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THE UNIVERSITY OF WITWATERSRAND

EXPLORING IMPROVEMENTS OF A CONTINUOUS IMPROVEMENT CAPABILITY ASSESSMENT MODEL AT A PETRO-CHEMICAL COMPANY

James Tsatsire

A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Masters of Science in Engineering.

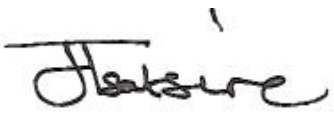
Johannesburg, 2016

DECLARATION

I, James Tsatsire, (Student number: 0618863X) herewith submit the research report, in partial fulfilment of the requirements for the degree of Masters of Science in Engineering.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and / or without acknowledging the original source) is wrong;
- I confirm that the work submitted herewith for assessment in the above course is my own unaided work except where I have explicitly indicated otherwise;
- This task has not been submitted before, either individually or jointly, for any course requirement, examination or degree at this or any other tertiary educational institution;
- I have followed the required conventions in referencing the thoughts and ideas of others;
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ABSTRACT

The purpose of the research was to identify improvements which can be made to the Continuous Improvement (CI) capability assessment model applied at a petro-chemical company in order to improve capability assessment results. The study was conducted in Mpumalanga at a subsidiary of an international integrated energy and chemical company headquartered in Johannesburg, South Africa.

To achieve the purpose of the research, the study was conducted in 5 stages namely: (1) developing a theoretical framework for Continuous Improvement (CI) capability assessment from the literature. This was achieved by reviewing the concept of CI and CI capability assessment, and it resulted in the identification of thirteen CI enablers and twenty-six enabler assessment areas which contribute to building an inclusive CI process. (2) Assessing the importance of CI enabler assessment areas identified through the theoretical framework, by means of statistical analysis of the data from a survey at the petro-chemical company. A survey was carried out to assist the researcher in identifying the key assessment areas from the twenty-six that were identified. Results indicated that all the twenty-six assessment areas are critical, (3) using the theoretical framework and results of the survey to identify gaps, which exist within the current Continuous Improvement assessment model, (4) determining what improvements need to be made to the current CI model based on the results of the gap analysis and (5) making recommendations on how to improve the CI model to the petro-chemical company.

The results of the gap analysis indicated that, (1) six enablers were adequately assessed; (2) two enablers had missing assessment areas as part of the assessment and (3) five enablers were not assessed by the petro-chemical company model. Thus in order to improve the company's assessment results it was recommended that the identified missing CI enablers and CI key assessment areas should be incorporated into the company model.

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LIST OF SYMBOLS

n	**Sample**
N	**Population**
e	**the level of precision.**
H0	**Null hypothesis**
HA	**Alternate hypothesis**
α =	**Cronbach's alpha coefficient**
Df	**Degrees of freedom**
F	**F-test or Fisher's F ratio**
Sig.	**Significance**
P-value	**The attained level of significance**
SD	**Standard deviation**
T	**Standardised T-score**
∑	**Sum**
>	**Greater than**
<	**Less than**
=	**Equal to**
μ	**mean**
Vi	**variance of scores on each question**
Vtest	**total variance of overall scores on entire test**

1 CHAPTER 1: INTRODUCTION

1.1 Theoretical Background of the study

Continuous Improvement (CI) is one of the most widely covered topics in both business and academic literature. According to Cochran, (2003, p.1), "Continual Improvement is the incremental process of becoming a smarter, stronger and more successful organisation". Chakraborty et al., (2013) mentioned that Continuous Improvement philosophy has generated a lot of interest among researchers across the globe. According to Shang & Sui Pheng, (2013), Continuous Improvement history and evolution has been widely covered and documented in the literature.

Although continuous improvements is widely recognised and covered, the mechanisms whereby a stream of continuous improvement ideas can be achieved are often less clearly identified (Bessant et al., 2001). Many of the organisations, which embark on continuous improvement programs, do not realise the full potential of the programs (Sharma, 2010). According to Anand, et al., (2009), research shows that 11% of companies considered their CI programs a success. Kerrin, (1999, p.1154) mentioned that "The development of a sustainable CI programme has proved more problematic and in some cases fails to proceed any further than one-off improvement activities". Burton, (2008) and Dabhilkar et al., (2007) noted that the problem is that focus is mainly on tools and techniques of CI. Burton, (2008, p.1) emphasises his views by pointing out the problem of current approach of CI as, "It's a dash of 5S and a smidgen of Visual Management and a few new cell signs hung up by the internal 'toolsultants' and buzzword bandits". The heavy focus on CI tools and techniques is a major reason why CI programs run out of steam (Dabhilkar et al., 2007).

According to Bessant et al., (2001, p.68), “it can be argued that much of the literature surrounding CI does not treat the behavioural aspects of the process well. In particular, three major criticisms can be levelled:

- it is often prescriptive and fails to cover implementation
- when it does explore implementation — how to introduce CI — it tends to assume a correlation between exposure to tools (such as the seven quality management tools) and CI — and neglects the other elements of behaviour building
- it assumes a binary split between having or not having CI, rather than seeing it as an emerging and learned pattern of behaviour which evolves over time

1.2 Context of the study

According to Prinsloo, (2009), South Africa has a strong petrochemical industry, which plays a significant role in the economy by contributing approximately 5% to gross domestic product and about 25% of its manufacturing sales. However, from the beginning of 2014 the industry has faced economic viability challenges due to the steep fall in oil prices (Sopel, 2015). To remain viable in these challenging times, the industry requires a continuous improvement process capability that will generate a continuous flow of improvement ideas across the entire organisation (Bumstead & Bruce, 2001).

Company X (the case company for this research study) forms part of the petrochemical industry. The company is an internationally integrated energy and chemical company headquartered in Johannesburg, South Africa. The company produces and commercialises liquid fuels, plastics, chemicals and natural gas. According to the company’s web site, the company operates from thirty-seven countries. In South Africa, the company has five operating plants in Mpumalanga, Free State and KwaZulu-Natal (Company X, 2015). The research was undertaken at the Mpumalanga plant.

Company X is committed to continuous improvement and this is demonstrated by identifying it as one of its core values. A formal Continuous Improvement program was introduced in 1996 and has been re-launched every three to four years under different names, be it Operations Excellent, Continuous Improvement or other names, to re-energise it. To demonstrate its commitment the company introduced a new department in its structure called the CI department, tasked to ensure that the CI is comprehensively implemented. The Senior Manager responsible for CI is a member of the plant's executive committee. To promote CI activity the company introduced annual awards where individuals or teams who have excelled in CI are recognized and rewarded. According to the company's General Manager, (2013) despite all the interventions, the envisaged benefits and improvements have not been forthcoming.

According to Company Newsletter, (2011) in order to embed the continuous improvement culture, and improve the effectiveness of the program the Continuous Improvement department within the organisation developed an in-house Continuous Improvement Capability Assessment model termed CI Healthy Check in 2010. The stated aim of the model is to assess the maturity level of Continuous Improvement enablers with the aim of identifying areas needing attention. A monthly self-assessment is prescribed for each business unit. Annually the CI department does an independent assessment. However, According to the Continuous Improvement manager, (2013), although there is explicit evidence from company database of the application of the model for over four years and subsequent actions taken to address gaps, the company is not satisfied with return on investment of the improvement program.

1.3 Problem Statement

Although there is evidence of application of the current model there is, however, a lack of explicit documentation of how the model was developed i.e. what method was used to identify and develop the assessed elements. According to the Continuous Improvement department, the assessment elements were identified solely based on the team's personal experiences. During the company's annual general meeting in 2013, the company's executive team, raised questions about the evaluation criteria i.e. whether the assessment is covering all the enablers of continuous

improvement. The focus of this research is to identify gaps, which exist within the current model applied at the petro-chemical company.

1.3.1 Central Research Question

What improvements can be made to the continuous improvement assessment model of a petro-chemical company to improve capability assessment results?

1.3.2 Research objectives

The objectives of the research are to:

- develop a theoretical framework for continuous improvement capability assessment from the literature
- assess the importance of CI assessment areas by means of statistical analysis of the results of a survey in the petro-chemical company
- use the theoretical framework and results of the survey to identify gaps, which exist within the current continuous improvement assessment model, applied at the petro-chemical company
- determine what improvements need to be made to the current CI model based on the results of the gap analysis and survey results
- make recommendations on how to improve the CI model to the petro-chemical company

1.4 Research Method

To achieve the stated objectives, the research was carried out in two stages. Firstly, an in depth literature review was done to clearly understand the concept of continuous improvement capability assessment resulting in the development of a theoretical framework. The theoretical

framework is used to conduct a gap analysis with respect to the current CI model. Secondly, a survey study in the form of a survey will be conducted. The results of both of these exercises will inform recommendations for the improvement of the current model.

Ethical clearance was obtained through the School Ethics committee. Clearance number: MIAEC 003/14.

1.5 Limitations and Constraints

Some of the limitations and constraints of this study are:

- Research was undertaken in the middle of a company restructuring exercise, which affected job security. As a result, the way of answering the questionnaire could have been biased; therefore, the rating could have been skewed.
- There can be role bias due to varying positions held in the company by the people surveyed. As a result, the way of answering the questionnaire could have been based on the role an individual fulfils in the company; therefore, the rating could have been skewed.
- The research used the convenience-sampling technique to gather information and a proportion of the population was not sampled. As a result, the sample used in this research may not represent the entire population accurately; therefore, the results of the research cannot be generalised to the entire population.
- The research was only limited to one petro-chemical company, as a result, the sample used in this research may not represent the entire petro-chemical industry accurately. Therefore, the results of the research cannot be generalized to the entire petro-chemical industry.
- The study was also limited to insufficient academic literature on continuous improvement capability assessment and existing assessment models.

1.6 Outline of Chapters

This thesis is divided into six (6) chapters as follows:
Chapter 1 begins with a section introducing the research context and the formulation of a problem statement. These are followed by a discussion of the research aim and objectives. The chapter concludes with outlining limitation and constraints of the research.

Chapter 2 comprises the review of available research on CI covering the definition of CI, its history and how CI can be achieved. This is followed by an in-depth review of CI capability assessment, covering definition, history and purpose, how it is conducted and benefits of CI capability assessment. This chapter ends with a wrap-up of the key information from the literature reviewed.

Chapter 3 describes the methodology utilised to conduct the research and research design in detail. The chapter concludes by describing data collection instruments, criteria for data validation and the description of data analysis instruments utilised.

Chapter 4 presents an analysis and interpretation of the data collected. This involves a process of converting raw data into categories or themes as an input in drawing conclusions from data collected. The first part of the chapter analyses data from a survey study. The second part analyses data from a gap analysis conducted on the petro-chemical CI capability assessment model and makes recommendations to the company on changes to the current assessment model.

Chapter 5 discusses research findings and makes recommendations to the petrol chemical company on improvements to the current assessment model.

Chapter 6 concludes the thesis, and proposes ideas for future research.

2 CHAPTER 2: LITERATURE REVIEW

The purpose of this chapter is to provide an overview and literature review of CI assessment. The chapter comprises the review of the available research on CI covering definitions of CI, its history and how CI can be achieved. This is followed by an in-depth review of CI capability assessment, covering definition, history and purpose, how it is conducted and benefits of CI capability assessment.

2.1 Introduction

To remain relevant in the ever-increasing complex business environment, organisations no longer compete on processes but the ability to continually improve processes (Anand, et al., 2009). However, of the many organisations that have adopted continuous improvement initiatives very few can claim success in getting what they set out to achieve (Anand, et al., 2009). According to Caffyn, (1999) organisations need to know the progress made in implementing CI in order to consolidate and develop the process further.).

2.2 What is Continuous Improvement?

According to Yokozawa & Steenhuis, (2013) the concept of CI/kaizen has been inconsistently interpreted in the previous literature by both scholars and practitioners. Sua´rez-Barraza, et al., (2011) noted that various authors have explained the concept from different perspectives. Some have interpreted the concept as suggestion schemes, others as a group of techniques and tools for cutting waste (Sua´rez-Barraza, et al., 2011). Cochran, (2003) defines CI as an incremental process of becoming a smarter, stronger and more successful organisation. Bhuiyan and Baghel, (2005, p.761) define it as “sustained improvement targeting the elimination of waste in all systems and processes of an organisation”. The GRIPS Development Forum (2009) defines CI as an on-going improvement of productivity and quality based on a participatory process involving

the entire workforce from top management to workers on the shop floor. Papadopoulos, (2011) defined CI as an ongoing interaction between operations, incremental improvement, learning, and radical innovation. The key words in all definitions are “on-going”, “incremental”, and “sustained” which means that the process is an endless effort of organisational improvement (Kr, 2011). Sua´rez-Barraza, et al., (2011) proposed three perspectives for understanding the concept as follows:

- management philosophy
- a component of TQM
- a theoretical principle for improvement methodologies and techniques.

Imai, (1986) deals with concept, tools and systems that are employed in CI by referring to Kaizen defining it as an umbrella concept covering most of those uniquely Japanese practices productivity improvement, Total Quality Control activities, Quality Control Cycles, or labour relations. Karkoszka and Honorowicz (2009) note that, the basis of Kaizen is constituted by the 5s concept.

This research will define CI as a process of making regular process changes or improvements to improve organisational performance.

2.2.1 History of Continuous Improvement

According to Singh & Singh, (2009) CI has kindled considerable interest among researchers because of its impact on organisations. However there are varying views among authors on the origin of continuous improvement. Zangwill & Kantor, (1998) trace its origins to two major occurrences i.e. in the 1920’s with the quality revolution and in the 1950’s within Toyota. Bhuiyan & Baghel, (2005) trace it back to the 1800’s with employee-driven improvements and incentive programs. Khan, (2011) notes the creator of the concept of continuous improvement was the late Dr. W. Edwards Deming, an American statistician. Singh & Singh, (2009) trace the origin to Japan in 1950, when business and political leaders realized that there was a problem with

the existing management style. The concept originated and developed in the United States of America and was transferred to Japan after the Second World War (Yokozawa, et al., 2012). Bogdănoiu, (2009) more specifically states that CI was developed by the Training within Industry (TWI) organisation, part of the United States of America War Manpower Commission during World War II. Whatever the origins of CI, it has spread worldwide and become a key initiative in many organisations.

2.2.2 How to achieve Continuous Improvement?

Oprime, et al., (2012, p.70) state "implementing continuous improvement activities can be considered an organisational renewal process, which is reached by introducing new behaviour and ideologies, especially regarding managerial practices". Continuous improvement is not something an organisation can implement overnight (Caffyn, 1999). Oprime, et al., (2012) note that Continuous Improvement is the result of a set of enablers which is related to the set of capabilities that an organisation accumulates over time. According to (Dennis, 2003), (Garcia-Sabater, et al., and 2011) these enablers contribute to building an inclusive CI process and advance collaborative participation thereby affecting the implementation and sustainability of the CI program. Therefore to ensure a sustainable CI program there should be a process to implement and manage these enablers.

2.2.2.1 CI Enablers

According to García, et al., (2013), many enablers contribute to the successful implementation and sustainability of Continuous Improvement. A literature review has identified generic enablers shown in Table 2.1 below:

Table 2.1: Continuous Improvement Enablers

	Literature Source (see below)						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Enabler							
Leadership commitment and support	*	*	*		*	*	
Strategy alignment	*	*	*		*	*	*
Improvement methodology	*	*			*		*
Target setting	*	*	*		*		*
Project management	*	*			*	*	
Communication	*	*		*			*
Project results		*					*
Employee participation		*		*	*		
Recognition	*	*					
Training	*	*		*			*
Information management				*	*	*	
Monitoring						*	
Knowledge management						*	*

1. Formento, et al., (2013), 2. Jaca et al (2012), 3. Sharma M, (2010), 4. KPMG, 2012), 5. Bannister, et al., (2006), 6. Kaye & Anderson, (1999), 7. Bumstead & Bruce, (2001)

Each of the enablers will be discussed in detail below:

- Leadership commitment and support

According to Jaca, et al., (2012), this is the first and most common factor covered in literature. Formento, et al., (2013), (Bannister, et al., 2006), (Sharma M, 2010) noted that it is not possible to develop a successful continuous improvement program without a strong commitment from top and senior management. Management are expected to make a real commitment to change by leading the process to ensure that continuous improvement isn't just something that is done now and again, but that it's something which is engrained into the cultural DNA of the organisation

(Khan IA, 2011), (KPMG, 2012). The leadership's main role is to create a constancy goal of the Continuous Improvement program, establish overall goals for continual improvement, and provide structure to support continuous improvement and review program effectiveness (Zarbo, 2012) and ((Bannister, et al., 2006)

- Strategy alignment

According to Martichenko, (2004) Continuous Improvement program sustainability and significant improvement results will only happen when the entire organisation recognises, understands and believes that continuous improvement has a purpose and true meaning for an organisation. According to Sharma M, (2010) lack of success in continuous improvement programs can be attributed to failure to establish a link between the organisational strategic goals and the program execution in order to ensure that employees understand the goals of continuous improvement.

- Improvement methodology

Martichenko, (2004) mentioned the lack of proper problem solving tools and a continuous improvement model to articulate the value and work plan of any improvement initiative as another common reason why companies fail with continuous improvement . Formento, et al., (2013) suggested a common scientific method to be used in a company. A common method can be a good starting point for motivating people to commit to improvement, as it provides a focus (what) and detailed processes (how) for the path to improvement (Jaca, et al., 2012).

- Target setting

A variety of authors highlights the importance of establishing a measurement system in order to sustain improvement processes in organisations (Jaca, et al., 2012). Sharma M, (2010) recommended cascading of metrics to all levels and roles and directly linking the continuous improvement results to a performance management system.

- Project management

The Continuous Improvement program requires project management skills to plan and manage all the improvement activities using all the skills and expertise, tools and techniques of project management (Martichenko, 2004), (Bannister, et al., 2006). (Jaca, et al., 2012) suggested prioritisation of processes to improve as not all processes can be improved at the same time.

- Communication

Effective communication systems provide the linkage between all the steps of the Continuous Improvement program (Bannister, et al., 2006). Communication is a factor not only essential for managing change, but also to continue getting people involved in daily improvement activities (Jaca, et al., 2012). (Formento, et al., 2013) advocates showcasing of project results as a way of motivating people to partake in improvement initiatives.

- Employee participation

To embed the CI program and ensure that it is integrated throughout the entire organisation, people physically working or who are dealing with problems directly should be involved in the improvement process. (Jaca, et al., 2012), (Haraburda & Zilafro, 2012).

- Project Results

According to (Jaca, et al., 2012) evidence of sustainable improvements will ensure the success of the CI program. (Sharma M, 2010) added that lack of visible results of the program make it difficult not only to demonstrate progress but also to identify changes needed to improve program performance.

- Recognition

According to Jaca, et al., (2012) recognition is connected with motivation. Bannister, et al., (2006) also supported recognition of successes in the Continuous Improvement program as a way to demonstrate top management support and commitment.

- Training

According to (Formento, et al., 2013) employees require specific training in methodologies and tools for analysis. Developing companywide competencies in problem solving is an essential feature of a broadly based continuous improvement process (Cachaya & Abelea, 2012). Cachaya & Abelea, (2012) further noted that what is needed is to establish technical as well as methodological competency on the shop floor in order to solve problems and develop production further, so that improvement processes can be achieved successfully in day-to-day operations.
According to Martichenko, (2004) one of the common reasons why companies do not succeed with continuous improvement is the lack of trained resources to commit to continuous improvement.

- Information Management

Oracle, (2013) define Information Management as the means by which an organisation seeks to maximise the efficiency with which it plans, collects, organises, uses, controls, stores, disseminates, and disposes of its information, and through which it ensures that the value of that information is identified and exploited to the maximum extent possible. Bannister, et al., (2006) and KPMG, (2012) identified information collection and utilisation as one of the fundamental principles essential to the effective introduction of structured Continual Improvement program. KPMG, (2012) observed that organisations collect a lot of data without using that data to manage or improve performance; therefore they recommended that data be used constantly to identify areas of improvement.

- Monitoring

According to Kaye & Anderson, (1999), establishing measurement and feedback systems is one of the ten essential criteria for continuous improvements. Monitoring provides performance feedback which in turn, is the driver of continuous improvement (Romaniello, et al., 2011), (American Public Human Services Association, 2015).

- Knowledge management

The Pennsylvania State University, (2009) encourages sharing of learning from improvement activities as it may trigger ideas for similar improvement opportunities elsewhere. Sharing of information encourages all employees to learn and may lead to changes in work practices that will improve performance and support continuous improvement efforts (Oliver, 2008). According to Oliver, (2008) knowledge transfer involves the dissemination of what has been learned, which may take a formal training approach or an informal approach with members of the group sharing their experiences. According to Deloitte Development LLC, (2014) today's workforce is evolving to become a mixture of full-time and part-time employees, contractors, and freelancers who move freely from role to role. As a result the implication for the Continuous Improvement program is that knowledge transfer, documentation, communication and learning has become critical to its sustainability.

2.2.2.2 Summary of CI Enablers

Based on the information discussed above, a summary of the enabler's characteristics is given below in Table 2.2 below.

Table 2.2: **Enabler requirements**

Enabler	**Characteristics**
Leadership commitment and support	Establishment of goals of the Continuous Improvement program provide structure to support the Continuous Improvement review program effectiveness
Strategy alignment	Understanding the goals of continuous improvement by entire organisation
Improvement methodology	Proper problem solving tools Scientific method
Target setting	Cascading of metrics Linking the continuous improvement results to performance management system
Project management	Project management skills Prioritisation of processes to improve
Communication	Effective communication to keep getting people involved in daily improvement activities Showcasing of project results
Employee participation	People physically working or who are dealing with problems directly should be involved in the improvement process
Project results	Evidence of sustainable improvements will ensure the success of the CI program Demonstration of progress
Recognition	Recognition is motivation Demonstrates top management support and commitment
Training	Training in methodologies and tools Competencies in problem solving Technical as well as methodological competency on the shop floor CI facilitator skill
Information management	Information collection and utilisation

Monitoring	Measurement and feedback systems
Knowledge management	Sharing of learnings to trigger ideas Knowledge transfer, documentation, communication and learning

The CI enablers identified will be used as an input to the development of a survey to be administered at the case site and to conduct gap analysis on the case site assessment model.

2.3 CI Capability Assessment

CI capability assessment is the process of checking or auditing the CI program performance against enablers organised in a model or tool (Hillman, 1994; Chen & Wu, 2007). According to Jørgensen, et al., (2003) self-assessment has become popular for evaluating CI activities, and a practical tool for driving CI.

2.3.1 History of Continuous Improvement Capability Assessment

According to Jorgensen et al., (2004) the origin of self-assessment of CI can be traced to quality award programs and business excellence models such as Deming Prize, European Foundation for Quality Management and The Malcolm Baldrige National Quality Assurance Award. The concept of CI capability assessments started in 1988 with the establishment of The Shingo Prize for Operational Excellence, established by Utah State University with the aim of recognising the best in operational excellence throughout the world (Miller, 2014).

In 1992 the University of Brighton introduced a capability assessment model under the Continuous Improvement Research for Competitive Advantage (CIRCA) program which according to Bessant, et al., (2001, p.69) “aimed to deliver a basic methodology for implementing and maintaining CI” . According to Dabhilkar, et al., (2007) the model depicts how CI capability

can be achieved by acquiring and practising certain CI behaviours. The CIRCA model brings insight into how CI maturity can be developed in an organisation (Dabhilkar, et al., 2007).

2.3.2 Purpose of Continuous Improvement Capability Assessment

Existing studies have acknowledged the importance and purpose of CI capability assessment e.g. Hillman, (1994), Caffyn, (1999), Bessant & Francis, (1999), Bessant, et al., (2001), Bessant, (2003), Jørgensen, et al., (2003), Jørgensen, et al., (2004), Fakier & Kruger, (2006), Chen & WU, (2007), Dabhilkar, et al., (2007), Anand, et al., (2009), Tidd & Bessant, (2014) . These authors identify the purpose of CI capability assessment as to:

- monitor CI progress check CI impact
- identify constraints in the CI process
- plan further development of CI
- identify areas of CI that need extra support
- identify transferrable good practice

2.4 Continuous Improvement Assessment Models in application

According to Caffyn, (1999), there are a number of CI capability assessment models in application both publically and proprietarily. Literature of available CI capability models was reviewed. To be included in this review articles had to be:

- published in English language
- covering CI capability assessment
- be industry non-specific

- easily accessible

The following method was used to identify eligible articles:

- A title search of scholarly articles on continuous improvement capability assessment models – this yielded 399 000 articles
- A sort by key words continuous improvement capability reduced the number to 350 articles
- Abstract review of articles to check the relevance of literature reduced articles to 14
- Full article review of the 14 articles.

From this method , the author has opted to review the three models namely the CIRCA CI self-assessment, the Shingo Prize for Operational Excellence and the European Foundation for Quality Management because they are commonly used in business and are easily accessible. The three models will be discussed in detail below.

2.4.1 The CIRCA CI self-assessment Model

The model was developed by the Continuous Improvement Research for Competitive Advantage (CIRCA) program, at the University of Brighton in the 90's (Bessant, 2003), (see Appendix 1). It measures CI capability in terms of a set of key behaviours which are essential for long-term success (Caffyn, 1999). The model suggests that organisations move through five different levels of CI maturity as follows (Caffyn, (1999) :

- Level 1: Pre-CI ("natural" or background improvement, ad hoc and short term)
- Level 2: Structured CI (formal attempts to create and sustain CI)
- Level 3: Goal oriented CI (CI directed at company goals and objectives)
- Level 4: Proactive CI (CI largely self-driven by individuals and groups)

- Level 5: CI capability (CI is the dominant way of life).

According to Caffyn, (1999), the model measures the following eight key abilities. Each of the key abilities has descriptions of the expected set of behaviours which typically may be displayed at each of the levels of CI maturity (Caffyn, 1999). The research has summarised the behaviours as shown in Table 2.3 below.

Table 2.3: Summary of behaviours (source: (Bessant, 2003))

Ability	Constituent behaviours
Understanding CI' – the ability to articulate the basic values of CI	• people at all levels demonstrate a shared belief in the value of small steps and that everyone can contribute, by themselves being actively involved in making and recognising incremental improvements. • when something goes wrong the natural reaction of people at all levels is to look for reasons why etc. rather than to blame individual(s)
Getting the CI habit – the ability to generate sustained involvement in CI	• people make use of some formal problem-finding and solving cycles • people use appropriate tools and techniques to support CI • people use measurement to shape the improvement process • people (as individuals and/or groups) initiate and carry through CI activities - they participate in the process • closing the loop - ideas are responded to in a clearly defined and timely fashion - either implemented or otherwise dealt with
Focusing CI - the ability to link CI activities to the strategic goals of the company	• individuals and groups use the organisation's strategic goals and objectives to focus and priorities improvements • everyone understands (i.e. is able to explain) what the company's or department's strategy, goals and objectives are

	• individuals and groups (e.g. departments, CI teams) assess their proposed changes (before embarking on initial investigation and before implementing a solution) against departmental or company objectives to ensure they are consistent with them • individuals and groups monitor/measure the results of their improvement activity and the impact it has on strategic or departmental objectives • CI activities are an integral part of the individual or groups work, not a parallel activity
Leading CI – the ability to lead, direct and support the creation and sustaining of CI behaviours	• managers support the CI process through allocation of time, money, space and other resources • managers recognise in formal (but not necessarily financial) ways the contribution of employees to CI • managers lead by example, becoming actively involved in design and implementation of CI • managers support experiment by not punishing mistakes but by encouraging learning from them
Aligning CI – the ability to create consistency between CI values and behaviour and the organisational context (structures, procedures, etc.)	• ongoing assessment ensures that the organisation's structure and infrastructure and the CI system consistently support and reinforce each other • the individual/group responsible for designing the CI system design it to fit within the current structure and infrastructure • individuals with responsibility for particular company processes/systems hold ongoing reviews to assess whether these processes/systems and the CI system remain compatible • people with responsibility for the CI system ensure that when a major organisational change is planned its potential impact on the CI system is assessed and adjustments are made as necessary

Shared problem-solving - the ability to move CI activity across organisational boundaries	• people co-operate across internal divisions (e.g. cross-functional groups) in CI as well as working in their own areas • people understand and share an holistic view (process understanding and ownership) • people are oriented towards internal and external customers in their CI activity • specific CI projects with outside agencies - customers, suppliers, etc. - are taking place • relevant CI activities involve representatives from different organisational levels
Continuous improvement of continuous improvement' - the ability to strategically manage the development of CI	• the CI system is continually monitored and developed; a designated individual or group monitors the CI system and measures the incidence (i.e. frequency and location) of CI activity and the results of CI activity • there is a cyclical planning process whereby (a) the CI system is regularly reviewed and, if necessary, amended (single-loop learning) • there is periodic review of the CI system in relation to the organisation as a whole which may lead to a major regeneration (double-loop learning) • senior management make available sufficient resources (time, money, personnel) to support the ongoing development of the CI system
The learning organisation– generating the ability to enable learning to take place and be captured at all levels	• people learn from their experiences, both positive and negative • individuals seek out opportunities for learning/personal development (e.g. actively experiment, set their own learning objectives) • individuals and groups at all levels share (make available) their learning from all work experiences

	• the organisation articulates and consolidates (captures and shares) the learning of individuals and groups • managers accept and, where necessary, act on all the learning that takes place • people and teams ensure that their learning is captured by making use of the mechanisms provided for doing so • designated individual(s) use organisational mechanisms to deploy

2.4.2 The Shingo Prize for Operational Excellence

Established in 1988 and administered by the Jon M. Huntsman School of Business at Utah State University, the prize was named for Shigeo Shingo, a Japanese industrial engineer (McKinsey & Company, 2011). It measures how principles of operational excellence culture are deeply embedded into the thinking and behaviour of all leaders of an organisation (The Shingo Price for Operational Excellence, 2014), (see Appendix 2). The model measures four elements which focus on five fundamental areas to check if they are understood and embedded into the cultural fabric of an organisation (Lean Enterprise Institute, 2013). The five fundamental areas are as follows:

- operational excellence requires a focus both on results and behaviours
- ideal behaviours in an organisation are those that flow from the principles that govern the desired outcomes
- principles construct the only foundation upon which a culture can be built if it is to be sustained over the long term
- creating ideal, principle-based behaviours requires alignment of the management systems that have the greatest impact on how people behave
- the tools of lean, TQM, JIT, Six Sigma, etc. are enablers and should be strategically and cautiously inserted into appropriate systems to better drive ideal behaviour and excellent results

The research has summarised the enablers and definition of each enabler in Table 2.4 below

Table 2.4: Shingo assessment criteria (Source: Shingo Institute, 2014))

Elements	Guiding Principles	Systems
Cultural Enablers	Lead with Humility Respect Every Individual	Individual development • on-the-job training/training within industry (OJT/TWI) • coaching • standard daily management • leadership development • idea sharing • suggestion and involvement • reward and recognition • communication • environmental, health and safety • education/training • community involvement • recruitment and succession planning • accountability
Continuous Process Improvement	Focus on Process Embrace Scientific Thinking Flow and Pull Value Assure Quality at the Source Seek Perfection	Voice of the customer • problem-solving (A3 Thinking, PDCA, DMAIC) • value stream analysis •total productive maintenance (TPM) • visual management • 5S methodology • supplier development • continuous improvement methodology • production Process Preparation (3P)

		• quick changeover or setup reductions (SMED) • error proofing/zero defects • new market development and current market exploitation • quality function deployment, concurrent engineering, etc. for product development • theory of constraints – managing bottlenecks • systems that make the customer/supplier linkage visible throughout all stages of the process and encourage/require regular communication • design for manufacturability, testing, maintenance, assembly — i.e. making it simpler and easier to deliver best quality and quickest, most reliable response to the customer at the lowest cost • involve suppliers and customers in product/ service design and continuous improvement • direct observation (go and see) and data based decisions and actions • cellular design/layout • variety reduction
Enterprise Alignment	Create Constancy of Purpose Think Systemically	Strategy deployment • daily management • assessment • communication • customer relationship management (CRM) • information technology • accounting/finance

		• measurement/scorecard • reporting/accountability
Results	Create Value for the Customer	Voice of the customer • strategy deployment • communications • visual management • management reporting

2.4.3 European Foundation for Quality Management Model (EFQM)

Introduced in 1992 as a framework for assessing applications for The European Quality Award, EFQM is a widely used organisational framework in Europe (British Association for Supported Employment, 2010) The objective of the EFQM model is to support organisations to achieve business excellence through continuous improvement (Kim, et al., 2010). The model is based on five enablers and a result section (see Appendix 3). The enablers measure what an organisation does and results measure what an organisation achieves (British Association for Supported Employment, 2010).

According to Kim, et al., (2010), the EFQM model is used:

- as a tool for self-assessment
- as a way to benchmark with other organisations
- as a guide to identify areas for improvement
- as the basis for a common vocabulary and a way of thinking
- as a structure for the organisation's management system.

The research has summarised the enablers and definition of each enabler in Table 2.5 below:

Table 2.5: Enablers and definitions (source: (European Fountation for Quality Management, 2012))

Enabler	Definition
Leadership	Excellent organisations have leaders who shape the future and make it happen, acting as role models for its values and ethics and inspiring trust at all times. They are flexible, enabling the organisation to anticipate and react in a timely manner to ensure the on-going success of the organisation.
Strategy	Excellent organisations implement their mission and vision by developing and deploying a stakeholder focused strategy. Policies, plans, objectives and processes are developed and deployed to deliver the strategy.
People	Excellent organisations value their people and create a culture that allows the mutually beneficial achievement of organisational and personal goals. They develop the capabilities of their people and promote fairness and equality. They care for, communicate, reward and recognise, in a way that motivates people, builds commitment and enables them to use their skills and knowledge for the benefit of the organisation.
Partnership and resources	Excellent organisations plan and manage external partnerships, suppliers and internal resources in order to support strategy and policies and the effective operation of processes.
Processes, products and services	Excellent organisations design, manage and improve processes to generate increasing value for customers and other stakeholders.
Results	Develop a set of key performance indicators and related outcomes to determine the successful deployment of their strategy, based on the needs and expectations of the relevant stakeholder groups. Set clear targets for key results, based on the needs and expectations of their business stakeholders, in line with their chosen strategy. Segment results to understand the performance of specific areas of the

	organisation and the experience, needs and expectations of their stakeholders. Demonstrate positive or sustained good business results over at least 3 years. Clearly understand the underlying reasons and drivers of observed trends and the impact these results will have on other performance indicators and related outcomes. Have confidence in their future performance and results based on their understanding of the cause and effect relationships established. Understand how their key results compare to similar organisations and use this data, where relevant, for target setting.

2.4.4 Limitation of the models

One major limitation identified on these models is the excessive paperwork required during assessment which is time consuming, (Chen & Jang, 2011), (Dahlgaard, et al., 2013). Secondly, the structure and language is complex, which require companies to hire expert assistance when using these tools (Dahlgaard, et al., 2013).

When compared against the enablers identified in section 2.2 above, this research has found out that individually the models does not assess all enablers identified (see Table 2.6, below).

Table 2.6: Comparison of models against enablers

	Literature Source (see below)		
Enabler	**1**	**2**	**3**
Communication	*	*	*
Employee participation	*	*	*
Improvement methodology	*		
Information management			*
Knowledge management	*	*	*
Leadership commitment and support	*	*	*
Monitoring	*	*	
Project management	*	*	*
Results	*	*	*
Recognition	*	*	*
Strategy alignment	*	*	*
Target setting		*	*
Training	*	*	*

1.Bessant, (2003), 2.Shingo Institute, (2014)), 3.European Fountation for Quality Management, (2012)

The CIRCA CI self-assessment Model does not measure Information Management and Target Setting. The Shingo Prize for Operational Excellence excludes Improvement Methodology, and Information Management in its assessment model. The European Fountation for Quality Management does not include Improvement Methodology and Monitoring in its model.

2.4.5 Identification of enabler assessment areas

Viewed collectively the three models cover all the CI enablers identified. Assessment areas per enabler covered by the collective three models were reviewed and summarised into assessment area shown in Table 2.7 below:

Table 2.7: Areas assessed per enabler

		Literature Source (see below)		
Enabler	**Assessment Areas**	**1**	**2**	**3**
Communication	Communication	*	*	*
Employee participation	Employee participation	*	*	*
	Employee participation in improvement efforts	*	*	*
Improvement methodology	Idea generating practices & systems	*		
	Types of Tools and technique applied	*		
Information management	Knowledge capturing			*
Knowledge management	Knowledge sharing	*	*	*
	Knowledge transfer	*		*
Leadership commitment and support	Leadership commitment and support	*	*	*
Monitoring	Monitoring and measurement	*	*	
	Performance review forums.	*		
	Review forums frequency	*		
	Review methodology	*		
Project management	Project Management Skills	*	*	*
	Improvement plans	*		
	Idea implementation rate		*	
	Pipeline of improvement ideas	*		
Project results	Project delivery	*		
Recognition	Recognition of participating employees	*	*	*
Strategy alignment	Employee understanding of strategic goals.	*	*	*
Target setting	Target setting		*	*
Training	Employee understanding of CI	*	*	*
	Leadership understanding of CI	*	*	*
	Shop-floor ability to use improvement tools	*		*
	Team leader/supervisor's ability to use improvement tools	*		*
	Training of employees on CI principles	*		*

1.Bessant, (2003), 2.Shingo Institute, (2014), 3.European Fountation for Quality Management, (2012)

The assessment areas identified in this section will be utilised as a basis for the development of a survey to be administered at the case site.

2.5 Conclusion of Literature Review

Continuous Improvement programs have been widely introduced in many organisations across the globe, though literature differs on its actual origin. CI can be traced as far back as the 1800's. The literature survey identified thirteen key enablers of a successful continuous improvement program. Literature also revealed the concept and history of CI capability assessments dating back to 1988. Literature supports the concept of capability assessment as a way of identifying gaps within the CI process, giving insights into its capability to deliver stated goals and reviewing what the program has achieved and what has not been achieved. The literature survey identified three assessment models and their limitations. Frome the three models CI enabler assessment areas were developed.

The literature framework developed in this chapter will be used as a basis for the development of a survey to be administered at the case site and to conduct a gap analysis. The next chapter of this research report will describe the methodology that was followed in order to answer the research questions.

3 CHAPTER 3: METHODOLOGY

3.1 Introduction

The purpose of the study was to identify what improvements can be made to the continuous improvement assessment model of a petro-chemical company to improve capability assessment results. The research method undertaken aimed to identify gaps in the current assessment model. The expected results from the study are:

- To determine what improvements need to be made to the current CI model based on the results of the gap analysis.
- To make recommendations on how to improve the CI model of the petro-chemical company.

3.2 Study Design

The study utilised information from both theoretical literature and empirical data obtained through a survey. The general structure of the research design is represented in table 3.1.

Table 3.1: General structure of research design

Phase	Objective
Literature Review	To develop a theoretical framework for a continuous improvement assessment model from the literature covering: • the concept of CI and CI capability assessment • CI enablers and assessment areas • review of existing CI capability assessment models
Survey study	To identify CI enabler key assessment areas through: • a survey in the petro-chemical company • a statistical analysis of the results of the survey
Gap Analysis	To identify gaps which exist within the current continuous improvement assessment model applied at a petro-chemical company by applying: • the theoretical framework • survey study results

3.3 Research Procedure

3.3.1 Literature review

The first part of the research was designed to develop a theoretical framework for a continuous improvement assessment model from the literature. The framework included the concept of CI and CI capability assessment, and reviewing of CI capability assessment models in use. The objective of the framework is to identify inputs for conduction gap analysis.

3.3.1.1 Identification of enablers of a CI program

Thirteen CI enablers were identified from the literature review. These enablers were identified as necessary for a sustainable and successful CI program. Refer to Table 2.1 in the Literature Review.

These enablers formed the base of the survey study, in the form of a survey at the case site, to identify the key enablers relevant to the case site. Details of the survey study and application of results are explained in section 3.2.2 below.

3.3.1.2 Identification of existing CI capability assessment models

A detailed Literature Review revealed three globally applied models namely the CIRCA CI self-assessment, the Shingo Prize for Operational Excellence and the European Foundation for Quality Management. A framework was developed that incorporated the assessment criteria utilised by all three models (see Table 2.7). The assessment criteria was utilised to develop a survey questionnaire for a survey study at the petro-chemical company.

3.3.2 Survey study

The objective of the survey study was to identify CI enabler key assessment areas from the assessment areas identified during the literature review. The results of the survey study will be utilised to conduct gap analysis against the current assessment criteria of the petro-chemical company in Chapter 4.

3.3.2.1 Survey

A Likert scale survey was developed to solicit views from participants drawn from the case site. According to Bertram, (2006), the Likert scale is a psychometric response scale primarily used in

questionnaires to obtain participant's preferences or degree of agreement with a statement or set of statements.

Based on twenty six CI enabler assessment areas identified in section 2.4, a survey questionnaire was developed (see Appendix 4). Questions were developed in two stages. Firstly, the researcher developed the questionnaire, and then the questionnaire was sent to a panel consisting of 2 senior managers and 2 CI specialists via email for review. The panel forms part of the case employees. The panel was given 2 weeks to provide feedback on how they understand and interpret the questions asked. Based on the panel feedback which centred on grammatical changes to limit ambiguity, the final survey questionnaire was developed.

The final survey was structured in two sections as shown in table 3.2 below

Table 3.2: Survey Structure

Questionnaire	Question type	Question format	Section Requirements
Section A	Classification	Closed	Requires completion of demographic-related questions role and experience
Section B	Opinion	Closed	Requires respondents to rate the importance of each enabler assessment area on a 4-point Likert scale with responses varying from totally unimportant to very important

The survey requested participants to rate each enabler assessment area on a 4-point Likert scale (totally unimportant, unimportant, important and very important). Participants were also requested to indicate their role in the organisation and the number of years they have been exposed to CI according to predefined categories. The role and experience information were gathered as a measuring instrument to indicate correlations with the opinions expressed in the study.

3.3.2.2 Sample and sampling method

Sampling is the selection of a number of units from a population for observation or study to represent the entire study population. Yount, (2006, p.7.1), describes sampling as, "the process of selecting a group of subjects for a study in such a way that the individuals represent the larger group from which they were selected. This representative portion of a population is called a sample." The reason for sampling is that the population of interest is usually too large or too scattered geographically to study directly, therefore by correctly sampling a researcher can analyse the sample and make inferences about population characteristics (Yount, 2006). A well-designed sample can provide representative data which is useful for evaluation (Israel, 2012). According to (Baker, 2012) when the population is bigger than 100, a probability sample should be selected.

- Population

According to company HR report (2013), the total population of the Business unit at the Mpumalanga plant is approximately 465. This number varies slightly due to the number of the approved vacancies but not filled. The recruitment process is ongoing and there is a continuous staff turnover of approximately 3%. At the time of the study the plant had a total of 450 employees. For this study only skilled professionals and managers (first line to senior management) were targeted because they have the required working knowledge of the subject matter of this research and have access to e-mail for easy accessibility. This provided a possible sample size of 105.

- Sample Size

According to Israel, (2013), sample size is influenced by a number of factors, including the purpose of the study, population size, the risk and the allowable sampling error. To calculate the required response rate in order to maintain a 95% confidence level and 10% sampling error, the research study used the formula discussed by (EDIS, 2013) as follows:

$$n = \frac{N}{1+Ne^2}$$

Where:

n = required responses

N= the targeted population size,

e = the level of precision.

When this formula is applied to the research the results are:

$$n = \frac{105}{1+105(0.1)^2}$$

$$=51$$

Fifty-one people will therefore be the lowest acceptable number of responses to maintain a 95% confidence level and a 10% sampling error.

3.3.2.3 Survey

The research used the volunteer sampling procedure where the participant volunteered to answer a questionnaire set. Davis, et al., (2012, p.165) describes volunteer sampling as, “It consists of people who are willing to volunteer for a study, perhaps people who respond to a flyer you send out or post”. Elder, (2009) mentions the main advantage of the volunteer sampling procedure is

that less effort is put in distributing questionnaires to particular individuals and convincing them that participation is worthwhile.

The survey was developed using Qualitrics™ tools and was conducted as a web-based survey. A link to the survey with a background of the research was e-mailed to 105 participants (see Appendix 5). The other method that could have been employed for the distribution of questionnaires was physically dropping questionnaires and collecting them from various work stations in the workplace. The shortcoming identified for this method was that it was not always possible to get participants at their workstation which could have meant several trips to a participant.

The survey was allowed to run for four (4) weeks from 11 June to 16 July 2014. An e-mail was sent during the second week reminding participants to complete and return the questionnaire. Participants were requested not to re-do the survey if they had already completed it.

3.3.2.4 Data Analysis

Statistics is a set of mathematical techniques used to summarise research data and determine whether the data supports a proposed hypothesis (California State University, 2013). The data were analysed by means of SPSS Version 20 statistical software with assistance from a Statistical Consultant from the South African Statistical Association (SASA) in Johannesburg. Descriptive and Inferential statistics were used to analyse the data obtained from the survey. According to Welman, Kruger, & Mitchell, (2005) descriptive statistics involves defining or summarising the data obtained. Trochim (2006) describes inferential statistics as reaching conclusions that extend beyond the immediate data alone i.e. to infer from the sample data what the population might think. Analysis of Variance (ANOVA) and T-test were the inferential statistics applied and are discussed below:

- One Way ANOVA

According to Statistics Solutions, (2015), the main purpose of an ANOVA is to test if there is any statistical significant difference between two or more groups. It is a statistical procedure concerned with comparing the variation in observations between groups (Ostertagová & Ostertag, 2013) and (Lund Research Ltd, 2013). According to Lane, (2008), ANOVA tests the null hypothesis that all population means are equal. That is:

$H_0: \mu_1 = \mu_2 = \mu_3 = ... = \mu_J$

H_A: The means are not all equal

A p-value greater than 0.05 means the hypothesis is accepted and vice versa (Hindle, 2013).

In this research analysis of variance will be used to determine whether there are any statistical significant differences of mean ratings among the assessment areas.

- One-sample T-test

According to Runkel, (2013), the T-test compares the means of a set of data against a hypothesized mean to establish whether the differences are statistically significant. One-sample T-test is used to compare a group of scores with a known population mean (Kremelberg, 2015).

According to (Weaver, 2011) T-test, tests the following hypothesis:

H0: $\mu 1 = \mu$

HA: $\mu 1 \neq \mu$

A positive t score implies that the mean is greater than the hypothesized mean value

The p-value greater 0.05 indicates that the difference between mean and hypothesized mean is not statistically significantly.

In this research, the T-test was used to identify, important and very important assessment areas in this study. The important and very important assessment areas will then be included in the gap analysis of the company assessment model.

3.3.3 Gap Analysis

According to Ritchey, (2014), Gap-analysis is the process of comparing two different situations or states in order to determine the difference that exists between them. Once the difference is understood it may then be possible to identify requirements to bridge the gap (Ritchey, 2014). The objective of Gap analysis was to identify gaps which exist within the current continuous improvement assessment model applied at a petro-chemical company. Gap analysis took the form of a comparison of assessment criteria of the company model against the results of the theoretical framework developed from the literature review and the survey study results from the statistical analysis of the survey. The aim was to identify the missing assessment elements in the company model.

3.4 Ethical considerations

The University requires people contacted during data gathering are treated fairly and meets certain ethical standards. Ethical clearance for this study was granted by the School of Mechanical, Industrial and Aeronautical Engineering Research Ethics Committee at the University of the Witwatersrand, clearance number MIAEC 003/14. To ensure these ethical standards, the data gathering phase ensured that:

- participants were informed that response is voluntarily without coercion
- questionnaire was not insulting or embarrassing
- the privacy of respondents will be upheld i.e. anonymity of respondents will be guaranteed

- the population will be fully informed about the aims of the research

3.5 Reliability and Validity Criteria

The key quality indicators of a research instrument are the reliability and validity of the data collected (Kimberlin & Winterstein, 2008). Therefore the research instrument used will be assessed for reliability and validity.

3.5.1 Reliability

Welman & Kruger, (1999) define reliability as the extent to which obtained data from any measurement procedure will produce the same results with repeated trials. To test the reliability of data collected, the research study used the Cronbach Coefficient alpha test using the following formula by (Allen, et al., 2008):

$$\alpha = \frac{n}{n-1}\left(1 - \frac{\sum Vi}{Vtest}\right)$$

Where:

n = number of questions

Vi = variance of scores on each question

Vtest = total variance of overall scores (not %'s) on the entire test

Alpha, which is expressed as a number between 0 and 1 was developed to measure internal consistency of a test or scale (Tavakol & Reg, 2011). An alpha value above 0.7 is an acceptable and reliable coefficient value (Reynaldo & Santos, 1999). Reliability test results are presented in Chapter 4.

3.5.2 Validity

Validity in research refers to how accurately the research has been conducted (Maylor and Blackmon, 2005). There are several types of validity measures; however this research will utilise content validity. Content validity addresses how well the questionnaire will accurately elicit the required information. According to Professional Testing Inc. (2006) content validity is typically estimated by gathering a group of subject matter experts (SMEs) together to review the test items. To validate the content, the questionnaire was piloted for two weeks using a panel consisting of two senior managers and two improvement specialists. Each member of the panel was emailed the questionnaire requesting inputs into refining the questionnaire. Based on this feedback, only grammatical changes were made to the questionnaire to limit ambiguity.

3.6 Summary of Methodology

The objective of the study is to identify and recommend improvements of an assessment model and will utilise information from both theoretical literature and empirical data. Research was conducted at a South African petro-chemical company and followed 5 steps namely literature review, survey study and gap analysis. Descriptive and Inferential statistics was applied for data analysis. For reliability testing Cronbach Coefficient alpha was applied.

4 CHAPTER 4 DATA ANALYSIS

4.1 Introduction

Data analysis involves a process of converting raw data into categories or themes as an input in drawing conclusions from responses from the planned interviews and questionnaires. Srivastava & Hopwood, (2009) gave guidelines of questions that serve as the framework for data analysis as follows:

- Q1: What are the data telling me? (Explicitly engaging with theoretical, subjective, ontological, epistemological, and field understanding)
- Q2: What is it I want to know? (According to research objectives, questions, and theoretical points of interest)
- Q3: What is the dialectical relationship between what the data are telling me and what I want to know? (Refining the focus and linking back to research questions).

This chapter presents, reports, analyses and discusses results of the survey study. For the study a questionnaire was distributed at a single manufacturing plant in Mpumalanga requesting participants to rate 26 elements on a 4-point Likert scale. The questionnaire was developed using Qualitrics™ tools and was implemented as a web-based survey. A link to the survey with a background of the research was e-mailed to participants. The survey ran for 4 weeks and in the second week a follow up email was sent to remind participants to complete the questionnaire. Statistical analysis was done utilising Qualitrics™ tools, SPSS version 20 software and Microsoft Excel ™.

The following analyses were done

- Reliability test
- Descriptive statistics
- Inferential statistics

- Gap analysis.

Interpretation of statistical results was done by the researcher in order to relate the results to the objective of the survey study.

4.2 Responses

A total of 105 questionnaires were distributed to individuals working in various capacities in the pilot site, via email with a link to the online survey. For statistical analysis, “n” represents the total population of questionnaires distributed, therefore (n=105). A total of 55 responses were received, giving a response rate of 52%. Of the 55 responses received, 51 were valid. This is within the required sample size of 51 expressed in section 3.3.2.2. Four of the 55 respondents were excluded from analysis because either the respondents did not complete the survey or they gave straight line answers. Straight line answers were for example that the respondent answered all questions as “totally unimportant”

4.2.1 Respondent Demographic Information

Two demographic questions were asked in order to determine if there are factors which may influence a respondents’ opinion. The following questions were asked:

4.2.1.1 Role in the Business Unit

The first question requested participants to indicate their role in the organisation. Figure 4.1 below shows the various respondents’ role.

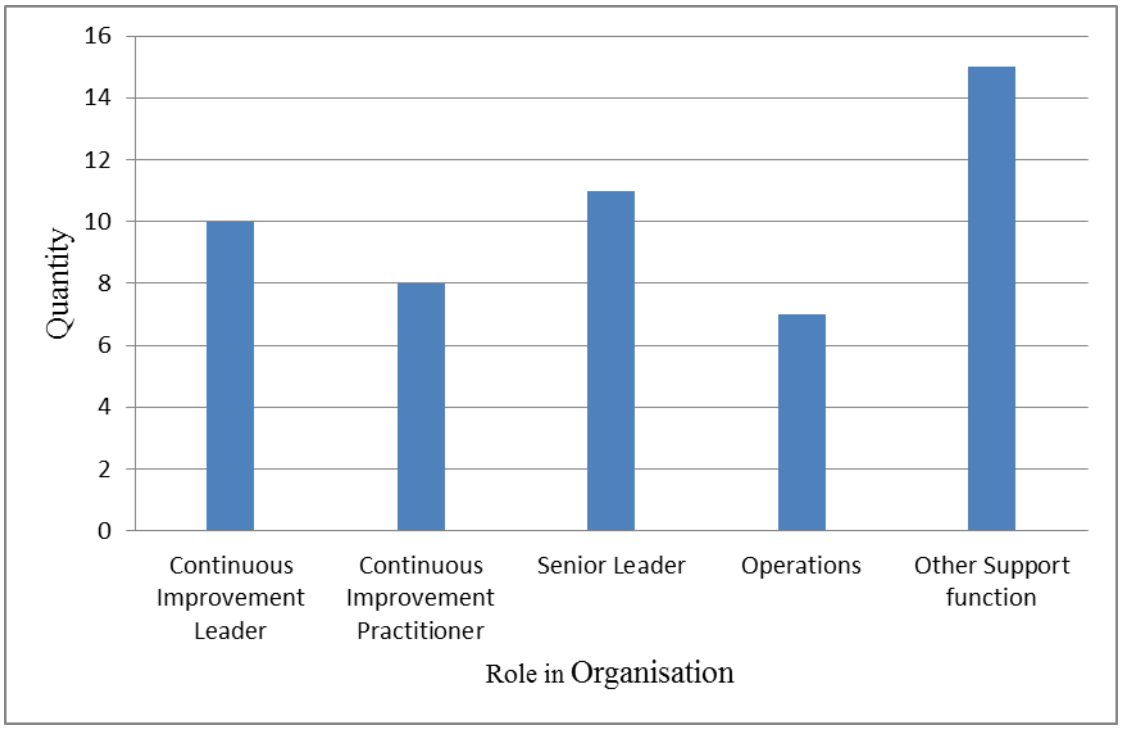


Figure 4.1: Respondents' role in the case site

The results indicated that 35% of the respondents were working in CI departments either as CI leaders or practitioners. 22% of respondents held senior positions in the Business unit. 14% of respondents were from operations covering production and maintenance and lastly 29% were from support functions like Supply Chain, Humana Resources, and Financial etc.

4.2.1.2 CI exposure

The second question requested participants to indicate the number of years they have been exposed to CI. Figure 4.2 below shows CI exposure in years of respondents.

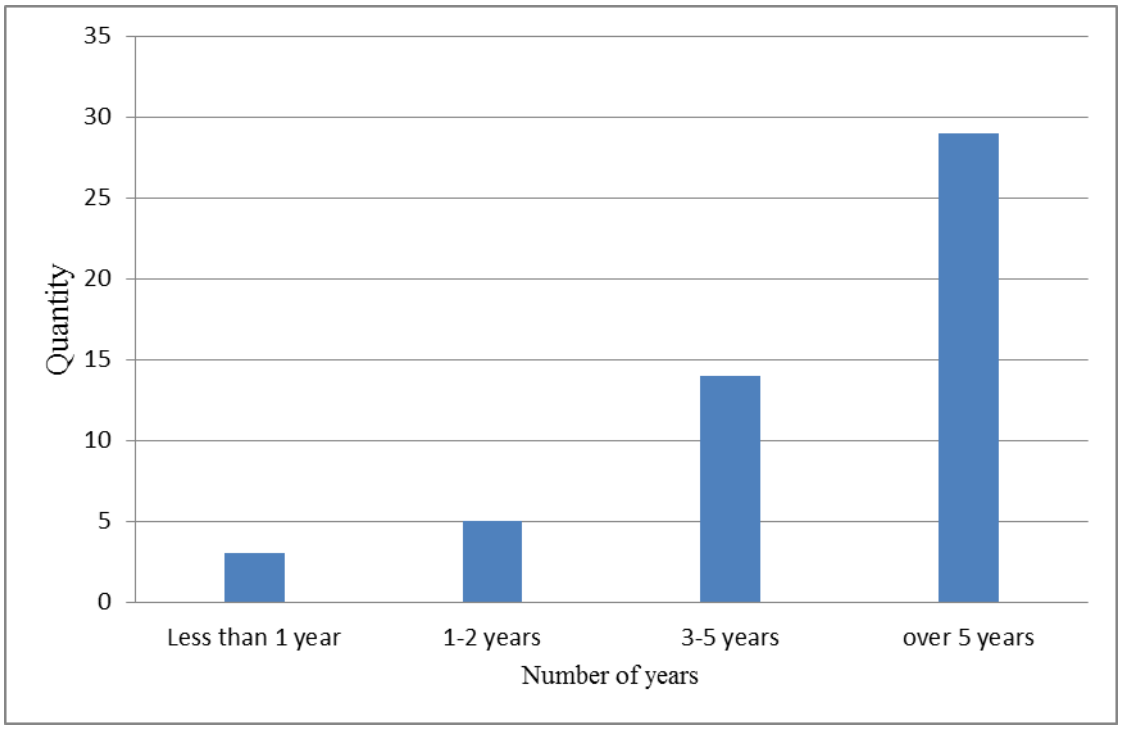


Figure 4.2: Exposure to Continuous Improvement

The results indicated that 57% of the respondents had over five years of CI exposure, 27% had between three and five years and only 16% had less than two years of CI exposure.

4.3 Reliability Test

Reliability relates to whether findings are credible and reliable (Welman, Kruger, & Mitchell, 2005) and to what extent data obtained from any measurement procedure will produce the same results with repeated trials (Welman & Kruger, 1999). The Cronbach coefficient alpha was used to test the internal consistency of the research instrument. The Cronbach coefficient alpha of 0.7 - 1.0, indicates high or good internal consistency and reliability. The Cronbach coefficient alpha for the instrument was calculated using a Microsoft Excel ™ based Reliability Calculator created by (Siegle, 2000) (refer to Appendix 6). The test result was as follows:

- Questions = 26
- Valid respondents = 51

- Cronbach's coefficient alpha = 0.90

The coefficient of reliability was 0.90, thus indicating a high level of reliability. Therefore the reliability analysis indicates the credibility and reliability of the questionnaire used.

4.4 Identification of Enabler Key Assessment areas

Part of the research was to determine CI enablers key assessment areas. Exploration of literature identified thirteen CI enablers and twenty six enabler's assessment areas (see section 2.2 and 2.4 above). The twenty six assessment areas were subjected to a survey to determined key assessment areas. The survey requested participants to rate each enabler assessment area on a 4-point Likert scale (totally unimportant, unimportant, important and very important. Data from the survey is analysed and discussed in sections below.

4.4.1 Descriptive Statistics

The mean and standard deviation of each of the twenty-six CI assessment areas indicated in Table 4.1 as calculated in SPSS

Table 4.1: Descriptive statistics of assessment areas scores

Factor	n	Mean	SD	Std. Error Mean
Top leadership commitment and support	51	3.9167	.34723	.05012
Types of tools and technique applied	51	3.5625	.50133	.07236
Target setting	51	3.6250	.53096	.07664
Project management skills	51	3.3542	.56454	.08148
Communication	51	3.7500	.43759	.06316

Team leader/supervisor's ability to use improvement tools	51	3.3333	.66311	.09571
Idea generating practices and systems	51	3.3750	.56962	.08222
Performance review forums	51	3.2917	.54415	.07854
Review methodology	51	3.0625	.56139	.08103
Shop-floor ability to use improvement tools	51	3.2083	.71335	.10296
Review forums frequency	151	3.0208	.52550	.07585
Pipeline of improvement ideas	51	3.2500	.60142	.08681
Employee participation	51	3.7660	.42798	.06243
Monitoring and measurement	51	3.7083	.45934	.06630
Idea implementation rate	51	3.3542	.66811	.09643
Project delivery	51	3.5217	.50505	.07447
Improvement plans	51	3.4792	.50485	.07287
Employee participation in improvement efforts	51	3.7083	.45934	.06630
Recognition of participating employees	51	3.5625	.54211	.07825
Training of employees on CI principles	51	3.3542	.56454	.08148
Employee understanding of CI	51	3.4375	.54211	.07825
Employee understanding of strategic goals	51	3.2500	.52592	.07591
Leadership understanding of CI	51	3.6667	.47639	.06876
Knowledge capturing	51	3.2708	.60983	.08802

Knowledge sharing	51	3.4583	.54415	.07854
Knowledge transfer	51	3.4792	.54537	.07872

The means range between 3.0208 and 3.9167. Standard deviation is between 0.34723 and 0.71335. The number of participants who rated each assessment area (n) is 51. Mean value of 2.5-3.4 and 3.5-4 on the 4-point Likert scale indicates the assessment area is important or very important respectively. Based on descriptive analysis the results indicate that all twenty-six assessment areas are either important or very important.

The results of the survey are presented graphically in a column chart that compares the different assessment areas. Figure 4.3 below presents the results which are sorted from highest ranking to lower with respect to the mean value.

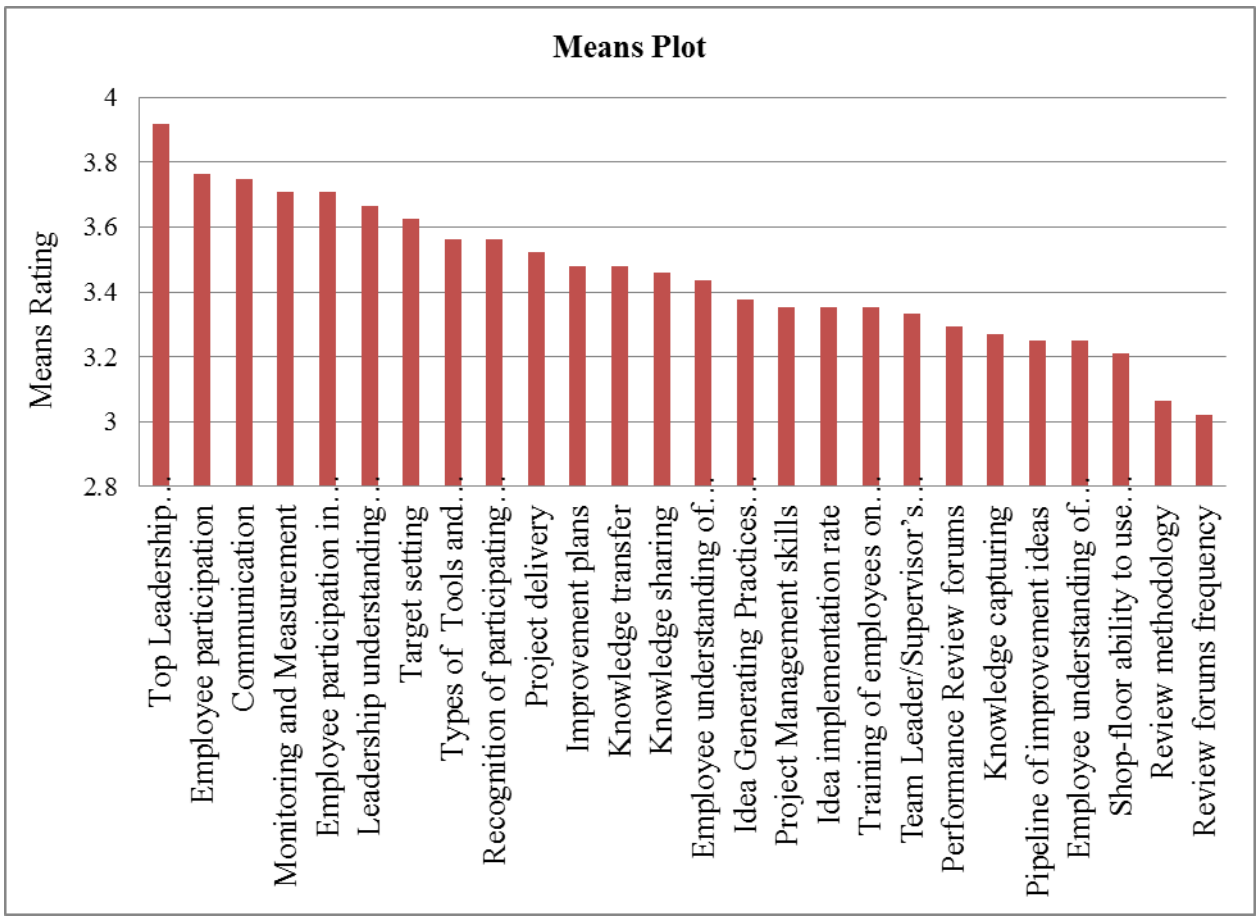


Figure 4.3: Mean rating of assessment area

4.4.2 Inferential Statistics

4.4.2.1 One Way ANOVA

The results of descriptive statistics showed that, although the twenty-six assessment areas were all important or very important, there were differences in the ratings. The next step was to determine whether the differences among the means were statistically significant. ANOVA was used to test for equality of means of the assessment areas. The null hypothesis states that the assessment areas' means are not statistically significant. Table 4.2 shows the results of the ANOVA.

Table 4.2: ANOVA Table

Ratings

	Sum of Squares	Df	Mean Square	F	p-value
Between groups	58.815	25	2.353	8.020	.000
Within groups	357.591	1219	.293		
Total	416.406	1244			

The null hypothesis is rejected because p-value is (< 0.001) indicating that the difference in means of the twenty-six assessment areas are statistically significant. In other words, at least two assessment areas have different mean ratings.

4.4.2.2 One-sample T-test

Since ANOVA has identified that at least two assessment areas have different mean ratings, the T-test is now employed to establish which of them are different and which among them are very important.

In order to identify very important assessment areas a new Likert scale based on the mean ratings is suggested. The reason for using the means in most inferential statistics is that the mean is a measure of central location whereas the maximum and minimum values are not measures of central location because they contribute to variability. The new scale is as follows:

- 0-1.49 totally unimportant,
- 1.5-2.49 unimportant,
- 2.5-3.49 important,
- 3.5-4 very important,

The T-test was performed at a hypothesised mean rating of 3.5 to test for assessment areas whose mean ratings are equal or above 3.5. Table 4.3 below presents results for the t-ratios and p-values (denoted by t and Sig. respectively).

Table 4.3: One-Sample T-Test table

Factors	Test Value = 3.5					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Top leadership commitment and support	8.314	51	.000	.41667	.3158	.5175
Types of tools and technique applied	.864	51	.392	.06250	-.0831	.2081
Target setting	1.631	51	.110	.12500	-.0292	.2792
Project management skills	-1.790	51	.080	-.14583	-.3098	.0181
Communication	3.958	51	.000	.25000	.1229	.3771
Team leader/supervisor's ability to use improvement tools	-1.741	51	.088	-.16667	-.3592	.0259
Idea generating practices and systems	-1.520	51	.135	-.12500	-.2904	.0404

Performance review forums	-2.653	51	.011	-.20833	-.3663	-.0503
Review methodology	-5.399	51	.000	-.43750	-.6005	-.2745
Shop-floor ability to use improvement tools	-2.833	51	.007	-.29167	-.4988	-.0845
Review forums frequency	-6.317	51	.000	-.47917	-.6318	-.3266
Pipeline of improvement ideas	-2.880	51	.006	-.25000	-.4246	-.0754
Employee participation	4.260	51	.000	.26596	.1403	.3916
Monitoring and measurement	3.142	51	.003	.20833	.0750	.3417
Idea implementation rate	-1.512	51	.137	-.14583	-.3398	.0482
Project delivery	.292	51	.772	.02174	-.1282	.1717
Improvement plans	-.286	51	.776	-.02083	-.1674	.1258
Employee participation in improvement efforts	3.142	51	.003	.20833	.0750	.3417
Recognition of participating employees	.799	51	.428	.06250	-.0949	.2199
Training of employees on CI principles	-1.790	51	.080	-.14583	-.3098	.0181
Employee understanding of CI	-.799	51	.428	-.06250	-.2199	.0949

Employee understanding of strategic goals	-3.293	51	.002	-.25000	-.4027	-.0973
Leadership understanding of CI	2.424	51	.019	.16667	.0283	.3050
Knowledge capturing	-2.604	51	.012	-.22917	-.4062	-.0521
Knowledge sharing	-.531	51	.598	-.04167	-.1997	.1163
Knowledge transfer	-.265	51	.792	-.02083	-.1792	.1375

All the questions with positive t-ratios indicate that they have mean ratings equal to or greater than 3.5 (very important category). From the T-test results the following assessment areas have positive t-ratios indicating they have a mean greater than 3.5, therefore they have been rated as very important:

- Top leadership commitment and support
- Types of tools and technique applied
- Target setting
- Communication
- Employee participation
- Monitoring and measurement
- Project delivery
- Employee participation in improvement efforts
- Recognition of participating employees
- Leadership understanding of CI.

Although the following assessment areas have negative t-ratios, the p-value was greater, 0.05 indicating that the difference between 3.5 mean is not statistically significant.

- Project management skills
- Team leader/supervisor’s ability to use improvement tools
- Idea generating practices and systems
- Performance review forums
- Review methodology
- Shop-floor ability to use improvement tools
- Review forums frequency
- Pipeline of improvement ideas
- Idea implementation rate
- Improvement plans
- Employee understanding of CI
- Employee understanding of strategic goals
- Knowledge capturing
- Knowledge sharing
- Knowledge transfer
- Training of employees on CI principles

Based on results of inferential statistics all twenty-six assessment areas are key assessment areas and will be included when conducting gap analyses of case site assessment areas.

4.5 Gap Analysis

Over the past 4 years the petro-chemical company has assessed CI capability in order to identify gaps and subsequent take actions taken to address gaps in its CI program. Despite this assessment, the company is not satisfied with the return on investment of the improvement program. This chapter represents the results of a gap analysis to review the Company's CI capability assessment model. This review forms part of the research objectives in order to answer the central research question of what improvements can be made to the continuous improvement assessment model, which was introduced in Chapter 1. The gap analysis results will set out a roadmap for the required changes to enable the company to meet its CI goals.

4.5.1 Current Company model review

The assessment model is based on the Company's Operations Excellence Blueprint (Company website, 2012). The tool is Microsoft Excel ™ and assesses twelve elements (see Appendix 7) for details) namely:

- Target setting
- Monitor operations
- Measure performance
- Analyse gap
- Gap closure planning
- Implement improvement plan
- Track and review improvement plan
- Capture and embed knowledge
- Knowledge and competency
- Meeting structure
- Change management, communication and recognition.

Each element consists of one or more "show me" questions/statements for each factor. Answers given are evidence based which requires certain evidence to be shown before it can be answered

"yes". The evidence is based on "show me" statements for each factor, which must be answered. The questions are answered in numerical values with 1=yes and 0=no. The assessment is based on 3 maturity levels expressed as a percentage and enhanced by a robot matrix (see Table 4.4 below for an extract of the company assessment model) where:

- >70% (green) - full compliance
- 50 – 69% (yellow) - partial compliance
- < 50% (red) - non compliance

Table 4.4: An extract of the company assessment model

OE Process Health Check based on Blueprint		Complete the yellow cells based on the health check questions in column C (1=yes, 0=no)				
Element Description	OE Process Health Check questions (a selection of the blueprint practices assessment and puzzle questions translated for the OE process specifically)	Show me... Principles for the health check questions to be answered positively: a selection of the blueprint practices show me and puzzle questions	Plant	Section A	Section B	Section C
Target setting	*Ensure relevant, cascaded QCDSM targets*		100%	100%	100%	100%
Annual	Does every section/team have (Q)CDSM targets, based on the BU targets and cascaded to section level	a. Proof of cascaded targets for QCDSM on lowest level (signed off) b. Regular communication with team regarding targets c. Updated communication boards	1	1	1	1
Monthly	Are Q and D targets reviewed and updated	a. Regular target setting sessions are conducted	1	1	1	1

	regularly to ensure section level targets stay relevant (to fit the section's situation)	b. OE calculator for mine/section D targets are used c. A process is in place to check targets per section				

4.5.2 Gap Analysis Methodology

According to Executive Consultancy Service, (2015) Gap analysis is a technique to compare 2 things, in order to identify the difference between them. Once the gap has been identified, action plans to close it can then be developed. The technique revolves around 2 basic questions, i.e. what is the current situation and what is the future state (Sharma, 2013). The Gap analysis for this research took the form of a comparison of assessment criteria of the company model against the CI enablers and key assessment areas from the literature framework in Chapter 2 and results of the survey study respectively. The aim was to identify the missing assessment elements in the company model.

4.5.2.1 Scope

In analysing the petro-chemical model the research aimed to answer the research question of whether the model can be improved. The analysis was limited to assessment elements and questions asked by the model. CI enablers and key assessment areas identified through the literature review and survey were used as the baseline for the gap analyses. Results of the gap analysis will inform the final recommendations to the company on what needs to change in the current model.

4.5.2.2 Instruments

According to Sharma, (2013) there is no formal method of conducting a gap analysis. For this research a gap analysis instrument was developed by the researcher in Microsoft Excel ™ (see

Appendix 8). The instrument was based on the thirteen enablers and twenty-six key success elements discussed in section 2.2 and 2.4 respectively.

The instrument is organised into thirteen sections of CI enablers. Each enabler consists of enabler key assessment areas which must be assessed whether they are included currently in the company model or not. The assessment gives two options namely:

- Not assessed – if the key success factor is not included in the company model
- Assessed – if the key success factor is included in the company model.

Each key success factor statement should be answered by typing 'X' in the relevant block. The ‘X’ is assigned numerical value with 1= Not assessed and 2= Not assessed. The scoring is enhanced by a robot matrix (see Table 4.5 below for an extract of the instrument) where:

- red (1) represents not assessed
- green (2) represents assessed

Table 4.5: An extract of the instrument

Enabler	Not Assessed	Assessed	Score
Communication			2.0
Communication		X	2.0
Employee participation			1.0
Employee participation	X		1.0
Employee participation in improvement efforts	X		1.0
Improvement methodology			1.0
Idea generating practices and systems	X		1.0
Types of tools and technique applied	X		1.0
Information management			2.0
Knowledge capturing		X	2.0
Knowledge management			2.0
Knowledge sharing		X	2.0
Knowledge transfer		X	2.0
Leadership commitment and support			1.0
Top leadership commitment and support	X		1.0
Project Results			2.0

4.5.3 Findings

As mentioned in section 5.3.2 above analysis compared the company's assessment criteria against CI enablers and key assessment areas identified through the literature review and survey study respectively. Figure 4.4 shows the overall results of the gap analysis against the CI enablers.

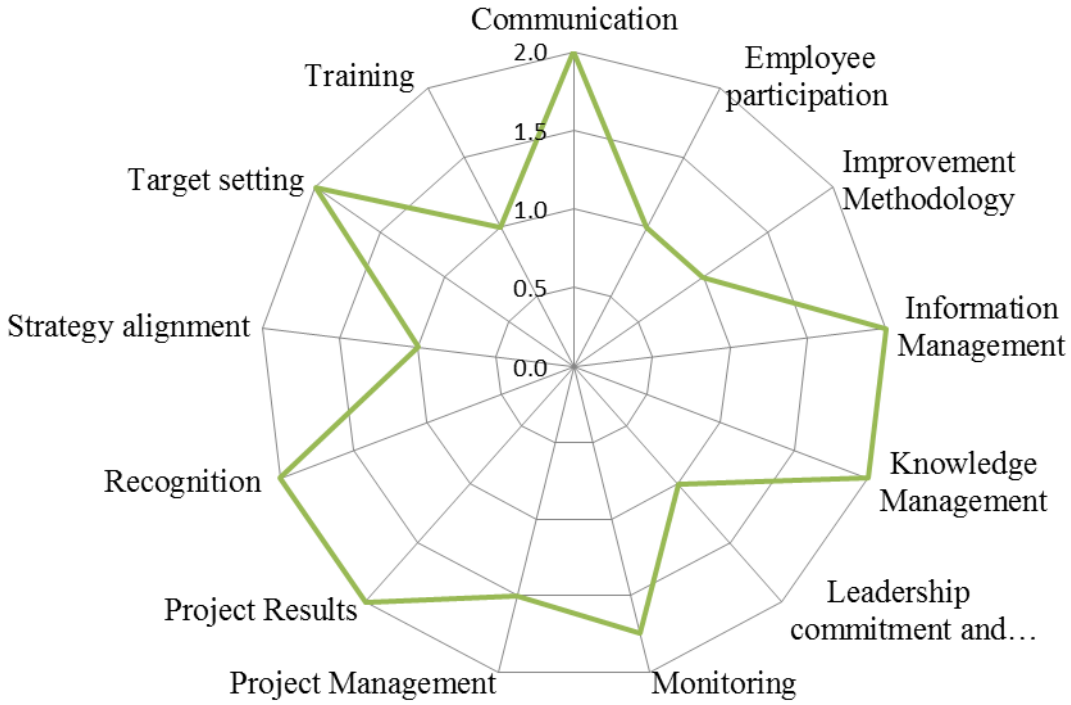


Figure 4.4: Gap analysis results

The overall finding from the gap analysis is that significant progress has been made towards developing a CI capability assessment model. However, there are several enablers which were not assessed at all or not adequately assessed. Details of the findings are discussed below:

I. The following enablers scored a 2 on the gap analysis instrument, indicating that they are adequately assessed:

- Communication
- Information management
- Knowledge management
- Project results
- Recognition
- Target setting.

II. Two enablers scored between 1 and 2 indicating that they are not covered adequately in the assessment model. The two are:

- Project management skills
- Monitoring.

III. Five enablers got a gap analysis score of 1 indicating that they do not exist in the current assessment model. The 5 are:
    - Employee participation
    - Leadership commitment and support
    - Strategy alignment
    - Training
    - Improvement methodology.

4.6 Summary of Data Analysis

This chapter presented the results and findings of the data analysis. Feedback was solicited from 105 people employed at the case site. A total of 55 responses were received, giving a response rate of 52%.

The survey data were analysed using The SPSS 20 software package. The Cronbach coefficient alpha test was applied to test for reliability. The coefficient of reliability was 0.90 indicating a high level of reliability. Both Descriptive and Inferential statistics was used to analyse the data obtained from the questionnaire. ANOVA rejected the null hypothesis that the assessment areas' means are not statistically the same indicating that at least two assessment areas have different mean ratings. The T-test revealed that only 10 of the 26 CI assessment areas were very important. However, the study also revealed that although some of the assessment areas may not be considered very important, none of those is totally unimportant or unimportant.

The gap analysis compared the assessment criteria of the petro-chemical company CI assessment model against the CI enablers and key assessment areas from the literature review and results of the survey study respectively. The analysis was limited to assessment elements and questions asked by the model. The enablers and key assessment areas were used as the baseline for the gap

analyses. The aim was to identify the missing assessment elements in the company model. The research utilised a gap analysis instrument developed by the researcher in Microsoft Excel ™. The overall finding from the gap analysis is that significant progress has been made towards the development of the company's CI capability assessment model. However, there were two gaps identified namely:

- inadequate assessment of enablers which require improvement
- missing enablers which should be included in the company model

The next chapter discusses the research findings and recommendations on improvements to the petro-chemical CI capability assessment model.

5 CHAPTER 5: DISCUSSION

This chapter discusses the main findings of the research vis-à-vis the central research question and objectives posed in Chapter 1 and existing literature as discussed in Chapter 2.

In an attempt to identify improvement areas of a Continuous Improvement (CI) programme, a company based in Mpumalanga, a subsidiary of an internationally integrated energy and chemical company headquartered in Johannesburg, South Africa, developed an in-house CI Capability Assessment model. However, there is a lack of explicit documentation of how the model was developed i.e. what method was used to identify and develop the assessed elements. Questions have been raised regarding the evaluation criteria i.e. whether the assessment is covering all the enablers of continuous improvement. The purpose of the research is to identify gaps, which exist within the current model applied at the company.

As noted in the literature review, there are a number of CI capability assessment models in application both publically and proprietary Caffyn, (1999). This demonstrates the popularity of evaluating CI activities, as a way of monitoring CI progress Jørgensen, et al., (2003) Fakier & Kruger, (2006), Chen & WU, (2007), Dabhilkar, et al., (2007), Anand, et al., (2009), Tidd & Bessant, (2014). Despite this popularity a major limitation among the existing models, identified during this research is that models assess different assessment areas.

Literature review also noted that success in continuous improvement can only be achieved through developing a set of essential capabilities called continuous improvement enablers, which must be implemented and managed, Dennis, (2003), Garcia-Sabater, et al., (2011) and Oprime, et al., (2012). Scholars such as Formento, et al., (2013), Jaca et al (2012), Sharma M, (2010) and Bannister, et al., (2006), identified thirteen enablers and twenty-six enabler assessment areas, which contribute to the successful implementation and sustainability of Continuous Improvement programme. As with assessment models, a major limitation identified is that scholars identified different CI success elements.

Thus, the findings from literature review point to a potential gap in how to identify assessment areas to include in an assessment model. To close this gap, a survey study was carried out at Company X to identify key assessment areas. Participants were requested to rate each of the twenty-six assessment areas identified during the literature review on a 4-point Likert scale (totally unimportant, unimportant, important and very important. Data gathered and analysed in Chapter 4 serves to approve or disapprove the hypothesis that all the assessment areas are important. The hypothesis is accepted or rejected based on the ratings of each element. The hypothesis that all the identified assessment areas are important was accepted because none of the assessment areas were rated as totally unimportant or unimportant. However some elements were more important than others.

In order to identify gaps with the current company model, a gap analysis study was completed using the results of the survey. The gap analysis compared the assessment criteria of the petro-chemical company CI assessment model against the CI enablers and key assessment areas from the literature review and results of the survey study respectively. The analysis was limited to assessment elements and questions asked by the model. The enablers and key assessment areas were used as the baseline for the gap analyses. The aim was to identify the missing assessment elements in the company model. Results of the gap analysis revealed that:

- only six of the thirteen CI enablers were adequately assessed i.e. all assessment areas were covered
- two enablers were inadequately assessed i.e. not all assessment areas were covered
- five enablers were not assessed by the company

There are two possible reasons identified why there are gaps in the current model. Firstly there is a lack of established and documented methodology of identifying assessment areas. This was also clearly apparent during literature review as different authors had identified different assessment areas. As a result, models developers selected assessment areas based on personal experience. Secondly although not fully explored during this research, inputs when developing the current model were solicited only from CI department views and not open to a wider population of the company.

Based on the findings of the gap analysis the following recommendations were made to the company:

1. Leadership support and commitment was identified as very important for the sustainability of a CI program. Literature revealed that leadership should take a leading role in defining the CI framework which explains the principles of CI, its role in the company and CI procedures. It is recommended that leadership commitment questions should be developed around the existence of the CI champion, budget, proof of leadership involvement, existence of CI structures and integration of CI in performance management systems.

2. Literature review revealed that a sustainable CI program requires employee involvement and contribution. Each employee should be made aware of the importance of his or her individual contributions to the success of an improvement effort. Therefore it is recommended that evidence-based questions around employee involvement should be asked.

3. In order for employees to participate in a CI program, the literature review revealed that, there should be an alignment across the organisation around the organisation's strategy and objectives. Without this alignment the organisation will lack a common purpose. It is recommended that the assessment model incorporate questions around the understanding of the strategy at all levels of the organisation, and a link between improvement activities and strategy.

4. Understanding of CI principles is critical in developing a sustainable CI process. CI training should be compulsory for all members of the organisation and questions should be developed around the existence of CI skills matrix, proof of training and leadership team including first line managers' knowledge of CI and CI models and techniques.

5. The literature review established that and organisation should have standard improvement methodology. This will ensure standardisation in training and application. Assessment questions around the application of standard improvement processes, tools and techniques are recommended.

6. There are four key assessment areas of monitoring enablers, namely monitoring and measurement, performance review forums, review forums frequency and review methodology. Review forums frequency is not assessed, however literature revealed that frequent review forums ensure quick CI programme performance feedback and provide swift identification of problem areas and progress on action taken. Therefore, it is recommended that it is added to the model.

7. Project management assesses only Improvement plans and Idea implementation rate elements of the four key assessment areas. Questions on project management skills and idea generation rate were not assessed. From literature it was revealed that success in CI programme requires (a) project management skills to plan and manage all the improvement activities. Therefore, project management skills should form part of the assessment (b) Literature also revealed active participation of employees in generating improvement ideas. One of method to measure employee participation is through measuring the rate at which employees are generating ideas. However ideas generation rate is not assessed and it is recommended that it forms part of the assessment

The measuring of research study's success is based on the achievement of the purpose, as indicated in section 1.3.1. The primary objective of the study was to identify what improvements can be made to the continuous improvement assessment model of a petro-chemical company to improve capability assessment results. The research was done with the aim of identifying gaps and providing suggestions on improving the current CI assessment model. Overall the research identified two gaps with the current company model namely:

- inadequate assessment of enablers which require improvement
- missing enablers which should be included in the company model

There are, of course, limitations to this study, the foremost of which is the lack of literature on assessment areas. Though literature acknowledged the existence of a number of CI capability assessment models in application both publically and proprietarily, there is very limited literature on the methodology used to establish the assessment areas. The challenge was further compounded by the fact that identified assessment models did not assess exactly the same areas.

As result the research had to develop a methodology which has not been thoroughly tested.

Secondly there is a limitation on the representativeness of the sample used in the survey. The survey was limited to a particular group of people i.e. skilled professionals and managers (first line to senior management) because of their perceived working knowledge of the subject matter and easy of accessibility through e-mail for. This challenge is further compounded by limiting the survey to one company; as a result, the sample used in this research may not represent industry views accurately. Furthermore, while the online survey had an advantage of ease of access with the potential to increase responses within the targeted population, large proportion of the target population did not participate. Therefore, the results of the survey should be limited to the group examined at the time of this research and cannot be generalized.

Lastly due to time constraints the effective of the model recommendations could not be tested and validated. Therefore the approach, research findings and conclusions cannot be presented with certainty.

Based on the findings of this study to determine improvement to a company's continuous improvement assessment model, it is clear that there is a lack of established and documented methodology of identifying assessment areas to be applied by continuous improvement practitioners. Therefore, it is recommended that researchers develop standard methodology for identifying assessment elements in order to address differences and to ensure that all elements are included in an assessment model.

6 CHAPTER 6 CONCLUSION

6.1 Introduction

Although, continuous improvement (CI) has kindled considerable interest among researchers because of its impact on organisations, previous studies have indicated that only 11% of companies develop a sustainable CI programme. One of the reasons identified by previous studies for CI programme failure is the heavy focus on tools and techniques as the main driver of success. In an attempt to improve CI programme success and effectiveness, the concept of CI capability assessment was introduced as a way of checking CI programme performance.

Literature revealed that success in CI can only be achieved through developing a set of essential capabilities. These capabilities called CI enablers contribute to building an inclusive CI process in an organisation and there should be a process to implement and manage them. In an attempt to manage these capabilities, the concept of CI capability assessment was introduced to monitor implementation and a number of CI capability assessment models have been developed and applied. However there is a lack of convergence among authors on the assessment areas as different authors utilise slightly different assessment areas. The lack of convergence among authors on the assessment areas pointed to a potential gap in literature on how to identify assessment areas to include in an assessment model.

The overall purpose of this research study was to establish a methodology for identifying assessment areas to include in an assessment model in order to improve the quality of capability assessment results. In this manner, the study sought to add to the board of knowledge regarding CI capability assessment. The assumption of this study was that a better understanding and inclusion of all key assessment areas in an assessment model will produce better assessment results.

6.2 Research Implications

The aim of the study was to identify and address gaps within a CI assessment model applied at a petro-chemical company. This has been accomplished by reviewing available literature around CI capability assessment. CI capability assessments have been acknowledged as critical to the success of a CI programme, as a result there are a number of assessment models in use both privately and publicly. However a major anomaly discovered during this research, within the current body of knowledge on CI capability assessment are the different assessment areas utilised by existing models. Models developed up to now have slightly different assessment areas. However a survey study carried out at Company X to identify key assessment areas to include in an assessment model revealed that all the assessment areas identified by different researchers are important to include in a model.

None of the previous studies on CI capability assessment identified during this research disclosed or discussed the methodology used to identify assessment areas. The finding of this research has identified a lack of assessment area convergence among researchers, suggesting that future research should focus on developing a methodology for identifying assessment areas

6.3 Contributions of this Research

The study undertaken by the researcher is meant to contribute to the field of CI capability assessment. The concept of CI capability assessments and assessment models has been in existence for over two decades. While there are a number of models in use, there has been limited research on how assessment elements are selected. The details of the methodology of establishing assessment areas are not normally released to the public or made into publicly available documentation.

The research aims to close the gap identified and contributes to the general body of knowledge concerning the development of Continuous Improvement Capability assessment models. Thus, the research will contribute to the literature of how to select elements to include in a model to ensure more effective assessment models. This research contributes by documenting the assessment

elements of a CI assessment model.

6.4 Areas for future research of CI capability assessment

a) The lack of assessment area convergence among researchers identified in this research suggests that future research should focus on developing a methodology for identifying assessment areas.

b) CI capability assessment has been acknowledged as a vital component of a CI program for identifying gaps within the CI process. Some of the areas of future research in the CI capability assessment that could be explored further include the following:

- Factors influencing the results of CI capability assessment models
- Attributes of a good CI capability assessment model
- Steps in developing a CI capability assessment model
- Assessment criteria for a CI capability model.

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APPENDIX 1
THE CIRCA CI SELF-ASSESSMENT MODEL

Key ability 1: Understanding CI

This cluster of behaviours refers to how well the organisation understands and shares the underlying values and beliefs about CI.

Key behaviours	*Trigger questions*	*Level 1*	*Level 2*	*Level 3*
1a. People 'live' the CI values – 'workplace innovation matters to this business', 'I can make a difference', the value of small steps, etc.	What do you think of CI? How frequently do people think about and come up with proposals for change?	Only when facilitated	From time to time on specific issues	Goal oriented Against targets (internal)
1b. The "management style" reflects commitment to CI values (e.g. the belief that everyone can make a contribution). *Examples might include:* *adopting a facilitating rather than directive approach;* *their reaction to individuals when things go wrong;* *attaching importance to smaller achievements;* *not letting go of CI principles when*	Are you allowed to recommend/suggest changes? Do you feel you can make a difference? Does management also contribute to improvement?	Yes, but….	Share ideas on a structured basis	Is it part of performance appraisal management

under a lot of pressure *providing recognition for small improvements*				
1c. When something goes wrong the natural reaction of people at all levels is to look for reasons why etc. rather than to blame individual(s).	What is the reaction around here when something goes wrong?	Who made the mistake?	'Let's talk about it'	What is the source of the problem? Problems are formally analysed

Key ability 2: Strategy deployment

This cluster of behaviours refers to how well the organisation links its CI activities to the strategic mission and key performance drivers of the business

Key behaviours	*Trigger questions*	*Level 1*	*Level 2*	*Level 3*
2a. Individuals and groups use the organisation's strategic goals and objectives to focus and prioritise improving their activities. CI is 'inline' rather than 'off-line'.	How do you prioritise? If you have problems, how do you decide which to work on? How far do you use the company strategy to help choose which problems to work on?	No role	Some alignment but not fixed. Loose view of strategy	Strategy is transformed targets and standards work are used in prioritising – policy deployment
2b. Everyone	Are targets for	Limited	Understanding	Understanding

understands (i.e. is able to explain) what the company's or department's strategy, goals and objectives are.	problem-solving linked to the bottom line? Are they linked to daily activities? Is there a link between department activities and higher level strategy? Ownership?	understanding of strategy	of strategy but not implemented continuously – 'flavour of the month'	is reflected in results – people know what the strategy is and how they fit in it
2c. Individuals and groups monitor/ measure the results of their improvement activity and the impact it has on strategic or departmental objectives.	Visible monitoring system? How do you measure activities and their results? Impact of results on strategy?	No measurement	Measuring takes place occasionally but no interpretation or action. May be carried out by outsiders	Measurement and feedback used to drive improvement and corrective initiatives

Key ability 3: Leading CI

This cluster of behaviours refers to how well leadership at different levels in the organisation supports the values and practice of CI.

Key behaviours	*Trigger questions*	*Level 1*	*Level 2*	*Level 3*
3a. Managers at all	Do they	Sometimes/	On formal	Frequently and

levels display active commitment to, and leadership of, CI	(management) visit your section or talk about it? Do they trigger you to think about new ways of doing things? Do they give you feedback on your CI activities?	rarely	occasions but not often. Not all managers do this	most managers do it – its part of their job.
3b. Managers give their time to CI related activities (e.g. as members of an improvement team, delivery of CI training, incorporating CI into business plans, leading local initiatives, recognising and acknowledging people's contribution, etc.)	Are they involved in problem-solving or part of focus groups? Does CI form part of their formal budgeting process – do they set targets and allocate resources to it?	Sometimes	On formal occasions but not all of them – pockets of support	All of them, most of the time – it's part of their job and they are judged on it
3c. Managers encourage their people to take part in CI activities (e.g. as facilitators, CI team members) for example by	Do they lead by example, by getting involved in CI? Do they take time	Occasionally	Some of them, regularly (once a month)	Most of them most of the time

allowing them time to do so, recognising people's involvement (ongoing, at appraisals).	off or allow others to do so to carry out CI activities?			

Key ability 4: Participation in CI

This cluster of behaviours refers to how well people are enabled to participate proactively in CI within the organisation

Key behaviours	*Trigger questions*	*Level 1*	*Level 2*	*Level 3*
4a. Individuals and groups use a problem solving improvement opportunity finding cycle	How do you solve problems round here?	No formal cycle but people might use problem lists and Informal approaches	Problem solving cycle exists and people have been trained in using it	Problem solving cycle used regularly to work on problems focussed on key drivers
b. Individuals and groups draw on a wide range of appropriate tools and techniques including process measurement to assist with CI activity.	Do you use problem-solving tools? Can you list/tell us about the ones you use?	People are aware of tools but not trained in their use	People are trained in basic cycle and tools	People use a cycle and a toolbox of different aids to help them
4c. There are 'vehicles' – problem solving teams, idea schemes, etc. which enable individuals and groups, at all levels, to initiate CI activities and carry them through to completion.	If you want to change/ improve something what do you do?	No formal approaches or mechanisms	Use of formal approach based on one major approach – e.g. teams	Use of teams working on strategic problems which may go beyond section to dept. or mine level May use multiple

				approaches – e.g. teams plus individual mechanisms

Key ability 5: Consistency in CI

This cluster of behaviours refers to how good a fit there is between CI and the rest of the organisation.

Key behaviours	*Trigger questions*	*Level 1*	*Level 2*	*Level 3*
5a. The CI system fits within the current structure and infrastructure of the organisation (e.g. in selecting the type of CI vehicle that is most appropriate to the work organisation).	How well does CI fit into the day to day operations and structures of the company? Is CI a special extra thing or part of the overall way the company works?	No fit – CI is an add-on extra	Some fit at local level but still seen as something different	Formally linked – CI is in-line with the day to day work of the business. People are expected to do it, time and resources are allocated for it, benefits which come from it are shared, etc.
5b. Individuals with responsibility for particular company processes/systems (e.g. the reward system, the personal development process, the production process) hold ongoing reviews to assess whether	Do the systems in the company make it easy for you to carry out CI as part of your daily working life? If so, where?	No links, systems often conflict with CI	Some links but also some conflicts –e.g. reward system	Formally linked – CI is in-line with the day to day work of the business. People are expected to do it, time and resources are allocated for it,

these processes/systems and the CI system remain compatible, and take action as necessary	If not, where and why not?			benefits which come from it are shared,
5c. Person(s) with responsibility for the CI system ensure that when a major organisational change is planned its potential impact on the CI system is assessed and adjustments are made as necessary.	When big changes happen is the CI system changed as well or is it something which is set in stone and doesn't change?	No links	Sometimes considered, usually as an afterthought	Formal links in process of change planning and implementation

Key ability 6: Cross-boundary CI

This cluster of behaviours refers to how well the organisation is able to extend CI activity across organisational boundaries.

Key behaviours	*Trigger questions*	*Level 1*	*Level 2*	*Level 3*
6a. People at all levels carry out CI activities – e.g. joint problem solving teams – effectively across internal (vertical and lateral) and external divisions (e.g. with customers or suppliers).	Who does CI? Is any of it done across departments? Who takes ownership? Is CI done over	No cross boundary	Informal network	Formal structure/ cross boundary teams

	external borders –e.g. with suppliers?			
6b. Everyone shares a holistic view of the organisation (common goals) and has a good understanding of what other departments/ functions do.	Do you know what other departments are doing? Do you know how you impact on their performance? Do you trust other departments?	Unhealthy Competition. No focus on shared concerns	Understand impact on others but still work in silos	Co-operation is enforced through formal structures
6c. People at all levels cooperate and work effectively across internal boundaries (e.g. between departments, functions, divisions).	Do you work with other departments?	No cross boundary working	Informal participation	Formal participation – action teams, problem-solving teams, etc.

Key ability 7: Sharing and capturing learning

This cluster of behaviours refers to how well the organisation shares and captures the learning coming from CI activities.

Key behaviours	*Trigger questions*	*Level 1*	*Level 2*	*Level 3*
7a Everyone learns from their experiences, both	Are you frequently involved in reviews of	Only on an ad hoc basis	Frequently but informal	Formal forums with action plans which

positive and negative (i.e. they don't repeat actions that gave rise to a negative experience; they build on / repeat actions that resulted in positive outcomes).	completed task/projects? (Post mortems) to identify problems and corrective actions/learning points?		discussions only	lead to changes – e.g. in SOPs, SPI,s etc. and generate post project reports
7b. Individuals and groups at all levels share their learning from CI activities, both positive and negative. (They do this formally and informally - e.g. participate openly in development project reviews, feed into the organisation learning / insights acquired from outside the organisation, do not try to hide negative experiences, talk to colleagues).	Do you discuss your problems and solutions with other People Departments Centres	Ad hoc or by accident Some use of different reporting/ sharing mechanisms –e.g. reports, presentations, story boards	Section or mine – internally and formally. Use of multiple mechanisms	Companywide focused interest groups. Use of multiple mechanisms
7c. Individuals are enabled to seek out opportunities for	Does the company give you opportunities to develop yourself and your skills?	No formal training/ development opportunities	Limited to task related skills	Training and development to enable strategic problem solving

learning / personal development (e.g. actively experiment, set their own learning objectives).	How? How else could they do it?			

Key ability 8: Continuous improvement of CI

This cluster of behaviours refers to how well the organisation monitors and develops its CI processes, structures and activities.

Key behaviours	*Trigger questions*	*Level 1*	*Level 2*	*Level 3*
8a. Designated individual or group monitors the CI system and measures the incidence (i.e. frequency and location) of CI activity and the results of CI activity.	Does anyone look after CI in this company – reviewing it and trying to improve the way it works? Who and how? Does anyone monitor the CI activities you do and the results they bring?	No-one responsible, CI not monitored or measured	Someone is responsible and monitoring takes place of activity but not necessarily of impact	Someone responsible and monitoring how well the systems work and the ways in which CI affects the business drivers/ bottom line
8b. Designated individual or group follows a cyclical planning process	Has the way you solve problems or carry out other kinds of CI activity ever changed?	No review of CI process or system	Review process takes place regularly but ad hoc framework	Review takes place regularly using consistent framework and results are used

whereby (a) the CI system is regularly reviewed and, if necessary, amended (single-loop learning) and (b) there is periodic review of the CI system in relation to the organisation as a whole which may lead to a major regeneration (double-loop learning)?	Do you think the way you do CI is the 'best way'			to improve aspects of CI system – e/.g. further inputs of training
8c. Senior management make available sufficient resources (time, money, personnel) to support the ongoing development of the CI system.	What changes have been made to CI systems in the company lately? Who and what helped you does CI better?	No changes to the way we do CI	Limited resources provided to review CI – time, money, people	Senior management allow changes to CI and support regular internal and external reviews

APPENDIX 2
THE SHINGO PRIZE FOR OPERATIONAL EXCELLENCE

Cultural Enabler Focus

		0	1	2	3	Objective
1	Managers and supervisors are seen as mentors & coaches	*No evidence*	Very little evidence that problems are made visible Manager as problem-solver	Manager leading problem-solving, engaging front-line staff	Significant problem-solving at lowest level of organisation Managers consistently acting as coach, asking Socratic questions	*Enabling guided decision-making at the lowest level*
2	Employees are empowered and recognized for signalling problems or defects that occur in their area.	*No evidence*	Few employees involved in signalling defects and problems, no recognition	Some employees are empowered and some recognition, or only in parts of the department	Significant # of problems and defects are identified and solved by employees, with visible and	*Problems are owned and embraced by the workforce. Problems are seen as opportunities*

					meaningful recognition	
3	On-the-job coaching in lean practices is a daily part of the culture	*No evidence*	No evidence of coaching. Posters, etc. but manager continuing to solve issues	Coaching evident but inconsistent. Manager continues to solve most problems without employee input	Coaching is consistent and evident throughout the organisation. Employees can site examples/ benefits consistently	*Coaching creates front line leadership and a culture of empowerment*
4	Recognition system focuses on performance that encourages ideal behaviour.	*No evidence*	Ideal behaviour, standard work, is found in spots but no recognition	Ideal Behaviour evident and recognition is seen though inconsistent in content and application	Recognition is consistent, evident and visible to everyone. Examples of ideal behaviour recognized, accompanies celebrations	*Recognition is frequent, timely and specific; awarded for achieving great performance with ideal behaviour*
5	Sense of trust among leaders, managers, and associates.	*No evidence*	Little evidence of issues being reported. Employees hiding	Employees reporting system issues but continue to hide "mistakes"	Employees express ability to report issues with confidence in a positive	*Eliminate a "we-they" culture*

			issues		response consistently	
6	Managers and supervisors are seen on a regular basis in the work area engaging with the workforce to better understand their reality.	*No evidence*	Few occurrences of leadership at place of value add (gemba)	Pockets of consistent leadership engagement at gemba, but not everywhere	Consistent and predictable leadership engagement at gemba	*Promotes go and see mentality and engaged, coaching leadership team*
7	Improvement ideas are processed quickly (within 2 weeks) with feedback to the originator regardless if the idea was implemented	*No evidence*				*Ideas are valued at all levels with open & transparent communication to encourage and coach*

Continuous Process Improvement Focus

		0	1	2	3	Objective
1	Immediate action is taken when the work area is ahead or behind schedule	*No evidence*	Associates can rarely detect when their area is ahead or behind schedule	Associates can detect if they are ahead/behind but no actions are taken to respond	Associates can predict throughout the day and immediate action is taken by the appropriate people to adjust, fix and	*It is easy to see when an area is ahead or behind schedule*

					improve the process	
2	The flow of service or product is simple and direct, creating continuous flow	*No evidence*	Services or patients are batched and process is complex and difficult to see. No visibility or communication between upstream and downstream processes	The process flow is easy to see but there's only communication between connected processes. Waste and bottlenecks are looked at during events only	All processes are connected visually and easy to see and understand. Waste is immediate identified and addressed to adjust for continuous flow of service to the patient and families	*Waste is eliminated that causes bottlenecks, waiting, excessive transportation and movement of patient*
3	The "Current State" and "Future State" are an ongoing continuous cycle – Actively pursued with a visual and detailed action plan and timeline	*No evidence*	Staff is unclear in describing the future state and how to get there	Staff reference displays of improvement goals that related to future state. Staff recognises the connection between current improvements and achieving future state. Mapping is	Work and improvements are reviewed on a scheduled basis so immediate adjustments can be made when deviating from the future state. The future state is met within 6-12 months where a new	*Improvement is truly continuous, not event driven. Areas are constantly moving toward an Ideal Future State*

				seen as an event with limited follow-up	future state is created	
4	Standards (SWI), work-areas – are highly visual, simple and USED (routinely being updated as improvements are made)	*No evidence*	Standard work is evident in the associate's work process, but not always followed. Updating it is more of a hassle	The associate's standard work program is displayed so that it is easy to audit for compliance	Associates improve SWI plan, documenting the improvement and sharing with managers	*All work is highly specified at content, sequencing, timing, and outcome – in order to signal abnormal conditions immediately*
5	There is a sense that 'continuous improvement' is just part of the job	*No evidence*	Continuous improvement is a burden and usually in the way of doing REAL work. Associates and managers are not able to describe improvement work/ projects in relation to their role	Staff can describe some improvement projects they've participated in	All Associates signal problems immediately and can speak to the response system. Staff integrates problem solving into daily activities and can speak on how they contribute to larger goals	*Continuous improvement is owned by the entire organisation.*

6	Improvement activities are directly linked back to the organisation's strategic focus and primary objectives	*No evidence*	Associates can show you where to find organisational goals, but can't describe how their work has impacted the goals	Staff can articulate organisational goals and objectives and identify some examples of improvement projects in their area	Staff integrates improvement into daily work and all can demonstrate how improvement work is linked back to strategic focus and primary objectives	*Improvement is not a shot-gun approach, rather specifically targeted in the strategic direction of the organisation*
7	Improvement ideas are routinely shared openly throughout the organisation, across multiple value streams & departments	*No evidence*	People are unsure how to share improvement ideas and are too busy to see them as priorities. There is limited communication and sharing between departments of improvements that are going on	Staff can tell you when and where regular forums occur to report on improvement efforts. Leaders and managers share ideas and work to implement these within their area. Not happening consistently across the organisation. People are expected to	Before any improvement is made the team systematically checks to see who if any has encountered the same problem, and use their countermeasure as a starting point to improve	*Avoid reinventing best practices*

				provide improvement ideas but are unclear about the process		

Enterprise Alignment Focus

		0	1	2	3	Objective
1	Employees can describe what the mission and vision of the organisation is and how they personally impact it	*No evidence*	Associates can communicate where to locate written definition of vision and mission	Associates are able to define several elements of the mission and vision, and provide examples of projects in their workgroup to support the mission and vision	Associates identify specific examples of how they impact the mission and vision. Management is coaching problem solving that is cantered on achieving the vision	*A well communicated vision that creates a sense of urgency, unity, and loyalty*
2	There is a structured process for aligning goals and strategic priorities that is simple and	*No evidence*	Associates can communicate where to locate organisational goals and	Associates can identify their goals for their workgroup and can articulate the	The workforce can quickly identify their goals and where they are in	*Each person in the organisation understands their role in supporting and achieving*

	visible at all levels of the organisation		goals for their work group	strategic nature of those goals	achieving them (visually). The goals are simple and directly related to their work area, but also tied directly to the strategic objectives of the organisation	*the strategic goals*
3	The voice of the customer directs focus of continuous improvement and future development of the organisation	*No evidence*	The workforce understands that the patient is the customer, but their processes don't demonstrate this understanding	Surveys are conducted to get feedback from the patient, but based on a push system. Seldom is feedback used to improve key systems in the area. Key issues repeatedly surface in the survey	Patients, families, and the community are actively and systematically listened to and involved in key improvement areas	*Understand what is valued by the customer and focus development on creating value for the customer*

4	Open communication across value streams, support and administrative departments	*No evidence*	We talk about the impact of improvements in our work area, but seldom about the impact we have in other departments	We ask and communicate about the impact of our work with other departments, but improvements are still made with local efforts	We coordinate our work across departments daily and collaborate to continuously create value for the customer. Cross functional teams are used routinely	*The organisation functions as a team, working together not against each other to create value for the customer…not waste*
5	Leaders and managers follow standard work and are routinely seen out of the offices and in the work areas	*No evidence*	Leader standard work is documented. Leaders and managers rarely are in the work area	Leader standard work is documented and posted. Managers are frequently in the work areas Managers ask questions predominately about day-to-day operations and offer	Managers are in workplace daily. While there, managers coach by asking questions and aid in eliminating barriers to help areas achieve strategic objectives	*Leaders systematically monitor and maintain organisational alignment*

				solutions. Dept. objectives and metrics are posted by not tied to organisational goals		
6	Tracking boards are used daily for open discussion and feedback so that adjustments can be made quickly	*No evidence*	Tracking boards are up. Managers listen to reports by team leads & workers daily. Managers solve problems after the huddle	Tracking boards are up. Managers facilitate discussion of daily work at huddle at the board. Manager's questions commonly result in problem solving by the team	Managers consistently ask questions in order to identify problems and barriers. The team is highly engaged in the huddles and discuss ideas for solving problems on a daily basis. Actions are specifically assigned and followed up daily to meet strategic objectives	*Quick adjustments can be made on a daily basis to re-align focus to strategic direction of the organisation*

7	Metrics and goals are simple and clearly aligned, driving the right behaviour to achieve the organisations vision	*No evidence*	Multiple metrics are tracked by managers and rarely shared with work unit	Metrics and goals are posted in work areas. Managers frequently refer to them while in the work unit	Specific key metrics are visually tracked in the work unit. Associates consistently discuss how the metrics show the work unit progress toward organisational goals	*Eliminate short-term focus that gets immediate results but damages the long term*

APPENDIX 3

EFQM SELF-ASSESSMENT 2013

Part 1 - Enablers

1. Leadership

	Fully Disagree	Disagree	Neutral	Agree	Fully Agree
Our leaders shape the future and make it happen					
Our leaders act as role models for our values					
Our leaders inspire trust at all times					
Our leaders are flexible					
Our leaders anticipate change and react in a timely manner					

2. Strategy

	Fully Disagree	Disagree	Neutral	Agree	Fully Agree
Our strategy is aligned to our Mission & Vision					
Our strategy is focused on our stakeholders					
Our strategy is supported by appropriate policies, plans and processes					
Our strategy has clearly defined objectives and goals					

3. People

	Fully Disagree	Disagree	Neutral	Agree	Fully Agree
We have aligned personal, team & organisational objectives					
We develop the skills & capabilities of our people					
We have a culture of involvement &					

empowerment					
We communicate effectively throughout the organisation					
We reward and recognise the efforts of our people					

4. Partners & Resources

	Fully Disagree	Disagree	Neutral	Agree	Fully Agree
We build sustainable relationships with our partners & suppliers					
Our financial strategies are aligned to the overall strategy					
We manage our buildings, equipment and resources in a sustainable way					
We manage our technology to support the delivery of our strategy					

Information & knowledge are managed to support effective decision making					

5. Processes, Products & Services

	Fully Disagree	Disagree	Neutral	Agree	Fully Agree
We have defined the key processes required to deliver our strategy					
We develop new, innovative products & services					
We effectively promote our products & services					
We effectively manage the production & delivery of products & services					
We effectively manage our customer relationships					

Part 2 - Results

6. Customer Results

	No results	In a few areas	About half	In most areas	In all areas
We have defined the key Customer Results required to achieve our strategy					
Customer Perception results are positive for 3 years					
Our internal customer measures are positive for 3 years					
Benchmarks show we out-perform our competitors					

7. People Results

	No results	In a few areas	About half	In most areas	In all areas
We have defined the key People Results required to achieve our strategy					
People Perception results are positive for 3 years					
Our internal people					

measures are positive for 3 years					
Benchmarks show we out-perform our competitors					

8. Society Results

	No results	In a few areas	About half	In most areas	In all areas
We have defined the key Society Results required to achieve our strategy					
Society Perception results are positive for 3 years					
Our internal society measures are positive for 3 years					
Benchmarks show we out-perform our competitors					

9. Business Results

	No results	In a few areas	About half	In most areas	In all areas
We have defined the key Business Results required to achieve our strategy					
Financial results are positive for 3 years					
Non-financial business outcomes are positive for 3 years					
Benchmarks show we out-perform our competitors					

APPENDIX 4

SURVEY QUESTIONNAIRE

I hereby voluntarily grant my permission for participation in the survey as has been explained to me. The nature, objective, possible safety and health implications have been explained to me and I understand them. I understand my right to choose whether to participate in the survey and that the information furnished will be handled confidentially. I am aware that the results of the survey will be used for academic purposes.

- Yes
- No

What is your role in the Business?

- Continuous Improvement Leader
- Continuous Improvement Practitioner
- Senior Leader
- Operations
- Other Support function

How many years of Continuous Improvement exposure do you have

- Less than 1 year
- 1-2 years
- 3-5 years
- Over 5 years

How do you rate the following continuous improvement process capabilities in order to ensure a sustainable continuous improvement culture? Please indicate your answer by selecting one of the following

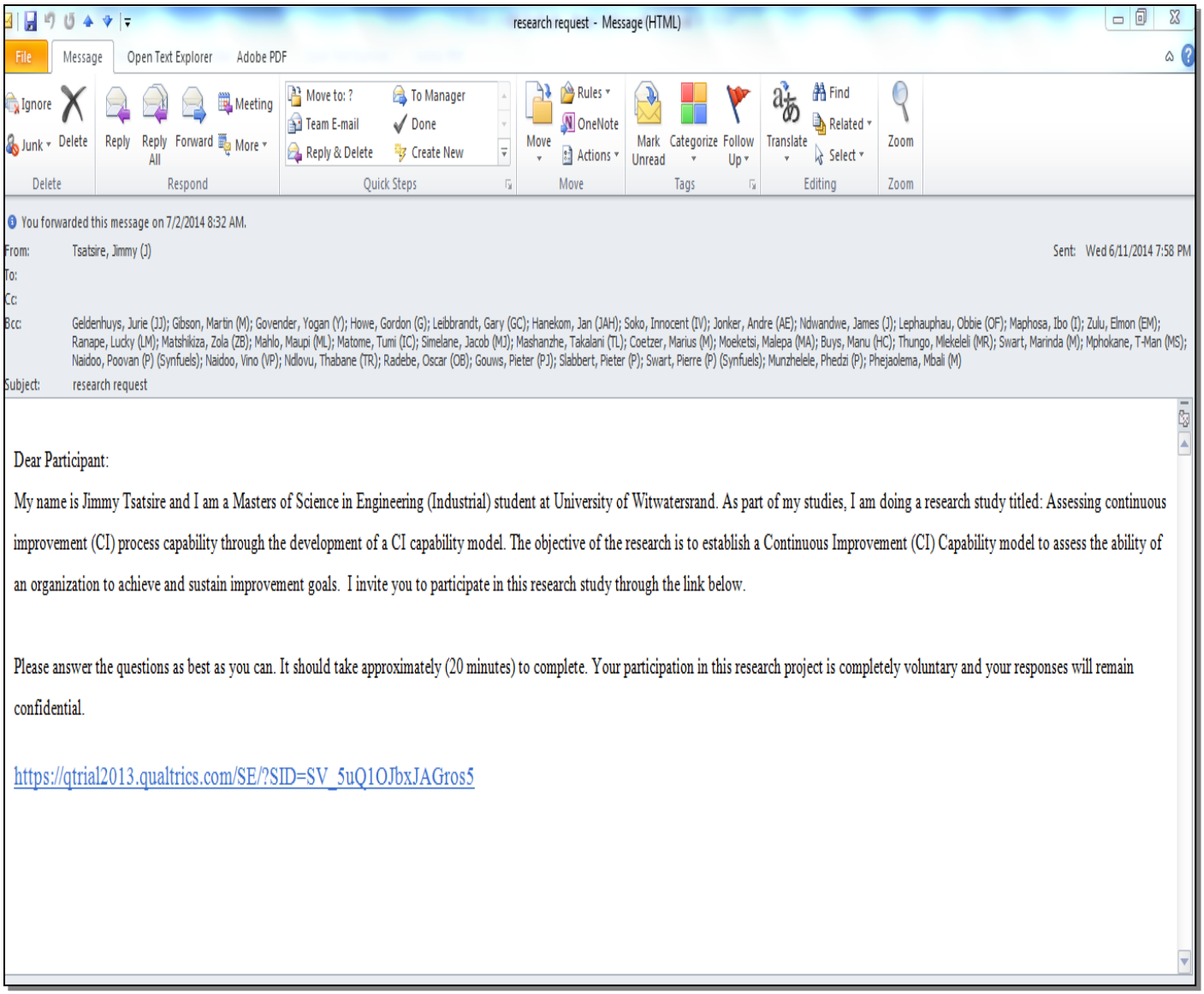
	Totally Unimportant	Unimportant	Important	Very Important
Top Leadership commitment and support	●	●	●	●
Types of Tools and technique applied	●	●	●	●
Target setting	●	●	●	●
Project Management Skills	●	●	●	●
Communication	●	●	●	●
Team Leader/Supervisor's ability to use improvement tools	●	●	●	●
Idea Generating Practices & Systems	●	●	●	●
Performance Review forums	●	●	●	●
Review methodology	●	●	●	●

	Totally Unimportant	Unimportant	Important	Very Important
Shop-floor ability to use improvement tools	●	●	●	●
Review forums frequency	●	●	●	●
Pipeline of improvement ideas	●	●	●	●
Employee participation	●	●	●	●
Monitoring and Measurement	●	●	●	●
Idea implementation rate	●	●	●	●
Project delivery	●	●	●	●
Improvement plans	●	●	●	●
Employee participation in improvement efforts	●	●	●	●
Recognition of	●	●	●	●

	Totally Unimportant	Unimportant	Important	Very Important
participating employees				
Training of employees on CI principles	●	●	●	●
Employee understanding of CI	●	●	●	●
Employee understanding of strategic goals	●	●	●	●
Leadership understanding of CI	●	●	●	●
Knowledge capturing	●	●	●	●
Knowledge sharing	●	●	●	●
Knowledge transfer	●	●	●	●

APPENDIX 5

COVER LETTER



research request - Message (HTML)

File | Message | Open Text Explorer | Adobe PDF

Ignore | Junk | Delete | Reply | Reply All | Forward | Meeting | More | Move to: ? | Team E-mail | Reply & Delete | To Manager | Done | Create New | Rules | OneNote | Actions | Move | Mark Unread | Categorize | Follow Up | Translate | Find | Related | Select | Zoom

Delete | Respond | Quick Steps | Move | Tags | Editing | Zoom

You forwarded this message on 7/2/2014 8:32 AM.

From: Tsatsire, Jimmy (J) Sent: Wed 6/11/2014 7:58 PM

To:

Cc:

Bcc: Geldenhuys, Jurie (JJ); Gibson, Martin (M); Govender, Yogan (Y); Howe, Gordon (G); Leibbrandt, Gary (GC); Hanekom, Jan (JAH); Soko, Innocent (IV); Jonker, Andre (AE); Ndwandwe, James (J); Lephauphau, Obbie (OF); Maphosa, Ibo (I); Zulu, Elmon (EM); Ranape, Lucky (LM); Matshikiza, Zola (ZB); Mahlo, Maupi (ML); Matome, Tumi (IC); Simelane, Jacob (MJ); Mashanzhe, Takalani (TL); Coetzer, Marius (M); Moeketsi, Malepa (MA); Buys, Manu (HC); Thungo, Mlekeleli (MR); Swart, Marinda (M); Mphokane, T-Man (MS); Naidoo, Poovan (P) (Synfuels); Naidoo, Vino (VP); Ndlovu, Thabane (TR); Radebe, Oscar (OB); Gouws, Pieter (PJ); Slabbert, Pieter (P); Swart, Pierre (P) (Synfuels); Munzhelele, Phedzi (P); Phejaolema, Mbali (M)

Subject: research request

Dear Participant:

My name is Jimmy Tsatsire and I am a Masters of Science in Engineering (Industrial) student at University of Witwatersrand. As part of my studies, I am doing a research study titled: Assessing continuous improvement (CI) process capability through the development of a CI capability model. The objective of the research is to establish a Continuous Improvement (CI) Capability model to assess the ability of an organization to achieve and sustain improvement goals. I invite you to participate in this research study through the link below.

Please answer the questions as best as you can. It should take approximately (20 minutes) to complete. Your participation in this research project is completely voluntary and your responses will remain confidential.

https://qtrial2013.qualtrics.com/SE/?SID=SV_5uQ1OJbxJAGros5

APPENDIX 6

RELIABILITY CALCULATION

Cronbach's Alpha	0.903093544
Split-Half (odd-even) Correlation	0.805545172
Spearman-Brown Prophecy	0.892301322
Mean for Test	88.84313725
Standard Deviation for Test	7.741845929
KR21	4.766084391
KR20	4.813941838

Reliability Calculator

created by Del Siegle (dsiegle@uconn.edu)

Questions 26	Subjects 51

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**1 4**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
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APPENDIX 7

CASE SITE ASSESSMENT MODEL

OE Process Health Check based on Blueprint

Complete the yellow cells based on the health check questions in column C (1=yes, 0=no)

Element	Element Description	OE Process Health Check questions (a selection of the blueprint practices assessment and puzzle questions translated for the OE process specifically)	Show me... Principles for the health check questions to be answered positively: a selection of the blueprint practices show me and puzzle questions	Alignment with Puzzle pieces (pp)	BU	Plant A	Plant B
4	Target setting	*Ensure relevant, cascaded QCDSM targets*		pp4	0%	0%	0%

	Annual	Does every section/team have (Q)CDSM targets, based on the BU targets and cascaded to section level	a. Proof of cascaded targets for QCDSM on lowest level (signed off) b. Regular communication with team regarding targets c. Updated communication boards	pp4	0.00	0	0
	Monthly	Are Q and D targets reviewed and updated regularly to ensure section level targets stay relevant (to fit the section's situation)	a. Regular target setting sessions are conducted b. OE calculator for mine/section D targets are used c. A process is in place to check targets per section	pp4	0.00	0	0
6	Run operations	*Ensure std compliance through assessment and coaching*		pp1,2	0%	0%	0%

	Section team	Each team's compliance to operational standards for QCDS are reviewed weekly through various assessments	a. Proof of underground assessments conducted by leaders and OE team (mines) b. Proof of standard compliance assessments conducted by leaders and OE teams (plants) c. Proof of safety, quality and cost check lists/reviews done on weekly basis to ensure standard compliance, SOP's, COP's	pp1	0.00	0	0
	Engineering	Work Management Process adhered to	a. Quality and integrity of WMP dashboard b. Proof of delivery of engineering tasks c. PDR meeting is effective	pp1,2	0.00	0	0
	Functional support services	The support services team is actively involved in reviewing and coaching teams to apply business principles and/or standards (Safety, HR, etc.)	a. Members of the services team goes underground/to shop floor level weekly b. Each team in the BU gets quality time for coaching from the services team at least once per month	pp2	0.00	0	0

	OE team's involvement	The OE team is actively involved in reviewing and coaching teams to apply OE principles daily	a. Members of the OE team go underground/to shop floor level weekly to coach based on gaps identified b. Each team in the BU gets quality time for coaching from the OE team at least once per month	pp2	0.00	0	0
7	Monitor operations	*Data systems are reliable and reporting done on time*		pp3	0%	0%	0%
	System health	*Mines:* Data recovery from DMS is > 95% *Plants:* operations monitoring systems are stable	a. Stakeholders meet monthly to discuss the health of the DMS (mines) b. Engineering/instruments teams take responsibility for the data recovery/stability of monitoring systems (mines and plants)	pp3	0.00	0	0

	Report availability	*Mines:* Daily opportunity reports and weekly reports and printed and distributed on time *Plants:* Monitoring systems are stable and accurate	a. Proof of high quality & integrity of opportunity reports a.2 Opportunity reports for each section sent by mail and printed before each shift (mines) b. Weekly reports sent by mail in time to use in weekly OE steercoms (mines) c. Proof that monitoring systems are stable and accurate (plants)	pp3	0.00	0	0
8	Measure performance	*QCDSM reporting adds value*		pp1,3	0%	0%	0%
	OE tool	QCDSM reports from the OE Tool are used by leaders	a. The OE tool is updated with QCDSM info on a weekly basis b. Reports from the OE tool are accurate and used to report on performance c. Leaders use the OE Tool reports in the	pp3	0.00	0	0

			OE Steercoms				
	Opportunity report	*Mines:* Opportunity reports are used daily in the s/b / miner pre-shift meeting to identify improvement opportunities *Plants:* Meaningful reports from the operations monitoring systems are used daily and weekly to identify improvement opportunities	a. Proof of completed and up to date opportunity reports used by the s/b and f/m for each section (mines) b. Proof of report from monitoring system used to identify improvement opportunities (plants)	pp1	0.00	0	0
9	Analyse gap	*Performance gaps are analysed to determine the correct focus areas*		pp1,3,5,6	0%	0%	0%
	U/g assessment	*Mines:* Underground section assessments are used to identify the correct focus area to close a KPI's	a. Proof of completed underground assessments with correlating quick hits to address gaps (mines)	pp3	0.00	0	0

		gap *Plants:* shop-floor level assessments of standard compliance are done to identify the correct focus areas for gap closure	b. Proof of completed assessment forms with correlating quick hits to address gaps (plants)				
	Filter	The action filter is used by teams to determine the correct action to take for gap closure and the escalation process is used to ensure management support	a. Proof of a Quick Hit and Support action list captured in action plan books b. Proof of Improvement action lists, captured in the OE Tool and IIP c. Proof of escalations of actions to relevant managerial levels and steercoms	pp1,5	0.00	0	0
	Quality of plans	Teams are involved in making and tracking plans to close performance gaps for QCDSM	a. Proof of involvement of teams to get bottom-up inputs b. Proof of Quick Hit books used for tracking c. Root Cause Analysis being done to	pp6	0.00	0	0

			identify true solutions				
10	Gap closure planning	*Effective planning and prioritisation for QCDSM plans and projects*		pp5,6	0%	0%	0%
	Action level	Effective planning for every improvement action, SCORE or DMAIC project is done	a. Proof of completed action plan forms for improvement actions (benefit calculation done) b. Proof of completed IVP forms for SCORE and DMAIC projects	pp5,6	0.00	0	0
	IIP	Integrated Improvement Plans (IIP)are used to plan QCDSM gap closure, to prioritise actions and to do resource allocation	a. Proof of current, up to date IIP's at least on BU and shaft level, used to guide the team's improvement actions b. IIP discussions take place in a dedicated forum (e.g. Specific IIP planning sessions or OE steercoms)	pp5,6	0.00	0	0

			c. Prioritisation is based on the 80/20 principle (min effort, max impact)				
11	Implement improvement plan	*Effective execution of projects and implementation of actions*		pp1,5,6	0%	0%	0%
	QH/SA/IA	Quick Hits, Support and Improvement actions are completed and ensure improvements in the BU	a. Proof of quick hits implemented b. Proof of support actions implemented c. Proof of improvement actions implemented	pp1,5	0.00	0	0
	SCORE	SCORE projects are executed and plans are implemented/alive in the BU	a. There are at least one SCORE project being executed in the BU at all times b. SCORE project timelines are adhered to (ave 8 weeks) c. SCORE team members are made	pp6	0.00	0	0

			available and commit to the project timelines d. SCORE project recommendations are implemented and embedded in the BU				
	DMAIC	DMAIC projects are executed and plans are implemented/alive in the BU	a. DMAIC project timelines are adhered to b. DMAIC team members are made available and commit to the project timelines c. DMAIC project control plans are implemented and embedded in the BU	pp6	0.00	0	0
12	Track & review improvement plan	*Improvement actions and projects are adding value in the business*		pp5,6	0%	0%	0%
	Systems	All improvement actions and projects are tracked for value delivery	a. Proof of SAP RPM updated weekly b. Proof of IIP tracking through the OE Tool	pp5,6	0.00	0	0

			c. Tracking reports from SAP RPM and OE Tool are discussed in the OE Steercoms				
	Value of Improvement actions	Improvement actions deliver value in the BU	a. Proof of value delivery of improvement (benefit) actions.	pp5,6	0.00	0	0
	Value (SCORE)	SCORE projects deliver value in the BU	a. Proof of value delivery of SCORE projects in the BU through RPM tracking b. Proof that SCORE project control plans ensure that implemented solutions stay implemented	pp5,6	0.00	0	0
	Value (DMAIC)	DMAIC projects deliver value in the BU	a. Proof of value delivery of DMAIC projects in the BU through RPM tracking b. Proof of DMAIC project embedding actions to ensure that implemented solutions stay implemented and that control plans are regularly checked	pp5,6	0.00	0	0

13	Capture & embed knowledge	*Good practices are embedded (sustainability)*		pp6	0%	0%	0%
	How we do things	Good practices implemented through support/improvement actions/projects are identified on section/shop floor level and transferred to other sections in the BU	a. Proof of good practice identification and transfer b. Proof of successful SCORE and DMAIC replication projects c. Proof of updating of SOP's/COP's/Induction/Training material	pp6	0.00	0	0
	People	New team members are trained and coached on the team's standards and the results of previous improvement actions and projects	a. Proof of updated training material after improvement actions or projects b. Proof of coaching of new team members by the team leader	pp6	0.00	0	0
14	Knowledge & competence	*Trained and coached to ensure people have the right skills and knowledge*		pp1,2	0%	0%	0%

	Schedules & registers	People are trained and needs are identified and addressed in a structured approach through schedules & registers.	a. Proof of job profiles linked to a skills matrix (especially *OE related skills*) b. Proof of training scheduling and attendance (especially S1-3,SMPT, POLC, POLC-in-action, puzzle program) c. External/new people are trained and coached on the OE way of doing	pp2	0.00	0	0
	T2 training	Compliance to the training matrix	a. Compliance to the BU T2 target for training	pp1	0.00	0	0
	T2/OE team doing competence assessment / coaching	Line team members' competences are assessed after training and coaching. Refresher training/coaching sessions are scheduled where necessary.	a. Proof of competence assessment and/or coaching records (SMPT, S1-3, POLC) b. Proof of refresher training incorporated in the training schedule c. Puzzle process rolled out and adhered to	pp1	0.00	0	0
15a	Meeting structure	*Meetings effectively govern business*		pp1,5,6,7	0%	0%	0%

		processes and QCDSM performance					
	General	Meetings have clear objectives and are effective in managing QCDSM performance and improvement	a. Proof of meeting objectives mapped against 5 Do questions b. Proof of meeting agenda, minutes and decision register per meeting c. Effective management of next steps	pp1,5,6, 7	0.00	0	0
	OE process health	OE Health Check is used in meetings	a. Proof that OE process health are measured and governed in the OE Steercom		0.00	0	0
	OE steercoms	OE Steercoms is effective	a. Proof that Do4&5 are the main focus of OE Steercoms b. Proof that meetings take place	pp6,7	0.00	0	0
15b	Organisation structure	*The right people in the right positions, roles and responsibilities*		pp2,7	0%	0%	0%

		are clear					
	General	Org structures are filled with competent people, OE related roles and responsibilities are clear and applied	a. Proof of vacancy rate, alignment of budget, staff establishment and actual b. Proof that the teams understand OE related roles and responsibilities per team/job c. Proof of OE related documentation (running/owning the OE process)	pp2,7	0.00	0	0
	OE structure	OE org structure is effective in support of the shaft/BU/SM	a. Proof that the OE team actively engages with the BU on a daily basis b. Proof that OE team delivers on all the roles and responsibilities per job c. No vacancies in team	pp7	0.00	0	0
16	Change mgt, comms, recognition	*Create OE energy and momentum*		pp2,7	0%	0%	0%

	C&C	OE related change management and communication plans are executed and create excitement and energy at shaft/BU/SM	a. Proof of OE-related C&C actions being executed weekly/monthly/annually b. Proof of OE energy in at shaft/BU/SM	pp2,7	0.00	0	0
	Recognition	OE related recognition creates the necessary "pull" to ensure momentum	a. Proof that there is a correlation between recognition and performance "pull" (e.g. production bonus, Super League, internal competitions)	pp7	0.00	0	0

APPENDIX 8

GAP ANALYSIS INSTRUMENT

Enabler	Not Assessed	Assessed	Score
Communication			2.0
Communication		x	2.0
Employee participation			1.0
Employee participation	x		1.0
Employee participation in improvement efforts	x		1.0
Improvement Methodology			1.0
Idea generating practices & systems	x		1.0
Types of Tools and technique applied	x		1.0
Information Management			2.0
Knowledge capturing		x	2.0
Knowledge Management			2.0
knowledge sharing		x	2.0
Knowledge transfer		x	2.0
Leadership commitment and support			1.0
Top leadership commitment and support	x		1.0
Monitoring			1.8
Monitoring and measurement		x	2.0
Performance review forums.		x	2.0
Review forums frequency	x		1.0
Review methodology		x	2.0
Project Management			1.5
Project Management Skills	x		1.0
Improvement plans		x	2.0
Idea implementation rate		x	2.0
Pipeline of improvement ideas	x		1.0
Project Results			2.0
Project delivery		x	2.0

Recognition			2.0
Recognition of participating employees		x	2.0
Strategy alignment			1.0
Employee understanding of strategic goals.	x		1.0
Target setting			2.0
Target setting		x	2.0
Training			1.0
Employee understanding of CI	x		1.0
Leadership understanding of CI	x		1.0
Shop-floor ability to use improvement tools	x		1.0
Team leader/supervisor's ability to use improvement tools	x		1.0
Training of employees on CI principles	x		1.0