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A report on the investigation into factors that impact the replication of operational excellence programs across the global operations of a top global mining company: The Case of Rio Tinto

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TABLE OF CONTENTS

DECLARATION

I, Moleboheng Tsomole (Student number: 601909), am a student registered for the course MECN7018 A– Research Report, in the year 2023, submitting in 2024. I herewith submit the following task "Investigating factors that impact the replication of operational excellence programs across the global operations of a top global mining company: The Case of Rio Tinto" in fulfilment of the requirements of the above course.

I hereby declare the following:

• I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.

• I confirm that all the work submitted for assessment for the above course is my own unaided work except where I have explicitly indicated otherwise.

I confirm that all the work submitted has not been submitted in the past and no part has ever been submitted for a degree at any other university.

• I have followed the required conventions in referencing the thoughts and ideas of others.

• I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.

Signed this 3rd of September 2024

ABSTRACT

Achieving operational excellence in mining is fraught with challenges, including the lack of standardized procedures, misalignment with company strategy, and cultural disparities across global operations. This study investigates the strategies for efficient deployment of operational excellence programs, with a focus on Rio Tinto's operational excellence framework, RTSPS (Rio Tinto Safe Production System). A mixed-methods approach was adopted, integrating qualitative data from semi-structured interviews with Rio Tinto managers and employees and an analysis of secondary data from company reports.

This study combined deductive and inductive research approaches to provide a comprehensive exploration of operational excellence at Rio Tinto. The deductive approach involved testing specific hypotheses drawn from existing literature on operational excellence programs, such as the assumption that standardized systems like RTSPS would encounter difficulties in culturally diverse environments. Inductive reasoning complemented this by allowing themes and insights to emerge directly from empirical observations during interviews, thus offering an authentic view of the challenges and successes of RTSPS deployment. The qualitative component of the study was centered around 14 semi-structured interviews with key stakeholders across various regions, including operational excellence managers and improvement leads. These interviews were conducted virtually using platforms like Microsoft Teams and Zoom, enabling broad participation across geographically dispersed sites.

The interview questions were meticulously crafted using Wengraf's pyramid model, which starts with Critical Research Questions (CRQs) that are broken down into Theoretical Questions (TQs) and further refined into specific Interview Questions (IQs). This structured approach ensured that the interviews remained focused on uncovering detailed insights into operational challenges and strategic alignment. The questions were adapted to account for the contextual nuances of each participant's operational environment, and particular care was taken to avoid leading questions, thereby minimizing researcher bias.

The analysis of data employed thematic coding, revealing key insights into behavioural adaptability, cultural diversity, and the influence of leadership on the adoption of standardized processes. Themes were generated from the qualitative data and cross-referenced with secondary data sources, including integrated annual reports that provided a broader organizational context and corroborated the findings. Secondary data analysis allowed for a deeper understanding of Rio Tinto's strategic objectives and how these aligned or conflicted with ground-level practices. Using qualitative data from interviews with 14 participants, the research highlights key themes identified through thematic analysis, focusing on the complexities of implementing RTSPS across diverse cultural and operational landscapes. Sentiment analysis conducted via ATLAS.ti software provided additional insights into participants' attitudes and emotional responses, shaping the creation of a comprehensive codebook that guided systematic data analysis.

The findings reveal that RTSPS faces significant deployment challenges, including the integration of a standardized system across culturally varied sites, a need for a more people-centric approach, and issues with communication, resource allocation, and adaptability. Participants with experience outside of Rio Tinto provided unique insights into alternative deployment strategies that could enhance replication and adaptability across different industries and operational settings.

The study also identifies the foundational elements critical to RTSPS, such as standardized processes, robust training programs, and a centralized knowledge-sharing infrastructure. These components were highlighted as essential for fostering a culture of continuous improvement and ensuring successful replication across Rio Tinto's operations.

Rio Tinto's annual reports from 2018 to 2022 emphasize RTSPS's role in enhancing safety, efficiency, and sustainability, with impacts on the triple bottom line of people, planet, and profit. However, the challenges identified through this research include cultural integration, resource constraints, and the need for local adaptability, mirror broader issues documented in the literature on operational excellence in the

mining sector. The study concludes that while RTSPS holds significant potential, its success hinges on balancing standardization with the flexibility to accommodate local conditions and prioritizing employee engagement throughout the deployment process.

DEDICATION

I am deeply indebted to my family for their unconditional love and unwavering support. The completion of this project owes its existence to my husband, Tshego, and our children, Resego and Bogosi. Their encouragement and understanding have sustained me through the challenges and triumphs of this journey. I am eternally grateful for their presence in my life.

Furthermore, I wish to recognize the inherent drive instilled within me by my ancestors, particularly the Tsomole family, whose legacy of resilience and determination has inspired me to pursue higher education and achieve my aspirations. It is a privilege to continue this legacy and live out our shared dreams.

I also extend appreciation to myself for the discipline and perseverance to see this endeavour through to completion. This accomplishment is a testament to my own dedication and commitment.

Lastly, I am humbled to acknowledge the divine guidance of God, who has continually provided clear pathways for me to succeed, regardless of the challenges or decisions I have faced. I am grateful for the blessings and opportunities bestowed upon me.

To each individual mentioned above, and to those whose support has contributed to this work in various ways, I offer my heartfelt thanks. This achievement would not have been possible without the collective efforts and encouragement of all involved.

ACKNOWLEDGEMENTS

I would like to express my sincerest gratitude to my supervisor, Dr. Bernadette Sunjka, for her unwavering support, patience, and invaluable guidance throughout the course of this research. Her insightful feedback and probing questions have greatly shaped the direction and quality of this paper. I am truly thankful for her mentorship and dedication.

Lastly, I would like to thank my employer, for granting me the permission to interview colleagues for the purpose of my research.

LIST OF FIGURES

LIST OF TABLES

NOMENCLATURE

RTSPS	Rio Tinto Safe Production System
DMAIC	Define Measure Analyze Improve and Control
5S	Sort, Set in Order, Shine, Standardize, Sustain
Muda	Eight Wastes (overproduction, waiting, transportation, excess inventory, motion, over-processing, defects, and underutilized talent).
OEMS	Operational Excellence Management System
OE	Operational Excellence
TPM	Total Productive Maintenance
TPS	Toyota Production System
KPIs	Key Performance Indicators
CAQDAS Software	Computer-Assisted Qualitative Data Analysis

CHAPTER 1

1. INTRODUCTION

1.1 Background

The mining industry plays a crucial role as a raw material provider for numerous other industries, serving as a foundation for economic development and industrial growth worldwide. Global mining companies hold significant importance in this regard, as they often set the tone for the rest of the industry and have a profound impact on the communities in which they operate. Literature highlights the vital contribution of the industry, recognizing its essential role in supplying raw materials such as minerals, metals, and energy resources that are essential for manufacturing processes, construction, energy production, and technological advancements Tilton (2003); De Lange, et al. (2017). These raw materials serve as fundamental inputs for sectors ranging from automotive and electronics to infrastructure and renewable energy.

Global mining companies have the potential to influence industry practices and shape the standards of operation through their size, reach, and influence. Their commitment to responsible mining practices, environmental stewardship, and community engagement can set the benchmark for other mining companies and impact the sustainability of the industry suggests Kemp, et al. (2010) and later Pardo & Chaparro (2014).

1.2 Context

Rio Tinto will be the case company for this research. It is an international mining company based in London, engaged in the extraction and processing of various commodities including Aluminium, Copper, Iron Ore, Diamonds, Titanium, and Heavy Minerals like Zircon. With operations spanning across 35 countries, the company holds a market capitalization of $132 billion, making it the second-largest mining company worldwide in terms of market value. Its revenue primarily relies

on sales in China, the United States, other Asian countries, and Japan, in descending order (Rio Tinto, 2023).

To ensure operational efficiency and proximity to customers, Rio Tinto employs a structured approach, consisting of regional hubs housing centres of excellence, as well as Satellite operations comprising mines and processing facilities tailored to specific purposes. This strategy is devised at the corporate level and then disseminated to the various satellite locations across functional groups (Rio Tinto, 2023).

In pursuit of continuous improvement, Rio Tinto has undertaken a global lean transformation initiative. As part of this effort, the company has developed the Rio Tinto Safe Production System (RTSPS), an operations excellence program that incorporates lean methodologies and six sigma principles (Rio Tinto, 2023).

1.3 Problem Statement

According to research by Durant, et al. (2011) and Galina, et al. (2018), the implementation of operational excellence programs in mining companies is confronted with a range of impediments. Smith, et al. (2019) discovered that the absence of standardized processes and procedures across various sites poses a significant barrier to replicating operational excellence initiatives. Additionally, cultural, and organizational disparities among sites can impede the successful deployment of these programs as indicated by Kumar, et al. (2018). Furthermore, limited communication and coordination among different site locations have been identified as notable challenges in achieving consistent operational excellence across mining operations by Jones, et al. (2017).

The pursuit of operational excellence strategies often necessitates substantial investments in technology, training, and organizational change. Nevertheless, these investments may encounter resistance and lack of support from site managers and employees who perceive them as disruptive to their daily operations outlines Wagner, et al. (2020). This resistance has been noted to pose an obstacle to the

successful replication and implementation of operational excellence programs across mining sites according to Wagner, et al. (2020).

To tackle these challenges, it is important to identify appropriate methodologies and approaches that can foster the efficient implementation of operational excellence programs in the context of mining operations. Such endeavours are crucial not only for the success of the program itself but also for enabling companies to obtain a substantial return on the substantial investments required for the deployment of these programs found Smith, et al. (2018) & Johnson (2019). By comprehending the barriers, site-specific factors, and managerial practices that hinder the replication of these programs, mining companies can devise targeted approaches to surmount these obstacles and attain consistent operational excellence.

1.4 Critical Research Question

What are the factors that enable successful replication of operational excellence programs at Rio Tinto, one of the top four global mining companies in the world?

1.5 Research Objectives

The aim of this research is to investigate the factors impacting Rio Tinto in replicating operational excellence programs across its' operational sites. Through an examination of the barriers, challenges, and site-specific factors impeding the deployment of these programs, this study will offer valuable insights into strategies and practices that can facilitate the successful replication of operational excellence initiatives in the mining industry.

- Identify and analyse the primary obstacles and challenges faced by Rio Tinto in replicating and implementing operational excellence programs across their operational sites.

- Classify the operational excellence components used by Rio Tinto to promote consistency across different operational sites and compare with literature findings.
- Recommend strategies, best practices, and managerial approaches that Rio Tinto can adopt to overcome barriers and achieve consistent operational excellence across their sites.

1.6 Summary of Research Method

This paper proposes a qualitative research method focused on conducting semi-structured interviews with operational excellence executives within Rio Tinto, a global mining company, to identify factors facilitating successful replication of operational excellence programs. Through purposive sampling, key executives were selected for their expertise and involvement in such initiatives. The interviews were guided by a predetermined set of questions, allowing for in-depth exploration of factors such as organizational culture, leadership strategies, resource allocation, and operational challenges. Thematic analysis was employed to analyze interview data, providing insights into common patterns and divergences across participants, ultimately contributing to a comprehensive understanding of the replication process within the context of Rio Tinto. The ethics clearance granted by the Ethics Committee was given the reference: MIAEC 011/23.

The scope of this study is confined to Rio Tinto employees. This limitation arises from the study's exploration of fundamental aspects of operational excellence, which are often regarded as intellectual property by organizations. Given the sensitive nature of this information, many companies, particularly those in competition with the researcher's employer, would be unwilling to disclose such details. Consequently, the research has been restricted to operations within Rio Tinto to ensure confidentiality and the integrity of proprietary practices.

1.7 Delimitations

Delimitations are the boundaries or limitations that researchers establish to narrow the focus of their study as described by Cresswell (2014). In the context of an interview research study at Rio Tinto exploring the replication of the operational excellence program, the following are the delimitations of the study:

- Geographical Spread of Participants:
    - Delimitation: The study will focus solely on participants employed by Rio Tinto, who are spread across geographic locations globally.
    - Justification: Limiting the study to Rio Tinto employees ensures a coherent focus on a specific organizational context, but it may limit the generalizability of findings to other mining companies or industries.
- Online Interviews:
    - Delimitation: Interviews will be conducted exclusively online due to the geographical dispersion of participants.
    - Justification: Online interviews allow for convenient data collection across different time zones and locations. However, this method may introduce technological constraints and limitations in non-verbal communication compared with face-to-face interviews.

- Power Dynamics:
    - Delimitation: The study acknowledges potential power dynamics between the interviewer and participants, particularly since the interviewer is junior to the participants.
    - Justification: Recognizing power dynamics is crucial for understanding how they might influence participant responses and interview dynamics. However, mitigating these dynamics entirely may be challenging due to hierarchical structures within the organization.

- Participant Selection:

- Delimitation: Participants will be selected based on their involvement in or knowledge of the operational excellence program replication at Rio Tinto.
- Justification: Focusing on participants directly involved in the replication process ensures relevant insights into the challenges, successes, and strategies employed. However, this approach may overlook perspectives from other stakeholders who could provide valuable insights.

- Organizational Context:
  - Delimitation: The study will specifically examine the replication of the operational excellence program within Rio Tinto and may not consider broader industry contexts.
  - Justification: Limiting the scope to Rio Tinto provides a clear and manageable focus for the study. However, findings may lack generalizability to other mining companies or industries with different organizational structures or operational contexts.

- Time Constraints:
  - Delimitation: The study will be conducted within a specified timeframe due to resource constraints.
  - Justification: Setting a timeframe ensures the research remains feasible and manageable within available resources. However, it may limit the depth of data collection and analysis, potentially overlooking nuances or evolving dynamics over time.

1.8 Outline of Chapters

Chapter 1 of this dissertation provides a comprehensive introduction to the study. It begins with an overview of the mining industry's critical role in global economic development and the influence of large mining companies on industry standards

and sustainability (Section 1.1). The context of the research is then established, with a focus on Rio Tinto as the case company, detailing its operations and recent efforts in operational excellence (Section 1.2). The problem statement highlights the challenges in replicating operational excellence programs across diverse sites, followed by the formulation of the critical research question (Sections 1.3 and 1.4). The chapter concludes with the research objectives, a summary of the research method, and a discussion of the scope and delimitations of the study (Sections 1.5, 1.6, and 1.7).

Chapter 2 provides a detailed exploration of operational excellence in the mining industry. It examines the necessary conditions for operational excellence, different approaches to achieving it, successful case studies, and the challenges faced by global mining companies in replicating such initiatives. This chapter concludes with the development of a comprehensive conceptual framework.

In Chapter 3, the research methodology is explained, focusing on the rationale for selecting interviews as the primary data collection method and outlining the process of formulating interview questions.

Chapter 4 presents the findings obtained from the empirical investigation, while Chapter 5 offers a thorough discussion that relates these findings back to the original objectives of the study.

Finally, Chapter 6 synthesizes the research journey, providing thoughtful reflections and drawing meaningful conclusions that encourage further consideration of the study's implications and potential future avenues of research.

CHAPTER 2

2. LITERATURE REVIEW

The literature examines the factors that necessitate operational excellence in the mining industry, the existing frameworks employed, and the efficacy of these frameworks in achieving operational excellence. This section will delve into the various elements that contribute to operational excellence in the mining sector, such as standardized processes, effective communication, and organizational alignment. Furthermore, it will critically evaluate the current frameworks and models utilized in the industry to assess their effectiveness in achieving operational excellence. By exploring what works and what does not work in these frameworks, this literature review seeks to provide valuable insights and inform the subsequent research analysis and recommendations.

2.1 Introduction

The mining industry requires operational excellence programs to address a range of challenges and maximize its operational performance. These programs aim to optimize efficiency, productivity, safety, and environmental sustainability, while also reducing costs and enhancing overall competitiveness. Operational excellence programs provide a systematic approach to improve processes, standardize procedures, and implement best practices across mining operations as proposed by Smith, et al. (2021).

Henderson & Barton (2016) have highlighted the significance of operational excellence programs in the mining industry, arguing that these programs enable mining companies to streamline operations, minimize waste, and enhance resource utilization.

These programs provide a systematic approach to drive continuous improvement, reduce costs, and optimize safety and environmental sustainability as proposed by Sánchez-Rodríguez, et al. (2018). However, when examining the historical development and implementation of operational excellence programs in the mining industry, challenges have been noted. Cultural and organizational differences across

mining sites have been identified as barriers to successful program replication by Radzimski, et al. (2017). Mining operations span diverse regions, each with unique labour practices and management styles, making it difficult to implement standardized processes and achieve consistent operational excellence as put forward by Radzimski, et al. (2017) and later, Masi & Cagno (2020).

Limited communication and coordination among mining site locations have also been highlighted as significant challenges in achieving operational excellence by Ljunggren & Adamsson (2015). Remote and decentralized mining operations make it challenging to share best practices, align strategies, and foster collaboration among different sites suggests Masi & Cagno (2020).

In a critical analysis of the mining industry's execution of operational excellence compared to other industries like Toyota, it is evident that the sector faces unique challenges. Researchers like Ljunggren and Adamsson (2015) and Radzimski, et al. (2017) emphasize the need for site-specific approaches and tailored solutions to address the complexities of mining operations. Cultural barriers and the need for a shift in organizational culture have further been identified as critical factors in achieving sustainable operational excellence as emphasized by Masi and Cagno (2020).

The intricate nature and distinctive attributes of mining operations pose significant obstacles when it comes to establishing standardized procedures and replicating operational excellence initiatives across various sites found Pettit, et al. (2017) and Rugman (2018). Each mining site presents unique geological, environmental, and logistical factors that necessitate a tailored approach rather than a one-size-fits-all solution suggest Mendibil, et al. (2019).

In addition to site-specific considerations, cultural and organizational disparities among mining sites further impede the replication and long-term viability of operational excellence programs highlights Rugman (2018) and Bruntland (2020). Mining companies operate globally and encounter diverse regions with their distinct

cultural norms, labour practices, and management styles, which can generate resistance to change and impede the effective implementation of operational excellence practices noted Rugman (2018) and Brundtland (2020).

Rugman (2018) underscores the significance of considering cultural and organizational factors when implementing operational excellence initiatives in a multinational mining context. The author asserts that tailoring strategies to accommodate the diverse environments and work cultures is crucial for the successful adoption and sustained application of operational excellence practices.

While the mining industry benefits from operational excellence programs, the execution and replication have not matched the success of industries like Toyota. The sector's historical challenges in planning, deployment, replication, and sustainability stem from the unique nature of mining operations, cultural and organizational differences, limited communication, and a need for a shift in organizational culture.

2.2 Operational Excellence Frameworks

2.2.1 Juran Model

Dr. Joseph M. Juran is widely regarded as a prominent authority in quality management and operational excellence, with his contributions significantly shaping the understanding and practice of operational excellence across diverse industries, including manufacturing and services (DeFeo, 2023). Juran's operational excellence model, known as the Juran Trilogy as denoted in Figure 1, encompasses three core elements: quality planning, quality control, and quality improvement.

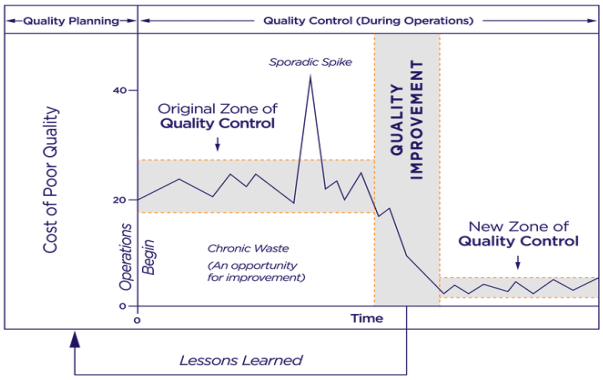

Figure 1 The three elements of the Juran Trilogy of quality. The Juran Trilogy: Quality Planning DeFeo(2019)

According to Juran (2023), attaining operational excellence necessitates a proactive approach to quality management. Quality planning entails establishing specific quality goals, identifying critical processes, and formulating strategies to meet customer expectations. Quality control involves implementing processes and systems to monitor and measure performance against predefined standards, ensuring compliance and identifying areas for enhancement. Lastly, quality improvement involves the continual evaluation and enhancement of processes, striving for incremental advancements and breakthrough improvements. The overall framework is founded on strategic objectives and each operation must ensure that the required enablers for success are in places to get the desired outcomes. The framework is fully depicted in Figure 2, Juran Model - Operational excellence framework DeFeo (2019).

Figure 2 Juran Model - Operational excellence framework DeFeo (2019)

Juran's model has garnered support and criticism from scholarly researchers. Numerous scholars have recognized the significance of Juran's model in achieving operational excellence. For example, Crosby (1979) underscored the importance of Juran's quality improvement approach in driving organizational success. Likewise, Antony, et al. (2002) emphasized the value of Juran's model in cultivating a customer-focused mindset and fostering a culture of continuous improvement.

Some academics have also examined the limitations and potential shortcomings of Juran's model. Dale & Plunkett (1991) argued that the model predominantly concentrates on the technical aspects of quality management, potentially neglecting the role of organizational culture and employee engagement. Oakland (2003) suggested that Juran's model does not fully address the strategic and systemic dimensions of operational excellence, which are crucial for achieving sustainable and long-term improvements.

Considering the criticisms and limitations of Juran's model, it is essential to acknowledge that operational excellence programs require a holistic and comprehensive approach. While Juran's model offers valuable insights into quality management and improvement, it may not suffice for the complete deployment and replication of operational excellence programs. To achieve consistent operational excellence in mining operations, additional factors such as organizational culture, leadership commitment, effective communication, and the integration of technology and innovation must be considered. Researchers continue to explore and develop frameworks that incorporate these broader dimensions to enhance the effectiveness and sustainability of operational excellence initiatives in the mining industry and beyond.

2.2.2 Lean Six Sigma

The Lean Six Sigma methodology has emerged as the leading operational excellence framework in the mining industry. By integrating Lean principles, which prioritize the elimination of waste and the improvement of efficiency, with

Six Sigma's focus on reducing process variability and defects, this framework has garnered widespread adoption and considerable influence across the sector. Its application in mining has been instrumental in driving operational improvements, increasing productivity, and achieving cost savings propose George & Wilson, (2018).

Lean Six Sigma is an operational excellence approach with different tools that form part of its founding principles. One such tool is the Define Measure Analyze Improve and Control problem solving methodology in Figure 3, DMAIC problem solving methodology (goLeanSixSigma, 2023).

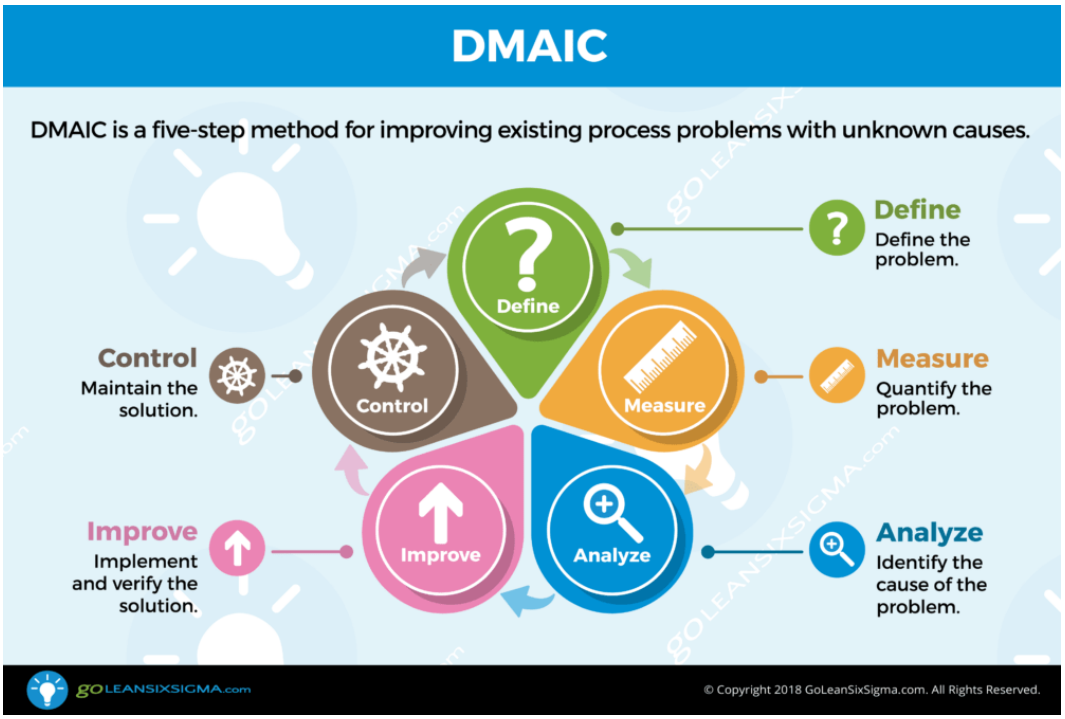

Figure 3 DMAIC problem solving methodology (goLeanSixSigma, 2023)

DMAIC is a fundamental problem-solving methodology used in Six Sigma, which is a data-driven approach aimed at improving operational processes and achieving excellence. DMAIC stands for Define, Measure, Analyze, Improve, and Control. According to Prybutok & Zhang (2014), DMAIC provides a structured framework that helps organizations identify critical issues, establish performance baselines, analyze root causes, implement solutions, and sustain improvements over time. This structured approach is supported by several scholars.

For instance, Folaronmi, et al. (2018) argue that DMAIC's emphasis on data-driven decision-making ensures that improvements are based on objective evidence,

leading to more effective and efficient outcomes. Moreover, Gupta, et al. (2019) contend that DMAIC's systematic approach fosters a culture of continuous improvement and empowers employees to participate actively in problem-solving initiatives.

Despite these benefits, some researchers have raised concerns regarding DMAIC's shortcomings. Nonthaleerak & Hendry (2019) suggest that DMAIC's rigorous data collection and analysis requirements may demand significant time and resources, potentially hindering its implementation in resource-constrained environments. Additionally, Petrillo, et al. (2016) point out that DMAIC's linear nature may not adequately address complex and dynamic problems that require more iterative and adaptive approaches.

In addition to DMAIC, a lean culture calls for working environments to apply 5S. 5S is a foundational methodology within the Six Sigma framework that focuses on workplace organization and standardization to improve operational efficiency and effectiveness. The 5S method comprises five steps: Sort, Set in Order, Shine, Standardize, and Sustain, as can be viewed in Figure 4, 5S process for six sigma in the workplace (goLeanSixSigma, 2023).

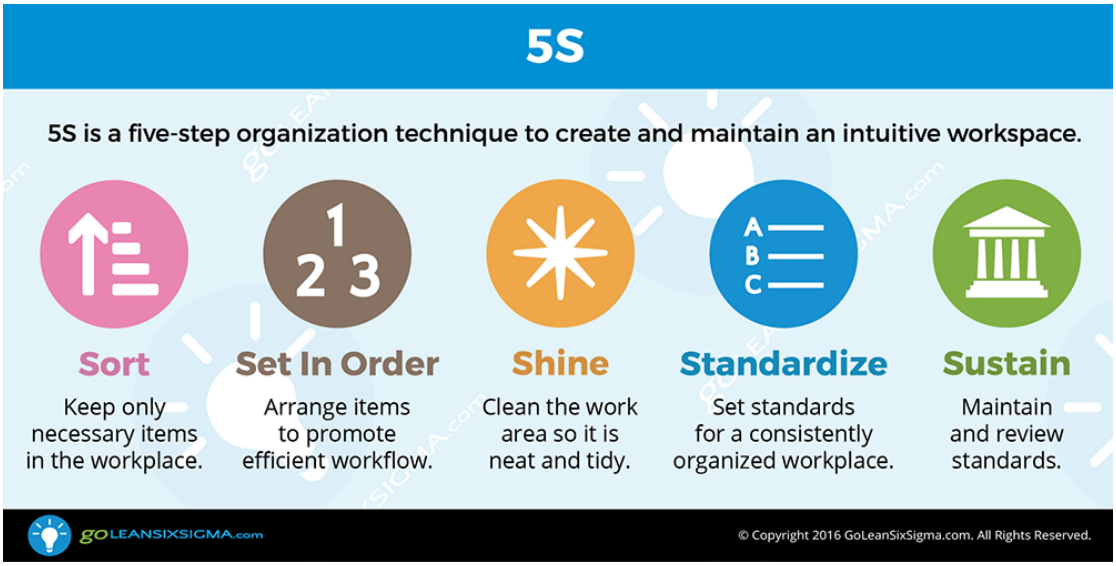

Figure 4 5S process for six sigma in the workplace (goLeanSixSigma, 2023)

According to Suksomboon & Wongthatsanekorn (2017), 5S promotes a clean and organized work environment, enhances productivity, reduces waste, and fosters a culture of continuous improvement. This perspective is reinforced by Womack & Jones (2003), who argue that implementing 5S principles can lead to streamlined processes and improved overall performance. Furthermore, Park, et al. (2018) emphasize that 5S can enhance employee morale and satisfaction, as a clean and orderly workplace tends to reduce stress and increase job satisfaction.

Despite its merits, some researchers have pointed out potential shortcomings of the 5S methodology. Rukuižienė & Bivainytė (2018) contend that the initial implementation of 5S may require significant time and effort, which could pose challenges in organizations with resistance to change. Additionally, Han, et al. (2021) suggest that sustaining the gains achieved through 5S can be challenging if not integrated with a broader continuous improvement culture.

A key aspect of Lean Six Sigma operational excellence programs is embedding the ability to identify and eliminate waste. The concept of the 8 wastes, also known as "Muda," is a fundamental principle within the Six Sigma and Lean methodologies. These wastes refer to non-value-added activities that exist in processes and impede operational excellence. The 8 wastes include overproduction, waiting, transportation, excess inventory, motion, over-processing, defects, and underutilized talent depicted in Figure 5, Eight Wastes that can be identified in processes, (goLeanSixSigma, 2023).

Figure 5 Eight Wastes that can be identified in processes, (goLeanSixSigma, 2023)

According to Ohno (1988), the pioneer of the Toyota Production System (TPS), eliminating these wastes is crucial for achieving process efficiency and reducing costs. This view is supported by Shingo (1989), who argues that identifying and eliminating the 8 wastes can lead to significant improvements in productivity and quality. Moreover, Li, et al. (2018) emphasize that the benefits of waste reduction extend beyond operational efficiency, as it also positively impacts environmental sustainability and resource optimization. However, some researchers have acknowledged certain challenges in applying the 8 wastes concept.

For instance, Liker & Meier (2007) note that waste elimination may not always align with short-term profit maximization, leading some organizations to prioritize immediate financial gains over long-term process improvements. Additionally, other scholars like Turner, et al. (2018) highlight that identifying and quantifying certain types of waste, such as underutilized talent or waiting, can be subject to subjectivity and measurement difficulties.

An additional element of Lean six sigma is continuous improvement, which comprises of projects with varying degree of complexity, as depicted in Figure 6,

Lean six sigma project types with varying degrees of complexity, (goLeanSixSigma, 2023).

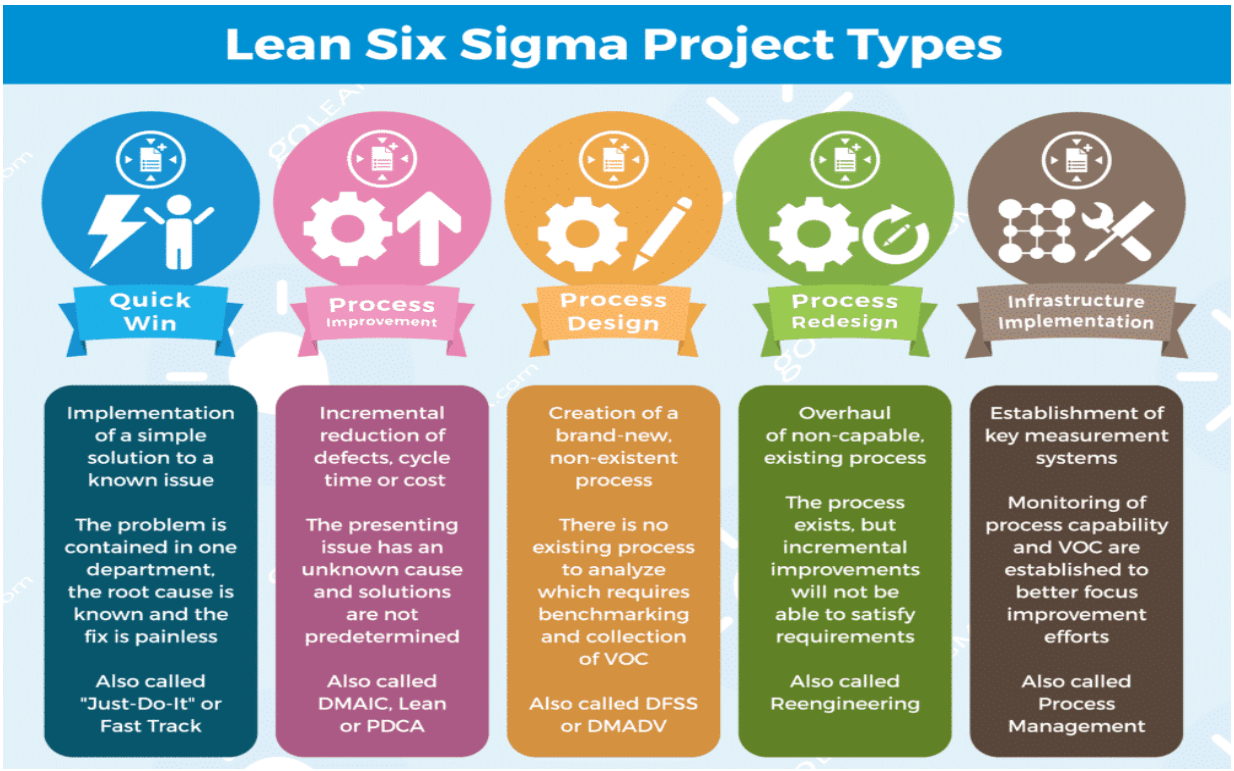

Figure 6 Lean six sigma project types with varying degrees of complexity, goLeanSixSigma, 2023

According to Antony & Banuelas (2002), continuous improvement projects enable organizations to streamline processes, enhance product and service quality, reduce costs, and improve customer satisfaction. This perspective is supported by Snee (2004), who contends that continuous improvement initiatives lead to increased efficiency and competitiveness. Moreover, a study by Ho, et al. (2015) highlights the positive impact of continuous improvement projects on employee engagement and motivation, fostering a culture of innovation and learning. However, certain shortcomings exist in implementing continuous improvement projects. Chiarini (2015) points out that organizations may face challenges in sustaining improvements achieved through individual projects, especially if they lack a wholistic approach to continuous improvement. Additionally, Singh & Singh (2019) argue that selecting and prioritizing the right projects can be difficult, as resources and time constraints may hinder the organization's ability to tackle all areas requiring improvement.

Researchers have examined the relevance of Lean Six Sigma in enabling the replication of operational excellence programs across global mining operations. Sampaio & Saraiva (2016) conducted a study on Lean Six Sigma's application in mining equipment maintenance. Their research demonstrated that this methodology provided a structured and systematic approach to improve maintenance processes, enhance equipment reliability, and reduce downtime across diverse mining sites.

Similarly, Schruben, et al. (2017) investigated the effectiveness of Lean Six Sigma in achieving operational excellence in underground mining processes. Their study showcased substantial improvements in productivity, quality, and cost savings resulting from the implementation of Lean Six Sigma tools and techniques. Additionally, Dehnavi, et al. (2018) explored the implementation of Lean Six Sigma in mining supply chains. Their findings highlighted the significance of this methodology in streamlining supply chain processes, reducing lead times, optimizing inventory management, and enhancing operational performance across multiple mining sites.

The systematic approach, data-driven decision-making, and focus on continuous improvement embedded in Lean Six Sigma contribute to its relevance in the mining industry George & Wilson (2018). By providing a standardized set of tools, methodologies, and performance metrics, Lean Six Sigma allows mining companies to establish consistency, promote best practices, and facilitate knowledge transfer across global operations. This standardization enhances the replicability of operational excellence programs by ensuring a consistent approach to problem-solving, quality improvement, and waste reduction George & Wilson (2018).

2.2.3 Shingo model

The Shingo model of operational excellence, developed by Shigeo Shingo, is a well-known framework that aims to guide organizations in achieving continuous improvement and operational excellence Bodek (2008) and Alukal & Williams (2010). This section explores the strengths and weaknesses of the Shingo model and its potential to ensure the replicability of operational excellence programs. Scholars have contributed to the discussion on the Shingo model and its application in various industries.

The model comprises five levels: Cultural Enablers, Continuous Improvement, Enterprise Alignment, Results, and Create Constancy of Purpose. Accompanying Figure 7, Shingo Operational Excellence Framework, Jon M. Huntsman School of Business (2020) shows the relationship between the different elements.

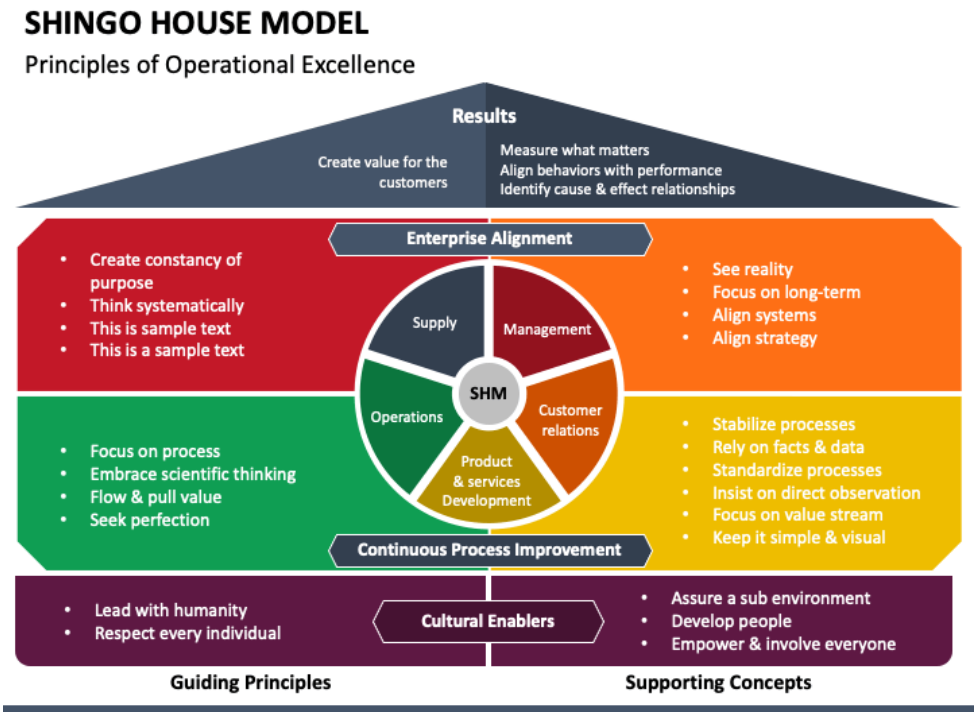

Figure 7 Shingo Operational Excellence Framework, (Jon M. Huntsman School of Business, 2020)

Scholars have lauded the Shingo House Model for its emphasis on developing a strong culture of excellence, aligning organizational goals, and fostering continuous improvement.

One of the main strengths of the Shingo House Model, as highlighted by Radnor & Walley (2008), is its focus on organizational culture as a critical enabler for operational excellence. By placing culture at the foundation, the model recognizes that sustainable improvements can only occur if there is a shared mindset and commitment to excellence at all levels of the organization.

Furthermore, Mann (2005) have praised the Shingo House Model for providing a comprehensive and systematic framework that integrates various improvement tools and methodologies. This integration ensures that improvement efforts are well-coordinated and aligned with the organization's strategic objectives.

However, the Shingo House Model also faces criticism and challenges in its practical implementation. Bhasin (2012), argues that the model's focus on cultural enablers may be difficult to quantify and measure, making it challenging for organizations to assess the impact of cultural improvements on operational performance. Moreover, Hines & Taylor (2000) point out that the Shingo House Model does not address the external environment and market dynamics. While the model is effective in building internal capabilities, it may not adequately consider factors outside the organization's control, limiting its ability to adapt to changing market conditions.

Another criticism of the Shingo House Model is its potential to oversimplify complex organizational challenges. By dividing operational excellence into five discrete levels, some researchers argue that the model may fail to capture the interconnectedness and interdependencies among different improvement initiatives Sousa, et al. (2018).

An additional key aspect of the Shingo model is its focus on waste elimination and the pursuit of perfection, which has been highlighted by researchers like Bodek (2008) and Alukal & Williams (2010). They emphasize how the model's principles, such as identifying and reducing non-value-added activities, can improve operational efficiency and effectiveness.

However, critics such as Muckstadt & Sapra (2006) have pointed out limitations of the Shingo model. They argue the model's emphasis on waste elimination may neglect other important aspects of operational performance, such as responsiveness to customer demand and adaptability to market changes. They propose a more holistic approach that incorporates concepts from other operational excellence frameworks.

Regarding replicability, the Shingo model provides organizations with a structured framework and guiding principles that can be applied across different operational sites according to Whiteley & Whiteley (2006). This promotes consistency and facilitates knowledge transfer. However, Shah & Ward (2007) caution that successful deployment of the Shingo model requires considering cultural and organizational factors, as well as customization to specific industry contexts. They advocate for adaptability and flexibility in applying the model.

In conclusion, the Shingo model offers valuable principles for organizations striving for continuous improvement. While it emphasizes waste elimination and standardization, critics argue for a more comprehensive approach. Replicability is supported by the model's foundation of consistent practices, but customization and contextual adaptation are crucial. Future research could explore the integration of the Shingo model with other frameworks and examine its applicability in diverse industries and organizational contexts.

2.2.4 Operational Excellence Management System

Operational Excellence Management System (OEMS) is a comprehensive framework that integrates various operational excellence principles, methodologies, and tools to drive continuous improvement and achieve excellence in operations Petrovic, et al. (2019). It has been recognized by several researchers for its potential benefits in organizational settings. Petrovic, et al. (2019) found that implementing OEMS enables companies to enhance operational performance,

improve process efficiency, reduce costs, and increase customer satisfaction. The framework provides a structured approach for aligning strategies, processes, and people towards operational excellence goals. Taticchi, et al. (2018) also highlighted the positive impact of OEMS on employee engagement, fostering a culture of continuous improvement, and facilitating knowledge sharing and learning within the organization as depicted in Figure 8, Operational excellence management system, Wilson Perumal & Company (2023).

Figure 8 Operational excellence management system, (Wilson Perumal & Company, 2023)

Consulting companies such as Bain, have gone into defining the key elements of creating an Operational Excellence Management System represented in Figure 9, The typical elements of an operational excellence management system span across functions and regions highlighted by Bain (2013).

Health, safety, security and environment	Asset integrity and reliability
Strategy and leadership	Contractor management
Organization and capabilities	Capital projects
Performance management	Operational risk
Change management	Incidents and emergencies
Planning and optimization	External stakeholders' responsibility
Operations and production	Supply chain management

Figure 9 The typical elements of an operational excellence management system span across functions and regions

However, when it comes to replicating OEMS across different sites, there are differing perspectives among researchers. Some argue that OEMS can be effectively replicated, leading to consistent operational excellence across multiple sites. Petrovic, et al. (2019) suggested that by adopting OEMS as a standardized framework, organizations can ensure consistent implementation of operational excellence practices and achieve similar outcomes across sites.

As OEMS implementation has become commonplace, it no longer sets a company apart or guarantees exceptional results; it is now considered an initial phase. Achieving outstanding performance relies on effectively integrating the system throughout the entire organization, from the front line to the back office, and on the consistent actions of employees daily. In essence, this process involves more than just creating new systems; it entails instructing people in a fresh approach to work and continually improving upon it over time, Bain (2013).

Challenges and shortcomings have been identified regarding the replication of OEMS across different sites. Ciarapica & Dal Maso (2019) found that cultural and organizational differences among sites can hinder the replication of OEMS. Each site may have unique characteristics, practices, and local requirements that necessitate customization of the framework. Additionally, Johnson, et al. (2017)

emphasized the importance of adapting OEMS to local contexts, as a one-size-fits-all approach may not be suitable for all sites.

Moreover, the complexity and resource requirements of implementing OEMS may pose challenges to replication. Delgado-Guzman, et al. (2021) pointed out that successful implementation of OEMS demands significant investments in training, change management, and organizational support. Replicating these investments across different sites may encounter resistance from site managers who have not yet witnessed the results of such changes.

OEMS is a comprehensive framework for driving operational excellence, but the replication of OEMS across different sites presents both opportunities and challenges. While some researchers advocate for its consistent implementation, others highlight the importance of customization and adaptation to local contexts. The complexity of implementation and resource requirements further influence the replicability of OEMS. Future research may focus on developing strategies to address cultural and organizational differences, as well as exploring effective approaches to manage the challenges associated with replicating OEMS across multiple sites.

2.2.5 Total Productive Maintenance

Total Productive Maintenance (TPM) is a comprehensive approach aimed at maximizing equipment and machinery efficiency and reliability through the active involvement of all employees in the maintenance process. The 8 pillars of TPM encompass various elements, including autonomous maintenance, planned maintenance, early equipment management, quality maintenance, training and education, safety, office TPM, and TPM in administration presented in Figure 10, The eight (8) Pillars of Total Productive Maintenance (goLeanSixSigma, 2023).

Figure 10 The eight (8) Pillars of Total Productive Maintenance , (goLeanSixSigma, 2023)

Academics who support TPM highlight its strengths, such as its holistic approach to maintenance, which involves all levels of the organization. Nakajima (1988) argues that TPM's focus on empowering employees to take ownership of maintenance activities can lead to increased productivity, reduced downtime, and enhanced equipment reliability. Furthermore, researchers such as Gijo & Antony (2002) point out that TPM's emphasis on continuous improvement aligns well with Lean principles, driving organizations to eliminate waste and optimize processes.

On the other hand, some academics have expressed reservations about TPM's practicality and challenges in implementation. Researchers like Hinchcliffe (2004) have raised concerns about the resources and time required for TPM implementation, particularly in larger and more complex organizations. Additionally, Madu, et al. (1998) argue that TPM may face resistance from employees who are not accustomed to taking on maintenance responsibilities, potentially hindering the effectiveness of the approach.

Another criticism is related to the difficulty of measuring TPM's impact on overall business performance. Scholars like Radnor & Lovell (2003) suggest that it can be challenging to isolate the effects of TPM from other improvement initiatives, making it difficult to attribute specific gains solely to TPM.

Researchers have examined the replication of TPM across various sites within mining companies, uncovering both benefits and challenges associated with its implementation. Suleiman, et al. (2018) found that implementing TPM can result in improved equipment effectiveness, reduced downtime, increased productivity, and enhanced overall equipment performance across multiple mining sites. The standardized practices and methodologies of TPM facilitate knowledge sharing, transfer of best practices, and the harmonization of maintenance activities across sites.

However, literature identifies factors that can hinder successful replication. Ali, et al. (2019) highlight that differences in equipment types, age, and operating conditions among mining sites can pose challenges in uniformly applying TPM. Each site may have unique equipment characteristics and maintenance requirements that require customization of the TPM framework. Furthermore, organizational culture, employee engagement, and management commitment are crucial factors influencing the successful replication of TPM across sites Deng, et al. (2019).

In terms of its relevance today, researchers hold varying perspectives on TPM. Some argue that TPM remains valuable in the mining industry, enabling companies to improve asset reliability, reduce maintenance costs, enhance safety, and increase overall operational efficiency Fadare, et al. (2019). The systematic approach of TPM aligns with the principles of continuous improvement and total quality management, which remain important considerations in today's mining industry.

However, researchers also identify limitations and areas for improvement in TPM. Aporius, et al. (2020) suggest integrating emerging technologies, such as predictive maintenance and condition monitoring, into the TPM framework to enhance its effectiveness and applicability in modern mining operations. They argue that by leveraging advanced data analytics and IoT technologies, TPM can be adapted to address the evolving needs and challenges faced by the mining industry.

TPM offers an approach to maximize equipment efficiency and reliability, but its replication across mining sites presents both benefits and challenges. While it can lead to improved performance and harmonization of maintenance activities, customization is necessary to accommodate site-specific equipment characteristics and maintenance requirements. Organizational factors and management commitment play crucial roles in successful TPM replication. Furthermore, researchers suggest integrating emerging technologies to enhance TPM's effectiveness in addressing modern mining industry needs. Future research may focus on developing strategies for customization, exploring effective change management approaches, and investigating the integration of advanced technologies into TPM.

2.4 How replication has been managed in other industries

Toyota and McDonald's are renowned multinational corporations that have effectively replicated their operational excellence programs, yielding remarkable achievements across their global sites noted Li, et al. (2019) and Khan, et al. (2020). Toyota is a world-renowned manufacturer owning a significant portion of the market as depicted in Figure 11, Most valuable brands within the automotive sector worldwide as of 2023, by brand value, highlights Li, et.al. (2019).

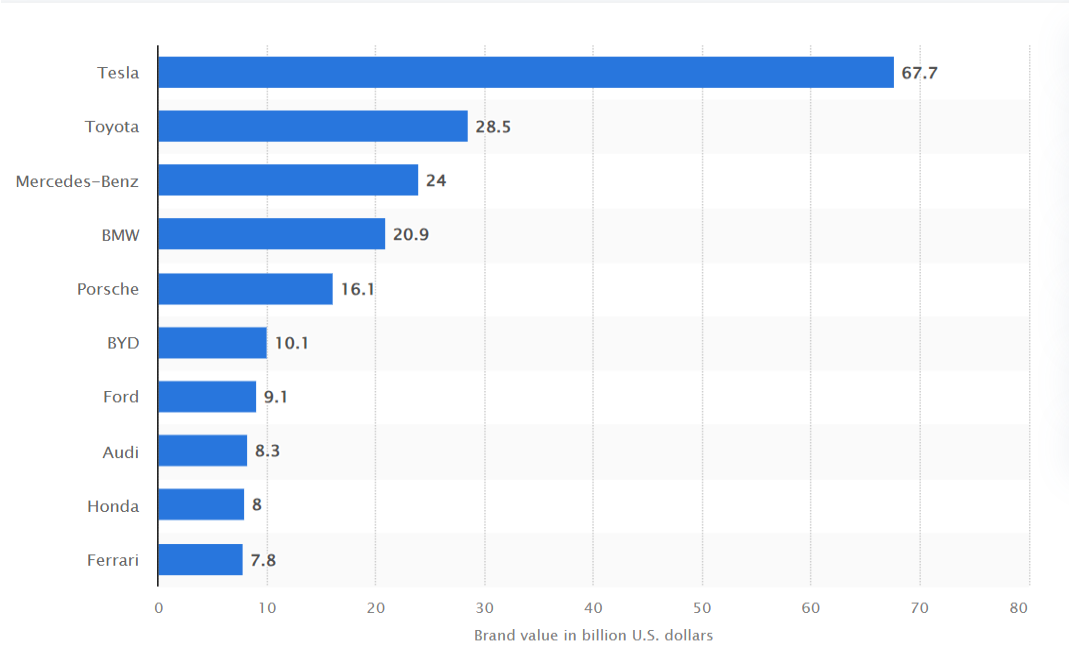

Figure 11 Most valuable brands within the automotive sector worldwide as of 2023, by brand value, Li et al. (2019).

Toyota operates in the manufacturing sector, whereas McDonald's dominates the fast-food industry posed Liker (2018) and Li, et al. (2019). A comparative analysis of these two companies will shed light on the commonalities and divergences in their approaches to operational excellence and replication strategies according to Khan, et al. (2020) and Liker (2018).

Toyota's famed production system, known as the Toyota Production System (TPS), serves as the foundation of their operational excellence program according to Liker (2018). TPS is characterized by its lean manufacturing principles, such as just-in-time production, continuous improvement, and waste reduction, which emphasize efficiency and flexibility in meeting customer demands Khan, et al. (2020). McDonald's, on the other hand, focuses on its operational excellence through standardization, streamlining of processes, and meticulous training of employees to ensure consistent service and product quality as put forward by Li, et al. (2019). Applying their chosen strategy, they have managed to become the leading fast-food restaurant globally as depicted in Figure 12, McDonald's market share in the global

fast-food segment presented by Li, et al. (2019) and Figure 13, McDonalds vs Competitors: Sales revenue summarized by Li, et al. (2019).

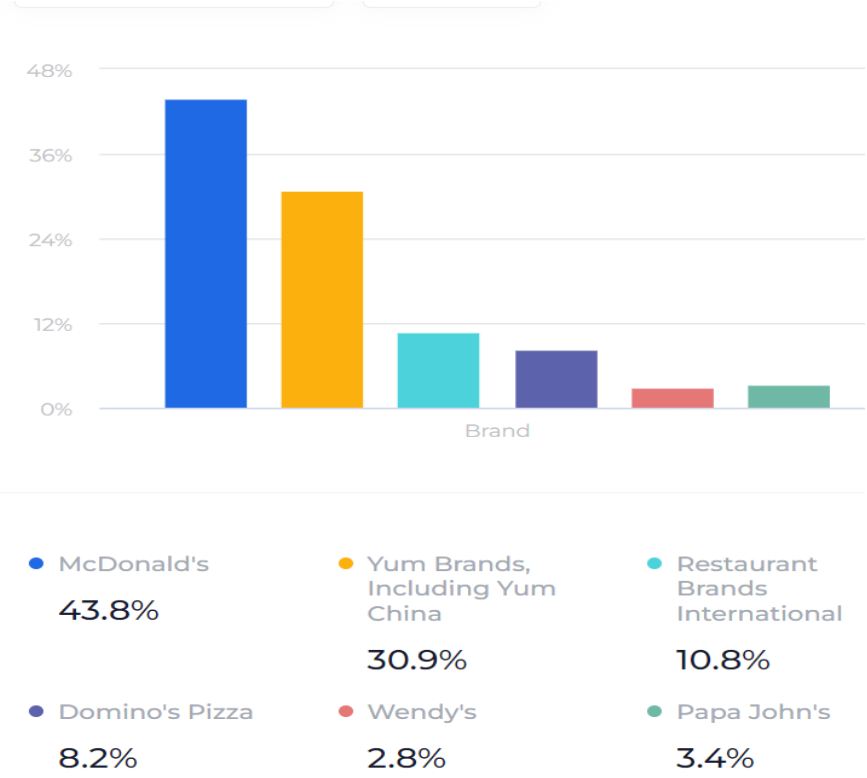

Figure 12 McDonald's market share in the global fast-food segment Li et al. (2019).

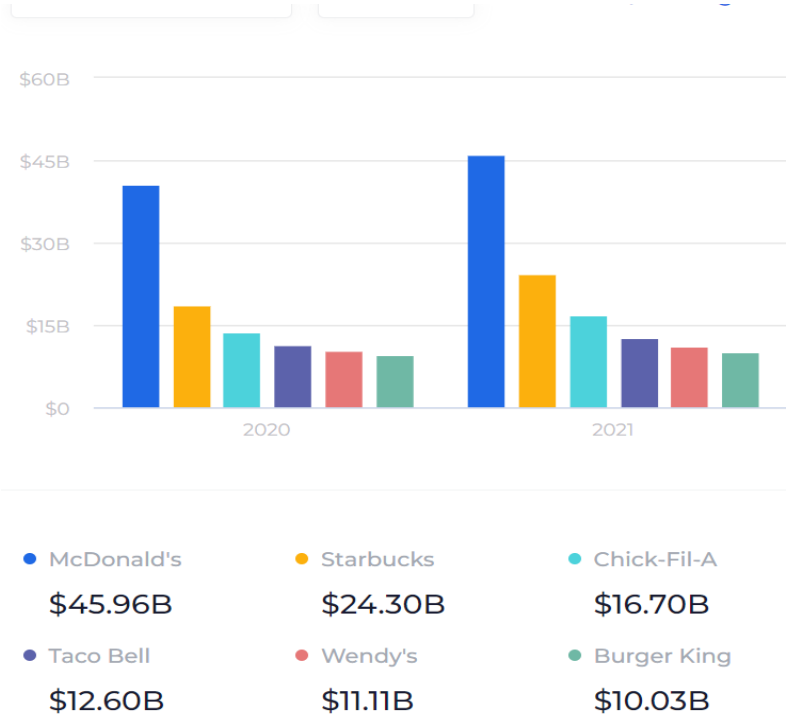

Figure 13 McDonalds vs Competitors: Sales revenue Li et al. (2019)

One of the commonalities between Toyota and McDonald's in their replication strategies is the establishment of a robust framework that allows for the adaptation of their operational excellence principles to span different cultural contexts says Liker (2018) and Li, et al. (2019). Both companies have recognized the significance of localizing their operational practices to suit regional preferences and comply with local regulations according to Khan, et al. (2020) and Li, et al. (2019).

However, the two companies differ in certain aspects of their replication strategies. Toyota tends to emphasize a decentralized approach, empowering local teams to customize their operational processes to align with specific market demands noted Khan, et al. (2020). In contrast, McDonald's relies on a more centralized system to maintain consistent quality standards and brand image across their vast global network highlights Li, et al. (2019).

2.4.1 Replication Strategies

Both Toyota and McDonald's have employed robust strategies to replicate their operational excellence programs across global sites. Toyota has focused on ensuring consistent implementation of TPS principles through comprehensive training programs, standardized work procedures, and knowledge sharing across sites highlights Womack & Jones (2003). McDonald's, on the other hand, has established rigorous operational standards, extensive training programs, and regular audits to maintain consistency in service quality and operational efficiency according to Delgado-Guzman, et al. (2015).

2.4.2 Cultural Factors

Cultural factors play a vital role in the successful replication of operational excellence programs. Toyota and McDonald's have recognized the significance of fostering a culture of continuous improvement and employee engagement. Both companies emphasize the empowerment of frontline employees and encourage suggestions for process improvement.

Toyota's strong culture of continuous improvement, known as "kaizen," is embedded in its operational excellence efforts. Robert E. Cole and Michael A.

Dennis in "Lean Production for Competitive Advantage: A Comprehensive Guide to Lean Methodologies and Management Practices" highlights the importance of Toyota's culture in achieving operational excellence as put forward by Cole & Dennis (1999). McDonald's places a similar emphasis on empowering employees through its "People Promise" initiative, which focuses on developing skills, recognizing achievements, and promoting a positive work environment according to Delgado-Guzman, et al. (2015).

2.4.3 Leadership Commitment:

Both Toyota and McDonald's demonstrate strong leadership commitment to operational excellence. Toyota's top management actively promotes and participates in TPS implementation, setting an example for the entire organization noted Liker (2004). McDonald's leadership emphasizes the importance of operational excellence by incorporating it into the company's strategic goals and ensuring that it is embedded in the decision-making processes of all levels of management notes Delgado-Guzman, et al. (2015).

2.5 Challenges in replicating operational excellence programs.

2.5.1 Organizational culture and change management

Organizational culture encompasses shared values, beliefs, norms, and behaviours that shape the way people within an organization think and act. A strong and supportive culture can facilitate the replication of operational excellence programs, while a culture resistant to change can impede progress.

Schein (1990), known for his work on organizational culture, emphasizes the importance of aligning the culture with the goals and values of the operational excellence program. Schein suggests that cultural change is necessary to support new ways of working and ensure successful replication.

In the mining industry, where traditional practices and attitudes may prevail, a hierarchical and risk-averse culture can hinder the adoption of operational excellence programs. Buchanan & Badham (2008, p.34) highlight the challenges of culture change in their book ‘Power, Politics, and Organizational Change:

Winning the Turf Game'. They argue that cultural resistance can stem from fear of loss of power, resistance to new practices, and entrenched beliefs in the effectiveness of existing methods.

Change management plays a pivotal role in facilitating the successful replication of operational excellence programs. It involves planning, implementing, and managing the processes of change to ensure organizational readiness and minimize resistance.

Kotter (1996, p.16), a renowned expert in change management, emphasizes the importance of effective leadership and clear communication in managing change. Kotter's influential book, 'Leading Change', provides a comprehensive framework for managing organizational change and highlights the significance of creating a sense of urgency, building a guiding coalition, and sustaining the momentum of change.

In the mining industry, change management becomes particularly crucial due to the complex and hazardous nature of mining operations. Ogden & Thomson (2008) emphasize the importance of addressing employee concerns, involving stakeholders, and providing adequate training and support during the implementation of operational excellence programs. They argue that resistance to change can arise from perceived threats to job security, lack of involvement in decision-making, and inadequate communication, Ogden & Thomson (2008).

2.5.2 Resource constraints and investment requirements

Resource constraints refer to limitations in terms of financial resources, human capital, technology, and physical infrastructure that can hinder the replication of operational excellence programs. Jha and Sharma (2017) argue that organizations with limited financial resources may struggle to allocate sufficient funds for implementing operational excellence initiatives across multiple sites. The costs associated with training, process improvements, technology adoption, and performance measurement systems can be substantial, making it challenging to replicate these efforts in resource-constrained environments. According to Zeng, et

al. (2018), the availability of skilled and knowledgeable personnel is crucial for the successful replication of operational excellence programs. However, resource constraints may limit the organization's ability to hire and retain experienced professionals who can drive the replication process effectively. This shortage of human capital can hinder knowledge transfer, training, and the overall implementation of operational excellence practices. Sharma, et al. (2019) point out that inadequate technological infrastructure and outdated equipment can impede the replication of operational excellence. Advanced technologies, such as data analytics, automation, and integrated systems, are often required to support the standardized practices and continuous improvement efforts associated with operational excellence. Limited access to such technologies and infrastructure can create barriers to replication.

Investment requirements on the other hand encompass the financial commitments needed to establish and sustain operational excellence programs across multiple sites. Liu & Bai (2016) emphasize that the implementation of operational excellence programs typically involves significant upfront investments. These investments cover activities such as training, process redesign, infrastructure upgrades, and technology adoption. The high initial investment required may deter organizations, particularly those with limited financial resources, from pursuing replication across multiple sites. According to Taneja & Gupta (2020), sustaining operational excellence programs involves continuous investments in terms of maintenance, employee training, process monitoring, and performance evaluation. Replicating these investments across multiple sites can be a significant financial burden, especially if organizations lack the necessary resources to support ongoing operational excellence activities. Qu, et al. (2018) argue that investment in operational excellence programs carries inherent risks and uncertainties. Organizations may be hesitant to invest in replication due to concerns about the return on investment, potential disruptions during the implementation phase, and the uncertainty of achieving the desired outcomes. These risk factors can act as deterrents to replication efforts.

2.5.3 Undefined measures for replication success

There is a need for clear and well-defined measures that align with the objectives of operational excellence initiatives according to Jin, et al. (2014). These metrics should capture both quantitative and qualitative aspects, encompassing key performance indicators (KPIs) such as productivity, quality, customer satisfaction, and employee engagement proposed Bhasin (2012). It is crucial to select metrics that are relevant to the specific context and goals of each site.

Ensuring consistency and standardization in measurement approaches across different sites is an additional challenge. Antony, et al. (2019) advocate for establishing standardized measurement frameworks and methodologies that enable comparability and meaningful analysis across sites. This requires defining consistent data collection methods, defining uniform metrics, and implementing robust data management systems proposed Gomes, et al. (2015). However, it is important to strike a balance between standardization and flexibility to account for local contextual differences and unique site requirements notes Hong, et al. (2018).

In the development of success measures. there are arguments that involving key stakeholders from different sites in the measurement development process enhances the accuracy and comprehensiveness of the assessment highlighted Sallis (2014). Collaborative discussions and consensus-building sessions can ensure that the selected metrics are meaningful, aligned with organizational goals, and reflect the diverse perspectives of the stakeholders involved noted Gomes, et al. (2015).

Measuring the success of operational excellence replication or deployment should extend beyond short-term performance indicators. Long-term evaluation is essential to assess the sustainability and continuous improvement of operational excellence practices across sites Jin, et al. (2014). Researchers recommend conducting periodic evaluations to monitor progress, identify areas for improvement, and capture the long-term impact of operational excellence initiatives Antony, et al. (2019). This requires establishing a feedback loop to

capture lessons learned and incorporate feedback into future replication or deployment efforts.

Measurement development should support a culture of continuous improvement and learning. It is important that measurement results to drive learning, identify best practices, and share knowledge across sites according to Bhasin (2012). Organizations should encourage the exchange of insights and experiences among different sites, facilitating cross-site benchmarking and fostering a culture of continuous improvement highlighted Sallis (2014).

2.5.4 Adapting operational excellence programs to local contexts

Adapting operational excellence programs to local contexts necessitates a deep understanding of the cultural and organizational nuances of each location. Researchers have emphasized that cultural factors significantly influence the success or failure of operational excellence initiatives (Liker & Choi, 2004). Different cultures may have distinct management styles, communication patterns, and decision-making processes, which can impact the implementation and adoption of operational excellence practices. Therefore, organizations must carefully assess and adapt their programs to align with local cultural norms and values as highlighted by Lam & Ooi (2016).

The challenge lies in striking the right balance between customization and standardization when adapting operational excellence programs. While customization allows for addressing local needs and preferences, excessive customization can result in fragmented approaches and hinder knowledge sharing and scalability across sites added Liker & Choi (2004). Conversely, overemphasizing standardization may overlook local contextual factors and hinder the program's effectiveness according to Lam & Choi (2016). Academics highlight the need for a hybrid approach that combines standardized principles with contextual adaptation according to Dixon, et al. (2018). This approach enables organizations to maintain consistency while addressing local variations.

Replicating operational excellence programs requires efficient knowledge transfer across sites. However, knowledge transfer can be hindered by language barriers, geographical distances, and variations in expertise and experience suggests Dixon, et al. (2018). Organizations must establish mechanisms for sharing best practices, facilitating cross-site learning, and leveraging technology-enabled platforms to bridge the knowledge gap. Additionally, fostering a culture of continuous learning and improvement at the local level is crucial for sustaining operational excellence efforts emphasized Lam & Ooi (2016).

2.6 Gaps in existing literature

In recent years, there has been increased attention among academics and experts on theories of operational excellence program deployment, replicability, and sustainability. Several influential researchers have contributed to the understanding of these concepts, shedding light on various aspects of operational excellence and its impact on organizational performance.

Banker (2008)’s research emphasizes the integration of operational excellence programs with organizational strategy, highlighting the importance of alignment and continuous improvement. This perspective provides insights into the strategic aspects of deploying operational excellence initiatives.

Heywood(2003) 's work has focused on the challenges associated with replicating operational excellence programs across different sites. Heywood (2023) recognized the trade-off between standardization and flexibility in global companies, emphasizing the need to address local market requirements while ensuring consistency Her research highlights the complexities involved in achieving replicability across diverse operational contexts.

Wang (2016)’s work emphasizes the integration of environmental and social considerations into operational excellence programs, highlighting the significance

of sustainable practices for long-term success This perspective expands the understanding of operational excellence by incorporating broader sustainability goals. This view comes into play, following the growing awareness of the enterprise's role in environmental sustainability.

Neilson & Martin (2014) have explored the concept of sustaining operational excellence over time. Their research underscores the importance of leadership commitment, ongoing employee engagement, and continuous learning and adaptation to maintain operational excellence. This perspective provides insights into the long-term sustainability of operational excellence initiatives.

While these researchers and experts have contributed significantly to the understanding of operational excellence, there are still gaps in the literature when it comes to successful replication across different mining sites. Additional research is needed to delve into these gaps and identify the factors that hinder the effective deployment of operational excellence programs in the mining industry.

Smith, et al. (2019), Kumar, et al. (2018) have highlighted the need to address challenges related to standardization, cultural and organizational differences, and limited communication and coordination among sites. Their works underscore the complexities and barriers associated with replicating operational excellence practices in mining contexts.

Furthermore, Wagner, et al. (2020) emphasize the importance of managing resistance and garnering support from site managers and employees during the implementation process. Their research highlights the need for effective change management strategies to overcome barriers to replication.

By conducting research in these areas, mining companies can gain valuable insights that will help them overcome barriers, optimize their operations, and achieve consistent operational excellence across multiple sites. Moreover, these research efforts contribute to the broader body of knowledge in the field, facilitating the

development of industry-wide best practices that ultimately lead to sustainable growth and improved competitiveness in the mining sector.

2.7 Development of a conceptual framework

The development of a conceptual framework is paramount in providing a structured foundation for research inquiry and interpretation of findings. As noted by Wengraf (2001) and Miles & Huberman (1994), a conceptual framework serves as a guiding roadmap, helping researchers define their focus and organize their thoughts while offering a lens through which to view complex phenomena. Drawing upon a systematic process outlined in Appendix A, this study embraces the iterative steps recommended by scholars such as Creswell & Creswell (2017); Boote & Beile (2005); Glaser & Strauss (1967); Corbin & Strauss (2008).

The conceptual framework, illustrated in Figure 14 captures key elements such as the importance of selecting a framework that is aligned with the organizational strategy operational excellence framework, replication factors, and organizational structure, each delineated through a process informed by grounded theory methodology and qualitative research techniques as highlighted by Patton (2015). This approach ensures that the framework remains robust and aligned with evolving research findings, facilitating a nuanced understanding of the complexities surrounding program replication within a multinational mining corporation like Rio Tinto.

CHAPTER 3

RESEARCH METHODS

3.1 Research Design

This section of the report presents an in-depth exploration of research design for a qualitative study utilizing interviews as the primary data collection method. Qualitative research, including interviews, offers a rich and nuanced understanding of individuals' experiences, perceptions, and meanings. This is a discussion on key considerations in research design, including selecting a research approach, how the research questions were formulated, sampling techniques, data collection and analysis procedures, and ensuring trustworthiness.

3.2 Selecting a Research Approach

This study adopted a deductive and inductive research approach, the former is characterized by a top-down methodology, as advocated by Burney, et al. (2008). The deductive approach involves formulating hypotheses based on existing theory and then systematically testing them through data collection and analysis. Rooted in positivist philosophy, this approach aligns with the perspectives of scholars like Babbie & Popper (2016), who emphasized falsifiability as a critical criterion for scientific theories. The deductive approach offers advantages such as precision, control, and generalizability, allowing researchers to build upon established theories, make precise predictions, and contribute to the broader understanding of a field. In contrast to the deductive approach, inductive research is characterized by deriving theories from empirical observations, often associated with qualitative methods. While inductive research is valuable for exploring new phenomena, it may lack the precision and generalizability associated with deductive reasoning, potentially being more susceptible to biases and subjectivity proposed Bryman & Bell (2019).

Inductive reasoning is evident as the research began with specific observations from interviews—such as concerns about the challenges of deploying RTSPS across diverse cultural landscapes—and moved toward broader conclusions about the program's overall effectiveness and its alignment with the company's strategic goals as reflected in the annual reports. The annual reports provided a secondary data source that helped to corroborate and contextualize the findings from the interviews, further supporting the inductive analysis.

Simultaneously, the research also incorporates deductive reasoning. This approach was applied in testing specific hypotheses or expectations derived from existing literature on operational excellence programs, such as the assumption that standardized systems like RTSPS would face challenges in diverse, global environments. By comparing these expectations with the actual findings from the interviews and reports, the research validated or refined these hypotheses.

Thus, the study is both inductive and deductive: inductive in its generation of themes and patterns from interview data and deductive in its testing and refinement of hypotheses based on existing theoretical frameworks and organizational documents. This combination enhances the robustness and validity of the research findings, as it allows for both the discovery of new insights and the testing of established theories.

3.2.1 Conceptual map: Theoretical stance from which deductive reasoning will be developed.

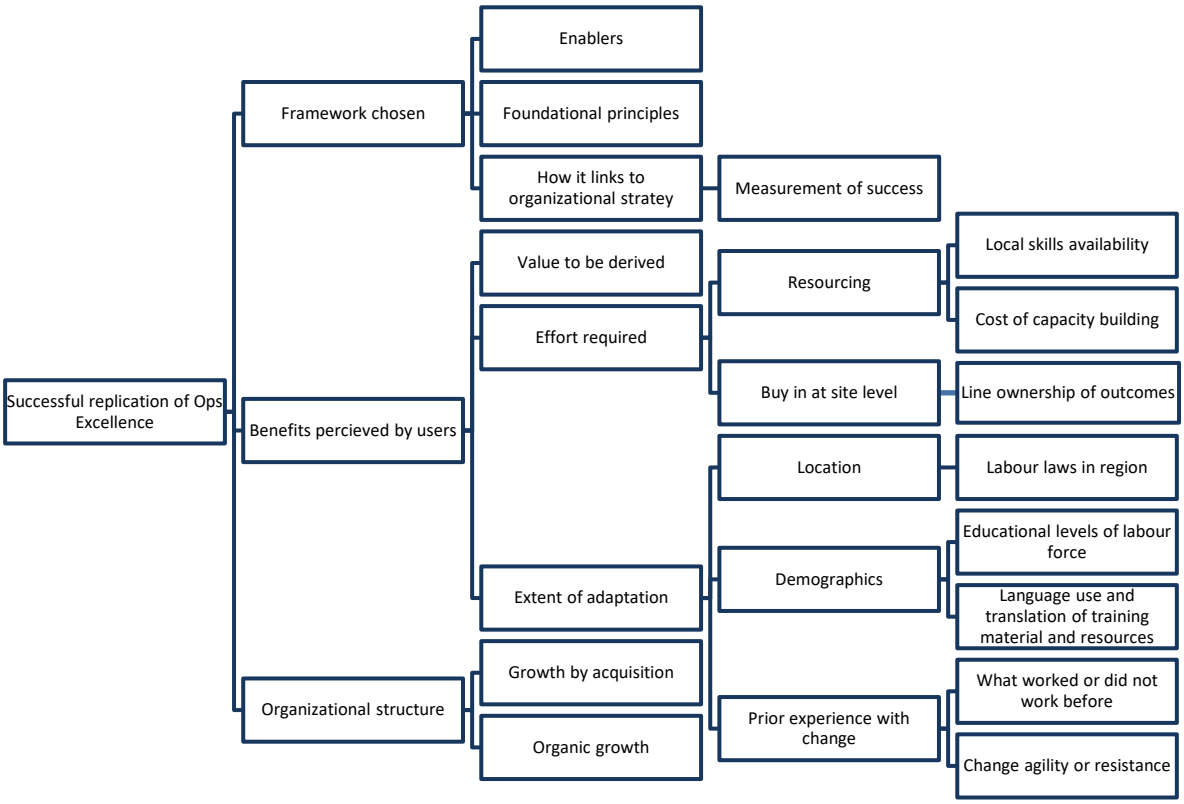

Figure 14 Contextual Map, Author (2023)

3.3 Instrumentation

3.3.1 Analysis of documentation

This research will utilize integrated reports obtained from the official website of Rio Tinto as a form of secondary research. Integrated reports serve as a globally accepted means for companies to communicate both financial and non-financial information to their various stakeholders. These reports provide insights into the organization's governance principles, strategies, policies, and their approach to value creation in the short, medium, and long term as discussed by Moloi, et al. (2020).

Integrated annual reports provide comprehensive and structured information about various aspects of a company's operations, including financial performance, corporate governance, sustainability initiatives, risk management, and strategic objectives according to Deegan (2014) and Dumay, et al. (2016). These reports serve as a rich source of data for researchers, offering a holistic view of the organization's activities and performance over a specific time period.

One key advantage of using integrated annual reports is the accessibility and reliability of the data they contain. Annual reports are typically publicly available and published by companies to fulfill legal requirements and communicate their performance to stakeholders noted Deegan (2014). Dumay, et al. (2016) suggest the standardized format and reporting guidelines ensure consistency and comparability across different organizations, enabling researchers to analyze and benchmark companies within an industry or across different sectors.

3.3.2 Semi-structured Interviews

The primary research for this study involved conducting semi-structured interviews. These interviews were conducted virtually using platforms like Microsoft Teams or Zoom. Conducting virtual interviews through these platforms offered several advantages. Firstly, it provided greater flexibility as the researcher could schedule interviews based on each participant's availability. Additionally, virtual interviews

eliminated the need for travel, making them a cost-effective method for obtaining high-quality data. The researcher could conveniently conduct the interviews using a laptop and an internet connection at no extra expense. Interviews serve as a powerful tool for gathering reliable and in-depth data about people's experiences due to their capacity for nuanced exploration and rapport building. Seale (1999) accentuated the significance of interviews, stating that they allow researchers to delve into the richness and complexity of human experiences, enabling a deeper understanding of individuals' perspectives and motivations. Moreover, Silverman (2010) emphasized the role of interviews in eliciting detailed accounts, highlighting that the interactive nature of interviews facilitates the exploration of subtle nuances and contextual factors that might not be evident through other data collection methods. Additionally, Mishler (1986) highlighted the importance of the interview setting, noting that the conversational nature of interviews fosters trust and encourages participants to share personal experiences, ultimately enhancing the reliability and authenticity of the data collected.

3.3.2.1 Benefits of using interviews as an instrument

Interviews represent a valuable research approach with numerous advantages in obtaining extensive and detailed data, as underscored by other researchers. As outlined by Patton (2002), interviews provide researchers with the opportunity to deeply delve into participants' experiences, perspectives, and emotions, enabling a nuanced comprehension of the research topic. This qualitative method empowers researchers to pose probing questions, investigate intricate matters, and reveal unexpected insights. Likewise, Bogdan, et al. (2007) stress the significance of interviews in enabling participants to express themselves in their own words, thereby enhancing the authenticity and depth of the collected data. By engaging in interactive and open-ended conversations, interviews foster a fertile exchange of information, facilitating a thorough exploration of the research subject. Ultimately, interviews serve as a potent instrument for capturing the complexities and nuances of human experiences and perceptions, enabling researchers to generate comprehensive and profound data.

Participant perspective and contextual understanding are crucial elements in conducting effective interviews, as emphasized by prominent research practitioners. Kvale, et al. (2014), that the participant's point of view sheds light on their subjective experiences and judgments. This perspective allows researchers to gain a deeper understanding of the participants' lived experiences, beliefs, and motivations, enabling a more comprehensive analysis of the research topic. Similarly, (Creswell, 2014) highlights the importance of contextual understanding, explaining that the consideration of the broader context in which interviews take place, researchers can better interpret and analyze the data, taking into account the influences and factors that shape participants' perspectives and experiences. Integrating participant perspective and contextual understanding enriches qualitative research, enabling a more nuanced and comprehensive understanding of the research topic.

Unlike structured surveys or questionnaires, interviews provided the researcher with the freedom to adapt and tailor their questions to the specific context and individual participant. This facilitated a more dynamic and interactive exchange, enabling the researcher to delve deeper into issues that were affecting replication within the individual companies of interest and probe for more detailed responses. It allowed for follow-up questions and clarification, creating a more comprehensive understanding of participants' perspectives, experiences, and motivations.

3.3.2.2 Limitations of using interviews as an instrument

To manage researcher bias, a neutral and non-judgmental mindset had to be set by the researcher by recognizing and setting aside preconceived notions or assumptions about the topic or the interviewees. In this process, the interviewer was experienced in the formulation and deployment of operational excellence programs, however, opinions had to be set aside, to get clear uninfluenced responses. The interviews were approached with an open mind and a genuine curiosity to learn from the experts' perspectives. Secondly, a structured and standardized approach

was maintained to questioning, ensuring consistency across interviews, and minimizing the potential for unintentional bias. The use of predefined interview protocols and avoiding personal opinions or leading questions that could sway the responses was prioritized. Additionally, actively listening to the experts' viewpoints, allowing them to fully express their ideas and experiences without interruption or influence played a critical role in maintaining data integrity.

Participant bias refers to the tendency of interviewees to provide responses that they perceive as socially acceptable or aligning with the expectations of the interviewer (Galdas, 2014). This can lead to a skewed representation of their actual experiences or practices. To mitigate participant bias, it was crucial to create a safe and non-judgmental environment that encouraged honest and open communication. The researcher assured participants that their responses would be kept confidential and emphasized the importance of their genuine insights for the research. Additionally, the researcher was mindful that social desirability bias is important. Participants may feel inclined to present themselves or their organizations in a favorable light, potentially altering or embellishing their responses. By actively acknowledging and addressing these biases, and by building trust and rapport with participants, the researcher could foster an atmosphere that promoted candid and authentic responses, thereby enhancing the reliability and validity of the data collected during interviews with operational excellence experts. It was important for the researcher to address biases by deliberately using neutral language and carefully crafted probing questions that were free of leading suggestions. For instance, instead of asking questions that implied a preferred answer (e.g., "Don’t you think this approach is effective?"), questions were framed openly (e.g., "Can you describe how this approach has impacted your operations?").

The interviews were such that they were not so long that it would become an inconvenience to the participant, but not so short that insights could not be fully gathered. The sample size was fourteen, and the researcher ensured that there would be enough time available to complete the study. The researcher had to make the best

of the available resources by scheduling the interviews over a two- month period and scheduling interviews over varying time zones.

3.3.2.3 Question formulation

To develop the interview questions, the study followed the pyramid model introduced by (Wengraf, 2001). This model serves as a framework for formulating interview questions based on addressing the critical research question. The CRQ-TQ-IQ(II) algorithm will be employed to create targeted interview questions. The process involves starting with the research's purpose, which outlines the objectives the study aims to achieve. The critical research question (CRQ) will be examined from multiple perspectives, leading to the development of theoretical research questions (TRQ) that the interviewer intends to explore. From each theoretical research question, a set of interview questions or interventions (IQ/II) will be formulated, following the methodology in Figure 15, CRQ - TQ- IQ and the Informants pyramid model of the co-determination of initial informant questions, Wengraf (2001).

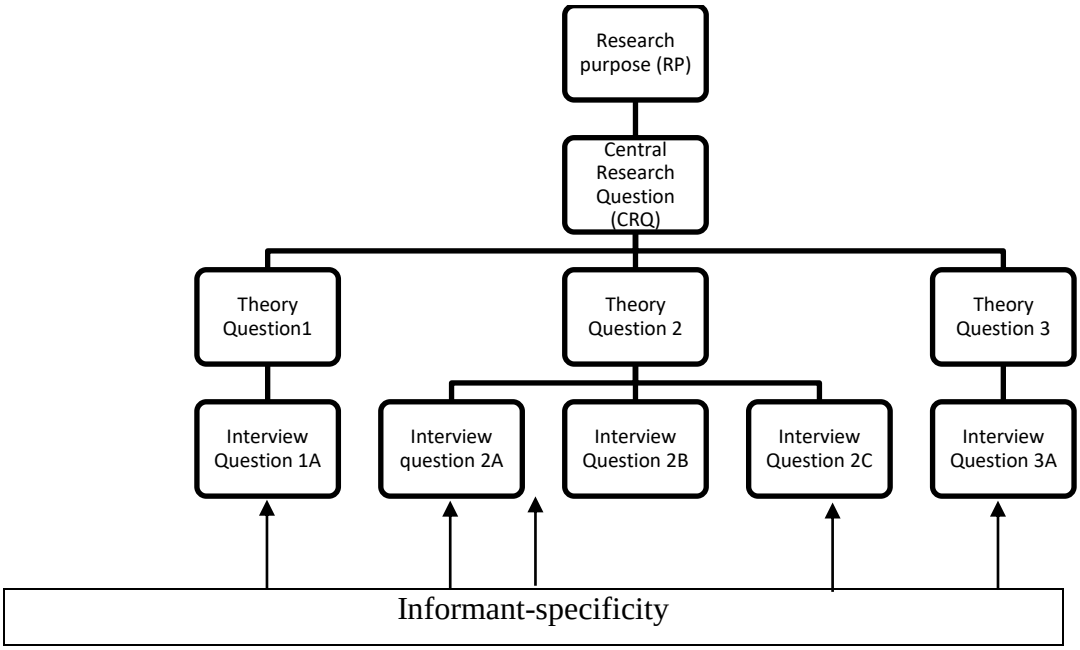

Figure 15 CRQ - TQ- IQ and the Informants pyramid model of the co-determination of initial informant questions, (Wengraf, T., 2001. Qualitative Research Interviewing: Biographic Narrative and Semi-Structured Methods. 7 ed. London: Sage Publications).

Following the method outlined by Wengraf (2001), interview questions were formulated from the Research Purpose, the Central Research Question, and the Theoretical questions. This was pivotal in ensuring that the interview questions address the purpose of the research, and they enable the research to achieve the objectives.

Research Purposes (RP):
To assist multinational mining companies in facilitating the successful replication of operational excellence programs using Rio Tinto as a case study.

Central Research Question(s) (CRQ):
What are the factors that enable successful replication of the operational excellence program at one of the top four global mining companies in the world?

Theoretical Question (TQ1):
What obstacles do mining companies face when deploying operational excellence programs?

Theoretical Question (TQ2):
What are the key foundational elements of the operational excellence program at Rio Tinto?

Theoretical Question (TQ3):
What strategies can be used to overcome challenges that prevent successful replication of operational excellence program?

Development of interview questions from theoretical questions

When developing interview questions based on theoretical concepts, the goal was to connect abstract understanding with real-world use. Table 1 displays an organized list of questions intended to assess how theoretical knowledge can be applied effectively in developing successful replication strategies for an operational excellence program in a global company. Each question in the table is carefully

crafted to prompt responses showcasing a detailed understanding of the theories and their practical significance.

Table 1 Formulating Interview Questions from Theoretical Questions

Theoretical Questions	Interview question
Theoretical Question (TQ 1)	How do you decide which factors to emphasize at different operational sites?
	How do you prioritize the areas of deployment?
	What aspects have proven to be the easiest and what has proven to be the hardest in deploying the program?
	How do you identify the relevance of the operational excellence at each site?
	What adaptations have you made for different local contexts?
	How do you manage and coordinate deployment at different sites?
Theoretical Question (TQ 2)	What are the foundational elements that ensure replicability across different sites?
	What metrics do you use to determine how successful the replication of the Operational Excellence program is?
	What role is played by communication and collaboration in ensuring replication?
	How does the program align with the organizational values
Theoretical Question (TQ 3)	What are the objectives of your organization's operational excellence framework?
	What is the process followed in your organization to replicate operational excellence programs within functional departments and across different operational sites?

	How do you assess the feasibility of successful deployment of the operational excellence programme prior to deployment at the various sites?
	What approaches have you used to overcome internal cultural barriers and external cultural influences from the operating environment?
	What are the advantages and disadvantages of deploying an operational excellence program in your commodity space?
	How do you ensure knowledge transfer across different sites?

Considerations when formulating interview questions.

Semi-structured interviews often employ open-ended questions that allow participants to provide detailed responses and share their experiences and perspectives according to Wengraf (2001). Open-ended questions encourage participants to express their thoughts freely and provide rich qualitative data, enabling researchers to gain in-depth insights into the research topic suggests Rubin & Rubin (2012). In addition to the open-endedness, probing questions are used to elicit further details or clarification on a particular topic or response provided by the participant noted Rubin & Rubin (2012). Wengraf (2001) proposes that these questions encourage participants to delve deeper into their experiences, emotions, or thought processes, providing a more comprehensive understanding of the research phenomenon.

According to Rubin & Rubin (2012). Follow-up questions are designed to explore specific points or themes raised by the participant during the interview. These questions allow researchers to obtain additional information or seek clarification, facilitating a more thorough exploration of relevant topics or concepts noted Wengraf (2001).

It is highly recommended to ask behavioral questions heighted Wengraf (2001). Behavioral questions ask participants to recall and describe specific behaviors or

actions they have taken in certain situations added Rubin & Rubin (2012). From Wengraf (2001)'s perspective these questions enable researchers to gain insights into participants' experiences, decision-making processes, or problem-solving strategies, providing concrete examples to support their responses. To explore behavioral elements, the researcher asked participants questions that required them to demonstrate their problem-solving skills in the process of successful deployment of operational excellence. These were associated to Theoretical Question 3.

Amongst the questions to be developed, sensitizing questions need to be included in the set of questions. Sensitizing questions introduce specific concepts, theories, or perspectives to participants, stimulating their thoughts and reflections on the topic suggested Rubin & Rubin (2012). Wengraf (2001) points these questions as being helpful to participants to explore their experiences from different angles, encouraging a deeper understanding and analysis of the research subject. The sensitizing questions were more associated with Theoretical Question 1, which required participants to reflect on challenges and their personal experience of the replication outcomes.

The last of the question types to be considered are grand tour questions. Grand tour questions are broad, open-ended queries that allow participants to provide an overview of their experiences or viewpoints on the topic of interest highlighted Rubin & Rubin (2012). These questions serve as starting points for the interview, setting the stage for more focused inquiries later in the conversation proposed Wengraf (2001).

3.4 Sampling

Sampling plays a crucial role in academic research as it involves selecting a subset of individuals or cases from a larger population to study and draw conclusions about the whole. Researchers employ various sampling techniques to ensure that their samples are representative and provide valid and reliable results. As Creswell (2014) suggests, sampling is essential for generalizing findings and making inferences about the target population. It helps in minimizing bias and enhancing

the external validity of the research. Moreover, Bryman & Bell (2019) emphasize that a well-designed sampling strategy ensures the selection of diverse participants or cases, enhancing the richness and depth of the data collected. By employing appropriate sampling techniques, researchers can enhance the quality and credibility of their findings, thereby contributing to the overall rigor of academic research.

3.4.1 Sampling Techniques

Purposeful Sampling was used in this research because of the nature of the research question and the objectives of the research. The aim is not to generalize, but to deepen the understanding of how operational excellence strategy replication works in large organizations, specifically in a complex industry like mining. Three of these purposeful sampling strategies were explored. According to literature, there are several more strategies that can be used in purposeful sampling.

One such, is ***maximum variation purposeful sampling***. It has been described by Patton (1990), is a sampling technique used in qualitative research to select diverse and representative participants or cases that offer a wide range of perspectives and experiences. This method aims to capture the heterogeneity within a population or sample by intentionally seeking out individuals or cases that differ in relevant characteristics or attributes. The purpose of maximum variation sampling is to enhance the depth and richness of data collected, allowing for a comprehensive exploration of the phenomenon under study. By deliberately selecting participants with contrasting backgrounds, perspectives, or experiences, researchers can gain a more comprehensive understanding of the topic and identify common patterns, unique insights, and potential variations. This sampling approach recognizes the value of diversity and ensures that multiple viewpoints are considered, contributing to the overall validity and credibility of the qualitative research findings. The diversity, in the participants selected was driven by the type of mining commodity space that the executive works in, this is critical because operations may face challenges that are exclusive to the value chain of the commodity being mined.

There were three commodities to be compared (Iron Ore, Copper, Diamond and Boron), and these 4 are in different geographical areas with varying demographics.

Homogeneous sampling, as described by Patton (1990), is a sampling technique employed in qualitative research to select participants or cases that share similar characteristics or attributes. This method is used when the goal is to study a specific subgroup within a population that exhibits a high degree of similarity. By intentionally selecting participants who possess common traits or experiences, homogeneous sampling allows researchers to focus on specific themes or patterns that may be unique to that particular group. This approach helps in gaining an in-depth understanding of the shared experiences, perspectives, or behaviors within the selected subgroup. Homogeneous sampling can be particularly useful when exploring topics that are specific to a certain demographic or when seeking to compare the experiences of individuals who belong to a particular category. By limiting the sample to participants with similar characteristics, researchers can delve deeply into the nuances of the phenomenon being studied and provide a comprehensive analysis within the selected homogeneous group. The homogeneity of the chosen sample was in the profiles of the participants selected, which were individuals who have experience in operational excellence program deployment and tracking and awareness of the company's corporate strategy.

3.4.2 Sample Size Considerations

The views of Ritchie, et al. (2003) regarding sample size selection for interviews present different perspectives that warrant a critical assessment. Ritchie, et al. (2003), argue that sample size in qualitative research should be determined by the principle of data saturation, which suggests that data collection should continue until no new themes or insights emerge from the interviews. They emphasize the importance of quality over quantity and suggest that sample sizes can vary depending on the research context and the complexity of the phenomenon being studied. On the other hand, Thorogood, et al. (2018) proposes a more structured approach, suggesting that sample size should be determined based on theoretical

saturation, where data collection continues until no new theoretical insights are obtained.

While both perspectives offer valuable insights, they also have potential limitations. Ritchie, et al. (2003)'s emphasis on data saturation provides flexibility in sample size determination, but it may lack a clear criterion for when saturation is achieved. Without a specific threshold or guideline, researchers may struggle to determine when to stop data collection, leading to uncertainty and potential bias in sample selection. Additionally, the reliance on data saturation alone may overlook the importance of diversity and representativeness in the sample, potentially limiting the generalizability of the findings.

On the other hand, Thorogood, et al. (2018) emphasis on theoretical saturation introduces a more structured approach to sample size selection. However, this approach assumes that theoretical insights can be neatly categorized and that a clear point of saturation exists. The challenge lies in determining when theoretical saturation is achieved, as interpretations and theoretical frameworks may vary among researchers. Furthermore, this approach may prioritize theoretical completeness over the inclusion of diverse perspectives, potentially limiting the richness and breadth of the data collected.

It was essential to strike a balance between ensuring data saturation or theoretical saturation while also considering the need for diversity and representativeness in the sample. The research context, objectives, and resources available were considered when selecting the sample size. According to the researcher's plan, the expectation was to have a minimum of four participants, per asset type.

Iron Ore: Four participants
Copper: Four participants
Diamond: One participant
Boron: Three participants
Titanium: Two participants

Total number of participants: 14 participants

The research design initially aimed to include four participants per operational area to ensure a robust and diverse dataset. However, this target was not fully met due to variations in the size and structure of Rio Tinto's different divisions. In some cases, the limited number of personnel available with the requisite experience and roles constrained the pool of potential interviewees. For instance, the Diamond division, comprising a single operation with a concentrated team, had only one suitable participant available for the study. Similarly, the Titanium division, despite its broader geographical spread, only had two individuals overseeing operational excellence at a management level who could be interviewed. In contrast, divisions such as Iron Ore, which have larger and more complex operational structures, provided a greater number of qualified participants. Consequently, the research reflects these structural disparities, resulting in variable participant numbers across divisions. This outcome underscores the influence of organizational structure on the availability of relevant expertise within different product groups.

3.4.3 Company Selection

The selection of Rio Tinto, as a company of interest to investigate operational excellence was rooted in their prominent position within the mining industry and their demonstrated success in operational performance. This organization is recognized as a global leader, renowned for their operational efficiency, profitability, and sustainable practices. By examining their approaches to operational excellence, valuable insights and best practices that can be applied across the industry have been gained Constantini, et al. (2022). Additionally, this company operates in different geographical regions, thereby offering diverse perspectives and experiences in managing operational challenges and optimizing performance in various contexts (Bain, 2013). The consideration of this industry giant ensures a comprehensive analysis of operational excellence strategies and provides a benchmark for comparison with other organizations (Cuccuzza, 2023). Through the investigation, the researcher uncovered innovative practices that can

drive operational excellence and enhance competitiveness in today's dynamic business landscape.

3.4.4 Interviewees

Selecting operational excellence expert interviewees to gather insights on successful rollouts of operational excellence programs required a systematic approach. Firstly, the researcher identified individuals who have a proven track record in implementing and managing operational excellence initiatives. This was done through industry research, looking at professional profiles on LinkedIn and the company's internal network with the approval of the line manager.

Once potential candidates were identified, their experience and expertise in driving operational excellence was assessed during the interviews to understand their background through their past project success, relevant certifications, or published works. It was also beneficial to consider the diversity of the mining commodities and contexts in which these experts have worked to gain a broader perspective. A diverse pool of interviewees provided different insights and approaches to operational excellence implementation.

As part of the participants' selection, each person needed to be in a senior operational excellence position at the site they work. The number of years was not a determinant in the selection process, however, interviewing experienced professionals within a specific field provides a wealth of firsthand knowledge and expertise crucial for in-depth investigations. Patton (2002) emphasized the value of tapping into experts' experiences, noting that their depth of understanding and nuanced perspectives enrich qualitative inquiries. These professionals often possess tacit knowledge and insights gained through extensive practical engagement, allowing researchers to access specialized information and nuanced insights that might not be available in literature or novice accounts. Moreover, Charmaz (2014) highlighted that interviewing experienced professionals facilitates the exploration of complex phenomena within a particular context, enabling researchers to uncover subtle nuances and understand intricacies relevant to the investigation. Engaging

with such individuals not only enhances the depth and authenticity of the data collected but also provides a comprehensive and holistic view of the topic under scrutiny, as emphasized by Flick (2018) in the context of qualitative research.

Lastly, ensuring that the selected interviewees were willing to share their knowledge and experiences openly was crucial to presenting valuable insights. This was determined through preliminary discussions with the potential interviewees to gauge their willingness and ability to contribute the valuable insights. By carefully selecting operational excellence experts based on their track record, expertise, diversity of experience, and willingness to share, the researcher was able to gather meaningful and practical insights into successful rollout methods of operational excellence programs.

3.5 Data Collection

Data was collected by means of interviews. Interviews offer researchers a valuable means of gathering rich, in-depth, and context-specific data directly from participants. This section explores the opportunities and limitations associated with data collection through interviews, including the advantages of rapport-building, flexibility in questioning, and the potential for participant insights. It also discusses the challenges and considerations, such as researcher bias, data quality, and resource constraints, that researchers must address to ensure robust data collection. By understanding the opportunities and limitations, the researcher could maximize the effectiveness of interviews as a research instrument.

3.5.1 Designing of interview sessions

The interview questions were piloted in the researcher's department, with three operational excellence professionals who did not form part of the sample participants. This allowed the researcher to test run the execution, but also get feedback on the questions and how well they would enable the researcher to fulfil the objectives of the study.

The nature of the interviews and questions to be asked, did not necessarily form part of public knowledge, for this reason, the researcher needed to be careful on how the questions were framed so that it does not border on the lines of disclosing company intellectual property.

3.5.2 Conducting the interviews

The interviews began with introductions. A warm and respectful tone was used to establish a positive connection. In addition to the pleasantries. the purpose, goals, and intended use of the research findings were reiterated. This was to ensure transparency about the research objectives and how the participants' contributions will be utilized fosters trust and ensures participants feel informed and involved.
One of the main challenges during the interviews, was to demonstrate active listening throughout the interview by maintaining eye contact, nodding, and providing verbal cues to show genuine engagement. This was exaggerated by the fact that the interviews were done virtually and recorded.

The participants were given feedback on the research findings. This was to demonstrate the commitment to transparency and has allowed for a continued relationship beyond the interview, enhancing trust and rapport.

3.5.2.1 Active Listening and Probing Techniques

During the interviews, the interviewer employed active listening techniques to ensure comprehensive understanding and engagement (Smith, 2017; Brown & Jones, 2019). The interviewer-maintained eye contact, leaned slightly forward, and nodded in affirmation, demonstrating attentiveness to the expert's insights, a technique highlighted by Johnson & Davis (2018).

However, challenges emerged in applying these techniques. In some instances, the interviewer's focus on maintaining eye contact and mirroring body language unintentionally led to overemphasis on non-verbal cues, occasionally diverting

attention from the actual content of the expert's responses (Smith & Baker, 2016). Balancing visual engagement with active listening without diluting the significance of the spoken information posed a nuanced challenge. Furthermore, the researcher had to be cognisant of the fact that the non- verbal cues were being executed over video, therefore, the impact may have not been the same as engaging a participant in person.

To navigate this, the interviewer incorporated probing techniques to delve deeper into specific aspects of the responses given as advised by Turner, et al. (2015); Martinez & Green (2017). By asking open-ended questions like "Can you elaborate more on that?" and "Could you provide an example?" the interviewer was able to encourage the participants to provide richer insights (Adams, 2018). Moreover, using reflective statements like "So, if I understand correctly…" helped validate the expert's perspective and encouraged them to further elaborate (Thompson, 2019).

There were challenges during probing as well. Some experts exhibited reluctance to share detailed information due to concerns over proprietary processes despite being colleagues of the researcher. This is a risk that has been discussed by Lewis (2021). The risk required the interviewer to carefully navigate the balance between pressing for information and respecting the participant’s boundaries.

In conclusion, the application of active listening and probing techniques during the interviews with the participants offered valuable insights into their strategies and perspectives (Garcia & Martinez, 2020). While some challenges arose, particularly in managing non-verbal cues and handling sensitive topics, these techniques remained instrumental in fostering in-depth discussions as suggested by Harris, et al. (2016).

3.5.2.2 Researcher-Participant Relationship

Borkan (1999) suggested that building rapport with participants is essential, as it establishes trust and encourages participants to share their experiences honestly. Active listening, as recommended by Rubin & Rubin (2012), demonstrates respect for participants' perspectives and encourages them to feel valued and heard. Being sensitive to participants' emotions and experiences, as highlighted by Fontana & Frey (2005), helps create a safe and supportive environment.

Additionally, being reflexive and aware of one's own biases and assumptions, as proposed by Lincoln and Guba (1985), allows for a more empathetic and respectful interaction. Ensuring informed consent and providing a clear explanation of the research purpose and expectations, as advocated by Creswell & Creswell (2018), empowers participants to make informed decisions about their involvement. Throughout the interviews, maintaining a non-judgmental and impartial stance, as discussed by Patton (2002), contributed to a positive and healthy researcher-participant relationship.

3.5.2.3 Data management

In- built transcription software specifically designed for audio recordings was used to transcribe the interview recording on Teams. The software utilizes advanced speech recognition technology to generate a preliminary transcript, which was refined and corrected manually. The automated transcription was used as a starting point and then the information was reviewed and edited to ensure accuracy and completeness. It was crucial to allocate sufficient time and attention to transcribing interview data accurately from the recordings, as it formed the foundation for subsequent data analysis and interpretation.

A structured digital repository where interview data is stored electronically was created. This included dedicated directories on a computer. The data was labelled and organized by interview session to facilitate easy retrieval and analysis. It was crucial to establish appropriate access controls and permissions to protect the confidentiality of the data, therefore password protection was employed to

safeguard sensitive information. Regular backups of the interview data were performed to prevent data loss due to technical issues or accidents. Additionally, the researcher anonymized the data by removing or replacing personally identifiable information to maintain participant confidentiality.

3.6 Data Analysis

This section provides a comprehensive overview of data analysis techniques used for extracting meaningful insights from the interviews conducted. The report highlights thematic analysis, as the primary method, while also discussing the importance of careful data collection, transcription, and the use of Computer-Assisted Qualitative Data Analysis Software (CAQDAS).

3.6.1 Thematic Analysis

Interview data analysis techniques encompass a variety of approaches that have been discussed by prominent researchers in the field. For instance, Cresswell (2014) emphasizes the importance of thematic analysis, which involves identifying recurring patterns or themes within the interview data. This method allows researchers to gain a comprehensive understanding of the participants' experiences and perspectives.

3.6.1.1 Thematic coding

Additionally, Miles, et al. (1993) highlight the significance of coding and categorization in interview data analysis. By assigning codes to specific segments of the interview data and organizing them into meaningful categories, researchers can identify commonalities, differences, and relationships among the participants' responses. Furthermore, Braun, et al. (2006) introduce the concept of thematic coding, where researchers identify themes through a process of systematic coding and constant comparison. This iterative approach enables a deeper exploration of the data and the emergence of nuanced themes. Overall, these researchers provide

valuable insights into interview data analysis techniques, guiding researchers in their efforts to analyze and interpret the rich and diverse information gathered through interviews.

The research methodology utilizing ATLAS.ti encompassed two fundamental tiers: the data level and the conceptual level. At the data tier, activities encompassed the segmentation of data files, the encoding of passages extracted from textual sources, as well as the formulation of annotations. Conversely, the conceptual tier focused on endeavors such as interrogating data and developing frameworks, exemplified by the interconnection of codes within networks, complemented by the creation of supplementary annotations.

Figure 16, ATLAS.ti Summary of data handling and analysis (Atlas.ti, 2023) outlines the key stages, commencing with project creation, incorporating documents, identifying noteworthy elements within the data, and coding them. Memos and comments were adaptable throughout the process, though there might have been a transition from writing comments to more comprehensive memo development in the later stages of analysis. Once the data was coded, it became available for querying using the diverse analytical tools offered. The acquired insights were then visualized using ATLAS.ti's network function.

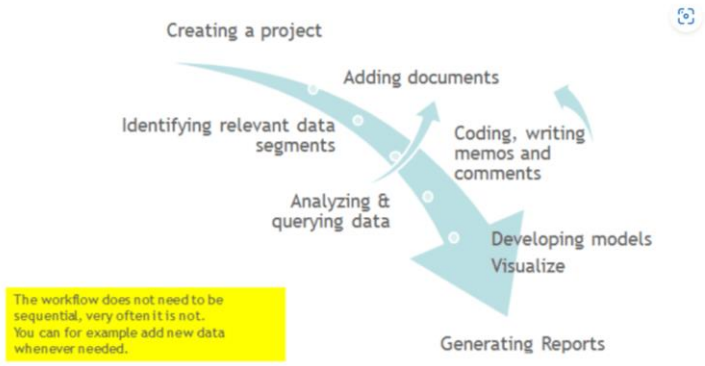

Figure 16 ATLAS.ti Summary of data handling and analysis (Atlas.ti, 2023)

Code document analysis was done to identify key words that appeared in the interview transcripts. The exercise involved removing interviewer questions and

comments to avoid corrupting the data. Only participant feedback was analyzed, with the exception of words such as “uhm”, “like”, “ah”. From this analysis, a frequency distribution was drawn to map out what was inherently common across all participants.

Following this, a co-occurrence analysis was done to check which phrases were used together in the responses. This would then give some indication of the relationships as understood by participants.

3.6.2 Sentiment Analysis

Sentiment analysis in ATLAS.ti involves the application of natural language processing techniques to analyze the emotional tone or sentiment expressed in textual data, such as interview transcripts. This process involves identifying and categorizing words or phrases within the text as positive, negative, or neutral based on predefined criteria.

Sentiment analysis was conducted on the interview transcripts to gain deeper insights into the attitudes, emotions, and perceptions of the participants regarding operational excellence programs within Rio Tinto. By analyzing the sentiment expressed in their responses, it assisted to uncover underlying themes, patterns, and trends that may not have been readily apparent through traditional qualitative analysis alone.

This approach was necessary because it allowed for a more nuanced understanding of the participants' perspectives, enabling the researcher to identify areas of consensus, disagreement, or ambivalence regarding the replication of operational excellence programs across Rio Tinto sites. Additionally, sentiment analysis provided a quantitative measure of sentiment, complementing the qualitative data collected through interviews and enhancing the overall rigor and comprehensiveness of the research findings.

Insights generated through sentiment analysis included identifying common sentiments among different participant groups, detecting shifts in sentiment over time or in response to specific factors, and uncovering subtle nuances in

participants' attitudes and opinions. Overall, integrating sentiment analysis into the research methodology helped to enrich the analysis and interpretation of the interview data, providing a more holistic understanding of the factors influencing the replication of operational excellence programs within Rio Tinto.

Sentiment analysis and opinion mining are analytical techniques used in qualitative research, particularly in the analysis of textual data. These methods, when employed within ATLAS.ti, a qualitative data analysis software, aim to discern and evaluate sentiments, attitudes, and opinions expressed within texts. According to qualitative research expert Friese (2019), sentiment analysis involves the systematic identification and classification of emotions, opinions, and attitudes embedded in textual data. It allows researchers to discern whether sentiments expressed are positive, negative, or neutral, enabling a deeper understanding of subjective viewpoints. Similarly, Charmaz (2014) highlighted the importance of such analyses, stating that opinion mining within qualitative data helps in identifying patterns of thoughts, beliefs, and emotions, thus illuminating underlying themes and perspectives present in the data.

The outcomes of sentiment analysis and opinion mining in ATLAS.ti provide valuable insights into the subjective viewpoints and emotional nuances present in the analysed text. As Patton (2002) articulated, these methods aid in uncovering not only what individuals express but also how they feel about particular topics or experiences. The results often reveal overarching sentiments prevalent in the data, helping researchers identify prevalent attitudes, sentiments, and subjective reactions towards specific concepts, products, services, or experiences. These outcomes contribute to a comprehensive understanding of participants' perspectives, as emphasized by Flick (2018), and can inform decision-making processes, shed light on stakeholders' viewpoints, and guide the development of strategies or interventions by elucidating prevalent sentiments and opinions within the studied population.

3.7 Validity and Reliability/Validation and Verification

3.7.1 Credibility: Triangulation and Member Checking

Triangulation involves the use of multiple data sources, methods, or perspectives to corroborate and validate research findings (Denzin, 2017). By employing this approach, researchers can enhance the robustness and reliability of their conclusions. As advocated by Flick (2018), triangulation not only strengthens the credibility of the study but also allows for a more comprehensive and nuanced understanding of the research phenomenon. This, however, was not entirely possible as previous research published by consulting companies such as McKinsey & Company (2023) does clarify the sample used; therefore it was not clear whether a reasonable comparison can be made between this study and previous industry studies on any of the aspects.

Other researchers have also proposed various strategies to ensure the reliability and validity of interview data. One key approach used for this research was intercoder reliability, as advocated by Miles, et al. (1993). This involves multiple researchers independently coding and analyzing the interview data to ensure consistency and agreement in the interpretation of themes and categories.

The researcher approached two other research colleagues to code the data and check whether all three researchers identify the same themes. The approached individuals were not part of the organization being studied and as such, some measures needed to be in place to protect the organization and participants. The names of the organization and program were changed on the interview scripts. Participant names were changed to Participant 1 to 14.

To protect the identity of participants during the triangulation process, several measures were implemented. First, all data were anonymized before being shared with the research colleagues involved in the coding process. This included removing any direct identifiers such as names, job titles, or specific site locations that could potentially reveal the identity of participants. Codes or pseudonyms were used instead to refer to participants, ensuring that their responses could not be traced back to them.

In terms of maintaining research ethics, the researcher obtained informed consent from all participants, explaining the purpose of the research, how their data would be used, and how confidentiality would be maintained. The participants were assured that their responses would be treated with the highest level of confidentiality and that the results would be reported in aggregate form to prevent the identification of any individual.

Additionally, the researcher ensured that the two colleagues involved in the data coding process were fully briefed on the importance of confidentiality and the ethical considerations surrounding the research. These colleagues were also required to sign non-disclosure agreements to formalize their commitment to maintaining the privacy of the data.

Throughout the triangulation process, ethical guidelines were strictly followed to ensure that the integrity of the research and the rights of the participants were upheld, consistent with best practices in qualitative research.

Additionally, member checking, as recommended by Lincoln & Guba (1985), involves sharing research findings with participants to verify the accuracy and authenticity of the data collected. This process not only validates the research outcomes but also enhances the trustworthiness of the research by allowing participants to contribute their perspectives and insights (Denzin, 2017). The interview participants were sent back the coded data for them to confirm that the identified themes resonate with their responses given in the interviews. By incorporating triangulation and member checking into the research process, researchers demonstrate their commitment to rigorous and credible research practices, ultimately bolstering the reliability and validity of their work.

3.7.2 Transferability: Thick descriptions and sampling strategies

In qualitative research, achieving transferability is essential to enhance the applicability and generalizability of the findings to other contexts. Two key strategies for promoting transferability are the use of thick descriptions and purposeful sampling techniques. Thick descriptions, as proposed by Geertz (1973), involve providing rich and detailed accounts of the research context, participants, and data analysis process. This allows readers to gain a deep understanding of the research setting and facilitates the assessment of how the findings might be relevant or applicable to similar situations. Purposeful sampling, as discussed by Patton (1990), involves deliberately selecting participants or cases that can provide rich and diverse information related to the research objectives. By purposively selecting participants who have experienced the phenomenon of interest, researchers increase the likelihood of capturing diverse perspectives and contexts, enhancing the transferability of the research findings to other settings (Lincoln & Guba, 1985). By employing thick descriptions and purposeful sampling strategies, qualitative researchers can strengthen the transferability of their research and contribute to the broader understanding and application of their findings.

3.7.2 Validity and reliability

In the study, the researcher ensured the validity and reliability of the qualitative research through various methods. Respondent validation was employed to validate whether the phenomena under study were accurately reflected (Long & Johnson, 2000). To manage the researcher's personal bias, being an employee of the studied mining company, acknowledgement was factored and it its potential impact on the analysis was mitigated.

For enhancing reliability, an internal assessment was conducted with the help of intercoder agreement, a quantitative measure, to assess the consistency among different coders when interpreting qualitative data (Lombard, Snyder-Duch & Bracken, 2002). This approach quantified the level of agreement or consensus among coders, thus strengthening the credibility of the qualitative findings.

To ensure a comprehensive and robust analysis, multiple data collection methods were incorporated, such as interviews, and document analysis, following the suggestions of Creswell & Miller (2000). Source triangulation was employed, involving multiple interviews from each organization, to verify emergent themes from colleagues. Additionally, theoretical triangulation was used by applying different theoretical frameworks as outlined in the literature survey to understand the responses more comprehensively.

Transparency and traceability were maintained by carefully documenting the data collection process, as emphasized by Lincoln & Guba (1985). Moreover, a reflexive stance was adopted throughout the research process, as advocated by Denzin & Lincoln (2011), to critically examine biases and assumptions.
By employing these rigorous strategies, the qualitative research was conducted with confidence, contributing to the trustworthiness and validity of the findings.

3.8 ETHICAL CONSIDERATIONS

3.8.1 Informed Consent and Confidentiality

Informed consent and confidentiality are fundamental ethical principles in research, and scholars have emphasized their significance in safeguarding participants' rights and privacy. According to Rassin (2008), informed consent should be obtained in a clear and understandable manner, ensuring that participants are fully aware of the research objectives, procedures, potential risks, and their rights to withdraw at any time. This process establishes a voluntary and informed agreement between the researcher and the participant. To achieve confidentiality, Koocher & Keith-Spiegel (2016) advocate for implementing measures to protect participants' identities and sensitive information. Researchers should ensure that data is anonymized or de-identified, and access to personal data is restricted to authorized personnel only. The use of pseudonyms and secure data storage methods are common practices to maintain confidentiality (Pappworth, 2021). By adhering to these ethical guidelines, researchers demonstrate respect for participants' autonomy and privacy, fostering

trust and credibility in the research process. The ethics clearance number granted by the Ethics Committee is: MIAEC 011/23.

3.8.2 Voluntary Participation and withdrawal rights

Informed consent is a foundational principle that must be upheld to respect the autonomy and rights of research participants. As emphasized by Beauchamp & Childress (2001), obtaining informed consent involves providing participants with comprehensive information about the study's purpose, procedures, risks, and benefits. Participants should have the freedom to make a voluntary decision regarding their participation without coercion or undue influence (Flick, 2018). Additionally, it is essential to emphasize the participants' right to withdraw from the study at any point without facing negative consequences Lancaster et al. (2003). This commitment to voluntary participation and withdrawal rights not only upholds ethical standards but also contributes to the credibility and trustworthiness of the research findings, as highlighted by Shenton (2004). By ensuring participants' informed consent and right to withdraw, researchers demonstrate a commitment to ethical research conduct and the protection of human subjects' welfare.

3.8.3 Anonymity and Privacy

Following the guidelines of Johnson & Christensen (2016), anonymizing data by removing any identifying information, such as names and specific details, is a primary step to safeguard participants' identities. Using pseudonyms, as advocated by Miles & Huberman (1994), further enhances privacy by assigning unique names or codes to participants in all research materials. To maintain data security, storing all research data in password-protected and encrypted systems is essential, in line with the recommendations of Morse (1994). Moreover, obtaining informed consent from participants, as emphasized by Creswell & Poth (2018), ensures that they are fully aware of the measures taken to protect their anonymity and privacy.

Throughout the research process, limiting data access to only authorized team members and adhering to strict data sharing protocols, as proposed by Denzin & Lincoln (2011), adds an extra layer of protection. By diligently adhering to these practices, researchers uphold ethical standards, foster trust with participants, and demonstrate a commitment to respecting their privacy and confidentiality.

CHAPTER 4

ANALYSIS AND RESULTS

This chapter presents the findings derived from the qualitative interview data and the subsequent analysis. It begins with a summary of the key themes identified through thematic coding. Following this, the results of the sentiment analysis, conducted using opinion mining techniques within the ATLAS.ti software, are discussed. The sentiment analysis provided valuable insights into the participants' attitudes and emotions regarding the operational excellence program. These results were instrumental in developing a comprehensive codebook, which ensured that the data analysis was systematic and closely aligned with the perspectives and sentiments of the participants.

4.1 Participants' profiles

A total of 14 participants were part of the research process. These are listed in Table 2 below:

Table 2 Summary of participants' profiles

Participant	Date of interview	Location	Current role	Years in Operational excellence
1.	2 July 2023	Australia	Operational Excellence Manager	8
2.	5 July 2023	USA	RTSPS Deployment lead	15
3.	8 July 2023	Canada	Global COO Office: RTSPS Lead	22

4.	30 July 2023	USA	Operational Excellence Manager	10
5.	30 July 2023	Canada	Operations Manager	6
6.	3 August 2023	South Africa	Operational excellence Manager	18
7.	8 August 2023	Canada	Operations Manager	12
8.	14 August 2023	Australia	COO Office: RTSPS Lead	25
9.	24 August 2023	Australia	Site: Principal Advisor	9
10.	10 October 2023	Australia	Operational excellence Manager	17
11.	17 October 2023	USA	RTSPS Deployment Lead	13
12.	19 October 2023	Canada	Operational excellence Manager	20
13.	24 October 2023	USA	Mindsets and Behaviors Coach	7
14.	25 October 2023	Australia	Operational Excellence Manager	14

Figure 17, Participants' work experience in the field of operational excellence, shows the experience in years, of the interviewed participants. Six out of Fourteen

participants had six to ten years of experience. Of those six, four started worked in other companies while two started their professional careers within Rio Tinto.

Although some bias existed in the responses, the people who had worked in other companies prior to joining Rio Tinto could give insights into what has worked in terms of deployment and replication strategies in other companies and industries, while the people who started their careers in Rio Tinto, were able to narrate the changes they had seen over the years and the different operational excellence programs that had been deployed, what contributed to the success and what were the reasons for discontinuation.

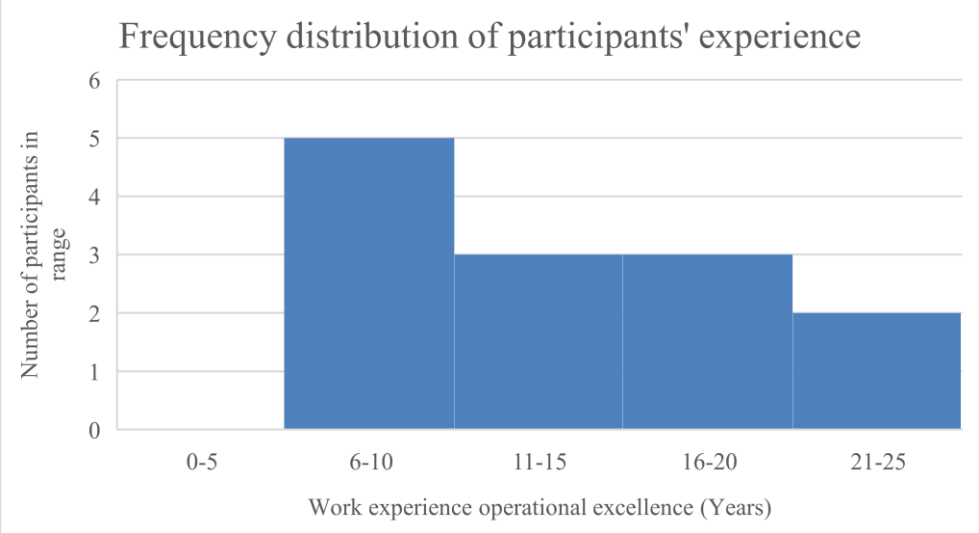

Figure 17 Participants' work experience in the field of operational excellence

4.2 Thematic analysis outcomes

4.2.1 Main Idea 1: Determining what the deployment challenges are (Q1 – Q6)

In discussions with 14 individuals within Rio Tinto, concerns surfaced regarding the deployment challenges associated with the Rio Tinto Safe Production System (RTSPS) on a global scale. Several interviewees stressed the complexity of integrating RTSPS within diverse cultural landscapes across various sites. One

interviewee mentioned, "Each site operates differently, and implementing a standardized system like RTSPS across these diverse environments is a significant challenge."

A recurrent theme among interviewees highlighted the need for a more people-centric approach in the implementation strategy. "RTSPS seems focused on processes; however, overlooking the human aspect might hinder its effectiveness," remarked another interviewee. This sentiment underscores the importance of considering the workforce's perspectives and involvement for successful deployment.

Past experiences with similar initiatives have left some interviewees apprehensive. One participant commented, "We've seen initiatives come and go. Sustaining engagement and commitment beyond the initial phase has been a recurring challenge." These apprehensions stem from historical instances where change programs failed to resonate with frontline workers or lacked continuous support from leadership.

Another challenge discussed was the need for effective communication. An interviewee emphasized, "Communication about the program's objectives and benefits hasn't been clear to everyone. Aligning everyone's understanding is crucial for successful implementation." Miscommunication or lack thereof can impede employee buy-in and support for the initiative.

Moreover, there were concerns regarding resource allocation and training. "Adequate resources and training are essential for employees to embrace RTSPS effectively," stated one interviewee. Insufficient resources or inadequate training might hinder employees' ability to adapt to new processes and methodologies, ultimately impacting the success of the deployment.

Lastly, the issue of adaptability emerged as a critical point of discussion among interviewees. "What works at one site might not be applicable elsewhere. Flexibility

and adaptability are key for the successful adoption of RTSPS across our global operations," noted one participant. This highlighted the challenge of tailoring the program to suit the unique needs and circumstances of diverse sites within Rio Tinto.

Participant 3 raised the growth option of mergers and acquisitions as one of the key challenges affecting both deployment and replication because each site has different reporting structures and systems.
Logistics and costs of global mobility were raised by Participant 12 as a challenge in that if the limitations did not exist, teams could easily travel between sites to train and develop capability. This would allow for “a single source” of truth per best practice.

Participant 1 mentioned the fact that large mining companies such as Rio Tinto, comprise of different departments and at times, programs are launched at the same time. The site at which the participant is based, has been in the process of deploying the new operational excellence program, however, the company was also introducing a new safety program to increase visibility, record near misses and share insights across different sites. This poses a threat of competing interests of programs. Neither one is less important, but the split focus affects the efficacy of deployment and replication.

Another key challenge that came up, was each site’s decision to deploy a certain practice, that is not yet established as part of the overall operational excellence program. In such an instance, the site does not have a reference point and relies heavily on external skills and benchmarking, when a practice is established across the whole organization, the said site then has to reform what they had implemented before. The impact of such adaptations or decentralization has not yet been investigated or quantified.

The Rio Tinto Safe Production System (RTSPS) is a critical element of the company’s strategy to enhance its triple bottom line—people, planet, and profit.

Since 2018, Rio Tinto's annual reports have consistently highlighted the importance of this program in driving safety, efficiency, and sustainability across its operations. However, deploying such a system across a large, geographically and culturally diverse organization like Rio Tinto presents unique challenges, which are echoed in both the company's internal findings and the broader literature on operational excellence in the mining industry.

The RTSPS was developed as part of Rio Tinto's broader goal to achieve consistent operational performance across all sites. Rio (2022) emphasizes that the system is designed to standardize processes, reduce operational variability, and improve safety outcomes across global operations. Safety, in particular, has been a recurring theme in the reports, reflecting Rio Tinto's goal of achieving zero fatalities and minimizing operational risks.

Impact on the Triple Bottom Line

- People: Rio Tinto's reports have consistently stressed the importance of safety and employee well-being. The RTSPS is intended to create safer work environments by embedding safety protocols into every aspect of the production process.
- Planet: The program also supports Rio Tinto's environmental goals by optimizing resource use and reducing waste. For example, Rio Tinto (2020) report highlighted how RTSPS contributes to more efficient energy use, which in turn helps lower the company's carbon footprint.
- Profit: Financially, the system is expected to drive cost savings by reducing downtime and improving process efficiency. This is a key part of Rio Tinto's strategy to deliver sustainable returns to shareholders, as highlighted in the reports Rio Tinto (2021); Rio Tinto (2022).

As corroborated in the findings from the interviews conducted, integrating a standardized system like RTSPS across culturally diverse sites is a significant challenge. Gupta and Govindarajan (2000) indicate that cultural differences can

impede the effective implementation of global strategies, leading to variations in adherence and outcomes across sites.

Employee Engagement and Change Management: Studies by Kotter (1996) and Cameron & Green (2019) emphasize the importance of engaging employees in the change process to ensure the success of operational excellence initiatives. The concerns raised by Rio Tinto employees regarding the need of a people-centric approach in RTSPS reflect this broader challenge in change management.

While Rio Tinto's annual reports from 2018 to 2022 emphasize the strategic importance of RTSPS in enhancing safety, efficiency, and sustainability, the challenges identified both in interviews and the broader literature suggest that successful deployment requires balancing standardization with local adaptability, and prioritizing employee engagement. The challenges of cultural integration, resource allocation, and communication reflect broader issues that are well-documented in the literature on operational excellence programs in the mining industry and they came up in the interviews as well.

4.2.2 Main idea 2: Determining the fundamental components integral to the operational excellence program and assessing their significance in subsequent replication. (Q7- Q9)

Participant 9 indicated the importance of doing initial assessments to determine the behaviours and attitudes of the site leadership and personnel. Assessments critical to the SPS operational excellence program include a cultural diagnostic, an Operational Excellence Maturity assessment. This was noted as a foundational element for this specific operational excellence program because of the lessons learned from prior attempts, which were centred around deployment and not the mindsets and behaviours that ensure success.

One interviewee highlighted, "Standardized processes are the backbone of operational excellence. Having consistent procedures ensures efficiency and quality

across sites." This sentiment underscores the significance of standardized processes as a fundamental element that lays the groundwork for successful replication.

Furthermore, interviewees emphasized the importance of robust training and skill development. "Investing in comprehensive training programs empowers our workforce, fostering a culture of continuous improvement," remarked another participant. Training initiatives play a pivotal role in equipping employees with the necessary skills to embrace and replicate operational excellence practices effectively.

Participant 4, as a long-standing employee at Rio Tinto, indicated the common thread across previous programs explored by the company, has been the tendency to lean towards Lean methodologies in operations. The business has not completely implemented lean yet outside operational disciplines however some concepts and tolls have been used overtime.

Participant 6 highlighted the importance of creating links between the operational excellence framework and strategic objectives of the organization. This becomes part of the “why” of the program and partially ensures buy-in as it is value driven.

Knowledge sharing stands to play a critical role in replication. The business has a separate structure, supporting different product groups and ensuring everyone has equal access to a central source of information. All templates and training packs are maintained in a central place. This also forms part of capability building and it is being supported centrally. According to Womack & Jones (1996), a robust knowledge-sharing infrastructure is pivotal in ensuring successful replication across diverse locations. A centralized repository allows for the dissemination of best practices, lessons learned, and standardized processes, facilitating seamless adoption and implementation across various branches or divisions. Additionally, as emphasized by Schonberger (1990), creating a centralized information base cultivates a culture of continuous improvement by enabling the accessibility of

critical insights, metrics, and success stories, fostering a shared understanding and alignment toward operational excellence goals globally.

RTSPS emphasizes standardization, aiming to create uniform processes across Rio Tinto's diverse global operations. The system is built on principles of continuous improvement and risk management, ensuring that safety remains paramount while optimizing operational performance. Rio Tinto (2019) highlighted the system's role in reducing operational variability, thereby improving consistency and reliability across different sites.

Over the past three years, the rollout of RTSPS has focused on embedding these standardized practices, particularly in areas with high safety risks and operational complexity. This has involved significant investment in training, technology, and process optimization to ensure that the system is not only implemented but also ingrained in the day-to-day operations of the company.

The implementation of RTSPS has directly influenced Rio Tinto's investment decisions, particularly in technology and safety-related upgrades. Rio Tinto (2020) emphasized the allocation of capital towards enhancing operational systems to support RTSPS. This includes investments in automation, data analytics, and digital tools to monitor and improve safety and performance in real-time. These investments reflect the company's commitment to achieving the strategic goals outlined in the RTSPS framework.

The financial impact of RTSPS is evident in Rio Tinto's improved cost efficiencies and operational reliability, which are consistently highlighted in the annual reports. Rio Tinto (2021) noted that the system had contributed to a reduction in operational disruptions, leading to more stable production levels and lower operational costs. Financially, this has helped Rio Tinto maintain strong margins even in volatile market conditions.

Operationally, the focus on standardization and continuous improvement has led to measurable improvements in safety metrics, with Rio Tinto (2022) indicating a decline in incident rates at sites where RTSPS has been fully implemented. However, the report also acknowledges the challenges of deploying RTSPS across culturally diverse and geographically dispersed sites, which has necessitated a flexible approach to implementation in some areas.

The general sentiment within Rio Tinto regarding RTSPS has been cautiously optimistic. While the benefits in terms of safety and operational efficiency are clear, there have been challenges related to cultural integration and the adaptability of the system across different sites. Rio Tinto (2022) reflects this by noting that while RTSPS has brought improvements, its success depends on effective communication, leadership engagement, and ongoing investment in people and technology.

4.2.3 Main idea 3: Identifying success factors for replication (Q10-Q15)

Participant 10 reflected on the importance of inclusion and collaboration. The participant raised the importance of having a unified structure and not creating competing programs. Rio Tinto was described as having a good knowledge base, the key factor of success lies in streamlining processes and letting go of initially adopted programs. The sentiment was that there are pockets of excellence in all the existing frameworks, however not everything can be executed at once.

Successful deployment requires recognizing the opportunity cost of selecting one framework over another. The adaptation and sustainability of different programs maintained at once inhibits successful deployment and replication. The learning was shared by a participant and was related to the importance of businesses focusing on one thing instead of trying to do everything at once. It emphasizes the significance of prioritization and concentration on a core idea or product rather than diluting efforts across multiple ventures, stressing the importance of making strategic choices to achieve excellence in a particular area.

Leadership commitment is identified as a fundamental driver of RTSPS success. The 2019 Annual Report stresses that strong leadership is crucial for embedding RTSPS principles at every operational level. Leaders are expected to actively engage in the system, model the desired behaviours, and hold their teams accountable for compliance and continuous improvement. This leadership-driven approach ensures that RTSPS becomes ingrained in the company's culture.

Standardization across operations is another critical success factor. Rio Tinto (2020) highlights the importance of establishing consistent processes and practices across Rio Tinto's diverse sites. By reducing variability, RTSPS aims to create a more predictable and reliable operational environment, which in turn enhances safety and efficiency. The report notes that standardization is essential for replicating best practices and achieving uniform outcomes.

The integration of advanced technologies is also highlighted as a key enabler of RTSPS. Rio Tinto (2021) emphasizes the role of digital tools, data analytics, and automation in supporting the system's goals. These technologies allow for real-time monitoring, better decision-making, and proactive risk management, which are crucial for maintaining high safety standards and operational efficiency.

A commitment to continuous improvement is central to the success of RTSPS, as noted in Rio Tinto (2022) . The system is designed to be dynamic, with a focus on learning from experience, adapting to changing conditions, and continually refining processes. This adaptability is particularly important given the diverse and often challenging environments in which Rio Tinto operates.

Finally, the importance of employee engagement and training is repeatedly emphasized. The reports note that for RTSPS to be effective, employees must be fully engaged and adequately trained in its principles and practices. Rio Tinto (2019) report highlights that ongoing training and clear communication are vital for ensuring that all employees understand the system's objectives and how they contribute to its success.

4.3 Sentiment analysis outcomes

This section provides a comparison of the operational excellence program implementation at Rio Tinto sites. The analysis focuses on key aspects such as keys success factors of the program itself and what has aided or impeded success at each site. Through this examination the researched aims to identify commonalities and differences between sites, highlighting best practices and lessons learned in the pursuit of operational excellence within Rio Tinto.
Prior to the data being coded, opinion mining and sentiment analysis were done. This is a function on the Computer Assisted Qualitative Data Analysis Software (CAQDAS) used. The selected software was ATLAS.ti.

To help interpret the graphs generated in ATLAS.ti, it's important to understand the colour coding and the significance of the visual elements. The graphs with green bars represent positive sentiments, indicating where participants expressed favourable views, optimism, or approval related to the operational excellence program. In contrast, the graphs with red bars signify negative sentiments, highlighting concerns, criticisms, or negative emotions associated with the program. The colours can be noted in Figure 18, Figure 19 and Figure 20.

The blue highlights in the graphs serve as a tool to help the researcher focus on specific words or phrases that are closely connected with the key themes or keywords identified in the analysis. These highlights allow for a deeper examination of how positive sentiments are associated with aspects of the program. By zoning in on these areas, the researcher can identify patterns, understand the context of the sentiments, and ensure that the analysis accurately reflects participants' perspectives.

There were 75 positive sentiments around how people should "be", this is depicted in Figure 18. It ranged from desired behaviours of those entrusted with the task of leading the organization through the change and those who are experiencing the change and being guided through the deployment. Key associated elements that

came along with the sentiment, included the advocacy for authenticity. With a key emphasis on how operational excellence professionals should engage authentically with employees. Investing in really helping them do things differently, for the benefit of the organization, but more so, for the benefit of the people. Another key element that came across was around embracing “differences”. Being part of a global organization requires some level of standardization, however in seeking to drive a people centric culture, participants believe that there needs to be room for adaptation.

Figure 18 Positive sentiments from Sentiment analysis

Figure 19 Negative sentiments and associated words from sentiment analysis

There were much more negative sentiments around the term “be”, shown in Figure 19, Negative sentiments and associated words from sentiment analysis. This suggested that the participants had noted specific behaviours that did not align with their values or those they identify with the business. The associated themes were around sustainability. Rio Tinto is one of the most versatile companies and this is driven more by the nature of their mergers and acquisitions growth strategies. Due to its size and reach, it also has experienced a lot of changes. For this reason, people sometimes get sceptical about the sustainability of operational excellence programs. There are also concerns around the level of difficulty for the sites to adopt best practices. A common theme of questioning the importance of the change as observed by site teams also came through.

Figure 20 Sentiments associated with "the how"

One of the more common themes was around “the how”, shown in Figure 20. All participants emphasized the importance of standardizing deployment. It became apparent that the professionals noted the criticality of determining a how and that this was a key success factor, because a well drafted strategy is only as good as its execution. General sentiments showed that participants identified the how as a factor that could promote or hinder success.

Once the sentiment analysis was done on all the documents, a codebook was created using the codes identified in section 2.6. Some of the words were not exact, but instead, synonyms were used due to the responses of the participants.

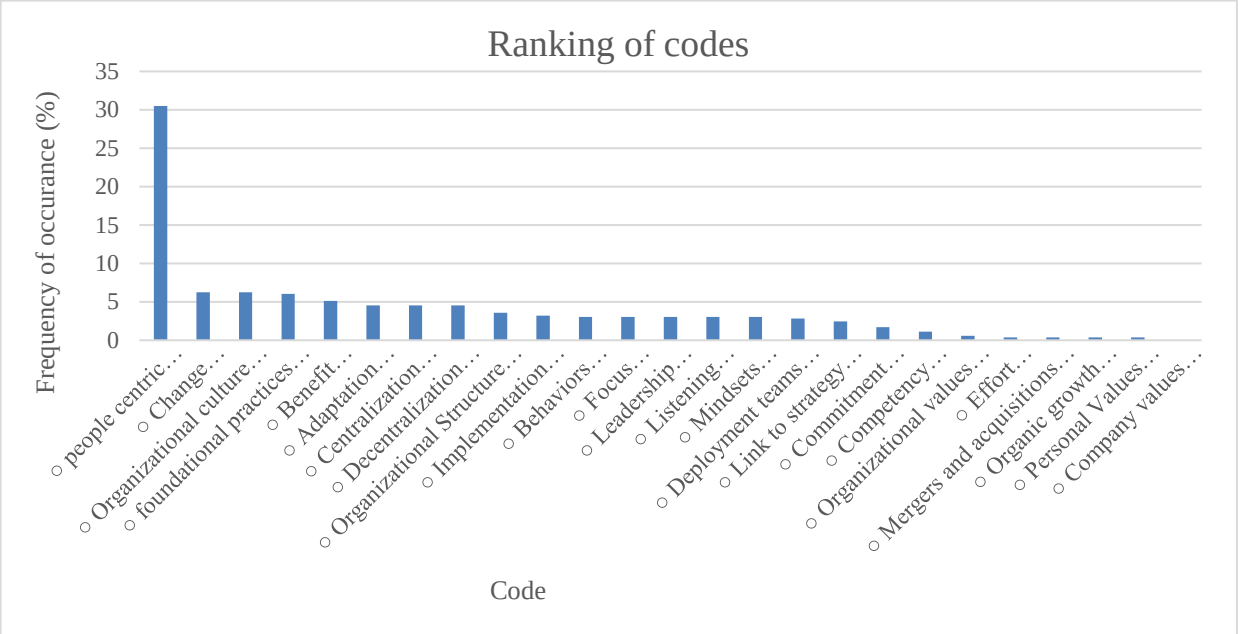

Figure 21 Codes identified in interview data.

The key factor that all participants considered important, was the people element. It far outweighed the other factors that were identified. The way in which an organization is structured to support the deployment of operational excellence programs, was deemed equally important as the organization's ability to manage change and the foundational principles of the program itself.

4.4. Conceptual framework testing

A preliminary conceptual framework was established and introduced in section 2.6. After gathering data through interviews, the subsequent phase involves validating the framework in accordance with the second research goal. Figure 22 is a revision of the framework. The changes to the conceptual framework are underpinned by the comparison tabulated in Table3, Comparison between literature and research findings .

Table 3 Comparison between literature and research findings

	Literature	Research Findings
Foundational Elements	Understanding of organizational objectives. Commitment to continuous improvement. Effective leadership and management support. Robust process management. Employee empowerment and engagement. Customer value and satisfaction	Comprehensive assessments during current state. Standardized processes Operational excellence program link with organizational strategy. Training and development
Success Factors	Leadership commitment and support Alignment of operational excellence goals with overall business strategy. Robust measurement and tracking of (KPIs). Effective communication Empowerment of frontline workers to drive improvements. Adoption of best practices and standardized processes Investment in employee training and development.	Knowledge management Unified structure One program at a time, no competing programs. Leadership visible exemplary behaviours. Process changes proven to be better for execution teams.

	Literature	Research Findings
Impediments	Resistance to change among employees. Lack of leadership buy-in or commitment.	Diverse cultural landscapes Program noted as process focused and not people focused.
	Inadequate resources (financial, technological, and human).	Previously unsuccessful operational excellence programs.
	Competing priorities and initiatives within the organization.	Unclear benefits
	Siloed or fragmented organizational structures. Poor communication and coordination across departments	Multiple competing initiatives
	Cultural barriers to collaboration and knowledge sharing,	

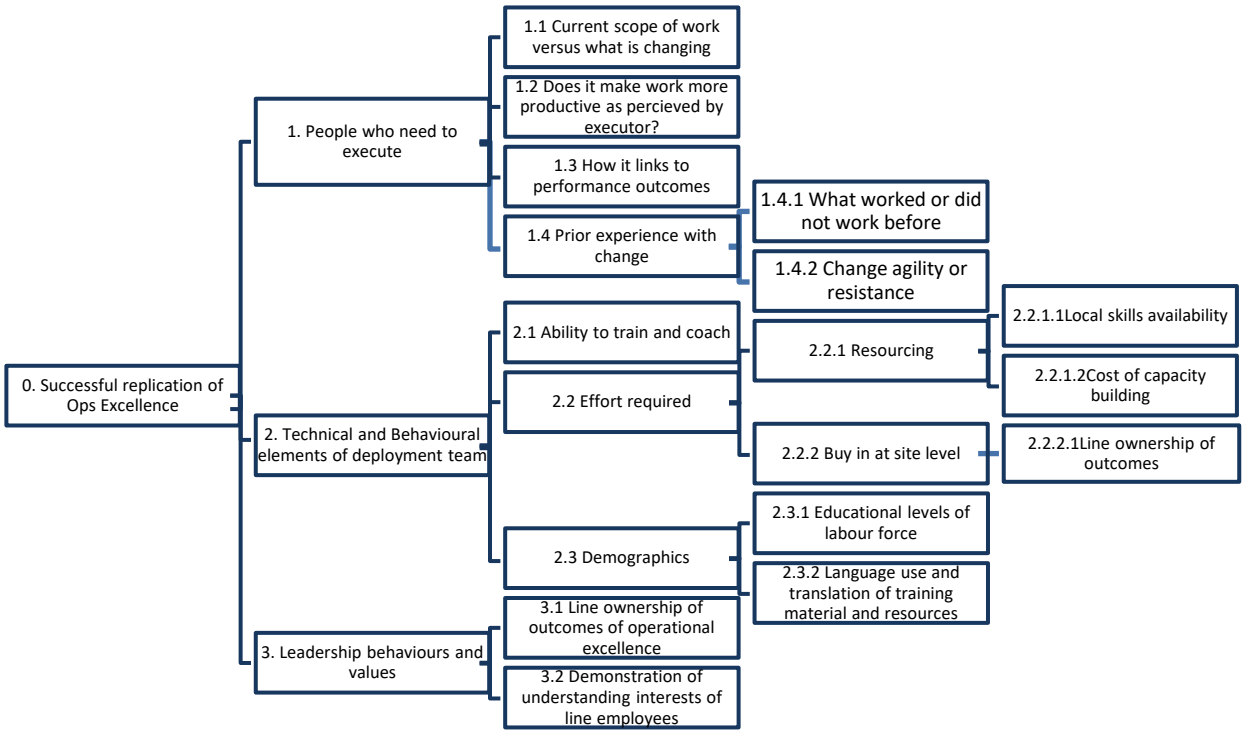

Figure 22 Revised conceptual framework.

Parent Node 0: No difference

Child Node 1: This is the initial change identified, where the initial node changes from being about the type of operational excellence framework chosen, to being about the people who need to execute the changes i.e. the operational teams.

Grandchild Nodes 1.1 – 1.4:

These nodes are a breakdown of aspects considered critical in ensuring the deployment of operational excellence programs is consistent is around people first. This is underpinned by the code outcomes, where participants highlighted the "people centric" element to ensure not only success but replication as well.

Child Node 2: The research findings indicate that the deployment team's skills and approach, once perfected, the framework chosen becomes immaterial as the delivery is expected to have greater impact on employees.

Grandchild Nodes 2.1-2.3:

The grandchild nodes related to Child node 2 are related to the skills and expertise of the deployment team. Traditionally, companies employ the services of consultants however, the related risk is the level of engagement employees have with people who are deemed "not part of" the organization. As a result, significant investment must be made in building internal capacity (ensuring the employment team is well versed in the organizational strategy, soft skills and technical elements of the operational excellence program.

Child Node 3: The change to this node is directly linked to the organization, however, specifically emphasizes the criticality of leadership behaviours and values. As a subset, a theoretical understanding, was that there would be differences resulting from whether a company grows organically or by acquisition.

CHAPTER 5

DISCUSSION

This section critically evaluates the findings of the study within the context of the research question and objectives outlined earlier. By adhering to a systematic thematic analysis of interview data, the study aimed to uncover the challenges inhibiting the successful replication of operational excellence programs at Rio Tinto, a prominent player in the global mining industry. Additionally, it sought to classify the operational excellence components utilized by Rio Tinto and recommend strategies to overcome identified barriers.

5.1 Introduction to research findings

Analysing the data collected from semi-structured interviews with operational excellence executives at Rio Tinto illuminated several primary obstacles and challenges. Thematic analysis revealed disparities in organizational culture, resource allocation, and operational complexities across diverse geographical locations. These findings were consistent with existing literature on the challenges faced by multinational corporations in implementing operational excellence programs. Thus, the validation of these challenges through both empirical data and theoretical underpinnings strengthens the credibility of the study's findings.

Moreover, the study's focus shifted from initially emphasizing the selection of an operational excellence framework to recognizing the pivotal role of the operational teams in driving successful implementation. This shift underscores the importance of a people-centric approach and aligns with the objective of identifying and analysing primary obstacles. By emphasizing the significance of the deployment team's skills and approach over the specific framework chosen, the study provides valuable insights into the key components of operational excellence.

Furthermore, the recommendations derived from the analysis offer actionable strategies for Rio Tinto to overcome barriers and achieve consistent operational excellence. These recommendations, such as fostering a unified organizational

culture and investing in employee training, are supported by existing literature on best practices in operational excellence and organizational management. The emphasis on building internal capacity within the deployment team aligns with the objective of recommending approaches for Rio Tinto to overcome barriers and underscores the importance of investing in human capital for sustained success.

5.1.1 Conceptual Framework Impact:

The modifications made to the conceptual framework, particularly the emphasis on a people-centric approach and the pivotal role of leadership behaviours and values, have significant implications for research in the field of operational excellence within the mining industry. By shifting the focus from a purely technical perspective to one that prioritizes human factors, the study contributes to a more holistic understanding of the determinants of operational excellence. This reconceptualization opens avenues for future research to explore the interplay between organizational culture, leadership, and operational performance in greater depth.

5.1.2 Impact on other Mining Organizations:

The findings of this study potentially have broad implications for other large mining organizations grappling with similar challenges in operational excellence replication. By highlighting the importance of addressing organizational culture differences, resource allocation disparities, and operational complexities, the study offers valuable insights that can be extrapolated to inform strategic decision-making in other contexts. Additionally, the emphasis on investing in human capital and fostering leadership commitment underscores universal principles that can be applied across diverse organizational settings. As such, the findings of this study can potentially serve as a foundation for further research and practical initiatives aimed at promoting consistent operational excellence in the mining industry and beyond.

5.1.3 Deployment Challenges

The challenges identified in deploying the operational excellence program align with what has been noted in literature. For instance, (Womack & Jones, 1996) emphasize the importance of considering cultural differences and involving the workforce in implementation strategies, which resonates with the sentiments expressed by some interviewees. Similarly, (Schonberger, 1990) stresses the significance of effective communication and resource allocation, both of which were mentioned as challenges by the participants.

Evans & Lindsay (2017) discuss the importance of balancing people-centric approaches with process standardization in achieving operational excellence. They argue that while involving employees is essential, it should not come at the expense of neglecting standardized processes, which are critical for achieving consistency and reliability in operations.

Hoerl & Snee (2012) emphasize the need for a balanced approach between people-centric strategies and process standardization in operational excellence initiatives. They argue that while adaptability is important, excessive flexibility can lead to variation and inconsistency, hindering the organization's ability to replicate best practices effectively.

Lastly, Hayes & Wheelwright (1984) emphasized the significance of process standardization as a cornerstone of operational excellence. They argued that while people-centric approaches are valuable, they must be complemented by standardized processes to ensure consistency and reliability across different sites and operations.

The research participants did not express a people-centric approach as something mutually exclusive to standardization. Rather, they highlighted the importance of balancing both aspects for effective operational excellence. While acknowledging the significance of people-centric approaches in fostering employee engagement and adaptation, they also emphasized the need for standardized processes to ensure

consistency and reliability across diverse sites and operations. This finding underscores the nuanced understanding within the research participants that operational excellence requires a holistic approach that integrates both people-centric strategies and process standardization. Unlike some research literature that might posit a dichotomy between people-centric approaches and standardization, this research finding suggests that successful operational excellence initiatives necessitate a synergistic integration of both aspects. It emphasizes the key point that achieving operational excellence involves not only focusing on the human element but also implementing standardized processes to drive consistency and efficiency throughout the organization.

5.2 Fundamental components of operational excellence

The findings also align with the principles advocated by Womack & Jones (1996), they underscore the significance of standardized processes as the backbone of operational excellence, a notion echoed in the research findings. However, it's imperative to acknowledge that while standardized processes are vital, they may not universally apply across all contexts and industries, owing to variations in organizational needs, culture, and environmental factors (Womack & Jones, 1996).

The emphasis on robust training and knowledge sharing also resonates with the works of Womack & Jones (1996), who highlight the pivotal role of knowledge-sharing infrastructure in ensuring successful replication across diverse locations. Nevertheless, the literature and interviews may uncover nuances in the effectiveness of knowledge-sharing mechanisms, such as cultural differences influencing employees' willingness to share knowledge and technological barriers impeding information dissemination. Thirdly, the importance of establishing a centralized information base to foster a culture of continuous improvement, as emphasized by Schonberger (1990), was highlighted. This resonates with research findings emphasizing knowledge sharing as a critical success factor for replication. However, while centralized information bases can facilitate access to pertinent data and best practices, they may encounter challenges like information overload and

employee resistance accustomed to decentralized decision-making. Hence, exploring a balance between centralization and decentralization is crucial to optimize the benefits of information sharing while addressing organizational resistance (Schonberger, 1990). Moreover, the findings regarding the challenges of deployment and replication, such as resistance to change and inadequate resources, are consistent with the impediments highlighted in existing literature on operational excellence and change management (Charmaz, 2014; Friese, 2019; Patton, 2002). While well-documented, emerging themes like the leadership's role in overcoming resistance to change and securing adequate resources deserve deeper exploration. Moreover, the impact of external factors such as market dynamics and regulatory changes on replication efforts warrants further investigation.

5.3 Success Factors for Replication

Identified success factors for replication include a people centric program, that employees deem beneficial and, alignment with organizational culture, sound foundational practices that come with the change, investment in employee training and development, and ensuring a unified structure with no competing programs. Appendix B shows a spread of the most used words the word “people” appeared as central. These factors are implicitly and explicitly cited in Figure 21 in decreasing order of occurrence. These factors highlight the importance of strategic choices, organizational alignment, and employee engagement in driving successful deployment and replication of operational excellence initiatives (Jones & Womack, 1996; Schonberger, 1990).

Further investigation is warranted to explore the impact of organizational structure, leadership behaviours, and cultural factors on the replication of operational excellence programs. Additionally, understanding the dynamics of mergers and acquisitions, logistical challenges, and competing initiatives within large organizations like Rio Tinto can provide valuable insights into overcoming barriers to replication. Moreover, assessing the long-term sustainability and scalability of operational excellence programs amidst organizational changes and evolving industry landscapes is essential for continuous improvement and success.

5.4 Sentiment Analysis Outcomes:

Existing literature provides valuable insights surrounding the themes highlighted in the sentiment analysis of the interview transcripts. On one hand, the positive sentiments around authenticity, diversity, align with the values often emphasized by scholars such as George (1997), as he argues that authentic leaders draw upon their own life experiences and values, fostering a sense of trust and commitment among team members. Authentic leadership aligns with the positive sentiment identified in your sentiment analysis regarding the importance of authenticity in the context of operational excellence. Moreover, diversity and inclusivity have been increasingly recognized as essential components of successful organizational cultures, fostering innovation and resilience (Cox & Blake, 1991). Therefore, further exploration into how these positive sentiments can be leveraged to enhance operational excellence programs and foster a culture of innovation and inclusivity within organizations would contribute to advancing our understanding of effective implementation strategies (Womack & Jones, 1996; Cox & Blake, 1991).

Conversely, the negative sentiments surrounding sustainability, difficulty in adoption, and competing priorities highlight potential challenges that warrant deeper investigation. Sustainability concerns within operational excellence programs reflect broader organizational challenges in maintaining long-term effectiveness and relevance amidst changing market dynamics and stakeholder expectations (Porter & Kramer, 2011). Understanding the root causes of difficulty in adoption, such as resistance to change or lack of alignment with organizational goals, is crucial for designing targeted interventions to overcome these barriers (Kotter, 1996). Additionally, addressing competing priorities underscores the importance of strategic decision-making and resource allocation in ensuring the success of operational excellence initiatives amidst other organizational initiatives (Kotter, 1996; Porter & Kramer, 2011).

5.5 Operational excellence components identified

As an outcome related to objective 2 of the research, a summary has been provided in Table 4, showing the categories that have been identified as success factors for the replication of Operational excellence programs. These were identified in literature and using interviews.

Table 4 Elements contributing to the replication of the operational excellence program at Rio Tinto

Component	Fit Classification	Reason
People-Centric Approach (Child Node 1)	Initial focus shifted from OE framework type to people, emphasizing operational teams as change executors.	Success hinges on people driving and sustaining improvements. This component ensures OE initiatives focus on empowering people, fostering engagement, and building skills that allow teams to adopt and adapt best practices consistently.
Critical Aspects for Consistency (Grandchild Nodes 1.1 – 1.4)	Emphasizes employee training, communication, and involvement.	A people-first approach addresses variability in skills, engagement, and understanding across geographies, aligning with human motivations and behaviours to enhance OE replication success.
Deployment Team's Skills and Approach (Child Node 2)	Highlights skills and approach of the team implementing OE, focusing on building internal capabilities.	Shifting reliance from external consultants to internal capabilities ensures technical competence aligned with company values and strategic goals, enhancing ownership and reducing resistance, making replication more sustainable.
Internal Capacity Building (Grandchild Nodes 2.1-2.3)	Emphasizes developing internal expertise in soft and technical skills, reducing reliance on external consultants.	Internal capacity building roots OE efforts within the organization, promoting continuity, strategic alignment, and stronger employee buy-in.
Leadership Behaviors and Values (Child Node 3)	Leadership's role in setting the tone, ensuring alignment, and committing to OE principles globally.	Leaders drive OE adoption through behaviours, values, and example-setting, fostering a supportive culture, overcoming resistance, prioritizing resources, and maintaining strategic focus.
Organizational Culture and Leadership Dynamics	Highlights the impact of organizational culture and leadership on OE success.	Leadership behaviours like authenticity and inclusivity create an environment for OE to thrive. Organizational culture influences the adoption and replication of OE across different sites.
Standardization and Adaptability Balance	Balances a people-centric approach with standardized processes for consistency.	Recognizes that while engagement and adaptability are essential, standardization provides a framework for replicating success across diverse operations, tailored to local conditions without losing core OE principles.
Investment in Training and Development	Continuous investment in developing skills of employees at all levels.	Training builds technical competencies and empowers employees, making them more effective change agents. This investment sustains OE replication by enhancing

		execution quality and adherence to best practices.
Unified Structure and No Competing Programs	Ensures alignment of OE efforts without dilution from competing initiatives.	A unified approach maintains focus, streamlines efforts, and avoids conflicts between programs, enhancing the effectiveness of OE initiatives.

5.6 Future work

From the analysis of the research findings and comparison with existing operational excellence literature, several potential areas for further exploration emerge. One significant theme commonly discussed in operational excellence literature but not explicitly observed in the practice of operational excellence deployment and replication at Rio Tinto is the role of organizational culture in driving operational excellence success.

While the research highlights disparities in organizational culture as a challenge, there is limited exploration of how specific cultural factors impact the effectiveness of operational excellence initiatives. For instance, existing literature often emphasizes the importance of a culture of continuous improvement, employee empowerment, and open communication in facilitating successful operational excellence programs Womack & Jones (1996); Luthans & Avolio, (2003). However, the extent to which these cultural elements are present or lacking within Rio Tinto and how they influence the replication of operational excellence initiatives remains unclear. Further investigation into the cultural dynamics within Rio Tinto and their implications for operational excellence replication can provide valuable insights for both theory and practice.

Additionally, the research findings suggest a need for deeper exploration into the interplay between leadership behaviours and operational excellence success. While the importance of leadership commitment and support is acknowledged, the specific behaviours and practices exhibited by leaders in driving operational excellence initiatives are not extensively examined. Existing literature highlights the role of authentic leadership, transformational leadership, and servant leadership styles in fostering employee engagement, innovation, and continuous improvement according to George (2007); Avolio & Gardner (2005). However, the extent to

which these leadership styles are manifested within Rio Tinto's operational excellence context and their impact on replication outcomes remains underexplored. Further research focusing on the leadership behaviours conducive to operational excellence success within the mining industry can provide actionable insights for organizational leaders and practitioners.

Moreover, the research findings underscore the importance of strategic decision-making and resource allocation in overcoming barriers to operational excellence replication. However, there is limited discussion on the specific strategies and approaches that mining organizations like Rio Tinto can adopt to address competing priorities and ensure effective resource utilization.

Existing literature offers frameworks and models for prioritizing site programs, optimizing resource allocation, and managing organizational change (Kotter, 1996; Porter & Kramer, 2011). Yet, the application of these frameworks within the unique context of mining operations and their effectiveness in driving operational excellence replication remain relatively unexplored. Further investigation into the strategic management practices and decision-making processes within mining organizations can provide practical guidance for addressing the complex challenges associated with operational excellence replication.

In conclusion, future research endeavours in the field of operational excellence within the mining industry should focus on exploring the role of organizational culture, leadership behaviours, and strategic decision-making in driving successful replication outcomes. By addressing these gaps in the existing literature and aligning research efforts with practical industry needs, scholars can contribute to advancing theoretical understanding and informing evidence-based practices for achieving consistent operational excellence in mining organizations like Rio Tinto and beyond.

CHAPTER 6

CONCLUSION

In the pursuit of operational excellence across its global operations, Rio Tinto faces a myriad of challenges that necessitate a nuanced and people-centric approach. The interviews conducted with key stakeholders within the organization illuminated the complexities involved in deploying the Rio Tinto Safe Production System (RTSPS) on a global scale.

The study aimed to uncover obstacles inhibiting the replication of operational excellence programs at Rio Tinto, focusing on organizational culture, resource allocation, and operational complexities. These findings aligned with existing literature, strengthening the study's credibility. Additionally, a shift towards a people-centric approach emphasized the importance of operational teams in driving successful implementation, offering valuable insights into operational excellence components.

6.1 Insights from findings

Recommendations derived from the analysis suggested strategies for Rio Tinto to overcome barriers, such as fostering a unified culture and investing in employee training, aligning with existing literature on best practices. The modifications to the conceptual framework, emphasizing a people-centric approach and leadership behaviours, have significant implications for research in operational excellence.

The findings potentially have broad implications for other mining organizations grappling with similar challenges, highlighting the importance of addressing cultural differences and investing in human capital. Challenges identified in deployment align with existing literature, emphasizing the need for a balanced approach between people-centric strategies and process standardization.

Fundamental components of operational excellence, such as standardized processes, training, and strategic alignment, emerged as crucial for successful replication. Success factors included leadership commitment, strategic choices, and effective communication, echoing principles in operational excellence literature.

Further investigation is warranted into organizational culture, leadership behaviours, and strategic decision-making's impact on replication outcomes, providing actionable insights for industry practitioners. Recommendations prioritize a people-centric approach, strategic choices, communication enhancement, training, knowledge sharing, and cultural navigation to pave the way forward for operational excellence at Rio Tinto and beyond.

6.2 Recommendations

Based on the outcomes of the analysis, the following is recommended:

6.2.1 Prioritize a People-Centric Approach: Focusing on the perspectives and involvement of the workforce is crucial. This involves aligning leadership behaviours and values with the organizational strategy, investing in internal capacity, and fostering a unified organizational culture. It is also important to prioritize what is important for the execution teams and not only focus on what is important for the process.

6.2.2 Strategic choices and prioritization: The organization needs to make strategic choices to focus on specific areas of excellence rather than diluting efforts across multiple ventures. Prioritize key initiatives to maximize impact and streamline deployment efforts.

6.2.3 Enhance communication channels: Improve communication about program objectives and benefits to ensure clarity among all stakeholders. Effective communication is integral to securing employee buy-in and support.

6.2.4 Invest in training and skill development: Comprehensive training programs are essential for empowering the workforce and fostering a culture of continuous improvement. Build internal capacity to ensure proficiency in both soft skills and technical elements of the operational excellence program.

6.2.5 Facilitate knowledge sharing: Establish a centralized knowledge-sharing infrastructure to disseminate best practices, lessons learned, and standardized processes. This infrastructure should support continuous improvement and ensure a shared understanding globally.

6.2.6 Navigate cultural complexity: Tailor the program to suit the unique needs and circumstances of diverse sites within Rio Tinto. Acknowledge and address the challenges associated with cultural differences, adaptability, and competing interests.

6.2.7 Embrace change leadership: Ensure leadership commitment to fostering a conducive environment for operational excellence. Align leadership behaviours and values with the objectives of the program, emphasizing a commitment to continuous improvement.

6.2.8 Regularly assess and adapt: Periodically assess the behaviours, attitudes, and mindsets within the organization. Adapt strategies based on the lessons learned from previous attempts, ensuring continuous improvement and sustained success.

In conclusion, Rio Tinto's path to operational excellence is a journey marked by challenges, opportunities, and the continual evolution of strategies. By prioritizing a people-centric approach, making strategic choices, and fostering a culture of continuous improvement, Rio Tinto can pave the way for consistent operational excellence across its global operations. As the mining industry undergoes transformation, Rio Tinto stands poised to lead with resilience, innovation, and a commitment to excellence.

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APPENDIX A

DEVELOPMENT OF A CONCEPTUAL FRAMEWORK

The development of a conceptual framework provides a structured foundation for the formulation of research questions and the interpretation of findings. As Wengraf (2001, p. 22) aptly notes, "A conceptual framework serves as a road map for guiding the research process, helping researchers define their focus and organize their thoughts." This sentiment is echoed by other academic researchers, such as Miles and Huberman (1994, p. 18), who emphasize the importance of a conceptual framework in research by stating that "it provides a lens through which researchers can view their data, enabling them to make sense of complex phenomena." To construct a conceptual framework, researchers typically engage in a systematic process of literature review, theoretical grounding, and concept clarification. This process entails the identification of key concepts, variables, and their interrelationships, which ultimately aids in the development of hypotheses and research design. By drawing on the insights of these scholars, we can appreciate the pivotal role a well-crafted conceptual framework plays in guiding the research process and enhancing the rigor of academic inquiry.

The development of a conceptual framework is guided by a series of steps.

a) **Identifying the Research Problem:**

The research problem or topic must be clearly defined. This initial step is crucial, as highlighted by Creswell and Creswell (2017, p. 77), who underscore the importance of a well-defined research problem in qualitative research in concept development.

b) **Literature Review:**

A comprehensive literature review must be conducted, as suggested by Boote and Beile (2005, p. 3), this is done to identify existing theories, models, and relevant concepts in the field. This step helps in understanding the current state of knowledge.

c) Theoretical Grounding:

The research must be grounded in relevant theories, as advocated by Glaser and Strauss (1967, p. 27), which provides a theoretical foundation for the conceptual framework. Grounded theory, introduced by Glaser and Strauss (1967), is a understood as a systematic qualitative research methodology that aims to generate theories from data, and it can be particularly useful in the development of a conceptual framework.

I. Concept Clarification:

Key concepts and variables that are central to the research need to be defined, following the guidelines set by Corbin and Strauss (2008, p. 25) in the grounded theory approach. The process of concept clarification is characterized by coding. Initially, one would use open coding. This process involves systematically labeling and categorizing the data without imposing preconceived ideas Charmaz (2014).

II. Conceptual Map:

When open coding is complete, Charmaz (2014) recommends, axial coding. In this phase, one would identify relationships and connections between the concepts derived from the data. As this is done, one begins to develop a preliminary understanding of the relationships between key variables and concepts. The diagram to visually represents the relationships between concepts and variables. This step is inspired by Miles and Huberman (1994, p. 18), who emphasize the utility of conceptual maps in organizing thoughts and data. In the final phase of grounded theory analysis, one would need to conduct selective coding to refine the emerging theory. As one focuses on the central categories and their relationships, a preliminary conceptual framework emerges based on the patterns and connections identified in the data , Miles and Huberman (1994).

d) Hypothesis Development:

Following the process of coding, hypotheses are developed based on the relationships between variables, as suggested by Bryman and Bell (2015), to guide the empirical aspect of the research.

e) Data Collection and Analysis:

Data that aligns with the developed conceptual framework should be analyzed using the appropriate research methods, as outlined in the work of Patton (2015, p. 38) on qualitative research techniques**.**

f) Comparison:

The research outcomes are then compared with the elements of the conceptual framework. Attention goes into checking whether the data confirms or contradicts the relationships and concepts proposed in the conceptual framework. This process involves aligning the research findings with the theoretical underpinnings. The conceptual framework is continuously refined and modified as the research progresses, this is advised by Charmaz (2014, p. 4) in her constructivist grounded theory approach. This iterative process ensures that the framework remains aligned with the evolving research findings.

Result of conceptual framework.

Open coding

Successful replication of Operational excellence program.

a) Operational excellence framework chosen
   - A1) Enablers
   - A2) Foundational principles
   - A3) Link to strategy
     - Measurement of success
   - A4) Purpose of operational excellence program
     - Break through projects
     - Day to day operational impact

b) Replication
   - B1) Value to be derived
   - B2) Effort required
     - Resourcing
     - Buy in at site level
   - B3) Extent of adaptation

Location

Demographics

Prior experience with organizational change

c) Organizational structure

C1) Growth by acquisition

C2) Organic growth

APPENDIX B

AUTO GENERATED WORDLIST FROM ATLAS.ti