Evaluating continuous improvement models to enhance organisational productivity in a diamond mining operation.

Motsi Chele

Student Number: 2482147

Supervisor

Dr Robert Venter

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Abstract

Evaluating continuous improvement models to enhance organisational productivity in a diamond mining operation. The study used qualitative methods to establish an appropriate continuous improvement methodology that will assist to enhance organisational productivity. The application of continuous improvement technique to help the organisation bridge observed non-productivity was the research gap being addressed. The study identified factors that are important for organisational productivity.

The study went in details to unpack organisational productivity, internal business processes and continuous improvement methodologies. This research established the model to support the business practice.

The challenges observed during the research study required a systemic approach, strong leadership support, effective communication and a commitment to building a culture of continuous improvement within the organisation to deal with them and easy the workflow.

The research study concluded that Theory of constraints was the relevant methodology to be adopted by the organisation to deal with lack of productivity which is currently the major challenge.

It is envisaged that the nominated continuous improvement methodology would be implemented and tested to validate its capabilities to drive the organisation to an acceptable productivity level.

Keywords: Continuous Improvement, Organisational productivity, Six Sigma, Theory of constraints, Lean thinking, Management, Mining Operations

DECLARATION

I declare that this research report is my own original work and that all sources have been accurately referenced and acknowledged. It is submitted for the degree of Master of Business Administration to the University of Witwatersrand, Johannesburg. This research has not been submitted for any degree or examination at this or any other university.

Motsi Chele

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CHAPTER 1: INTRODUCTION

1. Introduction

1.1 Background of the Study

The word "productivity" was used frequently in business. Businesses work to increase output while cutting costs, getting rid of waste, and raising standards of quality and efficiency (Choomlucksana et al., 2015). To increase productivity, numerous continuous improvement approaches were used in various industries. Continuous improvement entails steady and gradual advancement, value expansion, intensification, and improvement (Singh & Singh, 2015). According to Augusto & Pacheco (2015), Theory of Constraints, Lean management, and Six Sigma highlights shared presumptions and barriers to implementation.

Lean and six sigma, respectively, are globally adopted process optimisation techniques (Snee.,2010). Similarly, it is assumed that applying theory of constraints to remove bottlenecks will improve the process' overall results as indicated by Felsner (2015).

Many process improvement approaches seem to be at odds with one another or at the very least minimise the value of other methodologies. Lean management, which is centred on streamlining processes and eliminating waste, while six sigma as a problem-solving methodology, and constraints has been evaluated in this situation (Akabzaa & Darimani,2001).

A mechanistic way against systemic comparison of the effectiveness of these techniques to transform the organisation revealed to be complex. Dynamic mining systems are better served by a systemic flow-based strategy, which is incorporated into techniques like Theory of Constraints, Six Sigma, and Lean Manufacturing (Mokonyama, 2022). Systemic flow-based principles were employed to study these areas and to compile and establish a stable and predictive environment. The systemic flow-based principles considered included the following:

➤ Systems and steps followed in each methodology by which recognised elements and parts that are dependent on each other and on the environment; dependencies can be sequential or non-sequential(Claassen, 2015).

➤ Material, information, and money flow through the system in a specific direction (Lang et al.2006).

➤ Changing properties of material, information, and money as these flow through the system to enhance organisations' productivity (Du Plooy,2022).

1.2 Research Problem

Low productivity brings challenges for the organisation to be able to meet its targets. It has been seen that suboptimal utilisation of resources leads to inability to achieve production targets effectively and efficiently. When an organisation is not meeting its objectives its business activities struggle. The research work seeks to establish and find the appropriate continuous improvement model to enhance organisational productivity.

The research output is anticipated to bridge gap in which appropriate continuous improvement model to be used that can aid in enhancing organisational productivity. Amongst Theory of constraints, Lean management and six sigma models, an investigation needs to be undertaken to identify the relevant methodology to address organisational productivity.

Theory of constraints, Lean management, and Six sigma are the three models that have been chosen to be investigated to evaluate which one will be appropriate for enhancing organisational productivity within this organisation.

Continuous improvement is approached scientifically with the Theory of Constraints (Augusto & Pacheco, 2015). Any complex system, including industrial processes, is said to be made up of a number of interconnected activities, one of which imposes constraints on the entire system (the constraint activity is referred to as the "weakest link in the chain") (Augusto & Pacheco, 2015). According to Claassen (2016), rather than

concentrating on every facet of the business, complex systems can be made simpler by identifying and managing the primary throughput drivers of the industrial value chain.

Every process has a bottleneck, and eliminating that bottleneck is the quickest and most efficient way to increase profitability. According to Bertolini (2008), the Theory of Constraints is a process for determining the most significant limitation impeding the achievement of a goal and then methodically removing that constraint (Goldratt,2009).

Motorola created the Six Sigma tools and procedures in 1986 with the goal of enhancing the quality of process outputs by reducing variability and locating and eliminating errors' root causes (Tennant, 2001). According to Goldratt (2009), the goal of six sigma is to minimize defects, cycle time, enhance throughput, and boost customer satisfaction by minimizing variance in products and processes. This definition matches well with the challenge that company must overcome.

Lean management is a straightforward method for running a company or organisation efficiently by gradually enhancing and adjusting specific operations (Goldratt,2009). This method seeks to enhance consumer value while simultaneously reducing waste. This method is referred to as "Lean" in some business circles and regions of the world (Anvari et al., 2011).

There are many continuous improvement models that have been studied and they have been explored details with a specific objective. This was to address a particular problem or enhancing business activity existing within an organisation like Vanek et al (2015) and Bessant et al (2001) has mentioned. In this case study the issue is low organisational productivity, and this study contributes to the determination of the appropriate continuous improvement model to be used to enhance organisational productivity.

1.3 Research Questions

1. What are the elements to consider in assessing organisational productivity when taking into account the theory of constraints, lean thinking and six sigma?

2. What is the potential impact of continuous improvement on internal business processes to address low productivity?

3. Which continuous improvement model is most appropriate for improving organisational productivity?

1.4 Purpose of the Study

The purpose of the study was to establish which continuous improvement model would be appropriate to address the productivity bottlenecks seen within the process workflow of the organisation being researched.

The study's findings should give the company's decision-makers the tools they need to save costs, enhance productivity by minimising process variation, eliminating waste, and removing bottlenecks within the system.

The study was carried out using semi structured interviews with the focus having been on various levels of the company, from executive management, functional managers, frontline management and supervisory level.

1.5 Delimitations of the Study

The research was company focused and gave consideration to the mining process of extracting diamonds and the value within the system to enhance organisational productivity.

The study did not consider any other continuous improvement methodologies that were not mentioned in the study. After the literature was reviewed, the focus was solely on those approaches that were not only dominant in the organisation being researched, but also found to be pertinent and supported by the literature in order to help the business attain organisational productivity.

Lastly, the notion that the existence of limits generates opportunities for advancement served as the rationale for evaluating the theory of constraints (TOC). Theory of Constraints, in contrast to common opinion, viewed limitations as beneficial rather than negative (Dyckhoff, & Souren,2022). Since a system's productivity is based on identifying its weakest points, progressively tightening those limits will increase productivity by systematically resolving the constraints. The TOC's operating philosophy provided attention to a continuous improvement process (Rahman, 1998).

1.6 Operational Definitions

- **Continuous improvement**

  Continuous improvement, sometimes called continual improvement, is the ongoing improvement of products, services, or processes through incremental and breakthrough the processes(Anand et al., 2009).

- **Theory of Constraints**

  The Theory of Constraints is an approach for determining the most significant constraint impeding the achievement of a goal and then methodically removing that limitation until it is no longer an impediment (Dettmer,1997). The restrictions were frequently referred to as a bottleneck in manufacturing. The Theory of Constraints employs a methodical strategy for development.

- **Lean Thinking/ Manufacturing**

  The Toyota Production System's guiding concepts and practices were referred to as the Lean Thinking/Manufacturing technique to eliminate waste (TPS)(Yamamoto et al., 2019). Using lean methodologies, non-value-added activity (also known as "waste") were systematically identified and eliminated(Seifullina et al., 2018). The goal of Lean Production is the prevention of defects and the elimination of waste(Felsner, 2015a).

- **Six Sigma**

  Six Sigma is a quality management approach that focused on minimising variation, processes, and services (Furterer, 2011). The objective is the reduction of deviations and cycle times for products, processes and any kind of transactions which are critical for customer satisfaction(Schroeder et al., 2008). Six Sigma was developed by Motorola in the 1980 and popularised by General Electric in 1990.

- **Throughput**

  Throughput is the number of units of output that the process can produce in each period of time in an attempt to reach organisational productivity(Leitch, 2001).

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

It was crucial to fully comprehend the effects of six sigma, lean thinking, and the theory of constraints on the business to properly advise the company about which continuous improvement program would best suit organisational productivity. Although there are several advantages to each of the chosen approaches, managers and executives must also recognise that there are numerous drawbacks, which is why it was critical to maximise the efficiency that already existed (Tenera & Pinto, 2014).

Nave (2003) had articulated the basics of the three continuous improvement methodologies and presented a model narrating the concepts, effects and comparing the essence of each methodology. George (2002), Cheng& Chang (2012), Tenera & Pinto (2014) shared the same sentiments as Nave (2003), that making efforts jointly reduces production defects and process variability hence increase productivity.

Three continuous improvement programmes selected be evaluated were, theory of constraints, lean thinking and six sigma. The theory of constraints requires the process in which the system's constraints can be identified and determination be made in which the system's constraints could be exploited. This follows subordinating everything else to the decision made and further elevating the system's constraints and repeat the cycle (Bertolini, 2008 ;Nave, 2003). The method focuses on system improvement whereby its defined within a series of interdependent processes.

Six sigma proclaim that process and business problems could be solved by focusing on reduction of variation within the process (Nave, 2003). Management often use the statistical tools to pre-empt the outcome of the process. Nonthaleerak & Hendry (2006) stated that six sigma uses two data-driven concepts being deployment approach and these are DMAIC and DFSS. The acronyms for the DMAIC entails five phases of implementation process thus Define, Measure, Analyse, Improve and Control and this application is based on the current process or an existing product and service

performance. DFSS refers to Design for Six Sigma and this concept was applied to the development a new product or process(Felsner, 2015a)

According to Gillet and Seddon (2009), the beginning must be with a goal and a clear understanding of how it can be achieved; then develop a plan for how the goal would be achieved; the plan must be implemented, and the results (both good and bad) must be observed. The analysis of these results (and our understanding of the causes) then leads us to act to modify our original plan, which returns us to the beginning of the cycle and a test to see if we had achieved the goal before restarting the wheel if necessary.

Businesses use continuous improvement programs to create a more flexible work environment, which can lead to higher performance levels and lower staff turnover rates. However, to reap these benefits, managers and employees must agree to a system that may introduce additional demands on all employees to meet performance expectations.

The following key aspects of continuous improvement programmes are evaluated:

- Benefits and Challenges of selected continuous improvement programs
    - Lean Thinking
    - Six sigma
    - Theory of Constraints
- Convergence and Divergence between lean thinking, Six sigma and Theory of constraints

The consideration of the above key elements, make it easier to motivate for or against any chosen continuous improvement programme model that would aid the company to enhance productivity.

2.2 Approaches to continuous improvement

According to an analysis of the papers covering the history of continuous improvement, the writers are really examining the evolution of "enterprise-wide continuous improvement," not the core ideas and techniques of continuous improvement, which are arguably inherent human capacities(Zangwill & Kantor, 2008).

One must go beyond the programs that have gained popularity over the past century in order to comprehend the foundations and antecedents of continual progress(Bhuiyan and Baghel, 2005). The concept of learning should be taken into account in a more comprehensive analysis of continuous improvement. Locke and Jain (1995), who contend that learning and continual development are equivalent, lend credence to this.

It would be necessary to extend the research and historical development of continuous improvement beyond the late 19th century, when the majority of the authors mentioned above started their histories of continuous improvement, in light of learning history. It is worthwhile to revisit the beginnings of learning since there are significant connections between learning and continuous improvement(Şimşit et al., 2014).

On the other hand, continual improvement might be defined as a broader idea. According to Bessant et al. (2001), continuous improvement (CI) is an organisational culture that aims to eradicate waste from all systems and processes inside a company. The process offers every organisation member a voice and does not require any cash investments. According to Anand et al. (2009), continuous improvement might result from a rapid breakthrough in technology or invention, or it can develop gradually over time. Moreover, gradual systemic enhancements culminate in substantial systemic modifications. Any amount of improvement results from techniques and tools intended to identify and minimise waste, problems, and variances (Recht & Wilderom, 1998).

Many facets of continuous improvement have been studied and explored in the past; the examination of continuous improvement evolution and history, from its humble beginnings to advanced strategies for improvement to the widely employed practices of today will be briefly undertaken and also give a summary of the research that has been done on this subject(Bessant et al., 2001).

The earliest recorded instances of continuous improvement date back to the 1800s and were implemented by the management of different enterprises as a means of promoting progress(Bhuiyan and Baghel, 2005). In the late 19th and early 20th centuries, Scientific Management became popular because it gave managers access to scientific approaches for problem-solving and analysis while handling production line issues.

The idea revolved around teaching job procedures and introducing approaches for continuous development, emphasising their value to supervisors(Zangwill & Kantor, 2008). Japanese quality control techniques were later introduced into other countries which were originally developed for manufacturing, they subsequently evolved into a comprehensive management tool for ongoing improvement involving all levels of the business (Imai, 1986).

While the present ideas of continuous improvement apply to comprehensive and organised procedures, prior approaches focused specifically on improving the work. The new approaches, which almost equate entire organizations with themselves, gave rise to the widely accepted Total Quality Management ideas, which Edward Deming popularised in Japan as well(Yamamoto et al., 2019).

Over time, the organisations required large scale continuous improvement, this led to development of continuous improvement technologies that were based on process and quality improvement so that the quality is improved, production line is simplified, and waste reduced(Anand et al., 2009).

2.3 Lean thinking

The emphasis of this methodology is on process optimisation, the identification and elimination of non-value activities, and the creation of value for stakeholders (Dias et al., 2019).

Womack, Jones, and Roos (1992)’s study is where the term "lean" first appeared. The authors analysed the factors that led to Japanese automakers' startling advantages in productivity and quality: doubling the output with a halving of the effort (Felsner, 2015).

Lean Production Management (LPM) was the name given to these programs. Several industries, including those in manufacturing and production, as well as others, adopted

the lean mindset to cut waste and boost productivity(Yu & Sun, 2019).The prevention of defects and the removal of waste were the two main objectives of lean production(Singh et al., 2010).In order to integrate process chains with internal and external customer-supplier relationships, it is required to design processes, identify process owners, and summarize these processes(Dias et al., 2019).

The process control and defect-free quality are the responsibility of each process owner(Shah & Ward, 2007). Lean structures involve re-orienting processes like business re-engineering, reduce inventory and buffers to give customers the right amount at the right place at the right time(Uriarte et al., 2020).

According to certain academics (Rene, 2018; Shah et al, 2017; Sundareshan, Swamy & Nanjundeswara, 2015), a variety of lean management strategies and techniques have been applied to increase customer satisfaction. JIT, VSM, Jidoka, 5S, Heijunka, Kaizen, and Kanban are popular lean management strategies that organizations can apply to enhance their services.

Table 1: Showing comparative analysis of lean management tools

Source: Lawal & Elegunde (2020, p,27)

Tools	Description	Outcome	Application
Just In Time(JIT)	Pull parts through manufacturing based on customer request instead of pushing parts through manufacturing based on projected request.	Highly effective in reducing inventory levels. Improves cash flow and reduces space requirements.	Singh, Rajdeep, Jaskanwal & Sukhvir (2013) the study revealed that JIT play an importunate role in better functioning of supply chain management. The lean manufacturing principle used are: JIT inventory, JIT production, JIT human resource, JIT quality and JIT supply relation.
Value Stream Mapping(VSM)	A tool used to visually map the flow of production and it also shows the current and future state of processes in way that highlights opportunities for improvement.	Exposes waste in the current processes and provides a roadmap to improve the future state.	Gbedebo, Peter & Tiamiyu (2018) evaluated the adoption of lean technique for waste elimination through VSM. Series of VSP techniques were used such as 5s, Kanban pull system, supermarket pull system, SMED kaizen idea sheet. The results showed that production lead time was massively reduced from 34.4 hours to 5.04 hours with a 85.3% waste reduction.
Jidoka	Design equipment to partially automate the plant during manufacturing process and to automatically stop the plant immediately when defects are detected. It is much less expensive than the full automation	Workers can frequently monitor different stations (reducing labour costs) and many problems can be detected immediately (improving quality).	Muhmut, Murat, Mehmet, Ozdul & Ertugrul (2019) viewed that business have had to use sustainable flexible production methods and techniques which quality focused, cost-effective and the least wasteful in order to meet customer demand expection. Successful results were obtained regarding the applied jidoka and SMED techniques.
5S	Sort, Set in order, Shine, Standandise and Sustain.	It eradicates waste that comes from a poorly organised environment (e.g delaying work by looking for appropriate tool).	Fanny, Y. F (2014) pointed out the information about 5S lean ways to implement it in health care setting. Results shown that 5S can be applied to health care services with beneficial effects.

Heijunka	A kind of production scheduling that meant for producing smaller batches by sequencing product variants within the same process.	Reduces lead time (since each product is manufactured more frequently) and inventory (since batches are smaller).	Imam, Muhammad, Hizka & Toto (2018) they observed that company's current production system has not been in balance because production demand and production planning always change. Heijunka principle was applied to fundamentally remove the mura, muri and muda. The findings process and design the TPS based on the principle of heijunka to improve the productivity of human labour.
Kaizen	A strategy where employees work together proactively to achieve regular, incremental improvements in the production process.	Combines the collective talents of a company to create an engine for continually eliminating waste from production processes.	Omotayo & Kulatung (2017) they demonstrated of how kaizen which is continuous improvement in thework place can be implemented using busiess process modelling and notation. The findings of this study focused on the perception towards change, post-project reviews, openness to new ideas and innovation.
Kanban	Method of controlling the flow of product within the organisation and with outside suppliers and customers.	Elimination of waste from inventory and over production.	Muhammad, Jouni & Markku (2013) research was conducted in order to analyze the current trend of Kanban usage in software development and to identify the benefits and involved challenges. The findings of their work are intended for helping researchers and practitioners to gain the application of Kanban usage in terms of improving lead time, quality, communication and coordination, increase consistency of delivery and decreased customers reported defects.

Lean draws sequentially since the feature is not supposed to start producing until the resource downstream signal (Kanban) is received(Augusto & Pacheco, 2015). The purpose of pulling is to synchronize the neck with market demand, encourage the release of material into the system, and foster the search of perfection. According to Goldratt (1984), constant improvement is the only way a business can succeed after a change.

Since "value" serves as the foundation for Lean thinking, it is important to first distinguish between activities that provide value and those that don't in a process. The non-value-added processes in a Lean system should be minimized while the value-added

processes should be strengthened. Detailed analysis was carried out to determine the "waste" in those activities in order to reduce the resources and efforts associated to non-value-added processes(Yu & Sun, 2019).

Five fundamental principles, which are illustrated below, form the foundation of another often-used methodology in the lean philosophy. Each of those ideas will be thoroughly explained, along with how they relate to one another. The "five principles of Lean" technique provides an example for the design, development, operation, and administration of a production or business process. The use of this method was consistently applied to reap the rewards of the Lean concept, which has been shown to be highly effective in practice(Ade & Deshpande, 2012).

These five principles include:

Specifying value: This principle's main goal is to develop a clear grasp of customers' demands. The analysis of consumer needs can be used to determine the actions that produce or add value to the finished goods or services.

Identifying value stream: This principle's main goal is to stop non-value-added activities. This may be recorded by carefully examining each operation and work procedure to see if they improve the final goods or services from the customers' points of view. Resources and efforts devoted to tasks that don't add value need to be limited or drastically cut back. For instance, quickly cease any improper production, prevent overproduction, excessive material transportation, minimize inventory, and eliminate needless waiting.

Flow: The entire supply chain is the focus of this approach, which emphasizes process flow rather than final goods or services in order to ensure a continuous workflow and value generation chain in the process (Aziz & Hafez, 2013).

Pull: In contrast to typical mass production or push systems, pull systems place a greater emphasis on making and delivering the proper quantity of products at the appropriate time in order to meet consumer requests. One of the best examples of a pull production system is the flexible manufacturing system. The main goal of the pull system is to offer more responsiveness to consumer requests, which are highly unpredictable

and challenging to predict with any degree of accuracy (Vedpuriswar, 2014). Pull systems also reduce waste from overproduction by balancing production and demand, which is another benefit.

Perfection: Based on the four main tenets of the Lean concept, perfection seeks to maximize value creation for customers through continuous improvement and strives towards perfection(Aziz & Hafez, 2013). From the lowest to the highest levels of a Lean company, every single person whether they are top managers or lower-level staff members contributes to excellence (Yu & Sun, 2019).

Through the growth of the lean philosophy over the past 70 years, it has emerged as one of the most significant techniques and solutions for many operational difficulties in a wide range of industries, including production, service, logistics, healthcare, Mining and public sectors. Businesses of all sizes, from large corporations to small and medium-sized businesses, have widely adopted the Lean philosophy and methodologies over the years in order to eliminate waste of non-value-added activities and continuously improve their overall performance. (Singh et al., 2010).

The next portion of this section briefly discusses the advantages of the Lean philosophy.

Advantages of the Lean Philosophy and methodology can be used to assist businesses or organizations in reviewing their business operations to decrease waste, unnecessary costs, and expenses while increasing productivity and efficiency. The adoption of Lean methodology and philosophy is crucial for a variety of reasons. These include the following:

- By carefully examining each individual process or activity, the Lean mindset and methodology may be used to pinpoint problem areas and system bottlenecks.
- The workflow of a system can be enhanced, and complex business processes can be greatly simplified by implementing the Lean mindset and practices.
- Lean philosophy divides activities into two categories: value added and non value-added activities. The focus of the lean philosophy is on reducing waste associated with non-value add operations to improve corporate efficiency(Ferrin et al., 2011).

Lean philosophy, on the other hand, boosts earnings by cutting every tiny expenditure, and the money saved is simply added to the profits.

- The lean mindset and practices can assist businesses and organisations in more satisfactorily satisfying consumer needs. The goal of the lean mindset and methodology is to offer customers high-quality goods or services at fair prices. The delivery of goods or services at the proper time, in the proper amount, and to the proper location is also a priority (Jon et al, 2000).
- One of the most significant advantages of the Lean philosophy is often considered to be respect for people. People are viewed as the most valuable resource in a lean business and are always given top attention. Thinking and creativity were promoted to foster a better and more creative working environment. According to Jon et al (2000), Lean workers were appreciated more for their thoughts than their hands. it was stressed in a lean organisation to establish a clean, safe, and enjoyable working environment to enhance employee happiness because happy employees can contribute more to the ongoing advancement of the business(Felsner, 2015a).

2.3 Six Sigma

Six Sigma is a project management methodology that incorporates tried-and-true components of quality control. Reducing cycle durations and variations for processes, goods, and transactions of any kind that are vital to customer satisfaction is the goal; it also contributes to raising the degree of usage and efficiency of all input factors. The statistical criteria and objectives that define the Six Sigma concept have evolved into a new quality management philosophy and are now a crucial part of corporate management(Felsner, 2015a).

Six-Sigma was first created by Motorola officials in the late 1980s, and it was in 1995 when General Electric used the methodology in its strategy (Tennant, 2001). Six-Sigma is a "business technique used to improve business profitability, to improve the effectiveness and efficiency of all activities to meet or exceed customer needs and expectations," Knowles(2012,p.8).When it was first implemented in manufacturing operations, it quickly spread to other functional areas like marketing, engineering,

procurement, services, and administrative support as businesses realized its advantages, particularly when they connected Six sigma implementation with financial returns and cost reduction(Knowles, 2011).

According to Santos and Martins (2010), quality management has grown in importance in terms of measuring, quantitative methodologies, specialised teams, and well stated performance goals. As a result, Six Sigma is being employed in a larger context as a recognised method to enhance corporate performance.

Several Six Sigma components are already well-known from other management systems(Felsner, 2015a). The planned quality level of 3.4 defects per one million chances (DPMO), which applies a Gaussian distribution with specification restrictions based on the 6σ-level, ensures that a quality level of 99.99966% is guaranteed for all processes(Knowles, 2011). By using a Gaussian distribution with specification limitations based on the 6-σ-level, all processes must be guaranteed to have a quality level of 99.99966%. If the specified levels are exceeded, a defect arises. As a result, the characteristics should have a tiny scatter, as shown by their standard deviation σ around the mean or expectation μ. Put differently, all features must fall within the specification bounds and be separated from the mean value by 6 σ in order to get high quality. greater sigma levels correspond to greater quality levels, smaller tolerance ranges, and fewer allowable flaws. A problem occurs if the levels exceed the requirements (Felsner, 2015a).

Therefore, this suggests that the characteristics' standard deviation, which measures how widely apart they are from the mean or expectation μ, should be low. In other words, at a distance of 6σ to the mean value, all features should fall within the specification boundaries in order to attain good quality(De Mast & Bisgaard, 2007).

The greater the sigma level, the narrower the tolerance range, and the lower the allowable number of defects, the higher the quality level. Whether the goal is to enhance currently available items or to enhance brand-new products, the concept can be categorized. In the first instance, the DMAIC method used to analyse and improve customer satisfaction in a "backwards-oriented" manner(Rusu, 2016).

Design for Six Sigma is the application of Six Sigma throughout the development phase. The process optimisation is the key component of Six Sigma. The interfaces between the processes were also impacted in addition to the actual process. The opportunity for improvement was particularly great at these interactions. As a result, the origin and quantity of Six Sigma actors depend on both their functions and the cross-functional activities that must be handled(De Koning & De Mast, 2006).

2.3.1 Sigma-level demonstrated through key figures.

The actors must, as a first step, specify the parameters and key figures as explained to be the Sigma-level, in order to analyse the process quality in depth and pinpoint the reasons for deviations(Schroeder et al., 2008). Six Sigma focuses on the concept of defects per million opportunities (DPMO). It uses the standard normal distribution as its measurement system. From the standard normal distribution, the mean is μ and the standard deviation is denoted by σ. A measuring device that ensured a sufficient level of measurement accuracy is thus a prerequisite. The number of potential flaws was calculated using the Defects Per Million Opportunities (DPMO) calculation before the production process was developed. The sites were gauged using the Opportunities for Defects (OFD)(Schroeder et al., 2008).

Whilst the Parts Per Million (PPM) is the estimated number of flaws that have occurred, defects per million (DPM) are the number of problems that are possible. Only when a process or product has just one feature will DPMO and PPM be identical. When a product is made in numerous steps, the actual number of flaws is typically more than the number of defects that actually occur and are counted.

When the number of opportunities is taken into consideration, the DPMO is always smaller than the PPM; as a result, the PPM is a more dire indicator of inadequate quality. Nonetheless, the DPMO is frequently employed to compare and assess the level of quality of intricate operations. A conversion table can be used to calculate the Sigma-level after computing the DPMO. Continuous features, like cycle duration, are monitored and evaluated by comparison with a normal distribution, while the DPMO only focuses on discrete characteristics (Töpfer, 2003, 2004, 2007).

For measuring continuous attributes, process capability indices that also consider the mean value and the scatter are used. Process Variation Index Cp and Process Capability Index Cpk are two quality indicators that assess the efficacy of a processing step. With relation to the tolerance range, Cp describes the consistency or size of the distribution. Regarding the tolerance range, Cpk pinpoints the position of the distribution or scatter while the Cpk decreases, signifying a decline. Such changes are often anticipated in practice (see Figure 2). Because of this, the Six Sigma criterion has been changed to include the nominal distribution around such shifts. A Sigma value of 6 yields a probability value of 99.9999998% and a DPMO of 0.002 when no shifting is used. The probability value is 99.99966% and the DPMO is 3.4 on the assumption that the location has been moved by 1.5 Sigma to the left and right. Hence, when looking at the big picture, the 6 notion is a 4.5 σ concept.

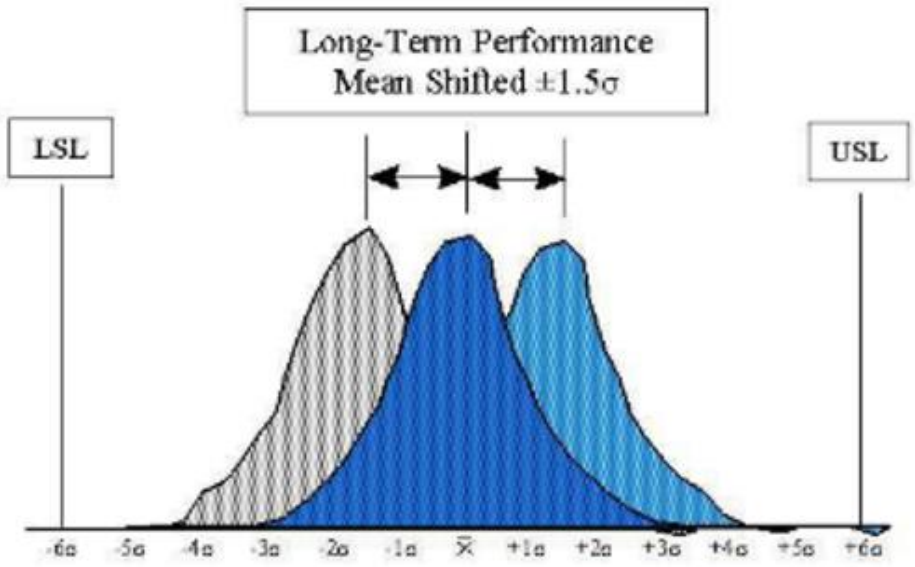

Figure 1: Long -term performance for a single process (Shifted 1.5 σ)

Source: (Aldowaisan et al.,2015).

2.3.2 Projects Selection on basis of Six Sigma

Many selection criteria for Six Sigma initiatives can be discovered in the literature. Töpfer (2003, 2004, 2007) provides a summary of the ones that have been successfully applied. It is important for Six Sigma projects to be realistic and controllable in terms of budget,

schedule, and scope. They ought to have a precise description of the issue, quantifiable goals, and reasonable expectations(Knowles, 2011). The project should boost consumer advantages while simultaneously generating profit for the business as evaluated by a Net Benefit analysis. To be able to measure and analyse them, all pertinent variables and parameters must be found. A high likelihood of success must meet a set of requirements. A clear and exact aim and project definition must also be created.

Six Sigma projects should not last longer than three months after the launch phase. The business also considers the potential harm that could result from a process or product failing to reach the Six Sigma level. The more expensive the consequences of poor quality, the harder it will be to achieve the Six Sigma level. Hence, Six Sigma will be the focus in sensible processes and products, such as software for medical diagnosis or satellite technology for aviation(Töpfer, 2003).

2.3.3 Principles of Design for Six Sigma (DFSS)

A poor product design and an insufficient development process can have significant effects on the overall costs since during the development stage, 5% of the effective costs affect 70% of the entire expenses(Banerjee et al., 2020). While a robust design serves as the foundation for robust processes and products and it also serves as the beginning point for development stage enhancements(Jenab et al., 2018). In this instance, "robust" refers to both high reliability of the underlying business procedures and a low probability of failure throughout the product life cycle(Mazur, 2003). Six sigma initiatives in many businesses have demonstrated that it is possible to reach a Sigma level of 4 or 5 in as little as 2 to 3 years, however getting a quality level above 5 is significantly more challenging(Schroeder et al., 2008).

While Six Sigma initiatives concentrate on streamlining processes, Design for Six Sigma projects concentrate on the development of materials or parts(Mazur, 2003). By removing failures both internally at the business and externally at the customer during the use phase, DFSS assists in reducing the number of Six Sigma projects throughout the value chain(Felsner, 2015a).

According to Felsner (2015), Design for Six Sigma projects adhere to a standardized process based on the PDCA cycle, just like Six Sigma projects. The DMADV cycle (Define,

Measure, Analyse, Design, Verify) is the name of this process; the methodologies and tools stated in the cycle's description will be discussed in the paragraphs that follow.

2.3.3.1 Define Phase

The project is defined during this phase, along with its goals and connections to other processes. The project charter has been created, and the project team has been established (Felsner, 2015b).

2.3.3.2 Measure Phase

After the project has been defined, it is vital to determine the demands of the client and to assess the performance of the present process using internal and external benchmarking. Through Quality Function Deployment (QFD), the customer needs are subsequently converted from Critical to Quality Characteristics (CTQs)(Engineering, 2019).

2.3.3.3 Analyse Phase

The examination of alternative product and process designs is a part of the DFSS's analyse phase(Banerjee et al., 2020). A High-Level Design is created based on the CTQs and then reviewed via customer feedback and the use of FMEA (Failure Mode and Effects Analysis) to assess potential hazards(Ferrin et al., 2011).

2.3.3.4 Design Phase

The design of the product or process is specified in order to create a solid design that satisfies the needs of the customer(Jenab et al., 2018). Using a statistical design of experiments makes it easier to combine input variables and take CTQs into account(Ferrin et al., 2011).

2.3.3.4 Verify Phase

Improvements are introduced in day-to-day operations once the performance of the newly designed product or process is monitored in a test phase. In the end, statistical process control is used to continually control the process capabilities(Felsner, 2015b).

2.3.4 The application of Six Sigma in the Mining Sector

Six Sigma is project-based and can increase productivity by identifying and resolving the underlying causes of process variability(Dunstan et al., 2006). Since 2003, Six Sigma programs have helped Rio Tinto Aluminium achieve gains estimated to be worth about A$25 million annually(Kesek et al., 2019).

Rio Tinto Aluminium introduced Six Sigma business improvement program to achieve continuous improvement activities at a workplace level(Graafmans et al., 2021). The rigour and discipline to Six Sigma in its application is every day and for everyone, everywhere in the workplace(Knowles, 2011). It is a valuable management tool. In a short time, the results achieved were good and sometimes spectacular in always improving productivity and efficiency. Six Sigma is a management tool that helps operations learn or re-learn fundamental skills more quickly, more methodically, and over an extended period(Anand et al., 2009). This strategy works especially effectively for companies with a highly educated and skilled workforce since it gives employees the chance to directly improve the company and feel good about it(Bayou & de Korvin, 2008). Improvement is nearly guaranteed when workers at all levels are so focused(Schroeder et al., 2008).

2.3.4 Service Sector applying Six Sigma

Six Sigma initiatives can also be used to improve service operations; however, these are more difficult than manufacturing processes Chakrabarty & Chuan Tan 2007). Phases and sub-steps in the value chain are more difficult to define and measure in service processes, such as those found in call centres or technical support departments Nakhai & Neves,2009). This makes it more difficult to apply statistical tools and to standardize anything.

A fully defined and instrumented process control that includes Six Sigma activities is the prerequisite for implementing Six Sigma in service processes. A five-step process is advised. First, the business strategy is used to determine the desired standards, which describe the desired quality level, such as answering the phone no later than three rings (Knowles, 2011). The external client needs, which are discovered by VOC analysis, are then contrasted with the internal standards. In order to control the adherence to the standards, it is now possible to create measurement parameters for each phase of the process; nevertheless, this necessitates the definition of criteria, meaningful measurement contents, and measurement sites at client interfaces(Yu & Sun, 2019).

2.4 Theory of Constraints

The Theory of Constraints (TOC) is a management philosophy that aims to enhance system performance by identifying and addressing the weakest links in the chain(Şimşit et al., 2014). Regardless of whether they operate in the production or service sector, companies need to prioritise understanding their internal processes to remain competitive in a global market. TOC serves as a crucial methodology for problem structuring and solving, altering managers' thinking patterns(Zangwill & Kantor, 2008). Since its introduction by Goldratt in the novel The Goal in 1984, TOC has garnered significant attention from both industry practitioners and academic researchers(Şimşit et al., 2014).

In his business book "The Goal," he examined the idea of a system restriction that impedes growth and profitability of a company(Goldratt & Cox, 1992). The manufacturing theory of managing inventory take time serves as the foundation for "The Goal's" theory. The weakest link or longest time in a series of manufacturing procedures needs to be eliminated to address bottlenecks and speed up production; this is a continual cycle(Felsner, 2015b). Goldratt extended this idea to the corporate setting(Zangwill & Kantor, 2008). Businesses are viewed in TOC as systems rather than as a collection of activities; these systems include company rules, business processes, and the complete eco-system, which includes consumers, suppliers, competitors, distribution routes, and governmental regulations (Goldratt,2009).

Business executives frequently struggle to concentrate on the correct objectives, according to Goldratt (2004). If management, for instance, prioritizes cost-cutting over enhancing "throughput," problem-solving will demand a different mindset(Dias et al., 2019). The goal is to identify the constraint and use TOC planning to overcome it (Pettibone, 2006).

TOC is a system of continuous improvement that aims to improve and control the performance of system constraints in a global context, not just locally. In TOC, the system is the primary focus, with the leverage points (constraints) coming first, followed by all system components that have an impact on how the leverage points function. When it comes to equipment, materials, or resources, constraints may be physical.

Nevertheless, when they are brought on by the market, management policy, roles, standards, or measures, they may be political(Dias et al., 2019).

The TOC has developed from the production planning technology to a system of management tools that combines the fields of logistics, production, project management, finances, accounting, performance assessment, distribution and supply chain, marketing, sales, and issue solving (Schleier, 2010).

Research has recently been done to analyse the TOC's evolution. By examining operations management, Boyd and Gupta (2004) examined the TOC's scope and came to the following four conclusions. First, the pursuit of the goal from a global viewpoint is more consistent with the new paradigm in Operations Management offered by the TOC, which substitutes an antiquated consensus to aim to achieve efficiency in the organization. Second, the TOC provides methods for operational decision-making that can optimize business operations. Third, the TOC offers a framework of criteria for operations management, but further empirical research is required to confirm its applicability in real-world situations. Fourth, the TOC is now starting to be debated and analysed with an eye toward becoming a legitimate theory in the field of operations management because of the evolution and expansion of its scope throughout time. This finding suggests the necessity for further investigation connecting it to other pertinent and related subjects, such as the Six Sigma methodology(Pacheco, 2014).

The TOC's adoption enhances results, which in turn enhances organizational productivity, as concluded by Pacheco (2014). As a result, the TOC's operational level effects are felt the most, indicating that operational and organizational results could be the focus of metrics related to the TOC's effectiveness (Pacheco, 2014).

2.5. Convergence and Divergence between Lean, Six Sigma and Theory of Constraints

The analysis of how Lean, Theory of Constraints, and Six Sigma approaches differ and overlap when applied in manufacturing settings for ongoing improvement(Diego, 2015). The current discussion is about how various organizations use the aforementioned

approaches to focus on continuous improvement, and generally speaking, these approaches have reached their performance ceiling in terms of the current competitiveness and approaches to provide integrated models of continuous improvement(Augusto & Pacheco, 2015). A comparative study was conducted between TOC, Lean, and Six Sigma about the research possibilities and constraints of integration in order to achieve continuous improvement, according to the literature review in the databases reviewed(Diego, 2015).

2.5.1 Theory of Constraints (TOC) and Lean

Computational simulation studies comparing JIT, now known as Lean, with TOC (2008) were conducted by Miltenburg (1997), Chakaravorty and Atwater (1996), Cook (1994), and Watson and Patti (1995). Miltenburg (1997) asserts that while JIT operates with less inventory and shorter lead times, TOC generates superior productivity. Chakaravorty and Atwater (1996) discovered that TOC is appropriate for systems with relatively high levels of variability and downtime (product not being accessible), in contrast to JIT, which is better for lowering system variability and downtime. Cook (1994) concluded that JIT was not as effective as TOC and that almost all of the unpredictability in the system would need to be eliminated in order for JIT to be as effective as TOC. When JIT and TOC are used together, as opposed to when they are used separately, performance can be higher, according to Sale and Inman's 2003 research. According to Patti and Watson (2008), for the same productivity, TOC requires on average 50% less inventory than JIT and is more tolerant of fluctuation. It also has shorter lead times. This data is based on a strategy that prioritises managing production bottlenecks rather than managing all of the resources of the productive system equally(Pettibone, 2006).

Antunes (1998) and (Pacheco et al., 2019) identified the following as the main points of convergence in the logistics approach: (i) the need for synchronization of production and the establishment of a systematic process of continuous improvement; (ii) the existence of specific techniques for addressing the problem of synchronization, such as the logic Drum-Buffer-Rope (DBR) for TOC and Kanban for lean production; and (iii) both are concerned with the improvement of Productive Systems continuously. Based on the analysis that was already done in Step 1 of the TOC, this appears in Step 4 (raise the

capacity of limitation) (identify constraints). Dettmer (2001) asserts that TOC and Lean philosophy evolved into a systemic vision and proposes that a hybrid of the two methodologies is more reliable, productive, and simple to execute, with the primary factor being the choice of model components.

2.5.2 Theory of Constraints (TOC) and Six Sigma

The five concentrating steps of the TOC, according to Husby (2007), can close this gap. The author does, however, draw attention to the fact that the terminology used in the thinking process of TOC analysis and troubleshooting calls for sophisticated intellectual advice from knowledgeable professionals as well as a different strategy for management and operators. According to Jin et al. (2009), although Six Sigma and TOC have different mindsets, both have been applied to process optimization across a variety of industries because, unlike Six Sigma, which calls for in-depth solutions, TOC can identify bottlenecks and help prevent them.

The main benefits of combining the two methods, according to Jin et al. (2009), are that (i) the restriction is analysed, measured, and controlled by a set of statistical tools, increasing the understanding of the issue and decisions; (ii) the bottleneck is the first point to be analysed, resulting in increased financial gain for the company; and (iii) the Six Sigma project will not be chosen by a single business area but by the overall view that the TOC will take.

Jin et al. (2009) list the following drawbacks of variation reduction: (i) it is not always the case that it will increase constraint capacity; (ii) when it increases the production rate of the bottleneck, downstream processes may experience higher rates of rejection because the focus was solely placed on the neck; and (iii) there is uncertainty when applying the principles of TOC and then the six sigma design, or vice versa. The Jin et al. (2009) integration model of Six Sigma and TOC assumes that there is a limited budget for improvements and that Six Sigma is applied to post-bottleneck resources in order to ensure quality and efficiency. This model has been successfully implemented in a motor manufacturing business.

This model has been successfully implemented in a motor manufacturing business. According to Ehie and Sheu (2005), there are parallels between the Six Sigma (DMAIC) and TOC improvement procedures. The initial stage of identifying constraints is the same for both ways in the integrated model the authors suggested. The following step uses the TOC's ability to leverage the measure and analyse Six Sigma stages as support to proceed according to its rationale.

2.5.3 Lean and Six Sigma

There is a limit to integration of lean and six sigma because the approach taken to improve depends on the issue that needs to be resolved; consequently, alignment between the two strategies is necessary to produce effective results (Banuelas and Antony, 2004). According to Sharma (2003), Lean implementation efforts should be accelerated through the utilization of Six Sigma. According to Bendell (2006), achieving balance involves creating value from the perspective of the client in order to concentrate on the market, while at the same time bringing down the variety to reasonable levels and cutting expenses. According to Bendell (2006), the two paradigms can be a potent tool for aligning with the cultural facets of Lean Six Sigma initiatives and are change accelerators.

Lean and Six Sigma integration offers tremendous promise for lasting organizational change and process improvement (Bendell, 2006). Snee (2010) claims that Six Sigma is often utilized to resolve complex issues for which there is no recognized solution. It is critical to keep in mind that the objective is to identify the causes of the poor performance rather than merely concentrating on the symptoms. In this situation, the implementation of Six Sigma and the simultaneous application of techniques is supported by the perspective of lean flow.

Snee (2010) outlined eight crucial characteristics that improve performance when Lean and Six Sigma are used in concert: Their projects are completed quickly, there is a clear definition of success, the human infrastructure (belts) created, the focus on customers and processes is increased, and they use a statistical approach. They also produce financial results, engage top leadership, use a disciplined approach (DMAIC), and use a

disciplined approach (DMAIC). According to Montgomery (2010), the DMAIC technique can be used to manage lean improvement projects.

Montgomery (2010) advocates the usage of Six Sigma and Lean as a model that encapsulates the Deming system of deep knowledge and the idea of continuous improvement. Higgins (2005) draws a distinction between the two methodologies, claiming that while Lean engages all organizational levels in training to find and eliminate non-value-added operations, Six Sigma is managed by a small group of highly specialized employees. In addition, Arnheiter and Maleyeff (2005) highlight the differences between the two approaches: Six Sigma firms require a broader systems approach that takes into account the full effects of waste on the system, whereas Lean firms should adopt the use of quantitative data to make decisions and a more scientific approach to assess the quality within the system.

According to Bendell (2006), Lean and Six Sigma philosophies have lost their effectiveness due to a lack of clarity, and frequently offered methodologies are put together without a rational justification or theoretical underpinning for the selection of techniques. By implementing Lean and Six Sigma, practitioners can find a variety of initiatives with insufficient returns for the time required to complete them, according to Spector and West (2006). The following conclusions appear to follow from the aforementioned considerations: (i) the two approaches complement one another, making it possible to evaluate how well they integrate; and (ii) integration, project management, and corporate strategy must all be in line with one another to prevent having separate systems. (iii) It was also noted that specialized tools necessary to fully utilize Lean's potential in relation to the complexity of the problem under investigation will be absent if it is done individually. According to this, the performance of an improvement project is jeopardized if a Six Sigma project is carried out without a systemic vision of lean.

As a result, in order to fulfil the primary goal of this study, which is to investigate the points of convergence and divergence between the three approaches from the perspective of continuous operational improvement and to deepen our understanding of their underlying principles. The knowledge of the comparative techniques was thought

to be based on these principles, which helped academics and practitioners alike(Diego, 2015). (Zangwill & Kantor, 2008)(Bhuiyan and Baghel, 2005)(Şimşit et al., 2014)(Bessant et al., 2001)(Bhuiyan and Baghel, 2005)(Zangwill & Kantor, 2008)(Yamamoto et al., 2019)(Anand et al., 2009)

2.6 Organisational productivity

Productivity is a central concept in economics and management and there are several theoretical frameworks that underpin the study of productivity (Kengatharan,2019). Some of the key theoretical backgrounds of productivity include:

Production function theory, this theory is based on the idea that the output of an organisation is a function of the inputs used in the production process. This theory helps to understand how changes in inputs affect output and how organisations can improve productivity by optimising the input mix (Klump, et al.,2012).

Resource-based view theory suggests that an organisation's competitiveness and productivity are determined by the resources and capabilities it possesses (Taher,2012). According to this theory, if an organisation has valuable, rare, inimitable, and non-substitutable resources, it is likely to outperform its competitors and achieve high levels of productivity (Barney,2001).

Organisational productivity is a key concept in management theory and refers to the efficiency with which an organisation can produce goods or services (Moletsane et al.,2019). Several theories underscore organisational productivity, including:

Contingency theory, this theory speculates that there is no one-size-fits-all approach to managing organisational productivity. Instead, the most effective management practices will vary depending on the specific circumstances and environment in which the organisation operates (Donaldson,2006).

Systems theory, Systems theory views an organisation as a complex, interconnected system in which various elements such as employees, processes, and technologies work together to achieve common goals (Johnson et al.,1964). According to this theory, improving organisational productivity requires a holistic approach that considers the interrelationships between these different elements (Skyttner,2005).

Total quality management is a management approach that focuses on continuously improving the quality of products and services in order to increase organisational productivity (Dale et al,.2001). This theory is supported by the argument made that the performance gains of organisations using quality management practices such as TQM lend credence to the conclusion that there is a link with competitive advantage(Reed et al., 2000).

Productivity is one of the primary sources of economic growth and competitiveness. At an organisational level, productivity measures the efficiency of a company's production process.

2.6.1Types of Productivity Measures

2.6.1.1 Labour Productivity

Production per worker or per hour worked is referred to as labour productivity. Workforce skills, technological development, managerial strategies, and adjustments to other inputs are all factors that may affect labour productivity such as capital.

2.6.1.2 Total Factor Productivity

Numerous factors have an impact on a country's productivity. These include advancements in supply chain logistics, innovation, the purchase of new machinery and equipment, as well as education, enterprise, and competitiveness. The Solow residual, also known as total factor productivity, calculates the percentage of output growth in an economy that cannot be accounted for by the accumulation of capital and labour.

2.6.1.3 Capital Productivity

To calculate capital productivity, liabilities are removed from physical capital. The difference is then added to the sales total. A greater capital productivity number demonstrates the effective use of physical capital in producing goods and services, whereas a lower capital productivity number demonstrates the inefficient use of physical capital.

2.6.1.4 Material Productivity

When productivity is measured in terms of materials, the output is compared to the materials used. Heat, fuel, or chemicals are examples of materials used to produce a good or service. It looks at the amount of output generated for each unit of input.

2.6.2 The four elements related to theory of constraints for organisational productivity

2.6.2.1 Production capacity-

The amount of ore that can be mined and processed at a certain rate. Theory of constraints tries to boost production capacity by locating and addressing bottlenecks in the process value chain, such as ineffective mining operations, equipment breakdowns, and subpar maintenance procedures.

2.6.2.2 Cycle time-

How long it takes to complete a mining cycle, including drilling, blasting, excavation, hauling, and processing before the final product is extracted.

2.6.2.3 Inventory-

The amount of raw material, work-in-progress and finished product that are stored in the mine and processing plant. Theory of seeks to reduce inventory by identifying and addressing the bottlenecks in the system that cause excess inventory by Implementing just in time (JIT) inventory management techniques.

2.6.2.4 Operating expenses –

the costs of labour, energy, maintenance, and overhead associated with mining and processing. The theory of constraints tries to lower operational costs by removing waste and non-value-added activities and by optimizing resource use to boost productivity and efficiency.

2.7 Interrelation of organisational productivity and continuous improvement

Increasing organizational productivity requires continuous improvement, which is crucial. Finding and removing process waste, bottlenecks, and inefficiencies is the main goal of continuous improvement(Diego,2015). Streamlining operations can help businesses deliver goods and services more effectively, increase productivity, and cut expenses(Zangwill & Kantor, 2008).

By lowering flaws, faults or variances and removing process bottlenecks, methodologies such as Theory of constraints, six sigma and Lean thinking seek to increase the quality of

goods and services(Diego, 2015). Increased market share, enhanced reputation, and greater customer satisfaction result from this (Anderson et al,.1994).

Organizations that practice continuous improvement are more likely to accept innovation and adjust to shifting market conditions (Jay,2013). Organisations may maintain their competitiveness in ever-changing surroundings by cultivating a culture of learning, experimentation and innovation (Dervitsiotis,1998).

2.8 Conclusion

In conclusion, the enhancement of organizational productivity in several aspects such as stakeholder satisfaction, loyalty, profitability, efficiency, effectiveness, productivity, quality, innovation, learning, adaptation, and organizational culture necessitates constant development(Erol et al., 2011).

Organizations can attain sustainable growth and a competitive edge in the ever-changing business landscape of today by adopting continuous improvement approaches and cultivating a culture of innovation and learning. Continuous improvement has a significant impact on organizational productivity and raises competitiveness, effectiveness, and efficiency(Bessant et al., 2001). Organizations can succeed over the long term in the fast-paced business climate of today by adopting a continuous improvement culture and funding organized improvement projects.

CHAPTER 3 - RESEARCH METHODOLOGY

3.1 Introduction

Pathak et al. (2013) define scientific research as the discovery of solutions to recognized problems. According to the authors, there are numerous approaches to data collecting and analysis, including qualitative and quantitative research. The paradigm is well stated as a method for how a researcher should study and answer their research questions in the works of Saunders, Lewis, and Thornhill (2003). There are different types of research: quantitative research and qualitative research and mixed methods (Saunders et al., 2003).

Pathak et al. (2013) define qualitative research as a humanistic method to better understanding people's ideas, attitudes, behavioural nuances, and interactions found in non-numerical data. When compared to quantitative research, qualitative research has the advantage of allowing the participant's voice to flow in and share experiences in a more informal setting (Pathak et al., 2013).

The methodology used to evaluate a continuous improvement model to improve organizational productivity in a diamond mining operation is described in this chapter. The study focused on measuring and collecting data using a qualitative technique. The interview questions will be utilized as a research instrument. This chapter describes all significant steps in the research process as well as the methods used. Collecting data, analysing it with appropriate methods, and interpreting the results to answer multiple research questions is the foundation of research (Neville, 2007).

3.2 Research Paradigm

A research paradigm is a conceptual framework that forms the foundation of the study. It offers a framework of presumptions and understandings that serve as the foundation for the research study's ideas and methodologies. A research paradigm is composed of ontology, epistemology, and research methodology (Benton & Craib, 2010). The nature of social reality, scientific cognition, and useful methods for carrying out social research were all examined from a variety of perspectives within the confines of fundamental philosophical presumptions. The presentation of two categories of social science

paradigms with attention to qualitative research is a significant component of the work (Benton & Craib, 2010).

The interpretivist paradigm is deemed appropriate for the investigation based on the research questions and the nature of the study. According to Alharahsheh and Pius (2020), reality is subjective, multiple, and socially produced. That is, there can only grasp someone's reality by their experience of it, which may differ from another person's according to the persons' historical or societal perspectives. Questioning and observation are used in interpretive techniques to find or produce a rich and deep understanding of the subject under investigation(Lan, 2018).

3.3 Research Approach

A research technique is the approach used by the researcher to collect, analyse, and interpret data(Kumar,2011.) Qualitative research describes variation in a phenomenon, situation, or issue. Qualitative data includes interview notes, focus group transcripts, open-ended responses, video transcripts, online product reviews, news reports, and responses to open-ended queries. The initial stage of data analysis is data reduction through coding and categorizing (Jain,2021).

The research methodology used in this study is qualitative research. A knowledge that is difficult to obtain from a closed question survey is provided by qualitative investigations(Beech, 2000).

This strategy was chosen to evaluate a continuous improvement model to increase organizational productivity in a diamond mining operation because it enabled participants to openly share their experiences, opinions, and feelings without restriction. According to Anderson et al. (2014), qualitative approaches provide a dynamic approach to research that allows the researcher to follow up on respondents' responses in real time and spark meaningful discussion about a topic.

3.4 Research Design

Sekaran and Bougie (2016) defined a research design as a blueprint or plan for gathering, measuring, and analysing data to answer research questions. Kumar (2011) defined research design as "a plan, structure, and strategy of investigation devised to obtain answers to research questions or problems."

The study is a case focused qualitative research and is directed on one organisation where the intend is to explore which continuous improvement methodologies that can enhance organisational productivity (Yin,2009).

An in-depth analysis of a single person, organization, or particular situation is the goal of case study research. In order to provide a thorough understanding of the situation and to draw conclusions that can have wider ramifications (Yin,2009).. The researcher gathered data from the employees of the organisation whom they were the participants in the study.

3.5 Data Collection and Analysis

3.5.1 Approach and Method

For this study, qualitative data has been gathered. A series of in-depth, semi-structured interviews with individual respondents was carried out. All of the respondents are workers of the company, but in different departments that are actively involved in production; some are in project management, sustainability, engineering, and finance and procurement.

This method of study seeks to investigate respondents' varying points of view regarding a certain topic (Boyce & Neale, 2006). Interviews with individuals in senior positions, front-line managers, and interested parties regarding organizational productivity were to be conducted. An attempt was made to involve a variety of employees with varying backgrounds in the search for ways to improve organizational productivity, in order to ensure that the research's findings could address all facets of organizational productivity.

One benefit of doing in-depth interviews is that the data acquired can be far more detailed than that gathered through surveys. Respondents can voice their opinions and interact with ideas through the use of open-ended questions (Boyce & Neale, 2006).

A drawback of this data collection strategy is that participant's honesty and willingness to share knowledge are key factors that determine the validity and value of the information obtained in in-depth semi-structured interviews (Boyce & Neale, 2006).

3.5.2 Population and Sample

The sample consisted of those organisation's employees who are active in the organisations' day to day operations with different roles from senior management and frontline managers and supervisors. The research was conducted over twelve respondents who were targeted due to their knowledge and experience in the activities of the company.

A purposive, non-probability sampling technique was used for this research report. Respondents were not selected randomly but based on their knowledge and possible insight on the subject (Ishak et al., 2014). Purposive sampling necessitates the use of personal judgment to select cases that answer research questions and aid in the achievement of research objectives. Purposive sampling approaches, according to Maree and Pietersen (2010), are utilized in unique instances where sampling is done for a specific purpose. The purpose of this study was to enhance organizational productivity by assessing which continuous improvement model could be recommended.

Table 2; The table shows number of respondents and their departments

	Respondent	Department	Rationale
Employees	1	Sustainability and Support Services	The department within the organisation responsible for the well-being of employees. They also provide guidance to the environmental compliance within which the organisation is operating from to make sure the operational activities are undertaken responsibly.
	2		
	3	Finance	This is the department within the organisation that handles all functions related to the company's financial well-being. The also manage IT related activities to make sure external risks are managed.
	4		
	5		
	6	Production	This is the functional core of the business whereby beneficiation take place, and the output must meet customer satisfactory level.
	7		
	8	Planning	Asset care and maintenance of the plant equipment is managed and controlled within this department. Further enhancement projects for productivity are planned in the area.
	9		
	10	Engineering	When the planning department had scheduled activities, they execute and make sure that the processing plant is operating optimally.
	11		
	12		
Total Number of Respondents = 12			

3.5.3 Research Instruments

The interview schedule was designed around the three themes explored in the literature review on continuous improvement models being Theory of constraints, Six sigma and Lean thinking, organisational productivity. The interview started with a broad question designed to open up the discussion but still keep the conversation within the scope of the research. The intention was to encourage respondents to provide input from their perspectives. The questions were designed as prompts to generate ideas around the themes and to allow people with experience and skills in their field to propose possible solutions or direction to the issues that the questions pose. The more difficult questions around continuous improvement models were asked later in the interview sequence. The Interview ended with a general question allowing the respondent to add any information that they felt was relevant to the research report that may not have been raised by the questions.

While some respondents had explicit expertise with the concepts of continuous models and the organizational productivity framework, others did not. Therefore, in order to enable the respondents to voice their opinions in regard to the themes selected, the interview schedule's questions were modified to accommodate those who needed further background information. In order to ensure that there was a shared understanding regarding the topic of the research, respondents who were unfamiliar with the words were given a clear explanation of continuous improvement models and organizational productivity.

The interview schedule follows the structure of the sample key stakeholder Interview guide proposed by Boyce and Neale (2006). Refer to **APPENDIX B: RESEARCH INSTRUMENT- Semi Structured interview**.

3.6 Data Collection

Twelve interviews with representatives of the organization's various departments were done. A pilot interview was done to test the format of the questions asked during the initial interview. The saturation threshold at which respondents repeat the same information served as a guide for determining the "sufficient" number of interviews (Boyce & Neale, 2006).

Open-ended questions were used in the interview structure to encourage respondents to discuss the topic more candidly. Every interview attempt was made to keep the duration to no more than one hour.

3.7 Data Analysis

Qualitative data analysis is the process of organizing, analysing, and interpreting qualitative data non-numeric, conceptual information and user feedback to capture themes and patterns, answer research questions and identify actions to take to improve the system (Ponelis & Shana, 2015).

Qualitative research yields mainly unstructured text-based data (Wong,2008). These textual data could be interviewing transcripts, observation notes, diary entries, or medical and nursing records (Seers,2012). In some cases, qualitative data can also include pictorial display, audio or video clips (audio and visual recordings of patients, radiology film, and surgery videos) or other multimedia materials.

The process of analysing qualitative data predominantly involves coding and categorising data. Basically, it involves making sense of huge amounts of data by reducing the volume of raw information, followed by identifying significant patterns, and finally drawing meaning from data and subsequently building a logical chain of evidence (Ruona,2005).

Coding or categorising the data is the most important stage in the qualitative data analysis process (Creswell & Poth, 2021). Coding and data analysis are not synonymous, though coding is a crucial aspect of the qualitative data analysis process. The data in this research will be based on thematic analysis.

Thematic analysis allows for either a theoretical or an inductive approach to analysis. This analysis followed a theoretical approach as a specific research question has been proposed. Themes were identified at an explicit level using an essentialist/realist approach (Braun & Clarke, 2006).

3.8 Quality Assurance

Leedy and Ormond (2010) explained validity through two fundamental questions: Firstly, does the study have enough control to ensure that the data indeed justify the conclusions

drawn? Secondly, can the researcher use the collected data to generalise to the population?. It encompasses quality, rigour, trustworthiness, and appropriateness of the method adopted to answer the research questions.

3.8.1 Dependability

The researcher verified the consistency of the findings by being consistent in interpreting and analysing the data. To establish the consistency and credibility of the findings, the researcher enlisted the help of other researchers in the data analysis. This technique will also include comparing the outcomes to verify they are comparable to improve consistency and dependability.

3.8.2 Confirmability

Confirmability is concerned with the researcher's objectivity in relation to the findings in order to minimise biases. The researchers promise that they recorded everything that happened and did during the study to confirm the impartiality and neutrality of the findings. As one of the approaches to assure confirmability, the researchers retained the audit trail (survey response transcripts) through data analysis and interpretation. The researchers cleansed the data through a coding and theme process to improve and ensure the correctness and objectivity of the study and its findings.

3.8.3 Transferability

Transferability is based on the applicability of the findings to other people and periods. The sample size was administered through literature review with in-depth and specialised knowledge of research studies; therefore, the sample size is a representative. The study will be transferable for as long as the scope of work is that same and could be repeated.

3.8.4 Credibility

The researcher conducted a qualitative study using a semi structured interview as part of the research technique. To avoid boredom or diminished personnel participation, the researcher took cognisance of the length and duration of the interview. As a result, the interview was brief and quick to complete to keep employees interested and engaged while creating a response report.

3.9 Ethical Considerations

Each and every interview response has been kept private and confidential. The study report does not reveal the data's source, and none of the information contained identified the responder.

Respondents were asked for their informed permission. Respondents were informed of the goal of the study and had their consent to participate in the interview verified. Refer to **APPENDIX D: PARTICIPANT INFORMATION SHEET**. As part of the interview procedure, respondents were also asked to attest to their agreement to the interview being recorded. Refer to **APPENDIX C: CONSENT FORM TEMPLATE**

The consent form described the nature of the research and how participation in the study affected or benefited the participants. The researchers considered that no personal information was required in the research instruments, which generally ensured that the participants remain anonymous.

Ethical clearance was granted by the Wits Business School Postgraduate Committee to proceed with this study. Refer to **APPENDIX A: ETHICS CLEARANCE CERTIFICATE**

It was crucial to ensure that the integrity of the data collected was maintained and protected. The researcher had ensured that this study's data collection process was done ethically. The data collected had been stored in a secure place to which only the researcher has access.

3.10 Limitations

The extent of the research was limited by the number participants who could take part in the research within an organisation. Interviews were only conducted with respondents employed in the organisation.

3.11 Conclusion

The guidelines for the qualitative research case study were undertaken to provide surety that the study consider all relevant elements on the research methods. All key additional information has been recognised and acknowledged on how the study was conducted.

CHAPTER 4 – FINDINGS FROM INTERVIEWS

4.1 Introduction

This chapter discusses the research findings gathered from the employee interviews. After being coded, the interview data items were compiled into developing sub-themes that complemented each of the study question themes.

The main concepts that surfaced for every study topic are shown in the sections that follow.

4.2 Organisational Productivity

This section looks at the respondents' views on what constitutes organisational productivity by considering the contribution coded of organisation 's resources, following up on the trend of productivity across different departments, evaluating the importance of performance metrics and reviewing the challenges of the current processes and systems.

4.2.1 Organisations' Resources

Most respondents talked about the need to approach each department within the organisation with the view to understand the level of resource allocation being capital, labour, or material. It was very clear that for the objectives to be met there has to be some trade and balancing on the resources deployment to achieve the mandate. To make sure that there is a smooth transition from one step of the value chain to another, example from drilling and blasting activities to load and haul, the areas to be drilled and blasted must be clearly identified and prepared. Then load and haul must make sure that trucks are available to move the ore from the mining pit to the processing plant area. One important factor that was highlighted was to make sure that material was not just drilled and blasted but should meet the fragmentation requirements, so the that processing plant does not encounter obstacles in processing.

So, for diamond extraction, the respondents have clearly articulated that competent and skilled human capital is required to drive optimal process with minimal losses along the processing treatment line.

4.2.2 Trend of productivity across different departments

The organisation has various departments, and they are all expected to work as a system. It was noted that some departments performed better than others and while others decimally under-performed. The underperformance has been a result of lack of clarity in roles and responsibility hence the respondents indicated that adoption of the continuous improvement methodologies will aid in improving the productivity in the organisation.

The respondents have indicated that some departments are forever over budget while other are struggling to keep up with the requirement to feed into the next stage of processing and sorting.

4.2.3 Performance Metrics

The respondents have emphasised the need to establish the performance metrics and roll-out of the job description to curb ambiguity on what each individual is expected to do and how. The performance metrics will give direction of measure of key performance indicators. Furthermore, respondents indicated that it will not be a secret to people that there are standards to be followed within the operations if the company has to be successful.

In every organisation accountability is paramount for success. The respondents showed that if they company could apply penalties clauses to employees and sub-contractors that do not meet the targets, then there might be a high level of diligence on business matters.

4.2.4 Challenges of current processes and systems

Lack of employee's engagement or and inclusive culture within the organisation brings about demoralised staff. The respondents showed that because the staff is not engaged on the issues within the organisation it appears as if people lack discipline while the people are confused and there is not clear direction from management.

Table 3: Organisational productivity - Coded interview extracts

Theme: Organisational Productivity			
Respondent	Interview Extract	Code	Theme
1	*'The mining teams, specifically drilling and the load and haul, they need to be provided with tools and machinery to perform their duties.'*	Resources	Organisational Productivity
10	*'Resource management has many functions like planning, managing, allocating, and scheduling to mention a few, such resources could include materials, technologies, skills, people, finance.'*		
3	*'The organization needs a good resource management strategy to improve productivity and maximize efficiency.'*		
6	*'Measuring productivity within the company in different departments gives an opportunity to make operational changes either with employees or equipment.'*	Trend of productivity across different departments	
7	*'With the current assessment done, it showed that amongst the company sub-divisions or departments, it was clear that it is only 17% productivity level that could be seen.'*		
11	*'Amongst other factors to be considered for organisational productivity the monitoring of performance metrics is very crucial.'*	Performance Metrics	
1	*'It is very important to indicate that when an organisation have a clear strategy with a well-rounded operational model, it is easy to work towards measurable key performance indicators.'*		
2	*'It is evident that there is lack of general employee engagement therefore that creates hindrance to progress.'*	Challenges of current processes and systems	
4	*'Many employees are not involved in the performance management process due to a lack of recognition or compensation for their work and rewards associated.'*		
9	*'The other issue which came out strong was that old employees are not willing to embrace and adopt new ways of dealing with problems and find alternatives to solve problems.'*		

4.3 The potential impact of continuous improvement on internal business processes

A sequence of events that occur inside an organisation to accomplish particular objectives without the assistance of outside partners is known as an internal business process. In order to complete daily activities and pinpoint opportunities for development, certain procedures are essential.

The efficiency of a company is correlated with internal business process measurements. What we must excel at is a critical question that these metrics aid in answering. Enterprises acknowledge the significance of these efficiency initiatives for their sustained prosperity.

Making problems visible. Obviously, if management cannot spotlight a problem at the real time, nobody can solve it correctly. If these complaints are not noted for management attention in real time, they will increase further, causing real damage to the business. Where visual management is practiced, such abnormalities can be made visible to management as soon as they arise and handled effectively in real time.

Staying in touch with reality. When process performance is made transparent, usually through documented performance that is, clear display of lists, records of performance, production figures and recurrent problems, workers and managers stay in direct contact with the developments in the workplace to keep in touch with reality. Overall, this keeps processes under control and sends early warning signals as soon as an abnormality arises.

4.3.1 Positive upliftment of organisational productivity

The respondents showed that if employees' development could be embraced, the four measures of productivity could appropriately be measured that is capital productivity, labour productivity, material productivity and total factor productivity. All these different measures of productivity have a potential to bring about a positive upliftment with the organisation as long as the company operates as a system with the same goals and objectives.

4.3.2 Objectives are clearly defined

Objectives should be understandable, measurable, achievable, and feasible. Program objectives must be clearly stated and include at least three components thus an acceptable outcome level which indicates amount of change that is expected. A quantitative indication of effectiveness and the achievement of results and benefits. The circumstances under which the objectives will be performed.

if objectives are clearly defined it is easy to increase efficiency, increase quality and reduce costs and wastage because there will not be any repeat jobs hence the above is achievable.

4.3.3 Operating model

An operating model is both an abstract and visual representation of how an organisation delivers value to its customers or beneficiaries as well as how can it actually runs itself. This operating model drives value creation and strategy execution across an organisation and it represents the guiding principles of operations.

The respondents recognised that there has to be synergy between the people, systems and processes in order to deliver the mandate to the shareholders. This operating model must be structured in a way the is achieving the aims and is managed and governed to the details where an assessment could easily be made of how well it is working.

Table 4: Internal business processes - Coded interview extracts

Theme: Internal business processes			
Respondent	Interview Extract	Code	Theme
7	*'Continuous improvement is essential for organisations, as it can lead to increased production and better revenue gains'*	Positive upliftment of organisational productivity.	Internal Business Processes
10	*'.... improved quality and reliability of processes, reduce costs and waste and to a great extend enhance efficiency .'*		
1	*'For business processes to be improved, there must be a determined and unwavering commitment.'*		
6	*'if objectives are clearly defined it is easy to increase efficiency, increase quality and reduce costs.'*	Objectives are clearly defined.	
2	*'Commitment to excellence should extend beyond singular initiatives and become part of the organisation's ethos.'*		
2	*'Roles and responsibilities are not clear when looking across an organisation's departments.'*	Operating model	
4	*'Distinct understanding of each person's role as well as the connections and interactions required to support organizational goals.'*		
9	*'It represents the guiding principles of operations: how different department of a business should work together to deliver value to shareholders and stakeholders.'*		
8	*'Finds a competitive edge by searching for alignment along the whole value chain.'*		
1	*'People, Processes, Partners and Platforms, each plays a pivotal role in reshaping the way business operate and stay competitive.'*		

4.4 Continuous improvement models focused on the diamond mining operation

Sustainable production can only be attained if the mining and treatment of our mineral resources are executed in an effective and efficient manner. This could be achieved using mine planning, asset management and diamond value management systems.

A focus on continuous improvement is to ensure for safe and efficient operations. The aim is to ensure responsible and sustainable production from our orebodies while maximising the life of mining operations.

In response to the question in which of Theory of Constraints, Lean thinking, and Six Sigma, could be appropriate continuous improvement model for improving organisational productivity.

4.4.1 Theory of constraints

Theory of constraints manages constraints and generates gains. The respondents have acknowledged that for the organisation to see progress there has to place an emphasis speed and volume, detailed analysis of the existing systems and make sure the interdependence between the processes does not have create any bottlenecks.

Respondents noted that Theory of constraints has side effects such as reduction in inventories and this could have a negative impact on the organisation due to the location of the operations. Inventory is needed to facilitate the production although this is against the principle of theory of constraints where inventory has to be minimised.

4.4.2 Six sigma

The respondents are aware that six sigma is mainly for reduction of variability. Since this methodology requires statistical tools to be effective that calls for highly skilled and competence personnel. The improvements in the rate of output of the system could be seen mostly be reduction of the variation within processes. The major contribution of six sigma success demands a clear organisational structure with experts' improvement, projects and guided quantification of cost reductions.

4.4.3 Lean thinking

The reduction of waste increases business performance and as noted by the respondents several small improvements are better than the overall analysis of the system. It was also noted that the respondents were aware that lean thinking methodology can generate uniform process output and improve quality and productivity.

Knowledge is shared as a reduction of losses and is the responsibility of each and every employee.

Table 5: Continuous improvement models - Coded interview extracts

Theme: Continuous Improvement Models			
Respondent	Interview Extract	Code	Theme
10	*'For the current challenges of the company, they could be addressed through theory of constraints methodology.'*	Theory of constraints	Continuous Improvement models
5	*'Ways in which theory of constraints could be applied in a diamond mining production environment is to identify the critical constraints in the mining process, such as equipment availability, processing capacity, or logistical constraints.'*		
8	*'Improving maintenance schedules, increasing equipment utilization and streamlining processes are implementable strategies to optimise the performance.'*		
4	*'Investing in additional resources, technology and training would increase capacity and improve performance which will ultimately yield positive upliftment within the organisation.'*		
11	*'By applying theory of constraints principles, this diamond mining operation can streamline its operations, reduce waste, and improve overall productivity in a sustainable manner. The production targets will be met more efficiently and effective while maximizing utilisation of resources.'*		
6	*'A production environment is bound to have some variation and as a result the issues could potentially be dealt with through application of six sigma.'*	Six Sigma	
12	*'By focusing on identifying and eliminating defects in processes this could lead to improved efficiency and productivity.'*		

9	*'Since six Sigma relies on data and statistical analysis to make informed decisions about process improvements it is worth focusing on implementing it.'*		
2	*'By aligning processes with customer needs, the company can deliver products more efficiently, leading to higher customer satisfaction and loyalty.'*		
1	*'Engaging employees in problem-solving and decision-making processes can lead to increased motivation, ownership, and productivity. Six Sigma encourages employee involvement in process improvement initiatives.'*		
2	*'The organisation must focus on maximizing value for customers while minimizing waste in processes.'*	Lean thinking	
7	*'By identifying and eliminating activities that do not add value to the final product would significantly enhance productivity.'*		
5	*'... it has been indicated that Lean thinking encourages employee's involvement and empowerment, enabling them to identify and solve problems themselves.'*		
8	*'Creating a conducive work environment led to increased productivity and boost morale which ultimately give sense of ownership.'*		

4.5 Conclusion

The results of the interviews emphasise that in order for an organisation to improve productivity through continuous improvement models, it is essential to not only focus on streamlining processes and removing bottlenecks, but also to take a comprehensive approach to clarifying roles and responsibilities. Additionally, there should be an emphasis on developing skills to facilitate cooperation, collaboration and teamwork among different stakeholders. The success of the project lies in utilising the skills and capabilities of these stakeholders to achieve common goals that benefit the organisation.

CHAPTER 5 – DISCUSSIONS

5.1 Introduction

The research study focused on evaluating continuous improvement models to enhance organisational productivity in a diamond mining operation. The predominantly evaluated methodologies were six sigma, lean thinking and theory constraints. As described in the literature, six sigma focuses on reduction of variation which solves process and business problems. Through a rigid and structured investigation methods the process elements are more understood, and this led to the assumption that the outcome of the entire process will be improved by reducing the variation of the multiple elements (Therond, 1995).

Lean thinking resulted from the Toyota production system, and it simply focused on the removal of waste which is defined as anything not necessary to produce the product or service. This methodology made the assumptions that people value the visual effect of flow and believe waste is the main restriction to profitability. The transitioning to flow thinking caused a vast change in how employees perceived their roles in the organisation and their relationship to the product.

Theory of constraints is the methodology that is focused on systems improvement. An analogy for the system is a group of interdependent links working together toward the overall goal. Then the constraint is a weak link between the interdependent links. Theory of constraints operates under the assumption that the current processes are essential to produce the desired output. The organisations with hierarchical and centralised knowledge value this approach.

5.2 The elements to consider in assessing organisational productivity considering the theory of constraints, lean thinking and six sigma

"What are the elements to consider in assessing organisational productivity considering the theory of constraints, lean thinking and six sigma?" Organisational Resources are paramount to the success of the company. It was very clear that for the objectives to be met has to consider some trade-off and balancing on the resources deployment to

achieve the mandate. To make sure that there is a smooth transition from one step of the value chain to another. It was demonstrated by the philosophy of lean thinking which embraced the removal of waste or any other step in the process which do not add value.

Tracking productivity across different departments made it easy to identify some of the issues within the organisation and therefore indicating which relevant methodology could be applicable to enhance productivity. The organisation has various departments, and they are all expected to work as a system hence the theory of constraints philosophy. It was noted that some departments performed better than others and while others decimally under-performed.

In all methodologies investigated, it was apparent the performance metrics are very crucial, and they are the variables to measure and track performance. Although each methodology has its own key performance indicators, they could all present a way to improve the organisational productivity.

5.3 The potential impact of continuous improvement on internal business processes to address low productivity

"What is the potential impact of continuous improvement on internal business processes to address low productivity?" The efficiency of a company is correlated with internal business process measurements. What we must excel at is a critical question that these metrics assist in answering. Enterprises acknowledge the significance of these efficiency initiatives for their sustained prosperity.

Making problems visible. Obviously, if management cannot spotlight a problem in real time, nobody can solve it correctly. If these complaints are not noted for management attention in real time, they will increase further, causing real damage to the business. Where visual management is practiced, such abnormalities can be made visible to management as soon as they arise and handled effectively in real time.

Staying in touch with reality. When process performance is made transparent, usually through documented performance that is, clear display of lists, records of performance, production figures and recurrent problems, workers and managers stay in direct contact

with the developments in the workplace to keep in touch with reality. Overall, this keeps processes under control and sends early warning signals as soon as an abnormality arises.

During research the author discovered some strongholds, which are actually derived from challenges. It seems that strategic factors treated as challenges need a decent strategy, so these issues can be solved. Case study research supports this observation well, for example if employees clearly understand their mandate, it is easy to drive the processes leading to an organisational performance upliftment.

Company's intention was to understand continuous improvement activities for all departments inside the company this will give support to those that have weaknesses. As shown in research chapter, the company allocated suitable amount of time and resources to support better workflow inter-departmentally.

5.4 Continuous improvement model most appropriate for enhancing organisational productivity

"Which continuous improvement model is most appropriate for improving organisational productivity?" Amongst, the three continuous improvement methodologies investigated in this case study, theory of constraints became the most appropriate model for enhancing organisational productivity. The processes within the diamond mining operation include drill and blasting, load and hauling ore, processing of the ore and final recovery of the diamonds.

Based on the theoretical application of theory of constraints, it was discovered that there was a weak link between certain core process value chain, and this could be addressed by adopting and implementing this methodology.

The theory of constraints (TOC) is an effective management philosophy for identifying and suggesting practical solutions to business problems (Gupta & Kerrick, 2014). Pacheco (2014) articulated that TOC could deliver positive outcomes such as increased profits, reduced inventory levels and operating expenses, and improved organisational performance.

Analysis of convergence between TOC, Lean thinking and Six sigma

In order to continuously improve the processes in production systems, this study attempted to examine the sites of convergence between Theory of constraints, Lean thinking, and Six sigma. By conducting a comparative examination of certain crucial features, the debate also attempted to aid in improving comprehension of the fundamental ideas behind such techniques. It was discovered after the analysis that the goals of analysing the points of convergence and exclusion between the three approaches and helping to improve comprehension of its core concepts had been achieved. In general, it was discovered that there are more areas of overlap than exclusion across the three techniques, therefore it is viable to consider building an integrated continuous process improvement system to boost competitiveness.

There are important variables that must be considered when building models by fusing the three techniques; otherwise, the development of a holistic model will lose its power. The literature still lacks a precise definition of the following elements, which are among the most important ones: The corporation must clearly declare what is their top priority: reducing variability or reducing losses or improving the flow or removing constraints? (i) How to choose the correct components of each method based on the organization's actual needs.(ii) a lack of study on this subject was revealed by the accurate diagnosis of the organization's culture, aims, strengths, and limitations, which should also be taken into account as a component of the integration of the three techniques,(iii) The building blocks of a model using such methods must necessarily be in line with the strategy and objectives of the organisation.

There are several benefits of this model, and they could be realised once it has been put to practice.

5.5 Conclusion

Continuous process improvement is fundamental for the organisation in mining operations industry to perform effectively and achieve sustainable growth (Bellin, 2016). Organisation with effective continuous improvement can make cohesive and quick process to improve competitive advantage, performance, and success (Ussahawanitchakit, 2017). Achieving the expected goals of continuous improvement requires senior leaders to engage employees to sustain the initiatives. Employees are the most valuable assets of organisation, yet managers find it difficult to engage and retain talented employees.

By providing foundational training to employees on the modelled continuous improvement framework, leaders may create continuous improvement behaviour. Creating an environment of continuous improvement requires leaders with transformational leadership skills. A transformational leader can articulate an appealing vision and paint a desirable future (Hassan et al., 2015) and create an organisational of sustainable continuous improvement.

CHAPTER 6 – CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

In a process full of bottlenecks, the theory of constraints (TOC) would be the most recommended model for enhancing organizational productivity as the driving force in continuous improvement program. The Theory of constraints is a management paradigm that focuses on identifying and improving the limiting factor in a system, known as the constraint. By addressing constraints and optimizing the flow of work through the system, Theory of constraints helps organizations improve overall productivity and efficiency.

In a process with bottlenecks, Six Sigma and Lean Thinking can also be beneficial in improving productivity, but they may not directly address the root causes of bottlenecks. Six Sigma focuses on reducing variation and improving quality, while Lean Thinking aims to eliminate waste and streamline processes. While these methodologies can help improve certain aspects of the process, they may not necessarily address the specific bottleneck and causes that are hindering productivity.

Therefore, Theory of Constraints would be the most recommended model for enhancing organizational productivity as it directly targets the constraint and helps optimize the workflow through the system.

It will also be more practical if it could be implemented when there is a clear operating model for the organisation so that that employees are not confused. Working documents such as policies, procedures and control philosophy must align with the long-term strategic vision to achieve organisational productivity.

6.2 Summary of results

On the outcomes of engagements and analysis of information gathered from the interviews, the organisation must adopt and formalise the implementation of continuous improvement methodology. This will assist in a structured way to manage the business and empower employees to benchmark against the best practices in the industry. Theory of constraints is a much more relevant continuous improvement methodology to address the challenges the organisation is facing.

Enhancement of skills and competencies will increase organisational productivity on the basis that, labour productivity, capital productivity and material productivity are all cohered to deliver a better total factor productivity.

The structured internal business processes have clearly indicated that if they are coordinated diligently an increase in productivity would be realised.

6.3 Recommendations

Even though we have seen ample research work being done on the distinct continuous improvement techniques and there has been development of quite a few tools that can be used for evaluating continuous improvement effectiveness, yet there is no knowledge of research work being conducted on designing a guideline or framework that would enable an organisation to select the most appropriate continuous improvement technique suitable for the organisation, within the budgetary constraints. Hence, mechanisms for determining which continuous improvement technique would be appropriate for an organisation needs to be studied at length with different scenarios. The specific tools and methodology required for successful implementation of the selected continuous improvement techniques should also be able to be identified by this mechanism.

6.4 Limitations

Although the study has been carried out, there were only twelve participants that could take part in the research as it is a company focused study. The extent of the research was limited by a small and non-representative sample, and this resulted in a non-replicable and less likely to generalise to the other settings as a whole.

6.5 Suggestions for further research

The research carried out so far has generated ideas for a number of further research areas. In particular, further studies are required to execute implementation of the continuous improvement methodologies that can quantify an upliftment on organisational productivity.

Secondly, an in-depth analysis of the internal business processes also required to be investigated. Improving internal business processes has the potential to speed up the journey towards accomplishing organisations goals. Having a clear set of goals, making the necessary changes and keeping track of progress would be easier to realise the improvements. However, poorly designed internal business processes could lead to chaos where it's difficult to manage or understand tasks, ultimately wasting time and resources.

Finally, because the work is undertaken be people who have expectation of rewards and recognition, the organisational strategy would need to be reviewed to consider and recognise the high-performance teams or individuals.

6.6 Conclusion

Some aspects of organisational productivity such as employee morale, organisational culture are intangible and challenging to measure accurately. Addressing these challenges will require a systemic approach, strong leadership support and effective communication and a commitment to building a culture of continuous improvement within the organisation

When building models by merging the three continuous improvement techniques, there are important considerations that need to be made; otherwise, the construction of a holistic model would become weaker. There is still a lack of clarity in the literature regarding the following primary key factors: The company must clearly define its priorities, which include reducing variability, reducing losses, improving flow, and removing constraints. Additionally, an accurate diagnosis of the organisation's goals, culture, and strengths and weaknesses must be taken into account as part of the integration.

It is envisaged that the nominated continuous improvement methodology would be implemented and tested to validate its capabilities to drive the organisation to a higher productivity level.

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APPENDIX A: ETHICS CLEARANCE CERTIFICATE

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School

Wits Business School Ethics Committee
Constituted under the University Human Research Ethics Committee (Non-Medical)

Ethics Clearance Certificate

Ethics protocol number: WBS/BA2482147/594
This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

This certificate is only valid if accompanied by formal permission from the relevant stakeholder(s).

Project title	Evaluating continuous improvement models to enhance organisational productivity in a diamond mining operation
Investigator / Researcher	Mr Motsi John Chele
Nature of Project	MBA (Research Article)
Decision of the Committee	Approved, provided stakeholders and participants are guaranteed confidentialty.
Issue Date of Certificate	9/11/2023
Expiry date	Date of submission of the project / research report
Chairperson	Dr Pius Oba ☎ +27 11 717 3976 +27 82 733 6587 pius.oba@wits.ac.za

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Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Ethics Committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I undertake to resubmit the protocol to the Committee.

MJ Chele
Signature

14/11/2023
Date:

APPENDIX B: RESEARCH INSTRUMENT- Semi Structured interview

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

University of the Witwatersrand,
Wits Business School, 2 St David's Place, Parktown 2193

Annexure B: Research Instrument- Semi-Structure Interview

1. Of Theory of Constraints, Lean thinking, and Six Sigma, which continuous improvement model is most appropriate for improving organisational productivity?

1.1 What do you think are the biggest opportunities for improvement in the organisation?

1.2 What do you think are the key competencies and skills that employees need to develop to support continuous improvement?

1.3 What will you consider as the appropriate continuous improvement model to enhance organisational productivity in the Company, amongst theory of constraints, six sigma and leant thinking?

1.4 Can you describe a time when you suggested a productivity improvement that was successfully implemented? What did you learn from that experience?

2.What are the elements to consider in assessing organisational productivity.

2.1 In your experience, what are the biggest obstacles to achieving high levels of productivity in the organisation?

2.2 Have you noticed any patterns or trends in terms of productivity across different departments or teams in the organisation? What do you think are the underlying causes of these patterns?

2.3 In your opinion, what are the most important performance metrics for evaluating organisational productivity?

2.4 How would you rate the effectiveness of the current processes and systems in supporting productivity in line with continuous improvement? What changes would you suggest?

3.What is the potential impact of continuous improvement on internal business processes?

3.1 In your experience, what are the most common sources of errors of delays in the current processes?

3.2 What do you think are the most important areas for us to focus on in terms of improving organisational productivity?

3.3 What changes needs to be implemented to refocus the trajectory of organisational productivity for Company?

APPENDIX C: CONSENT FORM TEMPLATE

University of the Witwatersrand,
Wits Business School,
2 St David's Place,
Parktown 2193

Title of project: Evaluating continuous improvement models to enhance organisational productivity in a diamond mining operation.

I, ……., agree to participate in this research project.

I agree to the following:

(Please circle the relevant options below)

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study	YES	NO
I agree that the interview/focus group/other activity may be audio recorded.	YES	NO
I agree that direct quotations from my interview/focus group/other activity may be used by the researcher in their research report.	YES	NO
I agree that my participation will remain anonymous (my name or other identifying data will not be used by the researcher in their research report/manuscript/book chapter)	YES	NO
I agree that other researchers may use the information I provide in my interview/focus group/other activity (depending on their own ethics clearance being obtained) but my name and any personal information will not be used or passed on	YES	NO

…… (signature)
…… (name of participant)
…… (date)

APPENDIX D: PARTICIPANT INFORMATION SHEET

University of the Witwatersrand,
Wits Business School,
2 St David's Place,
Parktown 2193

Dear Sir / Madam

My name is Motsi Chele, I am a master's student in Faculty of Business Management at the University of the Witwatersrand, Johannesburg. My supervisor is Dr. Robert Venter. I am conducting a research study about organisational productivity. The study title is Evaluating continuous improvement models to enhance organisational productivity in a Diamond mining operation.

I am inviting you to take part in an interview questionnaire. If you decide to take part, your participation in this research study will last about 15min.The research activity will take place at Liqhobong Mining Development Company at the time that is convenient for you to answer the questions once Ethics Clearance has been granted.

With your permission, I would like to send you the interview questionnaire. This data will be stored in the company information storage facility for 5 years. Only the researcher will have access to the data.

The interview will be confidential and anonymous. When I share the results of the research study, I will not include your name or anything else that could identify you. With your permission, other researchers may use the data collected from this research study, but your name and any personal information will not be used or passed on.

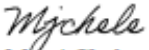
If you decide to take part in the research study, it should be because you want to volunteer. You do not have to take part. You can stop being in the study at any time. You do not have to answer any questions if you do not want to. You will not get any direct benefits if you choose to join the research study. You will not lose any services, benefits or rights you would normally have if you decided not to join. Taking part in the research study will not cost you anything. You will not be paid for being in this research study.

The risks for this research study are no more than what happens in everyday life and some of the questions asked may make you feel sad or upset. If this happens, you are welcome to stop responding to the questions. If you need some support or counselling services following the interview, these are available free of charge at our clinic. You will be assisted by any professional on duty at the time of the need.

This research study will be written up as a research report. The report will be available on the university library website. If you would like to receive a summary of this report, I will be happy to send it to you.

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor on the details listed below. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,



Motsi Chele

Researcher: Motsi John Chele;
2482147@students.wits.ac.za,
00266 5194 0299

Supervisor: Dr Robert Venter,
Robert.Venter@wits.ac.za,
011 717 8090