants to inform their professional work and best practice.

Confidentiality and Data Protection of Records

All the information that will be collected from participants about their organisations and practice during the research interview, with the use of an electronic recording device will be kept strictly confidential. Participants and their organisation will **NOT** be able to be identified or identifiable in any reports or publications. The interview questionnaire DO **NOT** require participants to indicate personal information and the name of their organisation. However, any data from a participant about their respective organisations will be represented with a code for analysis. Participants will **NOT** be recorded in any way other than their input to the questionnaire without separate permission being gained from them. Participants will be duly informed for assent before any further publication in the article and journal will be made by the researcher.

Research organiser and Ethical Review

The project is self-funded by Doctoral Student Researcher Mr Oboh **Louis** Edaki, in affiliation with the University of the West of Scotland. This project **has been** ethically approved by the University's Ethics Committee. The University of the West of Scotland Research Ethics Committee monitors the application and delivery of the ethics review procedure across the University.

Contact Information

Should you have any questions regarding this study, please feel free to contact the following:

- Primary Investigator: Louis Edaki; [redacted]
- Research Director of Study: Dr Daba Chowdhury; [redacted]
- Research Supervisor: Dr David Chitakunye; [redacted]
- Research Assessor: Professor Eleri Jones; [redacted]
- The University of the West of Scotland, Paisley Scotland; [redacted] All personal details withheld

Thank you for your consideration to participate in this important research. Subsequently, the participant consent form will be forwarded to you before the interview.

Your expertise and opinions are critical to the success of this study.

Yours Sincerely,

O. Louis EDAKI.

Doctoral Student Researcher,
Research School of Business and Enterprise
The University of the West of Scotland
[redacted]
Personal details withheld

Appendix E: Participant Consent Form sample

- I have read the information sheet about this study
- I have received enough information about this study
- I understand that I am / the participant is free to withdraw from this study without giving a reason for withdrawing
- I understand that I or my institution will not be able to be identified or identifiable in any reports or publications

I agree to take part in the Interview ☐

Please Tick

Participant Name:	
Participant Signature: (Please indicate your Initials)	Date:
Researcher's Name: Oboh **Louis** EDAKI,	
Researcher Sign: **L. Edaki** (Please indicate Initials)	Date: 29/10/18
This project is supervised by: **Dr Daba Chowdhury** (The University of the West of Scotland)	
Researcher's contact details: [redacted]	

Personal details withheld

Appendix F: Interview Participants Characteristics represented with ID

Interviewees	Job title	Years of experience	Level of Education	Professional Qualifications
A	CI Coordinator	7 years	Bachelor	Green Belt
B	CI Consultant	20 years	Masters	Black Belt
C	CI Manager	3 years	Bachelor	Lean Certification
D	CI Consultant	20 years	Bachelor	Master BB
E	CI Leader	10 years	Bachelor	Green Belt
F	CI Manager	14 years	Masters	Lean Certification
G	CI Coordinator	15 years	Bachelor	Master BB
H	CI Coordinator	15 years	Masters	Master BB
I	CI Leader	13 years	Masters	No Certification
J	CI Manger	14 years	Masters	Black Belt
K	CI Manager	10 years	Masters	Black Belt
L	CI Consultant	25 years	PhD	Lean Certification
M	CI Consultant	31 years	PhD	Master Black Belt
N	CI Coordinator	18 years	Masters	No Certification

Appendix G: Final Template Analysis: Categories, Theme and Code

Categories, themes and Codes	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1. LSS Project CSFs														
1.1 Aligning strategy with organisations objectives		*							*			*		
1.2 Clear definition of a problem										*				
1.2.1 Root Cause Analysis										*				
1.2.2 Team identification of measures										*				
1.3 Clear purpose and benefits		*					*	*		*				
1.3.1 Focus on customers satisfaction					*									
1.3.2 Focus on non-financial benefit					*									
1.3.3 Linking benefit to organisational goals						*				*				
1.4 Education and training														
1.4.1 Education of senior Leaders									*					
1.4.2 Embed CI knowledge in the organisation											*			
1.4.3 Staff Training	*		**											
1.5 Effective project coordination										*				
1.6 Embed practitioner role with an operational function											*			
1.6.1 Effective Kaizen team													*	
1.7 Good governance														*
1.8 Organisational Change														
1.8.1 Cultural Change			***			**		*				*		*
1.8.2 Speed of change							*							
1.9 Organisational structure								*						
1.10 Regular performance appraisal			*											
1.11 Resources availability			*											
1.11.1 Freeing up capacity					*									
1.12 Securing Buy-in for CI Programmes		***	*	*				**	*	*	*	*	*	*
1.12.1 Employee engagement	*			*	*					*		*		*
1.12.2 Mutual respect and authority													*	
1.12.3 Selling improvement idea							*	*						
1.13 Senior Management support and commitment			*		*	*				**		*	*	
1.14 Visual Management													*	
1.15 Data availability											*			
2. Challenges to LSS Project														
2.1 Choice of tools and methodology												*		
2.2 Difficulties of identifying customers												**		
2.2.1 Difficulties of identifying public value												*		
2.2.2 Difficulties of measuring customers value												*		

2.3 Focus on Cost savings					*						*	*		
2.3.1 Focusing on headcount					*									
2.3.2 Quick win mindset						**								
2.4 Lack of visible performance measures													*	
2.5 Lack of accurate and reliable data		*												
2.5.1 Huge cost of gathering data		*												
2.6 Lack of capacity					*		*		*					
2.6.1 Management unwilling to free up capacity									*					
2.7 Lack of employee engagement						**		*						
2.7.1 Disconnection between functional roles							*							
2.7.2 Lack of CI Manager responsibility to encourage staff									*					
2.8 Lack of Financial resources			*											
2.9 Lack of knowledge and skills							*							
2.9.1 Lack of knowledge and skills at the management level	*													*
2.9.2 Lack of effective CI team													*	
2.9.3 Lack trained staff and CI practitioners			*									*		
2.10 Lack of Leadership commitment and support	**		*		*			***			*	*	*	
2.10.1 Difficulties of getting buy-in from employees		*		*		*						*		
2.10.2 Instability of leadership														*
2.10.3 Lack of top management involvement	*				*									
2.11 Organisational Culture					*	*	*	*		*				*
2.11.1 lack of a culture of a lesson learned														*
2.11.3 Negative perception of LSS and CI methodology											*	*		
2.11.4 Resistance to change									*					
3. Benefits of LSS Programme														
3.1 Capacity building	*	**			**	*	*							
3.2 Cost Savings	*	*		*	*		*			*	*		*	
3.3 Customers Satisfaction	*				*	*			**	*				
3.4 Employee engagement	*		*		*	*			*					
3.4.1 Developed capability						*								
3.4.2 Employee empowerment					*									
3.4.3 Improved CI awareness in the organisation			*											
3.4.4 Increase in employee involvement and morale					*	*		*						
3.5 Evidence-based data to influence decision-making														*
3.6 Higher productivity										*				
3.7 Improved in Culture of change and CI			***											*
3.8 Increase in Lead time					*								*	
3.9 Increase in speed of delivery										*				

3.10 Local community engagement				*								
3.11 More responsive to customer value									*			
3.12 Waste reduction					*							
4. Benefits and performance Measurement and Quantification												
4.1 Measuring and quantifying benefits	*	*	*		*	*	*	*	*	*	*	*
4.2 Align with strategic direction									*			
4.3 Key Performance Indicator (KPI) Management			**	*				*			*	
4.4 Visual management board									*			
4.5 Performance Metrics		**	*		*	*	*	*			*	
4.6 Balanced Score Card										*		*
4.6.1 Financial metrics	*			*								
4.6.1.1 Cost saving		*		*								
4.6.2 Non-Financial Metrics												
4.6.2.1 Cultural Change metrics												**
4.6.2.2 Customer Satisfaction score	*	**		*	*		*		*			
4.6.2.3 Employee engagement level	*											*
4.6.2.4 Employee morals level					*					*		*
4.6.2.45 Lead time					**	*			*			
4.6.2.5 Resources utilised		*										
4.6.2.7 Services delivered					*							
4.6.2.7 Staff competency												*
4.6.2.9 Strategic metrics							*					
4.6.2.10 Transaction Throughputs					*							
4.6.2.11 Waiting time					**							
4.6.2.12 Waste reduction rate				*								*
5. Sustainability Enablers												
5.1 Availability of quality data				*						*		
5.1.1 Knowledge of data analysis				*								*
5.2 Continuous Training and Development			*		**				*			
5.4.1 Increase CI knowledge and practitioners			*		*		*					
5.4 2 Leadership and top management training									***			
5.4.3 Mandatory staff training on Kaizen					*							
5.4.4 Refresher training			*	*								
5.3 Create Understanding of CI Methodology						*						
5.3.1 Wider acceptance of CI methodology							*					
5.3.2 View of LSS as a problem-solving tool										*		
5.3.3 Modification of Concept Language								*				

5.3.4 Less focus on Toolkit level of LSS and CI											*			
5.3.5 Choice of the right tools and methodology												*		
5.4 Creating Capacity					*									
5.4.1 CI specialist team				*										
5.4.1 Professionalisation of CI function in PSOs											*			
5.5 Embed CI as part of the organisation's strategy						*								
5.5.1 Consistency of purpose					*			*		*				
5.5.2 Formal approach to CI across PSOs							*							
5.5.3 Strategic sets principles to CI application												**		
5.5.3.1 Contingent approach												*		
5.5.3.2 Coordination of CI programme							*							
5.6 Identifying the right performance measures			*					*						
5.6.1 Set CI as part of staff performance appraisal			*											
5.7 Leadership engagement with employees	*			*	**									
5.7.1 Effective Leadership communication						*								
5.7.2 Top management involvement					**								*	
5.8 Lesson learn mechanism				*										*
5.9 More commercial-minded PSOs		*												
5.10 Organisational Culture		*				*		*						
5.11 Senior Management buy-in and ownership			*	*				*	*	*	*			
5.11.1 Leadership support and advocacy	*						*				*			
5.11.2 Leadership accountability	*													
5.11.3 Leadership long term focus		**			*	*								
5.11.4 CI practitioner at senior management	*													
5.12 Service user-oriented approach						*		*						
5.13 Share of best practice			*											
5.14 Stakeholders’ engagement														*
5.14.1 Employee engagement and empowerment				*		*				*				
5.14.2 Top Management engagement						*					*			*
5.15 System approach to CI									**					
5.15.1 Process Thinking										**		*		
5.15 Using benefits to influence decision														*
5.15.1 Sharing and celebrating success						**								
5.16 Visibility Management														*
5.17.1 Publication of CI KPI in an annual report													*	

6. Barriers to Sustainability														
6.1 Attitude to change			*	*										
6.1. Fear of complete automation								*						
6.1.1 Perception of LSS and CI concept and Language used									*					
6.2 CI initiatives driven by cost savings		**					*		*	*				
6.2.1 Headcount									*					
6.3 Difficulties of measuring benefits	*	**						*				*	*	
6.3.1 Lack of CI performance measures													*	
6.3.2 Lack of clear benefit											*			
6.4 Failure to develop Culture of CI and Change		*				*								
6.4.1 Difficulties of getting buy-in		*				*								
6.4.2 Philosophical thinking											*			
6.5 Focus on individual performance						**								
6.5.1 Employees working in silos						*								
6.5.2 Speed of change						*								
6.6 Lack of CI knowledge and skill at the top management level	*													
6.6.1 Lack of CI practitioner at the top management level	*													
6.6.2 Lack of accountability	*													
6.7 Lack of engagement with service users				*										
6.8 Lack of resources			**									*		*
6.8.1 Lack of CI specialist				**							*			
6.10 Lack of senior leadership commitment	*	*			*			*		*	*	*		
6.10.1 Delegation of responsibilities	**	*											*	
6.10.2 Lack of effective communication top-down			*											
6.10.3 Lack of wiliness to invest time and effort	*													
6.11 Lack quality data				*										
6.11.1 Original data accessibility	*													
6.12 Proliferation of different methodology									*					
6.13 Short term focus		**			*	*								
6.13.1 Focus on quick win						*	*							
6.14 Unstable policies and environment		*	**	*	*									
6.14.1 Change in political leadership				*										
6.14.2 High management and staff turnover			*	***	*					*	*			
6.14.3 Inconsistency of CI strategy				****										