



Business Streamlining: Towards Sustained Business Process Improvement with implementation of Total Quality Management Tools

تبسيط الأعمال: نحو تحسين إجراءات العمل من خلال تنفيذ أدوات إدارة الجودة الشاملة.

by

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Abstract

This dissertation presents a case study of a company afflicted by inefficient business processes. The study underlines the significance of Business Process Improvement (BPI) and explores various frameworks and methodologies aimed at enhancing business efficiency. Specifically, the research employs Cause-and-Effect Analysis with a Fishbone diagram to examine and understand the underlying issues of a process in need of improvement. Data, both quantitative and qualitative, was collected and methodically analyzed to investigate the root causes. The "5 Whys" methodology was utilized to identify key factors and subfactors contributing to inefficiencies. These factors were then prioritized using a Pareto chart, targeting the most significant issues that account for 80% of the process inefficiencies. Statistical analysis pinpointed the bottlenecks, facilitating the formulation of multiple recommendations. It was concluded that implementing a lean process design could resolve approximately 80% of the identified inefficiencies. The research encountered certain limitations and obstacles, which are acknowledged as potential avenues for future research.

Keywords: business process improvement, subcontractor, facility management, site manager, cause-and-effect analysis

خلاصة

تقدم هذه الأطروحة تحليلاً لحالة شركة تواجه تحديات في كفاءة إجراءاتها العملية. تتناول الدراسة بعمق أهمية تحسين العمليات التجارية (BPI) ، مستكشفة مجموعة متنوعة من الأطر والمنهجيات الموجهة لتعزيز فعالية الأعمال. تميز هذا البحث باستخدامه لتحليل السبب والنتيجة، مدعوماً بمخطط هيكل السمكة، لتقصي وفهم الجوانب الجوهرية التي تحتاج إلى تحسين في العملية. تم جمع البيانات، سواء الكمية أو النوعية، وتحليلها بطريقة منظمة للكشف عن الأسباب الأساسية للمشكلات. كذلك، استُخدمت منهجية "5 لماذا" للتعلم في تحديد العوامل الأساسية والفرعية التي تسهم في النقص في الكفاءة. وباستخدام مخطط باريتو، تم تحديد الأولويات لهذه العوامل، مركزاً على القضايا الأكثر أهمية التي تشكل 80٪ من أوجه القصور في العملية. تمكن التحليل الإحصائي من تحديد نقاط الاختناق بوضوح، مما أدى إلى صياغة سلسلة من التوصيات العملية. وخلص البحث إلى أن تطبيق تصميم عملية مبسطة يمكن أن يحل معظم المشكلات المحددة، بنسبة تقارب 80٪. ورغم القيود والتحديات التي واجهت البحث، فقد تم الاعتراف بها كفرص للتحقيق والاستكشاف في الأبحاث المستقبلية.

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List of Abbreviations

BPI	Business Process Improvement
FM	Facility Management
SC	Subcontractor
SCA	Subcontractor Agreement
PR	Purchase Request
PE	Procurement Executive
GM	General Manager
SLA	Service Level Agreement
KPI	Key Performance Indicator
TQM	Total Quality Management
OEM	Original Equipment Manufacturer

Chapter 1 : Introduction

Time is money. In our dynamic and fast-evolving world, every single minute is costly. As businesses continually adopt new strategies and technologies to stay competitive, they often encounter obstacles when transitioning to these new systems. While some challenges diminish over time, others may be inadvertently ignored.

In business operations, each department is tasked with daily activities that contribute to the organisation's overall goals. However, when a business process involves multiple departments, the attention and priority given to the task can vary, leading to inefficiencies. This discrepancy in priorities among departments is one of the key obstacles to achieving seamless process completion.

Delays in crucial business processes can significantly impact on a company's performance and must be minimised or, ideally, eradicated. Aligning all departments to ensure timely completion of critical tasks is a formidable challenge. Streamlined management systems are crucial in addressing this challenge. They foster clear and effective communication between departments, enabling efficient tracking of tasks and promoting transparency within the organisation.

Businesses that successfully implement streamlined management practices enhance internal communications and achieve greater operational transparency and clarity. This clarity is essential for meeting business obligations, such as compliance with specific regulations and ensuring the timely delivery of products and services. Ultimately, in a world where time equates to monetary value, efficiently navigating and adapting to new business practices while maintaining cohesive interdepartmental collaboration is vital for any organisation's success.

1.1 Problem Statement

Delays in a process indicate a need for proper control measures. Total quality management introduces many tools which improve an organisation's processes that impact the performance of the business.

Continuous improvement and quality control mirror each other to provide operational efficiency. Quality management should investigate the possible factors and elements that hinder on-time completion, which leads to unnecessary delays. The implications could be adverse, increasing costs, contractual conflicts and competitive disadvantage.

Plentiful impediments could be identified. However, further analysis is required to highlight the critical-to-quality factors which should be eliminated first. Consequently upon it, enhancing the process becomes obligatory and inevitable. Thereby, the improvement will magnify and amplify the quality measures of the organisation and intensify the performance.

This paper will investigate the bottleneck of a critical process in an organisation through six sigma tools and techniques, analyse the elements impacting the efficacy, and suggest an ability to produce indented and desired results.

1.2 Aims:

- To develop a tracking mechanism for evaluating and improving process efficacy.
- To facilitate thorough root cause analysis by identifying factors that detract from efficiency.

1.3 Objectives:

- To improve communication channels and workflow productivity.
- To implement a systematic approach to boost overall process performance and cost efficiency.

1.4 Research Methodology

The methodology used in this research is Ishikawa's "seven basic tools". Kaoru Ishikawa (1915) is one of the Total Quality Management (TQM) gurus. He has contributed to four aspects of Total Quality Management; 1-quality circles, 2-the quality chain, 3- the question of continuous training 4-the quality tool cause-and-effect diagram. The latter is also known as the Ishikawa diagram or fishbone diagram (Kruger 2011).

Cano, Moguerza, and Redchuk (2012) presented the Cause-and-effect diagram as one of the seven basic tools of quality control. They also added that the seven basic tools are commonly identified as the magnificent seven statistical process control tools. There are seven quality control tools:

- 1- Check sheet
- 2- Pareto Chart
- 3- Cause & Effect Diagram
- 4- Flow Chart
- 5- Histogram
- 6- Scatter Diagram
- 7- Control Chart

The research model will be a case study of a business process for a contract agreement. The investigation will analyse the delay in approval from each department and find room for improvement which will add value to the business. The values will be discussed throughout the research.

1.5 Dissertation Structure

Chapter One: This chapter lays the foundational framework of the research study. It articulates the primary purpose and underlying motivation that guided the formulation of

the problem statement. The chapter also delineates the research aims and objectives, providing a concise overview of the methodology employed.

Chapter Two: In this chapter, a comprehensive literature review is undertaken, focusing on Business Process Improvement (BPI) and the principles of Total Quality Management (TQM). It delves into the details of various quality tools and techniques, drawing on existing theoretical frameworks. Additionally, the chapter presents an analysis of previous case studies in the field, providing a critical examination of the current state of knowledge and identifying gaps that the current research aims to address.

Chapter Three: This chapter presents an in-depth exploration of the research methodology adopted for the study. It details the precise steps involved in the research process, including the strategies employed for the collection of both primary and secondary data. The chapter outlines the analytical methods to be utilized in interpreting the data, ensuring a robust approach to research.

Chapter Four: is dedicated to the analysis of the collected data, encompassing both quantitative and qualitative aspects. It discusses the statistical methodologies applied in the analysis and presents the results of the comprehensive evaluation.

Chapter Five: The final chapter concludes the research by summarizing the key findings and discussing their implications in the context of business process improvement and quality management. It explores potential solutions derived from the research and proposes recommendations for future studies. This chapter not only summarizes the research outcomes but also opens opportunities for further research.

Chapter 2 : Literature Review

2.1 Introduction

Business Process Improvement is an approach that has evolved throughout history since the establishment of business processes. Seed Ahmed et al. (2019) remarks that the Gurus of Quality introduce methodologies and tools adapted to the Business Process Improvement practices. Walter A. Shewhart and W. Edwards Deming developed PDCA (Plan-Do-Check-Act) cycle and SPC (statistical process controls); Joseph Juran introduced the Quality trilogy: Quality Planning, Quality Control and Quality Improvement; Armand Feigenbaum contrived the concept of Total Quality that later developed to Total Quality Management; and Kaoru Ishikawa, the father of Quality Circles and the creator of the cause-and-effect diagram which is referred to as Fishbone or Ishikawa diagram (Mitra 2016).

On the other hand, Chountalas & Lagodimos (2019) claim that Frederick Winslow Taylor can be the earliest influential figure in the origins of business process improvement as he developed the principles of scientific management and H. Simon, who incorporated systemic thinking into businesses. However, Becker, Kugeler & Rosemann (2003 in Stravinskiene & Serafinas 2020) argue that following the methodologies presented by scholars from the 1980s to 1990s, the emphasis on processes emerged. Harmon (2016) likewise agrees that Business Process Improvement became a prominent priority in the same timeframe and has since been a consistent endeavour for big corporations worldwide.

Hammer's conceptual process management paradigm has produced new organisational structures and solutions intimately tied to information technology. IT, geared towards automating corporate processes, is rapidly developing. However, most of these information and communication technology-based process approaches failed because

the organisation focused more on the issues of fair business and IT alignment than on the solution of the chosen IT software (Becker, Kugeler & Rosemann 2003).

Similarly, Business process re-engineering (BPR), which aims to increase stakeholder value, lower costs, and improve performance, first became popular in 1990. Business Process Re-engineering entails fundamentally rethinking processes, starting with the productive and moving to the non-productive. Management magazines like Harvard Business Review highlighted the first success stories of businesses utilising Business Process Re-engineering. The necessity for more innovative managerial techniques in business was highlighted by the scientific community's criticism of Business Process Re-engineering for conjuring up more myths than useful methodologies (Klun & Trkman 2018).

2.2 Definitions

Yousfi, Batoulis & Weske (2019) state that Business Process Improvement needs more widely agreed-upon definitions and synonymous terms. However, it has been used knowingly or unintentionally by businesses and/or organisations over time. Yousfi, Batoulis & Weske (2019) and (Dong et al. 2011) agree that originally introduced by James Harrington in 1991 as “a systematic approach to assist an organisation to optimise its underlying processes and to achieve more efficient results”.

Scholars have introduced Business Process Management in various definitions and frameworks. Some refer to the concept as Business Process Management or Business Process Change or integrate the practices into Total Quality Management approaches. Nevertheless, all the interpretations of Business Process Management consist of defining the concept as a practice that is approached by an individual leader or as an organisation to habitually evaluate an inefficient business process and identify the areas of improvement

within the process. Consequently, analysing potential bottlenecks to re-design the process workflow aims to enhance quality and optimise performance (Page 2010).

Stravinskiene & Serafinas (2020) conclude that Business Process Improvement is a management strategy that views an organisation's operation as a web of connected business processes and lists four practices for success: 1) Understand the process precisely, 2) Assign a process owner 3) Evaluate and measure the process 4) The improvement of the process should be aligned with other processes.

Furthermore, Mehdouani, Missaoui & Ghannouchi (2019) express that examining a process model enables businesses to propose new improvements to enhance the performance of their processes and make better judgments. They must, however, be able to assess how these changes will affect things. As a result, they are constantly searching for practical tools for process analysis, fault identification, continuous improvement, and change adaptability.

It was claimed that Business Process Improvement implementation is a project in which all project management principles are applied, ensuring well-organised improvement processes free from any conflicts, the ultimate goal of Business Process Improvement is to bring about a drastic change in an organisation's performance, rather than bringing out the changes in incremental steps (Bahn & Paper 1998 in Seed Ahmed et al. 2019).

2.3 Benefits

There are numerous advantages of adapting business process improvement within an organisation. The following summarises the list of benefits that were discussed in the literature:

Process improvement involves eliminating redundant tasks and activities, re-engineering processes using efficient methods, and increasing employee productivity. By

removing inefficiencies, organisations can review performance indicators and modify processes without limiting teamwork. By utilising reporting and analytics, organisations gain valuable insights into delivery patterns, identify and eliminate bottlenecks, anticipate future challenges, and adjust workflow processes to enhance productivity (Page 2010) (Klun & Trkman 2018).

Companies may put software applications and other items into production more quickly by enhancing processes by implementing technologies like Kanban boards and Gantt Charts. By seeing roadblocks earlier and clearing them more rapidly, Scrum, Kanban, and operations teams can create a continuous flow of value (Page 2010) (Dumas et al. 2013).

Implementing business process improvement can accelerate development and enhance the quality of products. By employing appropriate testing techniques, companies can ensure that goods are only produced once performance, security, integration, and other issues have been addressed, thereby increasing their confidence in the final product. This commitment to delivering high-quality goods on time can increase customer satisfaction, foster customer loyalty, and drive increased sales. Business process improvement facilitates efficient and seamless workflows, contributing to improved operations and favourable outcomes for customers. Ultimately, a successful company strives to achieve customer satisfaction with its products or services (Harmon 2014).

Ineffective processes can dishearten employees, who may feel overwhelmed by the system's inadequacies. Dumas et al. (2013) highlight the importance of transparent, uncomplicated productive, understandable, and effective processes. Process improvement can help maintain employee satisfaction and ensure the team's success. Better accountability, visibility, and well-documented procedures contribute to a positive work environment.

Businesses can differentiate themselves from competitors by continuously improving their processes. This is crucial as some competitors need more product design, customer service, manufacturing, and distribution expertise. Establishing a distinctiveness can lead to a competitive edge and serves as the focus for ongoing improvement initiatives (Yousfi, Batoulis & Weske 2019).

Yousfi, Batoulis & Weske (2019) also add that processes are human-made; therefore, there are no well-designed processes for a lifetime with no errors in our dynamic economy. They state that “organisations seek business process improvement, often through mergers or acquisitions, to improve their operations. In good shape, these improvements occur through expansion, resulting in partially redundant processes. In bad shape, companies seek efficient processes, as those with the most efficient processes often survive, while others lose ground”.

Similarly, Van Dun et al. (2023) describe Business Process Improvement as the most value-adding one since it results in new process designs that take advantage of possibilities and handle current problems. They state that Business Process Improvement can significantly improve business operations' quality, customer satisfaction, cost, and income in this way, and firms must develop their processes at a growing pace in light of the volatile business conditions, rising customer demands, and increased competition.

Finally, Harmon (2014) summarises that using Business Process Improvement approaches can also improve how well a company meets consumer and corporate objectives. The potential of business process improvement to assist organisations in optimising their operations so they are prepared to compete in today's technology-driven business climate also adds value.

2.4 Frameworks

Effective management of business processes is crucial for organisations to thrive. Quality Management (QM) has long been based on understanding "process." Businesses have identified, described, and standardised their processes, emphasising their core importance in quality management approaches such as Total Quality Management (TQM), Lean, and Six Sigma. Business Process Management (BPM) and Business Process Re-engineering (BPR) have emerged as essential tools for organisational growth and innovation. Business Process Management involves designing and managing business logic implementation, while Business Process Re-engineering advocates for radical process re-design. Understanding and effectively managing business processes enable organisations to adapt, innovate, and meet customer needs (Stravinskiene & Serafinas 2020).

2.4.1 *Six Sigma*

Six Sigma is a statistical term used to express the standard deviation from the mean, which reflects the degree of variation within a process. It measures how far a process deviates from perfection, with higher Sigma indicating better performance. However, Bill Smith (1986), a senior engineer and scientist at Motorola, introduced the concept of Six Sigma as a highly disciplined process that enables organisations to deliver near-perfect products and services. It embodies a philosophy and goal of achieving perfection in practice and serves as a method and symbol of quality. Six Sigma emphasises continuous improvement by measuring and improving company performance, practices and systems. The number six in Six Sigma statistically represents the average maturity level of most companies. By implementing the Six Sigma approach, companies can improve their processing capabilities, resulting in reduced errors, increased profits, improved employee morale, and improved product quality. Six Sigma is a rigorous,

systematic approach that uses factual information, statistical analysis, and proactive error prevention to optimise operational performance and meet and exceed stakeholders' expectations while promoting efficiency. It aims for near perfection in meeting customer requirements and fosters a cultural shift that positions companies to achieve high customer satisfaction, profitability and competitiveness. It provides a comprehensive, flexible system for achieving, maintaining, and maximising business success through a deep understanding of customer needs, data-driven decision-making, and process improvement—a continuous program. Six Sigma serves as a philosophical vision and commitment to deliver the highest quality products at the lowest cost, a measure that represents a 99.9997% quality level for products.

Moreover, processes, and as a benchmark against which to compare performance with industry leaders. It is a practical application of statistical tools and methods to measure, analyse, improve and control processes. Six Sigma is a systematic approach that leverages insights, statistical analysis, and error prevention to optimise operational performance and achieve stakeholder efficiencies (Pande & Holpp 2002; Brussee 2010; Keller 2011).

2.4.1.1 DMAIC. DMAIC is a Six Sigma Improvement Methodology. It is an acronym for Define, Measure, Analysis, Improve, Control, that provides a logical and disciplined approach to problem-solving and process improvement. It emphasises ongoing progress over time and is distinguished by its iterative nature. DMAIC is a potent quality tool that strongly emphasises change management throughout the deployment.

Organisations can efficiently address difficulties, analyse data, pinpoint areas for development, and put into practice sustainable solutions while keeping control over processes by adhering to the DMAIC framework. This strategy enables businesses to

maximise their performance and provide high-quality results while fostering a culture of continuous improvement (Pande & Holpp 2002; Shankar 2009).

2.4.2 *Lean*

Lean management, a manufacturing approach popularized by Toyota, focuses on minimizing waste and utilizing minimal resources to achieve desired outcomes. It emphasizes continuous improvement and aims to enhance efficiencies within processes. Unlike Six Sigma, which targets defect elimination for improved product quality, Lean management aims to optimize the entire process. Toyota initially developed Lean management to reduce the order-to-cash cycle. Lean process improvement involves defining value, analyzing the process to identify non-value-adding steps, eliminating or modifying them, and repeating these steps for other business processes until the organization achieves sufficient efficiency. The book "The Machine That Changed the World" by Womack, Jones, and Roos outlines five principles of lean management: identifying value, value stream mapping, creating flow, establishing pull, and continuous improvement (Charron et al. 2014; Martínez-Jurado & Moyano-Fuentes 2014). Lean consists of the following quality tools & techniques:

2.4.2.1 Kaizen (Continues Improvement). Davis, Goetsch & Davis (2016)

remarks that Kaizen is a philosophy that emphasises continuous improvement through small, ongoing changes that accumulate into significant advancements. It focuses on identifying waste sources, enhancing process flow, and increasing value creation in daily work. They listed two types of Kaizen: process Kaizen and flow Kaizen. Process Kaizen involves incremental improvements to specific processes at the team level, while flow Kaizen focuses on the flow of information and materials throughout the value stream. Both forms are crucial for achieving genuine continuous improvement.

Scholars describe Kaizen as more of a philosophy than a methodology, emphasising the concept of change for the better and adaptability over perfectionism. Mitra (2016) lists an 8-step process that involves involving the team, brainstorming issues and problems, identifying opportunities, generating ideas and solutions, testing the proposed solution, analysing results, standardising solutions, and repeating the cycle for new processes or problems.

The philosophy of Kaizen draws from the idea of continuously improving life to achieve greater satisfaction and fulfilment. This concept can also be applied to businesses, as continuous improvement drives success. Kaizen aims to eliminate three types of waste: muda (wastefulness), mura (unevenness), and muri (overburden). Project management software can facilitate this transition by consolidating information, enhancing transparency, and promoting collaboration (Aikens 2011).

2.4.2.2 PDCA. Davis, Goetsch & Davis (2016) discuss the PDCA (Plan-Do-Check-Act) cycle as a structured framework for testing, analysing, and improving business processes. The cycle consists of four key steps: Plan: creating a detailed plan outlining goals, success criteria, and expected outcomes; Do: implementing the plan and carrying out actions; Check: measuring and analysing results; and Act: making necessary adjustments and taking appropriate actions to refine and improve the process. It was highlighted that Walter Shewhart and W. Edwards Deming developed PDCA. The cycle is an interactive problem-solving approach that originated from the scientific method's application to quality control and process improvement and an iterative process, repeating steps until desired outcomes are achieved. It provides a systematic approach to continuous improvement and problem-solving within an organisation (Doney 2019).

2.4.2.3 Total Quality Management. Total Quality Management (TQM) is a customer-focused approach to business process improvement that emphasises continuous improvement and data-driven decision-making. It optimises the entire organisation by placing customer value at the centre of management and operations. Unlike Lean Thinking, which focuses on specific tasks, TQM involves every department in the company working towards customer satisfaction and improving customer value. TQM aligns the entire organisation towards delivering value to the end customer. It involves full-team involvement, continuous improvement, and the use of data to drive decision-making. TQM is process-focused, aiming to improve efficiency and effectiveness rather than just minimising defects (Oakland 2014; Doney 2019).

2.4.3 Theory of Constraints (TOC)

Zhao & Hou (2021) and Wu, Zheng & Shen (2020) share that Theory of Constraints (TOC) is a business process improvement methodology that focuses on identifying and improving constraints or bottlenecks in a system as it determines the

specific constraint causing the bottleneck and implementing improvements to eliminate its adverse effects. They affirm that successfully implementing the Theory of Constraints can increase productivity, optimise workflow, and remove inefficient bottlenecks. The Five Focusing Steps methodology is often employed, which includes identifying the bottleneck, eliminating it, aligning activities with the correction, exploring additional actions, and transitioning to new inefficiencies.

TOC is an ongoing process, allowing managers to identify the most significant constraint hindering improvements and focus on improving processes until that constraint is no longer a barrier. The methodology emphasises continuous improvement and systematic removal of bottlenecks to optimise overall system performance (Chang 2016).

2.4.4 Cause and Effect Analysis

The fishbone diagram, also known as the cause and effect diagram, was created by Kaoru Ishikawa in the 1940s to display possible causes of a problem and their interrelationships. Using a fish-like skeleton, the diagram helps analyse and identify the root causes of a problem through brainstorming, investigations, and surveys. It serves multiple purposes, including ensuring a balanced list of ideas, refining brainstormed ideas, and guiding discussions to seek causes and collect relevant data actively. The process mapping approach depicts the steps leading up to an occurrence. A team is gathered, the problem is identified, and possible causes are developed and classified (Brussee 2010; Keller 2011).

This diagram fosters teamwork, breaks down problems into manageable pieces, and provides a common understanding of factors contributing to the problem. It can be used to determine the actual cause of a problem and assess the potential effects of a solution.

2.5 Industry-Specific Studies

Bhat (2010) questions if Business Process Management is a new or reformed concept of quality management with the same perception but different terminology. Thus, scholars began to develop or employ new methodologies for implementation and experimenting with different approaches that Business Process Improvement could utilise.

According to Wannes & Ghannouchi (2019), KPIs are performance standards for business operations with deadlines for achieving objective values. They highlight that KPIs are the method to measure the evaluation of the business processes in line with achieving organisational goals. Therefore, they experimented with the lifecycle of KPIs in the BPMN meta-model to test the business process, track the bottleneck tasks in the workflow, and propose improvement recommendations.

On the other hand, Van Dun et al. (2023) expressed the need for IT and AI use in Business Process Improvement. Nevertheless, modern information technology should facilitate the process and add value to the business. Hence, they conclude four factors to consider when adapting computational support: 1)The approach should boost creativity 2)The approach should aim for automation of future re-designing 3)The approach should involve the understanding of the current state of the process and consider the organisation's characteristics for utilisation available data and develop designs effectively 3) The approach should be user-friendly for the expertise in Business Process Management. Considering the discussed factors, the research implemented and evaluated ProcessGAN and showed its effectiveness in generating new ideas for Business Process Improvement. It was claimed that the first to use Generative Modeling Language in Business Process Improvement contributed to Design Science Research.

Furthermore, "Simulation is an approach that promotes the analysis and optimisation of the company's current processes. It identifies opportunities for change,

allowing the improvement of process performance by adopting a number of business process simulation tools”. Many scholars have employed simulations in their research on Business Process Improvement. The outcomes of simulations include optimised processes, reduced costs, analysed performance, risk assessments, and informed decisions. It identifies inefficiencies, evaluates cost impacts, and tests scenarios for decision-making, enhancing operational efficiency and facilitating effective decision-making within organisations. Conversely, there are limitations to business simulations that consist of simplification of real-world complexities, reliance on accurate data, implementation challenges, behavioural oversight, and limited predictive power. These limitations help make informed decisions and effectively utilise simulations (Mehdouani, Missaoui & Ghannouchi 2019, p. 226).

Alternatively, (Yousfi, Batoulis & Weske 2019) categorises business process improvement techniques into qualitative and quantitative methods. Qualitative techniques are summarised as follows:- 1) Variability that initiates business process to optimise commonality factors, 2) Design Patterns and how they affect the processes' performance indicators, 3) Automation that enhance the workflow and 4) Process Restructuring. Whereas quantitative techniques include 1) a Performance Analysis framework based on data and 2) Process mining that improves the compliance of a process. 3) Decision-making can be used to improve corporate processes by separating issues about the process from those of decision logic.

However, innovative and modern approaches must match the traditional approach with quality management methodologies. Researchers still argue and present the similarities and differences between both concepts throughout the past decade and recent developments. Schönreiter (2018) claims that process management is the subject of quality management. Therefore they are synonymous with embracing and guiding the activities in

the business systems. Agus & Hassan (2011) also indicate that all business processes are interconnected. Subsequently, small process changes will probably improve performance at all levels, leading to continuous improvements that impact effectiveness and efficiency and enhance customer satisfaction. This presents Total Quality Management in the context of Business Process Improvement.

Whereas the study of the link between Business Process Improvement and quality management demonstrated that Total Quality Management, Lean, and Six Sigma are just a few of the quality management paradigms that Business Process Management covers. Because business process management is a fundamental component of practically all quality management paradigms, it is frequently mistaken with other quality management paradigms. Instead of being a stand-alone management discipline, Business Process Management is a tool for attaining organisational objectives. Unlike a new theory or automation, it oversees the life cycle of improvement and optimisation (Stravinskiene & Serafinas 2020).

2.6 Conclusion

Business process improvement (BPI) implementation and quality management approaches go hand in hand. Both BPI and quality management share similar goals and objectives, highlighting the significance of reviewing business processes with the appropriate methodology to maximise improvements and raise performance. To manage the BPI activities effectively and precisely, it is essential to have clear goals and objectives in place.

Although there are always new strategies and approaches on the market, they all ultimately attempt to improve processes, efficiency, and quality. To pinpoint the precise issue that sparked the process, it is crucial to specify the factors that led to the demand for

improvement. This guarantees that the proper problems are identified for improvement, and the right solutions are implemented.

In conclusion, business process improvement will always be necessary because life and the economy constantly change and pose new problems that call for efficient quality control. These difficulties heighten competition and can jeopardise client happiness. The collection of literature on business process improvement includes a wide range of concepts, theories, methods, and research from various industries. This information aids in our comprehension of how companies might enhance their operations and provide better results. Organisations can create practical BPI projects that improve effectiveness, quality, and customer happiness by synthesising and using this literature's findings. BPI will continue to change as technology and the business environment does, offering fresh opportunities and difficulties for study and real-world application.

Chapter 3 : Methodology

3.1 Introduction

The methodology chosen for this dissertation is Cause-and-Effect Analysis and 5 Whys Technique. Most Business Process Improvement methodologies involve almost identical steps incorporated with the selected research methodology. Using a cause-and-effect analysis allows to assess an issue and uncover the root causes to create a solution. It is a method of evaluation by partitioning difficult problems into several more manageable subproblems.

According to Kiani and Standing (2018), difficulties have always been a component of running a business. In fact, businesses were created in order to provide answers to particular questions. Business analysts are often able to determine the nature of a problem, its underlying cause and the repercussions that arise if the problem persists. Business analysts are better able to develop practical solutions when they have identified the elements that lead to challenges and the implications of those factors. Thus, organisations must perform cause-and-effect analyses to ensure long-term success. The cause-and-effect diagram, often known as a fishbone diagram, can help businesses find the fundamental cause of an issue. This method entails finding and fixing a company's business issue. This can be done by analysing product line performance, finding the most efficient production methods, and applying good management practices.

Below, an elaboration of the general Business Process Improvement steps will be defined as concluded from the shared literature review, followed by the application details on a selected company.

3.2 Identify Process to Improve

The first step in enhancing organisational processes is pinpointing the processes that need improvement. Techniques like business process mapping will be used. A complete

study will be performed by starting with smaller-scale adjustments at the team level. Effective processes will be investigated to learn what makes them so, and those that are ineffective will be evaluated to learn what may be done better. At this stage, the emphasis will be on identifying the inefficient process rather than identifying problems or the reason. Therefore, the concentration will be on the process itself only. A single process will be chosen as the initial focus for improvement from the compiled list of processes that need improvement.

The selected company exercises different processes in each department. Table 1 Below is a summary of the most used processes: -

Table 1

Frequent Process in the Company

Department	No. of Process
Business Development	One
CAFM	One
Finance	Four
HR	Five
IT	One
Legal	Three
Operations	Three
Procurement	Six
QHSE	Four
Technology & Innovation	Five

The processes in each department could be only internal or interconnected with other departments. A meeting was conducted with a director to identify the inefficient processes. The director listed 4 processes that need improvement; 2 processes from operations, 1 process from HR and 1 process from procurement. These processes were prioritized based on critical-to-business where the delay of the process has financial impacts and affects the

operations of the business as some of the processes are related to contractual agreements with suppliers and clients. Then a request was raised to the senior management to investigate the top 3 critical-to-business processes as preliminary approval is crucial so no existing defined obstacles might hinder the investigation process Senior management approved to share the data of Subcontractor Agreement Approval.

Hiring subcontractors usually is an obligation to fulfil as per the client contract to maintain the KPIs and subcontractors contract negotiation is very challenging in the market. An interview was conducted with a facilities Manager from the organization to obtain full details about the scope and discuss the importance of subcontractors. It was stressed the importance of subcontractors in FM, defining them as specialized entities contracted for tasks beyond in-house capabilities or as per client requests aligned with Original Equipment Manufacturer (OEM) standards (Manager, 2023)

The interview highlighted key attributes sought in subcontractors, such as reputation, expertise, safety, punctuality, work quality, and effective communication. The Facilities manager underscored their critical role in providing specialized expertise, enhancing service range, and ensuring cost-efficient and flexible operations. He noted the potential adverse impacts of delays in hiring subcontractors, including project timeline disruptions, increased costs, and compromised safety and work quality.

Further, the manager (2023) elaborated on the benefits of subcontractors, like in-depth knowledge, operational scalability, economic efficiency, and distributed liabilities. However, he also acknowledged challenges such as potential misunderstandings, inconsistent work methods affecting client relationships and Key Performance Indicators (KPIs), availability issues in emergencies, confidentiality risks, and alignment with company values and safety practices. His insights illuminated the intricate dynamics and

crucial importance of subcontractors in the realm of FM. Full interview is provided in Appendix A.

3.3 Map the Process

A comprehensive process mapping shall start once a process is selected for improvement. Each process step will be documented and illustrated using flowcharts or other diagrammatical tools to obtain thorough insights and prevent missing critical details. People who routinely utilise the process will be included in this step, as the emphasis will be on accurately capturing the current process to highlight the need for improvement rather than rushing to solutions.

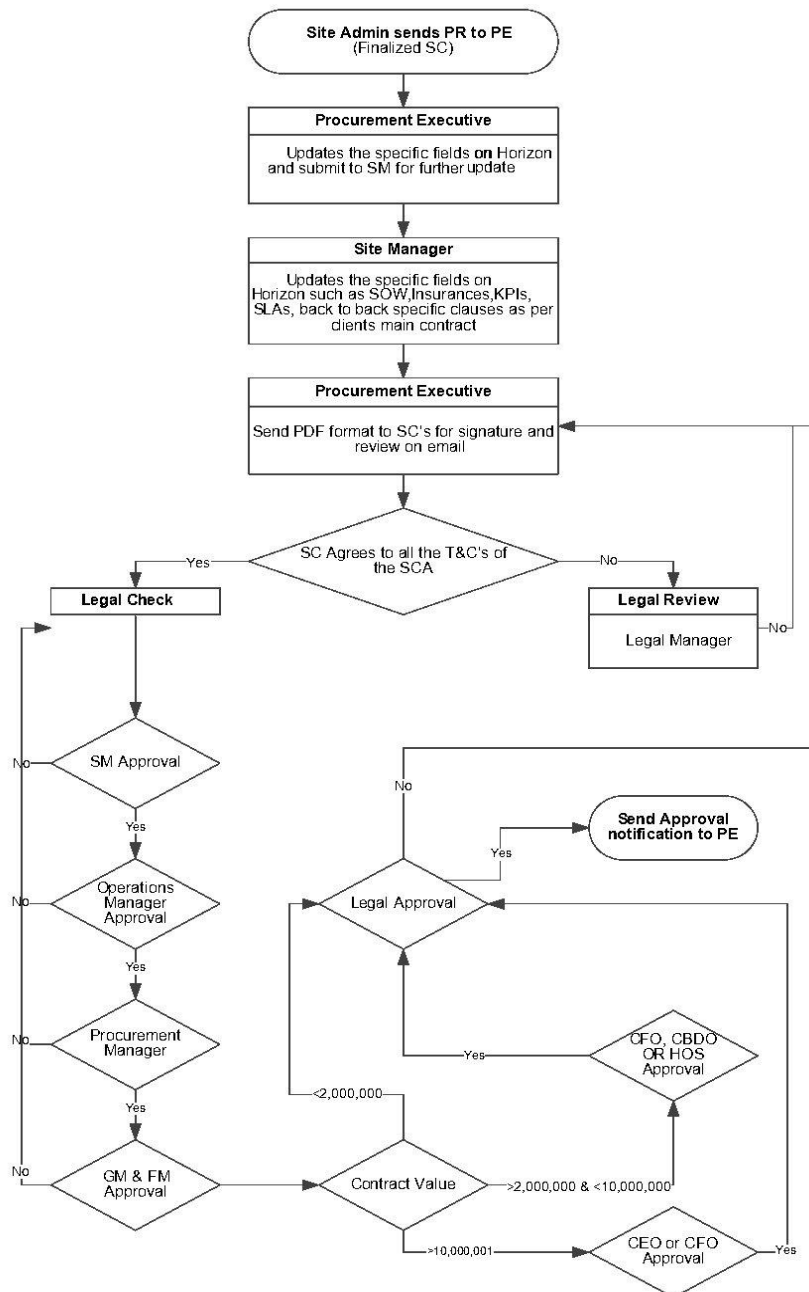
After Senior management approval to get the data of Subcontractor Agreement Approval process, a meeting was held with operations manager to understand the process flow. The company has multiple site projects, and each site project has a site manager & an admin. The company uses multiple systems for their daily operations such, Horizon, ESS, MS Sharepoint and SmartO&M. The subcontractor agreement process starts by rising Purchase Request (PR) from a site project by the site admin to the head office's procurement department using Horizon then the procurement executive will update procurement details and send the site manager to update operation details then send back to the procurement to send to the subcontractor agreement for approval via email. Then the next steps of the process are conducted on another system which MS Sharepoint.

If subcontractor disagrees with terms & conditions of the agreement, Legal Review will be generated on MS Sharepoint for the Legal manager to review the agreement as per the subcontractor comments. If subcontractor agrees with terms & conditions of the agreement, Legal Check will be generated on MS Sharepoint which contains multiple steps, Site Manager Approval, Operation Manager Approval, Procurement Manager Approval then General & Finance Manager Approval simultaneously. After that,

depending on the contract value, the approval process will go to CEO or CFO or CBDO or HOS then finally to the legal manager. Figure 1 illustrates the flow chart of the whole process:

Figure 1

Subcontractor Agreement Approval Process



3.4 Analyse the Process

Upon widespread mapping of the selected process, the analysis stage shall begin. At this stage, stakeholders will be asked challenging questions to conduct a Cause-and-Effect

analysis to investigate and identify the pain areas, such as delays, bottlenecks, frustrations, and problems with cost and quality. Moreover, the root-cause analysis will utilise input from affected individuals and learning from other efficient teams. The fishbone diagram and “5 Whys” tool will be used to conduct the root-cause methodology to investigate the process delays.

3.4.1 Fishbone Diagram

The Ishikawa or fishbone diagram, also called the cause-and-effect methodology, is a helpful tool for streamlining company operations. It assists in discovering the underlying reasons for an issue or process inefficiencies, allowing businesses to apply focused remedies. Mayne (2011), states that being able to perform a cause-and-effect analysis is a valuable skill which improves the ability to assess and solve problems that arise in professional life.

To conduct the diagram, the following step will take place:

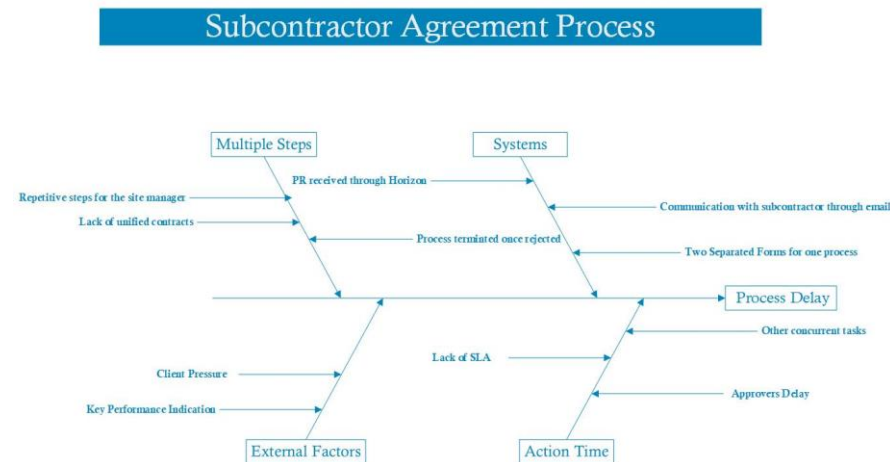
3.4.1.1 Defining the Problem. The problem that will be tackled in this research study is process delay. The inefficiency will be clearly defined and articulate the specific issue, its impact on the process and the organisation, and the desired outcomes that are targeted to achieve. Quantitative and Qualitative data will be collected accordingly. Quantitative data will be the time consumed in completing each step in the process from different departments or associates. Qualitative data will be accumulated from the interviews conducted from the start.

3.4.1.2 Creating the Fishbone Diagram. The diagram visually represents the potential causes contributing to the addressed problem. A horizontal line will be drawn representing the spine of the fishbone ending with a box containing the problem defined, process delay. This box symbolises the "head" of the fish. Moving forward, the next step will be identifying major categories by drawing several diagonal lines resembling the bones of a fish stemming from the spine. These lines will represent the significant categories of potential causes of the problem. The factors could be derived from the elements of the flowchart created and from the qualitative data collected through the department meetings. The objective will be to capture a comprehensive range of factors that may contribute to the problem under investigation.

3.4.1.3 Possible Causes Brainstorm. Following the identified significant categories of the problem, potential causes related to each category will be stated through brainstorming using the “5 Whys” tool to delve deeper into each cause.

3.4.1.3.1 “5 Whys”. The 5 Whys methodology is a problem-solving technique used in industries to identify the root cause of issues by repeatedly asking "Why?" until the underlying cause is uncovered. It is often used in continuous improvement initiatives like Lean Six Sigma to analyse and resolve problems effectively. The methodology encourages a comprehensive understanding of problems and facilitates targeted, sustainable improvements (George, Rowlands & Kastle 2004; Murmura et al. 2021)

Figure 2 illustrates the final diagram of the fishbone:

Figure 2*Cause-and-Effect Diagram*

3.4.1.4 Analyse and Refine. Upon listing potential causes, each cause will be evaluated on the significance and its likelihood of contributing to the problem using statistical tools to calculate the variabilities of delay periods and probability analysis to eliminate lower impact and unlikely causes, which will result in determining significant and feasible causes to address within the scope of improvement.

3.4.1.5 Determining Relationships. The selected causes will be examined using correlation analysis to identify potential relationships among them. The analysis will help to visualize how different causes interact and contribute to the problem which will support to gain insights of the complexity of the issue and provision effective solution.

3.4.1.6 Prioritizing Root Causes: After considering the impact, frequency, and persistence of each root cause, it will be possible to prioritize the root causes to direct resources and energy toward those that will have the greatest impact on solving the issue. This will be done by using the outcomes from the correlation analysis to select the causes that are critical and require immediate attention.

3.4.1.7 Developing Solutions. After determining the underlying causes, potential solutions will be outlined in a brainstorming session. The ideas gathered will be divided into short-term and long-term solutions, with an emphasis on solutions that are feasible, useful, and in line with organizational objectives. Based on the expected impacts, ease of implementation, and cost-effectiveness, each solution will be assessed.

3.4.2 Conclusion

The "5 Whys" tool and cause-and-effect diagram both provide a structured technique for process optimization. The methods encourage team communication and enhance data-driven decision-making; by systematically identifying and addressing the root causes of issues that will ultimately lead to the development of potential solutions for assessing and evaluating in the next stage of process improvement.

3.5 Redesign the Process

Potential Solutions will be presented to the stakeholders to address the impact and conduct a risk assessment. The most appropriate solutions will be selected, and an action plan will be developed for implementation. Key Performance Indicators (KPIs) can be established to monitor the effectiveness of the implemented solutions and regularly review and track progress, ensuring that the solutions are being implemented as planned. Control Charts will be introduced to limit the variabilities.

3.6 Acquire Resources

Before implementing the action plan, approval from senior management must be acquired. Therefore, the existing problem will be presented to the management highlighting the inefficiencies and the impacts on the business, followed by a demonstration of the benefits and value achieved from proposed improvements. This stage will seek guidance from relevant departments to obtain the necessary resources for successful process improvement.

3.7 Implement and Communicate Change

Effective process change will require starting with small-scale corrections, testing, and refining the planned changes, enlisting additional resources, and applying the final modifications throughout pertinent activities or processes. The deployment will be carefully planned and managed, with time set aside to resolve early difficulties and implement a trial phase. Successful adoption will depend on overcoming change resistance by integrating stakeholders early on and applying change management strategies.

3.8 Monitor Results

The effectiveness and impact of the implemented solutions will be continuously evaluated. The established Key Performance Indicators (KPIs) and Control Charts will be monitored to gather stakeholder feedback. The collected data will be analysed and assessed to determine whether the solutions achieve the desired outcomes. If necessary, adjustments will be made, and the improvement process can iterate, refining the solutions or considering alternative approaches to address any gaps or emerging challenges.

3.9 Expected Results and Limitations

The Business Process Improvement analysis will contribute to the organisation by identifying hidden bottlenecks and enhancing internal communication to improve problem-solving and decision-making skills. This methodical approach will target upcoming problems in systemic analysis, resulting in better solutions and a culture of continuous improvement.

Finally, several potential obstacles are expected when conducting cause-and-effect methodology. The challenges include a lack of data and resources, complexity and interdependencies, resistance to change and organisational culture. These difficulties may reduce the analysis's precision, objectivity, and potency. Appropriate measures shall be

considered to mitigate the potential roadblocks and optimise the effectiveness of the improvement initiatives.

Chapter 4 : Research Findings & Discussions

This chapter is dedicated to an in-depth discussion of the research analysis, both from a statistical and theoretical standpoint.

4.1 Cause-and-Effect Analysis

The multitude of factors and subcontractors delineated in the fishbone diagram (Figure 2) necessitates a prioritization strategy, contingent upon the magnitude of impact each factor or subfactor exerts on the process's problematic aspects. To this end, an incisive interview was conducted with the Operations Manager, focusing on addressing and evaluating the impact of the identified factors. The objective was to methodically assess and assign a relative weight to each subfactor, thereby quantifying their respective contributions to the process inefficiencies. The culmination of this deliberative session is systematically summarized in Table 8, which presents a detailed tabulation of the weights assigned to each factor derived from the fishbone diagram. This table serves as a conclusive representation of the interview findings, offering a structured insight into the relative significance of each factor in the context of the process improvement initiative.

Table 2

Fishbone Weight

Factor	Weight	Discussion
Action Time	50%	The primary issue in the process, initially highlighted by senior management, is the significant delay in the steps involving approvers, representing a critical area of inefficiency.
Multiple Steps	25%	Through process mapping, it was discovered that some steps are repetitive and unnecessary, leading to a prolonged process. These steps offer opportunities for improvement or elimination to streamline the process and increase efficiency.

Systems	15%	The use of multiple systems without proper synchronization contributes to an increase in the overall process time, affecting its efficiency.
External Factors	10%	Some factors outside the company's control can create major obstacles for the process, even though they don't directly interact with it and might be difficult to mitigate.

Note. Weights allocated based on the meeting with the Operations Manager (Manager, 2023)

Subsequently, the subfactors were also given weights as shown below the tables below:

Table 3

Action Time Subfactors

Subfactor	Weight	Discussion
Approvers delay	50%	The leading issue in the process is delay in approvers steps as first identified from the senior management
Other coherent tasks	30%	Approvers are often engaged in daily tasks to their respective departmental operations, which they may take prioritize, potentially impacting their availability and attention to the approval process.
Lack of SLA	20%	The absence of specified deadlines for each step in the process contributes to procrastination, as it lacks a defined time frame for completion.

Note. Weights allocated based on the meeting with the Operations Manager (Manager, 2023)

Table 4*Multiple Steps Subfactors*

Subfactor	Weight	Discussion
Repetitive Steps for Site Manager	40%	The site manager is involved in many steps of the process that are not necessary, leading to inefficiency.
Process Terminated once rejected	30%	If a manager rejects an entry, the existing procedural framework does not permit any modifications to be made to the entry, necessitating a restart of the process from the beginning.
Lack of unified contracts	20%	Numerous subcontractors are engaged across multiple projects, presenting an opportunity for the formulation of unified contracts. Nevertheless, as expressed by the Operations Manager, this approach encounters a notable constraint, owing to the unique nature of each contract as dictated by specific client requirements, thereby preventing the feasibility of a standardized contract framework.

Note. Weights allocated based on the meeting with the Operation Manager (Manager, 2023)

Table 5*Systems Subfactors*

Subfactor	Weight	Discussion
Horizon	10%	There are 2 steps only created on Horizon by the procurement department
Email	20%	Communicating through email do not keep all other process stakeholder in loop which might create misinformation and other repetitive steps
MS Sharepoint	70%	Most of process delay occurs when on submission type phase

Note. Weights allocated based on the meeting with the Operation Manager (Manager, 2023)

Table 6*External Subfactors*

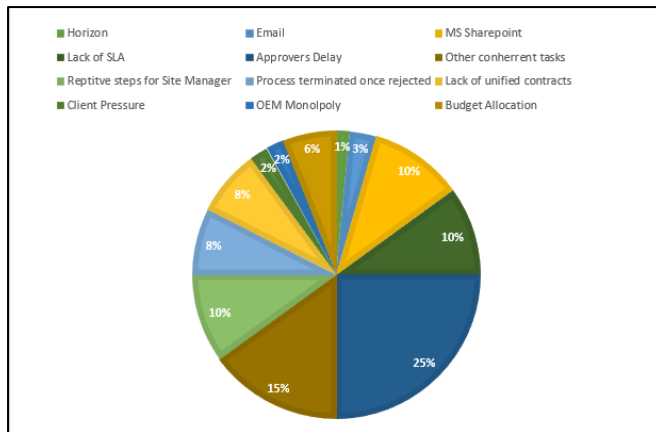
Subfactor	Weight	Discussion
Client Pressure	20%	Client request to have specific subcontractor on board
OEM Monopoly	20%	Lack of flexibility of subcontracts in the market on some services
Budget Allocation	60%	Budget restrictions as per client agreement which might affect the business profit

Note. Weights allocated based on the meeting with the Operation Manager (Manager, 2023)

By calculating the above subfactors, Figure 14 shows the weight of each subfactors that contributes to the overall process delay.

Figure 3

Subfactors Weight

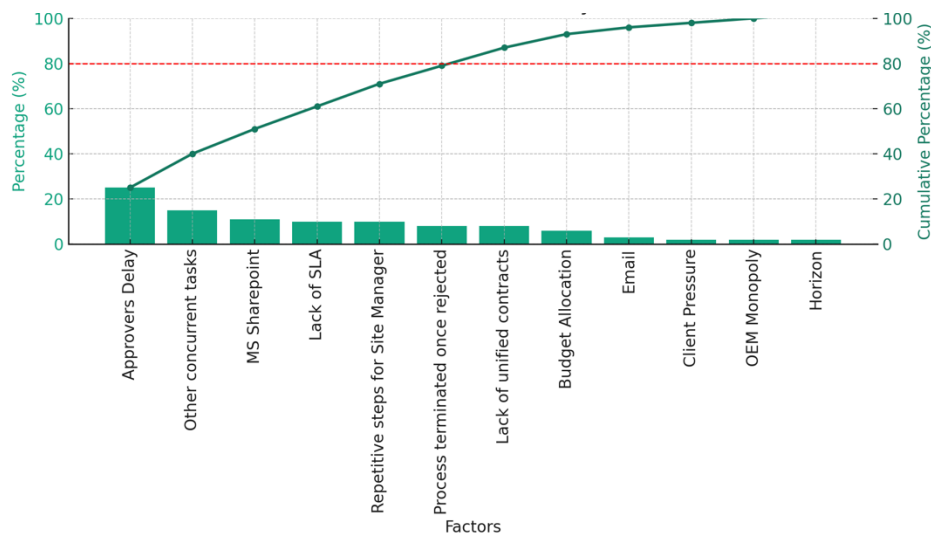


To determine 80% of the problem, a pareto chart was created as shown in Figure 4.

The vital few are: 1- Approver Delays 2- Other concurrent tasks 3- MS Sharepoint 4- Lack of SLA 5-Reptitive steps for Site Manager 6- Process terminated once rejected.

Figure 4

Subfactors Pareto Chart



A considerable proportion, approximately 80%, of the subfactors identified within the process are interrelated. For instance, the delay in action times by approvers on the MS SharePoint platform can be attributed to their engagement in other concurrent tasks, which

are often prioritized due to pressing operational deadlines. In contrast, the approval process itself lacks specific deadlines for action times, exacerbating these delays. Additionally, the procedural design mandates that the process be restarted entirely in instances where a single approver issues a rejection. This requirement effectively results in the repetition of the entire approval sequence by all approvers, further compounding the inefficiency of the process.

As the process does not operate within a singular, unified system, the lack of synchronization presents a notable limitation in tracking each entry from the site administration through to the legal approval stage. Senior management has expressed a distinct objective to enhance the efficiency of the approval process that starts at the submission type. Therefore, this necessitates that the research analysis be specifically focused on the second part of the process. This targeted approach allows for a more concentrated examination of the stages where the potential for optimization is most pronounced, thereby aligning the research efforts with the strategic goals of the organization.

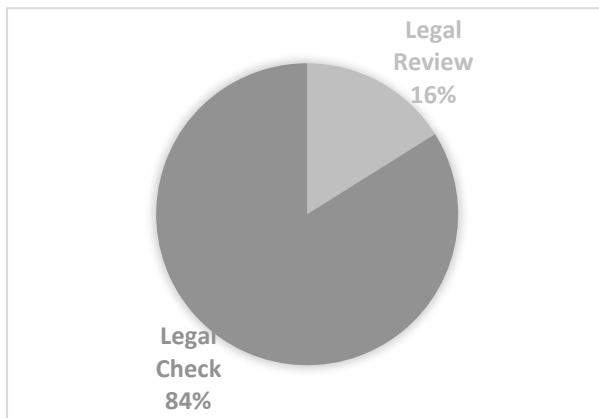
The comprehensive statistical analysis was initiated upon the data provided by the IT department, focusing specifically on the selected phase of the process as previously defined. Adhering to confidentiality protocols, any data pertaining to contract values exceeding AED 2,000,000 were systematically excluded from this analysis.

4.2 Submission Type

First, entries were segregated into the submission type to analysis each type separately as illustrated in Figure 3. 16% of submission is Legal Review which indicates the disagreement of the subcontracts on the terms of conditions of the agreement. This is a quarter of submission. The reasons for the disagreement should be investigated to reduce the percentage.

Figure 5

Submission Type



The legal review process contains only one step, which is Legal Review by the Legal Manager. While 84% of the entries are submitted as Legal check after the agreement of the subcontracts and this submission type includes multiple steps.

In order to thoroughly investigate the efficiency of each submission type within the process, a basic statistical analysis was conducted for both categories. This analytical approach should provide a comprehensive understanding of the performance characteristics and operational dynamics of each submission type, allowing a more nuanced interpretation of their respective efficiency.

Table 7*Submission Type Statistics*

Statistics	Legal Review	Legal Check
Mean	52.73	33.41
Median	43	20
Mode	16	19
Standard Deviation	49.52	40
Range	168	289
Maximum	168	291
Minimum	0	2

Table 7 shows that the average processing time for the legal manager in the "Legal Review" process is around 52.73 days. In contrast, the average total time for the "Legal Review" process is 33.41 days. This shows that a single step in the "Legal Review" process takes longer than the entire multi-step "Legal Check" process. The standard deviation for the "Legal Review" process is 49.52 days, which is quite high in relation to the mean and indicates that the time it takes the Head of Legal to act varies greatly. The "Legal review" process also has a high standard deviation (40.00 days) compared to its mean value, which indicates different processing times for the various entries.

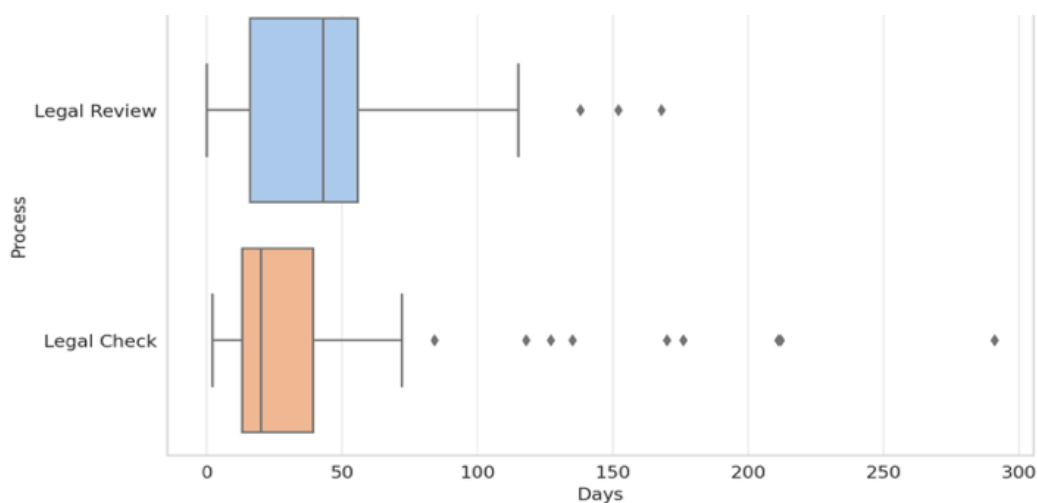
The range (difference between maximum and minimum value) of the processing times for the "Legal review" process is 168 days, which indicates a wide range between the fastest and slowest processed entries. The "Legal review" process has an even wider range of 289 days. The maximum processing time for the Legal Manager in the "Legal Review" process is remarkably high at 168 days, indicating that there may be significant delays in

some cases. The "Legal Review" process has an even longer maximum total processing time of 291 days, indicating possible bottlenecks or delays in some cases.

While the "Legal Check" process, with its multiple steps, seems to be more efficient on average than the single step "Legal Review" process, both processes exhibit a significant variability in processing times. This suggests that there might be room for improving consistency in both processes. There might be potential bottlenecks or external factors influencing these times, which could be investigated further to optimize the processes. Figure 6 provides an overview of the distribution of processing times for both processes. The median (central line in the box) and the spread (size of the box) provide insights into the typical range of processing times. Points outside the "whiskers" can be considered outliers, suggesting unusually long or short processing times. For the "Legal Review" process, we can see some entries with very long processing times, which are likely driving up the average. The "Legal Check" process has a tighter distribution, but there are still some outliers with longer processing times.

Figure 6

Boxplot for Processing Time



The histograms provide a frequency distribution of the processing times. The "Legal Review" histogram in Figure 7 shows that most entries have processing times between 0

and 50 days, but there are some entries with longer processing times up to 170 days. The "Legal Check" histogram in Figure 8 shows a peak around 10-30 days, with some entries taking much longer, up to nearly 300 days.

To conclude, the "Legal Review" process, even though it's a single step, seems to have more variability in its processing times compared to the "Legal Check" process. The presence of outliers in both processes suggests that there are occasional entries that experience significant delays. Investigating the reasons behind these delays could provide insights into potential areas of improvement. The clustering of most entries within a certain range in the histograms shows that there's a typical processing time for most entries, but there's a long tail of entries that take much longer.

Figure 7

Legal Check Histogram

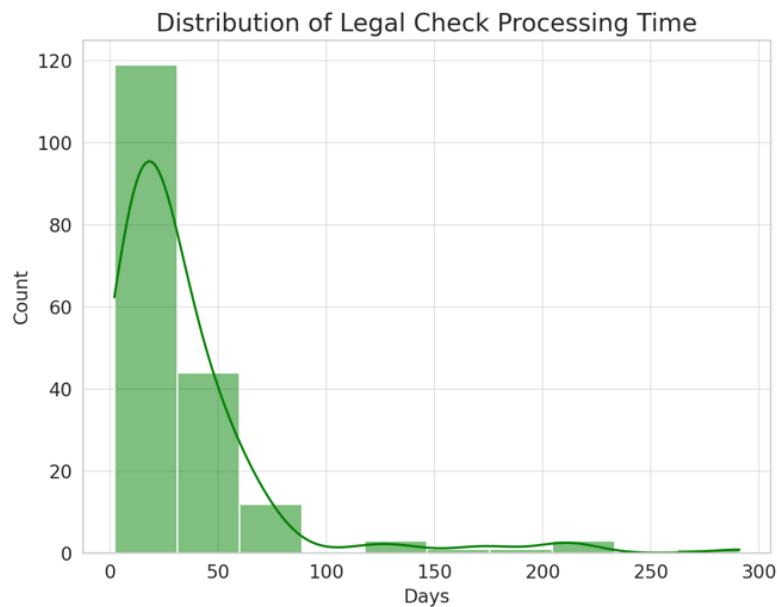
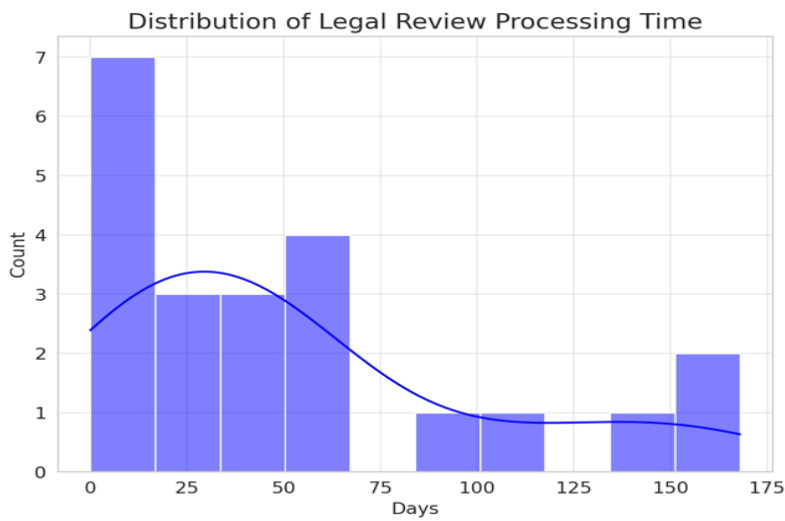


Figure 8*Legal Review Histogram***4.3 Legal Check**

Given that the Legal Review process contains only a distinct step, the identification of an obstacle inside this sector has happened honestly established. In contrast, the Legal Check process makes necessary a more elaborate case to find out the exact location of allure obstacle. To this end, a fundamental mathematical reasoning was carefully carried out, meeting on the event each executive demand to either authorize or reject an introduction. The results concerning this reasoning, that supply a detailed disruption of moment of truth captured by each director, are completely presented in Table 8 beneath, contribution visions into the functional shadings of the approval process.

Table 8*Legal Check Statistics*

Manager	Coun	Mea	Std	Mi	Media	Ma	Mod	Rang
	t	n	Dev	n	n	x	e	e
Site Manager	213	17.29	42.5	0	1	214	0	214
Operations Manager	208	0.81	4.32	0	0	55	0	55
Procurement	204	4.2	10.52	0	1	116	0	116
Manager								
Finance Manager	185	4.54	7.23	0	2	53	0	53
General Manager	185	1.19	0.0	0.0	2.58	14	14	0
Legal Manager	184	10.63	12.41	0	4.5	49	2	49
Total Days	184	33.41	40	2	20	291	19	289

The "Site Manager" has the highest count (213 entries), while other managers like the "Legal Manager" and "Finance Manager" have handled around 184-185 entries. This indicates that some entries were terminated before reaching the latter stages. The "Site Manager", despite handling the most entries, has a considerably higher average action time (17.29 days) compared to other managers like the "Operations Manager" (0.81 days). While some managers, such as the Operations Manager and General Manager, typically act swiftly with lower average action times, others like the Site Manager and Legal Manager take longer on average. There's considerable variability in action times for some managers, particularly the Site Manager, indicating inconsistency in their response times. The median action times for managers like the Operations Manager, Procurement Manager, and General Manager are low, suggesting that at least half of their decisions are made quickly. In contrast, managers like the Legal Manager have higher median action times, indicating a longer typical response duration.

Several managers, especially the Site Manager, have outliers, suggesting occasional instances where the action time was significantly longer than usual. This could be due to complex cases, external dependencies, or other challenges. The range of action times varies across managers. While some have a broad range, indicating a mix of swift and prolonged decisions, others have a narrower range, suggesting more consistency.

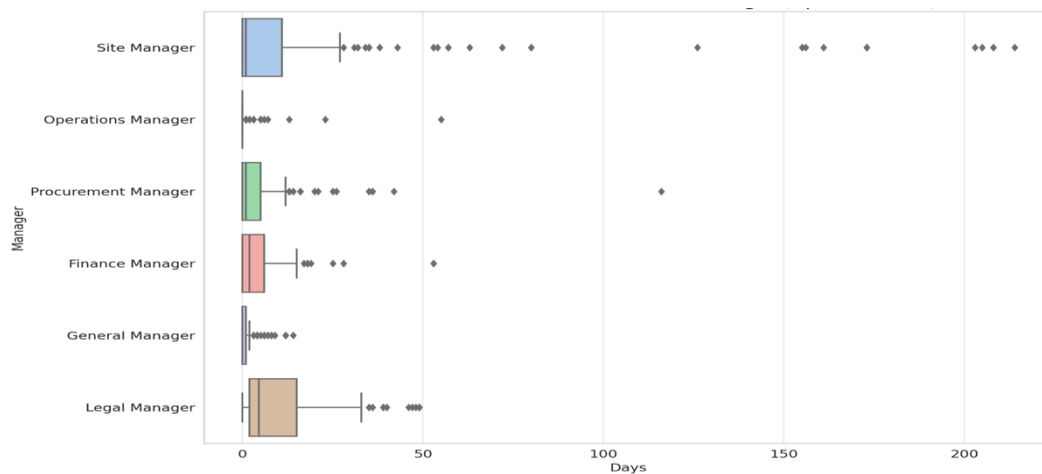
The cumulative data, represented by the "Total Days" statistics, suggests that the entire "Legal Check" process can be quite variable, with some cases being resolved quickly and others taking a longer duration. This cumulative time is influenced by the action times of all managers involved. While some managers consistently make swift decisions, others display variability, with occasional significant delays. The overall "Legal Check" process duration is influenced by the collective action times of all managers. For process improvement, it might be beneficial to delve deeper into the reasons behind extended action times, especially for managers with high variability.

Figure 9 shows that the Operations Manager and General Manager consistently showcase quick decisions. Their boxes are concentrated near the 0-day mark, indicating that a significant portion of their actions are taken almost immediately. The Site Manager displays considerable variability in action times, with a broad interquartile range (IQR) and multiple outliers. This suggests that while some decisions are made quickly, others can take significantly longer. The Procurement Manager also exhibits variability in action times, but not as pronounced as the Site Manager. The Finance Manager demonstrates consistent action times with a tight IQR and fewer outliers. The Legal Manager has a moderate IQR, suggesting some variability but not as much as the Site or Procurement Managers.

Multiple managers, particularly the Site Manager, have several data points beyond the whiskers of the box plot. These outliers indicate instances where the action time was considerably longer than usual. It might be worth investigating these outliers to understand the reasons behind such extended decision times. The distribution of action times across managers varies, with some acting swiftly and others taking longer. This variability across managers will influence the overall duration of the "Legal Check" process.

Figure 9

Distribution of Action Times for Each Manager

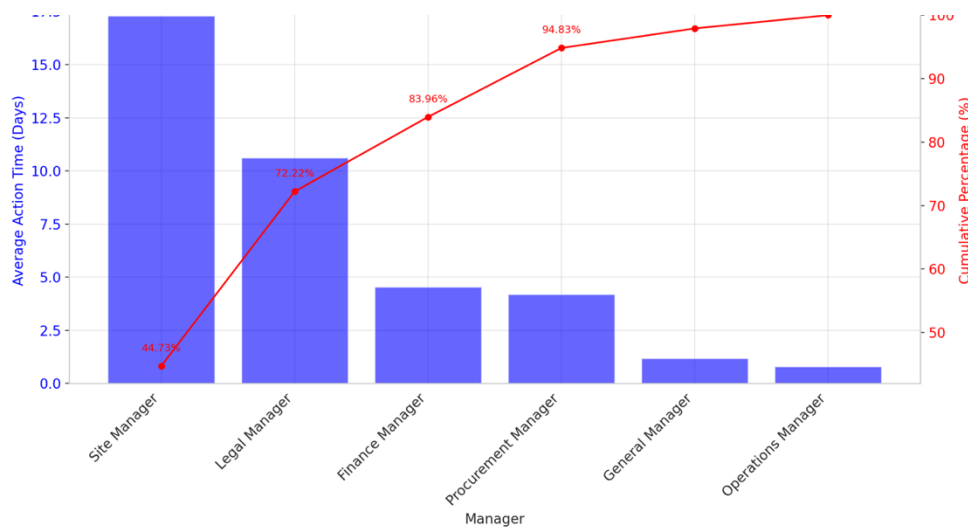


In summary, while some managers consistently make swift decisions, others display a range of action times, with occasional significant delays. The overall "Legal Check" process duration is influenced by the collective action times of all managers, and understanding the reasons behind the variability can aid in process optimization.

To delve deeper into the underlying root cause and rigorously investigate the bottleneck within the process, a Pareto analysis was meticulously constructed, as depicted in Figure 10. The Pareto chart, renowned for its efficacy as a visualization tool, plays a pivotal role in facilitating the prioritization of focus areas according to their relative impact. Upon careful examination of the Pareto chart, which graphically represents the duration of actions taken by various managers, a set of overarching conclusions has been drawn. These conclusions are instrumental in offering a clarified perspective on the distribution and magnitude of process inefficiencies within managerial actions.

Figure 10

Legal Check Pareto Chart



The Site Manager emerges as the most significant influencer of average action time, with their action time being the highest. This is evident from the tall blue bar at the beginning of the chart. By considering just the first three managers (Site Manager, Legal Manager, and Procurement Manager), we've already accounted for a substantial portion of the total average action time across all managers. This is indicated by the steep rise in the cumulative percentage line at the start. The Operations Manager and General Manager have lower average action times, which means their influence on the overall action time is

less compared to the dominant influencers. Their respective bars are shorter, and their addition to the cumulative percentage is gradual.

The Pareto principle, often known as the 80/20 rule, suggests that 80% of the effects come from 20% of the causes. In this context, a small number of managers (less than half of the total) account for most of the average action time.

4.3.1 Approval vs. Rejection Statistics

The subsequent phase of the investigation entailed a meticulous analysis of the action types attributed to each manager. The primary objective of this analysis was to ascertain whether a correlation exists between the nature of the action – approval or rejection – and the time duration required for decision-making. This aspect of the study, which probes into the relationship between decision type and efficiency, is presented in Table 9. This table serves as an illustrative tool, providing a detailed breakdown of the actions undertaken by the managers, thereby facilitating a comprehensive understanding of the decision-making dynamics within the process.

Table 9

Approval vs. Rejection Statistics

Manager	Status	Mean	Median	Mode	Std	Range	Min	Max
Site	Approval	16.81	1.0	0.0	40.38	208.0	0.0	208.0
Manager	Rejection	114.75	126.5	1.0	92.53	204.0	1.0	205.0
Operations	Approval	0.43	0.0	0.0	1.2	7.0	0.0	7.0
Manager	Rejection	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Procurement	Approval	3.38	1.0	0.0	10.57	116.0	0.0	116.0
Manager	Rejection	15.26	12.0	0.0	14.24	42.0	0.0	42.0
	Approval	4.08	1.0	0.0	7.67	53.0	0.0	53.0

Finance	Rejection	nan	nan	nan	nan	nan	nan	nan
Manager								
General	Approval	1.12	0.0	0.0	2.61	14.0	0.0	14.0
Manager	Rejection	0.0	0.0	0.0	nan	0.0	0.0	0.0
Legal	Approval	12.05	6.0	2.0	13.31	49.0	0.0	49.0
Manager	Rejection	14.23	7.0	2.0	13.62	46.0	0.0	46.0

Approval times vary significantly among managers. Some managers, such as the Operations Manager and General Manager, tend to have very short approval times within days. In contrast, the Site Manager and Legal Manager exhibit longer and more variable approval times, with some approvals taking several weeks.

Rejection times, display variability. Managers like the Procurement Manager and Finance Manager have moderate rejection times, while others, like the Site Manager, have longer and more variable rejection times. Rejection times, when available, show considerable variation across managers. The Procurement Manager and Legal Manager have higher variability in rejection times compared to others.

The Operations Manager, Finance Manager, and General Manager stand out as quick decision-makers, with approval times often near zero days. This suggests efficient decision-making processes for these managers. The Site Manager and Legal Manager often have longer approval times, with the Site Manager having the longest range of approval times, reaching up to 208 days.

4.3.2 Approval vs. Rejection Rates

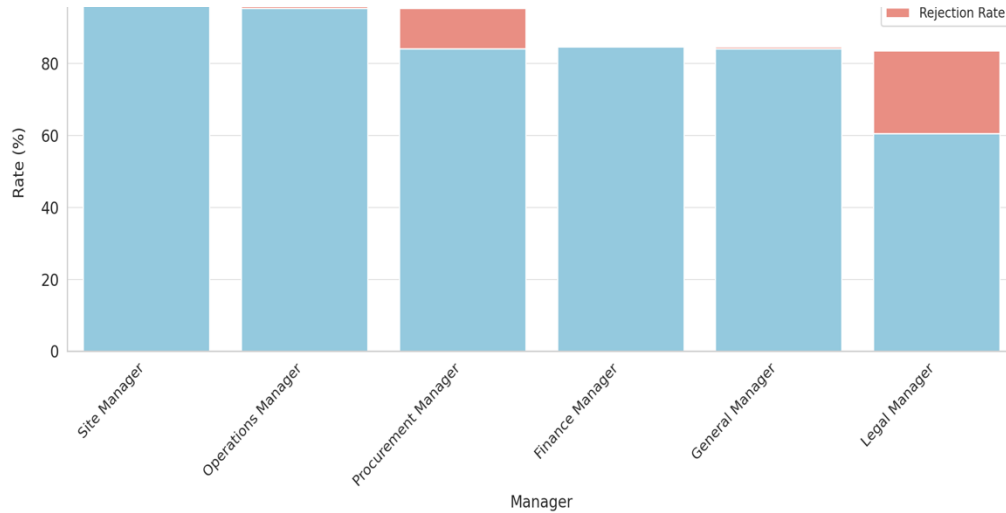
Transitioning to the subsequent analytical phase, the rates of approval and rejection were computed, as systematically presented in Table 10. This calculation offers an in-depth perspective on the frequency of approvals and rejections within the process, thereby enriching the comprehensive understanding of the operational dynamics at play.

The Site Manager and Operations Manager have notably high approval rates, with approximately 97.65% and 95.29%, respectively. This indicates that the majority of entries managed by these managers are approved, reflecting efficient decision-making processes. Both the Procurement Manager and Finance Manager have approval rates around 84%, indicating that a significant portion of entries they handle gets approved. However, the Procurement Manager has a relatively higher rejection rate (11.18%), suggesting that they encounter more rejections compared to the Finance Manager (0.0% rejection rate). General Manager's Low Rejection Rate: The General Manager has a low rejection rate of 0.59%, indicating that rejections are infrequent in their decision-making process. The Legal Manager stands out with a lower approval rate of 60.59% and a relatively high rejection rate of 22.94%. This suggests that a substantial portion of entries managed by the Legal Manager faces rejections, potentially indicating complex or stringent approval criteria in their process. The above is illustrated in Figure 11 as well.

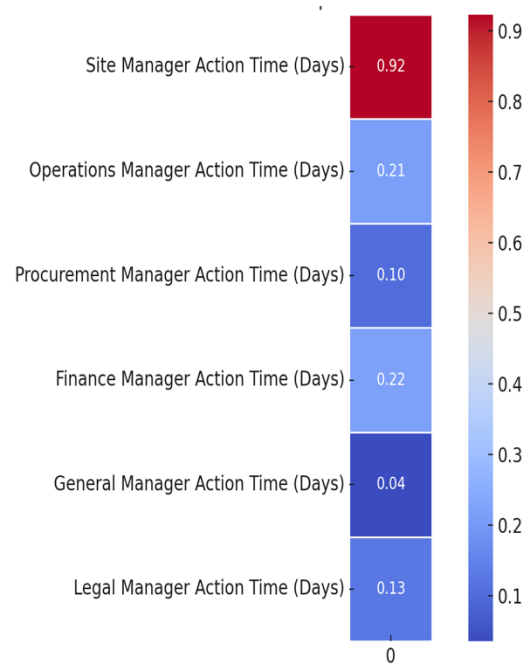
Table 10

Approval vs. Rejection Rates

	Approval Rate (%)	Rejection Rate (%)
Site Manager	97.65	2.35
Operations Manager	95.29	2.35
Procurement manager	84.12	11.18
Finance manager	84.71	0.0
General Manager	84.12	0.59
Legal Manager	60.59	22.94

Figure 11*Approval vs. Rejection Rate***Correlation Analysis**

A correlation analysis was methodically conducted to explore the relationship between the total days required for each entry and the time expended by each manager in the process. The outcomes of this statistical exploration are systematically presented in Table 11. To enhance the interpretability of these findings, a heatmap chart was crafted, serving as a visual representation of the correlations. This chart, as depicted in Figure 12, employs a gradation of colors to intuitively convey the strength and nature of the correlations. The insights gleaned from this analysis are summarized in the conclusions itemized below, offering an integrated understanding of the interplay between entry duration and managerial decision times.

Figure 12*Heatmap of Correlation Values***Table 11**

Correlation Analysis

Manager	Correlation Coefficient
Site Manager	0.92
Operations Manager	0.21
Procurement Manager	0.10
Finance Manager	0.22
General Manager	0.04
Legal Manager	0.13

- Site Manager: The correlation is close to 1, indicating a very strong positive relationship. This is evident from the intense color for the Site Manager. As the Site Manager's approval time increases, the total days for the process to end also tend to increase significantly.
- Operations Manager & Finance Manager: These managers have a weak positive correlation with the total days, as indicated by the lighter color compared to the Site Manager. Their approval times have some influence on the total process time, but not as much as the Site Manager.
- Procurement Manager, General Manager, & Legal Manager: These managers have very weak correlations, almost neutral, as indicated by the very light color. Their approval times have minimal influence on the overall process time.

In summary, The Site Manager has the most significant influence on the total process time, as indicated by the strongest color intensity in the heatmap. Operations and Finance Managers have some influence, but it's weaker. Procurement, General, and Legal Managers have minimal to no influence on the total process time based on the given data.

4.3.3 Managers Analysis

4.3.3.1 Finance Manager vs. General Manager. Given that the Finance and General Manager both receive entries simultaneously, an analysis was conducted to compare the time each takes to respond. The results of this comparison are clearly illustrated in Figures 13 and 14, providing a straightforward visual comparison of their respective action times.

Figure 13

FM Violin Plot

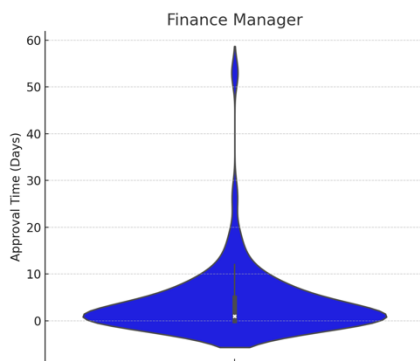
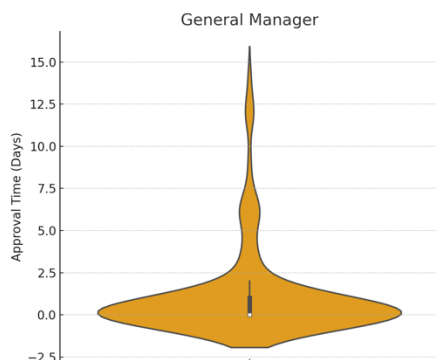


Figure 14

GM Violin Plot



Violin plots illustrate a higher density of longer approval times for the Finance Manager, whereas the General Manager has a peak at a shorter approval time which indicates that the Finance Manager typically takes longer to approve entries compared to the General Manager.

To accurately identify the root causes of delays, it was discovered that the process involves 26 site managers and a single legal manager. The legal manager is responsible for delays in both the Legal Review and Legal Check stages. This information, including the number of managers, is detailed in Table 12. Although there are two operations managers, further investigation into their performance was not necessary, as their action times were found to be the most efficient of all the managers involved.

Table 12

Managers' Count

Manager	Count
Site Manager	26
Operations Manager	2
Procurement Manager	1
Finance Manager	1
General Manager	1
Legal Manager	1

4.3.3.2 Site Manager Bottle Neck. To identify the bottleneck between the site managers that might be hindering and prolonging the efficiency of the process; a calculation of each manager's total entries is illustrated in Figure 16.

Figure 15

Percentage of SCA per Site Manager

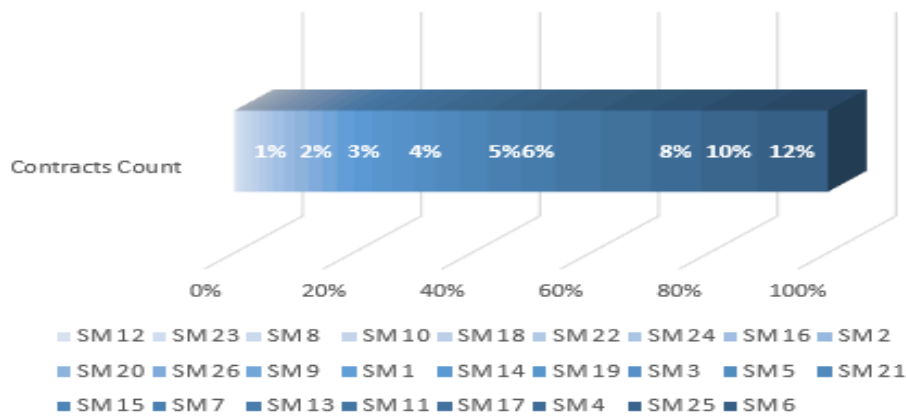
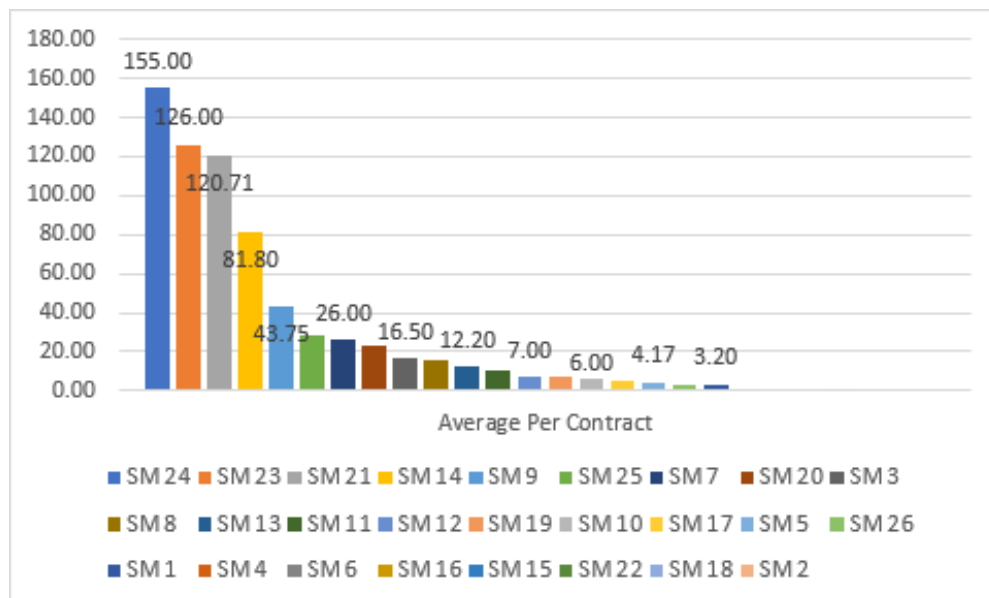


Figure 16

SM Average Time per Contract



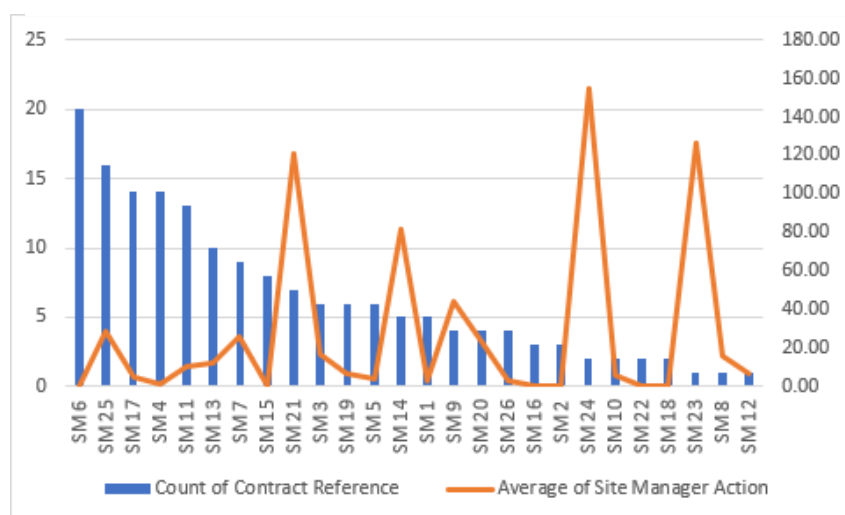
It is observed that the highest entry per site manager is 12% for Site Manager 6. However, it's required to calculate each site manager's average time taken per contract as shown in figure 16. The Highest average per contract is 155 days for Site Manager 24. To investigate the high average, a comparison of Figure 16 and average time is analyzed to identify the slowest site manager.

Figure 17 clearly contrasts the difference between total entry per site manager and average. Many site managers have an average of 0 days even though they have multiple entries per site like Site Manager 6, 4 & 15. Whereas some site managers have very high averages even though they handle few entries per site like Site Manager 21, 24, 23, & 8.

In conclusion, it appears that most site managers' action time are fast comparatively, and the identified Site Managers are the reason behind the outliers that was found in the analyses previously.

Figure 17

Count of SCA vs. Average Time

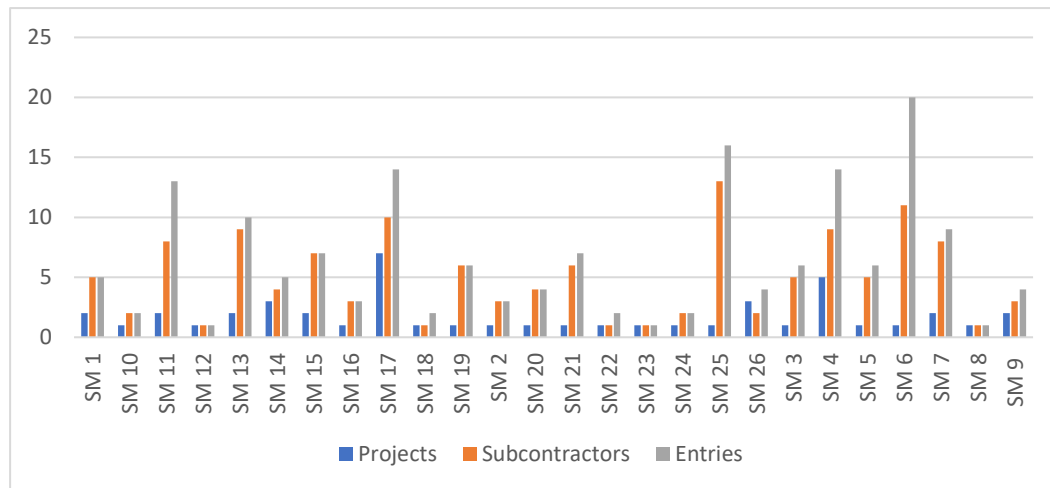


An analysis was conducted to evaluate the workload pressure experienced by site managers, considering the number of projects, subcontractors, and entries they manage. This analysis aimed to quantify their responsibilities within the process. The results of this

thorough evaluation are graphically represented in Figure 18, providing a visual summary of the Site Managers' Subcontractor Agreement distribution.

Figure 18

SM Work Pressure



The analysis indicates that Site Manager 17 oversees the largest number of projects and handles a relatively high volume of requests. Intriguingly, despite this substantial workload, the average action time for Site Manager 17 is notably low. While Some managers, despite managing a smaller number of projects, are responsible for a significant number of subcontractors and entries. This discrepancy necessitates a more in-depth investigation to understand the factors contributing to the variance in work pressure among different managers. Such an exploration is essential to discover the underlying reasons for this diversity in workload management and action times.

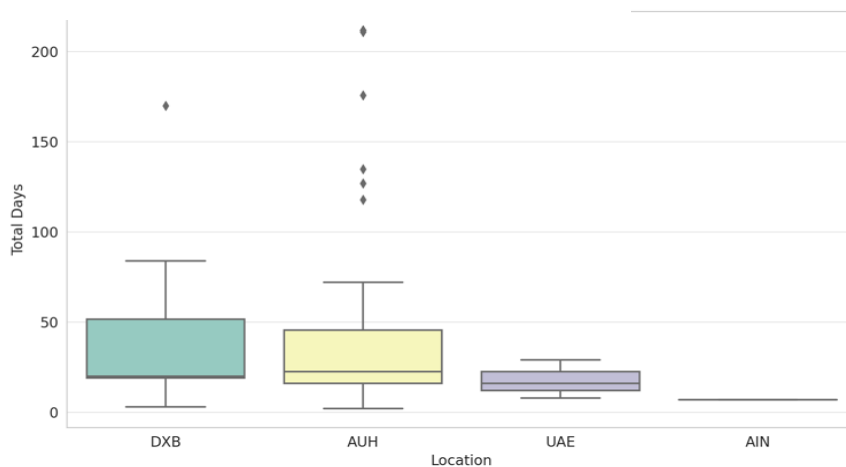
4.3.4 Location

Moving forward, a study was conducted to evaluate contracts initiated in different emirates. 'UAE' in the analyses below represents Northern Emirates.

Table 13*SCA's Locations*

City	No. of contracts	Average per contract
AIN	1	7
AUH	111	37.33
DXB	53	34.94
UAE	3	17.67

Table 13 shows that many entries are from Abu Dhabi (AUH) with 111 entries, followed by Dubai (DXB) with 53 entries. The UAE and Al Ain (AIN) locations have fewer entries, with 3 and 1 respectively. Al Ain (AIN) has the shortest average approval time at 7 days. Abu Dhabi (AUH) has the longest average approval time at approximately 37.88 days, which is higher than the overall average. Dubai (DXB) follows closely with an average of 34.93 days. The UAE location, despite having fewer data points, has a moderate average approval time of 17.67 days.

Figure 19*SCA's Locations Box Plot*

The box plot in Figure 19 indicates that the approval time in Abu Dhabi (AUH) has a wider range and variability. This suggests that some subcontractors in AUH face longer waiting times than others. Dubai (DXB) also has variability in approval times but shows fewer outliers than AUH. The UAE and Al Ain (AIN) locations show lesser variability, likely due to fewer data points.

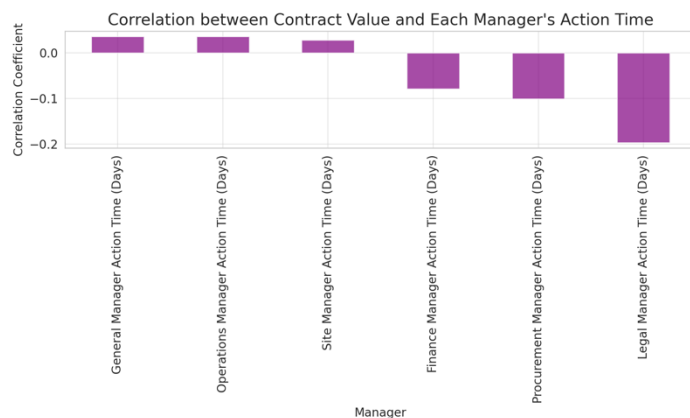
There are some outliers in Abu Dhabi (AUH) indicating that a few subcontractors faced significantly longer approval times than the majority. Dubai (DXB) also has a few outliers but not as pronounced as in AUH.

The wide range and variability in approval times, especially in AUH and DXB, may warrant an investigation into the approval process. Identifying bottlenecks or reasons for delays can help streamline the process. The outliers in approval times suggest that some subcontractors may face unique challenges or requirements that lead to extended approval durations. Understanding these specific cases can help improve the consistency of the process.

4.3.5 Contract Value

Figure 20

SCA's Value Correlation

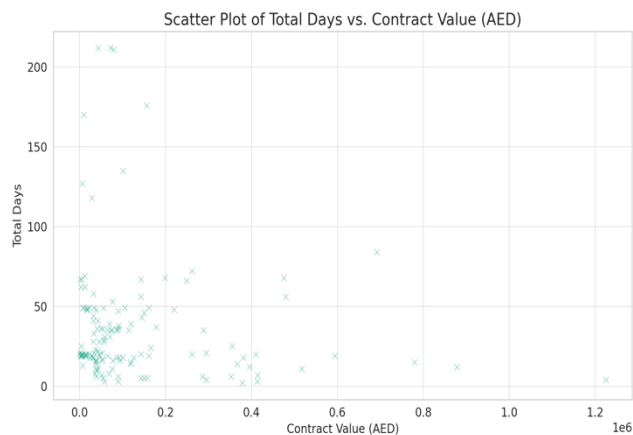


Another correlation study was conducted to evaluate if contract value has a relationship with decision making time as presented in Figure 20.

Most managers have a correlation close to 0, indicating a weak relationship. The Legal manager has a slightly stronger negative correlation, suggesting that as the contract value increases, the action time might decrease though the relationship is still weak. A scatter plot was created to illustrate the correlation in Figure 21.

Figure 21

SCA Value Scatter Plot



4.3.6 Distribution of Projects vs. Subcontractors

A study was undertaken to identify the project with the highest engagement of subcontractors, with the aim of highlighting and examining any potential delays associated with these projects. Figure 22 elucidates that Project 25 registers the highest number of subcontractor agreements, closely followed by Project 35. Subsequently, an average of the total days per project was calculated to facilitate a detailed observation and assessment of the time efficiency associated with each project.

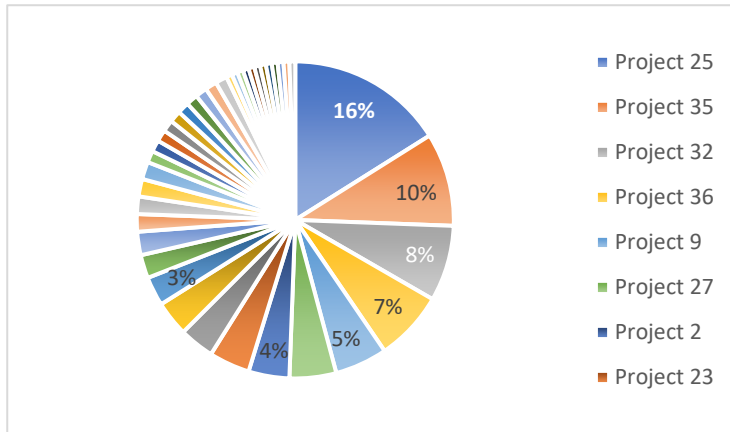
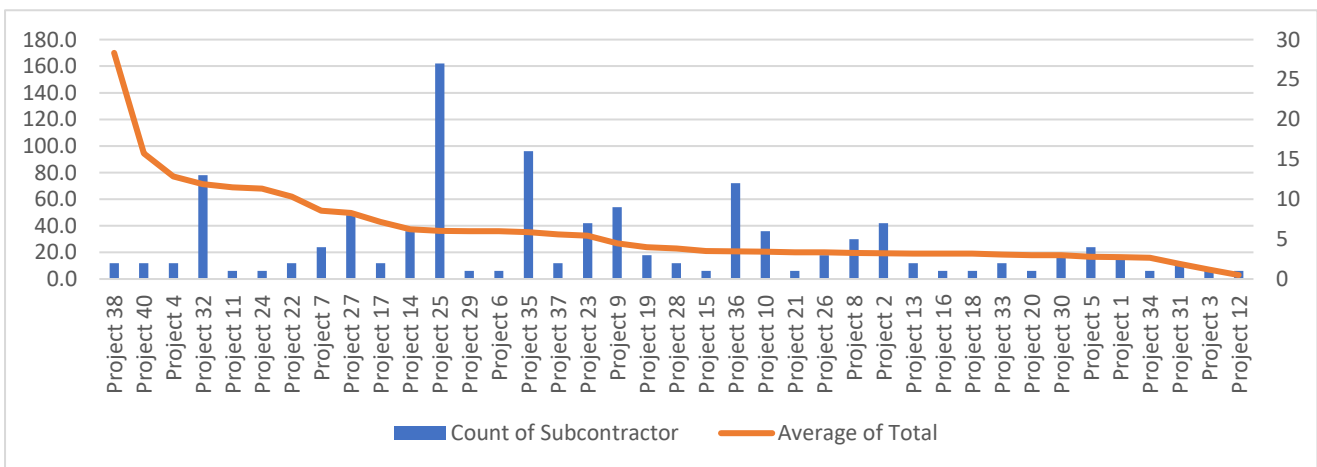
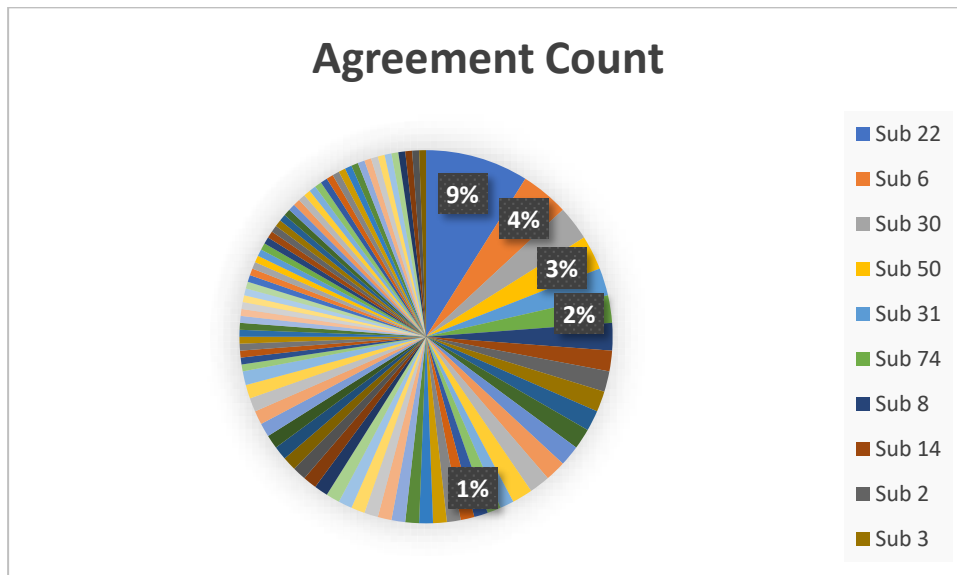
Figure 22*Percentage of Hiring SC per Project***Figure 23***Average Time vs. No. of SC*

Figure 23 shows that Project 25 and Project 23 demonstrate commendable averages in the duration required for processing approvals, indicating a relative efficiency in these projects. However, it is observed that certain projects with a minimal number of subcontractors still exhibit high average processing times. This pattern suggests a direct correlation with the previously identified bottleneck attributed to specific site managers. All Site Managers, Project reference and Subcontractor reference is listed in Appendix B.

In light of this, an investigative analysis was conducted to assess the feasibility of contract unification. This analysis aimed to comprehensively evaluate the distribution of all subcontractors across existing projects, as depicted in Figure 24. Notably, Subcontractor 22 is responsible for 9% of the company's subcontractor agreements, while the involvement of other subcontractors is considerably less. This disparity in subcontractor engagement across projects suggests that this recommendation might be feasible as it won't have great impact on the business process improvement.

Figure 24

Distribution of SC in the Company



Chapter 5 : Conclusion & Recommendation

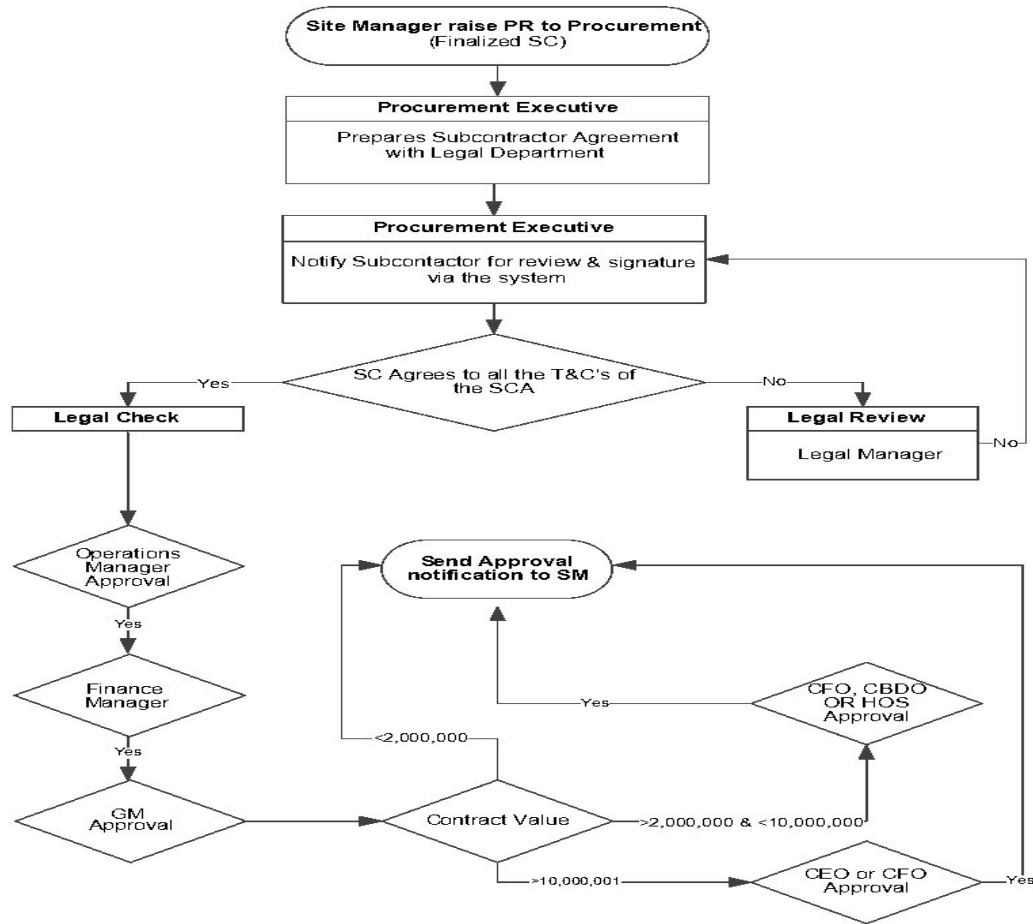
5.1 Recommendations

In the realm of process optimization for the Subcontractor Agreement Approval procedure, plenty of opportunities for enhancement have been identified. The process, as it currently stands, deviates notably from the principles of lean management, as interpreted by the factors outlined in the fishbone diagram. A rigorous statistical analysis has pinpointed the Legal and Site Managers as critical bottlenecks within the process. Based on these insights, several recommendations have been proposed to enhance the efficiency of the process:

- **Streamlining Repetitive Steps:** A notable inefficiency arises from the redundant steps involving the Site Manager. Currently, the Site Manager is responsible for approving the Purchase Request (PR) sent by the administrator, following which the procurement executive generates a form for the Site Manager to complete and approve. This recursive involvement accounts for approximately 45% of the total time required to complete the process. By eliminating the Site Manager's approval, a substantial increase in efficiency, estimated at 45%, can be achieved.
- **System Unification:** The current process is fragmented across two disparate systems without effective synchronization. The administrative team initiates the PR on the Horizon system, followed by the procurement executive's creation of a form for detail updates and subsequent approval. Consolidating all steps of the process onto a single, unified system would significantly streamline the workflow and reduce potential for errors and delays.
- **Subcontractor System Access:** The existing mode of communication with subcontractors, predominantly through email, has been identified as a source of unnecessary delays and repetitive steps. Granting subcontractors direct access to

review and provide feedback on agreements within the company's system would enhance the smoothness and responsiveness of the process. This direct engagement approach is anticipated to facilitate a more streamlined and efficient interaction, ultimately contributing to the overall efficacy of the approval process.

All the of above recommendations can be applied through Redesigning the process to the followings steps towards a lean process. The Site manager raises the PR with full details to procurement. The procurement prepares the Subcontractor Agreement with Legal Department then Subcontractor gets access to the system to review the agreement and give feedback. Once both legal and subcontractor agree, the approval process moves to Operations manager then finance manager, general manager and CEO depending on contract value. The redesigned process illustrated in the following figure 25:

Figure 25*Redesigned SCA Approval Process***5.2 Conclusions**

The restructured process, as proposed in this study, effectively addresses, and mitigates a multitude of factors identified through the research findings and subsequent discussions. A significant portion, approximately 25%, of the process delays were attributed to the involvement of the Site Manager in multiple and repetitive steps. In the redesigned process, the role of the Site Manager is streamlined to solely initiating the process with comprehensive details at the outset. This modification not only eliminates redundant tasks but also resolves the issue of the Site Manager being the slowest in decision-making, a factor which contributed substantially (50%) to the overall delays

under the subfactor 'Approvers Delay of Action Time'. Moreover, the procurement approval was also removed as the agreement was initially created by the procurement department.

Additionally, the Legal Manager, identified as a bottleneck in both types of submissions, has undergone a role revision in the new process design. The Legal Manager's responsibilities are now focused on creating the agreement and engaging directly with the subcontractor in cases of disagreement, thereby removing repetitive steps in the approval process.

Another critical aspect contributing to 15% of the process delays was the use of multiple systems. By unifying these systems, the redesigned process effectively eliminates this factor, thereby enhancing efficiency. Lastly, addressing the 10% of delays attributed to external factors poses a challenge due to the complexities inherent in contractual agreements.

5.3 Limitation and Future Opportunities

Due to constraints in the available time, certain subfactors were not addressed in this study, notably the absence of Service Level Agreements (SLAs) and the protocol for terminating and resuming processes from the beginning upon rejection. The implementation of definitive deadlines is suggested as a potential compound for enhancing the efficiency of the process. Moreover, a proposed modification involves the adaptation of the system to facilitate edits within the approval process, should a manager reject an entry and provide feedback. This capability to resume the process post-editing is anticipated to significantly reduce the repetitive steps inherent in restarting the process from the outset while retaining existing approvals.

Another area of opportunity identified pertains to the formulation of unified agreements with recurrent subcontractors, aimed at diminishing the time expended in

review. However, as expressed by the Operations Manager, the specificity and uniqueness of agreements to particular projects or clients present a challenge to this approach.

Notwithstanding, it is acknowledged that this is not always the case, thus paving the way for further research into the feasibility of standardizing similar agreements, or at least harmonizing certain elements of the terms and conditions, to optimize the overall efficiency of the subcontractor agreement process.

Finally, while external factors such as the monopoly of Original Equipment Manufacturers (OEMs) and client pressure objectives are recognized as challenging to mitigate, it is proposed that intensive research be undertaken. Such research endeavors should aim to explore these external dynamics in depth, providing insights and strategies to balance these external pressures with the imperative of maintaining financial goals and process efficiency.

References

- Agus, A. & Hassan, Z. (2011). Enhancing Production Performance and Customer Performance Through Total Quality Management (TQM): Strategies for Competitive Advantage. *Procedia - Social and Behavioral Sciences*. Elsevier, vol. 24, pp. 1650–1662.
- Aikens, C. Harold. (2011). *Quality inspired management: the key to sustainability*. Boston: Prentice Hall,.
- Bahn, D. & Paper, D. (n.d.). Association for Information Systems Association for Information Systems AIS Electronic Library (AISeL) AIS Electronic Library (AISeL), pp. 12–31
- Becker, J., Kugeler, M. & Rosemann, M. (2003). Process management: a guide for the design of business processes. Springer, p. 339.
- Bernal-Torres, C. A., Paipa-Galeano, L., Jarrah-Nezhad, Y., Agudelo-Otálora, L. M. & Millán, J. (2021). Continuous improvement and business sustainability in companies of an emerging market: Empirical analysis. *Journal of Industrial Engineering and Management*. OmniaScience, vol. 14(4), pp. 771–787.
- Bhat, J. (n.d.). A Holistic Adoption Framework for Long Term Success of BPM [online].
- Brussee, Warren. (2010). *Six Sigma on a budget: achieving more with less using the principles of Six Sigma*. New York: McGraw-Hill,.
- Business Process Improvement Guide 2023: 3 Methods*. (n.d.) [online]. Available at: <https://monday.com/blog/project-management/business-process-improvement/>.

- Cano, E. L., Moguerza, J. M. & Redchuk, A. (2012). *Six sigma with R*. s.l.:Springer Verlag.
- Casebolt, J. M., Design, S., Fellow, M., Jbara, A. & Dori, D. (n.d.). Business process improvement using Object#Process Methodology Business Process Improvement Using Object-Process Methodology.
- Chang, J. F. (2016). Business Process Management Systems: Strategy and Implementation. *Business Process Management Systems*. Auerbach Publications.
- Charron, R., Harrington, H. J. (H. J., Voehl, F. & Wiggin, H. (n.d.). The lean management systems handbook, p. 509
- Chountalas, P. T. & Lagodimos, A. G. (2019). Paradigms in business process management specifications: a critical overview. *Business Process Management Journal*. Emerald Group Holdings Ltd., vol. 25(5), pp. 1040–1069.
- Davis, D. L. G. S., Goetsch, D. L. D. L. & Davis, S. (2016). *Quality management for organizational excellence: introduction to total quality*. Pearson Education Limited. Boston: Pearson,.
- Doney, J. A. (2019). *Total quality management (TQM) : concepts, implementation and applications*. New York: Nova Science Publishers,.
- Dong, Y., Lu, H., Gajic, O. & Pickering, B. (1AD). Intensive Care Unit Operational Modeling and Analysis. <https://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/978-1-60960-872-9.ch006>. IGI Global, pp. 132–147.

Dumas, M., La Rosa, M., Mendling, J. & Reijers, H. A. (2013). Fundamentals of Business Process Management. *Fundamentals of Business Process Management*. Springer Berlin Heidelberg.

George, M. L., Rowlands, D. & Kastle, B. (2004). *What is Lean Six Sigma?* New York : McGraw-Hill,.

Gurkan Inan, G., Ergun Gungor, Z., Sezer Bititci, U. & Abdul Halim-Lim, S. (n.d.). Operational performance improvement through continuous improvement initiatives in micro-enterprises of Turkey.

Harmon, P. (2014). Business Process Change: A Business Process Management Guide for Managers and Process Professionals: Third Edition. *Business Process Change: A Business Process Management Guide for Managers and Process Professionals: Third Edition*. Elsevier Inc., pp. 1–488.

Harmon, P. (2016). The State of Business Process Management 2016 www.bptrends.com
The State of the BPM Market-2016

Kandemir, C., Handley, H., Holly, ·, Handley, A. H., Handley, H. A. H., Kandemir, C. & Handley, H. A. H. (n.d.). Work process improvement through simulation optimization of task assignment and mental workload VERIFIABLE MODELING & SIMULATIONS BASED ON COMPUTATIONAL CATEGORY THEORY
View project Comput Math Organ Theory Work process improvement through simulation optimization of task assignment and mental workload. *Computational and Mathematical Organization Theory*.

Keller, P. A. (Paul A. (2011). *Six sigma demystified*. New York : McGraw-Hill,.

Kiani Mavi, R., & Standing, C. (2018). Cause and effect analysis of business intelligence (BI) benefits with fuzzy DEMATEL. *Knowledge Management Research & Practice*, vol. 16(2), pp. 245-257.

Klun, M. & Trkman, P. (2018). Business process management – at the crossroads. *Business Process Management Journal*. Emerald Group Publishing Ltd., vol. 24(3), pp. 786–813.

Krüger, V. (2011). Main schools of TQM: “the big five”. *The TQM Magazine*, 13(3), pp. 146 - 155.

Manager, F., 2023. *Importance of SCA in FM Business* [Interview] (9 August 2023).

Manager, O., 2023. *SCA Root Cause Anaylsis* [Interview] (30 October 2023).

Martínez-Jurado, P. J. & Moyano-Fuentes, J. (2014). Lean Management, Supply Chain Management and Sustainability: A Literature Review. *Journal of Cleaner Production*. Elsevier, vol. 85, pp. 134–150.

Mayne, J. (2011). Contribution analysis: Addressing cause and effect. *Evaluating the complex*, pp. 53-96.

Mehdouani, K., Missaoui, N. & Ghannouchi, S. A. (2019). An approach for Business Process Improvement Based on Simulation Technique. *Procedia Computer Science*. Elsevier B.V., pp. 225–232.

Mitra, A. (2016). *Fundamentals of quality control and improvement*. Hoboken, New Jersey : John Wiley & Sons, Inc.,.

Murmura, F., Bravi, L., Musso, F. & Mosciszko, A. (2021). Lean Six Sigma for the improvement of company processes: the Schnell S.p.A. case study. *TQM Journal*. Emerald Group Holdings Ltd., vol. 33(7), pp. 351–376.

Oakland, J. S. (2014). *Total quality management and operational excellence : text with cases*. New York : Routledge,.

Page, S. (Susan A. (2010). The power of business process improvement : 10 simple steps to increase effectiveness, efficiency, and adaptability. American Management Association, p. 338.

Pande, P. S. & Holpp, Lawrence. (2002). *What is six sigma?* New York : McGraw-Hill,.

Schönreiter, I. M. (2018). Methodologies for process harmonization in the post-merger integration phase: A literature review. *Business Process Management Journal*. Emerald Group Publishing Ltd., vol. 24(2), pp. 330–356.

Seed Ahmed, E., Nazir Ahmad, M., Kebangsaan Malaysia, U. & Hajar Othman, S. (2019). Business process improvement methods in healthcare: a comparative study Business process improvement methods. *General review International Journal of Health Care Quality Assurance*, vol. 32(5), p. pp.

Shankar, R. (2009). *Process improvement using Six Sigma : a DMAIC guide*. Milwaukee, Wisconsin : ASQ Quality Press,.

SIPOC Diagram Template | Visual Paradigm Online. (n.d.) [online]. Available at:

<https://online.visual-paradigm.com/app/diagrams/#diagram:proj=0&type=SIPOCDiagram&gallery=/rep>

[ository/0ff2f8a9-6ad3-491d-943f-0a3ff70e4c31.xml&name=SIPOC%20Diagram%20Template](https://www.mdpi.com/2502-0717/13/10/1700/peer-review/0ff2f8a9-6ad3-491d-943f-0a3ff70e4c31.xml&name=SIPOC%20Diagram%20Template).

- Skoglund, B. & Perjons, E. (2020). Towards a goal and problem based business process improvement framework-an experience report.
- Stravinskiene, I. & Serafinas, D. (2020). The Link between Business Process Management and Quality Management. *Journal of Risk and Financial Management*. MDPI AG, vol. 13(10), p. 225.
- Van Dun, C., Moder, L., Kratsch, W. & Röglinger, M. (2023). ProcessGAN: Supporting the creation of business process improvement ideas through generative machine learning ☆. *Decision Support Systems*, vol. 165, p. 113880.
- Wannes, A. & Ghannouchi, S. A. (2019). KPI-Based Approach for Business Process Improvement. *Procedia Computer Science*. Elsevier B.V., pp. 265–270.
- Wu, K., Zheng, M. & Shen, Y. (2020). A generalization of the Theory of Constraints: Choosing the optimal improvement option with consideration of variability and costs. *IISE Transactions*. Taylor and Francis Ltd., vol. 52(3), pp. 276–287.
- Yousfi, A., Batoulis, K. & Weske, M. (2019). Achieving business process improvement via ubiquitous decision-aware business processes. *ACM Transactions on Internet Technology*. Association for Computing Machinery, vol. 19(1).
- Zhao, X. & Hou, J. (2021). Applying the Theory of Constraints Principles to Tourism Supply Chain Management. <https://doi-org.buid.idm.oclc.org/10.1177/1096348021996791>. SAGE PublicationsSage CA: Los Angeles, CA, vol. 46(2), pp. 400–411.

Appendices

Appendix A

Facility Manager Interview

(1) Interviewer: Good morning! Thank you for your precious time to join this meeting. Please introduce yourself and your role as a Facilities Manager.

Facilities Manager: I am the site manager for this contract. As a site or facility manager, we oversee the efficient functionality, maintenance, and safety of our facilities. The facilities can be divided into hard services and soft services. Our organization's Facility Management contracts are hard services only which includes Electrical, Mechanical, and plumbing systems. Also, Hard FM included the maintenance of specialized system depending on the site or contract.

(2) Interviewer: In the context of Facility Management (FM), how would you define a subcontractor?

Facilities Manager: Within FM, a subcontractor is typically a specialized individual or firm that we contract to undertake specific tasks or services that are beyond our in-house capabilities or requested by the client as per the OEM (Original Equipment Manufacturer)

(3) Interviewer: When you're in the selection phase, what attributes do you look for in a subcontractor?

Facilities Manager: Reputation and proven expertise are paramount. I also look at their track record for safety, punctuality, and the quality of their work. Communication skills and responsiveness are also crucial, given the collaborative nature of our work.

(4) Interviewer: Is hiring subcontractors critical to business?

Facilities Manager: Absolutely. Subcontractors provide specialized expertise we might not have in-house, offer flexibility during peak workloads, help in efficient cost

management, share potential risks with their own insurances, and enhance our service range, making us more competitive. They're pivotal in ensuring we meet diverse client needs effectively and efficiently.

(5) Interviewer: How does a delay in hiring a subcontractor impact the site?

Facilities Manager: A delay can lead to project timeline disruptions, increased costs, strain on in-house resources, potential compromises in work quality, risks to our reputation, and potential safety concerns. In short, timely subcontractor engagement is vital for efficiency, safety, and maintaining standards on site.

(6) Interviewer: Can you briefly explain the advantages of hiring subcontractors?

Facilities Manager: Subcontractors bring in-depth knowledge in specific areas, ensuring tasks are done with precision and up-to-date practices. We can scale up or down based on project demands without the commitments associated with permanent hires. Often, it's more economical to hire subcontractors for periodic tasks than to have full-time, in-house teams for every potential job. Also, the profit margin can be set if the cost & budget are determined from the main contract. Finally, Subcontractors often carry their own insurance and licenses, distributing the liabilities.

(7) Interviewer: Lastly, from your experience, what challenges have you faced, or might one endure when working with subcontractors?

Facilities Manager: Potential misunderstandings due to infrequent interactions or cultural differences. Variations in work methods leading to inconsistent results which might compromise quality and affect our relationship with the client and potentially the KPIs as we are accountable for the services offered by the subcontractor, and we must supervise multiple subcontracts at the same time to maintain the SLA. Also, there are risks of subcontractors not available in events of emergency if not included in contractual agreement and the confidentiality risks of handling sensitive information with external

parties. Finally, their safety and compliance in alignment with our company values and practices.

(8) Interviewer: Thank you for your insights. It's been enlightening to understand the dynamics of importance of subcontractors in FM.

Appendix B

SM 1

Project 5

Sub 6
Sub 60
Sub 65
Sub 81

Project 6

Sub 44

SM 10

Project 33

Sub 2
Sub 22

SM 11

Project 29

Sub 5

Project 36

Sub 16
Sub 3
Sub 37
Sub 5
Sub 6
Sub 64
Sub 80
Sub 90

SM 12

Project 9

Sub 35

SM 13

Project 25

Sub 30
Sub 50
Sub 51
Sub 8
Sub 87

Project 9

Sub 1
Sub 20
Sub 21
Sub 66

SM 14

Project 22

Sub 22
Sub 74

Project 24

Sub 82

Project 38

Sub 74

Sub 79

SM 15

Project 2

Sub 13

Sub 2

Sub 22

Sub 29

Sub 47

Sub 74

Project 34

Sub 23

SM 16

Project 19

Sub 28

Sub 62

Sub 86

SM 17

Project 1

Sub 85

Project 13

Sub 22

Sub 27

Project 15

Sub 68

Project 20

Sub 52

Project 21

Sub 68

Project 23

Sub 14

Sub 15

Sub 22

Sub 73

Project 30

Sub 70

SM 18

Project 1

Sub 85

SM 19

Project 10

Sub 10

Sub 2

Sub 48

Sub 54

Sub 67

Sub 68

SM 2

Project 26

Sub 29

Sub 39

Sub 89

SM 20

Project 9

Sub 1

Sub 63

Sub 66

Sub 75

SM 21

Project 32

Sub 3

Sub 49

Sub 55

Sub 6

Sub 78

Sub 90

SM 22

Project 31

Sub 12

SM 23

Project 25

Sub 8

SM 24

Project 30

Sub 19

Sub 40

SM 25

Project 35

Sub 17

Sub 22

Sub 30

Sub 32

Sub 33

Sub 38

Sub 4

Sub 46

Sub 57

Sub 69

Sub 75

Sub 77

Sub 8

SM 26

Project 16

Sub 34

Project 17

Sub 22

Project 18

Sub 22

SM 3

Project 14

Sub 11

Sub 24

Sub 25

Sub 26

Sub 88

SM 4

Project 28

Sub 31

Project 3

Sub 61

Project 37

Sub 22

Sub 56

Project 7

Sub 22

Sub 31

Sub 35

Sub 56

Project 8

Sub 22

Sub 26

Sub 31

Sub 40

SM 5

Project 32

Sub 18

Sub 22

Sub 6

Sub 71

Sub 84

SM 6

Project 25

Sub 30

Sub 36

Sub 41

Sub 50

Sub 51

Sub 59

Sub 7

Sub 72

Sub 83

Sub 87

Sub 9

SM 7

Project 12

Sub 58

Project 27

Sub 34

Sub 40

Sub 41

Sub 45

Sub 48

Sub 53

Sub 66

SM 8

Project 11

Sub 76

SM 9

Project 4

Sub 6

Sub 60

Project 40

Sub 6

Sub 69