Implementation of continuous improvement (CI) in manufacturing SMEs to promote economic growth in northern England

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Implementation of continuous improvement (CI) in manufacturing SMEs to promote economic growth in northern England

A CASE STUDY OF THE UK NORTHERN POWERHOUSE PROJECT

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ABSTRACT

Despite the fact that the continuous improvement (CI) philosophy benefits are widely recognised in many organisations, research indicates that its deployment role in macroeconomic growth in the small and medium-sized enterprises (SMEs) of developing markets in Europe (northern England) is still scarce. This exploratory research aimed to assess the potential CI contribution to the economic growth of manufacturing SMEs and their position in northern England to develop a customised and practical framework to support effective and widely used CI implementation. The thesis investigates CI philosophy by conducting a comprehensive literature review and analysing the current state of manufacturing SMEs' economic growth, CI principles, and macroeconomic growth factors in developed and developing countries.

A mixed method research strategy (qualitative and quantitative methodologies) was conducted through survey and interview and was adapted to achieve the aim of this research by answering the following major research question for manufacturing SMEs in northern England: What are the implications of continuous improvement (CI) principles on macro/regional economic growth in northern England?

More than 800 manufacturing SMEs in eight major industries (pharmaceuticals, textiles, technology, beverages, chemicals, machinery, construction, and motoring) have been identified in northern England to contribute to the survey. The employment of a mixed method strategy was aided by analysing 176 survey responses. The quantitative analysis implemented the study quality criteria of reliability and validity of data with various specific statistical tests aided in addressing the six-research questions. The qualitative analysis followed by a macro-CI framework to address macro-CI feasibility based on 18 semi-structured interviews with four specific groups (Academic, CI consultants, Local authorities, and manufacturing SMEs’ operation managers) in northern England.

In the first step, the manufacturing SMEs' economic growth and CI principles factors were identified through a systematic and critical literature review and core influential factors were explored and evaluated. In the second step of this research, the importance of the role of manufacturing SMEs in the macroeconomic growth of developed and developing economies. Also, the impact of CI implementation on the financial sustainability and economic growth of manufacturing SMEs were analysed, ranked, and evaluated.

Finally, the quantitative analysis results were analysed via the interview stage (quantitative method), the feasibility of CI implementation in microenvironments was assessed, and the key barriers, challenges, and requirements of CI deployment on manufacturing SMEs in northern England were identified and analysed.

The findings of this study revealed that there is a significant potential impact of CI philosophy in improving manufacturing SMEs’ operational performance in macro-scale environments. In addition, the research indicates that CI implementation has a significant positive impact on economic growth factors on a macro and regional scale for developing economies. The key practical contributions of this doctoral research were CI philosophy's constructive impact on economic growth and a customised CI framework for manufacturing SMEs at macro environment levels based on the findings from the empirical multiple-staged research process and literature.

Dedication

To my cherished daughter "Nilia" and my wife "Nazanin"

You both brought happiness and brightness into my life.

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I am deeply thankful to you all.

Declaration

I declare that the work contained in this thesis has not been submitted for any other award and that it is all my own work. I also confirm that this work fully acknowledges opinions, ideas, and contributions from the work of others.

Any ethical clearance for the research presented in this commentary has been approved. Approval has been sought and granted through the Researcher's submission to Northumbria University's Ethics Online System on 23/07/2020.

I declare that the Word Count of this Thesis is 75200 words

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List of Abbreviations

ANOVA	Analysis of Variance
BEIS	Business, Energy, and Industrial Strategy
CBOs	Core Benefit Objectives
CI	Continuous Improvement
CIMA	Chartered Institute of Management Accountants
CIPs	Continuous Improvement Projects
CMB	Common Method Bias
CSF	Critical Success Factor
DMAIC	Define-Measure-Analyse-Improve-Control
DTI	Department of Trade and Industry
EGM	Economy Growth Model
FSB	Federation of Small Businesses
GDP	Gross Domestic Product
HM	Her Majesty
IBM	International Business Machines
IT	Information Technology
KMO	Kaiser-Meyer-Olkin
KW	Kruskal-Wallis
LEPs	Local Enterprise Partnerships
LSEG	London Stock Exchange Group
LSS	Lean and Six Sigma
M	Mean
p	Probability Value
r	Correlation Coefficient
R&D	Research and Development
RQ	Research Question
SBC	Small Business Charter
Sig	Significance
SMAS	Scottish manufacturing Advisory Service
SMEs	Small and Medium-sized Enterprises
SPSS	Statistical Analysis Software System
Std	Standard Deviation

TCM	Theoretical Conceptual Model
TQA	Thematic Qualitative Analysis
TQM	Total Quality Management

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CHAPTER 1. INTRODUCTION

1.1. Introduction

The research project is introduced in Chapter 1 by providing an overview of research background information, a problem statement, research rationale (motivation) and the research questions. This research aims to develop a framework to support continuous improvement in manufacturing SMEs to build financial sustainability and economic growth for the developing economy. This research also has defined objectives established to achieve the aim. The structure of this thesis is also detailed in this section.

1.2. Research background

Chancellor of the Exchequer at the time, George Osborne, unveiled the "Northern Powerhouse" proposal in 2014 (HM Treasury, 2014). The purpose of the project was to rebalance the economy of the United Kingdom by giving high-quality opportunities and providing necessary infrastructure amenities to the 16 million people who live in the north of England, primarily in the "Core Cities" of Hull, Manchester, Liverpool, Leeds, Sheffield, and Newcastle ("The Northern Powerhouse strategy", 2016). The priorities of the northern manufacturing SMEs include boosting productivity, increasing economic expansion, creating jobs, and attracting substantial foreign investment (HM Treasury, 2014).

The Northern Powerhouse strategy outlines how the government collaborates with local stakeholders to remove significant impediments to productivity in the region and explains how they will do so in the document. The government will make investments in transport infrastructure to strengthen links between and within the towns, cities, and counties of the Northern Powerhouse; engage with local regions to raise education and skill levels; ensuring that the Northern Powerhouse is recognised worldwide as an excellent opportunity for trade and investment; and ensure that the Northern Powerhouse is a perfect place to start and expand a business (“The Northern Powerhouse strategy”, 2016).

While Her Majesty’s (HM) Government and the department for transport have articulated the ideas and development of the Northern Powerhouse project (NPH) for the North in broad outline known as a “vision statement” (Round and Hunter, 2019), the official publications for the NPH project addressed critical outcomes with a restricted systematic and strategic management improvement framework for continual improvement (Parr, 2017; Shutt and Liddle, 2020). The Northern Powerhouse project has been mainly focused on transportation and connectivity development such as a rail plan, highway plan, freight and logistics development and airport expansions. The Northern Powerhouse project has a minimal educational improvement plan for college and school education with no concern for business education and a skill improvement plan. Almost every company in the North's economic engine has less than 250 people (SMEs) (ONS 2018a). One of the most popular indicators of financial health is the productivity of SMEs (ONS 2018a). According to the Northern Powerhouse Strategy, the top objective of businesses is to “tackle major impediments to productivity” in the North (HM Government 2020), which can be improved by continuous improvement (CI) philosophy (Won et al., 2021). However, it is evident from Northern Powerhouse Strategy (2016) and strategic framework that CI education and implementation for manufacturing SMEs is a missing jigsaw piece that needs attention.

Consequently, several significant aspects of the strategic improvement plan for manufacturing SMEs and numerous concerns about the improvement of the project have not been investigated with a limited systematic and strategic management improvement framework for continuous improvements (Parr, 2017) such as manufacturing SMEs’ economic growth and its impact on regional economic development.

1.3. Research problem

According to the research of Chege and Wang (2020), manufacturing small and medium-sized enterprises (SMEs) are widely regarded as among the most critical drivers of economic growth and development worldwide. However, they must develop into self-sufficient and profitable companies to contribute to economic growth.

Manufacturing SMEs worldwide experience various issues, including unstable production processes, inferior product quality, financial damages, and delays in product delivery (Olsen and Tomlin, 2020). Companies frequently lack an understanding of the fundamental factors contributing to these issues. Manufacturing SMEs' problems can be caused by various factors in a wide range of industry sectors; they must constantly be able to satisfy their clients by making improvements if they want to thrive in the competitive industry.

Pambreni et al. (2019) discovered that a significant variety of manufacturing SMEs have difficulty maintaining their competitiveness in the marketplace. The emergence of the worldwide market has resulted in fewer corporate mergers and the establishment of a significant number of businesses with operations on a global scale (Cohen, 2018). Manufacturing SMEs aim to create the most outstanding possible product at the most economical price (Mittal et al., 2020). The following challenges are commonly mentioned: the company is entirely production-focused; the ability to learn and develop a learning organisation is inadequate; no response is provided to recommendations or ideas for improvement; there is no management commitment to long-term improvement projects; there is a shortage of resources; there is a culture of people who do not want to implement change; there are political concerns in terms of managers trying to implement change (Belhadi et al., 2018; Perasana et al., 2019; Mittal et al., 2020).

Manufacturing SMEs with no motivation to improve miss out on the numerous benefits that may easily be acquired from participating in the improvement programme, as Radziwon et al.

(2017) have pointed out. These benefits can be gained through participating in the continuous improvement (CI) philosophy. CI deployment delivers various financial and non-financial benefits to manufacturing SMEs (Antony et al., 2019). Improved customer focus and support, improved delivery performance, increased speed and flexibility, quick and straightforward changeovers, improved quality performance, reduced rework, positive customer feedback regarding the quality, reduced work in progress (WIP), an efficient supply chain, improved business performance, and decreased operating costs and financial sustainability are a few examples of potential benefits that might not be accomplished if CI philosophy is not established by manufacturing SMEs (Sahoo, 2020).

Whereas the CI philosophy programme proves that it positively influences individual businesses, the role of continuous improvement philosophy on financial sustainability and economic growth on a macro/regional project has not been evaluated, for instance, the Northern Powerhouse project in England.

The absence of attention to CI in the NPH strategic plan and the lack of macroeconomic emphasis on CI philosophy were the two major research issues that motivated the author to conduct this study.

1.4. Rational of Research

In today's competitive business world, authors are motivated to assist businesses in becoming more competitive. Surya et al. (2021) revealed that manufacturing SMEs are seen as significant economic growth and development drivers around the globe in both developed and developing countries. If manufacturing SMEs aim to be competitive, they must assimilate all available knowledge. Working within a region where they can gain understanding from the improvement experiences of others can lead them to be more productive. Further research is required to determine how manufacturing SMEs might minimise their expenses by enhancing efficiency in the production process (Choudhary et al., 2019).

Manufacturing SMEs must develop into viable, sustained enterprises to provide genuine economic benefits. Expansion into global markets is an eccentric growth strategy. However, several challenges prevent manufacturing SMEs from moving from domestic to international markets; for instance, one challenge is acquiring financing for the growth of export markets (Gragg et al., 2020). Financial institutions view manufacturing SMEs as high risk since they have limited resources and capacity and are more likely to default than larger enterprises, according to De Sousa et al. (2020). Manufacturing SMEs' performance is one of the critical problems. To ensure that all the customer's requirements are planned and the lack of macroeconomic emphasis on CI philosophy, it is necessary to prevent poor performance; this prevents the cancellation of orders and loss of revenue, resulting in more financial sustainability and economic growth (Choudhary et al., 2019).

Masood and Sonntag (2020) and Alexander et al. (2019) discovered that manufacturing SME issues include low-profit margins and relatively dated management. This can influence decisions on the financing required for SME growth. In addition, there has been a lack of confidence between SMEs, universities, research institutes, and government agencies (Ueasangkomsate and Jangkot, 2019). Manufacturing SMEs would see the benefits if they were devoted to changing their business environments. If manufacturing SMEs do not implement change, the issues will not be solved, which would negatively impact the performance of their businesses (Choudhary et al., 2019).

According to Nicola et al. (2020), the current economic crisis has raised the desire for profitable solutions that give businesses a competitive edge. For this reason, a growing number of companies seek out management techniques that enable them to enhance the characteristics of their products or services, such as refining their processes, reducing their costs, increasing the profitability of their invested capital, and boosting customer satisfaction.

Zubair et al. (2020) indicated that specific manufacturing SMEs that they studied lacked the financial means of large organisations to invest in these improvement strategies. Therefore, it may be challenging for them to execute such improvement plans.

Lack of management commitment is a common impediment noted by Imran et al. (2019). If this obstacle can be overcome, it may be possible to eliminate additional barriers by employing an efficient procedure to assist the growth of SME manufacturers. This support could come in the shape of a framework that does not require financial assistance or the assistance of outside experts. Adda et al. (2021) claim that management commitment is essential: management should facilitate change, and a coalition of change advocates should exist.

Therefore, improving manufacturing SMEs' performance is essential for any economy that aims to achieve sustainable economic growth. However, the problems that manufacturing SMEs regularly encounter regarding company performance led many companies to merge to produce with the highest efficiency (the most excellent possible product at the lowest cost) and operate on global high-quality operation standards.

Based on a literature study of manufacturing SMEs' contribution to economic growth and their current challenges to improve their financial sustainability (Alexander et al., 2019), CI macroeconomic requirements and challenges need to be addressed in the existing literature. Therefore, providing a strategic and systematic CI framework for manufacturing SMEs that can be supported by local authorities or projects such as NPH is essential for macroeconomic growth and can support growth in research on CI's role in macro-level environments.

1.5. Research Gap

An initial literature study in Chapter 2 suggests a depth of information regarding positive results from implementing CI philosophy in various industries. In a series of research on ways to enhance operational performance, the economic dimension of manufacturing SMEs have been thoroughly investigated, such as Lean and Six Sigma (Null et al., 2020; Sutrisno,2019).

Researchers have also examined these methods to enhance and quantify the performance of industrial organisations, primarily through manufacturing SMEs (Sodhi et al., 2020).

Despite the fact that economic development and financial sustainability appear to be popular academic issues, field studies indicate that the conversion to CI deployment by many organisations is not straightforward (Sahoo and Yadav, 2018).

A critical literature review suggested that CI is often not used in manufacturing SMEs because most have not heard about CI philosophy (Pfeifer, 2022; Ali et al., 2020). In addition, businesses that have CI deployment experience still prioritise operational effectiveness (quality, speed, flexibility, cost) and rarely place adequate financial metrics and measurements (Siegel et al., 2019) to evaluate their economic growth. Scholars like Yuik and Puvanasvaran (2020) and Vallejo et al. (2020) have offered CI transformation road maps on a case study or individual business. Still, there is a lack of development of a CI framework in macro environments to promote economic growth. Therefore, the existing research should be elaborated to fill this gap. In addition, the manufacturing literature seldom identified the CI deployment's benefits, barriers, challenges, and requirements in regional or macro environments, which are critical factors for successful improvement projects. Identifying these key factors will undoubtedly contribute to and improve existing CI implementation knowledge. This absence of frameworks was the momentum for doing this investigation. Nonetheless, a thorough literature review during the research endeavour reveals other gaps described below.

- There is no empirical research to identify the importance level of CI principles in macro environments.
- There is no empirical research on CI principles associated with economic growth factors.

There is no particular literature on a CI framework for manufacturing SMEs' economic growth and financial sustainability.

1.6. Research question

Following the assessment of prior work in Chapter 2, the present research has identified areas in the research topics examined by others, what they have found and their recommendations for future work. This has helped to narrow down the research questions. In addition, identifying areas that have not been investigated was fundamental in forming questions that address gaps in the existing body of knowledge. The investigation was narrowed down to the following research question:

"What are the implications of continuous improvement (CI) principles on macro/regional economic growth in northern England?"

1.7. Research aim and objectives

Aim

Evaluation of the CI contribution to improving the economic position of manufacturing SMEs in northern England

Objectives

1. Identify critical continuous improvement (CI) principles for manufacturing SMEs.
2. Investigating manufacturing SMEs' macroeconomic growth factors.
3. Investigating of continuous improvement (CI) principle's role in manufacturing SMEs economy.
4. Evaluating continuous improvement (CI) deployment feasibility for northern manufacturing SMEs.
5. Recommendation of a framework for Manufacturing SMEs to obtain maximum benefits of NPH project in northern England with generalisability.

1.8. Research Scopes

This study begins with the challenges, pressure, and rivalry that manufacturing SMEs confront in the global economy today. The literature on these obstacles will be read to evaluate the problems and reasons why many manufacturing SMEs' improvements require a scientific approach, especially for economic growth and financial sustainability. This research is focused on developing a CI framework that will support manufacturing SMEs' economic growth and can be used by manufacturing SME managers, CI consultants, academics, and local authorities (policymakers).

The study also concentrates on identifying critical CI principles and economic growth factors for management decisions to implement change, which are discovered using the framework. This will result in business economic improvements for the manufacturing SMEs and can be used by stakeholders in macro environment scales for regional economic growth.

The research will also be constrained by manufacturing SMEs in Northern England who express an interest in participating in a questionnaire survey and interview study or any other emerging and developing economy.

This project will develop a framework that will assist SMEs in deploying CI approaches by providing them with a new vision of CI potential in manufacturing SMEs' financial sustainability. In addition, this research offers a CI framework that various stakeholders can use to improve regional economic growth. This research employs the following framework to accomplish its aims and objectives.

1.9. Thesis structures

This section presents the thesis structure through each chapter and summarises the chapter contents.

Chapter 2 contains a critical worldwide literature review that identifies the research undertaken on continuous improvement to demonstrate the present degree of application and the barriers and challenges to adoption.

Chapter 3 describes the research methodology utilised for this study. The research methodology emphasises the significance of accurate study design and a well-structured programme employing well-established methods: a literature review, online questionnaires, and interviews.

Chapter 4 is based on significant CI principles and economic growth factors as stated in the literature review chapter (Chapter 2); the research questions are analysed with various statistical approaches. The importance of CI principles and CI project performance are evaluated. It considers CI principles' association with manufacturing economic growth factors and evaluates CI deployment's impact on economic growth factors. Importantly, this chapter explains the factors that must be considered in the framework's design to benefit manufacturing SMEs' economic improvement. In addition, the research questions' findings are evaluated and analysed to achieve in-depth knowledge and validation.

Chapter 5 is to answer the question 'What do the findings imply?' Chapter 5 evaluates and highlights the study's findings for both quantitative and qualitative research questions and demonstrates how the initial framework evolved from a fundamental idea to a framework that encompasses the critical needs for CI deployment in macro environments.

Chapter 6 summarises the research chapters with the answers to the research questions. The contributions of the study to knowledge and managerial contribution are highlighted. This study's recommended framework is provided and explored in terms of its implementation and the essential elements determining its success. The chapter then discusses the study's implications and suggests possible directions for further research.

1.10. Summary

Manufacturing SMEs are perpetually subject to intense market pressure, from shareholders desiring a return on capital invested and customers desiring a high-quality product at a reasonable price. Lack of managerial commitment, financial restrictions, and a deficiency of resources are the main obstacles to manufacturing SMEs. To remain competitive in the global market, manufacturing SMEs must face the task of overcoming such challenges to achieve economic growth. The way forward is for manufacturing SME performance to be enhanced. The goals and objectives of this study have been designed to establish a framework for improving the business performance of these SMEs and supporting the regional growth of any developing economy.

CHAPTER 2. LITERATURE REVIEW

2.1. Manufacturing SMEs

An ever-changing world with new customer needs, new markets, innovation, and social changes brings about a need to improve the existing processes of manufacturing small and medium-sized enterprises (SMEs) to serve existing customers and a need to develop new approaches to serve new customer needs in manufacturing (Snee, 2004; Lopes et al., 2020).

Many approaches to business improvement have been tried and developed since the early 1900s. Today, process-focused, statistically driven Continuous Improvement (CI) methodologies have been widely used by manufacturing SMEs to improve business performance and optimising the bottom-line benefits (Choudhary et al.,2019). Although many world-class organisations have exploited improving business management strategies, there is still less documented evidence of its implementation in manufacturing SMEs (Antony et al., 2018).

2.1.1. Market Pressure and Competitiveness

According to Omar et al. (2019), market pressure refers to various market-related factors such as consumer preference, social pressure, and public perception. The manufacturing sector is constantly pressured to increase profitability in a growingly competitive global market. (Omar et al., 2019). Because of the vital role it plays in many countries' long-term stability, there has been a realisation that sustainable manufacturing is a lifesaver for their economy. It generates revenue for national treasuries through exports, investment, and professional employment (CIMA, 2020). It also benefits from its contribution to economic infrastructure and overflow effects to other fields such as research, manufacturing, and logistics (Zhou, Bin. 2016).

For instance, the manufacturing sector represents almost one-tenth of all enterprises within the EU-28's non-financial business economy (Eurostat, 2019). It employed 29.7 million workers in 2013 and provided 26.1% of the non-financial market economy's value added (Eurostat, 2019). Despite these positive numbers, the manufacturing sector was reported as having the second lowest degree of profitability, with a gross operating rate of 7.9%, 1.6 percentage points lower than the non-financial market economy average (Carnevali et al., 2020).

In northern England, most private sector businesses (99.8%) are SMEs. Taken together, they employ over 3.3 million people – just under two-thirds (62.7%) of all employees – and account for £335 billion in revenue every year, over half (52.4%) of all private sector turnover in the region and 6% of all businesses are manufacturing SMEs (Round and Hunter, 2019).

The manufacturing sector is constantly under pressure to reduce prices and improve margins to compete with emerging markets (Shchepakin et al., 2018; Omar et al., 2019) which has led the manufacturing sector to try to move away from what has always been their major part (production) (Singh et al., 2018. Moreover, producers must constantly improve products and services and provide the best choice for customers to remain in an industry-leading position.

To match that suggestion, manufacturers must reach a high standard process to obtain high-value products or services (Zhou. 2016). As a result, manufacturing issues must be discovered and addressed to accelerate the improvement process (Carnevali et al., 2020).

There are signs that manufacturers are struggling to do this, which will pressure manufacturing companies (Eurostat, 2019), especially SMEs, due to their resource availability (Martinsuo and Luomaranta, 2018). Consequently, manufacturers' efforts to reach a higher level of efficiency and productivity require a clear strategy to understanding of customer's demands with a workforce and facilities that are sufficiently skilled and flexible (Martinsuo and Luomaranta, 2018; CIMA, 2020). The above market requirements and challenges lead manufacturing SMEs to pursue a feasible, sustainable production environment (Wyckoff, 2019).

2.1.2. Sustainable Manufacturing for SMEs

According to the Cambridge dictionary, the term sustainability means to keep operating over time. The United Nations defines sustainable development as: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Hauschild et al., 2005, Kuik et al., 2011; Tsalis et al., 2020).

In general terms, Sustainability covers economic, social, and environmental development (Sikdar, 2003; Gimenez et al., 2012; Swain, 2018), which are considered in the sustainability indicator framework construction, as shown in Figure 2.1. The concept of sustainability consists of many aspects of the businesses and operations, either due to increasing public interest, regulatory pressures, or corporate social responsibility (Cherrafi et al., 2016).

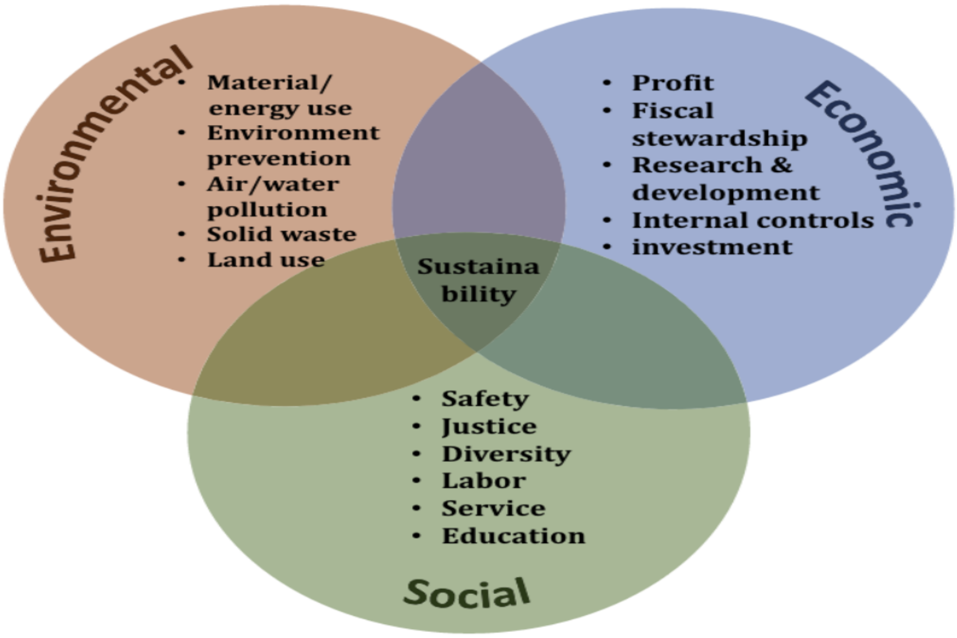

Figure 2.1: Three pillars of Sustainability (Sikdar, 2019; Gimenez at al., 2012; Purvis et al., 2019)

As manufacturing SMEs across the world face increased costs in materials, energy, and compliance coupled with higher expectations of customers, investors, and local communities (Farrington et al., 2018), sustainable manufacturing has become every day challenging core, especially for SMEs (Andalib and Halim, 2019). Governments in developed and developing countries have started to act in support of sustainable practices to improve the quality of life for current and future generations (Hauschild et al., 2005; Purvis et al., 2019).

Since the 1980s, the Sustainability concept has been introduced to manufacturing (Kaebernick et al., 2003, Kuik et al., 2011), and sustainable development has been considered the goal of a desired new industrial revolution (Jovane et al., 2008). The importance of manufacturing sustainability has gained much attention with the rise in global warming, public health problems, poverty, and resource shortages (Jiang et al., 2018).

In addition, manufacturing sustainability performance is defined in many ways, but in general can be best described as a strategy for corporates to seek a balance among economic profit (Law, 2010; Mostafa and Dumrak, 2015). Economic profit achievements in manufacturing have a positive relation with manufacturing methods and strategies regarding performing impacts of production and operations (Deif, 2011; Zhou, 2016). The performance of manufacturing methods can be measured in terms of labour efficiency, machine efficiency, trained professionals, manufacturing plant productivity, schedule adherence, on-time delivery, inventory management, production volume flexibility, and manufacturing cost efficiency (Law,2010; Arnold et al., 2016). Moreover, a company's manufacturing competitive capabilities are enhanced by its achievements in manufacturing performance (Wickramasinghe and Vathsala, 2017).

The main goals in achieving a better economic position for manufacturing are minimising resource use, waste, and production time (Shamsi and Aftab., 2018). Furthermore, manufacturers pursue process improvement methods regarding efficient resource consumption, resulting in a better economic position; thus, continuous improvement (CI) tools and techniques like Lean and Six Sigma methods are used more and more (Salem and Deif, 2017). Instead, various studies have given evidence that the continuous improvement philosophy is feasible and leads to rewarding results (Yang et al., 2010). There is an argument that performance practices constrain manufacturing operations in traditional operational ways (Rothenberg et al., 2001; Jiang et al., 2018). Moreover, in the latest report of the International Manufacturing Strategy Survey (IMSS), it was indicated from data collected from more than 650 companies in 19 countries beside those participating organisations becoming more interested in sustainability trends, but it is still poorly considered in the manufacturing strategy (IMSS, 2016). And sustainability as the basis for future wealth is not reflected in industrial strategies (Salem and Deif, 2017).

Apparently, the value of sustainability is not fully realised by companies, and they are still learning to use sustainability operational effectiveness principles (price, quality, plant flexibility, speed) and are not yet ready to make the next step and add innovation and sustainability to their competitive competences (Salem and Deif, 2017). Also, implementing sustainability practices is still not widespread (Netland and Frick, (2017). Therefore, it is crucial for manufacturing SMEs to prepare for a sustainable manufacturing road map.

2.1.3. The Role of global and UK Manufacturing SMEs

Due to the rising importance of production management challenges in the global market environment, large firms are heavily dependent on small and medium-sized organisations (SMEs) to deliver high-quality products and services at low costs (Jiang et al., 2018). SMEs are vital and significant contributors to economic development, job creation, and economies' general health and welfare (Morrison et al., 2003; Venkatesh and Muthiah, 2012). As a result, they are well-recognized and acknowledged nationally and internationally (Lopes et al., 2020). The following statistical indications support the fact of SMEs' global economically significant role:

- US SMEs contributes to 99.65% of employment (Small Business Administration, 2021)
- small businesses add to 96.38% of non-agricultural industries in Australia (Australian Bureau of Statistics, 2013)
- In the European Union, only 1% of companies have more than 50 employees (Department of Trade and Industry, 2021), and SMEs account for 99.9% of the business population in the UK (FSB,2021)

Manufacturing SMEs have different financial and employee positions in the UK. Table 2.1 presents a definition of the UK's SMEs. Sections 382 and 465 of the UK Companies Act 2006 define SMEs for accounting purposes in the United Kingdom. According to this definition, a small business has a turnover of less than £6.5 million, a balance sheet total of less than £3.26 million, and fewer than 50 workers. A medium-sized business has a revenue of less than £25.9

million, a balance sheet total of less than £12.9 million, and less than 250 workers (Table 2.1) (Lampadarios, 2016).

Table 2.1: UK SMEs definitions (Lampadarios, 2016)

UK SMEs definitions			
Category	**Headcount**	**Turnover**	**Balance**
Medium	< 250	£ 41 Million	£ 35.2 Million
Small	< 50	£ 8.2 Million	£ 8.2 Million
Micro	< 10	£ 1.7 Million	£ 1.7 Million

The United Kingdom's SMEs statistical reports by the Small Business Service (SBS), an agency of the Department of Trade and Industry (DTI), and the federation of small businesses (FSB), indicate and support the importance and vital role that SMEs play in economic growth.

- The UK had 5.94 million business enterprises that started in 2020. Almost all these enterprises (99.3%) were SMEs (6.0 million businesses) (FSB, 2021).
- SMEs account for three-fifths (3/5) of employment and around half of the turnover in the UK private sector (FSB, 2021).
- SMEs with less than 250 employees and turnover of less than £22.8 million (FSB, 2021).
- Employment in small businesses was 13.3 million (48% of the total), with a turnover of £1.6 trillion (36%) (FSB, 2021).

Furthermore, manufacturing SMEs are in a very dynamic market, and changes occur within concise time scales which causes SMEs' low success and failures (Liao and Rice, 2010). There is a variety of reasons for manufacturing performance failures, including lack of forwarding planning, cash flow problems, inability to capture agile market and innovation, lack of investment, lack of business experience, and limited external help (Antony et al., 2008, Jiang et al., 2018).

On the other hand, SMEs have strengths such as effective and open communication channels, low resistance to change, people orientation, company-wide awareness, functional integration, and employees adopting a natural responsibility for quality (Jiang et al., 2018; De Sousa et al., 2020). Table 2.2 presents some of the strengths and weaknesses of SMEs. The table was constructed by reviewing existing literature on SMEs and quality management practices such as Total Quality Management (TQM), Lean and Lean Six Sigma.

Table 2.2: Strengths and weaknesses of Manufacturing SMEs (Antony et al., 2008; Lopes et al., 2020)

Strengths and weaknesses of Manufacturing SMEs	
SMEs strengths	SMEs weaknesses
• Likely to deploy improvements quickly and gain rapid benefits ▪ Have a limited layer of management with fewer departmental interfaces ▪ Flexible and hence change can be introduced quickly ▪ Top management highly visible and hence provide leadership by example ▪ Absence of bureaucracy in management teams ▪ Tend to have high employee loyalty	• Low degree of standardisation focus is on operational matters rather than planning ▪ There are chances that management lay off employees when the work becomes unnecessary ▪ Limited investment in emerging technologies like IT ▪ No incentive programmes in many cases due to budget and resources constraints ▪ Lack of strategic planning and inspiring vision

▪ Managers and operatives are more likely to be directly involved with the customers ▪ Rapid execution and implementation of decisions ▪ Training likely to be focused ▪ Culture of learning and change rather than control ▪ People oriented ▪ More responsive to market needs and more innovative in their ability to meet customer needs	▪ Responsible for many aspects of the business and many decisions ▪ Decisions are generally made for short-term profitability ▪ Lack of skills, time, and resources; no specified training budget ▪ Decisions based on basic information and fire-fighting operation mode for survival (not systems oriented) ▪ Staff training and development is limited and informal ▪ Domination and dictatorial nature of owner can damage new initiatives ▪ Formation of strategy process is intuitive rather than systematic and analytical

Considering all the weaknesses of implementing CI tools and techniques such as time and cost issues, manufacturing SMEs have been advised and encouraged to practice those methods for their process improvement (Shamsi and Aftab, 2018).

Manufacturing SMEs are being the courage of developing their economy by embracing new business strategies like Lean and Six Sigma that can have a significant impact on their bottom-line results and transform organisation culture through those strategies (Shamsi and Aftab, 2018; Paipa et al., 2020). This research work aims to examine the extent to which Continuous Improvement methodologies are being implemented within UK Manufacturing SMEs. The next section presents a review of literature on Continuous Improvement methodologies that motivate manufacturing SMEs' strategies.

2.1.4. Manufacturing SMEs' Role in Northern Powerhouse Project

In 2014, George Osborne, Chancellor of the Exchequer, introduced a plan named 'Northern Powerhouse' (HM Treasury, 2014). The project aimed to rebalance the UK economy by providing essential infrastructure facilities and delivering high-quality opportunities for the 16 million people across the north of England. Raising productivity, stimulating growth, creating jobs, and attracting significant inward investment are major priorities (HM Treasury, 2014).

In the north of England, 99.8% of all businesses have fewer than 250 employees (Round and Hunter, 2019). In recent years productivity matters have become one of the most widely used measures of the economic performance of a country, region, or area (Mason et al., 2018). The Northern Powerhouse Strategy states that the government's key priority is 'tackling major barriers to productivity' in the North (Round and Hunter, 2019) especially macroeconomic challenges such as Brexit.

The Northern Powerhouse project (NP) principles and progress have been described by HM Government and Transport for the North (Round and Hunter, 2019) in a very wide-ranging sketch known as a 'vision statement' and many improvements related questions have not been examined. The NP project documents addressed principal outcomes with a very limited systematic and strategic management improvement framework for continuous improvement (Parr, 2017; Shutt and Liddle, 2020). Consequently, many vital strategic improvement plan issues have not been addressed, like manufacturing SME development.

The limitation of the NP programme improvement plan as a macroeconomic environment needs to be investigated to utilise the programme with the world-class management methodologies and techniques amongst Small and Medium Sized Enterprises (SMEs) in northern England.

Furthermore, economic growth studies suggest that Brexit will have a negative impact on manufacturing SMEs' development, because of skills shortages and lower levels of competition and innovation (Hantzsche et al., 2019). Therefore, it is essential that SMEs have access to high quality management skill and knowledge to compete and survive within a highly dynamic and rapidly changing market environment.

The global competition among organisations has led to higher demands on the manufacturing organizations. The global marketplace has witnessed increased pressure from customers and competitors in manufacturing and services sectors especially on SMEs (Ahuja and Khamba, 2008; Shutt and Liddle, 2020). As a result, these manufacturing organisations need to adopt some validated manufacturing philosophies/strategies like Continuous improvement (CI) I to improve the performance of current manufacturing and service system processes.

Moreover, one of the most reliable CI methodologies to improve productivity and gain a competitive advantage for any organisation is Lean Six Sigma (LSS) (Deshmukh and Chavan, 2012; Da Silva et al., 2019). Despite longitudinal studies in relation to LSS and its application in SMEs, there is no particular validated framework to evaluate the role of LSS in more macroeconomic environments in the UK, especially in northern England (Parr, 2017).

Further findings "highlighted that little comparable research has been carried out about the acceptability and practicality of manufacturing SMEs development initiative in policy-making process in the NP programme" (Parr, 2017).

2.2. Role of Manufacturing SMEs in Economic Growth

Manufacturing SMEs have increasingly come to prominence in the global economy and are playing an important role in increasing the economic performance of developed and developing countries (Harvie and Lee, 2002; Kravchenko et al., 2019).

According to the Organisation for Economic Co-operation and Development (OECD, 2017), SMEs play a significant role in most economies, particularly developing countries. SMEs account for most businesses worldwide and are essential contributors to job creation and global economic development. They represent about 90% of companies and more than 50% of employment worldwide (The World Bank, 2021). In emerging economies, SMEs contribute up to 40% of national income (gross domestic product, GDP) (The World Bank, 2021). According to the World Bank Organisation (WBO) estimation, 600 million jobs will be needed by 2030 to absorb the growing global workforce, making SME development a high priority for many governments worldwide. In emerging markets, most formal jobs are generated by SMEs, which create seven out of 10 jobs (The World Bank, 2021).

SMEs are distinguished from larger enterprises by their “reactive, fire-fighting mentality, resource limitations, informal strategies, and flexible structures” (Terziovski, 2010). Despite these characteristics, SMEs are fundamental for achieving and sustaining growth and performance across developed and developing countries and are key to the ccriticaletitive capacity of these countries. They directly contribute to employment creation and income distribution, improving sustainable development, especially in developed countries like the UK (Unzueta et al., 2020).

2.2.1 UK Manufacturing SMEs

In the United Kingdom (UK), there are 5.98 million private businesses at the start of 2020, and 95.7% were SMEs with less than ten employees (Figure 2.2) (Merchant Savvy, 2019).

	Businesses	Employees (Thousands)	Turnover (£ Millions)
With no employees	4,567,775	935	315,627
1 – 9 employees	1,156,925	3797	615,252
10 – 49 employees	211,845	4,081	645,662
50 – 249 employees	36,140	3,519	693,689
250 + employees	7,835	10,879	2,076,739
All businesses	**5,980,520**	**23,210**	**4,346,969**

Figure 2.2: UK business demographics, number of UK businesses in the private sector and their associated employment, employee, and turnover (Merchant Savvy, 2019)

The UK's SMEs accounted for 52% of private sector turnover in 2020 and 60% of all private sector jobs in the UK, a total of 16.6 million, which demonstrates that undoubtedly SMEs are crucial to the UK's economy and their contribution is increasing every year (Merchant Savvy, 2019).

Figure 2.3: UK's SMEs turnover (Merchant Savvy, 2019)

2.2.2. Manufacturing Role in Economic Development

Manufacturers are crucial to the growth of countries' exports (Tambunan, 2009; Budhwar et al., 2016) as manufacturing SMEs offer cheaper products than their counterparts in other countries (Terziovski, 2010; Tsui et al., 2021). However, it has been recognised that the manufacturing sector is responsible for a large part of the world's consumption of resources, air and water pollution, and waste generation (Ndubisi et al., 2021. Therefore, manufacturing must use resources efficiently and sustain productivity to be in harmony with sustainable economic growth (Ndubisi et al., 2021).

2.2.3. Manufacturing Value Added in Growth Domestic Product (GDP)

The critical measurement of the overall national economic strength and growth is Gross Domestic Product (GDP). GDP is the value of the goods and services produced by the nation's economy less the value of the goods and services used up in production; when the GDP goes up, economic growth also shows the health of the economy (Coyle, 2014; Asongu and Odhiambo, 2021). The relationship of GDP growth and manufacturing is solid, globally, manufacturing accounts for approximately 16% of global GDP and 14% of employment (Gabriel, 2019).

Several empirical studies have analysed the role of manufacturing as a driver of economic growth in developed and developing countries. Szirmai and Verspagen (2015) examined the relationships between the manufacturing value-added share and GDP per capita growth of 92 countries. This relationship was tested for three periods, 1950-70, 1970-90, and 1990-2005, and compared with the results for the service sector.

The study presents the contribution of manufacturing to GDP per capita growth conditional on the level of education and stage of development. It shows that manufacturing acts as an engine of growth for low and some middle-income countries, provided they have sufficient human capital. Such growth engine features are not found in the service sector. Interestingly, their findings for more recent periods indicate that a higher level of human capital is necessary for manufacturing to be an engine of growth in developing countries (Haraguchi et al., 2017; Asongu and Odhiambo, 2021).

2.2.4. UK manufacturing contribution

In 2020 manufacturing in the UK accounted for (Rhodes, 2020):

- 8% of jobs, 2.7 million in total
- £191 billions of economic output, or 10% of the UK's real GDP
- 42% of UK exports, worth £275 billion
- 65% (£16 billion) of UK research and development spending

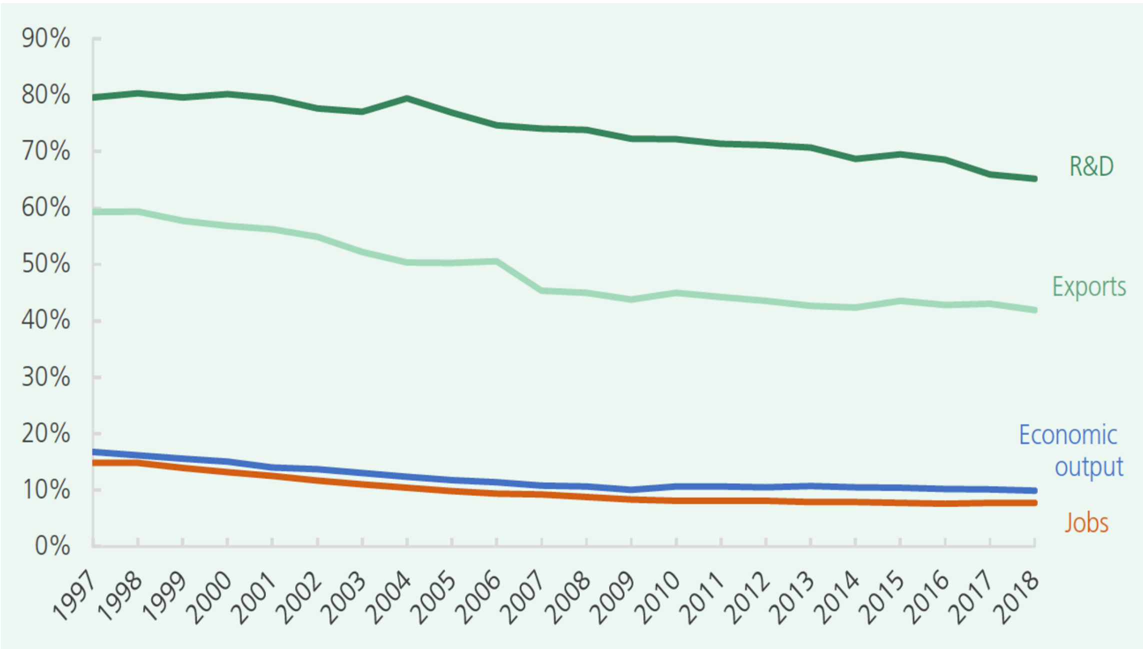

Figure 2.4: Manufacturing as a % of UK total; output, jobs, R&D, and export (Rhodes, 2020)

Manufacturing's share of UK economic output has been in steady decline for many decades, from 27% in 1970 to 10% in 2020 (Rhodes, 2020). Manufacturing's declining share of the economy in the last 30 years is the result of growth in other industries, particularly the services sector, rather than falls in manufacturing output (Figure 2.4). Manufacturing output in 2020 is

7% higher in real terms compared with 1990. But service sector output has risen by 106% over the same period (ONS, 2020).

UK manufacturing was the equivalent of 10% of GDP in 2020, a smaller proportion than most other major economies. In Germany, manufacturing accounts for 23% of GDP, which is unusually high among major Western economies (OECD, 2020). In France, it is 11%, USA 12% and Italy 17%. China and South Korea have significantly larger manufacturing industries, the equivalent of 30% and 29% of those countries' GDP (Figure 2.5) (OECD, 2020).

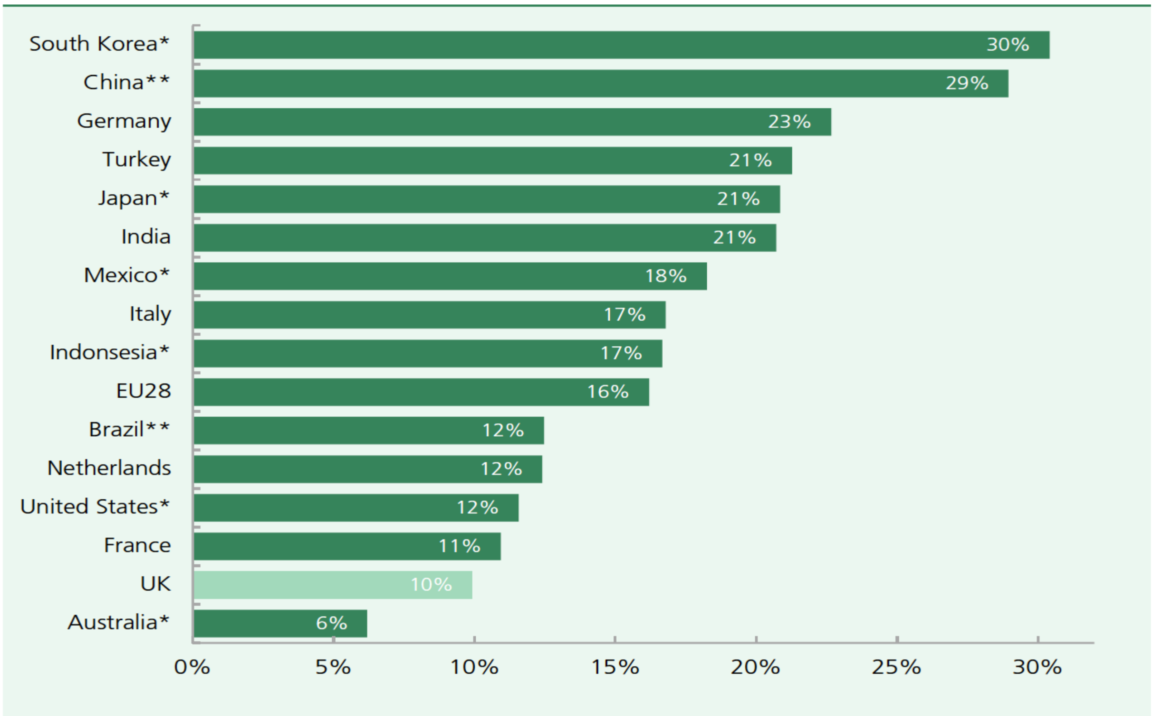

Figure 2.5: Major OECD countries Manufacturing as % of GDP (Rhodes, 2020)

2.2.5. Importance of Manufacturing SMEs in Economic Development

Almost no country has achieved and sustained a high standard of living without significant developments in its manufacturing sector, except for a few oil-rich countries and small financial havens (Chang, 2016). The manufacturing sector's higher potential for productivity growth benefits from the sector's ability to achieve higher levels of capital growth, economies of scale and technological progress relative to agriculture and some services (Szirmai, 2013).

In recent years, the shares of world manufacturing value added, and employment has not declined. However, a greater concentration of manufacturing activities has led to the decline of these shares in many developed and developing countries (Dadhich et al., 2021).

The potential of manufacturing benefit and importance of manufacturing in developing economies in terms of the sector's development quality (manufacturing's role as an engine of growth) and quantity (relative share of manufacturing value added and employment in GDP and total employment, respectively) are examined by (Tejani and Milberg, 2016) to see if it is changed or not.

With many developing economies experiencing premature deindustrialisation, it has recently been argued that development through manufacturing growth has become a more difficult path for current developing economies such as the north of England to take, especially for SMEs (Eichengreen & Gupta, 2009; Ghani & O'Connell, 2014; Rodrik, 2016). This argument is primarily based on the downward shifts of both manufacturing value added and employment share in GDP and total employment (Figure 2.6), respectively, across all income levels, as confirmed in recent studies (Ghani and O'Connell, 2014; Rodrik, 2016; Haraguchi et al., 2017) (Figure 2.7).

Szirmai (2013) and (Tejani and Milberg, 2016) argue that the manufacturing class plays a fundamental role in expanding the capitalist sector because they are the ones who reinvest profits for productive use more than others; hence, expanding industrial development represents a path for economic growth.

In this process, capital accumulation in the capitalist sector may not necessarily increase labour productivity if output expansion is proportional to labour expansion (Nobuya et al., 2017). However, the economy's productivity leads labour to be more productive by using more significant amounts of capital. Once wage levels in the capitalist sector start rising, work is increasingly substituted with money to make technology more capital intensive (Haraguchi et al., 2017; Tejani and Milberg, 2016).

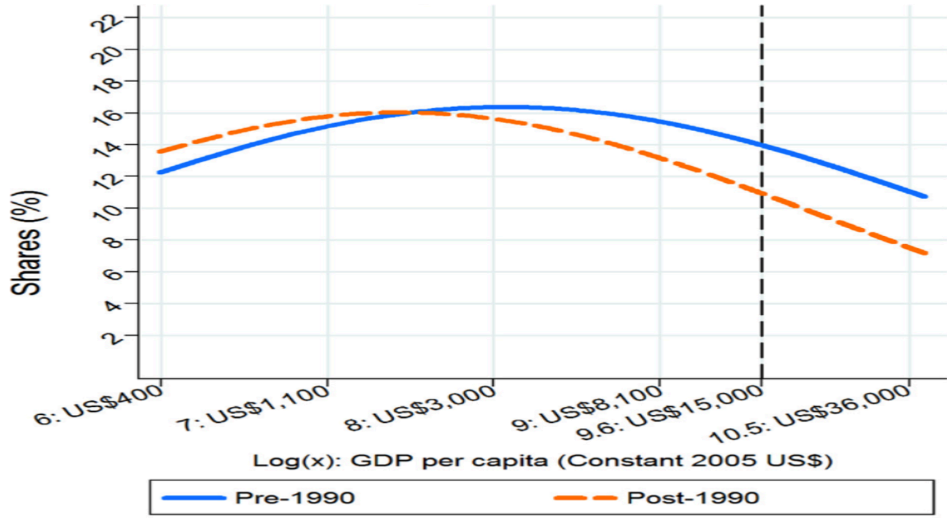

Figure 2.6: World development, manufacturing value added share to GDP (Haraguchi et al., 2017)

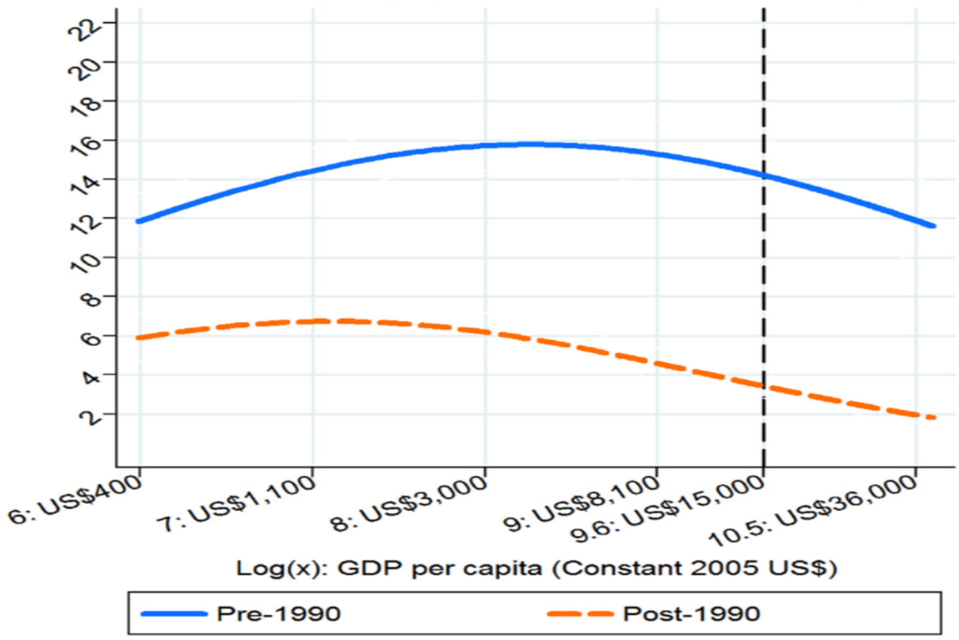

Figure 2.7: Manufacturing employment shares with total employment (Haraguchi et al., 2017)

The manufacturing sector, relative to other industries, has a higher potential for technological progress, as its progress does not depend on country-specific conditions (Tejani and Milberg, 2016) as the poorer an economy is, the faster the productivity in its manufacturing sector will increase (Rodrik, 2013; Somanathan et al., 2021) and manufacturing development tends to accelerate the rate of technological progress of the economy, partly due to the interest of excessive labour (Rodrik, 2013; Haraguchi et al., 2019) and the creation and dissemination of innovation in specific industries through linkage effects (Marconi et al., 2016). Economies of scale in manufacturing also drive the sector's productivity growth and the growth of the economy (Marconi et al., 2016; Haraguchi et al., 2019).

2.3. Manufacturing SMEs' Economic Growth Contribution

Productivity in the manufacturing sector has historically been higher than in most other sectors of the economy due to the sector's reliance on machinery and equipment (Szirmai and Verspagen, 2015). This means that for every hour worked in the manufacturing sector industry, more is produced compared with many other sectors (Vaidya et al., 2019). For instance, the UK's manufacturing productivity was 12% higher than the UK average (Rhodes, 2020).

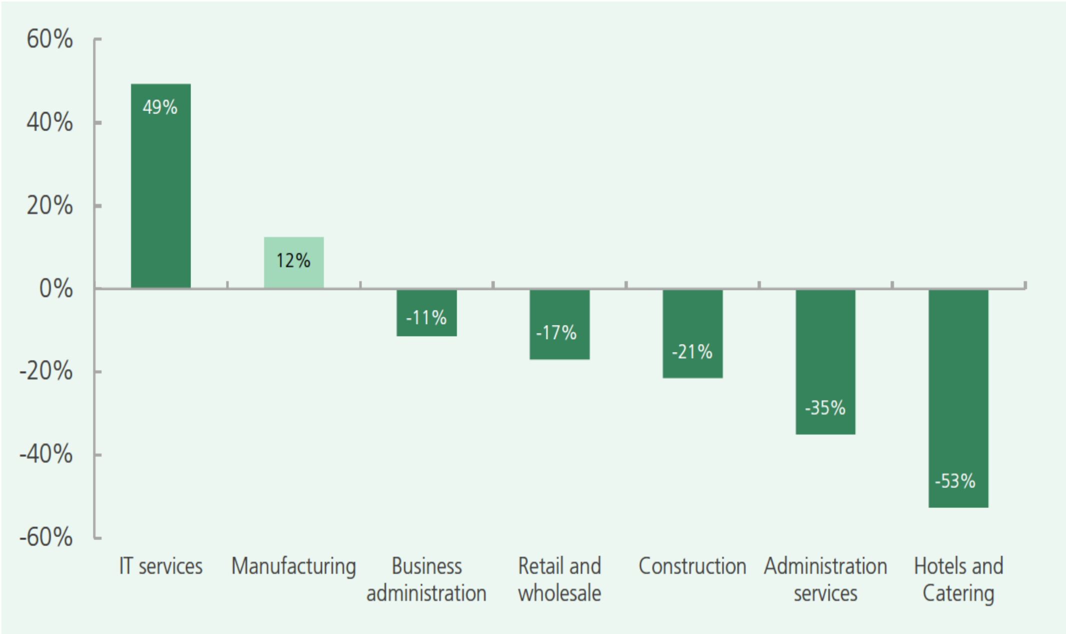

Figure 2.8: Productivity: % difference from UK average sectors (Rhodes, 2020)

Thus, it is vital to evaluate the critical factors that influence the manufacturing economy growth, which significantly contribute to strengthening the economic growth (Gabriel, 2019). In addition, industrial upgrading and diversity are considered as long-term fundamental factors in strengthening economic stability in developed and developing countries (Hameed et al., 2018; Yun et al., 2018).

2.4. Manufacturing SMEs' Growth Factors

Manufacturing SME growth refers to the expansion of a company's revenue, competitiveness, and long-term sustainability. Canals (2001) and Timans et al. (2012) highlighted two essential elements for companies' long-term and rapid growth: one is the growth mode, which is connected to the enterprise's resource and business competence, and the other is market dynamics. Wynarczyk et al. (2015) investigated the growth of 211 British subcontractors, and their findings revealed a favourable link between inter-enterprise collaboration and company growth.

The expansion of manufacturing SMEs is influenced by their operational behaviour, geographical locations, the country's political economy, and, lastly, the business environment (Rahman and Kabir, 2019). Operations management capability, internal business variables, and development strategy, according to Lopes et al. (2020), are key components that influence economic value.

Growth of SMEs, according to Alexander et al. (2019) is dependent on time management, external environment, and managerial competence. Industry characteristics, geographical location, personnel quality, and technical innovation capabilities are all elements that have a major influence on company growth, according to Timans et al. (2012). Penrose (2009), and Alexander et al. (2019) studied the driving factors of company growth and concluded that good resource use is critical to enterprise success.

2.4.1. Efficiency

The greater the operational efficiency, the more profitable a firm or investment is (Mamad, 2019). This is due to the fact that the entity may generate more significant income or returns for the same or lower cost than an alternative (Amritpal, 2018).

An efficient manufacturing SME operation allows stakeholders to make transactions that progress the market further towards the overall goal of practical capital allocation without being formed down by excessive frictional costs, which would trim down the risk/reward profile (Thanki et al., 2016; Mamad, 2019).

The impact of efficiency on manufacturing SMEs leads to an increase in an organisation's overall profitability and operational efficiency. It shows there is a positive link between profitability and efficiency. It implies that the efficient performance of manufacturing SMEs can be enhanced either by generating additional product sales volume and investment or by escalating the profit margin per sale which positively drives manufacturing SMEs' economic growth (Dhillon and Vachharajani, 2018).

2.4.2. Supply Chain Management

Regarding the dynamic growth and development encouraged by manufacturing, particularly small and medium-sized enterprises, supply chain management (SCM) plays a critical role in implementing sustainable manufacturing and improving organisational performance (Shi et al., 2017; Wu et al., 2016).

Manufacturing SME's global market accounts for more than 90% of the overall car industry's market share. It employs 6% of the workforce, making them perhaps the most influential segment of the world economy, according to the International Energy Agency (Law,2001, SMMT, 2019).

According to a study conducted by Centobelli et al. (2021), managing manufacturing SMEs' supply chain is a critical factor of process optimisation and efficiency and leads to superior economic growth results. Manufacturing SMEs need to apply sustainable manufacturing supply chain management to achieve economic and environmental growth (Shi et al., 2018; Centobelli et al., 2021).

2.4.3. Productivity

Manufacturing SMEs' productivity is the critical element of sustainable growth in developing economies. Moreover, manufacturing SMEs' ability to identify the strategic organisational and market competitiveness factors and influences has a strong positive relation with an increase of productivity (Orhan et al., 2019; Surya et al., 2020).

Kumar et al. (2019) suggest that economic development combined with technology innovation will raise manufacturing SMEs' economic performance and productivity and improve human resources and people's well-being. In addition, government policies, business capital assistance, and human resource capacity improvement all favour SMEs' development.

Furthermore, with increased productivity, manufacturing SMEs find room to grow their operation. Also, improving productivity means minimising the resources they need and the waste they produce; thus, they find ways to do more with less and spend less money (Jones, 2017).

In the context of regional growth at a macro level, support for the existence of economic enterprises, especially manufacturing SMEs, needs to be oriented towards creating competitiveness by business productivity that is competitive in global, national, and regional areas (Herman and Stefanescu, 2017; Kumar et al., 2019).

2.4.4. Job Opportunities

In most economies, manufacturing SMEs' stability plays a crucial role in promoting sustainable economic growth and job creation (Surya, 2016).

According to Kumar et al. (2,019) stability of manufacturing SMEs, developing in macro impact has three interpretations that can be proposed: (I) stability can be maintained based on an ability to manage a business, with a value of 20.57%, (ii) 23.43% is determined by sales proceeds, and the ability to generate profits or sales balances, and (iii) 16.57% is determined by an SME's ability to maintain market and consumer confidence (Figure 2.9).

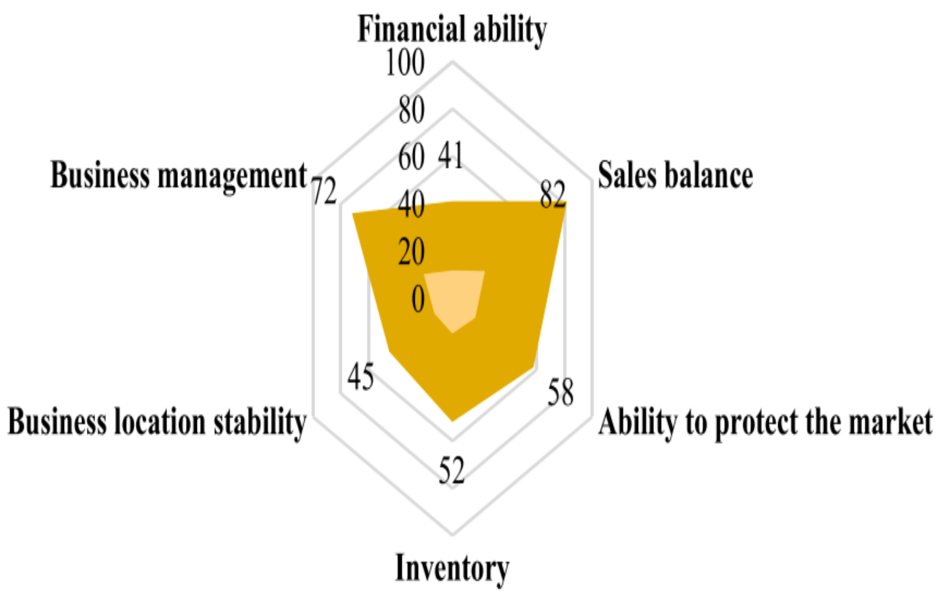

Figure 2.9: Stability of manufacturing small and medium enterprises (SMEs) (Kumar et al., 2019)

The research presents (Figure 2.9) and confirms that manufacturing SMEs' economic stability is influenced by several factors (Kumar et al., 2019). Financial stability creates opportunities in the market, such as job opportunities which become more available in both developed and developing economies. For instance, China is now following a pattern of structural change typical of a more mature emerging economy with the support of manufacturing SME job opportunities, exceptionally skilled workers (Lawrence, 2020).

2.4.5. Research and Development

Research and development (R&D) programmes and roadmaps at international and national levels are pushing the manufacturing sector towards new technological solutions, approaches, and paradigms (Jiang et al., 2018).

The manufacturing SME sector is considered a key driver to creating enterprise sustainability, through direct and indirect employment, and economic sustainability, through economic growth (Castro et al., 2012). The development of manufacturing SMEs' economy at a macro level requires a strategic and functional R&D and productivity road map. To encourage an increase in business productivity, creativity and technological innovation are needed in the development of economic enterprises (Yun and Lee, 2019).

Technological innovation, product marketing networks, and developing the human resource capacity of manufacturing SMEs were all part of the dramatic process of creating new R&D market sectors on a regional, national, and global scale. (Surya et al., 2021). Considering the macro scale of the innovation requirements, only governments can support enterprises as the cost of innovation is high with long-term economic rewards (Jiang et al., 2018).

2.4.6. Financial Support

In manufacturing SMEs, capital is a vital factor in ensuring long-term sustainability. It refers to the funds SMEs use to acquire machinery, structures, and raw materials, as well as to cover operational expenses. A large majority of SMEs lack access to formal finance and company capital, which appears to be the sector's principal limitation (Ted and Tracey, 2002; Elaswad et al., 2015; Surya et al., 2021).

Most SMEs rely on outside funding to expand and operate their businesses. Friends, family, private credits, and cooperative groups are common sources of capital (Jia et al., 2020). Formal sources of capital, such as banks and government organisations, are also accessible (Elaswad et al., 2015; Jia, 2020). Company owners handle cash from accessible sources in accordance with business rules to support manufacturing operations. However, research shows that increasing the size and growth of a team is linked to increased production. According to Bruce et al. (2012), Elaswad et al. (2013) and Jia et al. (2020), larger enterprises have more chance of obtaining financial support. Manufacturing SMEs, on the other hand, have no easy access to official and informal financial institutions to continue developing (Cheong et al., 2020).

To achieve economic growth for manufacturing SMEs, the critical strategy is to open international market opportunities through financial support, in which the central government reduces some restrictions on international trade and offers special priorities and incentives in terms of tax benefits, financial aid, and more flexible administration (Heinrich and Shuanping, 2016; Surya et al., 2021).

2.4.7. Sustainability

In the global economy, people are currently confronted with environmental and economic uncertainty, including financial crises and risks (Liu et al., 2017). Industry upgrading in conjunction with sustainable economic growth is seen as the practical strategy for increasing production efficiency, energy savings, and green manufacturing (Meng and Chi, 2018).

Furthermore, studies have discovered that industrial variety is beneficial to economic growth and employment stability in some locations (Fornahl and Guenther, 2010; Li et al., 2018) and that it is linked to economic resilience, and they consider that manufacturing SMEs diversification is another word used by development economists (Meerow and Newell, 2015). According to Li et al. (2018), exploration of the impact of manufacturing SMEs on industrial development advances our understanding of economic sustainability to some degree. The research by De Sousa et al. (2020) presents a positive relation of manufacturing SMEs' role in sustainable economic development from the perspective of industrial upgrading and diversity. However, as a result of inadequate capturing of all essential features of the role of manufacturing SMEs in economic sustainability, there are still other perspectives and requirements that need to be investigated (Li et al., 2018), such as the role of continuous improvement philosophy in their economic sustainability.

2.5. Manufacturing SMEs' Economic Growth Model (EGM)

GDP is one of the measurements of national revenue and output over a period. The total market value of all final products and services produced inside a country in a particular period is used to calculate GDP (usually one year) (Dynan and Louise, 2019). The following model (Figure 9) presents the manufacturing SME factors that have influenced and contributed to GDP. Macroeconomic models have been embraced in forming economic policy in most economies (Rhodes, 2020). The Manufacturing SMEs Economy Growth Model (Figure 9) provides an analytical framework for linking manufacturing SMEs' economy and GDP and presents the role of common critical manufacturing SMEs and growth factors. These key factors also have the potential to reduce volatility and boost economic growth, which is two important elements of any economy (Kishawy et al., 2018).

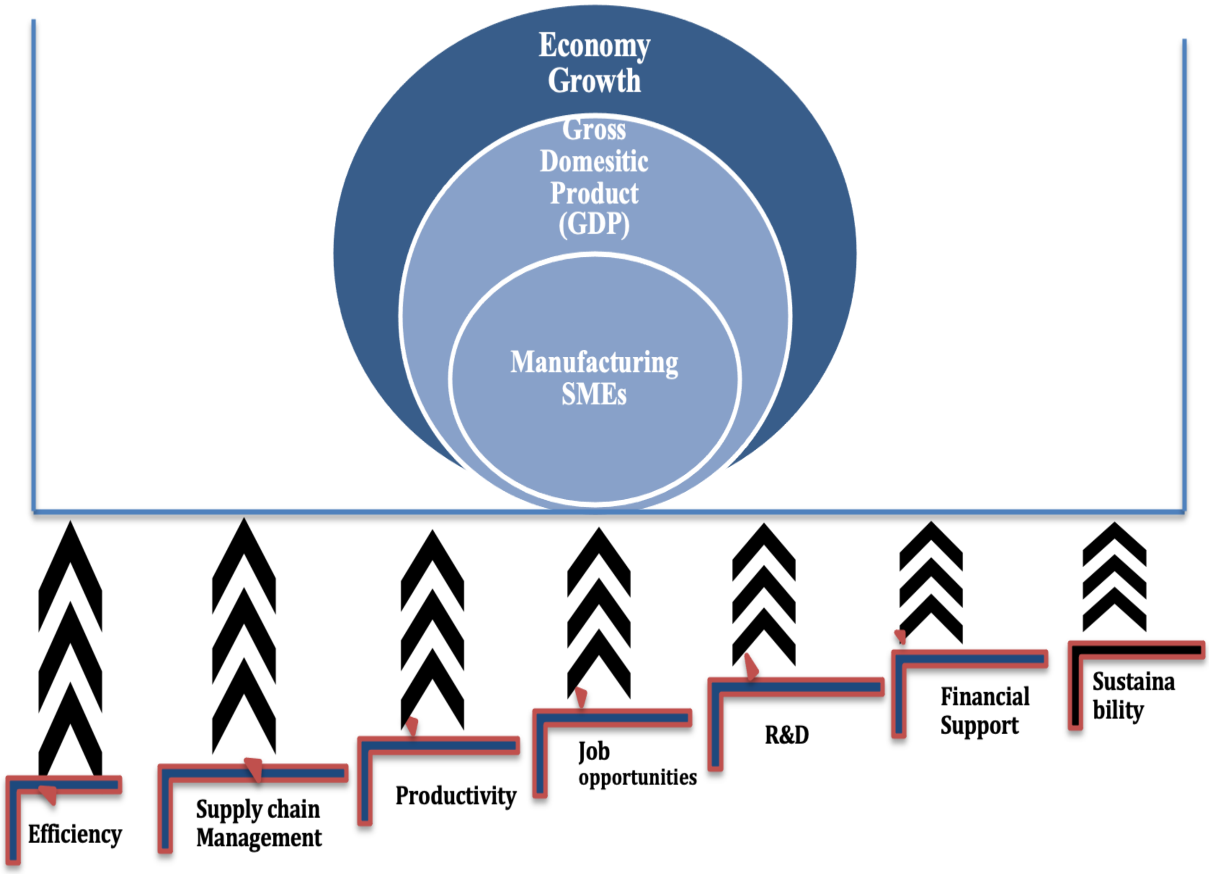

Figure: 2.10: Manufacturing SMEs Economy Growth Model (Key Factors and Drivers of Manufacturing Economy) (Dynan and Louise, 2019; Rhodes, 2020)

2.6. Continuous Improvement (CI) for Manufacturing SMEs

Continuous improvement (CI) is defined as a philosophy of sustained improvement targeting eliminating waste in all systems and processes of an organisation (Bhuiyan and Baghel, 2015). According to Audretsch et al. (2011) CI is, a systematic management philosophy that seeks to achieve ongoing incremental performance enhancements through a gradual never-ending change process. CI is gaining momentum in manufacturing SMEs and other industries (Audretsch et al., 2011; Bhuiyan and Baghel, 2015).

2.6.1. Continuous Improvement (CI)

The phrase 'Continuous Improvement' is used concerning multiple organisational initiatives; each put in place the necessary elements to allow an organisation to identify and implement improvements on an ongoing basis. Continuous Improvement initiatives aim to create a culture of constant improvement by including everyone involved (Bhuiyan and Baghel, 2015). According to Caffyn (2015), CI methodology develops over time, from an exploratory attempt and the adoption of new ways of doing things to the point where incremental improvement becomes implanted into the organisation's culture (Caffyn, 2015).

These improvements are achieved through the structured application of tools and techniques embattled at the identification, waste removal and variation in all improvement processes if they become a business culture (Farrington et al., 2018). Then CI culture will strive for sustained performance improvement with structural approaches to all aspect of the improvement process (Bhuiyan and Baghel, 2005). The structural methods started with Total Quality Management (TQM) methodologies simultaneously with the Toyota Production System (Caffyn, 2015) and developed and advanced with Lean Manufacturing (Bhamu and Sangwan, 2014) and Six Sigma (Braunscheidel et al., 2011), respectively.

Over the last few years, quality professionals have admired Lean Six Sigma and combined the two previously separate approaches (Juliani and Oliveira, 2020). The integration and improvement approaches are advanced of the mono methodology, incorporating the practical aspects and adding new methods to enrich further solo approaches (Snee, 2004; Jiang et al., 2018), and organisations that start to implement these methodologies identified them as effective in terms of elimination of variation and waste source and enhancing customer satisfaction (Singh and Singh, 2015). Ultimately, all are focussed on improving organisational performance (Van Assen, 2021). To define the conceptual boundaries, a brief systematic overview of each CI method and their application and approaches within manufacturing is provided.

2.6.2. Lean Manufacturing

The Lean philosophy and its journey began at the Toyota Motor Company in Japan at the end of World War 2 (Farrington et al., 2018). Its application was initially limited to large manufacturing companies (Yadav et al., 2020). Lean aims to eliminate waste and inessential actions, continually maximising quality, and minimising costs (Alsmadi et al., 2012) to prevent non-value-added activity in the process. Seven forms and types of waste were identified and categorised: defects; inventory; waiting time; motion; overproduction; over-processing; and rework (Juliani and Oliveira, 2020; Yadav et al., 2020), with two different types added recently: underutilisation of creativity and environmental waste (Vinodh and Joy., 2012; Ghobadian et al., 2020).

Many firms widely accept lean thinking principles and have applied quite successfully across many disciplines (Poppendieck and Cusumano, 2012; Ghobadian et al., 2020). The ultimate goal of Lean is to create a smooth and high-quality process that can produce finished products and provide service to satisfy customers' demand that utilises organisations with superior performance and the ability to provide competitive advantage (Zhou, 2016; Ghobadian et al., 2020).

Furthermore, "Lean" is a philosophy that emphasises efficiency and waste elimination while simultaneously emphasising a high level of client awareness (Farrington et al., 2018). Many manufacturing SMEs have adopted the strategy as a result of this mindset to focus their efforts and outlooks on improving their operations (Alkhoraif et al., 2019). This demonstrates how Lean applies to manufacturing of all types, sizes, and industries that seek to improve their competitive advantage, operations, and profits in regional and worldwide marketplaces, especially SMEs (Alkhoraif et al., 2019).

2.6.3. Six Sigma

Six Sigma has its roots in the industry, first developed by Motorola in the mid-1980s and subsequently implemented to significant effect in companies such as General Electric and Honeywell (Antony et al., 2018; Cudney et al., 2020). Six Sigma is a restrained, information-driven approach and scientific methodology for eliminating defects in any procedure from production to consumption, and the method has been utilised in manufacturing and service by quality professionals (Shah et al., 2008; Shamsi and Aftab., 2018; Gandhi et al., 2021). A Six Sigma project aims to reduce process variability by combining a systematic problem-solving approach, such as the Define, Measure, Analyse, Improve and Control (DMAIC) approach, with sophisticated statistical tools (Breyfogle, 2003; Tang et al., 2007; Swarnakar et al., 2020). Six Sigma is widely implemented by manufacturing SMEs, focusing purely on their quality improvements, organisational culture, and problem solving (Shamsi and Aftab., 2018). The method involves a variety of administrative personnel and sectors, such as change management, leadership, and manufacturing (Knapp, 2015; Cudney et al., 2020). Six Sigma methodologies are used by manufacturing SMEs and support them to continuously modify and optimise their operations both at the tactical and strategic levels, especially in existing intensified global competition with constantly increasing customer requirements, along with higher materials and energy costs (Shamsi and Aftab., 2018; Juliani and de Oliveira, 2020).

While Lean methodology emphasises on eliminating waste from a process, Six Sigma focuses on reducing variance. The Six Sigma method presents a comprehensive technique to attain improvement built on a foundation of statistical analysis (Shamsi and Aftab., 2018; Juliani and de Oliveira., 2020).

Using statistical techniques to analyse processes and uncover root causes is important to the Six Sigma tool set (Costa, 2018; Juliani and de Oliveira., 2020). The method is a highly rigorous, focused, effective implementation, proven principle and technique which aims to present an error free business performance, i.e., a defect rate of 3.4 faults per million opportunities is characterised as Six Sigma (Singh et al., 2020). Defects will be reduced, process capability will be improved, and process throughput will be increased due to its use (Jones et al., 2010; Singh et al., 2020).

2.6.4. Lean Six Sigma (LSS) Integration

The term "Lean Six Sigma" (LSS) was used in the early 2000s (Byrne et al., 2021; Mishra et al., 2021). The integration aimed to overcome the limitations of both continuous improvement methodologies and provide a way for organisations to increase their potential improvement (Bhuiyan and Baghel, 2005; Mishra et al., 2021).

Lean Six Sigma is defined as a business strategy and methodology that improves process performance and develops customer satisfaction, leadership, and bottom-line results by enhancing the quality, speed, and costs (Snee, 2004; Gandhi et al., 2021). To decrease variability, remove waste, and enhance process speed, a Lean Six Sigma project combines problem-solving techniques and tools from the Lean Production and Six Sigma approaches (Delgado et al., 2010; Furterer, 2009; Byrne et al., 2021). It achieves this by applying the tools and techniques from both Lean and Six Sigma.

Today, one of the most multifaceted problems organisations faces is achieving success through strategies that fit and support the sustainability process (Kaswan et al., 2020). The Determinations to improve business sustainability of industrial processes have traditionally been viewed as barriers to the economic sustainability of an organisation (Wilson, 2015; Kaswan et al., 2020). However, many businesses have discovered that those efforts result in reduced operating costs and improved employee satisfaction (Simboli et al., 2014; Byrne et al., 2021) and the use of management systems to solve the current global challenge of sustainability has been explored (Chiarini, 2015; Kaswan et al., 2020).

In this framework, Lean manufacturing and Six Sigma have emerged as major part of the sustainability reaction. The possible integration of Lean, Six Sigma and industrial sustainability has received increasing attention; many academicians and practitioners have contributed to the research and development of this field (Cherrafi et al., 2016; Chiarini and Vagnoni., 2015). As a result, Lean Six Sigma is one of the most used hybrid continuous improvement methodologies that have led many organisations worldwide (Byrne et al., 2021).

2.7. Implementation of CI Initiatives in Manufacturing SMEs and Service

To provide current evidence of CI initiatives' successful implementation in manufacturing, it is vital to provide empirical evidence on the role of continuous improvement initiatives in both developed and developing countries, in addition to highlighting key findings these research studies present (Tambunan, 2009; Manville et al., 2021).

It can be argued that the generalisation of some of this evidence does not create a clear picture of implementation issues experienced by organisations in both regions. However, this approach intends to develop an understanding of cases through different organisations.

In Table 2.3 on continuous improvement cases, one similar purpose for which these studies were undertaken was to expose further how each of these initiatives affects the performance of the environment to which they are applied.

The motivational factors for each case might differ, but the key message, regardless of the geographical region, is to sustain and optimise manufacturing SMEs, public, health care and finance industries output. From the cases, it is evident that the success of an initiative's implementation depends on a careful and structured approach to its application (Unzueta et al., 2020). Various issues are highlighted from the cases, as well as the corresponding initiative to challenge such problems.

In summary, applying these initiatives has been proven to support organisations in maintaining a competitive advantage. These initiatives have been around for an extended period, and the level of awareness and understanding could be the reason for their success in these cases. For new methodologies, such as the combined approach of Lean and Six Sigma, it is imperative to understand its approach first before assessing its suitability for organisations in developing environments (Swarnakar et al., 2020).

Table 2.3: Continuous Improvement Case

Continuous Improvement Cases				
Organisation Industry	**Source Date Country**	**CI Initiative**	**Research purpose**	**Key finding**
Public Sector (Services) **Continued**	Fletcher, 2018 UK	Continuous Improvement (CI) Total Quality Model (TQM) Lean Six Sigma (LSS)	• Improve organisation process • Reduce product cost • improve organisation culture and quality of goods and services • Better coordinate information and effort and eliminate waste • Offer supply chain solutions • Better management of finances	• Maximise the efficiency of available tax revenue while increasing the quality of their services. • Improve organisation process, reduce product cost, improve organisation culture and quality of services • Saving money and resources, increasing efficiency semitonically increase their overall citizen satisfaction • LSS implementation has positive impact on organisation culture and creates and yields significant value and saving to customers through their improvement process.

Finance SMEs	Ardeshir et al., 2017 Iran	Continuous Improvement (CI) Lean Six Sigma (LSS) (DMAIC cycle)	• Leads to a reduction in the process time • Improvement of the process sigma level • Improve top management and personnel skills • Explored cultural change issues	• Increasing sigma level from 2.84 to 2.88 and the average process time reduced from 3 to 2.40 min in the Bank • Reduction in the process time and improvement of the process sigma level • Income saving of 1.5% for the first year
Manufacturing SMEs (Environment)	Sagnak and Kaza ncoglu, 2016 Turkey	Continuous Improvement (CI) Lean Six Sigma (LSS)	• Green lean and LSS approach • Improve measurement system analysis • Green lean and LSS approach	• Decrease the unfavourable ecological impacts • Enhancing environmental efficiency • Reduction of waste in every area of organisational activity • Improve added value by decreasing and removing the non-value-added activities throughout the value chain • Improve environmental sustainability • Emphasise and underline the preventive action, rather than focusing on the end of the process • Create a culture of continuous improvement
Manufacturing SMEs **Continued**	Leavengo od et al., 2017 Mexico	Continuous Improvement (CI) Lean Six Sigma (LSS)	• Identify manufacturing process problems • Opportunities for improvement	• Reduce defects by 25% in the first year • Reduce waste by 13% in the first year • Increase sales productivity by approximately 14 % in the first year

				• Create opportunities to propose a training programme • Emphasising theoretical knowledge for managers and employees
SMEs Medical	Mishra et al., 2021 India	Continuous Improvement (CI) Lean Six Sigma (LSS)	• To explore the advantages and obstacles of implementing Lean Six Sigma • Changing the culture • Explore factors that influence motivation to implement Lean • Explore factors that inhibit the implementation	• Analytical personnel skill improvement • Process improved • Quality and productivity improved • Explore the limitation of LSS • The implementation of Lean Six Sigma during COVID-19 is not yet a matter of urgency or priority, and hence, cannot yet be applied • SMEs, measurement practices to improve their performance
Manufacturing SMEs	Antony et al., 2018 UK	Continuous Improvement (CI) Lean Six Sigma (LSS)	• Linking Total Quality Management and Innovation	• LSS viewed as fostering Process/Product/Service Innovation, Incremental Innovation • LSS features are likely to have significant influence
Manufacturing SMEs Supply chain Management Manufacturing SMEs Aerospace **Continued**	Manville et al., 2021 UK	Continuous Improvement (CI) Lean Management Lean Six Sigma (LSS)	• Promoting the use of a simple standard improvement framework • Defining performance goals and standardise the process	• Accelerating the competitiveness of the aerospace industry by fostering managerial development of supply chain partners • Highlight a very successful approach in bridging the gap of differing agendas between supply chain partners • More established SMEs with a headcount of more than 50 employees are capable of

				developing and documenting strategic plans
Manufacturing SMEs	Howell, 2011 USA Garza-Reyes et al., 2020 USA	Lean KAIZEN	• To expose the usefulness of KAIZEN within its operations.	• Achieved significant improvements through the application of • Cost savings of about $1.6m • 70% inventory reduction • 50% productivity improvement • Lead-time reduction of about 60%

2.8. Critical Success Factors (CSFs) of Continuous Improvement Projects (CIPs)

In an increasingly competitive market, businesses must understand how equipment usage impacts profitability and seek to improve it. Productivity plays a critical part in enhancing the organisation's growth and ensuring its survival in a competitive environment to achieve these goals (Singh and Singh, 2014).

Nowadays, in addition to measuring productivity, which allows managers to understand their company's current state, several CI tools and techniques assist managers in increasing productivity, improving the organisation's competitive image, improving overall equipment effectiveness, lowering overhead costs, reducing operator errors, eliminating waste, and maintaining health and safety standards (Suzuki, 1994; Singh and Singh, 2014; McLean et al., 2017).

CI may be defined as improving manufacturing processes in incremental steps rather than striving for large-scale productivity and quality gains (Singh and Singh, 2015). CIP consistently produces astonishing results, especially in terms of reducing equipment breakdowns, minimising idling, and minor stops, lowering quality defects and claims, increasing productivity, reducing labour and costs, shrinking inventory, reducing accidents, and promoting employee involvement (Suzuki, 1994; Moeuf et al., 2018).

Some businesses reported a 15-30% decrease in maintenance costs after successful CI strategy deployment, while others reported a 90% reduction in process errors and a 40-50% gain in labour productivity (Singh and Singh, 2014). In addition, some Japanese businesses that have implemented effective CI programmes have witnessed a 40-50% improvement in equipment productivity (Willmott,1994; McLean et al., 2017).

Despite the success of CI implementation cases, many businesses struggle to achieve their intended degree of improvement or to maintain the expected outcomes from a CI programme (Yuksel, 2012). As a result, several systematic reviews and empirical investigations have been undertaken identify critical success factors (CSFs) associated with the successful implementation of a CI programme in manufacturing SMEs (Antony and Banuelas, 2002; Antony et al., 2008; Albliwi et al., 2014).

Many of these CI programmes employ project-driven approaches, with continuous improvement projects (CIPs) (Timas et al., 2016) as a fundamental component of the CI programme (Jin and Doolen, 2014). A CIP is a project that uses a specialised project team to enhance a process or system with little or no capital expenditure and in a short amount of time (Bhuiyan and Baghel, 2005; Jin and Doolen, 2014). Kaizen Events, Six Sigma projects, and Lean Six Sigma projects are types of common CIPs: a Kaizen event is "a focused and structured continuous improvement project that uses a dedicated cross-functional team to address a target work area and achieve specific goals in an accelerated time frame" (Farris et al., 2008. P.10). It is frequently (but not exclusively) used to implement Lean Production principles and tools.

According to studies conducted by Farris et al. (2009); Gonzales-Aleu et al. (2018); McGrath et al. (2019), the most comprehensive list of potential CIP success criteria was identified with a list of components and their definitions, and the higher-level categories that were utilised to categorise them (Table 2.4).

Table 2.4: Potential CIP success criteria for manufacturing SMEs (Farris et al.,2009; Gonzales-Aleu et al., 2018; McGrath et al., 2019

CIP success criteria for manufacturing SMEs		
Definition	**Factor name**	**Category**
Task design	• Goal development process • Goal clarity • Goal difficulty • Goal alignment • Project duration Problem scope • Target area routineness	**Task design** • Development of goals by CIP team members during the project • Extent to which CIP goals are clear to CIP team members and stakeholders • Level of difficulty, technical challenge, or complexity of CIP goals • Alignment of CIP goal(s) with organisational goals, objectives, strategies and/or priorities • Size and nature of the problem addressed by the CIP, in terms of number of employees, physical space, organisational processes and functional boundaries and breadth of problem areas targeted
Team design **Continued**	• Target area routineness • Target area commitment to change • Target area understanding of CI • Team design, Team member experience, Team autonomy • Stakeholder representation • Cross-functionality • Target area representation Internal team roles • External champion/sponsor Team size • Team improvement skills	**Team design** • Level of complexity of the target area, in terms of product mix, process stability • Understanding by target area employees of improvement principles, methodologies, and tools • Experience of team members (including leader) with previous CIPs
Organisation	• Management support and involvement	**Organisation**

	• Management understanding of CI • CIP planning • Project identification • Information from previous CIPs • Financial resources • Materials and equipment • Recognition and rewards • Performance evaluation/review • Organisational policies and structure • Organisational culture • Follow-up activities • Lessons learned • Deployment of changes	• Level of control that team members have over CIP activities and decisions • Representation from key stakeholders on CIP team • Representation from a breadth of functional roles and expertise (e.g., quality, engineering, purchasing, scheduling, IT, HR) on CIP team • Representation of target area employees on CIP team • Use of clear team roles and responsibilities on CIP team • Support, guidance, and approval provided by champion(s) and sponsor(s) external to CIP team • Number of people directly participating as members of CIP team • Team members' knowledge and skills in problem-solving, improvement and change management methodologies and tools
CIP process **Continued**	• Team commitment to change • Team harmony • Team communication and coordination • Activities performed by CIP to communicate • Action orientation • Tool appropriateness • Structured methodology • Solution iterations • Planning for institutionalisation • CIP progress reporting	**CIP process** • Support of higher-level managers for the CIP and its goals • Participation of top managers in activities to support CIP during launch, throughout project • Top level managers' understanding of CI principles, methodologies, and tools • Activities conducted before CIP launch to plan and coordinate the CIP selection • Activities conducted to identify and select a CIP out of possible candidates • Relative priority of a CIP as compared to other CIPs and other major initiatives • Availability of information from previous relevant CIPs • Ability of CIP members, general resources, materials and equipment, software, training needed • Access for CIP to data needed

		• Incentives, recognition, and rewards provided to team members for achievement of CIP goals • Impact of achievement of CIP goals on performance evaluation • Alignment of organizational roles, responsibilities, and structure with CIP activities and goals • Follow-up activities after CIP is completed to ensure changes are continued, action items are completed, and results are sustained • Documentation of lessons learned from the CIP experience • CIP team members' commitment and accountability to improve the target area • Environment and culture within the team • Extent to which CIP team has a focus on action including data collection, experimentation/testing, and implementation • Appropriateness of problem-solving and improvement tools used to analyse and solve problems • Extent to which improvement methodology is systematic, well-defined, and executed thoroughly • Use of multiple solution iterations by CIP team to explore and test alternative solutions • Planning activities conducted by CIP for development of new work procedures, delivery of training on new work procedures • Extent to which CIP team reports on progress to higher-level management and other stakeholders • Documentation and dissemination of information to stakeholders on goal achievement, changes made to processes

According to Gonzales (2016) study in Table 2.4 list of criteria influencing the success of a CIP that can be used as a framework for manufacturing SME managers and CI professionals.

2.9. Role of Continuous Improvement in Economy Growth Factors

Continuous improvement promotes improvements to manufacturing SMEs by providing a collection of more complex tools and procedures for locating and limiting sources of inconsistencies, waste, and other issues that contribute to decreased efficiency. The most well-known CI variations, according to Bhuiyan and Baghel (2005), include Lean manufacturing, Six Sigma, Lean Six Sigma (LSS), Kaizen and Total Quality Management (TQM). These initiatives assist manufacturing SMEs through the improvement journey by reducing the cost and waste on the production line and eventually boosting manufacturing SMEs' economy (Farrington et al., 2018). Therefore, it is crucial to present continuous improvement core principles, benefits, and challenges.

2.9.1. Principles

There are a host of continuous improvement methodologies that manufacturing uses to bring structure to the process of identifying and acting upon opportunities for improvement, as mentioned in the previous chapter, such as Six Sigma, Kaizen, Lean, and TQM. Although these methodologies differ, the heart of each of them is the continuous improvement model (Farrington et al., 2018).

CI is a proven and successful approach for achieving significant long-term benefits, especially for better economic results (Bumblauskas and Meyer, 2015). The specific concepts of continuous improvement core principles need to be identified and evaluated to assist manufacturing SMEs through the CI journey and succeed in resulting in a better economic position.

2.9.1.1. Project Selection

The first steps in project management are to choose the right project and team, fill out a project charter, and describe the project's result. One of the most essential in every organisation's performance is how well they implement CI projects (Salah et al., 2015). Even with the most remarkable techniques in place, multiple studies have found that most industries fail to enhance their processes (Bhasin and Burcher, 2006; Khan et al., 2019). One of the most common reasons for failure in the implementation of improvement approaches is the way projects are chosen and prioritised, as this significantly impacts the efficiency with which they are performed (Bumblauskas and Meyer, 2015).

Organisations that commence CI implementation commonly select and initiate their project based on the required impact on corporate strategic objectives (Matthews and Marzec, 2017). Professionals working on CI projects frequently ask what the project selection impact is on the continuous improvement journey. If projects are not chosen carefully, the CI initiative might be jeopardised: projects do not produce the promised bottom-line results, the organisation becomes dissatisfied with the effort, and attention and resources are gradually diverted to other initiatives (Lameijer et al., 2020).

Successful CI projects have a lot of essential aspects to be considered, primarily in the starting stage. Important considerations include assigning the right CI specialist and consultant, completing the project promptly, receiving support and involvement from various functions, and conducting management reviews to keep the projects focused and on schedule (Bumblauskas and Meyer, 2015, Lameijer et al., 2020).

According to empirical studies, using a structured approach in CI is more beneficial than having no structure. A structured approach such as project selection can direct CI projects properly from the start with an accurate expectation of the project’s process and result (Salah, 2015). Selecting the right project is a critical component of project success (Khan et al., 2019). Companies with no systematic approach to project selection can end in disaster, o create unnecessary work, complexity, and cost for the project team (Khan et al., 2019). As a result, the project selection process must be organised around a series of activities carried out in a specific order to select the best project with the highest priority.

The characteristics of an affected CI project selection have been identified as the following features (Antony et al., 2008; Salah and Souraj, 2015; Khan et al., 2019; FSB, 2021).

Strategic and annual operating plans need to be inextricably tied to business objectives and the problem be relevant to the company's success, resulting in an efficiency of the process that significantly enhances, and significant financial progress is made. A reasonable scope should take four to six months to finish as project support typically dwindles after six months. Also, an overly broad project scope is a common problem.

Success can be measured quantitatively, and baseline, goals, and entitlement should all be well established. When an organisation understands the significance, their people are more likely to support a project. Lastly, a project that has received management approval and support is more likely to succeed in collecting necessary resources, removing barriers, and be maintained over time.

2.9.1.2. Continuous Improvement and Culture Change

The approach of a corporation is referred to as organisational culture. It shows itself in how challenges and opportunities are handled and how the firm controls and adapts to change, all of which become internalised as routines and behaviours, then transmitted to new employees as a way of thinking and acting (Alvesson and Sveningsson, 2015).

In general, implementing a CIP necessitates a cultural shift which mainly affects how routine tasks are carried out and appraised (Alvesson and Sveningsson, 2015). By combining cultural and strategic elements, according to Unzoeta et al. (2020), when organisational culture and strategy are matched, improvement programmes are easier to implement and achieve higher levels of excellence. Organisation cultural change has several factors, s including the culture of collegiality, resistance to change, enthusiasm towards attaining goals, respect for people, achieving goals and knowledge sharing (MacGrath et al., 2019; Kurpjuweit, 2019).

Top management, leadership teams, or outside consultants do not drive continuous improvement (MacGrath et al., 2019). Instead, it comes from the workers who engage with processes regularly and are intimately familiar with them (Salah, 2015). "How could they enhance this stage of the process?" is a question that frequently yields innovative solutions that save time or money, makes operations safer, or eliminate needless processes (Singh, 2012; Kurpjuweit, 2019). Moreover, more worker engagement leads to less resistance to change (Kurpjuweit, 2019).

Historically, the question has been asked about how culture can be changed. This necessitates providing individuals with the time and space to produce and develop worker knowledge rather than requiring them to battle fires or do repetitive activities all day. It also enables employees to take ownership of their work and participate in its implementation rather than delegating responsibility to others (Kurpjuweit, 2019).

2.9.1.3. Continuous Improvement Benefits and Goals

To demonstrate that manufacturing SMEs have genuinely improved, they must compare where they started and are now. To achieve desired outcomes, they must continue implementing continuous improvement methods to make improvements permanent. If not, they should evaluate and adjust as needed to get back on track (MacGrath et al., 2019). Continuous improvement allows for controlled testing. Continuous improvement initiatives should yield visible and immediate benefits and quantify and monetise the outcomes wherever feasible to demonstrate the benefit to the organisation (Knapp, 2015).

To achieve continuous improvement, modest quantities of incremental change are introduced on a regular basis. As a result, there are several advantages (Honda et al., 2018; Rhodes, 2020):

- Minor adjustments may have a significant impact.

- Smaller modifications are usually less expensive and less risky than larger ones.
- Minor adjustments are more accessible to adapt to than substantial changes.
- Smaller increments provide a faster rate of change, allowing results to keep pace with changing technology and other factors.
- More minor modifications may be implemented more rapidly than larger ones, resulting in quicker results.
- Taking care of the tiny details of a complicated situation may reveal easy answers to the more significant issue.
- Continuous improvement, like compound interest, accumulates with time, resulting in more considerable long-term advantages.
- Minor adjustments allow for continuous evaluation and, if necessary, course correction.

Moreover, continuous improvement needs long-term and short-term objectives to see overall outcomes, especially in manufacturing SMEs, as an annual reward is linked to meeting those goals to some extent (MacGrath et al., 2019). Set short-term goals or project objectives connected to habits or results to engage in continuous improvement.

Participants are driven to accomplish more when these short-term goals are met and rewarded, whether internally or extrinsically (Manville et al., 2021). As a result, the continual development cycle becomes self-reinforcing, becoming the base of subsequent success.

2.9.1.4. Leadership and Engagement

While worker ideas are the most important part of CI, leadership support is equally critical (Hegade et al., 2017). Leaders are not often the ones that come up with new ideas or assign work, but they do have many duties when it comes to CI, including (Lu et al., 2017; Omar et al., 2019):

- Strategy communication
- Goals must be aligned throughout the process

- Customer requirements are shared, resources are provided, barriers are broken down, and reinforcement is given.

A leader who does not promote CI initiatives will soon stifle employee creativity and excitement (Omar et al., 2019). Individuals may accomplish continuous improvement success, but the team environment is essential for achieving maximum CI results (Hegade et al., 2017). Teams may accomplish that self-reinforcing dynamic through the synergy of ideas, shared accountability, social reinforcement, and even healthy competition, especially in manufacturing SMEs (Butler et al.,2018).

2.9.1.5. Knowledge exchange

Regarding continuous improvement, CI professionals may learn from W. Edwards Deming, the renowned quality guru, who claimed that learning and improving regularly is essential to survive (Hegade et al., 2017). Furthermore, training and implementing a consistent improvement strategy have been emphasised as crucial mechanisms for facilitating continuous improvement (Lleo et al., 2017). As a result, businesses spend much money on buying standard, off-the-shelf improvement methods and putting staff through extensive training in these approaches, as well as the tools and practices that go along with them (Costa et al., 2019; Van and Marcel, 2021).

Employee engagement and skill are crucial to the success of continuous improvement efforts (Lleo et al., 2017; Costa et al., 2019). According to Van Assen (2021), continuous improvement training usinge of a common improvement method are positively related to employee involvement. Still, there is a negative interaction effect between training and the use of a common improvement method, the higher (adherence to) the use of a common improvement method, the lower the positive effect of training. Also, employee involvement partially influences the impact of training on continuous improvement (Van Assen, 2021).

2.9.1.6. Summary

CI is a proven and successful approach to achieving significant long-term benefits. The concepts of continuous improvement core principles have been identified and evaluated to present a key critical improvement principle for manufacturing SMEs, shown in Table 2.5.

Table 2.5: Key continuous improvement principles for manufacturing SMEs (Costa et al., 2019; Rhodes, 2020; Van Assen, 2021)

Key CI's Principles				
Project selection	**Cultural change**	**Scopes**	**Leadership and engagement**	**Knowledge exchange**
Strategic project selection	Culture of collegiality	Saving business process time	Top management commitment	Training and education
	Resistance to change	Data and information collection	Team working	Knowledge sharing
	Enthusiasm towards achieving goals	Gradual movement to quality perfection		Employee engagement and empowerment
	Respect to people			

2.9.2 CI Benefits for Manufacturing SMEs

The continuous improvement benefits reflect the idea that manufacturing SMEs should undertake incremental improvements to their services, products, and processes. Table 2.6 presents a few individual benefits and expected benefits of Continuous Improvement core tools and techniques for manufacturing SMEs that are supported in the different case studies and systematic literature review papers.

Table 2.6: Continuous Improvement Benefits (Albliwi et al., 2014; de Castro Freitas et al., 2018; Alexander et al., 2019; Kurpjuweit et al., 2019; Mishra et al., 2021)

Continuous Improvement Benefit					
CI methodology	**Defining literature**	**Tools, methods, and concepts**	**Sector**	**Benefits by Specific model**	**Common Benefits Lean/ Six Sigma/ LSS/ Kaizen/ TQM**
Lean	Womack et al., 1990 Alexander et al., 2019	Flow; Pull; Customer value; Value Stream Mapping; 5Ss; Kanban; poka-yoke; Gemba Walk; A3 Reporting; Process activity mapping; Supply chain response matrix; Production variety funnel; Quality filter mapping; Demand amplification mapping; Decision point analysis	Manufacturing SMEs	Elimination of waste ("Muda") Eliminating	• Increased business net profit • Optimised productivity • Increased organisational adaptability to change • Increased capability to economic growth • Optimised supply chain management • Better product/service pricing • Increased economic stability • Increased reputation • Enhanced competitive advantage • Developed unique product/ service • Adaptation to new initiative • Optimised supply chain management • Better product/service pricing • Increased economic stability • Increased reputation • Enhanced competitive advantage • Developed unique product/ service • Strategic project selection • Change management • Saving business process time
Six Sigma	Schroeder et al., 2008 Timans et al., 2012 Gandhi et al., 2021	Belt certification system; DMAIC toolbox; expected financial benefits from every initiative; Service	Manufacturing SMEs	Eliminating waste	

		Blueprinting; Policy deployment			• Continuous data and information collection • Top management commitment • Employee engagement and empowerment • Training and education • Culture of collegiality • Gradual movement to quality perfection • Enthusiasm towards achieving goals • Respect to people • Team working • Knowledge sharing • Resources availability (e.g., time, staff)
Lean Six Sigma	Arnheiter and Maleyeff, 2005 Prasanna et al., 2013 Gandi et al., 2021	Combining above with emphasis on order and timings of implementation	Manufacturing SMEs	Facilitates elimination of defects	
Kaizen	Brunet and New, 2003 Hailo et al., 2020	Defect Mindset; Small Group Activities; Quality Circles	Manufacturing SMEs	Eliminate defects through employee engagement	
TQM	Deming and Edwards, 1982 Adebanjo et al., 2016	Statistical Process Control; Total Productive Maintenance; Control charts; Pareto charts	Manufacturing SMEs	Increase customer satisfaction and reduce resources	

2.9.3 Challenges

While most manufacturing SMEs recognise the value of continuous improvement, not all are able to incorporate it into their culture or way of operating due to insufficient CI knowledge and resources and most permanent manufacturing SMEs changes fail to reach objectives, according to reports (McLean and Antony, 2014). Thus, it is important to appraise and identify the reasons of continuous improvement projects fail in manufacturing SMEs.

To solve organisational change challenges, the identification and evaluation of continuous improvement challenges is necessary.

According to studies conducted by Del Angel and Pritchard (2008) and Gandhi et al. (2021), 60% of Six Sigma projects partially fail to reach the anticipated objectives in terms of continuous improvement due to the lack of several factors, such as insufficient leadership support. Furthermore, several studies were done by researchers to identify the core challenges that face manufacturing SMEs through the continuous improvement journey and adopted by several researchers in the management field (McLean and Antony., 2014). The following are core continuous improvement challenge themes.

2.9.3.1. Motivation and Expectation

Before any implementation can begin, the motivations for the project, as well as the expected consequences, must be carefully considered and evaluated as launching an effort for the wrong reasons might result in its failure (Akhmetshin et al., 2018)

Starting an initiative because others have done so or reacting to external forces is usually the wrong reason. The journey of continuous improvement needs to be prepared and match organisational aims and objective requirements and ed by their facility (McLean and Antoney., 2014). As a result, organisations may have unreasonable expectations, which, if not satisfied, can lead to dissatisfaction and failure. Expecting temporary satisfaction or immediate solutions will be challenging (Butler et al., 2018).

2.9.3.2. Organisation Culture

The business culture, as well as the environment in which it works, can contribute to the failure of any initiative. A company's culture can suppress improvement attempts or cause opposition (McLean, 2017). The company's present culture may not be well matched to the programme, with the implementation efforts being seen as resistance to resistant-Manzano et al., 2012; McLean et al., 2017).

Some businesses will also make irrational assumptions about their capacity to change attitudes and develop a new culture (Nguyen and Robinson, 2015). This resistance to change may be due to the organisational structure (Butler et al., 2018) and may result in the failure of the CI initiative.

2.9.3.3. Insufficient Leadership

Change programmes are likely need significant engagement and time, so management support and commitment are constant elements associated with initiative failure (Butler et al., 2018). As the programme continues, management's early excitement and support may diminish due to competing objectives inside the company. Managers must, however, show leadership in addition to dedication. A lack of genuine leadership will hamper the efforts, and at all levels of management, this leadership must be consistently maintained (Kurpjuweit et al., 2019).

2.9.3.4. Implementation Approaches

The Implementation Approach is crucial, with inadequate implementation, deployment, or execution being cited as overarching causes for project failure (Jeyaraman and Teo, 2010; Shamsi et al., 2018). The level at which the initiative is implemented, the frequency with which it is implemented, and the method by which it is implemented will all impact the outcome (Nguyen et al., 2015). There must also be a visual representation of what will be executed and how all the elements will fit together. Tools and approaches must complement each other and be added into current processes to achieve, optimise, and continue improvement results (Kumar et al., 2020). As a result, a lack of a plan from the start is problematic. It is also vital to consider who will lead the implementation effort (Shamsi et al., 2018).

2.10. Theoretical Conceptual Model (TCM) for Manufacturing SMEs

A conceptual framework for developing a continuous improvement programme is required to expand on past research and provide a research output of practical significance (McLean et al., 2017). Continuous improvement practices create the conditions for an organisation to discover and implement improvements on the regular basis and its philosophy paved the way for structured approaches to quality and process improvement, which evolved into its tools and techniques such as Lean manufacturing, Six Sigma, and Lean Six Sigma (Butler et al., 2018; Zavala et al., 2020). The process of this journey needs to be planned and structured in advance with a framework that utilises the whole CI development stages, requirements, and challenges (Zavala et al., 2020).

The framework contains several barriers or enablers (determinants) which influence the overall outcome of the manufacturing SME implementation. As has been the case with this research, determinant frameworks are typically developed by collating results from previous studies of barriers and enablers through the review of existing frameworks or the originator's own experience (Nilsen et al., 2020; Zavala et al., 2020). The new conceptual framework for manufacturing SMEs has utilised all these approaches.

The new conceptual framework will be developed and finalised through different stages of this thesis by incorporating continuous improvement philosophy derived from literature, along with the positive aspects identified from continuous improvement methodology's role in manufacturing SMEs' economic growth. As it explains what influences the implementation outcomes and details a structure and plan for achieving these, the implementation guide detailed is categorised as a framework.

This chapter offers a critical literature review of the existing Continuous Improvement implementation philosophy. A systematic and critical literature review is required to analyse existing practical frameworks critically and clearly demonstrate the research gaps. The original systematic and critical literature review results are combined to create a new conceptual framework for implementing a continuous improvement practice in UK manufacturing SMEs. This research adopted Forza et al.'s (2002) proposed methodological structure and process, which is organised in six phases:

(1) synthesising a conceptual model from a literature review; (2) survey design; (3) survey refinement and testing; (4) data collection; (5) data analysis; and (6) final and new framework. Thus, to achieve the objectives of this study, the research protocol was based on these two parts (P) with three relationships (R) steps, as presented in Figure 2.10.

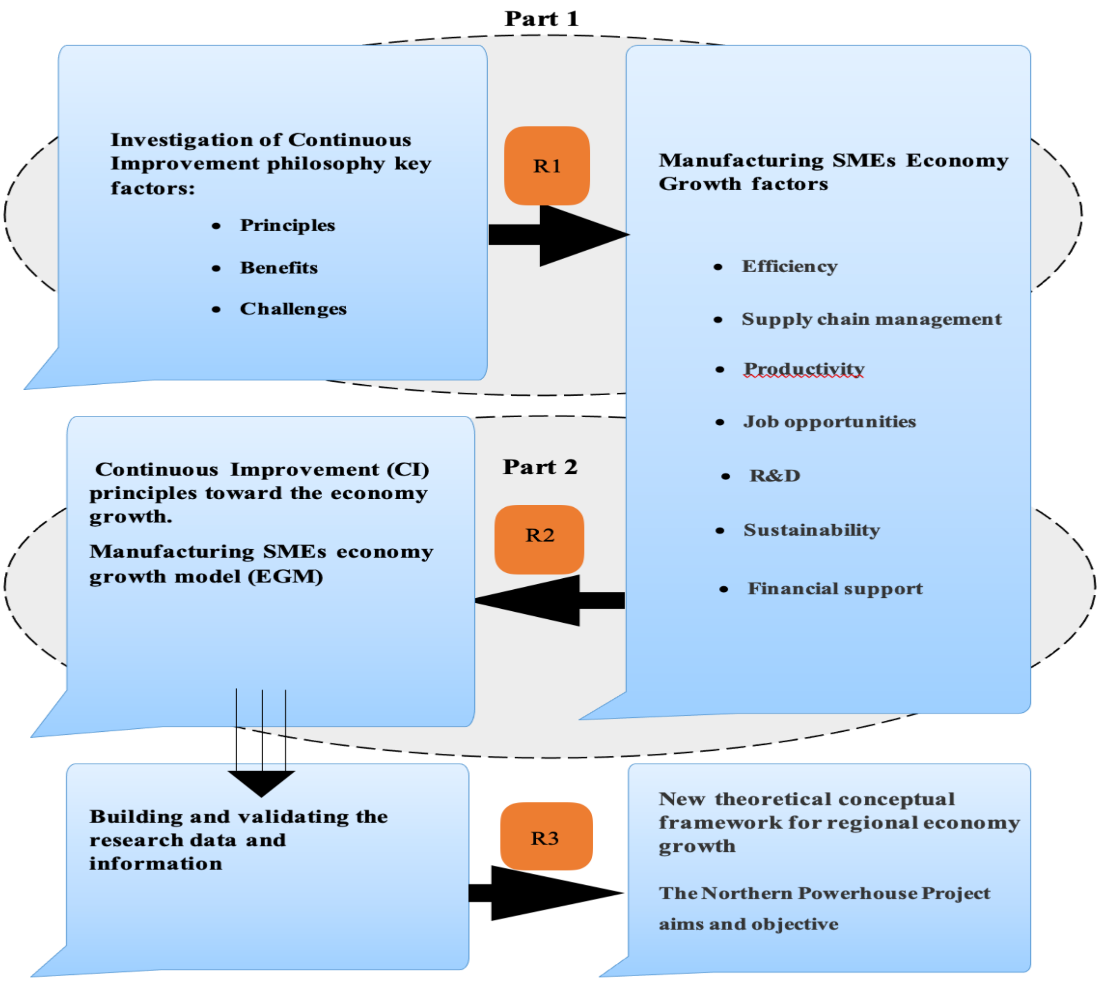

Figure 2.11: Theoretical framework of Continuous Improvement (CI) philosophy role in manufacturing SMEs economy growth (Forza et al., 2002)

The stage of the theoretical, conceptual model (TCM) presented proposes three relationships that have been translated into two parts: Part one (P1), the CI philosophy led manufacturing SMEs to improve their resource allocation and the development of processes (operations and management), cultural change for formulating and managing the right policies. For instance, Six Sigma and Lean six sigma initiatives improve process efficiency through decisions and activities related to production planning. In part two (P2), the economic growth factor can be enhanced by the CI methodology; as a result of the positive impact on economic improvement, the framework can be used as a theory for regional projects like the Northern Powerhouse.

The stage of the conceptual model presented in Figure 2.10 will be developed in this research that combines the study improvement models as Continuous Improvement (CI) detailed in factors and elements areas. The model presented in Figure 2.10 suggests two relationships: the first relationship (R1) aims to investigate the CI deployment's principles for microenvironments like manufacturing SMEs and to identify the CI methodologies challenges; the second relationship (R2) seeks to determine the impact of CI principles toward the macroeconomic growth factors. And consequently, the research contribution presents a new CI economic growth framework for manufacturing SMEs (R3).

2.10.1. Conceptual Continuous Improvement (CI) Framework Questions

To develop conceptual relationships, it is necessary to create meaningful research questions and hypotheses (Smith et al., 2019). The author builds on opportunities to explore individual elements of continuous improvement principles previously mentioned to be helpful in industry-based economic growth potential. Also, there is an opportunity to further the development of these potentials by applying specific research to create a value improvement model. Therefore, this thesis is structured around theoretical and practical investigations developing and testing concepts with the overall objective of validating the findings against the following research questions to clarify the current state of CI principles benefits and opportunities and its role in developing the manufacturing SME economy.

Very little is known about the role of continuous improvement and the level of importance of its role in manufacturing SMEs' economic growth projects (such as the Northern Powerhouse project) at the regional (macro) level; this requires further research at the regional scale, which in this research is northern England. Thus, research question one needing appraisal is as follows.

- **RQ1:** How important are continuous improvement projects to achieve economic growth factors for manufacturing SMEs in northern England?

The continuous improvement principles are being used to a certain degree to level up manufacturing SMEs' economic position. However, the economic impact it can have on a macro scale is much less understood (Timans et al., 2012; Alexander et al., 2019). Thus, research question two needs appraisal at the regional scale.

- **RQ2:** How important are the continuous improvement principles for manufacturing SMEs?

The association between critical economic growth factors for manufacturing SMEs are rarely evaluated, especially at the macro scale (Daway et al., 2019); thus, research question three requires evaluation and analysis at the regional scale.

- **RQ3:** What are the associations between critical economic growth factors for manufacturing SMEs in northern England?

The association between critical continuous improvement factors for manufacturing SMEs are unknown and has not been approached within the research-specific area (Northern England) (Yadav et al., 2020). This research question four, requiring evaluation and analysis at the regional scale, is as follows.

- **RQ4:** What are the associations between critical continuous improvement factors for manufacturing SMEs?

The level of validity of research results needs to be confirmed by evaluation of the possibility of identifying any significant difference amongst respondents in terms of regions, organisational size, sector, and experience of respondents about the importance of CI factors for economic growth in the specific regional context of research respondents (Northern England), therefore it needs to be tested as follows.

- **RQ5:** Is there any significant difference amongst respondents in terms of regions, organisational size, sector, and respondents' experience about the importance of CI factors for the economic growth of manufacturing SMEs in northern England?

The level of validity of research results needs to be confirmed by evaluation of any significant difference amongst respondents in terms of region, organisational size, sector, and experience of respondents to identify the most critical continuous performance improvement factors for manufacturing SMEs in the specific regional context of research respondents (Northern England). Therefore, it needs to be tested as follows.

- **RQ6:** Is there any significant difference amongst respondents in terms of region, organisational size, sector, and experience of respondents to identify the most critical continuous performance improvement factors for manufacturing SMEs?

2.11. Summary

The systematic and critical literature shows that no industry-specific or region-specific continuous improvement frameworks or models at the macro scale are available for manufacturing SMEs. Manufacturing SMEs lack the knowledge and ability to fulfil improvement efforts and the lack of a roadmap to follow are top obstacles for continuous improvement implementation in the manufacturing industry. As a result, this field holds much potential for future research. Moreover, Chapter 2 starts with developing a meaningful research question through a systematic and critical literature review.

In Figure 2.11, the author presented core economic growth factors and drivers identified in GDP. All elements are then separated into two sections depending on their most impact on the financial growth aspect, sustainability, and productivity. Then the factors with the influential critical impact identified and evaluated in the literature reviewed have been coloured in yellow (Figure 2.11).

The author builds on opportunities to explore individual elements of Continuous Improvement (CI) philosophy and its initiatives such as Lean, Lean Six Sigma Kaizen previously implemented in manufacturing SMEs and found to be applicable including key GDP factors and drivers (Figure 2.12).

Finally, continuous improvement principles and their role in economic growth factors are illustrated in a new research framework presented in Figure 2.13.

The framework in Figure 2.13 presents a whole picture of this research. Research questions are the main focus of this research that need to be evaluated. Then a questionnaire survey will be presented to the manufacturing SMEs in northern England to identify continuous improvement principles and their role and find the core impact of CI in their process.

In the next step, the author will interview CI professionals, manufacturing SMEs, academics, and local authorities to investigate the feasibility of continuous improvement implementation in northern England.

Finally, the result will be analysed to identify the key CI implementation barriers, challenges, and requirements on manufacturing SMEs in the north of England.

With the knowledge that there is an opportunity to further develop these potentials by applying specific research to develop a value improvement framework (Figure 2.13).

The framework presents the research's aims and objectives to be investigated through Manufacturing SMEs managers and consultants with contributions from academics and local authorities in northern England through a survey questionnaire (quantitative research). It will then be analysed with statistical test approaches.

The findings are then presented and evaluated through qualitative research by interviewing CI consultants, manufacturing SMEs, local authorities, and academics. The qualitative results will be validated through different qualitative analysis approaches. The following chapter aims to structure theoretical and practical investigation, to develop and test continuous improvement concepts with the overall objective of validating the research finding.

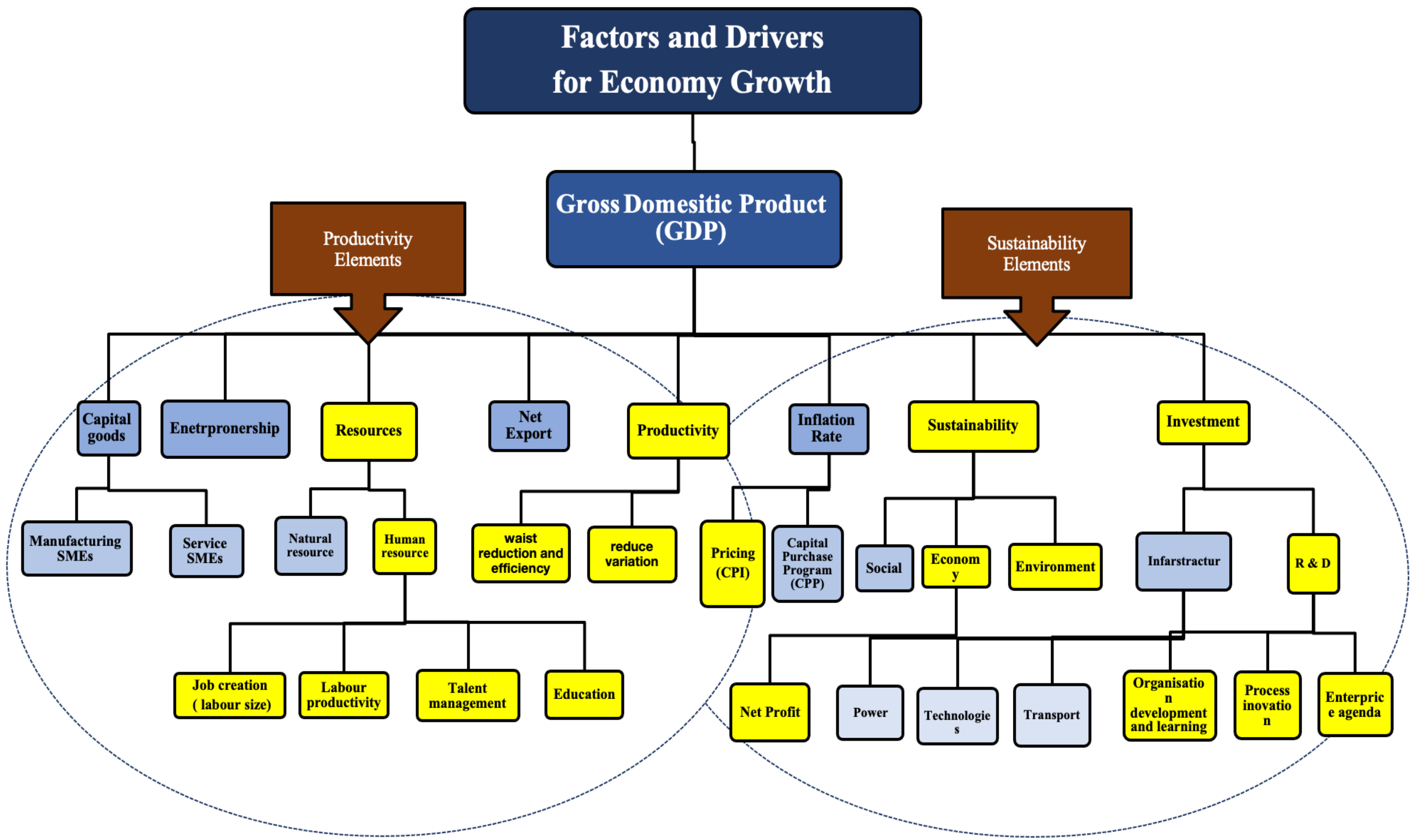

Figure 2.12: Factors and drivers for economic growth (Fabus et al., 2019; Visco, 2020)

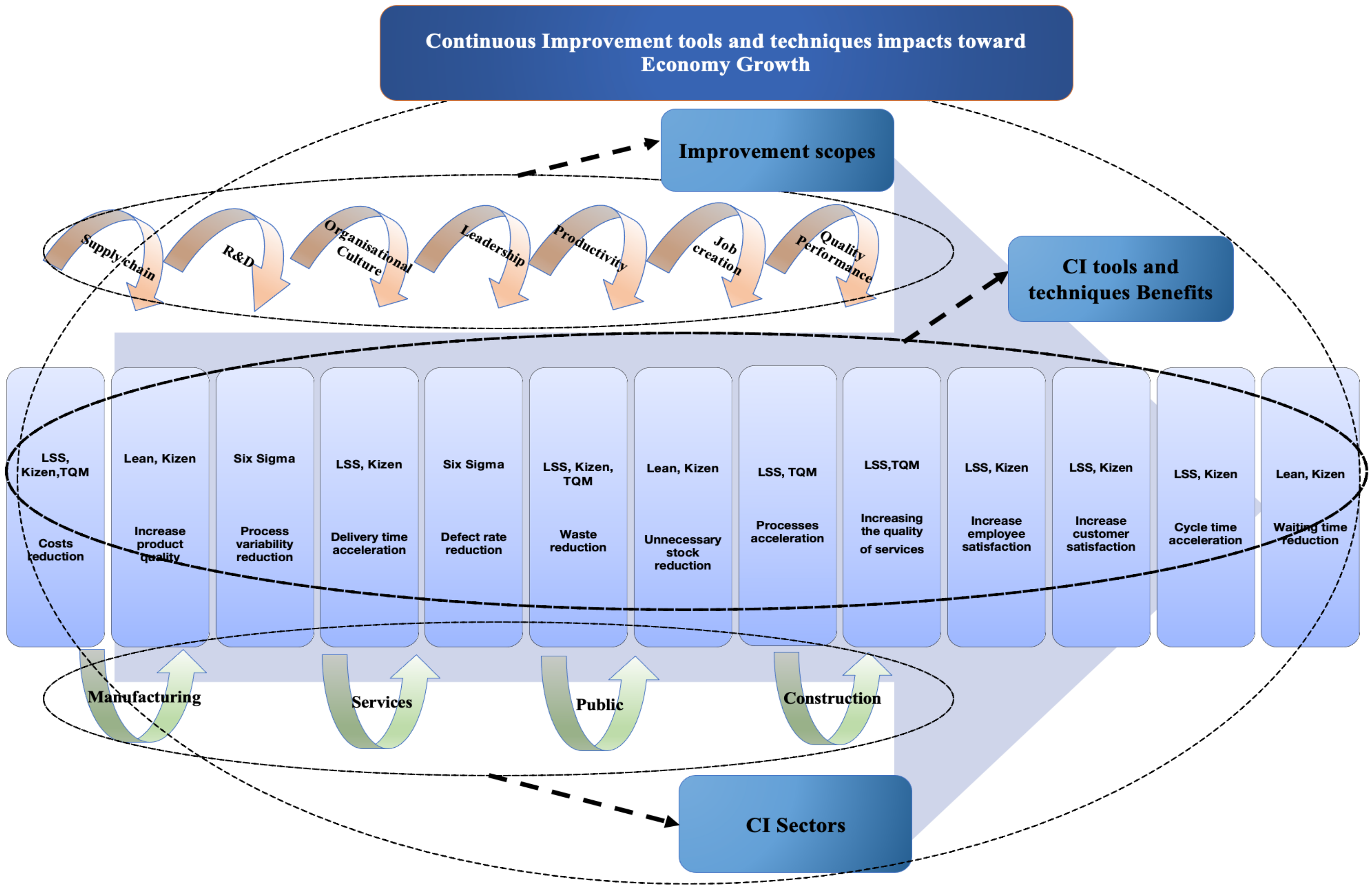

Figure 2.13: Continuous Improvement tools and techniques impacts toward economic growth. (Allawi et al., 2015; de Castro Freitas et al., 2017; Alexander, 2019; Kurpjuweit et al.,2019; Mishra et al.,2021; Gandhi et al., 2021)

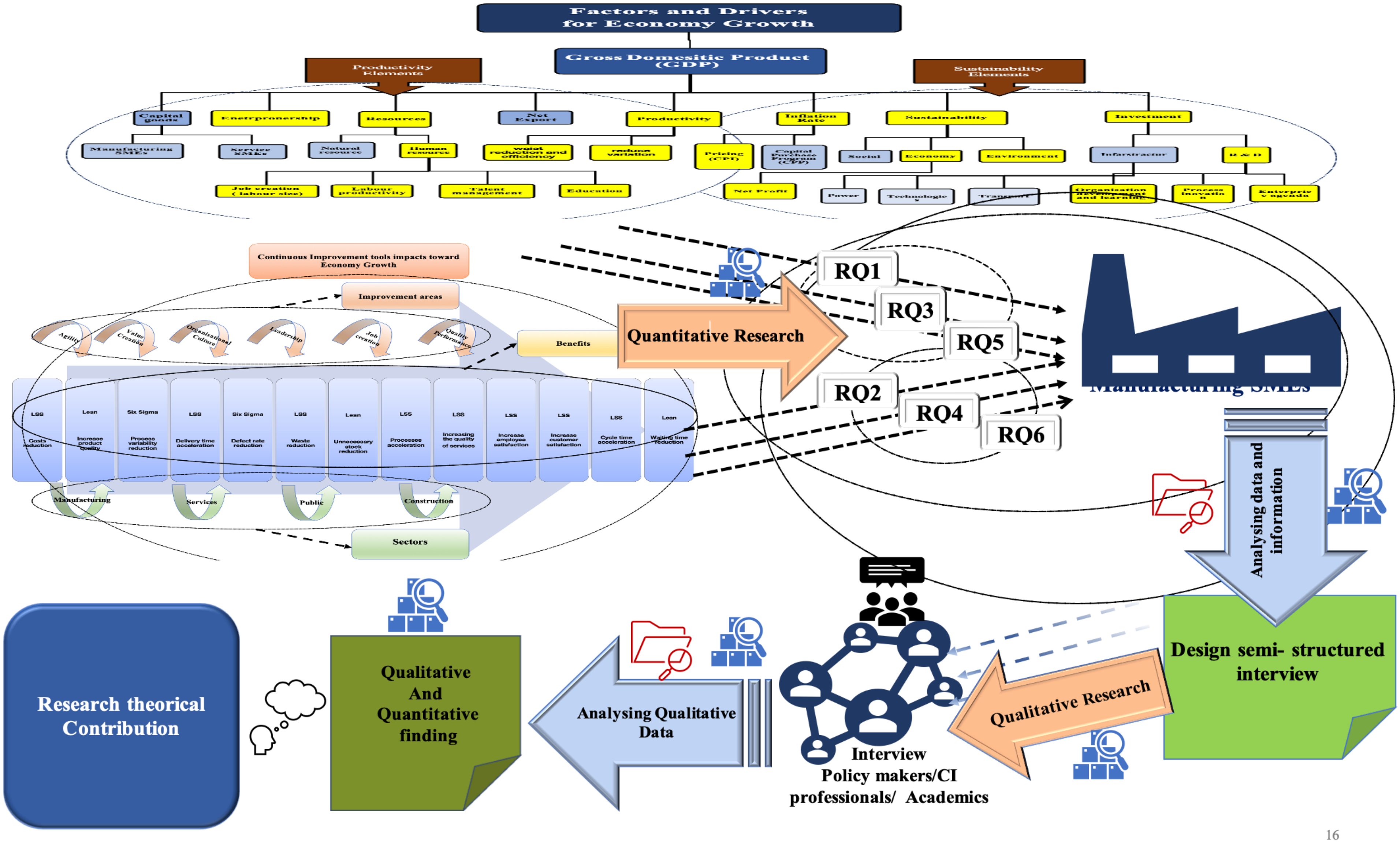

Figure 2.14: Continuous improvement principles toward economic growth factors framework (Manufacturing SMEs in northern England)

CHAPTER 3. RESEARCH METHODOLOGY

3.1. Introduction

According to Snyder (2019), research methodology is “a process for systematically solving a research topic”. It outlines the actions the researcher takes to investigate the research problem and the components of the research process, and data gathering methods. Scholarly research begins with identifying a specific topic, followed by a literature evaluation (Aithal and Aithal, 2018), which serves as the research beginning point.

The present research considers an existing problem that can be investigated through a specific field of study using various research methodologies. This research follows an abductive approach where a theory exists. The research examines it to support or reject it, aiming to inform the current theory and add and contribute to the existing knowledge. This research began with the statement that CI principles can optimise process value for manufacturing SMEs and would improve their economic performance.

This concept will be investigated using a variety of research and analysis methodologies. It is critical to locate the optimal methodological fit for this study. The methodological fit was defined by Edmondson and McManus (2007, p15) as “internal consistency among aspects of a research effort”. Table 3.1 shows these characteristics and this chapter: research questions, preceding work, and study design.

Table 3.1: Four critical elements of field research (Edmondson and McManus, 20

Element	Descriptive
Research question	• Focuses a study • Narrows the topic area to a meaningful, manageable size • Addresses issues of theoretical and practical significance • Points toward a viable research project—that is, the question can be answered
Prior work	• The state of the literature • Existing theoretical and empirical research papers that pertain to the topic of the current study • An aid in identifying unanswered questions, unexplored areas, relevant constructs, and areas of low agreement
Research design	• Type of data to be collected • Data collection tools and procedures • Type of analysis planned • Finding/selection of sites for collecting data
Contribution to literature	• The theory developed as an outcome of the study • New ideas that contest conventional wisdom, challenge prior assumptions, integrate prior streams of research to produce a new model, or refine understanding of a phenomenon • Any practical insights drawn from the findings that may be suggested by the researcher

It is necessary to identify how research should be conducted, the theoretical and philosophical assumptions that research is built on, and the implications of these assumptions for the method or procedures used (Saunders et al., 2009). As a result, before analysing the research design used in this study, it is crucial to define the researcher's philosophical perspective, as this informs the study's overall methodological approach. The methods used in this study are illustrated in Figure 3.1 below.

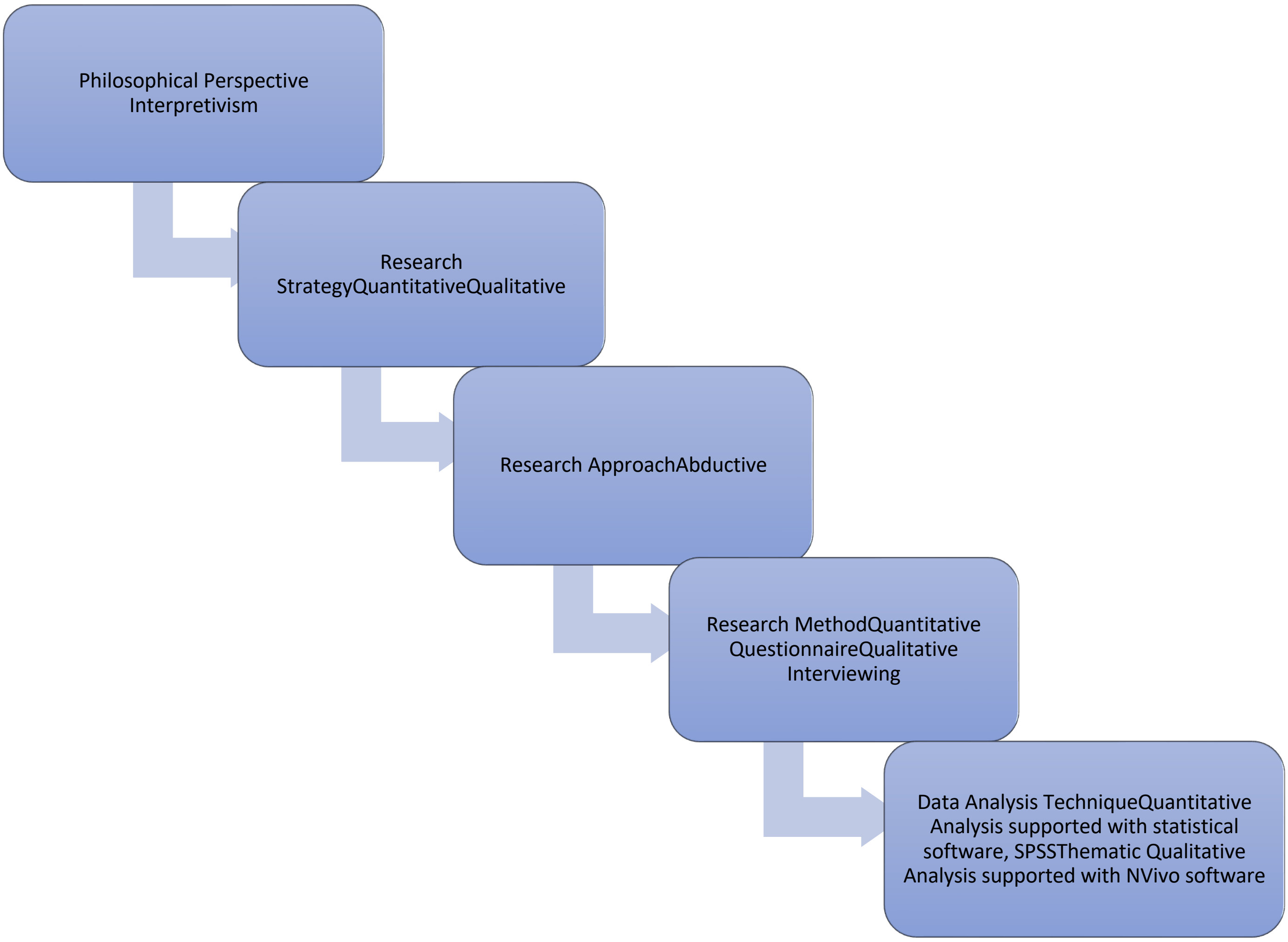

Figure: 3.1 Research Methodology

The chapter begins with an introduction of philosophical issues that arise in research before expanding into the philosophical perspective used in this study, i.e., interpretivism. It then describes the study's research plan, including its research approach, method selection, data collection and analysis procedures, sampling strategy, and ethical considerations.

3.2. Research Design

Based on previous research, it was concluded that this project would require intermediate theoretical research. This type of study requires both qualitative and quantitative data. This form of analysis is referred to as developmental research by Ellis and Levy (2009, p 21), who claims that "developmental research aims to answer the question: How can researchers build a ‘thing’ to address the problem?” The framework is the ‘thing’ that this research intends to create.

Following the identification of research questions in the preceding section, the researcher must create a research design that permits them to be answered and enhance the original framework. “The arrangement of conditions for data collection and analysis in a manner that tries to balance relevance to the study purpose with efficiency in method”, according to Rahi (2017, p 12). He also mentioned the following crucial characteristics of a study design:

- It is a strategy that identifies the sources and types of data relevant to the research question.
- It is a strategy that specifies which method will be utilised to collect and analyse data.
- Because most investigations are conducted under these two constraints, it also involves time and budget.

Figure 3.2 shows the research design of this project. It consists of three main stages that are influenced. The research project period is three years, the standard duration for PhD studies. The three stages of the project are discussed in the subsequent sections. The research design process plan is presented in Table 3.2. It starts with a literature review to find the research gap and create the research questions. The quantitative research method is used to identify the critical continuous performance benefits in manufacturing SMEs in northern England. Following the result, quantitative analysis, the result author used the effect to create interview questions. In the next step, quantitative and qualitative analysis were used to establish a research framework. Finally, triangular, and expert panel methods were used to verify the framework. The author planned for more verification via journal articles and future research plans.

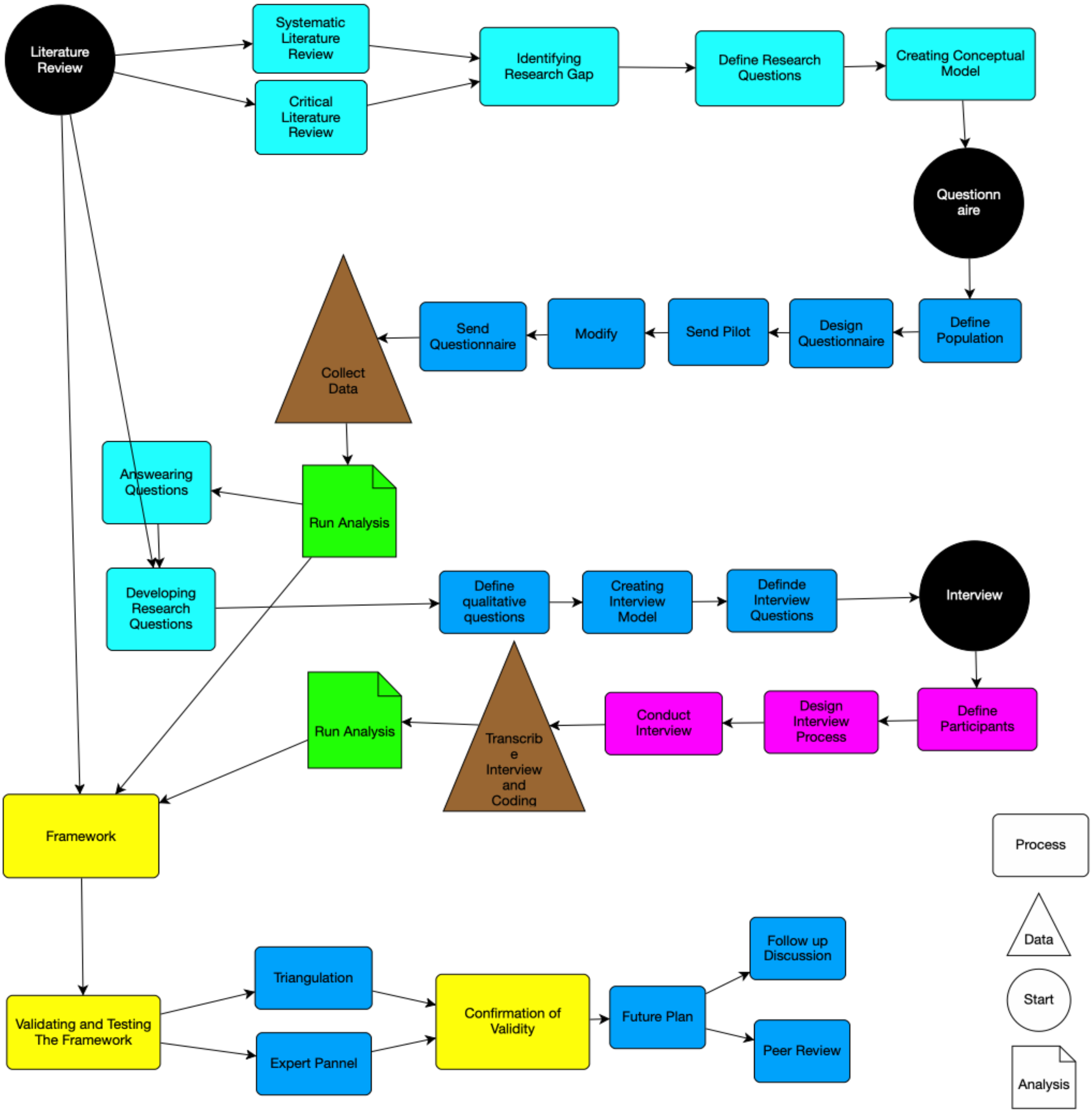

Figure: 3.2 Research Design

3.2.1. Phase 1: Define – a literature review and a survey in academia

The most straightforward and successful technique for establishing a research problem and developing a hypothesis is to conduct a review of relevant literature (Synder, 2019). This is the research's foundation, intending to establish the context and formulate the research problem. In the disciplines of continuous improvement principles, manufacturing SME's economic growth factor, economic growth strategies and economic factors related to continuous improvement implementation impact manufacturing SMEs' economic development, a literature review was done. In this section, the most essential concepts and issues have been highlighted. The literature valuation findings narrowed the study's scope to a few key points. It also contributed to the continued development of the research framework and the preparation of the framework for empirical testing in the study's later stages. Throughout the entire research procedure, the literature review was carried out.

After that, a survey study by a researcher in the field of continuous improvement principles in manufacturing SMEs was addressed to gain insight into the economic growth impact at the macro scale, which had not been discussed in the literature before. This survey aims to assess academics, manufacturing SME managers, and CI consultants' opinions to explore ideas and the critical needs for developing the framework.

3.2.2. Phase 2: Measure/Analyse – a survey in industry and interviews

The empirical tests were carried out in the study's second phase. Primary data was collected in this study to corroborate the literature findings (e.g., the drivers of continuous improvement tools and technique impact in manufacturing SMEs). It was also required to discover answers to problems not addressed in the current literature (e.g., continuous improvement principles' macro impact on manufacturing SMEs' economic growth). A questionnaire was created to collect data from managers in industrial firms, consultants, and experts/academics in the field.

3.2.3. Phase 3: Validity and reliability tests

The validation of the quantitative survey is addressed in the third phase of the research. Four validity and reliability tests are used to ensure that the data is valid and reliable for the purpose for which it was intended.

3.2.4. Phase 4: Measure/Analyse interviews

The data gathered was subsequently coded and statistically analysed. To obtain qualitative data, semi-structured interviews were done with local authorities, manufacturing SMEs' operation managers, CI consultants and academics (academics from operation and quality management fields) throughout the next phase. The framework was to be developed in the second part of the research.

Furthermore, the framework will be evaluated to demonstrate its potential benefits. 'Thought experiments' is the term for this method. The following sections describe the types of data collected and the methods utilised for this research.

3.3. Research philosophy

The philosophical foundation for a study must be explicitly defined (Lyons and Doueck, 2010). The questions of 'What to research?' and 'How to research?' are critical and must be carefully considered by the researcher—considering that researchers' philosophical attitudes and opinions on how research should be conducted impact the research process, it is critical to think about this before starting any research effort (Coates, 2021). According to Pidgeon (2019), developing an understanding of research paradigms is the first and most crucial step in any researcher's journey since this influences data collection, analysis, interpretation, conclusions, and the entire research process.

3.4. Research paradigm

A paradigm is a set of thoughts and beliefs that guides a researcher's work regarding method selection and fundamental ontological and epistemological dimensions. The four main notions embodied by paradigms are ontology, epistemology, axiology, and methodology (Kaushik and Walsh, 2019). According to Lincoln and Guba (1985), a paradigm consists of four elements: epistemology, ontology, methodology, and axiology. It is critical to clearly understand these parts because they include each paradigm's essential assumptions, beliefs, norms, and values.

Consequently, establishing the research proposal within a particular research paradigm implies that research will sustain and be directed by the chosen paradigm's assumptions, beliefs, norms, and values. As a result, the researcher must show that understanding of each of these terms.

3.4.1. Epistemology of a paradigm

Epistemology comes from the Greek word episteme, meaning "knowledge". Simply expressed, epistemology is a term used in the study to describe how the researcher gets to know something, how a researcher comes to know the truth or reality, or, as Cooksey and McDonald (2011) put it, what constitutes knowledge in the world. It is concerned with the very foundations of knowledge, its nature, forms, and acquisition and how it can be transmitted to other humans.

Epistemology study focuses on the nature of human knowledge and comprehension that the researcher, as a researcher or knower, may be able to gain to extend, widen, and deepen understanding in their field of study. It is defined by Schwandt (1997) as the study of the nature of knowledge and justification. As a result, when thinking about the epistemology of the research, it poses questions like: Is knowledge something that can be gained on the one hand or something that must be directly experienced on the other? What is the nature of knowledge, and how do the knower and the would-be known interact? What is the connection between me, the inquirer, and the known? (Cooksey and McDonald, 2011)

3.4.2. Ontology of a paradigm

Ontology is a discipline of philosophy concerned with the assumptions we make to believe that something makes sense or is accurate, as well as the nature or substance of the social phenomenon researcher are looking at (Scotland, 2012). It is the philosophical study of the nature of existence, reality, being, and becoming, as well as the basic categories of existing things and their relationships.

Ontology study is about the assumptions researchers make to believe something makes sense or is genuine or about the nature or essence of the social phenomenon researchers are looking at. It aids in conceptualising reality's form and nature and what researchers believe can be known about it. Ontology is critical to a paradigm since it aids in understanding the things that make up the world as we know it (Scott and Morrison, 2005). It aims to establish the true nature or basic concepts, of the themes we examiners and the meaning embedded in study data.

3.4.3. Axiology of a paradigm

The ethical problems that must be considered while designing a study proposal are referred to as axiology. It examines the philosophical approach to making valuable or correct decisions (Finnis, 1980). It entails identifying, analysing, and comprehending concepts of appropriate and inappropriate behaviour in relation to the research. It evaluates how much weight researchers will give to various parts of our study, such as participants, data, and the audience to whom we will present our findings (Biddle and Schafft, 2015).

Axiology study aims to answer the following question: What is the nature of ethics or ethical behaviour? In answering this question, researchers should think about how they consider the human values of everyone who will be involved in or participate in the research study (Zaidi and Larsen, 2018). The following questions will help researchers to think about it. As the researcher undertakes the research, what values will they live by or be guided by? What should be done to ensure that all participants' rights are respected? What are the moral concerns and features that must be considered? What cultural, intercultural, and ethical difficulties arise, and how will researchers deal with them? (Scott and Morrison, 2005).

3.4.4. Attributes of a research paradigm

In academic research, there are five basic philosophical positions: positivism, interpretivism, critical realism, pragmatism, and postmodernism (Biddle and Schafft, 2015). Table 3.2

provides an overview of these five philosophical views, showing their distinct characteristics, and serves as a framework for justifying this study's interpretivism philosophical approach.

Table 3.2: Attribute of the paradigms (Makombe, 2017; Adapted from Lovett, 2020; Barmeyer et al., 2019; Ryba et al., 2020

Research Philosophy					
Attributes	**Positivism**	**Interpretivism**	**Critical realism**	**Pragmatism**	**Postmodernism**
Ontology: **Assumptions about the nature of reality**	Reality is external, objective with independent actors. Can be understood with appropriate methods.	Subjective in nature; no one truth; instead, many 'truths' dependent on the observer's viewpoint. Different observations can emerge from the study of a single phenomenon.	Stratified/layered (the empirical, the actual and the real) External, independent Intransient Objective structures Causal mechanisms.	Complex, rich, external 'Reality' is the practical consequences of ideas Flux of processes, experiences and practices.	Nominal Complex, rich Socially constructed through power relations Some meanings, interpretations, realities are dominated and silenced by others Flux of processes, experiences, practices.
Epistemology: **Assumptions about the Continued theory of knowledge and ways of**	Objectivism. Focuses on establishing findings as true.	Subjectivist – believes social phenomena are created from the perceptions and actions of social actors and are in a constant state of	Epistemological relativism Knowledge historically situated and transient Facts are social constructions	Practical meaning of knowledge in specific contexts, Focus on problems,	What counts as 'truth' and 'knowledge' is decided by dominant ideologies

Continued **inquiring into the world**		revision; emphasises the interaction between researcher and subject of study.	Historical causal explanation as contribution.	practices and relevance Problem solving and informed future practice as contribution.	Focus on absences, silences and oppressed/ repressed meanings, interpretations and voices.
Methodology: **Defines how the researcher will go about studying the phenomenon of interest**	Mainly quantitative; experimental or manipulative techniques, verification of hypothesis, correlational survey designs and quantitative statistical analysis.	Employs predominantly qualitative methods such as grounded theory, case studies, qualitative interviewing, and ethnography as they are well suited to gaining the perspectives of social actors in their natural settings.	Value-laden research Researcher acknowledges bias by world views, cultural experience and upbringing Researcher tries to minimise bias and errors Researcher is as objective as possible.	Value-driven research Research initiated and sustained by researcher's doubts and beliefs Researcher reflexive.	Value-constituted research Researcher and research embedded in power relations. Some research narratives are repressed and silenced at the expense of others Researcher radically Reflexive.
Methods: **Techniques employed for data collection, analysis etc.**	Uses quantitative research methods; seeks to align social research to scientific research. Experimental designs and	Employs predominantly qualitative methods such as grounded theory, case studies, qualitative interviewing, and ethnography as they are well	Retrodictive, in-depth historically situated analysis of pre-existing structures and emerging agency. Range of	Following research problem and research question.	Typically, deconstructive – reading texts and realities against themselves In-depth investigations of anomalies, silences and absences

	surveys involving large samples to aid with generalisations.	suited to gaining the perspectives of social actors in their natural settings.	methods and data types to fit subject matter.		Range of data types,
Data Collection: **Main data collection techniques employed with each paradigm**	Structured interviews, measurements, self-administered questionnaires with large sample sizes.	Unstructured and semi-structured interviews, focus groups, field notes and diaries with small sample sizes to enable extensive analysis of each case.	Typically, qualitative methods of analysis.	Mixed, multiple, qualitative, quantitative, action research Emphasis on practical solutions and outcomes.	Typically, qualitative methods of analysis.
Data Analysis: **Main data analysis techniques used with each paradigm**	Quantitative methods such as content analysis. Uses statistical tools such as SPSS employing techniques like regression analysis, structural equation modelling (SEM) and multivariate analysis.	Uses analytic induction, grounded analysis, thematic analysis, narrative analysis. Computer Aided Qualitative Data Analysis Software (CAQDAS) also used to facilitate ease of analysis, e.g., NVivo.	Qualitative Data Analysis, used to facilitate ease of analysis. e.g., NVivo, ATLAS.	Can be used with multiple methods.	Qualitative Data Analysis, used to facilitate ease of analysis, e.g., NVivo.

Strengths: **Strengths of each paradigm**	Provides wide coverage of a range of situations; largely value-free; speedy and cost efficient; generalisable.	Focuses on understanding people in their natural settings and seeing social phenomena from their perspectives; ability to investigate change processes over time; adopts a more natural approach to data gathering; has the flexibility to adjust to new issues and ideas as they emerge; can contribute to new theory generation.	Retrodictive, in-depth historically situated analysis of pre-existing structures and emerging agency. Range of methods and data types to fit subject matter.	Perfectly possible to work with different types of knowledge and methods.	Nominal Complex, rich Socially constructed through power relations, Exposure of power relations and challenge of dominant views as contribution.

Weaknesses: **Weaknesses of each paradigm**	Methods are inflexible and artificial; not useful for understanding processes or the significance people attach to them; not suited to theory generation; not useful for inferring future changes.	Data collection can be very time consuming and resource intensive; analysis and interpretation of data can be difficult and is highly dependent on the researcher's knowledge and experience; due to its subjective nature, policy makers may consider the findings to have low credibility; its relative lack of structure makes it feel very untidy as it is much harder for researchers to control their progress.	Cannot be understood independently of the social actors involved.	Likely to incorporate the pragmatist emphasis of practical outcomes.	As power relations cannot be avoided, it is crucial for researchers to be open about their moral and ethical positions, and thus it would strive to be radically reflexive about researcher own thought. Not very descriptive.

3.4.5. Research paradigms and research association

The interpretive paradigm is associated with qualitative research and is frequently viewed as a counterpoint to positivism (Bryman, 2016). It recognises the meanings that human or social actors bring to their acts, distinguishing them from physical objects. As a result, to comprehend social behaviours, the inquirer must first understand the meanings that underpin those actions

(Lincoln & Guba, 2000), going beyond simply learning the actions to comprehend why they are taken.

Interpretivism aims to study social actors in their natural circumstances and understand phenomena from their perspective, allowing for many interpretations of social phenomena. The nature of reality is accepted as subjective in this philosophical viewpoint, emphasising the interaction between the researcher and the research topic in UK manufacturing SMEs.

Because corporate continuous improvement philosophy in manufacturing SMEs is a relatively under-researched field (Panwar et al., 2018; Addis, 2019; Ahokangas et al., 2021), this study took an exploratory approach based on the interpretive paradigm. This allowed the study's goal and objectives to be met and the research questions answered.

The primary goal of this research is to look at the elements that influence UK manufacturing SMEs' corporate continuous improvement behaviour. The interpretive paradigm allows the researcher to see the phenomenon under investigation through the eyes of the subjects and is flexible enough to allow for numerous perspectives on the same phenomenon.

The core idea of positivism, as shown in Table 3.1, is that the social world exists externally and that its features should be measured using objective methods (Easterby-Smith et al., 2012). It encourages the application of scientific methodologies to the study of social reality and beyond (Bryman, 2016). Positivist approaches to research are commonly used to determine cause and effect relationships between variables, operationalise theoretical relationships, measure and quantify phenomena, and generalise findings (Bergman, 1998).

From an ontological standpoint, the exploratory research uses a literature review that clearly follows research objectives. While conducting survey studies, the researcher is an independent observer in the second research phase and was looking for answers for the quality management procedures through manufacturing SMEs. The researcher had no intention of influencing the study's outcome and remained an impartial observer throughout the research process.

In terms of epistemology, the author used a triangulation of phenomenological and positivist paradigms, collecting hard and soft data to achieve the research goal. The epistemological perspective is positivist through the investigation, where a survey was done.

3.5. Research approaches

Social work research is structured and informed by theory. Social work research, on the other hand, structures and informs theory (Sekaran and Bougie, 2019). When researchers investigate the relationships between theory and research in inductive, deductive, and abductive approaches, they become aware of the reciprocal relationship between them. The theory is important in both circumstances, although the link between theory and research varies depending on the technique (Mitchell, 2018).

Furthermore, data analysis approaches are essential because they provide a theoretical foundation for practice. In the literature, three sorts of methods are frequently mentioned.

The approaches to study that are inductive, deductive, and abductive are highly distinct but can also be complementary (Awuzie and McDermott, 2017). All three approaches are concerned with the nature of the link between theory and research, i.e., the role of theory and how it will be applied to the study (Bryman, 2016).

3.5.1. Deductive research approaches

The deduction approach has been well-known as a method of social study, and it is most closely identified with a form of classical and logical positivism (Sekaran and Bougie, 2019). The hypothetico-deductive approach has been associated with deductive logic in its purest form. Based on existing practical and theoretical knowledge, this consists of creating specific hypotheses regarding phenomena in general. The theory is subsequently tested via an experiment (Mitchell, 2018).

The hypothetico-deductive technique is most linked with "the scientific method", but it also underpins desk-based research like meta-analysis and systematic reviews. Deductive logic is criticised for misrepresenting natural scientific procedures and, more importantly, natural science work. Second, it has a built-in logic of confirmability; if researchers search for an association, they will probably find it. Third, it concentrates on the relationship between occurrences without providing the thorough analytical explanation required to prove causation (Conger and Donnellan, 2007).

If the data support the hypothesis, then the hypothesis, and the theory that underpins the hypothesis, can be said to hold in this context; if not, then, assuming that the research was well-designed and rigorously carried out, the hypothesis, and the theory that underlies the hypothesis, can be said not to hold in this context (Woiceshyn and Daellenbach, 2018). The researcher looks at what others have done, reviews existing theories about whatever phenomenon they are exploring, and then puts those theories to the test (Azungah, 2018). Figure 3.3 illustrates the procedures needed in conducting research using a deductive method.

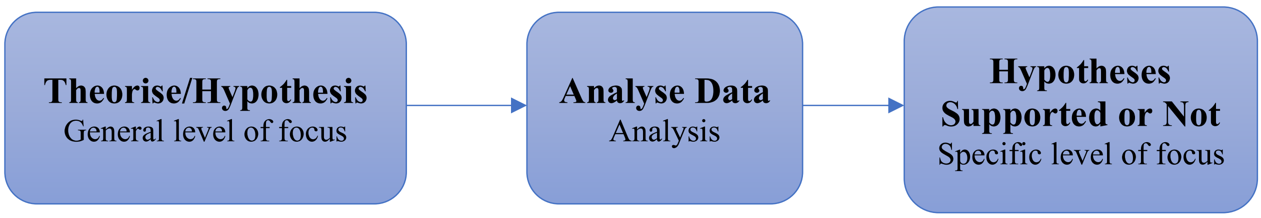

Figure 3.3: Deductive approaches

3.5.2. Inductive research approaches

Induction is the process of drawing a broad conclusion from a set of circumstances or observations. The advantages of an inductive method, as demonstrated in grounded theory, are that it allows for flexibility, tends to focus on context, and encourages the production of new theory (see, for example, the study on social loss) (Eisenhardt et al., 2016).

When researchers use data analysis with an inductive approach, they begin with a set of observations and work their way up to a more general set of propositions regarding those data. Put another way; they go from data to theory or from the specific to the broad. The steps of an inductive research approach are depicted in Figure 3.4.

Figure 3.4: Inductive research

The researchers are assisting in developing theories that will provide knowledge of reality. To provide it, the researcher must make connections between theory and reality. One of the most pressing issues in all studies is connecting theory with reality. The production and testing of theory can be accomplished in a deductive and an inductive approach, as illustrated in Figure 3.5.

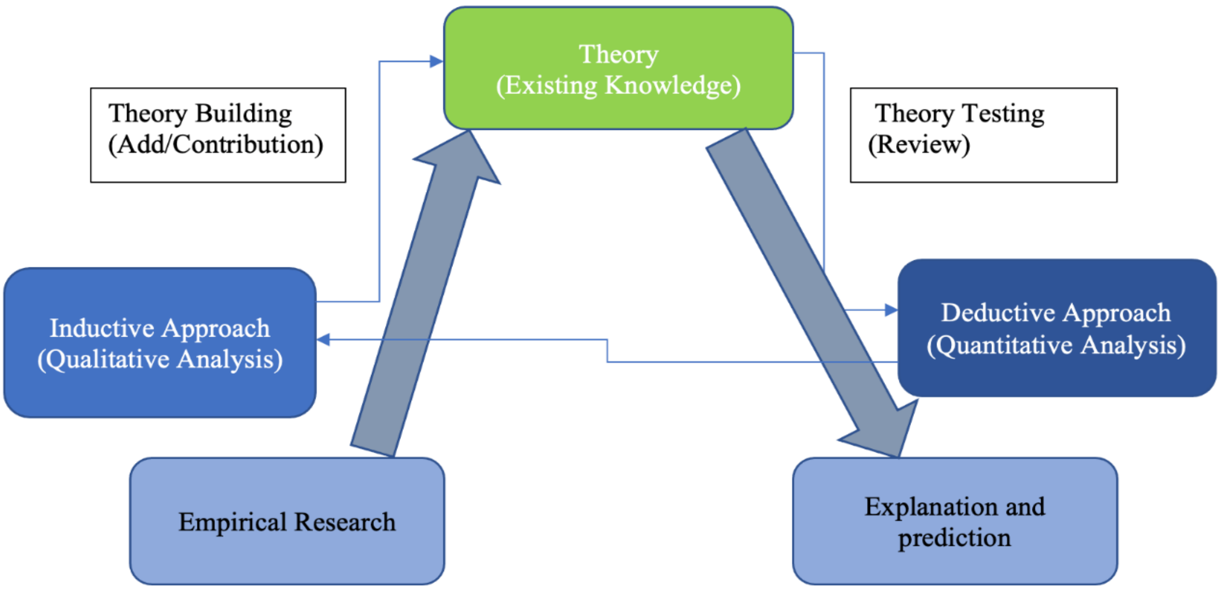

Figure 3.5: Comparison of inductive and deductive research approaches (Adapted from Woiceshyn and Daellenbach, 2018)

Any research has two goals: to develop a theory or test an existing hypothesis. The research method in theory development starts with observations/data collecting and then uses inductive/qualitative reasoning to derive a theory from these observations. The question here is whether the observation is a specific instance of a more general component or if it fits into a pattern or a tale (George, 2019). On the other hand, the theory is a beginning point in the theory testing process, guiding which observations to make from the general to the specific (De Vaus, 2005). Deductive reasoning is used to generate a set of hypotheses that are then evaluated against data obtained using a particular method to prove or disprove the hypotheses, hence accepting or rejecting/altering the existing theory.

3.5.3. Abductive approach

The claims made for an inductive or deductive approach are contested fiercely, but there is increasing recognition that this might not be a choice between one or the other. Instead, research can, and often does, proceed by taking an alternating inductive and deductive perspective with observation leading to hypotheses which are then explored about the data. In practice, interviewees show the flexibility associated with an abductive approach whatever their explicit particular views on research and social theory (Graneheim et al., 2017).

The nature of abductive research, unlike inductive and deductive reasoning, means it can explain, develop, or replace the theoretical framework before, during, or after the investigation (Dubois and Gadde, 2002). Abductive research alternates between inductive and open-ended research settings and more hypothetical and deductive approaches to test hypotheses. Abductive reasoning, as shown in Dubois and Gadde's model below (Figure 3.6), is a practical method for improving the social sciences through a process of "systematic combining" in academic research (Dubois and Gadde, 2002; Friedrichs and Kratochwil, 2009).

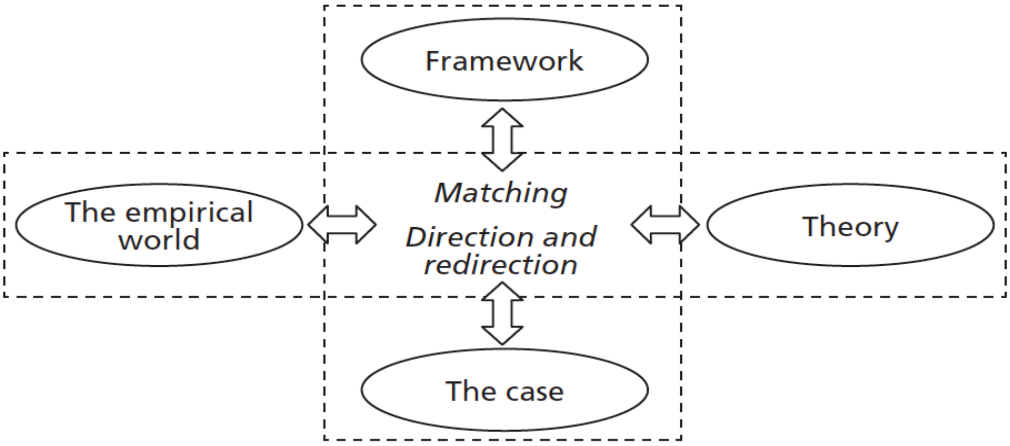

Figure 3.6: Abductive reasoning (Dubois and Gadde, 2002)

The deductive strategy is best suited for research that follows the positivist paradigm, but the inductive approach can be used to construct reality following the phenomenological paradigm socially. However, commenting on whether a paradigm is preferable is not suggested, as researchers may fall into the trap of believing that one research approach is "better than the other". In many fields of social science research, combining inductive and deductive methodologies in a single study is widely performed and approved (Saunders et al., 2009; Antwi and Hamza, 2015; Natow, 2020).

The potential effectiveness of multiple methods for this research can be attributed to at least two reasons. The first argument is that using different methods helps to overcome the limitations of any single research method. The second reason is that multi-method research involves more than two distinct approaches (usually a quantitative and a qualitative method) throughout the study.

Triangulation is the employment of multiple research approaches, methods, and procedures in the same study to overcome the bias and sterility of a single scientific course (Collis and Hussey, 2003). According to Denzin (2000), using many approaches to explore the same phenomenon by several researchers will result in more validity and reliability than using a single scientific method if the results are the same. For those factors mentioned in the above section, the author used an abductive process to review existing knowledge and theory and used the result to investigate and analyse the empirical data for more profound findings and to create a reliable framework (Figure 3.5).

3.6. Research Strategy

Research strategy refers to a general orientation to the conduct of business research (Bell et al., 2018). Research strategy is a systematic and orderly approach taken toward collecting and analysing data so that information can be obtained to answer the research questions posed by the researcher (Jankowicz, 2005).

Research strategy is classified at two levels – level 1 takes into consideration quantitative and qualitative research (Bell and Bryman, 2007); and level 2 forms the distinctive cluster of strategies such as experiments, surveys, case studies, ethnography, grounded theory, and action research (Saunders et al., 2009). The following data analysis tools are used in this study to analyse both quantitative and qualitative data.

3.6.1. Quantitative data

Quantitative refers to quantity or amounts. Quantitative research, according to Perl and Noldon (2000), assumes a value-free or objective process for arriving at generalisations. Many surveys aim to investigate the characteristics of a specific group of people. When researching data, survey research designs are frequently employed to answer questions pertaining to attributes. As with any new study involving human subjects, the data acquire depends on the respondents' willingness to submit correct information.

Quantitative strategy approaches are generally used in supporting project evaluation and selections, according to Thamhain (2014), if the decisions require economic rationale. They are widely applied to back up judgment-based choices. The production of numeric measures for simple and effective comparison, ranking, and selection is one feature of quantitative techniques.According to Fassinger and Morrow (2013), a quantitative technique can give large representative samples of cultural communities, assert cause and effect links, and test or disprove theories. A quantitative method can also summarise numerical facts clearly and appealingly for leaders and policymakers.

3.6.2. Qualitative data

According to Isaacs (2014), a qualitative research approach allows researchers to investigate social and behavioural demands. It has various applications, including analysing social, cultural, economic, and political issues, examining group relationships, and studying people and their communities. Qualitative research can be a valuable resource for policymakers and practitioners. It can help collect a large amount of data fast and cost-effectively, and the results can be generalised (Sallee and Flood, 2012).

Hancock et al. (2021) are interested in finding out how to explain social phenomena. Qualitative research, according to them, tries to comprehend the world we live in and why things are the way they are. It is concerned with the social aspects of our world. It seeks to answer questions such as why people act the way they do, how opinions and attitudes are formed, how people are affected by events in their environment, how and why cultures have developed in the way they have, and the differences between social groups.

3.6.3. Mixed methods

Thamhain (2014) and Fassinger and Morrow (2013) proposed a blended strategy employing qualitative and quantitative methodologies to support research projects. Mixed methods research involves using more than one research approach and working with various data (Brannen, 2005). The methods used were questionnaires and semi-structured interviews.

Mixed methods studies are frequently employed jointly to acquire quantitative and qualitative data (Harris and Brown, 2010).

Both strategies have their own set of advantages and disadvantages. Questionnaires can be well-structured and specific, and their validity and reliability can be checked. They can, however, be disconnected from the fundamental issue. Semi-structured interviews may or may not have some of the characteristics of questionnaires. As a result, they are less particular and precise. On the other hand, interviews can provide information about personal sentiments, thoughts, and ideas, which can be helpful when researching new topics. Mackey and Bryfonski (2018) find that both methodologies are necessary for a complete picture of phenomena to be painted.

The two approaches of questionnaires and interviews will be used to produce empirical data, i.e., data based on real-world observations or experiments that may realistically represent the problems under research. Empirical methods carry considerable risk because they rely on respondents' willingness to participate and provide correct data. They also require time and financial resources, which raises a risk because repeating data gathering would be prohibitively expensive, in contrast to other methods such as mathematical modelling and simulation, which are regarded as "safer" to carry out.

3.6.4. Choice and rationale for research methods

As previously stated, the nature of this investigation prompted the use of a mixed methods approach. Edmondson and McManus (2007) indicate that qualitative illustration is essential to corroborate quantitative findings to offer credibility to newly generated measures in intermediate research. The mixed-method study presented more phenomena from various perspectives, which led to gaining and improving the ability to collect and analyse questionnaire and interview data (Mikalef et al., 2019).

On a more philosophical level, mixed methods research combines paradigms, allowing inquiry from both inductive and deductive perspectives, enabling researchers to connect theory generation and hypothesis testing within a single study (Stern et al., 2020). It serves three primary purposes: to enhance validity, generate a more in-depth picture of a research topic and evidence, and explore different approaches to comprehending a research challenge. Additionally, triangulation can be utilised to strengthen the findings.

In addition to aiding in developing researchers' skills, the requirement to apply various methods is particularly important for those early in their careers.

The advantages of using questionnaires and interviews to collect quantitative and qualitative data are that the advantages of the other can address the disadvantages of one approach. Another factor influencing the researcher’s decision to use mixed techniques as a study strategy is that mixed methods research offers the opportunity to gain and improve abilities in collecting and analysing questionnaire and interview data (Brannen, 2005). Second, mixed methods research supports diverse perspectives and thus helps in the exploration of phenomena from multiple perspectives (Brannen, 2005). However, it requires time and financial resources, which increases the risk because repeated data collection would be extremely expensive, unlike other methods such as mathematical modelling and simulation (Creswell, 2013).

In terms of the order in which the methodologies are utilised, the research design can use either a simultaneous design, in which surveys and interviews are conducted simultaneously or a sequential design, in which one approach is followed by the other (Brannen, 2005).

The explanatory sequence, consisting of a series of questionnaires followed by interviews, was the best fit for this study. Explanatory sequential mixed methods research, as defined by Creswell (2013, P 22), is “one in which the researcher first conducts quantitative research, analyses the results, and then builds on the results to explain them in more detail with qualitative research”, and it is recommended for research fields with a quantitative orientation, such as the field in this study.

Furthermore, conducting the questionnaire first aids in identifying organisations that may be able to provide more thorough information during interviews. Finally, doing interviews later allows the researcher to get a thorough knowledge of the research problem (Figure 3.5), resulting in more fruitful conversations during the interviews. Considering the above advantages and disadvantages of using mixed methods and the rationale for choosing the appropriate strategy, the mixed methods strategy was applied for this study.

3.7. Data collection methods

As indicated in the previous section, the current study aims to collect data from various sources to examine the framework given in this study from multiple viewpoints to evolve it properly. Because the available literature could not answer some of the research questions, primary data was required to fill in the gaps in knowledge. Preliminary data was gathered through surveys of academics, industry, and local authorities, as well as semi-structured interviews. This section describes the steps involved in collecting data.

3.7.1. Quantitative and qualitative data collection

Despite its several advantages, there is a challenge in conducting mixed methods research. The main issues were of time and resources required to collect and analyse the qualitative and quantitative data and training the researcher to have a good understanding of both methods of data collection (Creswell et al., 2007; Phillippi and Lauderdale, 2018).

A quantitative research strategy (survey) was used to triangulate with and facilitate the qualitative research. The author collected data in the first phase using a survey instrument and followed up with interviews in the second phase to investigate the phenomenon of interest in-depth.

3.7.1.1. Survey of manufacturing SMEs

The views and insights of manufacturing SMEs in the field of CI in manufacturing were explored as part of the research design. A survey was undertaken with the primary goal of obtaining insight from manufacturing SMEs in northern England on the planned continuous improvement philosophy to obtain economic advantages and test the validity of various components of the research.

3.7.1.1.1. Types of survey research

Three types of survey research have previously been used to produce theory, test theory, or refine an existing theory (Forza, 2002; Andres, 2012; George, 2019). The first is an 'exploratory survey', in which the goal is to better understand the phenomenon of interest by gathering preliminary insight and laying the groundwork for a more in-depth investigation. The information collected could be utilised to discover new possibilities and dimensions of interest, along with proof of conceptual association. Another type of survey study is the 'descriptive survey', which aims to describe the distribution of a phenomenon in a population and establish facts. Hypotheses relating to common perceptions or changes through time are generated and examined, providing important insights for theory creation and refining (Malhotra and Grover, 1998; Forza, 2002; George, 2019). Other critical differences between the three types of survey research are presented in Table 3.3.

Table 3.3: Critical differences in the three types of survey research (Forza, 2002)

Survey Types			
Survey Type Element/Dimensions	**Exploratory**	**Descriptive**	**Explanatory**
Unit(s) of analysis	Clearly defined	Clearly defined and appropriate for the	Clearly defined and appropriate for the research questions/ hypotheses

		research questions/hypotheses	
Respondents	Representative of the unit of analysis	Representative of the unit of analysis	Representative of the unit of analysis
Research Hypothesis	Not necessary	Questions clearly stated	Hypotheses clearly stated and theoretically motivated
Representativeness of sample frame	Approximation	Explicit and logical argument to choose among alternatives	Explicit and logical argument to choose among alternatives
Representativeness of the sample	Not a criterion	Systematic, purposive, random selection	Systematic, purposive, random selection
Sample size	Sufficient to include the range of the interest phenomena	Sufficient to represent the population and conduct statistical analysis	Sufficient to test categories in the theoretical framework with statistical power
Pre-test of questionnaires	With sub-sample of the sample	With sub-sample of the sample	With sub-sample of the sample
Response rate	No minimum	Greater than 50% of targeted population and study of bias	Greater than 50% of targeted population
Data triangulation	Multiple methods	Not necessary	Multiple methods

For this research, an exploratory survey was used in the first phase to assess the CI practices in UK manufacturing SMEs and to identify the key CI principles that have influenced their economic situation. The exploratory survey was the ideal technique to learn about essential CI practices in manufacturing SMEs and reveal new aspects of the research issue. As mentioned in Section 3.6.3, this study used a mixed methods approach. A survey (quantitative) was the initial step in the research plan, followed by interview studies (qualitative) to address the research questions.

3.7.2. Defining the population

The survey was addressed to manufacturing SME managers, academics, CI consultants based in northern England. A search was done to find manufacturing SMEs in northern England. London Stock Exchange Group (LSEG), UK Small Business Directory, online profiles of every UK business registered with Companies House (the Gazette) and other variations of search terms were used to find contacts such as UK manufacturing SMEs and Northern England continuous improvement groups on LinkedIn. There was a total of 800 manufacturing SMEs found within a variety of industry sectors.

3.7.3. Designing the questionnaire

The survey instrument was created using a questionnaire used in the published literature of leading CI practitioners and academics (Antony et al., 2007; Jurburg et al., 2017; Tortorella et al., 2021) and a brainstorming session with several CI professionals and academics within the UK, who were familiar with continuous improvement and other quality and operation management philosophies such as Lean and Lean Six Sigma methodologies.

To increase the response rate, the first concern in constructing the questionnaire was to keep it simple and brief. The questions in the sequence moved from simple to more detailed. The majority of questions were designed under a seven-point numerical scoring system from 1 (extremely low) to 7 (extremely high). This was done to encourage participation by making it easier and faster to select a favourite solution (Krosnick, 2018). Each question included a space for comments in order to obtain extra qualitative feedback.

The survey questionnaire was divided into three sections. Section one included demographic questions related to the type of position and field of work, size of the firm: key CI methodologies practical experience (Lean and Six Sigma), qualifications, type of manufacturing industry.

The questions in the second section included information on 23 critical success factors of continuous improvement (CI) identified from the existing literature on continuous improvement implementation in manufacturing SMEs (Singh and Singh, 2015; McLean et al., 2017; Kumar et al., 2018; Gutierrez-Gutierrez and Antony, 2019; Janjić et al., 2020). The important factors listed in the CI study and Table 3.3 were extracted and incorporated in the survey instrument. The purpose of this section was firstly to identify the importance of core benefit objectives (CBOs) in achieving the successful implementation of continuous performance improvement projects. CBOs were scored on a Likert scale of 1-7, with 1 being not important to 7 being very important. The CBO findings facilitated in the identification of a gap in the participating manufacturing SMEs with respect to the importance and implementation level of CBOs. The intention was also to test the difference in scoring of CBOs when compared across the variables in manufacturing SMEs.

Table 3.4: Continuous improvement core benefits in manufacturing SMEs (Singh and Singh, 2015; McLean et al., 2017; Kumar et al., 2018; Gutierrez-Gutierrez and Antony., 2019; Janjić et al., 2020

Number	Continuous improvement benefits
1	Increased business efficiency
2	Reduced product/service quality variation
3	Increased creativity
4	More resilience to operational risks
5	Responsiveness to opportunities
6	Ability to deal with obstacles
7	Increased job opportunities
8	Increased performance management
9	Better human resource and career development
10	Increased job security

11	More employee engagement and empowerment
12	Better internal communication
13	Increased business net profit
14	Optimised productivity
15	Increased organisational adaptability to change
16	Increased capability for economic growth
17	Optimised supply chain management
18	Better product/service pricing
19	Increased economic stability
20	Increased reputation
21	Enhanced competitive advantage
22	Developed unique product/service
23	Adaptation to new initiative

The second question in this section included information on 14 continuous improvement principles identified from the existing literature on continuous improvement philosophy implementation in manufacturing SMEs (Singh and Singh, 2015; Aleu and Van Aken, 2016; Zhou, 2016; Carnerud et al., 2018) (Table 3.5) to identify the importance of continuous improvement principals for northern manufacturing SMEs. The continuous improvement principles findings facilitated in identification of a gap in the participating SMEs with respect to the importance and implementation level of CI principles.

Table 3.5: Continuous performance improvement principles in manufacturing SMEs (Singh and Singh, 2015; Aleu and Van Aken, 2016; Zhou, 2016; Carnerud et al., 2018)

Number	Continuous improvement principles
1	Strategic project selection

2	Change management
3	Saving business process time
4	Continuous data and information collection
5	Top management commitment
6	Employee engagement and empowerment
7	Training and education
8	Culture of collegiality
9	Gradual movement to quality perfection
10	Enthusiasm towards achieving goals
11	Respect to people
12	Team working
13	Knowledge sharing
14	Resources availability (e.g., time, staff)

The final section included information of the difference in scoring of CI benefits and principles when compared across the control variables of the industry sector.

3.7.4. Sampling framework

Any research project's sampling strategy must be carefully considered during the design stage. Because it is uncommon to investigate an entire community in a single study, it is necessary to pick a sample from that population. A sample is a portion of a population that has been segmented for research purposes and from which conclusions are formed based on evidence (Easterby-Smith et al., 2012; Bryman 2016).

Probabilistic sampling and purposive sample are the two basic types of sampling used in research (Bryman, 2016). Quantitative research designs tend to favour probabilistic sampling procedures, whereas qualitative research favours purposive sampling strategies. The goal of probabilistic sampling is to choose a sample that is representative of the entire population so that the final results can be generalised. Random Sampling, Systematic Sampling, Stratified Random Sampling, and Multi-stage Random Sampling are some examples of probabilistic sampling procedures (Bryman, 2016). Convenience sampling and quota sampling are two types of non-probabilistic sampling that are used in quantitative research.

Purposive sampling, on the other hand, is not founded on the concept of representativeness because it does not seek to generalise, but rather on the sample being appropriate for the study's objective (Bryman, 2016). Theoretical Sampling, Generic Purposive Sampling, and Snowball Sampling are three types of purposive sampling procedures outlined by Bell et al. (2018). Theoretical sampling involves choosing samples based on their relevance to the researcher's theory development, whereas snowball sampling is a type of convenience sampling in which the researcher contacts respondents who are relevant to the research topic and then uses them to contact others who are similar. The generic purposive sampling approach entails choosing samples based on their relevance to the study's research issue (Bell et al., 2018).

The generic purposive sampling strategy is used in this study since it is most suited to the circumstances. Purposive sampling is the term used to describe the sample approach that was used in this study. The samples were drawn from the population of manufacturing SMEs because the study's focus is on the factors that influence their corporate economic improvement and sustainability business behaviour. Participants were specifically sought from manufacturing SMEs in northern England.

According to the European Commission's definition (Berisha and Pula, 2015), SMEs are firms with between 1 and 249 employees. Owner/managers from the SMEs accessed were interviewed because research has shown that SMEs are run primarily in accordance with the norms, attitudes, and beliefs of their owner/managers, and that owner/managers have a strong influence on decision-making (Chassé and Courrent, 2018; Rasheed and Siddiqui, 2019).

This proliferation has resulted from the region's manufacturing SMEs' continuous economic expansion, giving a relevant sample for this study.

3.7.5. Administering the questionnaire

Because of the multidisciplinary character of continuous improvement research, as well as to assure the validity of responses, it was necessary to tailor the questionnaire to people who already know and comprehend the concepts at hand. As a result, the prospective sample was reduced to only individuals with manufacturing, operations management and continuous improvement consultants' backgrounds, degrees, and experience.

As this research topic focuses on manufacturing SMEs in northern England, all participant manufacturing SMEs geographical contacts were limited to northern areas including Humber, Northeast, Cumbria, Lancashire, Great Manchester, Liverpool, and Yorkshire. They have been targeted from mainly eight different industries including automotive, machinery, chemical, pharmaceutical, food and beverages, energy, construction, semiconductor, and textile.

The final question is the only one that is totally qualitative and has no options. Such qualitative questions provide useful qualitative insights; nevertheless, they run the danger of being skipped, and if used too frequently, respondents may abandon the survey. Three academic researchers and two CI professionals were sent a pilot questionnaire, and their feedback was used to enhance the phrasing of the questions. Appendix A contains the questions and their accompanying options.

Because the target audience can all be contacted directly via email, which is faster and more reliable than other methods such as fax or post, an internet-based questionnaire was chosen as the best technique for administering the questionnaire.

The questionnaire was administered using Qualtrics, which is a free online survey software programme. The amended questionnaire was delivered to the targeted group after getting replies from the three pilot respondents. Fifty-five people answered in the first week, while the rest did so after the third reminder. There were no more responses after the third reminder. A sample of questionnaire is included in Appendix I.

3.7.6. Response rate

The targeted manufacturing SMEs were emailed invitations to participate in the survey, which were followed by two reminders at two-weekly intervals, resulting in a total of 176 responses. Because it comprises 22% of the target population, the sample is representative, this represents a highly satisfactory response (Hart, 1987). Other details related to the survey response are presented in Table 3.6 Of the participating firms' response, 2.8% (23) was not included for analysis due to incomplete filling in of the questionnaire or not fitting within the definition of SMEs, i.e., having more than 250 employees, thus failing to qualify within the manufacturing SMEs category.

Table 3.6: Key facts from survey response

Survey response key facts	
Quality initiative in survey participants	**Key fact from survey response**
Completed and usable responses	176
Unusable responses	23
Wrong address/contact details	52
Declined to participate	35
No response	514
Total	800

In total, 514 manufacturing SMEs did not response to participate in the survey. In a survey, it is also crucial to look at the non-responses to see whether they are different from the respondents, which could lead to bias in the results (Forza, 2002; Peters, 2015). Nonrespondents can therefore limit the generalisability of results. Eight firms from the non-respondent list were randomly selected and contacted by telephone to identify the reasons for their non-participation. Five firms had a company policy of not participating in surveys and the rest of the manufacturing SMEs did not participate due to work pressure and limited time to respond to a survey. However, none of the manufacturing SMEs had any objections about the content of the questionnaire. Finally, no differences were observed in the characteristics of participating and non-participating manufacturing SMEs in the survey, which limited the biasness creeping into the analysis and results.

The sample is also stratified, which means it represents different layers of the population fairly and questionnaires were completed by companies with different manufacturing and engineering backgrounds with different levels of experience in continuous performance improvement projects.

3.7.7. Interview

The second step of the research, as stated in the methodology section, entails collecting empirical data from SME manufacturing managers, CI experts and practitioners and CI academics through interviews. Empirical evidence was required for this study to move forward and verify the information obtained through the literature review and academic survey, as well as to acquire new data linked to the framework's design. The information obtained from the data was meant to be as follows:

- To explore the participants' perceptions of core continuous improvement principles which have positive impact on manufacturing SMEs economic level and the possibilities for the suggestion of improving the framework.
- To determine the variables that underpin the drivers of continuous improvement manufacturing to improve economic growth factors based on the data collected.

- To determine the feasibility of implementation of CI philosophy at the macro scale in manufacturing SMEs.
- To determine the broad characteristics of sustainable manufacturing.

3.7.7.1. Selection of participants

Initially, the interviews were limited to manufacturing SME operation managers, local authorities, CI consultants and CI academics that replied to an industry survey. Because some information about these businesses was already known, the interviews were narrowed down. Furthermore, choosing from this group enhanced the possibility of accepting the interview invitation. The following list explains the characteristics of the interviewees that were targeted:

1. Managers in manufacturing SMEs (only for companies)
2. Located in northern England (applied for all interviewers)
3. Have knowledge of CI philosophy (applied for all except local authority)
4. Have experience in CI implementation (applied for all except local authority)

Purposive sampling is a sort of sampling in which participants are chosen based on "predetermined criteria related to a specific study purpose" (Etikan et al., 2016, P34). The survey data was used to create a list of 70 manufacturing SMEs, CI consultant, authorities and academics that represent a ranked purposive sample. To identify the manufacturing SME managers and CI professional participants, the author searched the leading northern manufacturing SMEs on the questionnaire database who were willing to contribute to an interview. In addition, local northern England authorities including members of parliament (MP) and local enterprise partnership (LEP) members were identified from local government websites. And for academics, the author searched on Google Scholar and Northumbria University Library and then the leading academic author with highest academic publication in field of CI philosophy identified and categorised. The author sent them an email which contained an abstract of the research purpose and interview outline six months in advanced to obtain an interview. Only 25, however, accepted the invitation to interview and finally 18 attended interviews. The next section addresses the number of interviews required in research projects in order to decide whether they are sufficient for this study.

3.7.7.2. Determining the number of interviews required

The interviewing procedure began with all participants who accepted the invitation, as this number appeared acceptable based on the preceding discussion and because this research is phenomenological research to investigate a phenomenon. However, while the interviews were being conducted, a search for new participants from beyond the initial list began in order to boost the sample size as a cautionary measure to ensure that saturation was reached. As a result, three further interviews were acquired, bringing the total number of interviews to 18. After the first 16 interviews, though, the saturation threshold was achieved. Table 3.7 provides additional background about the participants.

Table 3.7: Interviewee information

Code	Position	Type
L1	Member of Parliament (MPs)	Local Authority
L2	Knowledge Development Manager/Local Enterprise Partnership (LEP)	Local Authority
L3	Head of Business and Innovation	Local Authority
L4	Chair of the North East LEP and Pro Vice Chancellor	Local Authority
A5	Professor/Consultant	Academic
A6	Small Business Charter member/Lecturer	Academic
A7	Project manager/Small Business Charter member	Academic
A8	Professor/Consultant	Academic
C9	Director/LSS Consultant	Consultant
C10	Director/CI Consultant	Consultant
C11	Director Manager/Transform manager	Consultant
C12	Director/ CI Consultant Manager	Consultant
C13	Senior/Lean Consultant	Consultant
M14	Production Manager/CI manager	Manufacturing SME Manager
M15	Quality Manager/CI manager	Manufacturing SME Manager
M16	Director/CI Consultant	Manufacturing SME Manager
M17	Financial Performance Manager	Manufacturing SME Manager
M18	Education Enterprise Advisor	Manufacturing SME Manager

3.7.7.3. Interview protocol

Creswell (2013) advised creating an interview protocol to ensure that consistent procedures are followed from one interview to the next. The interview protocol for this study consisted of the following elements:

- An invitation letter of gratitude for accepting the interview invitation.
- A consent document for the interviewee to sign.
- The form used to agree to audiotaping is a typical university paper.
- The participant is assured of confidentiality and has the option to withdraw from the study at any time.
- There is a spoken introduction to the study and its aim and objectives.
- The questions.
- Taking notes.

Appendix II contains the consent form, an invitation, a brief introduction, and interview questions.

Easterby-Smith et al. (2012) and Moser and Korstjens (2018) argue that interviews are the ideal way to collect in-depth data in a short amount of time. The interview may take a structured format with specific questions for the interviewee, or it may take a semi-structured, open-ended format to allow interviewees to expand on the topics they consider important and frame those issues in their own terms to open up new lines of inquiry, depending on the purpose of the research (Whiting, 2008; Adams, 2015).

Table 3.8: shows the important distinctions between structured and semi structured/unstructured interviews (Whiting, 2008; Adams, 2015)

Structured interviews	**Semi-structured/unstructured interviews**
Standardised pre-prepared questions to impose a structure	Flexible framework to open new lines of enquiry
Easier to time and control the interview	More time consuming and chances to digress away from the topic of interest
Suitable for less experienced interviewer	Need for experienced interviewer who can hold an interesting conversation during the interview
Comparable data	Can be difficult to compare the results
Difficult to follow-up point of interest or emerging themes	New points or emerging themes are followed up

Multiple case studies were conducted in the selected manufacturing SMEs using semi-structured interviews (at the company site) as the primary data collection method. The interview strategy model provided in Appendix II.

3.7.7.4. Interview questions and themes

To create qualitative interviews questions based on the literature review and findings from the questionnaire, continuous improvement critical factors that ranked highly and were indicated in the quantitative survey analysis including efficiency, supply chain management and productivity were considered in the design of interview questions. The following four questions were designed to investigate the interview data.

RQ 1: How are continuous improvement critical factors important for northern manufacturing SMEs?

RQ 2: Why are continuous improvement critical factors_important for northern manufacturing SMEs?

RQ 3: How feasible is continuous improvement for promoting in northern manufacturing SMEs? (In macro scale projects like the Northern Powerhouse project).

RQ 4: What are the potentials (region potentials), barriers (cost, time etc), challenges (professional staff availability, knowledge transfer, resilience etc) and requirements (local authority policy, financial support, long term, and strategic plan in government body (local enterprise partnerships (LEPs) etc) for continuous improvement projects in northern England?

The research questions and findings from the first phase of the study aided in the development of the interview protocol (with established themes) for conducting semi-structured interviews in the qualitative data collection procedures, and the theme identified for interview (Adams, 2015).

The focus of the interview theme was on feasibility of CI initiatives and influential factors that were identified in quantitative analysis. The factors identified were supply chain management, productivity, and efficiency that have the highest rank in the quantitative analysis. The detail of interview question themes is presented in Figure 3.7.

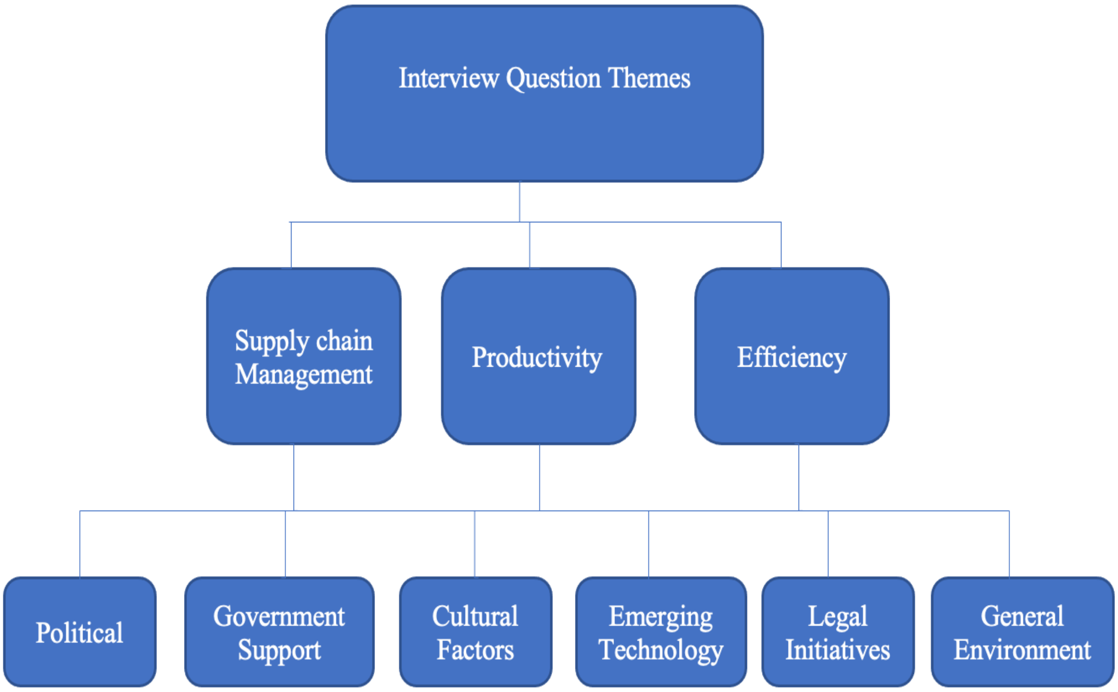

Figure 3.7: interview question themes

The aim and objective of the interview questions was to outline the feasibility of CI initiatives to manage core influential factors of northern manufacturing SMEs. As the interview procedure was a semi-structured method, interviewees have an opportunity to add their thoughts about other important factors. In addition to each question, interviewees were encouraged and motivated by the author to present CI implementation benefits and challenges and what can be done to motivate northern manufacturing SMEs.

3.8. Data measurement systems

The data collected was utilised to evaluate the framework's continuous improvement principles for manufacturing SMEs. Also, the data collected was employed to evaluate the framework's applicability for the research's aims and objectives. This chapter explains how the data was analysed and what findings were discovered as a result of the procedure.

3.8.1. Data validity test

The Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measures were used to assess the appropriateness of the sample size. First, the Bartlett's test of sphericity is used as a measure of data appropriateness (Sutrisno and Ardyan, 2020).

The result tables of both economic growth and continuous improvement factors show that the value of the Bartlett's test of (Sig.) 0.0 ($p < 0.001$) which indicates the appropriateness of the data sample size in terms of validity. The KMO measure of sample adequacy of the economic growth factors and continuous improvement principles are calculated, and the value was 0.975 and 0.974 respectively which is above the commonly suggested threshold of 0.6 (Jena and Sahoo, 2014). Both measures indicate the appropriateness of the sample size. KMO and Bartlett's test for the economic growth factors data in manufacturing SMEs are presented in Table 3.9.

Table 3.9: KMO and Bartlett's Test for the economic growth

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.975
Bartlett's Test of Sphericity	Approx. Chi-Square	4734.286
	df	91
	Sig.	0.000

KMO and Bartlett's test for continuous improvement factors in manufacturing SMEs are presented in Table 3.10.

Table 3.10: KMO and Bartlett's test for CI factors

KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.974
Bartlett's Test of Sphericity	Approx. Chi-Square	5480.616
	df	253
	Sig.	0.000

3.8.2. Data reliability test

The validity and reliability of the survey questionnaire data need to be examined and tested; therefore, the Cronbach's Alpha data was run in SPSS software. Internal consistency reliability is how Benders et al. (2017) describe this approach. A set of variables that are meaningfully correlated and measure the same thing and "the standard statistical approach to reliability is to assume that individual items (or sets of items) should give results that are consistent with the overall questionnaire" (Taber, 2018, P9).

The test was run on both CI principles and economic growth factors. Tables 3.11 and 3.12 show the Cronbach's Alpha for both objectives.

Table 3.11: Data reliability for CI principles

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	176	100.0
	Excluded[a]	0	.0
	Total	176	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.983	23

Table 3.12: Data reliability for economic growth factors

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	176	100.0
	Excluded[a]	0	.0
	Total	176	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.991	14

Cronbach's Alpha, a common internal consistency test, was employed to assess the questionnaire's reliability (Bujang et al., 2018). Field (2009) recommends breaking the questionnaire into sections to test distinct constructs individually and claims that an acceptable alpha level is more than 0.7. The consistency of the Cronbach alpha coefficient was measured, and the value of economic growth factors (N of Items 23) and continuous improvement principles (N of Items 14) was 0.983 and 0.991. Based on these results, the data was considered consistent.

3.8.3. Data normality test

In statistics, Levene's homogeneity test is an inferential statistic that is used to determine whether two or more groups' variances are equal (Parra-Frutas, 2013). The variances of the populations from which various samples are obtained are assumed to be equal in several standard statistical procedures. This assumption is evaluated using Levene's test. It examines the null hypothesis that the variances in the population are equal. The obtained disparities in sample variances are unlikely to have occurred based on random sampling from a population with equal variances if the resulting p-value of Levene's test is less than some significance level (usually 0.05) (Kim and Cribbie, 2018). As a result, the null hypothesis of equal variances is rejected, and it is concluded that there is a difference between the variances in the population. The survey questionnaire attracted responses in between one and three months. The questionnaire data was segregated into categories to check whether there is any difference between them as follow.

- Early responses – first two months
- Late responses – last month

Therefore, the data homogeneity needs to be analysing for validity and reliability. Table 3.13 shows the SPSS analysis for the questionnaire data.

Table 3.13: Test of data homogeneity of variances

Test of homogeneity of variances					
CI Factors		**Leven Statistic**	**df1**	**df2**	**Sig.**
Increased business efficiency	Based on mean	0.586	1	174	0.445
	Based on median	1.026	1	174	0.313
	Based on median and with adjusted df	1.026	1	129.249	0.313
	Based on trimmed mean	0.441	1	174	0.508
Reduced product and service quality variation	Based on mean	0.832	1	174	0.363
	Based on median	0.060	1	174	0.807
	Based on median and with adjusted df	0.060	1	173.983	0.807
	Based on trimmed mean	0.450	1	174	0.503
Increased creativity	Based on mean	0.288	1	174	0.592
	Based on median	0.676	1	174	0.412
	Based on median and with adjusted df	0.676	1	133.633	0.413
	Based on trimmed mean	0.446	1	174	0.505

More resilience to operational risks	Based on mean	1.619	1	174	0.205
	Based on median	0.407	1	174	0.524
	Based on median and with adjusted df	0.407	1	165.722	0.524
	Based on trimmed mean	0.894	1	174	0.346
Responsiveness to opportunities	Based on mean	3.805	1	174	0.053
	Based on median	1.987	1	174	0.160
	Based on median and with adjusted df	1.987	1	162.052	0.161
	Based on trimmed mean	3.244	1	174	0.073
Ability to deal with obstacles	Based on mean	10.320	1	174	0.002
	Based on median	4.523	1	174	0.035
	Based on median and with adjusted df	4.523	1	169.590	0.035
	Based on trimmed mean	9.543	1	174	0.002
Increased job opportunities	Based on mean	0.596	1	174	0.441
	Based on median	0.616	1	174	0.434
	Based on median and with adjusted df	0.616	1	116.163	0.434
	Based on trimmed mean	0.880	1	174	0.350
Increased performance management	Based on mean	1.187	1	174	0.277
	Based on median	0.459	1	174	0.499
	Based on median and with adjusted df	0.459	1	145.170	0.499
	Based on trimmed mean	0.876	1	174	0.351
Better human resources and career development	Based on mean	0.002	1	174	0.965
	Based on median	0.163	1	174	0.687
	Based on median and with adjusted df	0.163	1	115.511	0.687
	Based on trimmed mean	0.115	1	174	0.735
Increased job security	Based on mean	1.002	1	174	0.318
	Based on median	1.741	1	174	0.189
	Based on median and with adjusted df	1.741	1	111.537	0.190
	Based on trimmed mean	1.747	1	174	0.188

More employee engagement and empowerment	Based on mean	0.036	1	174	0.850
	Based on median	0.002	1	174	0.963
	Based on median and with adjusted df	0.002	1	115.766	0.963
	Based on trimmed mean	0.047	1	174	0.828
Better internal communication	Based on mean	0.018	1	174	0.893
	Based on median	0.071	1	174	0.790
	Based on median and with adjusted df	0.071	1	113.849	0.790
	Based on trimmed mean	0.012	1	174	0.913
Increased business net profit	Based on mean	2.381	1	174	0.125
	Based on median	1.281	1	174	0.259
	Based on median and with adjusted df	1.281	1	135.369	0.260
	Based on trimmed mean	2.250	1	174	0.135
Optimised productivity	Based on mean	0.296	1	174	0.587
	Based on median	0.587	1	174	0.445
	Based on median and with adjusted df	0.587	1	104.124	0.445
	Based on trimmed mean	0.519	1	174	0.472
Increased organisational adaptability to change	Based on mean	0.757	1	174	0.386
	Based on median	0.797	1	174	0.373
	Based on median and with adjusted df	0.797	1	102.039	0.374
	Based on trimmed mean	0.622	1	174	0.432
Increasing capability for economic growth	Based on mean	0.084	1	174	0.772
	Based on median	0.121	1	174	0.728
	Based on median and with adjusted df	0.121	1	105.353	0.728
	Based on trimmed mean	0.031	1	174	0.861
Optimised supply chain management	Based on mean	1.612	1	174	0.206
	Based on median	1.763	1	174	0.186
	Based on median and with adjusted df	1.763	1	95.409	0.187
	Based on trimmed mean	1.582	1	174	0.210

Better product/service pricing	Based on mean	0.631	1	174	0.428
	Based on median	0.896	1	174	0.345
	Based on median and with adjusted df	0.896	1	102.198	0.346
	Based on trimmed mean	0.654	1	174	0.420
Increased economic stability	Based on mean	0.244	1	174	0.622
	Based on median	0.304	1	174	0.582
	Based on median and with adjusted df	0.304	1	106.195	0.582
	Based on trimmed mean	0.226	1	174	0.635
Increased reputation	Based on mean	0.005	1	174	0.946
	Based on median	0.154	1	174	0.695
	Based on median and with adjusted df	0.154	1	112.619	0.695
	Based on trimmed mean	0.011	1	174	0.916
Enhanced competitive advantage	Based on mean	0.109	1	174	0.742
	Based on median	0.207	1	174	0.650
	Based on median and with adjusted df	0.207	1	106.215	0.650
	Based on trimmed mean	0.083	1	174	0.774
Unique developed product/service	Based on mean	0.249	1	174	0.618
	Based on median	0.393	1	174	0.531
	Based on median and with adjusted df	0.393	1	102.418	0.532
	Based on trimmed mean	0.174	1	174	0.677
Adaptation to new initiative	Based on mean	0.067	1	174	0.797
	Based on median	0.015	1	174	0.904
	Based on median and with adjusted df	0.015	1	109.150	0.904
	Based on trimmed mean	0.026	1	174	0.873

The table above shows that the Sig. values are greater than 0.05 therefore the variances are statistically significantly not different and equal variances are assumed. The only exception is

'Ability to deal with obstacles' with Sig. value of .002 which is less than 0.05 and its variance is significantly different.

3.8.4. Data accuracy test (Response bias)

To reduce the problem of common method bias, whenever possible, the questionnaire was administered to different respondents within the same field. Also, the author practiced different approaches to eliminated survey bias such as reduce questionnaire complexity ambiguity. To check for non-response bias, common method bias (CMB) test was used to ensure that the respondent sample was not biased toward the sample. It was checked with the application of the single factor test as in much other empirical research (Fuller et al., 2016; Aguirre-Urreta and Hu, 2019; Jordan and Troth, 2020).

Table 3.14: CMB test for continuous performance benefits

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	17.059	74.169	74.169	16.816	73.113	73.113
2	1.137	4.944	79.113			
3	.730	3.175	82.288			
4	.488	2.120	84.408			
5	.436	1.895	86.303			
6	.421	1.832	88.135			
7	.302	1.315	89.449			
8	.280	1.217	90.667			
9	.258	1.122	91.789			
10	.235	1.021	92.809			
11	.223	.970	93.780			
12	.195	.849	94.628			
13	.182	.791	95.419			
14	.165	.718	96.138			
15	.151	.655	96.793			
16	.129	.561	97.355			
17	.114	.495	97.850			
18	.111	.482	98.332			
19	.101	.438	98.770			
20	.087	.377	99.147			
21	.070	.306	99.453			
22	.068	.296	99.748			
23	.058	.252	100.000			

Extraction Method: Principal Axis Factoring.

Tables 3.14 and 3.15 show there is common method variance of 73% and 88% for continuous performance benefits and continuous performance principles respectively.

Table 3.15: CMB for continuous improvement principles

Total Variance Explained

Factor	Initial Eigenvalues Total	Initial Eigenvalues % of Variance	Initial Eigenvalues Cumulative %	Extraction Sums of Squared Loadings Total	Extraction Sums of Squared Loadings % of Variance	Extraction Sums of Squared Loadings Cumulative %
1	12.557	89.693	89.693	12.447	88.908	88.908
2	.238	1.701	91.394			
3	.209	1.492	92.886			
4	.149	1.064	93.950			
5	.134	.960	94.910			
6	.125	.890	95.801			
7	.109	.776	96.577			
8	.103	.739	97.315			
9	.087	.618	97.933			
10	.081	.576	98.509			
11	.071	.508	99.016			
12	.064	.457	99.473			
13	.042	.299	99.772			
14	.032	.228	100.000			

Extraction Method: Principal Axis Factoring.

The author considered all factors that may cause CMB in the questionnaire such as less question similarity and ambiguity, varying location items, appropriate questionnaire length, ease of survey administration (online) with no time limit. The author explored the bias with participant response data and identified two reasons as follows:

- Most key CI benefits and principles are occurring in every CI projects.
- Key CI benefits and principles have high effectiveness on project result.

Therefore, participants answered the questionnaire with same score also, scored CI benefits and principles with high score. Therefore, the common method bias can be disregarded in terms of data reliability and accuracy. In addition, triangular method may reduce the effect of this bias as this research uses interview data for more clarification and verification of questionnaire results.

3.9. Data analysis techniques

This section explains the research data analysis techniques used during the research design to establish the quality of this research. Data analysis techniques that are used for both quantitative and qualitative analysis are identified, and scientific test implementation addressed to ensure research questions addressed and the contribution made to the theory and core factors of CI principles in the manufacturing SME environment.

3.9.1. Quantitative data analysis techniques

The questionnaire answers were coded and entered into the statistical analysis software SPSS to obtain required results for six research questions. Data collection was performed electronically via Qualtrics online platform and sent to more than 800 manufacturing SMEs within a variety of manufacturing sectors, academics, and continuous improvement (CI) consultants in northern England. In total, 176 valid and fully completed responses were identified and selected, representing a 22% response rate. Questionnaires were completed by companies, CI consultants and academics with different manufacturing/management backgrounds and with different levels of experience in continuous performance improvement projects. The survey questionnaire was open to response for up to three months.

The aim of the data analysis in this research is to answer the research questions and therefore identify and explore the Continuous Improvement (CI) principles and economic growth factors in manufacturing SMEs. Besides, the survey questionnaire highlighted the most critical CI principles and economic growth factors to ask respondents (Manufacturing SME managers, CI consultants and Academics) to consider and indicate how important they are. For data processing, statistical methods were used to analyse data from the completed questionnaires.

The operational procedures for processing the data included spreadsheets for organising (Excel format) and creating the descriptive analysis (Mean, Median, Std, Variance) on the IBM SPSS statistical software for the first two research questions. For research question numbers 3 and 4 Spearman's Rank-Order Correlation test was applied to create the correlation table and for research questions 5 and 6 Kruskal-Wallis non-parametric test was applied to explore whether there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable in questionnaire data.

3.9.1.1. Descriptive statistics

Analysis starts with descriptive statistics, which were used to mathematically compare and describe variables (Saunders et al., 2009; Mishra et al., 2019). The data is explored using diagrams and summary tables. The mean (M) is used to characterise the central trend of data, while the standard deviation (σ) is used to describe how the data are scattered around the central tendency.

The descriptive analysing has been run through SPSS software. The data consisted of 176 respondents to the questionnaire survey. The analysis was run with specification query of mean, standard deviation, and variance.

The importance of continuous improvement on economic growth is not fully developed, as noted in the literature study in Section 2.5, because there is no identical model or universal agreement on how to do this. As a result, the first question was created to delve deeper into this topic by assessing the findings of research that looked at continuous improvement principals and their impact on economic improvement factors on manufacturing SMEs in northern England.

3.9.1.2. Spearman's Rank-Order Correlation

The association between critical economic growth factors for manufacturing SMEs in northern England is not evaluated at the macro scale, as noted in the literature study and there is no identical model for that. As a result, the third and fourth questions were created to evaluate the findings of research that looked at association between critical economic growth and critical continuous performance factors for manufacturing SMEs in northern England.

To determine the relationship between the choices participants made on critical economic factors for manufacturing SMEs, more analysis was undertaken using inferential tests to explore associations between variables. Correlation coefficients test was used to measure the strength of the relationship between variables (De Winter et al., 2016) of those who chose economic growth and critical continuous performance factors as their main concern.

Pearson correlation is the one most commonly used in statistics. This measures the strength and direction of a linear relationship between two variables. The Spearman's Correlation test is used to measure these correlations. The Spearman's rank-order correlation is the nonparametric version of the Pearson product-moment correlation. Spearman's correlation coefficient, (ρ, also signified by rs) measures the strength and direction of association between two ranked variables (Thirumalai et al., 2017).

3.9.1.3. Kruskal-Wallis non-parametric test

The Kruskal-Wallis's test (sometimes also called the "one-way ANOVA on ranks") is a rank-based nonparametric test that can be used to determine whether there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable (Alqattan et al., 2018). As our data is ordinal the Kruskal-Wallis's test is appropriate for the measurement of data variables, and the result for the data is valid.

It is essential to evaluate data to check significant differences between variables scored in the questionnaire. Thus, the fifth and sixth research questions investigate to check whether there is any significant difference amongst respondents in terms of region, organisational size, sector, and experience of respondents about the importance of CI factors for economic growth and continuous performance improvement of manufacturing SMEs in northern England.

3.9.2. Qualitative data analysis techniques

Through the examination of quantitative data, a better knowledge of how the suggested framework might be enhanced has been achieved. As mentioned in Chapter 2, this section offers the analysis of the qualitative data acquired through semi-structured interviews and comments from questionnaires.

A preliminary analysis has already been built up from the previous processes of conducting the interviews by the end of data collection. The participatory nature of data collection, note-taking, and analysis, as described by King and Brooks (2021), allows relevant themes, patterns, and linkages to be recognised as data is collected.

Due to the vast amount of material acquired, the audio recordings and notes were reviewed multiple times. The information gathered was examined carefully in order to determine the main themes expressed in the interviews. Themes are frequent expressions, behaviour patterns, or observations found in the data by the researcher. Themes are also known as "codes", "categories", "labels", and "incidents" (Ryan and Bernard, 2003).

Data for the qualitative phase was transcribed, reviewed, and re-read for familiarisation with notes made continuously and then input into NVivo software, following the data analysis process outlined in qualitative analysis. Following that, initial codes were created, which were used to identify general patterns in the data.

3.9.2.1 Interview data coding system

The interview data coding proceeded in five stages from a primary level which includes the planning stage, level A which includes coding data; level B which involves categorising data;

level C which includes sorting code and level D which includes analysing data, all these stages have several steps and are presented in Table 3.16.

Table 3.16: Interview data coding system

Interview data coding system		
Level Name	**Level aims**	**Level Steps**
Preliminary Level	Planning	Step1: Making mind mapping Step 2: Coding Map Step 3: Node structure (on NVivo software)
Level A	Coding research data Descriptive strategy Creating an anchor code for each of the research questions	Step 1: Descriptive data coding (Investigating Participant's direct answers for research question). Step 2: Question labelling (for developing the themes that answer research question). Step 3: Create and define labels (digesting respondent data and labelling them). Step 4: Assign labels to the relevant information (Manual coding in Microsoft Word, defining codes, what the codes stands for).
Level B	Categorisation strategy Individual-based sorting strategy Identifying relevant excerpt Assign a code or connecting to the existing code	Step 1: Compile Nodes (copy and paste all comments in a pile). Step 2: Consolidate Nodes (the more participants talk about an issue, barrier, suggestion etc are more important and significant). Step 3: Review characteristic of the Nodes Step4: Create theme based on features (themes that are consistent with the research questions)
Level C	Sorting codes consolidated data in each question in different cluster numbers	Step 1: Clustering the data (evidence) Step 2: Thematise the data (connecting evidence to the themes, including consolidated data in each question in different cluster numbers). Step3: Label the themes

Level D	Analysing data and structuring result	Step 1: Analysing data Step 2: Establishing Report

3.9.2.2. Transcriptions analysis system

Transcriptions were marked with symbols (interview voice level, tone, and body language) and are presented in Table 3.17. They were also marked with different colours to identify the relation level of interviewee response to the questions, including direct and related, less important, and not related answers, presented in Table 3.18.

Table 3.17: Voice confident sound level

Voice sound	Symbols
Confident	@
Important	***
Interesting	**
Hesitation	&
Disagree	%

Table 3.18: Data relation level with research quest

Relation level	Colours
Comment with the direct and related answer of RQs	Yellow
Less important but can explain part of RQs	Green
Not related but good information/new information about UK CI	Blue

3.9.2.3. Nodes plan

The node plan was created based on a literature review with the aim of covering different areas of continuous improvement project requirements at the macro scale. They included political requirements, government support, cultural factors, emerging technology, legal initiatives, and the general environment of continuous improvement in manufacturing SMEs (Figure 3.8).

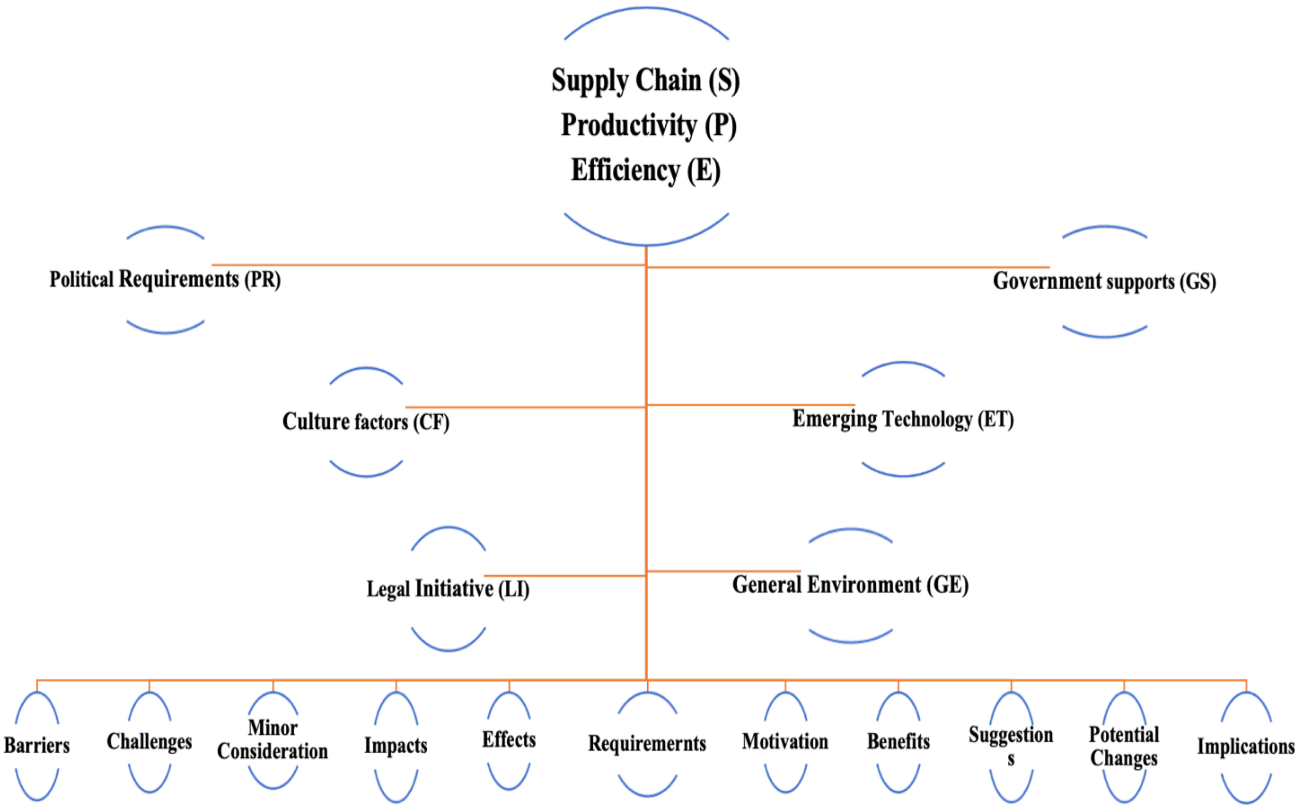

Figure 3.8: Interview question Node plan

3.9.2.4. Qualitative analysis methods

Qualitative data analysis can be compared to putting together a jigsaw puzzle with the parts representing the data (Saunders et al., 2009). The most challenging problem in qualitative research is analysing enormous amounts of data collected through interviews (Eisenhardt, 1989; Yin, 2003). The researcher's task is to reduce the rich data into a format that a target audience can understand (Easterby-Smith et al., 2012). Miles and Huberman (1994) presented many data presentation and analysis methodologies as well as logical criteria for qualitative data analysis. Qualitative researchers have used their proposed procedures for data analysis up to this point. Qualitative content analysis and thematic analysis are two commonly used approaches in data analysis (Chapman et al., 2015).

Content analysis, grounded theory, cognitive mapping, repertory grid, protocol analysis, pattern matching, and critical incident procedures, to name a few, have all been proposed for qualitative data analysis (Easterby-Smith et al., 2012; Vaismoradi et al., 2013). By identifying causally connected variables, content analysis aids in accepting or rejecting a priori hypotheses. In explanatory or descriptive case studies, pattern matching is used to identify causal links between variables, assuring internal validity (Eisenhardt, 1989).

Thematic analysis is an excellent research approach where researchers try to find out something about people's views, opinions, knowledge, experiences, or values from a set of qualitative data, for instance, interview transcripts, social media profiles, or survey responses (Alhojailan, 2012). To investigate the research questions, the researcher needs to collect data from a group of relevant participants and then analyse it. The thematic analysis allows researchers a lot of flexibility in interpreting the data and approaching large data sets more easily by sorting them into broad themes.

In this study, there was no a priori hypothesis or attempt to discover a causal relationship between variables. Rather than establishing connections between variables, the focus was on studying and understanding the impact of quality management principles within one cluster, namely CI philosophy, and proposing ideas/generating hypotheses for additional research. As a result, content analysis and pattern matching were not used in this study's data analysis.

Furthermore, there is another method named template analysis which is a type of thematic analysis. Template analysis requires that all data items are coded first before the research for themes fully begins (King, 2012); in this study, all data were not coded, and therefore, the author employed the thematic analysis method for this study.

3.9.2.5. Thematic analysis procedure

In the thematic analysis procedure, the author used interview protocol applied to specified topics constructed beforehand to simplify data analysis; and data gathered through interviews was manageable to transcribe, document, and present using the established themes within the interview protocol (Appendix II).

There are different approaches to consider, as below.

There is a distinction between inductive and deductive approaches (Fereday and Muir-Cochrane, 2006) as follows:

- An inductive approach involves allowing the data to determine researcher themes.
- A deductive approach involves coming to the data with preconceived themes that one expects to find reflected based on theory or existing knowledge.

As in this research, the researcher planned to develop his framework based on what may be found based on existing knowledge and theory (inductive). There is also the distinction between a semantic and a latent approach:

- A semantic approach involves analysing the explicit content of the data.
- A latent approach consists of reading into the data's subtext and assumptions.

Due to the nature of this research, the researcher is interested in people’s stated opinions. Therefore, semantic approaches will be conducted. All 18 interview transcripts have been tested and evaluated in NVivo software to indicate the sub-themes.

3.9.2.6. Generating themes

The data was evaluated, and patterns were identified among CI factors to start coming up with themes. In this research, themes are generally broader than codes. Therefore, several codes are combined into a single theme considering research interviewee questions, research survey aims, and objectives based on the literature review.

3.10. Ethical considerations

In academic research, ethics relates to how researchers develop and clarify their research topic, design the study, acquire access, collect, process, store, and analyse data ethically and responsibly, and write up their findings (Saunders et al., 2009).

This requires the researcher to accept responsibility for conducting the study in a way that does not harm participants directly or indirectly.

This study did not pose any significant health and safety risks, and it was carried out in accordance with commonly accepted business and management ethical norms, including those of Northumbria University. Before data collection began, a research ethical screening was done in accordance with university standards.

Participants were assured of the confidentiality of information received from them and complete anonymity during the research procedure, which addressed privacy and confidentiality concerns. To ensure this, participants were given fake identities, and participants' information, as well as the data obtained, were securely stored in accordance with university laws. During the study, no harm was done to any of the volunteers, and the data collected was presented accurately and precisely.

Participants' consent can be obtained by having them sign informed consent papers to meet this ethical criterion. This serves the dual function of providing thorough information on the research's nature as well as information on the implications of their participation. It also safeguards the researcher in the case that participants or anyone else express any concerns. To meet these criteria, all participants in this study were asked to sign informed consent forms, which they all did.

All data was stored on the author's computer and online cloud storage (Microsoft one drive) with a strong password and agreed with interviewees to be destroyed after thesis submission. In addition, Northumbria University has an online approval application for research ethics used by the author. Once the ethical proposal was approved, the author obtained the ethical research code.

3.11. Methodology limitations

Despite the importance of contexts and limited conditions, there are significant constraints regarding method design, empirical data selection, and analysis. A common concern in this research is a lack of rigour, leading to the researcher biasing the experiment's outcome due to a lack of systematic methods. Other academics have claimed that case studies lack external validity and provide little basis for scientific generalisation because the findings cannot be applied to theoretical assumptions (Ellis and Levy, 2009). Some of the study's limitations are also implied by the assumptions made. It is critical to state the limits clearly when evaluating the research findings because constraints reveal how the study could have been improved. It is also necessary for other researchers to be able to reproduce or expand on the survey (Ellis and Levy, 2009). The following are limitations of this study:

- Moderate sample size.

Larger sample size would provide a more accurate depiction of the population. If the study's statistical conditions are completed, the findings will have a more significant impact, and generalisation will be possible.

- All the study's participants were volunteers who were not obligated to participate.

This significantly impacted the length and level of detail sought in the questionnaire and interviews. A better study could be carried out in a research centre/group that has a joint agreement with businesses ready to supply more information and devote more time to the research.

- Demographical limitation.

The choice of manufacturing SMEs in northern England and the timeframe for empirical investigation will differ between researchers in this study. As interviewees came from various industrial sectors, some recorded data may be challenging to understand and may not fully contribute to the research analysis and finding phase.

- COVID-19.

The final limitation of this research was COVID-19. The pandemic seriously affected this research primarily through the data collection procedure. Most of the questionnaires that were not responded to were due to businesses closing during the pandemic restrictions. Some companies that had been contacted dissolved their business permanently; therefore, author had to spend more time contacting other companies. Also, several potential interviewees cancelled their meetings due to COVID-19, and some postponed their meeting times. Thus, the author had to wait extra time for another meeting time to become available (their postponement was between one and two months).

- Risk of bias.

Although every attempt was taken to avoid bias in all aspects of the research, including the literature evaluation, survey design, and analysis, the researcher's ideas about CI performance impact may have resulted in a bias in favour of manufacturing SMEs' economic sustainability. However, all assessments of CI principles that place a premium on its value are likely to be biased (Sangwan and Mittal, 2015).

- The mixed methods approach.

Throughout the study process, the researcher endeavoured to address these concerns. The mixed methods approach focused on manufacturing SMEs, CI consultants, academics, and local authorities, which included analysing a wide range of collected data, public documents, and interviews.

- Research Scope.

It was critical to deciding on a reasonable study scope considering the time and resources available. CI philosophy is a broad field of study with economic impact. Within three years, doing research that covered all dimensions would have been impossible. As a result, this study focuses on the integration of economic elements, which is only one aspect of long-term economic impacts. The scope is further narrowed to concentrate on manufacturing SMEs in northern England as global coverage was not feasible given the above limitations.

3.12. Summary

The utilisation of an appropriate research strategy and data collection methods, including the findings and type of conclusions drawn from this research, are determined by research design. As a result, it was critical for the author to comprehend the concept of study design and how it affected the research findings. This chapter discussed several research techniques, data collection methods, and the rationale for using a mixed methods approach of survey (quantitative) and interview (qualitative) for this study.

The chapter also included a discussion on the design of the survey instrument and interview protocol, sample selection criteria for survey and interview participants, and research quality criteria to establish the quality of this research. This chapter provides the base for conducting the data analysis in Chapters 4, 5 and 6.

The specific Northumbria University ethical application was applied via an online application form, and an ethical certificate was obtained for this research. Several research methodology limitations, such as the COVID-19 pandemic, slowed the research progress.

Chapter 4. Data Analysis and Findings

4.1. Introduction

This chapter outlines the data finding process through research questions for both quantitative and qualitative analysis. As mentioned in the preceding chapters, this research was conducted in two parts: firstly, the preliminary study and secondly the main study. The purpose of the preliminary study was to ascertain the feasibility of the research and to gain first-hand insights (Gray, 2021) into CI principles and benefits impacts on Northern manufacturing SMEs' improvement projects. The main study built on the theoretical lens identified from literature and findings from the preliminary data to identify key CI factors and develop a theoretical framework. Consequently, the framework explores CI implementation impacts on manufacturing SMEs' economic performance.

For the first section, quantitative data were analysed in the SPSS software. The results of questionnaire tests are outlined and followed by all six research questions' findings.

In the next step qualitative data were analysed by a Thematic Qualitative Analysis (TQA) process through NVivo software. The data collected was utilised to evaluate the continuous improvement principles for manufacturing SMEs as per the previously presented framework. Also, the data collected was employed to evaluate the applicability for research aims and objectives. This chapter explains what findings were discovered as a result of the procedure.

4.2. Quantitative findings

For quantitative analysis, data collection was performed electronically via Qualtrics online platform and sent to more than 800 manufacturing SMEs within a variety of manufacturing sectors, academics, and continuous improvement (CI) consultants in northern England. In total, 176 valid and fully completed responses were identified and selected, representing a 22% response rate.

The questionnaire answers were coded in Microsoft Excel format and entered into the statistical analysis software (SPSS) to obtain descriptive statistics.

4.2.1. Questionnaire data analysis

The aim of this research data analysis is to answer the research questions about the continuous improvement (CI) principles and economic growth factors identified and explored in manufacturing SMEs as mentioned in the literature review chapter (Chapter 2). Besides, the survey questionnaire highlighted the most critical CI principles and economic growth factors by asking respondents (SME managers, consultants, and academics) to consider and indicate how important they are. For data processing, a variety of statistical methods were used to analyse data from the completed questionnaires.

4.2.2. Quantitative research questions findings

In the literature review (Chapter 2) six questions were identified for quantitative study and analysis. Those six questions are divisionally explored and tested thorough the questionnaire survey responses data with the SPSS statistical software and the test results and findings of those results are presented for each question in the following sections.

4.2.2.1. Research question 1

How important are continuous performance improvement projects to achieve economic growth factors for manufacturing SMEs in northern England?

The descriptive analysis has been run through SPSS software. The data consists of 176 respondents of the questionnaire survey. The analysis was run with the specification query of Mean, Standard deviation, and Variance. The descriptive analysis table of macro-economic factors is shown below to analyse research question one.

The importance of continuous improvement on economic growth is not fully developed, as noted in the literature study in Section 2.5, because there is no identical model or universal agreement of how CI principles are important in manufacturing SMEs at the macro scale. As a result, the first question was created to delve deeper into this topic by assessing the findings of research that looked at continuous improvement principals and their impact on economy improvement factors through manufacturing SMEs in northern England.

4.2.2.1.1. Descriptive statistical analysis with Likert score

Descriptive analysis was used for analysing CI achievement factor's importance level. It shows the Mean, Standard deviation and Variance value of CI achievement factor data mentioned in the methodology chapter (Chapter 3). The perceived influence and importance of how CI factors have impacted manufacturing SMEs are evaluated in the questionnaire to better understand how CI factors influence their economic achievements and present the level of CI factor importance. The CI perceived achievement factors widely reported in the literature are evaluated in Table 4.1.

The result of analysing indicates all continuous improvement factors have a high impact on macro-economic factors. The Mean value of almost all factors ranked more than 5.58 which confirms those factors have very high mean scores.

Table 4.1: CI project achievements

Descriptive statistics of CI perceived project achievements				
CI achievement factors	**N**	**Mean**	**Std. Deviation**	**Variance**
Optimised productivity	176	6.64	1.738	3.020
Optimised supply chain management	176	6.58	1.970	3.879
Increased business efficiency	176	6.41	0.903	0.816
Enhanced competitive advantage	176	6.00	2.503	6.263
Increased organisational adaptability to change	176	5.99	2.011	4.046
Increased economic stability	176	5.99	2.388	5.703
Adaptation to new initiative	176	5.98	2.777	7.714
Better internal communication	176	5.97	1.867	3.485

Increasing capability for economic growth	176	5.96	2.126	4.518
Increased job opportunities	176	5.95	1.556	2.421
Unique developed product/service	176	5.92	2.613	6.828
Increased job security	176	5.91	1.740	3.027
Better product/service pricing	176	5.91	2.274	5.169
More resilience to operational risks	176	5.90	1.599	2.556
Increased creativity	176	5.89	1.381	1.907
Increased performance management	176	5.89	1.811	3.278
Increased reputation	176	5.88	2.556	6.533
Better human resources and career development	176	5.87	1.669	2.784
Increased business net profit	176	5.86	2.142	4.587
Responsiveness to opportunities	176	5.86	1.638	2.683
Ability to deal with obstacles	176	5.80	1.771	3.135
More employee engagement and empowerment	176	5.78	1.783	3.179
Reduced product and service quality variation	176	5.58	1.424	2.028
Valid N (listwise)	176			

There are three top factors with highest mean value including, optimised productivity, optimised supply chain management, increased business efficiency (Table 4.2). All those top three factors had mean values greater than our established threshold of 6 that means they have the highest impact in view of respondents for the CI projects results.

The standard deviation of economic growth factors shows data distribution from the Mean. The Std was between 0.903 and 2.777. It presents factors that have a high Std which indicates the values were distributed far from the Mean. The achievement factors with lower standard deviation have a closer distribution to the Mean value that can be interpreted, the factors with low standard deviation are more representative than others such as increased business efficiency, increased creativity, and increased job opportunities with standard deviation at 0.977, 1.381 and 1.556 respectively.

The result indicates that all macro-economic growth factors on the table are influenced and achievable through continuous improvement projects. However, the top three factors that are highly influenced through CI project progress and demanded by stakeholders are optimised productivity, increasing business efficiency and optimised supply chain management compared to the influence that another factor has, as seen in Table 4.1. Some participants provided important comments at the end of questionnaire including the following:

- *"We had several CI projects and we saved time and money in supply chain procedures also production lines and employees became more efficient and productive than before, in fact, we stand in better economic position"*

  "We saw our CI project results in first month, we produced more goods, and the product waste was decrease by around 15%. CI Project result was very valuable and helpful for us as it not only improved our employees' efficiency it caused our management team to become more efficient and productive"

To sum up, interviewees emphasised that their CI projects made their employee, supply chain and management team become more productive and efficient and produce less waste; as a result, they save money and stand in a better economic position.

Table 4.2: CI factors with highest Mean value

CI project achievements with highest Mean value	
CI achievement factors	**Mean**
Optimised productivity	6.64
Optimised supply chain management	6.58
Increased business efficiency	6.41

4.2.2.2. Research question 2

How important are continuous improvement (CI) principles for manufacturing SMEs?

The second question was created to assess continuous improvement principle's role and its impact on manufacturing SMEs in northern England. The finding evaluated and statistical analysis supported with participants comments that have been provided at the end of questionnaire.

4.2.2.2.1. Descriptive statistical analysis with Likert score

To evaluate the second question, the descriptive analysis ran through CI independent factors that are widely indicated in literature to identifying the most important CI principles for manufacturing SMEs in northern England. Table 4.3 presents CI principles (14 principles) with Mean value between 5.69 and 6.56, that indicate almost all CI principles have high rankings. It presents that there are five factors with the Mean value of less than 6 included as indicated in Table 4.4.

Table 4.3: Descriptive analysis for CI principles

Descriptive statistics for CI principles				
CI principles	**N**	**Mean**	**Standard Deviation**	**Variance**
Resource availability (e.g., time, staff)	176	6.56	3.455	11.939
Enthusiasm towards achieving goals	176	6.53	3.180	10.113
Top management commitment	176	6.45	2.793	7.803
Culture of collegiality	176	6.15	3.184	10.138
Team working	176	6.14	3.447	11.878
Saving business process time	176	6.12	2.824	7.973
Knowledge sharing	176	6.11	3.554	12.634
Employee engagement and empowerment	176	6.05	3.075	9.455
Gradual movement to quality perfection	176	6.01	3.292	10.840
Respect to people	176	5.97	3.519	12.382
Training and education	176	5.95	3.184	10.135
Continuous data and information collection	176	5.95	2.980	8.883
Change management	176	5.93	2.833	8.023

Strategic project selection	176	5.69	2.771	7.679
Valid N (listwise)	176			

Table 4.3 presents CI principles (14 principles) with Mean values between 5.69 and 6.56, that indicate almost all CI principles have high rankings. It presents that there are five factors with a Mean value of less than 6 included as indicated in Table 4.4.

All low Mean CI principles are very important for CI project success as widely mentioned in the literature, for instance Strategic project selection which ranked with the lowest Mean at 5.69. In addition, Table 4.4 presents that strategic project selection has the lowest mean value (5.69) as respondents indicated it with lowest score, however, it is a very critical success factor of CI principles that needs to be reconsidered by stakeholders as incorrect strategic project selection is one of the biggest reasons for uncompleted and failed CI projects mentioned in the literature review chapter.

Table 4.4 CI principles with the lowest Mean value

CI Principles with the lowest Mean value	
CI principles name	**Mean**
Respect to people	5.97
Training and education	5.95
Continuous data and information collection	5.95
Change management	5.93
Strategic project selection	5.69

Moreover, the table presents the top three Mean values of CI principles as follows (Table 4.5). Table 4.5 presents three principles ranked highest by respondents. The highest CI principle is Resource availability. Therefore, stakeholders need to evaluate their resource availability before starting the CI project as it is a key for a successful CI project.

The high Standard deviation of all CI principles indicates the wide data distribution from the Mean value that means CI principles with higher standard deviation are less representative than others. For instance, the Strategic project selection with the standard deviation of 2.771 and the Mean value of 5.69 has a better distribution and is more representative than the other three factors, resource availability, enthusiasm towards achieving goals and top management commitment with the standard deviation of 3.45, 3.18 and 2.79 with the Mean value of 6.56, 6.53 and 6.45 respectively. Some participants provided important comments at the end of questionnaire including the following:

- *"Without our top management team's help and support we could not even start our improvement project"*
- *"The lack of time and employee stopped us for long term CI project and our performance was changed as we expected"*
- *"There was an employee resistance to change when we started, but gradually CI philosophy became the culture, employees and management team were passionate to achieve improvement goals, without that we were not able to continue our improvement journey"*
- *"Our employees obtained more knowledge towards our CI journey as a result they become more passionate during our CI project"*

The above comments reflect the views of those who consider that their CI principles caused their employees and management team to become more passionate towards the end of their CI projects as a result of their knowledge of CI philosophy. Furthermore, it shows that top management commitment and resource availability contributions were vital for starting and continuing the CI projects respectively which implies without these CI principles the improvement projects would be more likely to be stopped or fail.

Table 4.5: CI principles with high Mean value

CI principles with high Mean value	
CI principles	Mean
Resource availability (e.g., time, staff)	6.56
Enthusiasm towards achieving goals	6.53
Top management commitment	6.45

4.2.2.3. Research question 3

What are the associations between critical economic growth factors for manufacturing SMEs in northern England?

The association between critical economic growth factors for manufacturing SMEs in northern England is not evaluated at the macro scale, as noted in the literature study and there is no identical association growth factor model for that. As a result, the third question was created to evaluate the findings of research that looked at associations between critical economic growth factors for manufacturing SMEs in northern England.

4.2.2.3.1. Spearman's Rank-Order Correlation

Research question 3; Tables 4.6 visualised the high ranked correlation between economic factors that are more critical for manufacturing SMEs.

There were 102 correlations between economic growth factors which are indicated with bold squares in Table 4.6. The bold rectangles present factors with significant positive correlation with the moderate strength between 0.4 and 0.7 in 95% coefficient.

Table 4.6: Indication of correlation between economic factors

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Reduced product and service quality variation	Correlation Coefficient			.413**		.444**		.464**													
		Sig. (2-tailed)			0.000		0.000		0.000													
2	Increased creativity	Correlation Coefficient			.432**																.417**	
		Sig. (2-tailed)			0.000																0.000	
3	More resilience to operational risks	Correlation Coefficient	.413**	.432**			.545**															.426**
		Sig. (2-tailed)	0.000	0.000			0.000															0.000
4	Responsiveness to opportunities	Correlation Coefficient					.512**															
		Sig. (2-tailed)					0.000															
5	Ability to deal with obstacles	Correlation Coefficient	.444**		.545**	.512**			.467**					.411**		.460**	.404**	.402**			.438**	.494**
		Sig. (2-tailed)	0.000		0.000	0.000			0.000					0.000		0.000	0.000	0.000			0.000	0.000
6	Increased Job opportunities	Correlation Coefficient							.400**	.419**	.432**											
		Sig. (2-tailed)							0.000	0.000	0.000											
7	Increased performance management	Correlation Coefficient	.464**				.467**	.400**			.407**			.443**								
		Sig. (2-tailed)	0.000				0.000	0.000			0.000			0.000								
8	Better human resources and career development	Correlation Coefficient						.419**			.410**						.403**		.442**			
		Sig. (2-tailed)						0.000			0.000						0.000		0.000			
9	Increased job security	Correlation Coefficient						.432**	.407**	.410**												.414**
		Sig. (2-tailed)						0.000	0.000	0.000												0.000
10	More employee engagement and empowerment	Correlation Coefficient											.407**									
		Sig. (2-tailed)											0.000									
11	Better Internal communication	Correlation Coefficient										.407**		.404**								
		Sig. (2-tailed)										0.000		0.000								
12	Increased business net profit	Correlation Coefficient					.411**		.443**				.404**						.445**	.440**	.491**	
		Sig. (2-tailed)					0.000		0.000				0.000						0.000	0.000	0.000	
13	Increased organisational adaptability to change	Correlation Coefficient																.470**	.421**			.506**
		Sig. (2-tailed)																0.000	0.000			0.000
14	Increasing capability for economic growth	Correlation Coefficient					.460**										.525**	.336**	.473**	.421**		.446**
		Sig. (2-tailed)					0.000										0.000	0.000	0.000	0.000		0.000
15	Better product\service pricing	Correlation Coefficient					.404**			.403**						.525**		.464**	.503**	.453**	.452**	
		Sig. (2-tailed)					0.000			0.000						0.000		0.000	0.000	0.000	0.000	
16	Increased economic stability	Correlation Coefficient					.402**								.470**	.336**	.464**		.458**	.558**	.559**	.405**
		Sig. (2-tailed)					0.000								0.000	0.000	0.000		0.000	0.000	0.000	0.000
17	Increased reputation	Correlation Coefficient								.442**				.445**	.421**	.473**	.503**	.458**		.503**	.467**	.515**
		Sig. (2-tailed)								0.000				0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000
18	Enhanced competitive advantage	Correlation Coefficient												.440**		.421**	.453**	.558**	.503**		.487**	.408**
		Sig. (2-tailed)												0.000		0.000	0.000	0.000	0.000		0.000	0.000
19	Unique developed product/ service	Correlation Coefficient		.417**			.438**							.491**			.452**	.559**	.467**	.487**		.467**
		Sig. (2-tailed)		0.000			0.000							0.000			0.000	0.000	0.000	0.000		0.000
20	Adaptation to new initiative	Correlation Coefficient			.426**		.494**				.414**				.506**	.446**		.405**	.515**	.408**	.467**	
		Sig. (2-tailed)			0.000		0.000				0.000				0.000	0.000		0.000	0.000	0.000	0.000	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

It implies that economic growth factors are related to each other, and it confirms that growth on one factor affects other factors simultaneously and with the same direction. Furthermore, there is strong relationship between some of economic growth factors that implies their influence on other factors for instance ability to deal with obstacles and adaptation to new initiative with 10 and 9 relationships respectively.

The correlation Table 4.7 shows that there are seven economy growth factors that have significant positive correlation with other factors. All seven factors are related to the three economy growth subcategories as follows (Table 4.7). Table 4.7 shows that economic growth factors with lower Mean rank have a significant correlation level. For instance, the ability to deal with obstacles factor had low mean rank (Mean rank 21 and Mean value 5.80) however it has 10 correlations with other factors. In general, if three subcategories, productivity, sustainability, and R&D factors change, this can have high and positive impact on the other economic growth factors even with low mean rank.

Table 4.7: Economic growth subcategories based on number of correlations

Economic growth subcategories					
Economic growth categories	**NO**	**Economy growth factors**	**Correlation No**	**Mean Value**	**Mean Rank 1-23**
Productivity	1	Ability to deal with obstacles	10 correlations	5.80	21
	2	Better product/service pricing	7 correlations	5.91	13
	3	Increased economic stability	7 correlations	5.99	6
Sustainability	4	Increased reputation	9 correlations	5.88	17
R&D	5	Enhanced competitive advantage	7 correlations	6.00	4
	6	Unique developed product/service	8 correlations	5.92	10
	7	Adaptation to new initiative	9 correlations	5.98	7

4.2.2.4. Research question 4

What are the associations between the critical continuous performance factors for manufacturing SMEs?

The association between continuous performance factors for manufacturing SMEs in northern England is not evaluated, as noted in the literature study and there is not any macro framework to assess the association, thus the fourth question was created to evaluate the findings of research that looked at the association between critical continuous performance factors for manufacturing SMEs in northern England.

4.2.2.4.1. Spearman's Rank-Order Correlation

Research question 4; Table 4.8 visualises the high ranked correlation between continuous performance factors that are more critical for manufacturing SMEs. Table 4.8 of Spearman test shows there was a correlation between the critical continuous improvement factors, which was statistically significant. There were six correlations between each other as presented in Table 4.8.

Table 4.8: The correlation of continuous improvement factors

		Strategic project selection	Saving business process time	Continuous data and information collection	Top management commitment	Employee engagement and empowerment
Strategic project selection	Correlation Coefficient					.461**
	Sig. (2-tailed)					0.000
Saving business process time	Correlation Coefficient			.434**		
	Sig. (2-tailed)			0.000		
Continuous data and information collection	Correlation Coefficient		.434**		.402**	
	Sig. (2-tailed)		0.000		0.000	
Top management commitment	Correlation Coefficient			.402**		
	Sig. (2-tailed)			0.000		
Employee engagement and empowerment	Correlation Coefficient	.461**				
	Sig. (2-tailed)	0.000				

Table 4.8 presents factors with significant correlations with the moderate strength between 0.4 and 0.7 in the 95% coefficient. All five factors related to the one-critical continuous performance subcategory as follows (Table 4.9).

Table 4.9: Critical continuous improvement factor association subcategory

Critical continuous improvement factor association subcategory					
CI Categories	**NO**	**Continuous Improvement Principals**	**Correlation No**	**Mean Value**	**Mean Rank 1-14**
Critical Continuous Performance	1	Strategic project selection	1 correlation	5.93	14
	2	Saving business process time	1 correlation	6.12	6
	3	Continuous data and information collection	2 correlations	5.95	12
	4	Top management commitment	1 correlation	6.45	3
	5	Employee engagement and empowerment	1 correlation	6.05	8

Table 4.9 presents continuous improvement principals with low mean rank that have a significant correlation level. For instance, the continuous data and information collection factor has low mean rank (Mean rank 12 and Mean value 5.95). However, it has two correlations with other factors. In addition, the data shows five continuous performance factors. It implies that continuous performance factors have positive association and correlation to other factors and should be considered as an important and influential factor regarding of their impact on continuous improvement projects.

4.2.2.5. Research question 5

Is there any significant difference amongst respondents in terms of region, organisational size, sector, and experience of respondents about importance of CI factors for economic growth of manufacturing SMEs in northern England?

It is important to evaluate the respondent's data with different variables which they selected in the survey questionnaire; thus, the following research question was created to investigate any significant difference amongst respondents in terms of region, organisational size, sector, and experience of respondents about importance of CI factors for economic growth of manufacturing SMEs in northern England.

4.2.2.5.1. Kruskal-Wallis Test

The research question (RQ) 5; The RQ 5 (Critical economic factors) was analysed with Kruskal-Wallis (KW) Test via Monte Carlo confidence levels of 95% and 90%. The KW test indicates that there are few significant differences among respondents in terms of region, organisational size, experience, and sectors of respondents about importance of CI factors for economic growth of northern manufacturing SMEs. Continuous improvement factor variables identified those which have a significant difference among respondents and acting differently (Table 4.10).

Table 4.10 presents that regions, organisation size, experience and industry sectors have 10, 6, 4 and 4 factors respectively with significant different across the group on the independent variable. It implies that all factors in Table 4.10 are not equal to other factors and act differently toward the variables (region, organisation size, experience, and industry sector).

Table 4.10: Kruskal Wallis test for continuous improvement factors

Kruskal Wallis test

Regions	95 %	Organisation Size	95 %	Experience	95 %	Industry Sectors	95 %
Reduced product and service quality variation	0.063	Reduced product and service quality variation	0.031	Increased creativity	0.073	Better human resources and career development	0.039
Increased creativity	0.028	Increased job opportunities	0.049	Increased performance management	0.058	Increased job security	0.027
More resilience to operational risks	0.008	Increased performance management	0.002	Increasing capability for economic growth	0.048	Optimised productivity	0.007
Responsiveness to opportunities	0.060	Better human resources and career development	0.036	Adaptation to new initiative	0.046	Increased reputation	0.082
Increased job opportunities	0.019	More employee engagement and empowerment	0.100				
Better human resources and career development	0.037	Better internal communication	0.014				
Increased job security	0.025						
Optimised productivity	0.024						
Optimised supply chain management	0.006						
Better product\service pricing	0.072						

4.2.2.6. Research question 6

Is there any significant difference amongst respondents in terms of region, organisational size, sector, and experience of respondents to identify the most critical continuous improvement factors for manufacturing SMEs in northern England?

It is important to evaluate the data through the respondents with different variables which they highlighted in the survey questionnaire to identify the most critical continuous performance improvement factors for manufacturing SMEs in northern England, thus, the following research question was created.

4.2.2.6.1. Kruskal-Wallis Test

Research question 6; RQ 6 (CI principles) has been analysed with Kruskal-Wallis Test via Monte Carlo confidence levels of 95% and 90%. The KW test indicates that there are significant differences in the terms of regions, organisational size, experience, and sector of respondents in the level of 95% as follows in Table 4.11.

Table 4.11 shows that there are differences across the groups on the independent variable. The table shows that regions, organisation size, experience and industry sectors have 2, 3, 2 and 1 factor respectively with significant difference across the groups on the dependent variable. It implies that these factors are not equal and concludes that they act differently compared to other factors.

Table 4.11: Kruskal Wallis test for continuous improvement factors

Kruskal Wallis test

Regions	95%	Organisation Size	95%	Experience	95%	Industry Sectors	95%
Gradual movement to quality perfection	0.060	Change management	0.005	Strategic project selection	0.098	Top management commitment	0.079
Enthusiasm towards achieving goals	0.009	Respect to people	0.073	Top management commitment	0.027		
		Team working	0.054				

4.2.3. Summary of findings from quantitative data analysis

Descriptive analysis was used for research questions 1 and 2 and the analysis was run with specification query of Mean, Standard deviation, and Variance to indicate important continuous improvement principles to achieve economic growth at the macro level. It was found that all CI projects had positive relation on economic growth factors and the highest influential factors were identified as optimised productivity, optimised supply chain and increased business efficiency respectively.

Spearman's Rank-Order Correlation on qualitative data was also used for research questions 3 and 4 and high ranked correlation amongst economic growth and CI factors was identified for manufacturing SMEs in northern England. All factors of economic growth and CI had positive correlations with each other. In addition, significant correlations between continuous factor identified, ranked, and evaluated.

Research questions 5 and 6 were analysed with KW non-parametric test via Monte Carlo confidence levels of 95% and 90%. The KW test was used to identify and evaluate significant differences among respondents in terms of region, organisational size, experience, and sectors of respondents considering the importance of CI factors for economic growth of northern manufacturing SMEs. There were several factors in both CI factors for economic growth and critical CI factors for manufacturing SMEs in northern England.

4.3. Qualitative finding

A preliminary analysis was already being built up from the previous processes of conducting the interviews by the end of data collection. The participatory nature of data collection, note-taking, and analysis allows relevant themes, patterns, and linkages to be recognised as data is collected.

4.3.1. Interview data analysis

Interview data for the qualitative phase was transcribed, reviewed, and re-read for familiarisation with notes made continuously, and then input into NVivo software, following the data analysis process outlined in qualitative data finding. Following that, initial codes were created, which were used to identify general patterns in the data.

4.3.2. Qualitative research questions and their findings

To create qualitative interview questions based on the literature review and findings from the questionnaire, continuous improvement critical factors that ranked highly and were indicated in qualitative survey analysis including efficiency, supply chain management and productivity were considered in the design of interview questions. The following four questions were designed to investigate interview data.

RQ 1: How are continuous improvement critical factors are important for northern manufacturing SMEs?

RQ 2: Why are continuous improvement critical factors important for northern manufacturing SMEs?

RQ 3: How feasible is continuous improvement for promotion in northern manufacturing SMEs? (In macro scale projects like Northern Powerhouse project?)

RQ 4: What are the potentials (region potentials), barriers (cost, time etc), challenges (professional staff availability, knowledge transfer, resilience etc) and requirements (local authority policy, financial support, long term, and strategic plan in government body (LEPs, etc) for continuous improvement projects in northern England?

4.3.3. Thematic analysis

To investigate the research questions, the author collected data from a group of relevant participants and then analysed it. Thematic analysis allows lots of flexibility in interpreting the data and approaching large data sets more easily by sorting them into broad themes. All 18 interview transcriptions have been tested and evaluated in NVivo software to indicate the sub themes.

The data was evaluated, and patterns identified among CI factors and to start identifying themes. In this research themes are generally broader than codes. Therefore, several codes combined into a single theme considering research interviewee questions, research survey aims, and objectives based on the literature review.

4.3.4. Research question 1

How are continuous improvement critical factors important for northern manufacturing SMEs?

The interview data shows that all interviewees agreed and emphasised that continuous improvement factors are very important as essential factors for manufacturing SMEs in northern England and without them business cannot survive, especially in hard times as interviewee L4 said "*I would say, my perspective is we believe many businesses in the northeast need to use continuous improvement, ticking manufacturers of course to thrive and to survive at the moment in the Covid world*".

Table 4.12: Thematic CI critical factors importance level (How)

Thematic CI critical factors level				
Node's name	**Theme**	**Degree**	**Files**	**References**
1. Data collection, provides the right data	Technology and Data Management	**4**	1	1
2. Technology is very important to manage large data			2	2
3. Measurement of data by the CI progress after years			1	1
1. Lack of university and business connection for CI projects	External and outsource Connection and help	**12**	3	3
2. SMEs need consultant from outside to come and fix			2	2
3. There is manufacturing SME hub in northern UK			3	3
4. Government, academia, consultants work together			5	5
1. Make CI more representative, engaging employees and managers	Employee training, skill, and engagement	**11**	6	6
2. Share skills			1	1
3. Understand, trust, and encourage employees and believe in their work			4	4
1. Avoiding SMEs firefighting, help them for national issues	Preventing plan	**5**	5	5
1. Time is not big issue	Time	**2**	1	1
2. CI methods should test in small scale in short time			1	1
		7	3	3

1. Government, academia needs sustainable connection with manufacturing SMEs 2. Government needs to offer more support to SMEs, e.g., fund, knowledge improvement and new rules in hard time	Government critical support availability		4	4

The sub themes in Table 4.13 show three potential improvements areas often mentioned by interviewees: external and outsource connection and help, employee Training, skill, and engagement, preventing plan, 5, 6 and 5 times respectively.

Table 4.13: Sub thematic CI critical factors importance level

Thematic CI critical factors level			
Node Name	**Sub Themes**	**Degree**	**Files**
Government, academia, consultants work together	External and outsource connection and help	**5**	5
Make CI more representative, engaging employees and managers	Employee Training, skill, and engagement	**6**	6
Avoiding SMEs firefighting, help them for national issues	Preventing plan	**5**	5

The matrix coding Table 4.14 presents how continuous improvement critical factors are identified as important by specific interviewees. A8 interviewee said, *"The connection between academic and businesses is the only way of proper business improvement"* and L1 interviewee stated that *"Helping business is our priority but they need to come to us and engage with our improvement programmes to prepare in advance for their business issues"*. C11 interviewee said, *"CI philosophy needs to be presented to businesses by consultants and CI journey needs both employees' and managers' contributions to be successful"*.

The table shows that academics, northern manufacturing SME managers and CI consultants are more concerned about the importance of CI factors than the local authority.

Table 4.14: Matrix coding, sub themes of potential improvement areas

Sub themes of potential improvement areas					
Themes	**Academics**	**Local Authorities**	**Managers**	**Consultants**	**Total**
Make CI more representative, engaging employees and managers	2	0	2	2	6
Government, Academia, consultant work together	2	0	1	2	5
Avoiding SMEs firefighting, help them for national issue	3	0	1	1	5
Total	7	0	4	5	16

Furthermore, local authorities need to be informed of how important continuous improvement potentials are. For instance, the comparison diagram Figure 4.1 of L2 (local authority) and A5 (academic) shows the number and variety of CI potentials mentioned by A5 and L2. It clearly presents that the potentials of CI philosophy are missed by local authority (L2) as at some point they were not aware even of CI philosophy or successful CI projects in their area. However, A5 was not only aware of CI potentials, but he was also aware of positive impacts and potentials in some CI projects in northern manufacturing SMEs.

A5 interviewee said, *"I was aware of several key CI positive potentials from manufacturing SMEs feedback during my previous and existing role in government organisations, also aware of some issues in terms of CI promotion to manufacturing that may need to be considered such as lack of connectivity between businesses, academia and authorities"*. In addition, A5 interviewee said, *"To rectifying the issue, it is essential that government, academia, and consultants establish a specific connection hub in the region"*. The below graph shows how lack of connection can limit the knowledge of local authorities of potential CI factors in business.

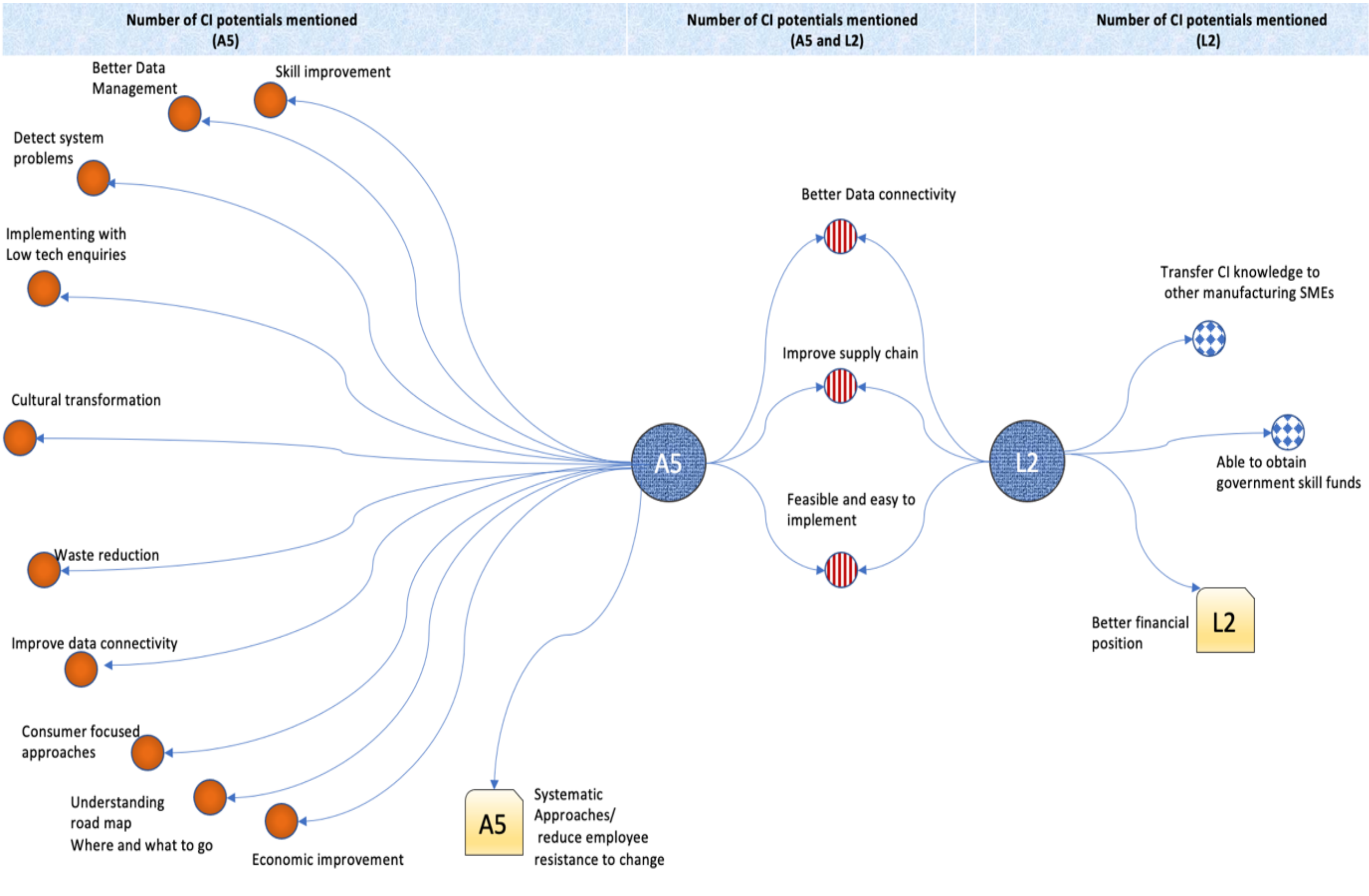

Figure 4.1: Comparison diagram between L2 and A5 interviewees

The word cloud presents (Figure 4.2) words with different sizes based on the frequency of interviewees using those words. Figure 4.2 present a box of bold words with different font sizes. The largest word font sizes were improvement, continuous, people and think on the word cloud from interviewee transcription.

A8 said *"the impact of CI learning is not just for the moment that employee using its tools and techniques, the impact will be remained for the whole CI journey"*. Also, M16 said *"the most important aspect of improving the cultural change is learning, give employees the CI philosophy knowledge, gradually change how they think and how they make decisions"* and L3 said *"I have seen CI learning impacts were not only for a short period of time, but it also permanently changed the way of work progress and work culture"*. It can be interpreted that for any continuous improvement, changing employee culture of learning is very important and needs to be considered more in continuous improvement journey.

Figure 4.2: Word cloud of interviewees' responses

To sum up, analysing both tables above shows that manufacturing SMEs hugely require external help and guidance from continuous improvement specialists. Furthermore, employee training and engagement are crucial for their improvement. It seems unlikely there is a government plane to prevent manufacturing SMEs operation and economy issues, especially in the context of national economic issues such as COVID19 and Brexit.

4.3.5. Research question 2

Why are continuous improvement critical factors important for northern manufacturing SMEs?

The interview data shows that most of interviewees agreed and emphasised that continuous improvement critical factors are essential for developing manufacturing SMEs in northern England. L1 said *"increasing productivity will help businesses take steps to reduce waste, improve efficiency and implement continuous improvement internally"* and M15 said *"improving efficiency protects vital supply chains that enable small manufacturing businesses to continue to operate"*. A6 said *"CI critical factors need to be evaluated as they have more positive implications on manufacturing SMEs operation and economy"* and C10 said *"manufacturing SMEs have quite limited resources therefore identifying CI critical factors supporting manufacturing SMEs needs to be prioritised"*.

The data of sub themes Table 4.16 show that interviewees indicated why continuous improvement factors are very important and essential factors for manufacturing SMEs in northern England. Improving efficiency (5 scores), productivity (6 scores), and supply chain management (6 scores), cost reduction (6 scores), improve manufacturing SMEs' economy and improve the way of thinking and cultural behaviour (5 scores) were the main indications emphasised by interviewees many times.

Table 4.15: Thematic CI critical factors importance level (why)

<table>
<tr><th colspan="5">Thematic CI critical factors importance level</th></tr>
<tr><th>Nodes Name</th><th>Theme</th><th>Degree</th><th>Files</th><th>References</th></tr>
<tr><td rowspan="2">1. Shows the issue, increase efficiency, productivity quality
2. Streamlining what they need in business process</td><td rowspan="2">Improve efficiency, productivity and supply chain management</td><td rowspan="2">6</td><td>5</td><td>5</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>1. CI methods engage and motivate employee and solve the problem faster</td><td>Engaging employees</td><td>2</td><td>2</td><td>2</td></tr>
</table>

1. Cost reduction and economic improvement	Cost reduction	6	6	6
1. Economic growth, improve sustainability, capacity agility, social, cultural change, and process stability (sustainable performance), cheaper product 2. Just in time and low inventory that help manufacturing SMEs' economy	Improve business economy	9	6 3	6 3
1. Encourage the way of thinking to flourish, accepting CI process, identifying KPIs	Improve the way of thinking and culture	5	5	5
1. Customer focused, zero complaints, great service, more compatible	Customer satisfaction	5	5	5
1. Increase job opportunities and sustain	Job creation	3	3	3

Furthermore, Table 4.16 also indicates the main potential opportunities that cause the change in organisational behaviour and culture that are classified as long-term effects. M18 said *"The way employees and managers are thinking is the only way continuous improvement can be maintained"* and C10 said *"I have seen the permanent change in manufacturing SMEs when the employee knowledge and behaviour changed through their work progress"*. Furthermore, A6 said, *"to maintain the continuous improvement long term sustainability, manufacturing SMEs need constant government support, to do so they need constant connection as well"* and C12 said "there is a limited fund available for companies who has aware of these funds". However, L3 said "*there is always help available for manufacturing SMEs, especially for operation development*, *but manufacturing SMEs need to come to us,* then we will assess their situation" and L2 said *"we have extra funding available for manufacturing every year and we return extra funds to government after three years"*. M14 said "*they are not aware of any government fund available for operation development"*.

Also, in terms of CI economic improvement potentials, C11 said *"The main concern is the manufacturing SMEs economic flourishment supported by cost reduction and productivity, efficiency and supply chain management which leads to better economic position and market competition"*.

Table 4.16: Sub thematic of CI critical factors importance level (Why)

Thematic CI critical factors importance level			
Node Name	**Sub Themes**	**Degree**	**Files**
Shows the issue, increase efficiency, productivity quality	Improve efficiency, productivity, and supply chain management	**5**	5
Cost reduction and economic improvement	Cost reduction	**6**	6
Economic growth, improve sustainability, capacity agility, social, cultural changed and process stability (sustainable performance), cheaper product	Economy improvement	**6**	6
Encourage the way of thinking to flourish, accepting CI process, identifying KPIs	Cultural improvement	**5**	**5**

The matrix coding (Table 4.17) shows why continuous improvement is important by each classification of interviewees. The table presents academics, managers and consultants who emphasised of importance of CI potential improvement areas more than local authorities. The sub themes of economy improvement, increasing efficiency, improving sustainability and cultural change ranked 6, 7, 7 and 2 respectively.

Table 4.17: Matrix coding, sub themes of potential improvement areas

Sub themes of potential improvement areas					
Theme Name	**Academics**	**Local Authorities**	**Managers**	**Consultants**	**Total**
Cost reduction and economic improvement and management, recover itself.	1	0	2	3	6
Show the issue, increase efficiency, productivity quality.	1	1	1	1	5
Economic growth, improve sustainability, capacity agility, social and cultural changed and process stability.	2	1	2	2	6
Flourish the way of thinking, accepting CI process, identified KPIs.	2	0	2	1	5
Total	6	2	7	7	22

Moreover, the local authorities did not indicate the cost of CI projects can be recovered by the benefit of the CI projects and they do not consider long term effect on manufacturing SMEs by CI projects, which can be supported by L3's response *"our department funds available are maximum for period of three years so the future plan should not be more than that"* and L1 said *"development projects needs to be funded from CI project starting point to the end"*.

In addition, the Tree map (Figure 3.8) shows that economic growth and economic sustainability has the biggest area compared with other CI potential improvement factors within manufacturing SMEs who deployed CI philosophy in northern England. C12 said *"economic improvement is one of the main reasons that manufacturing SME managers are interested in continuing the CI journey"* and M14 said "*CI philosophy has a huge potential that positively improve our economic sustainability*". However, A7 said *"I have seen some business that their* *economic situation had not been changed through the CI projects especially in short time"* and M13 said *"achieving sustainable financial improvement require a long-term CI deployment plan, manufacturing needs at least six months to see any sustainable developments such as financial improvement"*.

Figure 4.3 Tree Map of CI potentials improvements

4.3.6 Research question 3

How feasible is continuous improvement for promotion in northern manufacturing SMEs?

The aim of the third question of transcription interview data is to evaluate the feasibility of continuous improvement deployment through the manufacturing SMEs in northern England as follows.

Table 4.18 presents a thematic analysis of CI feasibility as indicated by interviewees. The number of times of CI feasibility nodes indicated by interviewees identified and evaluated and consequently themes degreed (Table 4.18). All themes identified in Table 4.18 are from 18 interviewees' responses and present how many times they indicated and emphasised CI feasibility in northern England (macro scale).

Table 4.18: Thematic analysis of CI feasibility

Thematic analysis of CI feasibility				
Node Name	**Theme**	**Degree**	**Files**	**References**
▪ Political initiatives are targeted to help SMEs, lobbying, remove monopolies, improve infrastructure, more contribution	There are adequate political initiatives	8	7	9
▪ There is political and economic imperative for CI			1	1
▪ There is legal initiative required for establishing economic zones, secure supply chain, more investment, national issues (e.g., Brexit), less tax for CI projects, protect labour rights	There are legal Initiatives	9	8	6
▪ Legal initiative would not be needed for SMEs			1	1
▪ Government funded CI projects and knowledge transfer in manufacturing SMEs, apprentice programmes	Government financial support is available and enough	20	7	7
▪ I am not aware of that			10	10
▪ LEPs have fund to help SMEs			1	1
▪ Market flooded with SMEs funding support			1	1
▪ We received government support, but very challenging			1	1
▪ Yes feasible, there are CI projects implemented before (enhance efficiency, process, capacity, supply chain management, less inventory, reduced waste, manage output, improve internal and	CI project in progress in the region	15	15	15

external policies, survive in national and international disasters, economy control, feasible process, less risk).				
▪ Good data connectivity which expedites performance and causes more efficiency and productivity	Technology foundations are available and acceptable	12	11	11
▪ Tech help but CI is more about people than digitalisation, concentrate on people			1	1
▪ Manufacturing SMEs cultural transformation is established, definitions and discipline, Black and ethnic minority groups, appetite to change, reduce cultural resistance, educate people, change the system	Cultural factors are established	8	7	7
▪ Personnel feel threatened from CI specialist from outside			1	1

The sub themes in Table 4.19 present six main categories that indicate the feasibility of promoting CI methodologies to manufacturing SMEs in northern England. It includes improvement of efficiency, productivity, cost reduction, economic, culture and technology. Furthermore, respondents indicated 23 times (improve efficiency, productivity and supply chain management, cost reduction and economic improvement respectively 7, 8 and 7) indicated that promoting CI is practical and feasible and also the CI projects will support manufacturing SMEs' efficiency, productivity, supply chain management and cost reduction can be managed through the CI journey.

Table 4.19: Sub themes of CI feasibility

Sub themes of CI feasibility			
Node Name	**Sub Themes**	**Degree**	**Files**
Political initiatives are targeted to help SMEs, lobbying, remove monopolies, improve infrastructure, more contribution.	Adequate political initiatives	7	7

There are legal initiatives required for establishing economic zones, secure supply chain, more investment, national issues (e.g., Brexit), less tax for CI projects, protect labour rights.	Adequate legal initiatives	8	8
Government funded for CI projects and knowledge transfer in manufacturing SMEs, technology, network hub, apprentice programmes.	Adequate and available financial support	7	7
Yes feasible, there are CI projects implemented before (enhance efficiency, process, capacity, supply chain management, less inventory, reduced waste, manage output, improve internal and external policies, survive in national and international disasters, economic control, feasible process, less risk).	Existing CI project in the region	15	15
Good data connectivity, expedite performance, more efficient and productive.	Available and acceptable technology level	11	11
Manufacturing SMEs cultural transformation is established, definitions and discipline, Black and ethnic minority groups, appetite to change, reduce cultural resistance, educate people, change the system.	Established Cultural factors	7	7

Moreover, *"the CI philosophy support businesses by offering a better economic position and maintain that by changing the organisation culture"* said A6 and supported by C9.

A8 said *"the cultural transformation is a long-term investment and requires more employee and manager collaboration and engagement through CI journey"* and C13 said *"The cultural transformation will not appear at the starting point of the journey, so it requires more persistence, and patience"*.

Another top common factor mentioned by all interviewees was developing technology, *"the most important infrastructure for CI projects is technology"* said A7 and *"developing technology and data connectivity is crucial to manage data and supporting CI project"* said L1 and all C12, C9 and M14 supported the view that developing technology is essential for running a CI project. *"The emerging technology will be offering better data management and* *connectivity and effective performance analysis in CI process"* said A7 and this quote from A7's interview was typical of C12 and C10 view. The comparison diagram (Figure 4.4) shows developing technology is taken very seriously with many mentions in interviewees' responses.

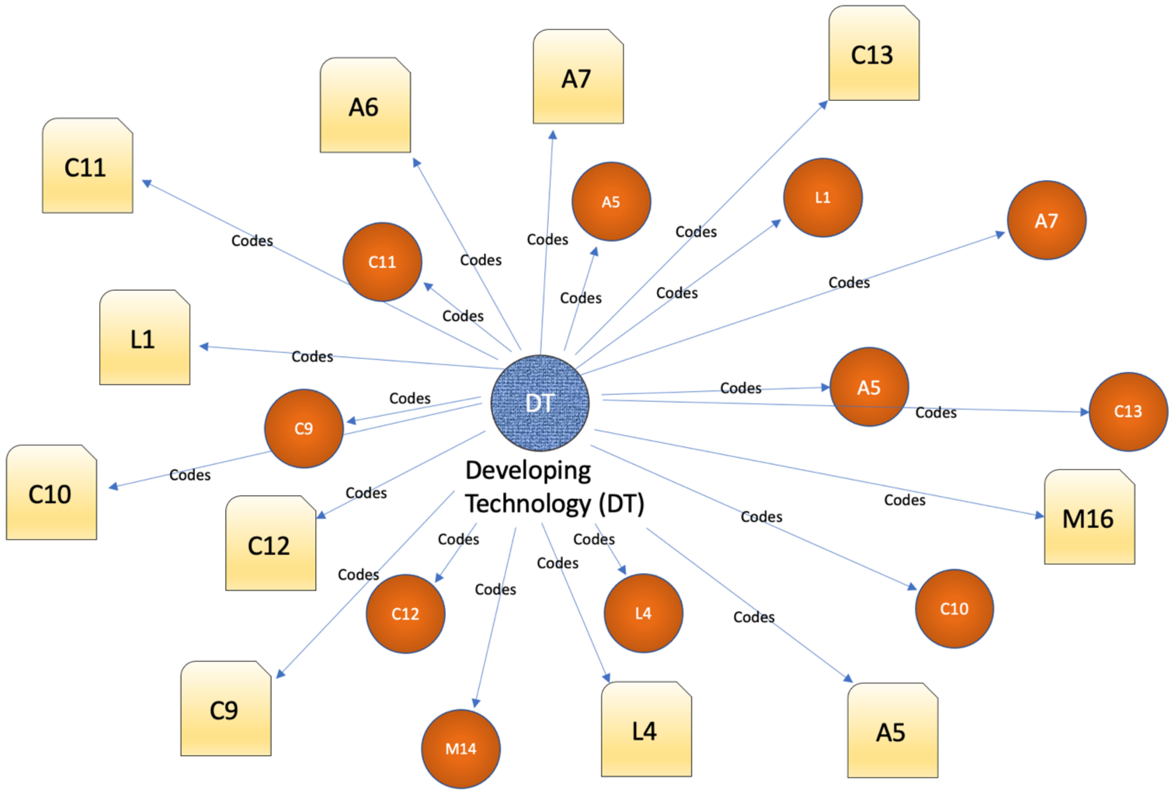

Figure 4.4: Comparison diagram of emerging Technology

The matrix coding in Table 4.20 shows that almost all classifications of interviewees indicated sub themes of feasibility of promoting CI to northern England with a total of 55 times in their responses. The result indicated that promoting CI philosophy is highly feasible with huge advantages that offer to the northern manufacturing SMEs.

Table 4.20: Matrix coding of CI feasibility factors

CI feasibility factors					
Themes	**Academics**	**Local Authorities**	**Managers**	**Consultants**	**Total**

Manufacturing SMEs' cultural transformation, definition and discipline, Black and ethnic minority groups, appetite to change.	2	1	2	1	7
Yes, feasible, enhance efficiency, increase process capability, better supply chain management, less inventory, reduce waste, manage output.	2	3	5	5	15
Better data connectivity, expedite performance, more efficient and productive.	3	2	1	5	11
Manufacturing SMEs need to be funded by government in CI projects, technology, SMEs' network, and knowledge hubs.	1	3	2	1	7
New legal initiative required for establishing economic zones, secure supply chains, more investment, national matters (e.g., Brexit).	2	1	2	3	8
More political initiative needed that targets SMEs, lobbying, remove monopolies, improve infrastructure, more contribution.	1	1	2	3	7
Total	11	11	14	19	55

4.3.7. Research question 4

What are the barriers, challenges, and requirements for continuous improvement projects in northern England?

The aim of the fourth question of transcription interview data is to identify the barriers, challenges, and requirements of continuous improvement through the manufacturing SMEs in northern England as follows. The table presents five theme categories: barriers and challenges, requirements, implementation difficulties, mental resistance, CI project funding, which are indicated with allocated node names and score degree extracted from interviewee responses. The major theme categories are barriers and challenges and mental resistance with score degree of 19 and 10 respectively and the lowest degree is requirement them with a score degree of 2.

Table 4.21: Thematic of CI implementation's barriers, challenges, and requirements

Thematic of CI implementation's barriers, challenges, and requirements				
Node Name	**Theme**	**Degree**	**Files**	**References**
1. Lack of political initiatives encouraging manufacturing SMEs	Barriers and challenges	19	1	1
2. Bureaucracy			1	1
3. During CI Projects considering company confidential matters			1	1
4. Lack of SME connection with LEPs, network and hub			9	9
5. Pool of employee and management knowledge and experience, CI methodology awareness, need consultant from outside, lack of road map, overestimate their performance, lack of structure for implementation, complication in start			1	1
6. Long CI project time			3	3
7. Manufacturing SMEs with low tech			2	2
8. The result needs to be visible and tangible			1	1
1. Apprenticeship programme and recruited expertise (cost and time)	Requirements	2	1	1
2. Better manufacturing SMEs connectivity			1	1
1. Academic language difficult to understand to businesses	Implementation difficulties	6	1	1
2. Lack of academic experience facing business			1	1
3. Lack of data to start CI project			1	1
			3	3

4. LSS is too difficult				
1. Organisational employee and top management resistance, shows their mistake, policy, technical and family-oriented, no proactive need for improvement, wait for something to go wrong 2. Less resistance to change in employees than managers and CEOs 3. There is good communication but difficult to engaging SMEs 4. More theory less practice in SMEs	Mental resistances	10	7 1 1 1	7 1 1 1
1. Lack of investment, lack of gov funding, resource constraints, not eligible for gov fund	Funding CI projects	5	5	5

The sub theme Table 4.22 presents that the main themes are the general barrier and challenges, mental resistance and funding CI projects which were indicated by interviewees 9, 7 and 5 times respectively.

Table 4.22: Sub themes of CI implementation's barriers, challenges, and requirements

Sub themes of CI implementation's barriers, challenges, and requirements			
Node Name	**Sub Themes**	**Degree**	**Files**
Lack of SME connection with LEPs, network and hub	Lack of outsource connectivity	9	9
Organisational employee and top management resistance, shows their mistake, policy, technical and family-oriented, no proactive need for improvement, wait for something to go wrong	Mental resistance	7	7
Lack of investment, lack of gov funding, resource constraints, not eligible for gov fund	Funding new CI projects	5	5

In the view of the interviewees some of the barriers and challenges are very common as the Matrix Table 4.23 presents, such as lack of knowledge and difficulty of understanding statistical approaches during the CI journey. However, "*the mental resistance and funding CI projects are considered individually due to the important of the barrier also challenging to rectifying them by manufacturing SMEs in northern England"* said A5 and consultant interviewees indicated that it is a very challenging part of CI journey (C12, 9, 10).

Furthermore, *''funding CI projects is very crucial''* said M17 *''especially for those need a CI consultant in their factory for the time of the project''* said M14. L1 and L2 indicated that government providing adequate fund to the market, and there is not any barrier to obtain that, however, there is huge unused fund at the end of the government plan therefore they have to return the unused funds back to government. On the other hand, M14 and M15 indicated that it is really challenging to access the funds and M18 said *''we could not obtain any fund for our CI project, and we had to self-funding our project''* and M16 said *''we are not aware of any fund available for CI project at all''*.

Table 4.23: Matrix coding of CI implementation's barriers, challenges, and requirements

CI implementation's barriers, challenges, and requirements					
Themes	**Academics**	**Local Authorities**	**Managers**	**Consultants**	**Total**
Lack of employee and management knowledge and experience, CI methodology awareness, Six Sigma methodology is too difficult.	3	2	2	2	9
Yes, feasible, enhance efficiency, increase process capability, better supply chain management, less inventory, reduce waste, manage output.	0	1	1	0	2
Lack of investment for supply chain infrastructure.	2	0	1	3	6
Organisational employee and top management resistance, show their	3	3	2	3	11

mistake, policy, technical and family oriented, not productive.					
Total	8	6	6	8	28

The Tree Map (Figure 4.5) illustrates that two main general and internal manufacturing SMEs barriers are lack of employee knowledge and employee resistance to change which are both considered several times and by different interviewees' professions. A5, A6, A7, C11 and C12 indicated that employee knowledge is crucial, and it needs to be planned and continuous. However, M14, M15 and M18 indicated and supported that they need their employees for daily duties, so we cannot rely on employee's knowledge for our CI project also M16 quoted that *''some of CI tools and techniques are difficult to understand for our employees, so we hire external experts to support and cover the knowledge gap''*.

Figure 4.5: Tree Map of CI implementation's barriers, challenges, and requirements

As mentioned earlier, one of the main barriers for manufacturing SMEs was employee resistance to change and manufacturing SMEs manager interviewees mentioned that they cannot rely on their employees' and managers' knowledge. However, A5, A6 and A7 indicated the view that process of business developing, and cultural change cannot be happened without continuous improvement of business employees and managers knowledge. In this regard a comparison diagram is drawn as shown in Figure 4.6 to see details of change resistance connection through interviewees' responses. The comparison diagram shows that the employees and managers resistance to change routed in the variety of interviewees views and they mentioned it through different sections of their interviewees. The figure 4.6 shows that how many times resistance to change as a CI implementation's barrier, indicated and emphasised by academics (A5 and A7), manufacturing SMEs (M17) CI consultants (C12, C9 and C10).

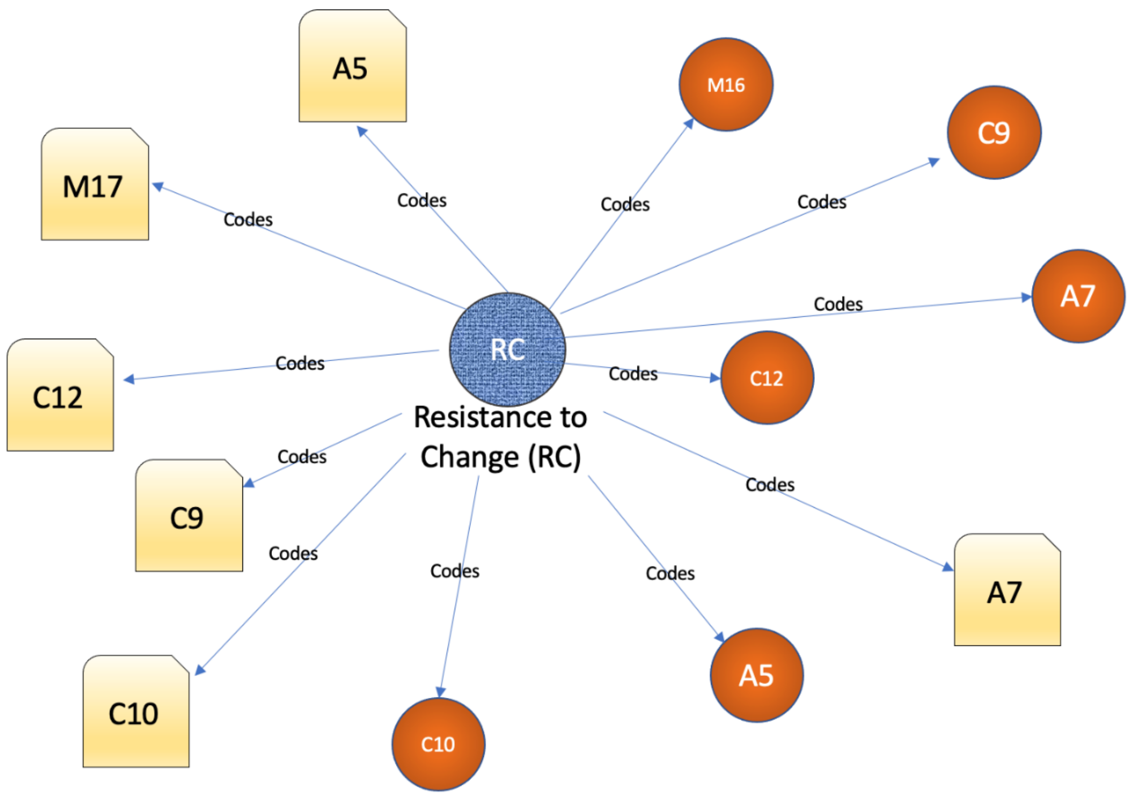

Figure 4.6: Comparison diagram of mental resistance

4.3.8. Summary of findings from the qualitative data analysis

In this approach, the author identified the expected themes based on the literature review in Chapter 2 and methodology approaches in Chapter 3 and qualitative analysis from interviewee transcriptions on NVivo in this chapter. These themes were analysed and evaluated with different quantitative analysing approaches such as themes ranking word tables, sub themes tables, word tree and comparison diagrams.

The findings of the qualitative questions were presented in a different section and evaluated for each qualitative question. Furthermore, the author presented several interviewee quotes for a deep understanding of various aspects of the qualitative question findings with critical aspects of essential factors that were raised through the interview.

4.4. Summary

The process of establishing findings from analysing quantitative data (questionnaire survey) and qualitative data (semi-structured interviews) was presented in this chapter. The questionnaire surveys used the same methodology for defining the target audience, choosing the sample, creating, and administering the questionnaires, and analysing the method analysis tests identified in the previous chapter (Chapter 3), allocated to investigate the quantitative and qualitative research questions.

The author assessed and tested all data, presented target resonances, and evaluated findings through their reactions to this study's aims and objectives. The framework shown in Figure 4.7 illustrates findings from empirical data from quantitative results. The findings assessment implies various aspects of CI importance and achievement factors at the macro scale through the six quantitative questions, and it was found that there are many advantages of implementing CI projects which support the economic level of manufacturing and important CI principles for manufacturing SMEs in northern England such as optimising productivity and top management commitment respectively. In addition, the finding implies an influential and positive association between critical economic growth and CI factors. Lastly, several factors identified from both economic growth and CI factors had significant differences amongst regional, organisation size, sector, and respondents' experience.

In the next step of finding empirical data through qualitative data collection, the feasibility of CI projects through manufacturing SME managers, CI consultants, academics, and local authorities (policy makers) was investigated and analysed. Four qualitative questions were designed and tested. It was found that interviewees had a strong belief in the positive feasibility of CI projects through manufacturing SMEs in northern England. Lastly, the CI projects' challenges and requirements were identified for future research, and the summary of findings is presented in Figure 4.7.

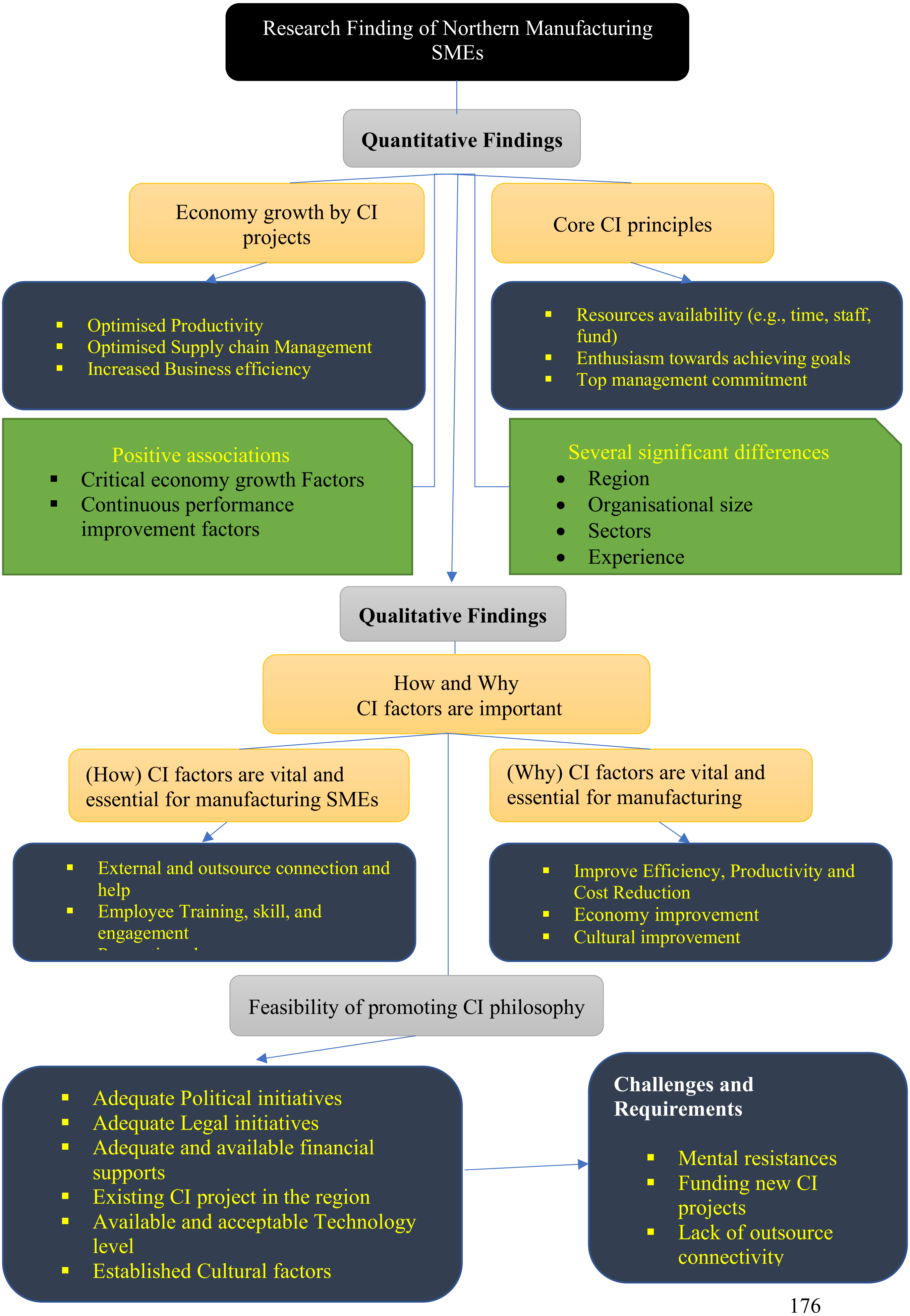

Figure 4.7: Research finding for manufacturing SMEs in north of England

Chapter 5. Discussion chapter

5.1. Introduction

In 2014, a project named 'Northern Powerhouse' was introduced by the UK's Chancellor of the Exchequer. The project aimed to rebalance the UK economy by providing essential infrastructure facilities to the 16 million people across the north of England (HM Treasury, 2014). Significant priorities were raising productivity, stimulating economic growth, creating jobs, and attracting investment (HM Treasury, 2014). One of the significant Northern Powerhouse project's strategies is tackling major barriers to productivity (Round and Hunter, 2019). The project presented several plans and addressed solutions for improving productivity. However, the Northern Powerhouse project document addressed manufacturing SME growth in northern England in a minimal way (Parr, 2017; Soroka et al., 2017; Shutt and Liddle, 2020). The UK's Manufacturing SMEs make vital and significant economic contributions, create jobs, and contribute to general economic health and welfare (Lampadarios, 2016). Therefore, it is crucial to address the Northern Powerhouse strategic plan limitations for manufacturing SME growth through a continuous and systematic approach. To fill this limitation and knowledge gap, the CI theory was reviewed and highlighted as one of the most used theories by manufacturing SMEs in Chapter 2.

Management theories are a collection of ideas that recommend general rules for managing an organisation or business (Brigham and Ehrhardt, 2019). Management theories address how supervisors implement strategies to accomplish organisational goals and motivate employees to perform at their highest ability (Paais and Pattiruhu, 2020; Mykhailichenko et al., 2021). In regard to business management theory's strategic goals, the theory has been evaluated through different sub-sections of 2.6 and the main application of CI theory, such as Lean manufacturing, Six Sigma and Lean Six Sigma, briefly explained and successfully implemented CI initiatives in manufacturing SMEs highlighted and supported with CI critical success factors through academic papers.

5.2. Contribution to CI theory

The most important aspect of a PhD thesis is to provide clear proof of the contribution to theory (Easterby-Smith et al., 2012). The contributions can be made in various ways, such as the confirmation or expansion of an existing theory, the merging of two previously separate ideas, the formulation of hypotheses, or the improvement of methodology (Kar and Dwivedi, 2020). This research study was begun to explore CI definitions and theory. CI philosophy implementations were explored. The CI implementation impact on manufacturing SMEs is evaluated through the business development projects as stated in Chapter 2's 'Defining Continuous Improvement' section. Despite its popularity, failure CI adaption in different environments is still the most likely barrier to a successful CI implementation (Antony and Gupta, 2018). Despite, or perhaps because of the breadth of research on the topic, the systematic literature review found many different perspectives on CI operational capability (See Table 2.3) with limited creation of CI strategic frameworks or models (McLean et al., 2017, Kwakye, 2018, Schreiber and Melonçon, 2019) specifically for manufacturing SMEs (McLean, 2019, Setiawan et al., 2021).

According to Flynn et al. (2018), it is a vital requirement to have a systematic and strategic framework for CI deployment as most researchers only focus on the practical aspect of CI deployment impact and rarely study CI philosophy at the macro-level. For instance, Timans et al. (2012) researched three cities in the Netherland to evaluate the result of CI deployment on business performance however, they did consider providing a systematic and strategic macro framework. Therefore, this is necessary that CI theoretical effectiveness at the macro-level needs to be expanded especially for manufacturing SMEs.

The critical contribution to CI theory here is to study the theory from a more strategic long-term and macroeconomic growth viewpoint; as mentioned above, CI theory is commonly addressed at the operational level, with microeconomic growth for individual businesses rather than regions.

Considering the above CI theoretical limitation, industry and region-specific guides are needed for manufacturing SMEs. Before this research, there was no practical or strategic guide for northern England manufacturing companies. This research began by identifying and evaluating the CI principles in the north of England's manufacturing SMEs. The research questions assessed and analysed the theory of CI feasibility for northern manufacturing SMEs. Critical CI factors and their economic growth impacts on manufacturing SMEs were identified.

5.3. Research contribution of findings

Management research has improved the idea of CI philosophy during the last decade, which was previously employed in a wide range of contexts (Sanchez-Ruiz et al., 2018). Researchers view CI philosophy as a dynamic process that focuses on improvement programmes and their relationship to other organisational elements in the organisation and its environment (Pérez Rave et al., 2022). An improvement programme, in this case, is understood as an induced change effort focused on improving the effectiveness of an organisation's existing processes (Harmon, 2019). In addition, an improvement program is tightly connected to other functions in the firm and the firm's customers, suppliers, competitors, capital markets and economic growth (Huda et al., 2019).

For many years, manufacturing SMEs practised CI philosophy, and CI implications have been shown to directly influence their operational, process and economic improvements (Sahoo and Yadav, 2018; Choudhary et al., 2019; Sahoo, 2020). This has been achieved through enhancements in quality improvement processes, waste elimination and process streamlining (Wong and Headrick, 2021; McDermott et al., 2021).

To achieve CI benefits and advantages, the level of acceptance and implementation of CI tools and techniques such as Lean and Six Sigma among manufacturing companies in developing economies is critical (Jevanesan et al., 2021), as it facilitates them not only to improve survival in poorly planned systems and cultural practises, but also to allocate resources efficiently, ensure profitability, and eliminate waste while providing customers with the highest quality and efficient services (Yuik and Puvanasvaran, 2020; Vinodh et al., 2020) which consequently provide manufacturing SMEs with a better economic position (Vinodh et al., 2020). Besides, CI factors support the manufacturing SMEs to achieve their goals and objectives and improve their operational and financial efficiency through CI philosophy practices (Prasad et al., 2020). This research will indicate and highlight more CI theoretical relations to manufacturing SME performance capability and contextual factors and investigate CI implications and capabilities of macro-economic growth. Consequently, research findings added more context to the existing knowledge. Based on these research objectives, the following section discusses continuous improvement's capabilities, acceptability, and impacts on manufacturing SMEs within northern England from the macroeconomic perspective. To achieve these objectives, six questions will be analysed through the quantitative method and four questions through the qualitative method.

To evaluate CI philosophy's impact on developing economic growth and the feasibility of practising CI philosophy on a macro-scale, each section presents all research questions and findings of both quantitative and qualitative research results. In addition, each research question discussion is supported by CI philosophy and the level of its impact factors on the latest literature review, and finally, attributes and frameworks that aid or benefit manufacturing SMEs in northern England will be assessed to evaluate a CI philosophy macro impact on manufacturing SMEs' economic growth.

5.3.1. Research contribution of quantitative findings

This section explores and investigates the quantitative research findings and evaluates them to identify whether the quantitative results confirm or reject research objectives also quantitative findings are critically assessed to identify how they can contribute to the literature.

5.3.1.1. Research question 1

How vital are continuous improvement projects to achieve economic growth factors for manufacturing SMEs in northern England?

Research question 1 is designed to evaluate how vital continuous performance improvement projects are to achieve economic growth factors for manufacturing SMEs in northern England. In the first step, economic growth factors which are critically improved by CI deployment were identified from the literature review. Then, through the research questionnaire, all CI achievement factors were presented to indicate the level of a CI factor's importance in manufacturing SME economic growth in northern England.

The result indicated that all CI factors are critical and have a very high impact on macro-economic factors due to the implementation of CI philosophy through manufacturing SMEs in northern England.

The research finding indicated that productivity, business efficiency and supply chain management are the most influential and effective factors in manufacturing SMEs' economic growth. These findings align with the latest academic papers, such as Adbi et al. (2022). They considered CI achievement factors critical and influential on manufacturing SMEs' economic development. They believed that improving productivity and efficiency in the manufacturing process refers to increasing the value of outputs produced for a given level of inputs over a given period. In addition, since 1947, productivity gains have allowed the American corporate sector to generate nine times more goods and services with only a tiny increase in hours worked (Klein and Crafts, 2020). Schandl et al.'s (2018) research indicated that increased efficiency translates to higher profit margins via lowering costs. Employees will be paid better, there will be more working capital, and the company will be able to compete better (Schandl et al., 2018). Effective supply chain management allows businesses to enhance product flow by accurately estimating demand, sales, and inventory management to minimise the bullwhip effect and underproduction (Ghadge et al., 2020). Firms and consumers in countries with a well-developed supply chain infrastructure (modern interstate highways, a massive railroad network, and multiple modern ports and airports) would exchange many goods efficiently and inexpensively (Meyer, 2020).

In manufacturing, the supply chain supports the transfer and transformation of raw materials into final products in product manufacturing and then transports and distributes the merchandise to a merchant or a consumer directly. To improve manufacturing SMEs' economy, warehousing and storage must be fully optimised as part of a larger supply chain strategy. To reduce costs, companies can focus on their operations, for example: optimising space, reducing damage, and minimising packaging; therefore, optimising the supply chain is a critical and key factor in a company's economic improvement (Karaosman et al., 2020).

The literature review and the research findings of both descriptive analysis and interviewee views indicated that manufacturing economy growth could be achieved by CI factors, mainly by developing and optimising its top factors – productivity, efficiency, and supply chain management – which leads to manufacturing SMEs' economic growth in northern England as they can produce and consume more products and services for the same amount of effort.

5.3.1.2. Research question 2

How important are the continuous improvement principles for manufacturing SMEs?

The aim of designing research question 2 was to assess how important continuous improvement (CI) principles are for manufacturing SMEs. This question was created to identify the CI principles' role and impacts on manufacturing SMEs in northern England. Critical CI principles are determined from the latest academic papers in the first step. The questionnaire result was tested and analysed through statistical tests in SPSS software. The result from northern England indicated that all CI principles had a high ranking, confirming that critical CI principles are fundamental and crucial for these manufacturing SMEs in business improvement and operation management growth. The highest-ranked CI principles identified for the manufacturing SMEs in northern England are resource availability (e.g., time, staff), enthusiasm towards achieving goals and top management commitment.

The result has synergy with studies conducted by Choudhary et al. (2019) in manufacturing SMEs in the UK and Prestiadi et al. (2019) in the education of the global industry. Choudhary et al.'s (2019) research findings indicated that resource availability is an essential asset whose primary purpose is to assist in the completion of a task or project, such resources could include a person, a team, a tool, funds, and time. Before a project begins, resources should be reviewed and allocated. Their research findings signified that CI initiatives and resource availability are crucial for CI practice's success in manufacturing SMEs (Choudhary et al., 2019). Prestiadi's research findings specified that knowing which resources are accessible at any given time is crucial when selecting how to divide and allocate the appropriate resources for a CI industry educational improvement project (Prestiadi et al., 2019).

The impact of enthusiasm to achieve business CI goals by employees presented in Makwana and Patange's (2022) research shows numerous effects that an employee's passion might have on CI projects. Motivating employees to take positive steps toward CI goals is crucial as it provides excellent customer service, efficiently resolves interpersonal conflict, and collaborates effectively with others (Makwana and Patange, 2022).

The last significant CI factor was management's commitment to CI philosophy. Ahmed et al. (2021) research findings revealed that management commitments in CI practices are critical because they supply the resources for implementing and maintaining the management system, including all quality-related processes (Ahmed et al., 2021). Lizarelli et al. (2021) research found that top management commitment has been recognised as one of the most critical variables influencing the effectiveness of continuous improvement practice in a business. Also, this has been claimed by quality gurus in the field (Aburayya et al., 2020).

The literature review and the research findings of both descriptive analysis and interviewee views confirmed that CI principles play a vital role in manufacturing SME's development, mainly by developing and optimising top factors, resource availability (e.g., time, staff), enthusiasm towards achieving goals and top management commitment.

Considering analysing question 2 results, interviewees' views, and the latest literature, appropriate focusing and addressing to achieve critical CI principles can stimulate manufacturing SME growth and development in northern England.

5.3.1.3. Research question 3

What is the association between critical economic growth factors for manufacturing SMEs in northern England?

Research question 3 was created to identify the associations between critical economic growth factors for manufacturing SMEs in northern England. The aim of identifying the association between critical economic growth factors was to assess the interaction between different elements in manufacturing SMEs in the north of England. In the first step, critical economic growth factors were identified from academic publications and confirmed by academic leaders in northern England.

The results revealed several correlations between economic growth factors, confirming that growth on one factor affects other factors simultaneously and in the same direction. Analysing the results showed that seven economic growth factors have a significant association with other elements; these factors were related to the three-economy growth subcategory, productivity, sustainability, and R&D. These three subcategories have a high and positive impact on the other economic growth factors.

The result was in line with Kaydos's (2020) research that implies that since 1947, productivity improvements have enabled the American corporate sector to generate nine times more products and services with only a minor increase in hours worked. And with productivity growth, an economy can produce and consume more goods and services for the same time and effort, leading to economic growth (Prasanna et al., 2019). In terms of manufacturing SMEs' sustainability and R&D effect on economic growth, de Sousa et al.'s (2020) research in Asian manufacturing SMEs has synergy with this study in that sustainability development is identified as a factor that can influence manufacturing SMEs' environmental/social and financial performance. Innovation (R&D), entrepreneurial orientation, governmental policy and support, and continuous improvement of manufacturing systems are among the critical factors driving manufacturing SMEs in Asia towards improved financial performance (De Sousa et al., 2020).

Analysing the results shows that improving sustainability and R&D has a significant association with technological resources; this result is in line with Acheampong and Hinson (2019). Their research implies that technical resources are critical for manufacturing SMEs because they help them expand fast and economically while also responding to changing consumer tastes by acting as a facilitator of production and service operations. People in manufacturing SMEs have varying perspectives on new technology adaptation. Some are favourable regarding optimism and innovativeness, while others are negative regarding discomfort and insecurity.

Ioanid et al. (2018) also highlighted and specified several barriers to manufacturing SMEs that correlated to adopting new technology in the literature, including lack of initial cash required to obtain new technology, skilled labour shortages, and appropriate tactics to use the technology, as well as a lack of information and uncertainty.

In addition, the study indicates that there are some less important than the above factors; however, they still need to be considered as they significantly correlate with economic growth factors. For instance, ''the ability to deal with obstacles'' factor is less considered by manufacturing SMEs in northern England; however, it has high correlations with other economic growth factors. This finding is in line with Sandybayev's (2019) research findings in organisational performance and Chaurey et al. (2021) in Indian manufacturing industries. Their findings indicated that the problem-solving capability would determine the long-term success of continuous improvement and lead an organisation to sustainable improvements achieved by instructing team members to change to a better process or by showing them how to improve the process, as struggling with a problem is where the learning and development happens.

Further, their findings indicated that guiding people through identifying the problem, analysing the data, developing a hypothesis, and then designing an experiment to test the hypothesis is the only way to help them learn in a way that allows them to play the continuous improvement game. It is not about compliance and audit; it is about developing the skill of learning to see a gap and responding to it by working out how to prevent it from occurring again. You learn from your own struggle.

5.3.1.4. Research question 4

What are the associations between critical continuous improvement factors for manufacturing SMEs?

Research question 4 was created to evaluate the associations between manufacturing SMEs' critical continuous performance factors. The result shows a significant correlation between the critical CI factors. The second step of analysing data revealed six critical CI factor association subcategories: strategic project selection, saving business process time, continuous data and information collection, top management commitment and employee engagement and empowerment.

The result implies that CI factors positively correlate to other factors and should be considered an important and influential factor regarding their impact on continuous improvement projects. The research question 4 result indicated in academic publications with comparable findings that there is a significant correlation through the above critical CI factors. The research was micro research within a variety of manufacturing sectors and developed and developing countries; strategic project selection in the study of Laureani and Antony (2018) in the UK through various sectors of manufacturing SMEs, Hastig and Sodhi's (2020) literature review research with similar analysing method (thematic analysis) indicated saving business process time as one of the top critical success factors, continuous data and information collected from Gonzalez-Aleu et al.'s (2018) empirical research through the healthcare in Mexico, and top management commitment factor identified by Moktadir et al. (2020) research through the literature review methodology and employee engagement and empowerment indicated as one of the main critical CI factors by Hong et al.'s (2018) research in Malaysian manufacturing SMEs.

5.3.1.5. Research question 5

Is there any significant difference amongst respondents regarding the region, organisational size, sector, and respondents' experience with the importance of CI factors for the economic growth of manufacturing SMEs in northern England?

Research question 5 was created to investigate whether there is any significant difference amongst respondents regarding the region, organisational size, sector, and respondents' experience regarding the importance of CI factors for the economic growth of manufacturing SMEs in northern England.

The result implies that several CI factors act differently amongst respondents. For instance, reduced product and service quality variation was a CI factor that acted differently amongst respondents' regions and organisation size. Also, increasing performance management and optimised productivity were other CI factors that act differently amongst respondents' experiences and industry sectors.

The result of this difference synergises with similar research findings such as Rossini et al.'s (2019) empirical study on European manufacturers and Alefari's (2020) research on UAE's manufacturing SMEs. Thus, this is common that there is a difference amongst respondents in terms of region, organisational size, sector, and experience of respondents in the other academic publications as CI factors may be evaluated differently depending on independent variables.

5.3.1.6. Research question 6

Is there any significant difference amongst respondents in terms of region, organisational size, sector, and experience of respondents to identify the most critical continuous performance improvement factors for manufacturing SMEs?

Research question 6 was created to find any significant difference amongst respondents regarding the region, organisational size, sector, and experience to identify the most critical continuous improvement factor for manufacturing SMEs in northern England. It is essential to find significant differences amongst respondents regarding the region, organisational size, sector, and respondents' experience with the importance of CI factors for the economic growth of manufacturing SMEs in northern England.

The result revealed a significant difference amongst respondents about critical CI factors in terms of organisational size compared with region and experience, which have only two factors and the industry sector has only one aspect. This suggests that critical CI factors may have different effects depending on independent variables. The findings are in line with other academic research findings, including Rossini et al.'s (2019) study on European manufacturers with organisation size, Singh and Rathi's (2018) research in various industries and Arnaiz et al.'s (2022) survey on manufacturing SMEs.

5.3.2. Research contribution of qualitative findings

This section explores and investigates the qualitative research findings and presents literature to identify whether qualitative results confirm or reject research objectives and quantitative findings are critically assessed to identify how they can contribute to the literature. All four qualitative questions will be presented in a separate section, followed by an evaluation of the research findings' themes.

5.3.2.1. Research question 1

How are continuous improvement critical factors important for northern manufacturing SMEs?

Research question 1 was formed to discover how continuous improvement critical factors are important for northern manufacturing SMEs. The research findings show that all interviewees agree and emphasised that CI critical factors are vital for manufacturing SME development, especially economic growth in the north of England (see Section 4.3.4).

In addition, the findings present that achieving CI critical factors is not just for business development; in some circumstances, they act as a business survival, especially during exceptional national situations such as COVID-19 and Brexit.

The findings indicate that CI philosophy can support manufacturing SMEs in obtaining external and outsourced resources with more employee skills and engagement and suggest a prevention plan.

According to respondents from UK manufacturing enterprises, an efficient CI philosophy structure requires an organization-wide strategy thoroughly customised to meet CI Critical factors led and supported by employees and top management. This conclusion is supported by Sanchez-Ruiz et al. (2020). They claim that organisations that take an active role in implementing all CI principles within their implementation programme would see considerable gains in operational performance. The importance of completely embracing the CI critical factors during the CI practical phase has been disclosed to enhance manufacturing SMEs' financial performance and sustainability, as well as a competitive advantage (Singh and Singh, 2018, Beyhan et al., 2019, Van Assen, 2021, Galeazzo, 2021). The CI critical factors identified in Section 4.3.4 revealed that manufacturing SMEs exceptionally require external and outsourced connections and help as much as improving employee skills and preventing plans, especially for national issues and changes such as COVID-19 and Brexit.

In terms of external support and outsourcing connection, these research findings supported by Alotaibi et al. (2019) research that government funds and university connections to business can improve manufacturing SMEs' long-term performance and sustainability. The research finding argues that improving employee skills makes them more motivated and engaged. Employees with more motivation and engagement led to increased job satisfaction, innovation capability and a decrease in absenteeism and employee turnover (Davidescu et al., 2020). In addition, the research by Sopa et al. (2020) through Indonesian businesses indicated that improving employee skills led to increasing efficiency and production as well as employee innovation capability.

This research revealed that a prevention plan, an initial plan that prepares manufacturing for any incident, is a critical CI factor for manufacturing SMEs in northern England. A prevention plan positively impacts other CI factors, such as increased productivity and efficiency. It seems unlikely there is a government consideration to offer a strategic plan for manufacturing SMEs' operation and economic issues. The findings are in line with and supported by Regarding Improta et al.'s (2018) research, the main idea of CI practice is to move from corrective to preventive actions, and one of the primary goals of continuous improvement is to move away from managing cures and toward more prevention (Gemar et al., 2019).

5.3.2.2. Research question 2

Why are continuous improvement critical factors important for northern manufacturing SMEs?

Research question 2 was formed to investigate why continuous improvement critical factors are important for northern manufacturing SMEs. The research findings indicated that most of the interviewees agreed and emphasised that continuous improvement critical factors have a tremendously positive effect on developing manufacturing SMEs in northern England (see Section 4.3.5).

From the qualitative thematic research findings in Chapter 4, organisations which effectively implemented CI principles listed in Table 4.15 and ensured the CI tools, and techniques were tweaked towards the organisation's requirements have experienced positive effects on their operational performance and financial sustainability. The sub-thematic analysis of CI critical factor's themes (See Table 4.16) revealed that improving efficiency, productivity, supply chain management, economic improvement and cultural change have essential impacts on CI factors. The findings from the critical CI factor potentials indicated that the attitudes towards implementation are highly associated with the effect of CI on the organisation's economic growth. It can be observed from Figure 4.3 that generally, the northern manufacturing SMEs perceive CI as having massive potential for economic growth and financial sustainability. The finding was also validated by northern Manufacturing SMEs who embarked on a comprehensive CI approach and had steady performance improvements and impact within their operations, simultaneously recording financial gains. The above findings are also in line with other research; for instance, improvement of economic sustainability by CI deployment in micro impact was argued by Laureani and Antony (2018), Garza-Reyes et al. (2018), Mong et al. (2021), and Bernal et al. (2021). They state that organisations with an active approach towards CI's critical success factors (CSFs) within their project experienced significant improvements in their operational performance and financial sustainability.

Respondents within the northern manufacturing SMEs indicated that organisations should take a long-term approach, led by top management, and entirely bespoke to fit the culture, systems, and employees for an effective CI structure. That point was argued by Vallejo et al. (2020), who state that a CI philosophy deployment has positive, sustainable, and influential impacts on organisations with long-term vision if the executive team is fully engaged and supports the project.

From Table 4.17, It can also be observed why CI is significant by each classification of interviewees. The findings revealed that academics, managers, and consultants emphasised the importance of CI potential improvement areas more than local authorities, which indicated that there is less concern about CI importance within government bodies than in other respondent categories. Majumdar and Manohar (2016) argue in their research on India's manufacturing SMEs that strong government support is vital as they deploy a long-term CI project, leading to a successful CI project.

5.3.2.3. Research question 3

How feasible is continuous improvement for promotion in northern manufacturing SMEs?

The objective of the third question was to evaluate the feasibility of CI deployments through the manufacturing SMEs in northern England. The thematic analysis revealed six CI theme categories that indicated the infrastructure factors that exist and are available for manufacturing SMEs in the north of England (See Table 4.18). The findings showed that respondents strongly believed that adequate political and legal initiatives, financial support, technology level and cultural factors for CI deployment within manufacturing SMEs in northern England (see sub-themes of CI feasibility, Table 4.19). The findings revealed that most interviewee types believed in CI regional feasibility, especially CI consultants who visit many manufacturing SMEs and have a close connection with their operational managers (see Table 4.20).

Furthermore, the findings uncovered critical challenges for deploying CI projects, such as cultural transformation. The result revealed that cultural change for manufacturing SMEs would be achieved with a long-term CI philosophy vision considering persistence and patience on their improvement journey. That point is argued by Hess and Benjamin (2015), Elias and Davis (2018), and Alvino et al. (2020) that CI initiatives implementation provides a cultural change mechanism to support organisations through a long-term strategy.

The findings indicated that the most essential and supporting factor for CI deployment is technology level and data connectivity. All four types of interview respondents emphasised that developing technology is necessary for CI implementation. This finding is in line with Meinert et al.'s (2020) research point those businesses with more improved technology infrastructure are more likely to have successful CI projects. Better technology can provide intelligent and integrated improvements, identify new opportunities, offer more excellent value to customers, and reach new productivity levels through their CI journey.

5.3.2.4. Research question 4

What are the barriers, challenges, and requirements for continuous improvement projects in northern England?

The aim of the fourth question of transcription interview data is to identify the barriers, challenges, and requirements of continuous improvement through the manufacturing SMEs in northern England as follows. The research revealed the 19 themes of CI barriers, challenges, and requirements. These CI implementation barriers, challenges and needs are identified mainly by academic and CI consultants compared with local authorities and northern manufacturing SME managers (see Table 4.23). This indicates that academic and CI consultants are more aware of CI deployment barriers, challenges, and requirements due to their vast knowledge gained from studying and working in various manufacturing SME sectors and sizes.

The main challenges for manufacturing SMEs in northern England are the sub-themes of lack of outsourcing connectivity, mental resistance indicated by managers, and funding shown by local authorities for CI projects. In addition, employee knowledge (see Figure 4.5) and resistance to change (see Figure 4.6) were considered the main barriers to a long-term successful CI process.

It can be seen from the northern manufacturing SMEs (see Section 4.3.7 and Table 4.21) that the primary determinant of their most challenging factor in successful CI deployments came from their ability to connect to the government business bodies effectively, facilities and programmes such as Local Enterprise Partnerships (LEPs), Business, Energy, and Industrial Strategy (BEIS), the Federation of Small Businesses (FSB) and small business charter (SBC) knowledge transferring to their organisation's strategic objectives. These research findings are in synergy with Caldera et al. (2019), Vinodh et al. (2020), and Yin et al. (2020) results that indicate that government supports are necessary for SMEs to achieve sustainable business improvement through their CI deployments.

Northern manufacturing SMEs considered CI's potential for overall cultural improvement and integrated CI initiatives within their internal culture and corporate structure. Unzueta et al. (2020) argue that business cultural change needs employee mindset and knowledge change. The findings revealed that manufacturing SMEs who recruit highly qualified CI experts or consultants cultivate employee trust and drive a change mindset within the organisation.

Northern manufacturing SMEs also consider mental resistance and funding CI projects challenging. These practical and essential factors are in line with the research conclusions of Hussain et al. (2019) in Pakestan, Moroz et al. (2020) in Canada and Lizarelli et al. (2021) in Brazilian manufacturing SMEs.

The outsourcing connectivity challenges, such as the evaluation of universities and local authorities' connections impact on manufacturing SMEs were not explicitly mentioned in the research, except for business' positive connection results with colleges and schools as identified in Wijayanti et al. (2020) and Vinodh et al. (2020). These issues were identified in the Northern Powerhouse project in Chapter 2 (see Section 2.1.4).

5.4 Core Discussion

This section discusses the core findings against the survey results and the literature.

The findings from the literature review on the aforementioned questions were compared and contrasted with the findings from the empirical research. The key findings from the literature and the RQs findings were combined to address the research RQ objectives on potential implementation impact on manufacturing SMEs economy growth on a macro scale.

Retrospectively, the importance and influence of CI's factors on manufacturing SMEs' economic growth were evaluated in Chapters 5 and 6. The critical challenges and requirements of CI implementation on a macro scale were identified from the qualitative (interview) findings. The key critical findings difference for an important CI implementation and challenges in a macro scale in manufacturing SMEs are identified and stated below.

5.4.1 Manufacturing SMEs versus large organisations

The results of 176 survey questionnaires and interviews revealed that productivity, efficiency, and supply chains have a significant positive impact on the economic growth of manufacturing SMEs.

Manufacturing SME managers reported that CI programme provided several benefits to their manufacturing operations, including faster communication, greater top-down visibility, and a faster decision-making process, which put our supply chain management in a better position than before its implementation.

Considering manufacturing SMEs versus large organisations, research findings on manufacturing SMEs can be critical in terms of the SMEs' limitations. The finding declared that in manufacturing SME firms, where resources were limited, middle managers were burdened with managing multiple departmental responsibilities simultaneously, such as human resources (HR) and new product development (NPD), which prevented them from having a sufficient CI strategy. In the flat organisational structure prevalent in SMEs, the proprietor or supervisor completely understood operational difficulties, procedures, and customer requirements, and was closely associated with their clients and suppliers. SMEs' strategic activities are informal, intuitive, and invisible, and frequently depend more on a quick response than a thorough analysis (Zighan and Ruel, 2021; Touriki et al., 2022)—which is consistent with research findings.

The empirical research identified the availability of resources required to bring CI change as the biggest challenge for SMEs compared to large organisations that may hinder or jeopardise their motivation to embark on the CI journey (Matt et al., 2020; Papulová et al., 2021). The findings from the literature were in consensus with the qualitative (interview) results on the differences in characteristics of SMEs compared to large organisations. The analysis of the research findings indicated a lack of awareness among SMEs regarding networking opportunities with other businesses, government bodies and local authorities, and academic institutions.

The manufacturing SMEs have limited knowledge of the support offered by government organisations such as MAS in the UK.

The finding suggests that they lack familiarity with networking opportunities with academic universities, which could lead to a transfer of knowledge and an improvement of their existing capabilities. The finding was in line with the factor as interviewers especially academics, claimed that local universities play a crucial role in spreading the most recent technical knowledge to small companies through collaborative programmes such as Knowledge Transfer Partnerships (KTP). KTP programmes between academic institutions and industry are an effective channel for introducing and implementing CI initiatives in manufacturing SMEs. However, only a tiny fraction of SMEs, less than 2%—are familiar with these programmes (White et al., 2019). Knowledge programmes like KTP may allay SMEs' concerns and dependence on outside consultants for improving their process performance.

According to interviewees, understanding the CI practical models for manufacturing SMEs that have been proposed in the literature may help manufacturing SME managers understand where their company stands in relation to various stages of CI models and fundamentals and established criteria for each model. However, they believed that it would be difficult for manufacturing SMEs to understand CI methodologies, e.g., making a transition from an existing quality operation to a Lean or Six Sigma implementation, depending upon their positioning on the growth model. Similar findings were observed during the literature review process, such as that stage models proposed in the past have received criticism in recent years for being conceptual, and descriptive (Boer et al., 2017; Belhadi et al., 2018).

5.4.2 CI implementation challenges in northern England's manufacturing SMEs

The most frequently cited reasons in the literature on manufacturing SMEs for not implementing continuous improvement (CI) initiatives like TQM, Lean, or Six Sigma were a lack of resources, a lack of top-management commitment to investing in the resources needed for implementation success and thinking of quality certifications as a goal for CI efforts (Prasanna et al., 2019; Choudhary et al., 2019; Ghadge et al., 2021).

The finding presents the fact that very few manufacturing SMEs are aware of continuous improvement tools and techniques such as Six Sigma and Lean, and those who have a CI implementation experience of no more than three to five years.

In this empirical study, CI implementation programmes were frequently attributed to factors such as lack of system knowledge, lack of funding, and lack of resources. According to McLean et al. (2017) and Alexander et al. (2019), pilot studies noted that the participating companies had little knowledge of or experience with the initiative. The author asserts that the majority of manufacturing SMEs are in the early stages of their CI journeys, where processes are not standardised, performance metrics are not established, and SMEs have limited knowledge of the use of CI tools and techniques.

The research findings claim that the long-term sustainability of the CI programme can be achieved by training new staff along with current team members. This compensates for limited resources and aids in the development of a company-wide CI knowledge team. If employees continue to work in a reactive mode, prioritising deadlines over product and service improvement, the desired outcome will not be achieved. Also, for the starting stage of the CI journey, manufacturing SMEs should avoid difficult tools and techniques, as SMEs struggled to use complex tools and techniques of CI such as SPC, DOE, and FMEA, to name a few.

The research indicates that management in manufacturing SMEs has a scarcity of theoretical knowledge regarding the utilisation of CI statistical approaches to address problems. Additionally, a fear of statistics is hindering their adoption of tools and techniques that have the potential to greatly impact the performance of manufacturing SMEs (Siegel et al., 2019; Usai et al., 2018; Selviaridis, 2021). Interviewees especially CI consultants, believe that the use of Lean for the first round of improvement and quick wins in manufacturing SMEs will accelerate breaking down employee resistance to change.

Moreover, manufacturing SMEs expressed a desire to network and collaborate with academic institutions or government entities to gain knowledge of funding opportunities and improve their business performance through the implementation of CI methodologies (tools and techniques). Some of the manufacturing SMEs were familiar with government funding programmes offered by organisations such as MI, SMAS, and MAS, however, the vast majority lacked an understanding of how to obtain government funding or academic support.

The finding indicated that the participating firms in the study did not adhere to a specific framework or model for the implementation of CI. However, it was acknowledged that a framework or principle that serves as a guide could aid in the implementation of CI methodologies and ensure their long-term benefits. The literature often cites incorrect implementation approaches as the primary reason for the failure of business improvement methodologies (Antony and Gupta, 2019; Hines et al., 2020). This is why numerous scholars have emphasised the necessity of designing a structured framework for CI (Khana et al., 2020; Alexanderet al., 2022; Chong and Perumal, 2020). The benefits of an implementation framework include:

- Providing a clear focus on the objectives to be achieved and connecting the change management effort to business goals (Khana et al., 2020; Chong and Perumal, 2020)
- Reducing reactive behaviour and offering a simple, efficient, and cost-effective guide that can be easily implemented (Khana et al., 2020)
- Encouraging the management to address critical issues that may otherwise go unaddressed (Alexanderet al., 2022)
- Providing a platform for leaders with a genuine interest in quality improvement to take charge of the change initiative (Alexanderet al., 2022; Chong and Perumal, 2020)
- Facilitating the integration of multiple disciplines in the change process (Alexanderet al., 2022; Chong and Perumal, 2020)

There is a scarcity of models and frameworks for CI implementation in manufacturing SMEs as compared to larger organizations. Several existing quality frameworks for manufacturing SMEs fail to address how these enterprises with limited resources can effectively implement them. The literature and empirical evidence strongly indicate the need for a customised framework tailored to the specific requirements of SMEs to ensure successful implementation and long-term sustainability (Kiangala and Wang, 2021; Alexanderet al., 2022; Chong and Perumal, 2020). In light of this, the author presents a personalised CI framework for manufacturing SMEs in northern England, derived from empirical research and supported by the literature, in Chapter 6.

5.4.3 CI success factors

All research participants concurred on the importance of several key factors for the success of continuous improvement (CI) efforts or certification systems in manufacturing SMEs. These factors include strong leadership, management dedication, communication, education, training, data gathering and measurement, and a customer-focused approach. They believed that strong top management commitment and training were the most critical aspects, as the decision-making authority in manufacturing SMEs is typically in the hands of the managing director or owner. Specifically, CI practitioners' viewpoints also matched the research findings and were mentioned in their multiple case studies. The literature review also identified the aforementioned factors as critical to the implementation of CI initiatives (Georgiev and Ohtaki, 2020; Alefari et al., 2020; Tavana et al., 2021; Zhang et al., 2022).

Two previously under-represented critical success factors (CSFs) have come to light through the interview process. Networking and psychological resistance are examples of these. As previously noted in Section 5. Manufacturing SMEs had weaker networking abilities compared to larger organizations. Additionally, SMEs were found to be less informed about potential networking or funding opportunities available through government organisations or academic institutions. Moreover, mental resistance prevents manufacturing SMEs from starting the CI journey and manufacturing SMEs that have already started, their mental resistance becomes more serious over time as some of the CI factors will be achieved through long-term implementation (Costa et al., 2019). The author identified these factors while conducting interviews to analyse CI implementation success factors in manufacturing SMEs in northern England.

The most frequently cited barrier to implementing change across the northern manufacturing SMEs was the scarcity of resources, followed by the role of managers, a lack of commitment from senior (top) management, changes in management structure, and inadequate training and coaching. However, the individual interviewers and practitioners perceived the scarcity of resources as a top management justification for not dedicating resources to CI initiatives. Those barriers have been mentioned in literature for SMEs (Singh and Singh, 2018; Caldera et al., 2019; Dutta et al., 2022) , however there was a few of them even mentioned for manufacturing SMEs and none of the research was in macro scale.

The survey results and the interviews showed identify the lack of commitment from top management as one of the top obstacles, lack of commitment from senior management was a hindrance to implementing continuous improvement (CI) initiatives. Consequently, it is challenging to initiate or maintain change management efforts without support from the top management in manufacturing SMEs. It is difficult for them to get started with any change management initiative or sustain their efforts without the commitment of the top management. The finding states that it is crucial for manufacturing SMEs to possess robust management dedication and exceptional leadership abilities prior to beginning the CI program. Failing to do so can result in the failure of the program, as a mere implementation of practical methods and techniques to address organisational challenges will not suffice. The CI approach encompasses overall business strategy, organisational culture, and change management. As such, manufacturing SMEs should integrate all these elements into a comprehensive corporate strategy plan before embarking on the CI initiatives (Shokri et al., 2021; Bhat et al., 2021).

5.5. Summary

This research focused on an appraisal of developing manufacturing SMEs in northern England by promoting CI philosophy by assessing frameworks, methods of preparation and execution, and employing both secondary and primary data sources to achieve the overall goal of determining how to sustain CI principles successfully at the macro/regional scale. The discussion chapter presents a convincing argument based on the survey results and interview of manufacturing SMEs in northern England and a literature review of other research results. The discussion chapter confirmed that the adoption and implementation of CI positively affect the organisation's management operations and economic growth. The latest academic research on micro-scale in a particular sector, region (developed and developing) and scope has supported findings.

Research questions' 1 and 2 results indicated the important continuous improvement principles to achieve economic growth through manufacturing SMEs in northern England. It was found that all CI projects positively related to economic growth factors, and the highest influential factors were identified as optimised productivity, supply chain, and increased business efficiency, respectively.

The findings of research questions 3 and 4 suggested a high-ranked correlation between economic growth and CI factors for manufacturing SMEs in northern England. All aspects of economic growth and CI had positive correlations with each other. In addition, significant correlations between continuous factors were identified, ranked, and evaluated.

Research questions 5 and 6 were discussed to identify and evaluate significant differences among respondents regarding the region, organisational size, experience, and sectors of respondents, considering the importance of CI factors for economic growth and critical continuous improvement factors for northern manufacturing SMEs. Several significant factors may act differently and affect both CI factors for economic growth and critical CI factors for manufacturing SMEs in the north of England.

The findings from the survey within manufacturing SMEs in northern England indicated that CI philosophy positively impacts an organisation's economy with a direct fundamental effect on productivity, efficiency, and supply chain management. The findings confirmed that CI principles significantly and progressively impact northern England's manufacturing SMEs. Critical CI principles are indicated as resource availability, enthusiasm toward the goals and top management commitment. To achieve effective operational management, manufacturing SMEs must continuously involve all relevant participants and constantly evaluate and monitor their CI performance.

The findings relating to the critical economic growth factors confirm that growth on one aspect affects other factors simultaneously and in the same direction with a strong relationship between some of the economic growth factors that imply their influence on other factors, for instance, the ability to deal with obstacles and adaptation to the new initiative. Furthermore, evaluation of CI principles indicated a correlation between the critical continuous improvement factors, which was statistically significant and shows that most factors have a solid relationship with each other and that any change to one factor affects the others. There were few significant differences between CI factors for economic growth and critical CI factors through the region, organisation size, experience, and industry sector.

The qualitative data indicated that CI critical factors have a high potential for improving manufacturing SMEs in northern England. CI factors, including technology, external outsourcing, employee training, prevention plan and government support, need to be considered as critical factors for manufacturing SMEs in northern England, considering a consistent effort from top management to lead CI deployment while ensuring continuous training of employees. In addition, those finding indications should be transferred to the policymakers as the lack of CI potential awareness by them is indicated in Figure 4.1. Critical CI factors were significant for manufacturing SMEs due to their highly effective impact on improvement projects. Influential factors, including improving productivity, efficiency, supply chain management, cultural transformation, cost reduction and job creation, directly level up manufacturing SMEs' economic position. All interviewees indicated that deploying CI projects on the macro/regional level is highly feasible. Most CI deployment requirements identified are available and adequate in northern England for manufacturing SMEs, including political and legal initiatives, financial support, technology infrastructure and cultural factors.

Many challenges identified need to be considered, such as lack of manufacturing connectivity with government bodies, universities and education centres and mental resistance. These challenges are accepted by academic and CI consultants and denied by policymakers and manufacturing SMEs' operational management in northern England.

Chapter 6. Conclusions

6.1. Introduction

Chapters 1 and 2 identified the limitations of a development framework to guide northern manufacturing SMEs in the Northern Powerhouse project (NPH). Based on the lack of a suitable framework, this present study was established and formed to support northern England's manufacturing SMEs in meeting the existing challenge of northern England's unbalanced economy.

Identifying a practical and theoretical operational development philosophy has been investigated. The CI philosophy, which positively impacts businesses' operating performance, is named the Continuous Improvement (CI) philosophy. A successful CI deployment can improve manufacturing SMEs' performance and financial viability, leading to sustainable economic growth.

The critical factors of the philosophy have been identified along with critical economic growth factors to create a systematic approach to evaluate the potential of continuous improvement (CI) philosophy on a macro scale. To conclude this research, the summary of the research chapters will be explored then each of the research objectives will be evaluated based on the systematic and critical literature review and research findings.

Furthermore, the research findings' contribution, recommendations, generalisability evaluation and, finally, research limitations and future studies will be explored, answers to the initial research framework objectives summarised and the research contributions of this project outlined. Possible implications are discussed, and suggestions offered for possible directions for further research.

6.2. Overview of research chapters

The following sections will evaluate this research chapter and provide a summary of the chapters accordingly.

6.2.1. Chapter 2

In Chapter 2, the research was formed to construct the research foundation based on a systematic and critical literature review on manufacturing SMEs to evaluate CI philosophy's capability and critical macroeconomic growth. Manufacturing SMEs' role and contribution to macroeconomic growth are explored in developing and developed countries, along with their role in the UK's manufacturing SME economic growth contribution. Furthermore, Chapter 2 presents a comprehensive and critical literature review to evaluate the published work in continuous improvement areas and manufacturing conditions in the industry.

CI philosophy's capability and its critical success factors in manufacturing SMEs and the critical macro-economic growth factors have been explored and identified through academic publications. The role of CI critical factors on macroeconomic factors has also been investigated. In the final step of Chapter 2, all the above findings were formed, and a conceptual model was conducted through the research.

6.2.2. Chapter 3

In Chapter 3, the research methodologies have been explored to find an appropriate research methodology. Research design and its phases were identified and presented in Figure 3.2. Various research philosophies and paradigms were studied, and an exploratory approach based on the positivism and interpretivism paradigm was allocated for the research methodology. This allowed research goals and objectives to be met and research questions to be answered.

The abductive research approach has been allocated for this research as this research has been based on reviewing theory with quantitative analysis (explanation) and contributing to the theory based on qualitative analysis (empirical). Therefore, the mixed method strategy was applied. The rationale behind choosing the mixed method was based on this methodology's advantage, as the mixed method approach supports research with more in-depth, reliable, and creditable data. The mixed method is a method for analysing the same study's results utilising multiple data collection methods. A mixed-method (triangulation method) study presented more phenomena from various perspectives, which led to gaining and improving the ability to collect and analyse questionnaire and interview data.

On a more philosophical level, mixed methods research combines paradigms, allowing inquiry from both inductive and deductive perspectives, enabling researchers to connect theory generation and hypothesis testing within a single study. It serves three primary purposes: to enhance validity, generate a more in-depth picture of a research topic and more evidence, and explore different approaches to comprehending a research challenge. Additionally, triangulation can be utilised to strengthen the findings.

The questionnaire instrument has been defined and designed based on Chapter 2's finding of critical CI benefit factors (a total of 23 CI factors) and CI principles factors (a total of 14 factors) in the Likert score model. The research questionnaire population (purposive sampling) was divided into four categories: manufacturing SME managers, CI consultants, local authorities and academic.

In the second step, the qualitative data collection methods were evaluated, and the semi-structured interview was conducted through the same questionnaire category and with knowledge of CI philosophy. Four research questions were designed to be investigated through the interview data and interview questions' themes created and CI philosophy implementation feasibility outlined in northern England's manufacturing SMEs.

Data measurement systems were evaluated for both qualitative and quantitative data analysis. The data were tested with various tests for specific reasons, data was validated as tested by the KMO test, data was reliable as tested by the Cronbach's Alpha test, data were normal as tested by Levene's homogeneity test, data was accurate as tested by common method bias (CMB) test.

In Chapter three, data analysis techniques were evaluated and used for quantitative and qualitative analysis. Data was collected via Qualtrics online platform and sent to more than 800 manufacturing SMEs within various manufacturing sectors, academics, and continuous improvement (CI) consultants in northern England. More than 800 online questionnaires (using an online platform named Qualtrics) were distributed through northern England's manufacturing sector. In total, 176 valid and fully completed responses were identified and selected, representing a 22% response rate. Statistical methods were identified and used for quantitative research questions; for questions 1 and 2, descriptive analysis, questions 3 and 4, spearman's Rank-Order Correlation test and questions 5 and 6 Kruskal-Wallis non-parametric test was applied.

For qualitative data analysis, semi-structured interviews were conducted, and an interview data coding system was formed and planned. The thematic analysis was applied, and semantic approaches were conducted. The interview data coding system was identified and designed with four levels of aims and steps. The transcription analysis systems include voice confidence sound level and data relation colour code. Seventy interview invitations were sent, and 18 participants accepted those invitations.

Ethical considerations such as research health and safety and information confidentiality and privacy were evaluated and addressed. Finally, this research identified and considered methodology limitations such as researcher bias, sample size, and demographical limit.

6.2.3. Chapter 4

In Chapter 4, data analysis and findings were tested and evaluated through two main sections: quantitative results and qualitative findings.

Quantitative research data analysis evaluated all six questions formed in Chapter 2. Research question 1's findings presented the importance of CI projects to achieve economic growth factors for manufacturing SMEs. Descriptive statistical analysis with a Likert score evaluated all 23 CI factors identified in Chapter 2. Top CI project achievement with the highest Mean value identified includes optimising productivity, supply chain management and efficiency. Research question 2's findings evaluated the importance of CI principles for manufacturing SMEs. The finding indicated resource availability, enthusiasm for achieving goals and top management commitment with the highest value of CI principles for manufacturing SMEs.

Research question 3's findings section presented the evaluation of the association between critical economic growth factors for manufacturing SMEs in northern England. The findings visualised and indicated three subcategories that significantly correlate with other factors, indicating productivity, sustainability and R&D had the most correlation with other critical economic growth factors. Research question 4's findings section presented the association between the critical CI performance factors for manufacturing SMEs. Five critical CI factor association subcategories evaluated and identified CI principles with correlation with other factors, including strategic project selection, saving business process time, continuous data and information collection, top management commitment, employee engagement and empowerment.

Research question 5's finding section evaluated and indicated the significant difference amongst respondents in terms of region, organisational size, sector, and respondents' experience regarding the importance of CI factors for the economic growth of manufacturing SMEs in northern England. The findings showed that several CI factors for economic development act differently toward regions, organisation size, experience, and industry sector for manufacturing SMEs in northern England.

Research question 6's finding section evaluated and indicated the significant difference amongst respondents regarding the region, organisational size, sector, and respondents' experience regarding the importance of critical CI principles factors for manufacturing SMEs in northern England. The findings showed that several CI principles factors act differently toward regions, organisation size, experience, and industry sector for manufacturing SMEs in the north of England.

In both analyses, several CI factors act differently amongst respondents regarding the region, organisational size, sector, and experience.

In the qualitative research questions section, six questions' findings were discussed. Research question 1 highlighted the importance of CI's critical factors for northern manufacturing SMEs. All interviewees agreed and emphasised that CI critical factors are vital for manufacturing SMEs' development, especially economic growth in the north of England. The findings present that CI philosophy can bring external and outsourced help, employee skill and engagement and prevention plan for manufacturing SMEs improvement projects and nominated them as a critical factor in northern England. Research question 2 indicated why critical CI factors are essential for northern manufacturing SMEs. The finding stated that most of the interviewees agreed and emphasised that continuous improvement critical factors have a tremendously positive effect on developing manufacturing SMEs in northern England. The sub-thematic analysis of CI critical factor themes revealed that improving efficiency, productivity, supply chain management, economic improvement and cultural change have essential impacts on manufacturing SME performance with a high positive effect on the other CI factors. Research question 3 evaluated CI deployment's feasibility in northern manufacturing SMEs. The findings showed that respondents strongly believed currently there are adequate political and legal initiatives, financial support, technology level and cultural factors for CI deployment within manufacturing SMEs in northern England.

Research question 4 highlighted the challenges and requirements of CI deployment in northern manufacturing SMEs. The research revealed the 19 themes of CI barriers, challenges, and requirements. These CI implementation barriers, challenges and needs are identified mainly by academic and CI consultants compared with local authorities and northern manufacturing SME managers. The main challenges for manufacturing SMEs in the north of England are the sub-themes of lack of outsourcing connectivity, mental resistance indicated by managers, and funding shown by local authorities for CI projects. In addition, employee knowledge and resistance to change were the main barriers to a long-term successful CI process.

6.2.4. Chapter 5

Chapter 5 presents the contribution of research findings to CI theory and existing literature. The research contribution of results was discussed in two main sections of qualitative and quantitative analysis. Each research question's findings were evaluated and discussed for each main area.

The CI principles are essential for northern England's manufacturing SMEs. CI principles factors include resource availability (e.g., time, staff), enthusiasm towards achieving goals and top management commitment, identified as the highest-ranked of CI principles. Reflecting on analysing respondents' views, an appropriate CI deployment can stimulate manufacturing SME growth and development in the north of England.

There are various associations between critical economic growth factors and critical CI factors for manufacturing SMEs. Both economic growth and CI factors have interacted between them, which was identified through the survey analysis and confirmed by academic leaders, CI consultants and manufacturing SME managers in the interviews.

In this research, the contribution of CI theory highlighted that implementation of CI philosophy has proven to have a significant positive effect on manufacturing SMEs which is stated in various research on micro case studies; however, the macro aspect of the CI philosophy has not been investigated on manufacturing SMEs' economic growth. Further, this research revealed a significant relationship between manufacturing and CI economic growth factors and indicated that CI philosophy deployment could improve manufacturing SMEs in macro environments. In addition, CI deployment can play a significant role in improving economic growth on macro or regional scales as it positively affects manufacturing SMEs' economic growth and financial sustainability.

The CI theoretical relations to the manufacturing SMEs' performance capability and contextual factors of macro-economic growth are highlighted within various research sections. The critical research contribution indicated that CI theory suggests a strategic, sustainable, long-term viewpoint for manufacturing SMEs with common factors of macroeconomic growth factors.

In addition, the CI practical indications through this research highlighted that CI projects positively impact manufacturing SMEs to achieve an enhanced economic position. This research suggested that critical CI factors can play a vital role in northern manufacturing SMEs and indicated that productivity, efficiency, and supply chain management were the most influential and effective factors in manufacturing SMEs' economic development. The aforementioned research considerations and results support stakeholders such as policymakers, manufacturing SME managers, academics, and CI consultants to have a broadened view of CI philosophy's potential for developing macro and regional economic growth.

6.3. Research objectives

This research was formed to investigate an initial theoretical conceptual model (TCM) (Figure 2.10) and the CI principles' role in the manufacturing SME economic growth framework's (Figure 2.13) objectives through research questions that have been investigated through Chapters 2 to 5. The conclusion of those research objectives is presented as follows.

This section evaluates research objectives to highlight how this research's methodology, findings and discussion address each objective.

Objective 1: Identify critical continuous improvement (CI) principles for manufacturing SMEs.

Chapter 2's systematic and critical literature review identified essential CI principles for manufacturing SMEs. All CI principles were identified through the latest academic publications. In total, 23 CI principles were identified and highlighted as vital CI principles in manufacturing SMEs in northern England. The literature review analysis indicated that those critical CI principles were achievable through CI projects.

The questionnaire analysis findings also highlighted literature review findings. They indicated that all CI principles had a positive impact in terms of changing the way manufacturing SMEs operate and develop their management system.

Furthermore, the research findings indicated the top three critical CI factors that are highly influenced through CI projects include optimised productivity, increasing business efficiency and optimised supply chain management. It has been discussed that all the CI principles have been investigated in different academic publications. All that research proves that all CI principles positively impact the manufacturing and services industries. Also, research findings indicated that manufacturing SME managers with CI deployment experience and CI consultants highlighted that all these CI principles are critical for manufacturing SMEs and that addressing and achieving CI principles is essential for surviving in the global markets.

Objective 2: Investigating manufacturing SMEs' macroeconomic growth factors.

Manufacturing SMEs' macroeconomic factors have been identified in a critical literature review analysis. The critical manufacturing SMEs' macroeconomic growth factors are identified and investigated in the latest academic publications. The literature suggests that macroeconomic growth factors can be improved by manufacturing SMEs and supporting economic growth (Li et al., 2018; Surya et al., 2021; Jiang et al., 2018; Kumar et al., 2019; Herman and Stefanescu, 2017; Amritpal, 2018). The findings from empirical research agreed with the literature review. Most manufacturing SME growth factors had a strong relationship with macroeconomic growth measurements such as the gross domestic product (GDP) in both developed and developing countries, including efficiency, productivity, supply chain management, job creation, R&D, financial support, and sustainability. It implies that the aforementioned manufacturing SME growth factors can positively impact macro-financial sustainability and economic growth. In addition, manufacturing SMEs can increase productivity, efficiency and development of supply chain management and play a key role in promoting job creation. The evaluation of research findings suggests that the potential of value added to macroeconomic environments is substantial.

The interviewees agreed on the importance of manufacturing SMEs' economic growth factors and their impact on macroeconomic growth. Also, it implies that the way manufacturing SME economic growth factors are positively associated with macroeconomic growth factors supports policymakers in making more appropriate and efficient decisions.

Objective 3: Investigating of continuous improvement (CI) principles' role in manufacturing SMEs economy (Survey).

This research evaluates the situation of manufacturing SMEs in the UK economy. Manufacturing SMEs' revenue significantly, positively, and directly contributes to the UK's GPD growth.

Manufacturing SMEs have various operational efficiency and productivity problems with minimal resources to rectify. The research findings imply that the CI philosophy is one of the most creditable improvements that has successfully improved manufacturing SMEs' financial sustainability and economic growth.

Furthermore, the research findings revealed that CI principles and manufacturing SMEs' economic growth factors are common with several manufacturing SMEs' economic growth factors that have been directly influenced by CI deployment. CI principles play a vital role in developing manufacturing SMEs' operational performance and have proven to have a high potential for positive change in manufacturing SME management systems. Furthermore, CI principles factors directly and positively impact the manufacturing SME's financial sustainability, especially in long-term CI implementation, which implies that CI philosophy has enormous potential for improving the economy on a regional and macro scale.

The thematic analysis highlighted that the success of improving manufacturing SMEs' economy by CI philosophy depends on various critical provisions, including top management support and employee skill level. Also, respondents indicated an emerging new factor which was least cited in the previous studies; communication and networking development between all stakeholders, including CI consultants, academics, manufacturing SME managers and policymakers. In addition, in terms of the development of a macroeconomic achievement, policymakers and local authorities must support manufacturing SMEs individually, contact them, introduce CI philosophy, deployment preparation and resource requirements, and offer appropriate financial support to start a CI project.

Objective 4: Evaluating continuous improvement (CI) deployment feasibility for northern manufacturing SMEs (Interview).

The research highlighted that CI deployment is feasible for northern manufacturing SMEs.

The research findings indicated that CI deployment has contributed to manufacturing SMEs' performance improvement. The research finding revealed that CI tools and techniques, such as Lean manufacturing, Six Sigma and Lean Six Sigma, significantly improve operation and culture in manufacturing SMEs in various sectors in northern England in manufacturing and service companies.

The research findings showed that respondents strongly believed that there are adequate political and legal initiatives, financial support, technology level and cultural factors for CI deployment in northern England for manufacturing SMEs. Therefore, deploying CI at the micro or organisational level within manufacturing SMEs in the north of England is feasible with potentially feasible economic growth in the northern region of England if political, technological, and financial support is available. Several critical suggestions need to be considered to enhancement the CI progress in the region, including more policymaker engagement with more detail of manufacturing SMEs' current performance situation, academic research with more practical aspects to be understandable by manufacturing SME managers (e.g., action research), northern England requires more CI consultants and manufacturing SMEs need to update themselves more frequently by contacting government support centres.

The technology infrastructure and financial support were the key challenges for a macro and regional CI implementation that were considered by stakeholders, especially for manufacturing SME managers, as they have limited resources such as time, employees, and funds.

The three cores of macro-CI deployment barriers are identified: the lack of outsourcing connectivity; the lack of manufacturing SME connectivity with government and academic organisations such as LEPs; and knowledge centers need to be improved by all stakeholders.

Secondly, mental resistance, several reasons for mental resistance indicated by respondents that have a negative effect on CI deployment such as the scarcity of showing employee and managers mistakes, owner decision-oriented, reactive firefighting approach rather than proactive approach to CI are the primary organisation, employee, and top managers' mental resistances. This problem can be rectified by providing more CI philosophy knowledge and cultural change during a long-term CI deployment.

Thirdly, funding new CI projects is a fundamental barrier as manufacturing SMEs have limited resources of funds, time, and employees. The government needs to offer more funds and investment in CI projects, especially at the starting point, as it takes time to manufacture. SMEs are benefiting from their CI deployment.

Objective 5: Recommendation of a framework for manufacturing SMEs to get maximum benefits of NPH project in northern England with generalisability.

The initial framework has been formed to investigate the possibility of helping northern manufacturing SMEs to improve their performance by CI deployment on a macro scale. The framework has set the aim and objectives for this research to solve the problems that manufacturing SMEs face regarding the barriers and challenges that prevent business improvement.

The research revealed that the CI philosophy facilitates manufacturing SMEs for an improvement journey. Therefore, based on the research findings, a new framework has been formed to highlight the capacity and influence of CI theory that proposes sustainable economic growth for manufacturing SMEs, which is presented in this chapter in the recommendation section.

6.4. Managerial contribution

There are several definitions for CI in the literature. These embrace the planned, ongoing, and systematic process of constant, incremental and company-wide change of existing practices aimed at improving company performance and, more widely, a type of change that is focused on increasing an organisation's effectiveness and efficiency in fulfilling its policy and objectives.

The research presented that CI philosophy is not limited to quality initiatives. Continuous improvement can be applied to corporate strategy, performance, and relationships with clients, employees, and suppliers. CI needs are implemented in the whole organisation, including all employees. From a practical point of view, the CI activities should be regular and connected to the day-to-day routines. Finally, to complete the above consideration, manufacturing SME managers should maintain CI in a sustainable, focused way in their improvement projects. This iterative and repetitive nature of improvement is traceable to several other cyclical scientific and managerial methods such as Six Sigma, Lean and Lean Six Sigma.

The research highlighted CI managerial effort as the cultural shift for manufacturing SMEs that can be the most profound and challenging to realise. The study revealed that CI enterprise and manufacturing SME managers are responsible for creating the strategy. The workforce must design and implement the tactical solutions required to execute the strategic plan. This frees managers from the day-to-day follow-up, so they can focus on performance measurement, strategy and removing operational obstacles. At the same time, the workforce's knowledge base and level of fulfilment grow exponentially. The research also revealed that manufacturing SME managers from various industries must boost their relationship with local authorities to achieve appropriate support from government bodies, including financial and knowledge support. Macroeconomic growth is achievable with the managerial strategies through CI deployment and can support manufacturing SME managers through other macro improvement projects such as the NPH project.

6.5. Contribution to NPH

The research findings evaluated the data on manufacturing SMEs in northern England in a macro level, like the Northern Powerhouse project. Northern powerhouse project has introduced a road map for north England to balance their economic growth by investing in transport, schools and colleges skills improvement, innovation, and culture. These investment areas have a solid indication of achieving economic growth with no definition of the continuous improvement approaches with a long-term vision.

In addition, The Northern Powerhouse strategy plan has not considered any development plan for manufacturing SMEs. As manufacturing SMEs have a significant economic contribution in the UK, it is essential to have an individual plan to enhance their performances, resulting in economic growth and financial sustainability. Therefore, this research identified the CI philosophy's most appropriate operational and practical management approach for manufacturing SMEs that successfully improves manufacturing SMEs for various industries in developed and developing countries.

The research findings presented that CI philosophy can change the economic position of manufacturing SMEs on a macro/ regional scale with practical and achievable short- and long-term deployment results. The CI deployment is feasible with tangible macro-economic growth results. The research findings indicated that northern manufacturing SMEs are constantly required to improve their performance efficiency and productivity to achieve sustainable economic growth.

Northern manufacturing SME managers indicated that they have minimal resources. The CI project needs appropriate time, employees, skills, and funds to start such improvement projects. The research stated that CI projects fundamentally need to be supported by local authorities, policymakers, and other supportive governments from financial and CI skill support.

As a consequence of these research findings, CI philosophy can be fitted in to the Northern Powerhouse project for manufacturing SMEs to provide financial sustainability and competitive operational advantages.

6.6. Recommendations

In the academic literature, there is no standard framework for CI project deployments on a macro scale. CI is implemented in the industry and approached only on a micro scale with little relation to the regional economic development or specific prominence on manufacturing SMEs' financial sustainability.

The recommendations are intended to identify factors for promoting CI's acceptance, knowledge, and implementation success in northern England's manufacturing SMEs industry. As the CI philosophy aims to pursue improvements within an organisation's operations, finances and strategic objectives while improving organisational competitive advantage, all the recommendations proposed in this section are geared towards these targets.

The following are recommendations on successfully promoting CI philosophy for

the manufacturing SME industry with the purpose of macroeconomic growth in northern England. These recommendations are based on research findings in Chapters 4 and 5 on promoting CI philosophy in developing and developed economies highlighted in a CI philosophy deployment framework.

6.6.1. Sustainable manufacturing SMEs economic growth framework

The framework has been developed based on the initial proposal into a framework that captures the relevant concepts and theory from the literature and builds on the results accumulated from the questionnaire and interviews. The result is a framework that enables manufacturers to be sustainable by achieving a strategic fit across the activities of CI promotion. The elements discussed in the previous section are put together to form the framework, as seen in Figure 1.

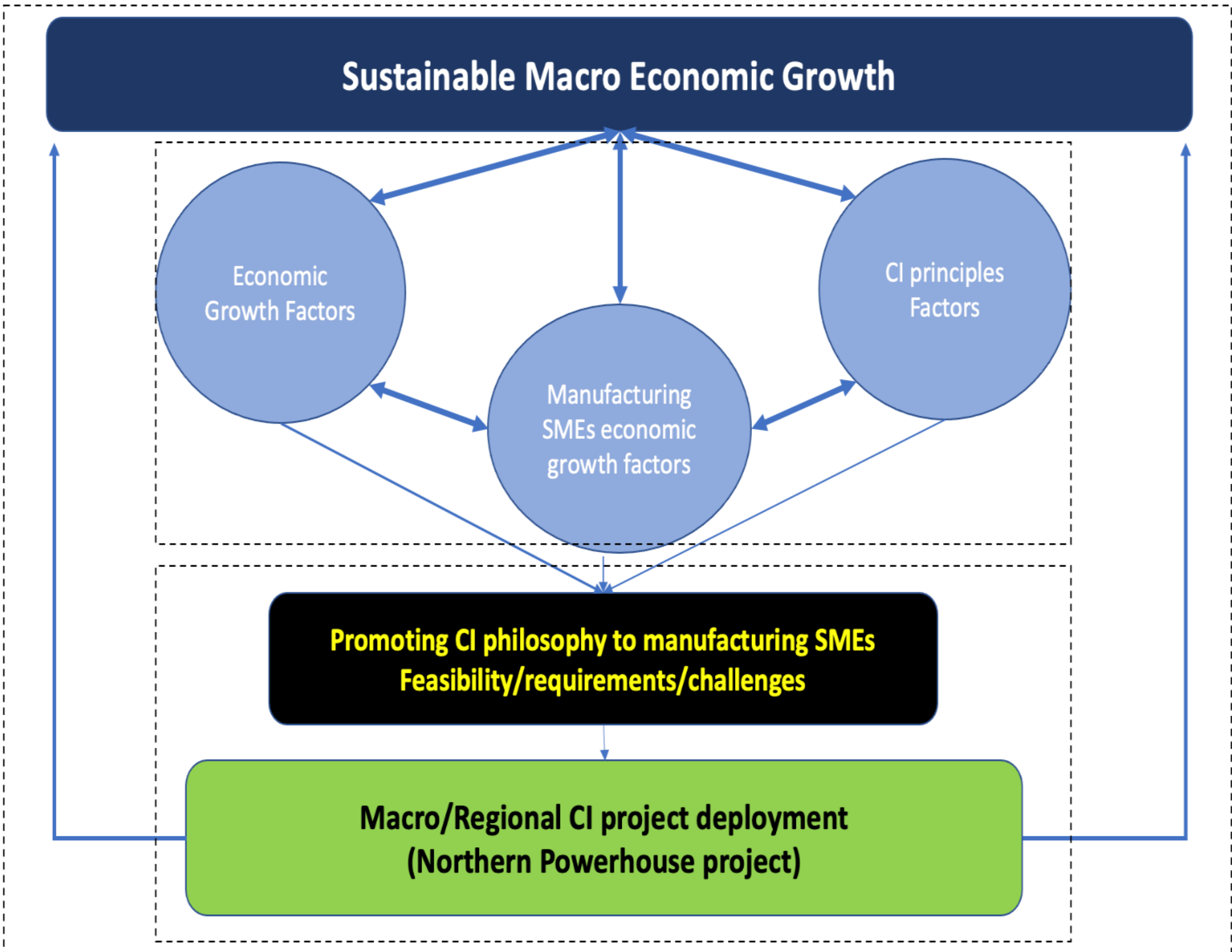

Figure 6.1: Sustainable Manufacturing SMEs economic growth framework

This section describes how sustainable manufacturing SMEs' economic growth framework components were formed. The literature review shows that CI deployments positively affect manufacturing SMEs in various industries and developed and developing economies. Also, there is a strong connection between CI principles and economic growth factors, and those common factors positively affect manufacturing SMEs' operation management and economic sustainability.

Therefore, CI deployment can change manufacturing SMEs and achieve macro/regional economic growth.

Data sources suggest that CI deployments require a practical strategy and framework aligned with the company's objectives. Lessons learned from the literature on manufacturing SMEs' strategies show that CI deployment is beneficial because it brings opportunities for economic improvement that can be realised if the CI practices are implemented in the long term. Moreover, setting a strategic direction to align the company's sustainability and business strategies has been considered a crucial financial sustainability requirement.

The results from the questionnaire and interviews indicate that a well-defined CI promoting strategy to improve economic performance might be missing. It was found that companies are willing to make efforts and allocate resources to financial improvements; their efforts appear to be well-coordinated; however, their outcomes need to be economically measured in macro-scale impacts with the help of local authorities and politicians. Promoting CI deployments on a macro/regional scale was evaluated as a feasible deployment with several challenges and requirements from manufacturing SMEs managers' viewpoints. The last section of the framework highlighted that CI could be promoted in the Northern Powerhouse project or any macro development projects regarding sustainable economic growth.

Based on the above framework and research results, the recommendations proposed here are intended to identify methods for enhancing CI philosophy's roles, acceptance, knowledge, and implementation success within northern England's manufacturing SME industry. All the suggestions in this part are orientated towards these goals because the CI philosophy seeks to improve an organisation's operations, finances, strategic business objectives and competitive advantage in a macro scale environment.

The following are recommendations on how CI philosophy improves the manufacturing SME economy. These recommendations are based on the secondary findings in Chapter 2 on CI's role in improving the manufacturing SME economy in developing and developed economies, the preliminary research results of Chapters 4 and 5 and the framework created within Chapter 6.

6.6.2. CI principles and manufacturing economic growth factors

One of the keys to regional economic growth relies on manufacturing SMEs' financial sustainability and growth. The manufacturing economy growth factors can be improved by CI deployment. Therefore, CI principles have been identified and ranked within northern England's manufacturing SMEs and evaluated as the critical and most influential factor.

CI philosophy can change the business development culture and positively affect the short- and long-term. Changing regional/macro-economic growth is feasible and can be successfully achieved with a strategic CI deployment plan for manufacturing SMEs. In the CI deployment journey, several key and critical challenges were identified and needed to be considered and treated effectively.

6.6.3. Alignment of manufacturing SMEs' objectives with CI principles

Manufacturing SMEs must link CI principles to their organisation's strategic objectives to effectively apply the tools and techniques of CI to their functions, operations, and projects relevant to achieving their overall business targets. This decision will enable organisations to benchmark effectively, track performance improvements, and find creative solutions to organisational issues. To effectively structure the CI tools, techniques, and preparation patterns required to ensure the long-term sustainability of the initiative, organisations should adequately review and spell out areas needing improvement as well as their strategic objectives before adopting CI principles within the northern England manufacturing SMEs framework.

6.6.4 CI knowledge and awareness

The lack of CI potential awareness and knowledge was recognised as a significant element that will complicate the deployment of CI inside northern England manufacturing SME firms. Manufacturing SMEs need to be informed of the CI potentials and advantages, as respondents indicated inadequate awareness was one of the significant challenges. The CI knowledge also resulted in manufacturing SMEs' financial sustainability and long-term economic growth.

To achieve the above objectives, northern England's manufacturing SMEs need a substantial long-term investment in employee training. The justification for this recommendation is based on manufacturing SME managers and CI consultants' responses, where it was noted that there is a paucity of CI investment by northern England's manufacturing SMEs.

6.6.5. Top manager engagement

Another CI deployment challenge was the limitation of manufacturing SMEs' top manager engagement. This challenge is indicated as a significant barrier to manufacturing SMEs. Manufacturing SMEs are primarily owned and directed by a single director or family member and make their own investment decisions rather than relying on an independent manager. CI consultants and academic respondents indicated this barrier. Top managers support tackling resource limitations such as funds, time, and employee knowledge, however, they do not adequately engage with the improvement process, especially in long-term projects.

Manufacturing SMEs managers for the starting point of CI deployment can focus on the top CI principles that have more impact and influence on their financial sustainability and economic growth, such as productivity, efficiency, and supply chain management. Therefore, they can manage their resources efficiently and prioritise their business priority objectives.

6.6.6. Policymakers and local authority support

Northern England's manufacturing SMEs require support from the government to appropriately implement CI projects. There are two groups; the first group knows about CI's operational and economic growth potential and has already contacted government bodies to support it; however, they found it an arduous, complicated, and time-consuming application process with a low acceptance rate. The second group are those who had never heard about the CI philosophy at all. Both groups must be supported by the local authority with CI project funds and knowledge. Thus, policymakers have a crucial role and responsibility in promoting CI philosophy within manufacturing SMEs.

Local authorities claimed that financial and knowledge support is available for CI projects for manufacturing SMEs. However, they are rarely contacted and have minimal CI proposals each year. The local authority receives the initial government funding for manufacturing knowledge development; however, they must send the funding back to the government if it is not used. The complicated supporting issue came from a lack of communication between the local authority and manufacturing SMEs. Based on the manufacturing SME managers, CI consultants and academics, raising the CI project financial support and CI potential awareness and attractiveness can work through two mechanisms:

First, local authorities can directly support existing CI projects. For instance, they can update their application policies by reducing the CI fund application process with an immediate admission response. In addition, local authorities can provide individual and exceptional CI fund application support, especially within vulnerable and unexpected national economic crisis times such as pandemics (Covid19) and Brexit.

Second, policymakers can introduce individual and local CI potential awareness by establishing a particular CI knowledge hub. The CI knowledge hub can send a CI philosophy booklet with an online link with more free CI knowledge. The knowledge Hub can encourage manufacturing SMEs by inviting them to a CI conference or networking event. Businesses with CI deployment experience can share their real CI project challenges and results with others. In addition, they can provide individual CI courses for manufacturing SME employees, so they rely less on the CI consultant and outsource knowledge support. They can have a permanent employee with CI knowledge in their business.

Furthermore, policymakers can establish an individual CI local government department that can send CI consultants to visit manufacturing SMEs, introduce CI philosophy, and follow up with their progress. Due to manufacturing SMEs' financial limitations, government support needs to be free of charge to be more effective and sustainable.

6.7. Triangulation validity/reliability

In mixed-methods research, triangulation is regarded as a means of assessing the internal validity of findings (Woolcock, 2019). Triangulation is a validity process where researchers investigate for convergence across numerous sources of information (Campbell et al., 2020). Analysing the evidence from the different data sources in this study has formed an articulate justification for the CI framework and supported its internal validity.

The results were mainly found to cross-validate each other when the study's many components were evaluated using the literature review, the academic survey, the industrial survey, and the interviews. In the quantitative method steps, relevant sampling and statistical tests were also applied to increase confidence in the framework's accuracy (Mays and Pope, 2020).

Table 6.1: Multiple data collection methods corroborated the triangulation findings

Methods \ Findings	No CI deployment framework on a macro and regional scale.	Manufacturing SMEs contribution to economic growth.	CI principles have common factors with manufacturing SMEs economic growth factors.	CI deployment significantly and positively affects manufacturing's economic sustainability.	Identify critical CI principles in achieving manufacturing SME's economic growth factors.	CI deployment feasibility within manufacturing SMEs on a macro and regional scale.
Literature review • Systematic • Critical	✓	✓	✓			
Questionnaire survey • Northern England's manufacturing SME managers • CI consultants • Academics			✓	✓	✓	
Interviews • Northern England's manufacturing SME managers • CI consultants • Academics • Policymakers and local authorities	✓		✓			✓

6.8. Generalisability (practicability and feasibility)

Contribution to generalisability refers to the implications and findings from a study that can be used by other researchers, policymakers, sectors, or managers to make decisions for their procedures, businesses, or other emerging challenges. The researcher can contribute by creating frameworks, models, guidelines, strategic initiatives, and policies or by making recommendations for improvements relating to business or other social issues.

This research finding can be used in manufacturing and services in developed and developing economies to support macro/regional economic sustainability projects. The developed CI framework can be used in different manufacturing SME industry sectors. The CI framework can be used by other stakeholders such as academics, policymakers, CI consultants and manufacturing SME managers. Following is a list of the practical contributions made by this research:

- Identification of CI principles factors associated with manufacturing SMEs' financial sustainability.
- Identification and evaluation of critical CI performance on manufacturing SMEs' economic growth.
- The conception of CI project deployment impacts manufacturing SMEs' economic growth on a macro/regional scale.
- The CI principles readiness index is created to evaluate manufacturing SMEs' readiness for more efficient deployment of CI without making any significant disturbance.
- Improved knowledge of the essential elements of manufacturing SME's requirements before starting the CI journey.
- Establishing a practical and feasible CI deployment framework tailored to manufacturing SMEs' financial growth requirements to streamline deployment and long-term sustainability of advantages identified from CI principles.
- Indicating the significance of local authority and policy support to ensure a sustainable approach towards CI implementation in manufacturing SMEs aligning with targeted macroeconomic growth by local authorities.

6.9. Research limitations

This research evaluated the state of CI philosophy deployment on economic performance, limited to helping manufacturing SMEs exclusively in northern England. The author decided to undertake exploratory research since this was one of the few studies on CI implementation about manufacturing SMEs on a regional/macro-economic growth scale for developing economies such as northern England. The design of the CI deployment framework was based on the key findings from the limited sample and matching it with the literature.

There are several limitations to both data collection methods, quantitative and qualitative. The response rate of the quantitative study (questionnaire) was limited to 22% of manufacturing SMEs through businesses with limited and non-CI implementation experience. All the facts above may limit the statistical generalisability of the findings.

In the qualitative method, the author selected 85 potential interviewees with experience or knowledge of manufacturing SMEs' performance improvement in their previous or existing job position. Only 25 of them accepted. Due to the Covid19 pandemic, all interviewees required an online interview. However, instead of their acceptance, seven interviewees cancelled their appointments, including three manufacturing SME managers, due to staff shortages. One of them suffered from Covid19, and three policymakers (MPs) cancelled the interviewee appointment due to the critical situation of covid19 and their constant Brexit meetings. Two MPs accepted to contribute; however, only one MP contributed after postponing his appointment six times. However, at the last minute, he cancelled and provided a written statement of interview questions. Thus, the interview approaches shifted to the Local Enterprise Partnership (LEPs) members; consequently, two LEP members were interviewed.

Consequently, this research is limited to 18 interviews contributed by four groups of respondents: manufacturing SME managers, academics, CI consultants and local authorities (policymakers). The rate at which each individual assimilates knowledge will vary among individuals with varied learning and knowledge capacity.

In addition, during the qualitative data collection, the author suffered from herniated discs and worked with severe back pain for over two months. The health issue caused the data collection phase to take more time than expected. The author could not sit for more than 30 minutes, so the health issue limited this research for about three months, from eight hours of study to five hours per day.

This research was based on an empirical study. The author has not implemented action research or case studies to test, improve and analyse the factors that affect the outcome in each macro or regional case research, such as the Northern Powerhouse project.

6.10. Future research directions

CI philosophy is a quality journey; there is still room for enhancement or refinement throughout the PhD process. The limits of this doctoral research were briefly discussed in the paragraph above. Future research could address these issues to increase the generalisability of the results to a broader audience. The following is a list of some potential solutions to the generalisability problem:

- A more extensive survey can be conducted that covers more aspects of what motivates a sustainable manufacturing SME economy through increased sample size for both questionnaire and interview to obtain more accurate information, less bias and help improve understanding of CI philosophy potentials. Also, expanded research creates the knowledge gain that can develop more sophisticated systems that call for numerous optimisations via analysing updated and new elements and driving factors.
- Comparing the variations in performance measures and management styles between SMEs and their larger counterparts, new research could include large enterprises so that

findings can be generalised to the whole manufacturing industry with the possibility of comparative analysis.

- Incorporating service companies from around Europe and other continents, the scope of CI research in SMEs can be expanded to provide a richer and more reliable view of the state of CI philosophy implementation in SMEs worldwide. This could also help determine whether a nation's culture has any bearing on the success of CI deployment.

Future academic research design methods are also essential for more profound and richer findings. In this PhD case, the author preferred to limit the PhD research to the positivist paradigm solely due to the extensive and full-time PhD term. However, I decided to combine a positivist and phenomenological paradigm to answer my study objectives. It was logical to adopt a mixed method approach to ensure that the new theory is created and evaluated in the sample firms as CI deployment to develop the regional economy is a newly emerging area of research in manufacturing SMEs with insufficient theoretical information. By raising the awareness of mixed methods at operations management conferences and publishing more articles on mixed methods in top operations management journals, this research methodology can be expected to alter in the future.

Future academic research can be conducted to find more deeper understanding of CI's potential for developing economic growth in macro environments. More academic research also reflects a more accurate CI deployment structure in diverse markets and industry sectors with different cultural limitations and economic growth factors. Future research results contribute to more prosperous and profound academic publications and can be used by policymakers, CI consultants and operational managers in various industry services.

6.11 Summary

The conclusion chapter presented and evaluated all chapter conclusions. All five research objectives were explored, and the conclusion of the research objectives was evaluated. The managerial contribution of this research was assessed, and the practical implications of these research findings on operation management systems were investigated and presented. The Northern Powerhouse project was considered a macro-environment project, and the impact of this research's conclusions on similar macro-environment projects has been analysed, evaluated, and presented as the potential contribution of CI philosophy on manufacturing SMEs.

With various research conclusions, the researcher's recommendations were presented and evaluated, and the sustainable manufacturing SMEs economy growth framework was recommended, explored, and evaluated.

For the reliability and validity of the research findings, the triangulation of this research presented and the area of each research aspect that presented with its findings have been drawn and evaluated alongside the research methodologies used for that particular stage.

The generalisability of the research findings and conclusions were evaluated and explored in terms of how CI philosophy can be used with various industry sectors. Finally, future research directions were presented and evaluated how this research can be used in academics with the potential of future research with more expansion areas and factors for manufacturing and service sectors.

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Appendices

Appendix I. Survey Questionnaire

Continuous improvement strategy survey questionnaire

Dear Participant,

I am a PhD student at Northumbria University currently working on research about continuous performance improvement and its impact on economic growth of manufacturing Small to Medium size Enterprises (SMEs) in northern England. To accomplish this research, I am collecting your valuable view through this survey questionnaire. The key objective of this study is to assess the association between continuous performance improvement practices and macro-economic growth for manufacturing SMEs.

Your participation in this study is voluntary and you are free to withdraw your participation from this study at any time. The survey should take only 10 minutes to complete. The results of the study will be shared with all participants in the form of an executive summary at the end of the study on their request. There are no risks associated with participating in this study. All responses of this survey will be recorded anonymously. If you have any questions regarding the survey or this research project in general, please contact Mahmoud Ramezani on mahmoud.ramezani@northumbria.ac.uk or Dr Alireza Shokri on alireza.shokri@northumbria.ac.uk.

By completing and submitting this survey, you are indicating your consent to participate in the study. Your participation is appreciated.

Continuous Improvement questionnaire

1.0. What is your current position in this company (please select as many applicable)?

Continuous Improvement (CI) manager quality manager Lean practitioner

Lean and Six Sigma practitioner Managing director consultant supervisor

operative/employee production manager Academic Other (please, specify…..)

1.1. How many years of working experience do you have at this position field?

0-5 years 6-10 years 11-15 years 16 – 25 years >25 years

1.2. What is your company industry sector that you are currently working for?

Manufacturing Education/Training Consultancy Service

Not for profit Other (please, specify….)

If you <u>DO NOT</u> work in the manufacturing sector, please go to question 3. Otherwise, continue answering questions.

1.3. What type of manufacturing sector you are currently working?

Automotive Aerospace Chemical Financial Pharmaceutical Energy

Logistic Educational Construction Food/beverages Information technology

R&D Other (please, specify)

1.4. What is the size of your organisation?

Micro (<10 people) Small (10-49 people) Medium (50-250 people) Large (>250 people)

1.5. What region of England, your manufacturing cite is?

North-East North-West Yorkshire and Humberside

Other (please, specify)

2.0. Have you ever had any experience of implementing or using any Continuous Improvement practice in your organisation/department before?

No **Yes**

If Yes, please, specify the type of Continuous Improvement practice……………….

2.1. How long the company has been using continuous improvement practices/strategies?

0-5 years **5-10 years** **11-20 years** **>20 years** **Not applicable**

3.0. Have you ever known Lean or Lean Six Sigma methodologies in your organisation?

Yes **No**

***If the answer is "No", please go to question 4.**

3.1. Do you have any Lean or Lean Six Sigma qualifications?

Yes please, specify your qualification level…. **No**

3.2. How do you feel about the role of Lean Management in organisational growth (please, tick as many applicable)?

Socially strong **Socially moderate** **Socially weak**

Economically strong **Economically moderate** **Economically weak**

Environmentally strong **Environmentally moderate** **Environmentally weak**

3.3. How do you feel about the role of Lean Six Sigma/Six Sigma in organisational growth (please, tick as many applicable)?

Socially strong **Socially moderate** **Socially weak**

Economically strong **Economically moderate** **Economically weak**

Environmentally strong **Environmentally moderate** **Environmentally weak**

3.4. Roughly what proportion of your employees has had training about lean or Lean Six Sigma concepts?

0% <25% 25-50% 51-75% >75%

4.0. What is the most common type of staff development practice in your organisation?

Residential course training Consultation On the job training (in the workplace

Written instructions Supervision None

Other please, specify….

5.Generally, how important **are continuous performance improvement** projects to achieve these objectives in a manufacturing SME in northern England (from 1 as not important to 7 as significantly important?

		1	2	3	4	5	6	7
5.1	**Increase business efficiency**							
5.2	**Reduce product/service quality variation**							
5.3	**Increased creativity**							
5.4	**More resilience to operational risks**							
5.5	**Responsiveness to opportunities**							
5.6	**Ability to deal with obstacles**							
5.7	**Increased Job opportunities**							
5.8	**Increased performance management**							
5.9	**Better human resource and career development**							

5.10	**Increased job security**							
5.11	**More employee engagement and empowerment**							
5.12	**Better Internal communication**							
5.13	**Increase business net profit**							
5.14	**Optimised productivity**							
5.15	**Increased organisation adaptability to change**							
5.16	**Increased capability to economic growth**							
5.17	**Optimised Supply chain management**							
5.18	**Decrease final product\service price**							
5.19	**Increased economic stability**							
5.20	**Increased reputation**							
5.21	**Enhance competitive advantage**							
5.22	**Developing unique product/ service**							
5.23	**Adaptation to new initiative**							

6.How important are the following continuous performance improvement principals for manufacturing SMEs (From 1 as not important to 7 as significantly important)?

		1	2	3	4	5	6	7
6.1	**Strategic project selection**							
6.2	**Resistance to change**							
6.3	**Saving business process time**							
6.4	**Data and information collection**							
6.5	**Top management commitment**							
6.6	**Employee engagement and empowerment**							
6.7	**Training and education**							
6.8	**Culture of collegiality**							

6.9	**Gradual movement to quality perfection**							
6.10	**Enthusiasm towards achieving goals**							
6.11	**Respect to people**							
6.12	**Team working**							
6.13	**Knowledge sharing**							

The questionnaire survey is finished. Please provide your valuable comments on the last page.

Thank you for participating in this survey.

Appendix II. Interview invitation letter

Dear……

I am writing regards to our research at Northumbria University, Business and Law faculty, with the principal supervision of Dr Alireza Shokri.

The research has been introduced to evaluate the role of **continuous improvement** (CI) principles and tools in Small and medium-sized enterprises (**SMEs**) to aid business resilience and future growth. The research aims to highlight the potential of a scientific and systematic management approach to improve manufacturing SME's economic performance**.**

The research is now in the second year and more than 800 northern manufacturing SMEs have been approached. The research plan is to interview Northern MPs members, Academies leaders, CI consultant and manufacturing SMEs managers by **Nov 2020.** The research is really needed to be supported by your view and vision. I would be grateful if you could help us with an interview appointment, please.

The interview will take between 30 to 45 minutes. All interview questions will send to you in advanced to obtain a better result and all research outcomes will be primarily shared with you.

Thank you in advance as your view and advise are very valuable to this research.
Kind regards,
Mahmoud Ramezani

PhD researcher
Northumbria University
Business and Law faculty
Email: manhmoud.ramezani@northumbria.ac.uk

Appendix III. Interview consent form

Consent form

Northumbria University NEWCASTLE

Project Title:

THE ROLE OF CONTINUOUS IMPROVEMENT ME HODOLOGIES TO

ECONOMIC GROWTH

A CASE STUDY OF THE UK NORTHERN POWERHOUSE

Principal Investigator:

Please tick or initial where applicable -

I have carefully read and understood the Participant Information Sheet.

I have had an opportunity to ask questions and discuss this study and I have received satisfactory answers.

I understand I am free to withdraw from the study at any time, without having to give a reason for withdrawing, and without prejudice.

I agree to take part in this study.

I also consent to the retention of this data under the condition that any subsequent use also be restricted to research projects that have gained ethical approval from Northumbria University.

Signature of participant.................................

Date ……………

(NAME IN BLOCK LETTERS) ....

Signature of researcher.................................

Date ….…............

Appendix IV. Participants debrief

Name of Researcher:
Name of Supervisor:

Project Title:
THE ROLE OF CONTINUOUS IMPROVEMENT METHODOLOGIES TO PROMOTE REGIONAL ECONOMIC GROWTH
''A CASE STUDY OF THE UK NORTHERN POWERHOUSE ''

1. What was the purpose of the project?

In 2014, George Osborne, Chancellor of the exchequer, introduced a plan named 'Northern Powerhouse' (HM Treasury, 2014). The project was aimed to rebalance the UK economy by providing essential infrastructure facilities and delivering high-quality opportunities for the 16 million people across in the North of England. Raising productivity, stimulating growth, creating jobs, and attracting significant inward investment are major priorities. The Northern Powerhouse Strategy states that the government's key priority is 'tackling major barriers to productivity' in the North (HM Government 2016) especially macroeconomic challenges such as BREXIT.
The limitation of NP program improvement plan as a macroeconomic environment needs to be investigated in order to utilise the programme with the world class management methodologies and techniques amongst Small and Medium Sized Enterprises (SMEs) in northern England. Economic modelling suggests that Brexit will have a negative impact on productivity, as a result of skills shortages and lower levels of competition and innovation (Hantzsche et al2019). Therefore, it is essential that manufacturing SMEs have access to high quality management skill and knowledge to compete and survive with highly dynamic and rapidly changing market environment. The global competition among organisations has led to higher demands on the

manufacturing organizations. The global marketplace has witnessed an increased pressure from customers and competitors in manufacturing and services sector especially manufacturing SMEs (Ahujaand Khamba, 2008). As a result, these manufacturing organisations need to adopt some modern improvement philosophies to such as CI utilising its relevant initiatives. Continuous Improvement is a long-term business strategy to improve business performance in terms of customer value and satisfaction, quality, speed to market, flexibility, and reduced cost (Ralph Keller, 2009).

Continuous improvement (CI) is a philosophy that is described simply as consisting of "Improvement initiatives that increase successes and reduce failures" (Juergensen, 2000). It is a sustained improvement targeting the elimination of waste in all systems and processes of an organization. It involves everyone working together to make improvements without necessarily making huge capital investments. In the first research step, CI critical factors analysed from the northern manufacturing SMEs, academics, and consultants via a survey (questionnaire).

The result indicated that there are three critical aspects of CI with the highest ranked on the northern manufacturing SMEs: business Efficiency, productivity, and supply chain management. Therefore, the current interview designed to obtain the feasibility of managing these macroeconomy factors through CI initiatives in northern manufacturing SMEs.

Your view and thought will support this research to create a reliable and creditable CI knowledge framework to promote manufacturing SMEs economy growth in northern England.

How will I find out about the results? Once the study has been completed and the data analysed by February 2021 approximately five months after taking part, the researcher will email to you with a general summary of the results. The data collected in this study may also be published in scientific journals or presented at conferences. Information and data gathered during this research study will only be available to the research team identified in the information sheet.

Should the research be presented or published in any form, all data will be anonymous (i.e., your personal information or data will not be identifiable).

All information and data gathered during this research will be stored in line with the Data Protection Act and store in a safe offline database and will be destroyed 5 months following the conclusion of the study. If the research is published in a scientific journal it may be kept for longer before being destroyed. During that time the data may be used by members of the research team only for purposes appropriate to the research question, but at no point will your personal information or data be revealed. Insurance companies and employers will not be given any individual's personal information, nor any data provided by them, and nor will we allow access to the police, security services, social services, relatives, or lawyers, unless forced to do so by the courts.

If you wish to receive feedback about the findings of this research study, then please contact the researcher at mahmoud.ramezani@northumbria.ac.uk. This study and its protocol have received full ethical approval from Faculty of Business and Law Research Ethics Committee at Northumbria University. If you require confirmation of this, or if you have any concerns or worries concerning this research, or if you wish to register a complaint, please contact the Chair of this Committeekimberley.hardcastle@northumbria.ac.uk stating the title of the research project and the name of the researcher.

Appendix V. Interview questions

Q1: How do you outline the feasibility of CI initiatives to manage supply chain of northern manufacturing SMEs (Motivation, Benefits, Challenges)? Why?

1.1 Are there any political initiatives required to promote (motivate SMEs, remove barriers) CI for managing supply chain in manufacturing SMEs in northern England?

1.2 How do you see government-supported economic horizon (financial arena, fund availabilities) of supporting northern manufacturing SMEs to improve their supply chain?

1.3 Are there any social trend or culture factor that has an impact on the supply chain improvement for these manufacturing SMEs in the north?

1.4 What emerging technologies might have implications on supply chain optimisation?

1.5 Are there any legal initiatives and challenges that might affect the supply chain for these SMEs?

1.6 How are these changes likely to affect the general environment in which manufacturing SMEs operates?

***How could barriers overcome and what would be required?**

Q2. How do you outline the feasibility of CI initiatives to manage productivity of northern manufacturing SMEs (Motivation, Benefits, Challenges)? Why?

2.1 Are there any political initiatives required to promote (motivate SMEs, remove barriers) CI for managing productivity in manufacturing SMEs in northern England?2.2 How do you see the government -supported economic horizon (financial arena, fund availabilities) of supporting northern manufacturing SMEs to improve their productivity?

2.3 Are there any social trend or culture factor that has an impact on productivity improvement for the manufacturing SMEs in the north?

2.4 What emerging technologies might have implications on productivity optimisation?

2.5 Are there any legal initiatives and challenges that might affect productivity improvement for these SMEs?

2.6 How are these changes likely to affect the general environment in which manufacturing SMEs operates?

***How could barriers overcome and what would be required?**

Q3. How do you outline the feasibility of CI initiatives to manage efficiencies of northern manufacturing SMEs? (Motivation, Benefits, Challenges)? Why?

3.1 Are there any political initiatives required to promote (motivate SMEs, remove barriers) CI for managing efficiency in manufacturing SMEs in northern England?

3.2 How do you see the government -supported economic horizon (financial arena, fund availabilities) of supporting northern manufacturing SMEs to improve their efficiencies?

3.3 Are there any social trend or culture factor that has an impact on efficiencies improvement for the manufacturing SMEs in the north?

3.4 What emerging technologies might have implications on efficiency optimisation?

3.5 Are there any legal initiatives and challenges that might affect the efficiency improvement for these SMEs?

3.6 How are these changes likely to affect the general environment in which manufacturing SMEs operates?

***How could barriers overcome and what would be required?**

Appendix VI. Interview transcriptions

Example 1. Academic

Q1. How do you outline the feasibility of CI initiatives to manage Supply chain of the northern England manufacturing SMEs?

The answer is yes, absolutely I strongly believe in that, I think there are host challenges in introducing developing and implementing continuous improvement initiatives and there are so many changes within continuous improvement so when you actually mentioned continuous improvement initiatives, I would say is a very broad term to me for example Kaizen can be continuous improvement, it can be fairly easily introducing in SMEs and supply chain, compare to Six Sigma@, because six Sigma because one spectrum.

So, I am now referring to the maturity of continuous improvement so there is element of maturity starting from simple Kaizen initiatives are rapid improvement events for example adopted by many companies, all the way through to implementing six Sigma and Lean Six Sigma which is heavy I have to say. In between you have got probably things like **total productive maintenance** (TPM) some Japanese companies adopting to continuous improvement not TQM is TPM.

Also, **theory of constraints** actually is under continuous improvement adopted by many American companies and also you have lean in between all these, so there are different clusters of complexity within continuous improvement initiatives, starting from Kaizen and all the way through to lean six Sigma@ for example so depending upon the problem you face in the supply chain you need to adopt actually which strategy meaning to choose.

So, I would say rather than using or sticking to one particular strategy within SMEs, it is important and actually there is a need to understand and realize, educate continuous senior managers. There's only one way to implement continuous improvement depending upon the problem you have got you need to adapt like lean tools or six Sigma tools or kaizen, it doesn't matter what you used but it all depends on the complexity of the problem you're dealing with supply chain.

Q2. Are there any political initiatives required to promote CI for managing supply chain in manufacturing SMEs?

I think again the term politics is very much it is prevalent in organisations today and that politics can be internal politics an external politics so two different aspects you can actually point on it. One can be internal politics and other one is external politics.

External politics can be later too of course ministers, NSP's, in England you called MPs for example local,

when it comes to the internal politics I would say 80s more in my opinion that politics is probably come from senior managers all the way down to middle managers and so on so primarily is politics actually played by senior managers to people on the show flow who are the doers for example and sometimes their voices never heard bias many people and this is something when I go to shop flow people in many companies in Scotland I'm realizing actually that how little people at the top are aware of these guys on the show flow lack of communication@ for example and the politics so politics to me is of course there is an element of politics and resistance is again is another element.

The resistance actually it can be in the form of politics sometimes in some companies I mean I refer to the turn off system it can be individual resistance sometimes it can be technical resistance sometimes can be political resistance sometimes and it can be organisational resistance so four different types of assistance.

I would like to emphasize so individual resistance when is somebody actually one person is playing some politics and say I am the best in the company, that kind of attitude.

Sometimes you have got, technical resistance, that means we already know Lean we have tried lean and six Sigma and it doesn't work in this company. Many SMEs actually have that attitude that is kind of family business sometimes and they realize, look, we have tried this or something similar to lean or TQM etc., we have trying so many things but they are not working for us what is a point of using of CI initiatives for us. That is a technical resistance.

Then comes actually the political assistance says there are some players within the organization different layers of management they just don't want it. so, this is the biggest resistance I was just seen in organisations and timely you see this kind of resistance at the senior management level and middle management levels and they actually kind of opposed the suppress the people on the shop floor known to get on with continuous improvement journey.

And the last one is all layers, all layers of people involved in across the organisation vertically and horizontally I called organizational resistance sometimes because again sometimes it organisation resistance comes from previous that experience with a particular continuous improvement journey. Everybody says we have tried lean across the business particularly horizontally it did not work so we don't want actually you know to go back and applying CI again. So sometimes that's the organisational resistance all levels from top to bottom I think can happen@.

Q3. Is there any cultural factors have impact on organisational resistance?

Yes, defiantly there is really good point, organisations resistance reflex on three different elements first element is leadership the second dimension is organisational culture and the third dimensions for you asked me to draw is a country culture@ so you have got leadership and actually Y axis X axis that goes into the culture and the is it accesses the country culture so three aspects can play the resistance tense and if you play these three these 3 dimensions properly, you can look and actually minimize the resistance in my opinion.

Q4. Are there any legal initiatives and challenges that might affect manufacturing SMEs?

Yes, I think in in manufacturing SMEs some of the primary challenges legal issues on getting the fund as we know that they are always at least scrutinise by the government. Sometimes they don't get the right found, sometimes the bigger players get sometimes there's politics actually you know some of the SMEs are pet's SMEs, if I know you and you are the managing director of a business of SMEs in the northern part of England, and I am a local MP and I know you very well this is where politics comes into and I give you some money the funding and someone else will missed that opportunities to get that funding, so this is politics OK so it happens. Here also it happens.

But I think the part from the legal issues and so on or political issues I would say the major challenges for SMES are budget resources constraints. People in different layers of management within SMS they have to do so many tasks compared to bigger companies so they know what exactly they want to do and you need to do. But in SMEs, you will be dragged into so many different places by the senior management team and you want you must be running around like a reckless chicken, sometimes actually SMEs operating like that, so there's always a resource constraint in terms of people and number two is of course the budget constraints that they will have.

Number three I would say is, they always are struggling with training for example train the right people infrastructure required to restore road map for continuous improvement.

I have done some research on continuous improvement in Scottish service one of my major findings was when I actually asked OK so you implement continuous improvement yes, we do, can you share your road map or framework for continuous improvement but we don't have one.

That is very clearly answer I was getting, shows SMEs that talk about CI but they don't have a road map how to implement continuous improvement which is missing in many services as a challenge so training, I would say budget constraints resource constraints and time constrains of course for example because again unlike bigger players or bigger companies time is a major challenge for small and medium sized enterprises.

Q5. What do you think about communication challenges between Government knowledge transfer funds and manufacturing SMEs?

There is no network for SMEs, I would like to have some sort of every region North South etc. they should have one or two CI networks, like CI hubs, helping companies but funded by the government actually and they should have some sort of internal consultants at a low cost@. So, the government should fund and that's what actually the one we have something called Scottish Manufacturing Advisory Service (SMAS)(https://www.smas.co.uk/). There are 62 consultants and their primary job is to go into small and medium size companies. They will never ever go to larger companies so every day at least they have to visits three companies, imagine times 60, 180 companies they are going to help. That is a full-time job in five days a week.

So, I think that sort of interventions should be carried out in different parts of England I don't know whether it exists but I think that could help a lot of knowledge transfer training program and helping actually some sort of CI projects.

For example, I think one of the major things I'm seeing in many companies today is that continuous improvement is more theory and little practice. In other words, you can ask, are you doing undo some and yes how many continuous improvement projects you have carried out last year showing the evidence of they don't want to share the evidence. They said well I think we have done some five S and I said so you are doing cherry picking of tools from here and there and then use them but there is no coherent road map how to go about continuous improvement how do you measure the maturity of continuous improvement now. After few years if you ask them, they don't have the answer, how do you know your progress in that area, you need to show that you're improving with something but how do you know you are moving so we don't have anything so common answer I'm getting. As part of your PhD, I think that would be very useful how do we measure the progress of continuous improvement in SMEs.

Q6. How we can see the result, as the statistical process is seeming very complicated and time consuming for SMEs?

I'm actually seeing these managers first thing I will tell them is what is time consuming is not applying statistics that's wrong what is time consuming is getting the right data for analysis. Sometimes companies are so scared that when you ask them, some of the managers some other operators etc. you need to collect the data and we need to actually analyse the data they think you're going to find their mistakes statistics@ and that is the biggest fear so statistics is viewed as a fear factor for many people in this country I'm seeing this across the United Kingdom manufacturing companies are service companies is because numbers mean they think that their job will be gone. They think they're making mistakes we're making defects and you're analysing defects and that means actually most likely my job will be under threat.

So I think, how do we fix this only by education*** I have to say we need to go back to the grass roots for how to educate our managers in organizations, it could be 25 people or 30 people but education , educating apply statistical methods number 1.

Number 2 is what is data? what sort of data we need to collect from our own business processes to make good decisions? managers should be educated to understand the type of data they need to collect so that they can make the decisions if somebody can help them what data should be collected and why? OK now we collected the data what can you do with the data ask this. So, it is not actually throwing Pareto over doing heavy analysis variance of hypothesis testing, regression is not about getting tool centre, let them think about it themself. How do you make you have this data in front of you but you could do with it ? tell me and then guide them through that process of making decisions for the right tools, then they understand that.

Usually, consultants they just go in and say OK I'm going to teach you analysing variance I'm going to teach you regression I'm going to teach you hypothesis test that is not something actually these managers like to hear because they scare. Quality

So, it is a psychology matter, what data you need to make the decision? why I need this kind of data? do you collect then? shall I help you with the collection of data to help them with the collection of the data then ask the question OK now you have the data in front of you but you going to do with it? I want to calculate the mean and standard English she said it and you make the decision from that? maybe not so this is the way of coaching and mentoring managed to understand not only just analysing the data but what data should be collected. That is more important in my opinion so statistical way is just a tool, but getting the right data how to collect the data what sort of data should be collected are we going in the right data these are the things they need to be aware of.

Q7. How likely that CI changes effect manufacturing SMEs operations?

When I look at the type of projects they carry out very little they're doing with environmental performance so when we look at sustainability performance table dimension which has got the economic part then it has got the environmental part and then he has also got the social performance for example keep sustainable so when we look at the sustainable performance dimensions I think many estimates aren't even larger companies they failed to do a good job on the environmental part as well as the social performance to me that is the key part a lot of British companies are failing to do social performance an inviable performance they flying absolutely they flying through or pressure performance and financial performance no problem end or when it comes to the environment performance very few projects and that is why your supervisors done project on lean and Six Sigma green points. It is open up my eyes because then we realized that very little number of projects have been executed especially by larger companies who are having using lean Six Sigma for years, they have no on environmental performance nothing you know most was operational performance and financial performance and so on so very little projects that have executed to improve social performance and environmental performance@ so that's why that's my opinion about that.

Q8. Do think emerging technology can help for these CI challenges?

People are now talking about the advent of industry 4.0 the number of tools from industry 4.0 can expedite the process of embracing some of the tools into environment performance and to another types of performance I'm sure.

I think we are in the very early days of doing the empirical study because there are so many considers and companies are doing it or from an empirical point of view is still are learning what sort of tools have industry 4.0 can be useful but can we integrate it with Lean six Sigma and CI or enhancing environment performance and social performance etc. we're still at the early stages@ in my opinion.

Consulates actually are making a lot of money by introducing for example it could be big **data analytics** would be **cloud computing** for example or it could be what is it called the **cyber physical sensors** for example **CSP** systems it could be **IoT Internet of Things** for example you know single system pulling data from various sources and so on analysing the data accordingly.

So, I honestly think we are at the very early stages and understand what tools emerging of emerging technology can be integrated with CI to achieve superior performance.

Q9. Are you agree challenges and barrier of promoting CI to supply chain are similar to productivity and efficiency?

I agree with this your comment on the supply chain with this productivity and efficiency as well you mentioned some supply chain you can look into supply chain efficiency and effectiveness for example in supply chain to measure and also supply chain frameworks for example I'm sure probably available score model and again I'm not seeing as many people integrating score model with the lean six Sigma and score for example a case study in companies for example for example running Lean and Six Sigma in SMEs.

So, supply chain efficiency effectiveness etc. we need look into productivity you very well mentioned because if you apply lean for example it has to do with projectivity. **Six Sigma it's more to do with effectiveness** in my opinion rather efficiency and of course there are other tools and techniques which can help organisations.

Q10. What do think about this research?

The research is quite interesting. One of the things probably you need to include in my opinion probably you have not actually talked to me is organisation and supply chain resilience. Because of the Covid situation, I think my current research is primarily looking at resilience for three things one is leadership resilience.

If I actually I just wanted to get example you are a leader for one automotive company I am another leader for another automotive company and we are hit in March and if I observe your behaviour and somebody's are observing not I am observing somebody and researcher psychologist with interest study your behaviour during the COVID-19 situation how did you react for example to the overnight situation as the leader CEO yeah and they also study my behaviour and sure we behave differently for the public situations two different things this is what I call the resilience leadership so we need to understand how leaders are resilience and for the situations like COVID-19 which are uncertain in the world.

We need to be more prepared, and I think leaders must be more resilience. it's very important supply chain resilience how flexible and adapt resilience they can because they can they play a big part for bigger players in the market supply resilience. And more suppliers and I am sure you would know better than me are small medium size enterprises to larger companies that would be more resilience.

And last part I would say is the organisational resilience for example must be resilient and if their SMEs are working with their suppliers then I would say the suppliers must be resilience which the organization must be resilience again and the leadership resilience for both companies leadership resilience so we are actually developing some sort of studies that the moment, ongoing study US some of the US universities about how can we create an organizational resilient model in the era of COVID-19 and that includes supply chain.

You will be finding there are lacking of social performance@ and environment performance, they do not pay attention on that as they looking for saving money which is financial aspect focused, the second aspect is operation performance. Can we increase the employee morale? within SMEs are we measuring that? if so where is the evidence how you're measuring it? where is the other place for moral? so people introducing continuous improvement, they don't focus on social performance outcomes rather than focusing on projects, training... to do some projects which group X amount of money savings and financial performance and operational performance and so on very little focus on end primary performance environment outcomes and social outcomes nothing you should be looking into that.

Q11. What do mean by employee moral?

Employee moral means, people are upset. You and me are working in a company shop floor in manufacturing company with hundred people, thought Ali is the CEO of the company. he's not communicating anything whatsoever about Kaizen has been introduced at senior level and middle level but Kaizen was never known to you and me for at least six months and we come to know that something called Kaizen is has been implemented at the top level and middle level and the story will come so that is called this lack of communication that cause employee demotivated so there's no reason why should I get up in the morning and go to the work.

So, you and me will be thinking I'm not so happy that there is clearly they are not interested in our work for example that's why they never told or introduced Kaizen for example so I think it's very important so one is actually communication from them. And number 2 is recognition thanks for what we do employees won't be happy for what we do. They want to be motivated. This called moral intervention, moral need to be high.

Example 2. CI consultant

RQ1: How do you outline the feasibility of continuous improvement and to manage supply chains in North and manufacturing SMEs?

Yes, In terms of productivity of the supply chains I think persistent SMEs tend to be ruled by people that are good about producing a certain product so electrical bullet might be so list thanks turns out the skill set I rather product's brought through into a successful business the problems that I see often is predicted in supply chain is the understanding of processes, processes involved and how you can influence processes and what you tend to find with managers and senior managers in these businesses very much look at things in the short term the alarms and don't seem to be able to create the coaching is our problem zones and there's no motivation to people or seems to be able to think about people looking at day to day challenges. Because the way that the contracts around supply chain is a lot of support I think should be put into helping remove their supply chain I buy working the computer support they support the people who supply chain to work together rather than be taking bits from it rather than be truly against each other so challenges to me is to help SMEs managers is because they have too much going their mind because they are technical people and not operationally improving people.

RQ2: Are there any political initiative required to promote continuous improvement?

That is interesting because I think in the UK is a north people towards the South of England the skill set the people has got more educated people, the people up onto developing the careers. As a pole and I think for initiatives have been driven in the southern part of England. What we need to do is recognise that the North of England is not as old fashioned that are behind the times as well there are several developing cities.

I think politically or going to do is improve infrastructure that includes travel and around the cities from Newcastle to Leeds to Manchester to Liverpool too Midlands.

But also, the mindsets of there is opportunities in northern England to try and keep trying keep trying to stop the brain drain to people. I am thinking with the way that COVID is affected not just in the UK but the whole world is that that could probably be a plus coming from that because people realising that you can work remotely a lot more, so I do think politicly we need to get development into digital infrastructure as well as transport infrastructure to create powerhouse.

RQ3: How do you see actually what the government support in terms of the economy horizon area or fund available to manufacturing services?

I've been involved with many government initiatives on implementing productivity and an awful lot waste I do think that the government and the academia and the independent consultancies need to work together on this. We need to provide more practical support and to get into the integrity what there businesses are too many government supports is so bureaucratic by the time it gets to where it needs to be the drain of percentage at this we need to rethink that and we need to rethink.

Also government funding into apprenticeships you know I'm involved in apprenticeship schemes and we need to focus more money into that to get people doing the practical things that manufacturers need you don't have to always go to University get the balance right you can we need to put money into funding get companies to become centres of excellence and developing the skill set of it for the future because I do see people engineering and manufacturing companies the skills are dissipating we're done created engineers today that we should double should be doing for what times are there.

RQ4: How do you know there's the SMS knows about the fund availability in government?

Most SMEs do not know it causes jargon and it is it's language they don't understand they are too busiest in goal through the steps to drawdown the money.

I was interested and I listen to one of the chief executives of the organisations that have developed this new vaccine for the covid and counting the specific name of the company but it's the one that said the chief exec was saying they've done this without government funding. They've done it from their own funding and it's not the risk and the reason being was to drawdown government funding the process is so small and so many bottlenecks it just slows down the process of what we're trying to achieve So what you find the SMEs thing you found with their studies assuming mergers are frightened by the process if they have to go through to get governments of their government funding I think government need to work on that.

RQ 5: Are there any social trend at the moment or cultural factors that impact on supply change or continuous improvement or productivity or efficiencies?

I don't believe there is really I don't think don't think@ socially it is a problem we will transfer find is that manufacturing companies are tent to be a little bit more difficult to change. The people in the in the organisations are very more resistant to change and you probably get that little bit more in the North of England and they think know more what they know.

I think you know more I do think culturally as well to get ambitious about politics and do you think the trade unions have a bigger impact out there but trade unions need to modernise as well and realise that continuous improvement and productivity positive words are not negative words a lot given our Theatre negative word which means that we're trying to get more workout the workers the less money that way it's all.

RQ6: You said you think the union should be more modernised than before is there any emerging technology can might have helped them?

it's a bit like using the digitalization for having meetings like this is happening now because it's been forced upon people and it's not as difficult as what people think it is what do you find this is that businesses are trade unions tend to protect the trade which sometimes protect old fashion thinking modern technology will probably mean less manual work and sometimes the trade unions were stop to happening and really because the value out there is in the engineers that will be created higher value add.

I also think that as well is that and this might be a political as well as that and watch out supply chain of getting cheap imports from the Far East from China from plus last Indian I know that's important to the economy over there but we need to start checking the weather word today to be more self-sufficient and now the rest of the world accomplish as well so the rest of the world you know can redevelop just as quickly just. We need to stop relying on the cheap supply chain.

RQ7: How do you I do however these changes likely to affect the general environments? in which manufacturing ISM is already currently operating now?

I do think the change mean is that companies need to collaborate Better together companies valuable turn cocoon themselves into their own area so they get so busy in their base and they're not learning from others. I do think we need to generate images where we even get competitors working together in the supply chain.

As an example, I am not my business but I want my consultant said I always wanted by competitors because sometimes you know I can password counter then password consummate the culture of collaboration needs to it needs to improve rather than working in sales.

RQ7: How do you do actually outline the visibility of that productivity?

To me productivity this got to measured on outputs to inputs ways you can do that he's got is lots of the getting greater outputs for the same or less inputs yeah not certain that isn't so you can then sort of getting more out of people for less yeah so you can increase capacity is increasing the mindset increasing the culture yet in the operational measures that way that we can see the grass look like direction that increase the capacity to do more value at work.

RQ8: what do you think that we can actually give them the manufacturing SMEs that awareness of continuous improvement benefit or motivation as a whole in North of England, encourage them to collaborate and give them CI knowledge?

This is a big task because the private sector of SMES will probably distance themselves from public sector or certification. I think, the things to do here is spend time investing I think in the in the way that people who run SMEs, I think we've got to try and support managers directors are running businesses who was very much driven by the bottom line because it's there is the align result of business are faild. Government doesn't support through the hard time. We need to get people who have run successful businesses as I need and try and take them away from the day-to-day activity and create collaboration of people across the whole of North of England and where they can identify the opportunities and do the strategic work for these SMEs and that has to be driven by me think by practical people at work in these businesses.

RQ9: How do you see this research do you think this kind of research is invisible after that attracted to introduce?

We need to identify where the problems are and where the opportunities are. I'm working contestant training development 25 years before that I was working in organisations and brochure management SMES, there is an awful lot we still needs to do and there's an awful lot of waste out there's a lot in efficiency I don't mean that as a negative thing because a lot of inefficiency is driven by the culture of the way we went away worked the way we live and companies count count changed on the role we've got to be honest and open and we've got to educate people about the amount of waste or isn't supply chains amounts of waste erase in the economy but not in negative as a positive about how we can invest to try and get companies to try that try and try to address that.

RQ10: SMEs managers improvement mentality?

It exactly what is you will find the range for a lot of knowledge is SMEs owners estimate you know the very clever intelligent people was successful in business not making lots of money having a lifestyle you know and the and they enjoy it they get used to it and it became very busy people.

I think what it is the culture of contention improvement is far too many problems end up being pushed off into the top of the chain. The director at the top is solving problems that they should not be solving. When I speak with small businesses, I want to make a culture of my business where our people can see their job day to day. To do that we need to build the confident and educated people. people have got stuck in their daily job behind in terms of the way there will be difficulty in education to see the way the world moving. Is not their fault. The key is we have to build an infrastructure of support where we simplify that and make it pragmatic approach.

The some of CI training are complicated and difficult and is not used in day-to-day projects. I am not interested people passing exam and showing them talk about their knowledge bases I'm interested in how they strategic apply CI, I want to show me in your business and keeping doing that. What will happen, we do initiatives course they do finishes it works in the short term as soon the support is pulled away they got back what they are thinking.

Senior manager and directors are looking they want people to come to manufacturing who are problem solvers. I do not think manufacturing industries are attracting problems solvers.

RQ11: SMEs looking for a prevention or improving their process?

Most of them they are looking in day to day problem (short term). It leads to at least to the supply chain unnecessary strain on bottlenecks asking for delivery schedules that are impossible and then and then playing companies off against each other I see rather than thinking asking for the impossible thought process of that you know we want our suppliers to be successful.

I think the large companies more to support to see CI to help the management teams within these smaller companies to think more as he was saying there more proactive and less reactive. Currently we live in an age where there is still too much reactivity and we need to create more proactivity and that's the challenge.

Big company can or will help small companies by the cash flow cash because you know them big companies are often late payers so all the pressure is on the small companies I mean I'll give you the example with I won't mention the competent but it's a larger is one of the big 5 food and drink companies. They bring initiative around continuous improvement where they want their suppliers to meet certain standards So what they do is they bring sultans to create a whole better of systems and processes to meet and then they don't put them to the suppliers and they leave them to it to try understanding it try to play.

And they threaten them with if you don't meet the standards you won't be able to supply us in our supply chain English is not you shouldn't be dumping this on the suppliers you should be taking it to them and helping them achieve these stuff it's because these small companies haven't got their hands on the resource is on the other bigger resources both financially and resource is operationally to do what the big companies ask them. The larger companies should be to make investing in in a sort of formed for the future to support the smaller companies to help them achieve this isn't just around productivity, this is ethical standards this is you know moral standards environmental standards things that the world is really taking seriously.

RQ12: Large companies looking for a cheaper resource?

Companies will invest more I'm not guarantee but it is this in the contracts they are winning sustainable or if you see a comment trying to invest in quality infrastructure underline supplier might take the contract somewhere else the fear is we don't want to invest to watch into our instruction if we're not going to get to work forward, with bold you know because it is really sad and also as well they have that this problem with developing people because you have a lot of smaller companies that are frightened to train develop people too much because they lose their best either by the larger organisations. I don't think that problem is as bad now as when it was nearly 20 years ago yeah but for training these people and they get qualified and they gone work somewhere else fear factor within the SMEs means they just take long as the competent doing the job there were happy with the status quot.

RQ12: How could these barriers as general you said can overcome and what would be required?

I think uni and researcher do a lot of research into a lot of information out there. sometimes the information is so much of it all is digesting it working with it know I don't know you might know that better than me.

I think there's got to be is going to be collaboration government supported initiatives to get people are successful on their business to be to get them to be almost become nonexecutive directors of SMEs try and support their SMEs to think about the big picture for example come into my career now. We need to get the governments the academia and the private sector bodies working together I know that that does exist in some extent but I don't think it does mean a successful.

RQ13: What do you think about this research?

What are I would probably suggest is the research needs to frighten the decision makers tried centre politicians by saying all this money is going in here is wasted your throwing it in the wrong direct direction our searches are showing this is the way it should be done?

If it is on that way and you would get him a bigger return investing. When I say Fear factor it is not in the negative factor it is a positive factor is no we're trying to do things we're trying to do it the right way but it's not working we need to get that would have a bigger voice of the people that run these and on these manufacturing companies.

RQ14: How they get awareness of any availability of CI?

Mine come from referrals. I do think we've lost similar with all do think decentralisation is as a sort of government working they're all doing it in different ways so smaller companies get confused to get support.

we need to have a system that will run for decades rather than years how is too to give them these small business manages conference that is a body at her where they can select to training@@.

Some consultancy do a project that they do not know about the businesses, I never go into a project that I am not comfortable with delivering by Lauren sources that will underlines win the project and the work out how to deliver it when they're in their why who is it stop I don't understand that is understand that understand what they need I'm not going to do it coz I'm not the best person to do it that's worked well for me why no other consultants is just going to go and get money off the client that's why SMBs are frightened of is more cost out of the business and we needed less resort or probably not is all or is or is a short result should actually result so okay thank you very much thank you for is very good idea and you instead anyway good actually factors actually which is the affected the same is manufactured to reach the console turn and what it was exactly problem.

Appendix VII. Semi- structured interview data analysis strategy

Description-focused Nodding (coding) with the final report on NVivo software

Preliminary (Planning) Level:

1) **Making mind mapping**
2) **Coding Map**
3) **Node stricture on NVivo software**

Level A: Coding research data

Descriptive Strategy

Creating an anchor code for each of the research questions

Step 1: Descriptive data coding (Investigating Participant's direct answers for research question).

Step 2: Question labelling (for developing the themes that answerer research question).

Step 3: Create and define labels (digesting respondent data and labelling them).

Step 4: Assign labels to the relevant information (Manual coding in Microsoft Word , defining codes, what the codes stands for).

Level B: Categorisation strategy

Individual-based sorting Strategy

Identifying relevant excerpt assign a code or connecting to the existing code

Step 1: **Compile Nodes** (copy and paste all comments in a pile).

Step 2: **Consolidate Nodes** (the more participant talk about an issue, barrier, suggestion etc are more important and significant).

Step 3: **Review characteristic of the Nodes**

Step4: **Create theme based on features (Themes** that are consisting of the research questions)

Level C: Sort codes

Sorting codes

consolidated data in each question in different clusters number

Step 1: **Clustering the data** (evidence)

Step 2: **Thematic the date** (connecting evidence to the themes, including consolidated data in each question in different clusters number).

Step3: **Label the themes**

Level D: Analysing

Analysing data and structuring result

Step 1: **Analysing data**

Step 2: **Establishing Report**