QUALITY 4.0: REDUCING CUSTOMER COMPLAINTS

by

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DECLARATION

I, Gerrit Isaacs, declare that the content of this dissertation represents my own unaided work, and that the dissertation has not been previously submitted for academic review towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

Signed  Date: 15 July 2020

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ABSTRACT

The purpose of this research is to realise the positive change that comes from customer complaints experienced in the organisation. Analysis indicates by comparison that the number of customer complaints confirmed for the company in question did not decrease for a certain period. In the same period, the company lost market share to the opposition and the contribution to the bottom line was negatively affected. This prompted the research statement: *"Despite the efforts made by the quality management fraternity to ensure excellence in quality, high levels of product quality complaints still impede operations excellence."* The research adopted a mixed-method methodology with an explanatory approach. Through this approach, the researcher was able to investigate possible opportunities for the reduction of customer complaints. Quality 4.0 emerged from the research, and in particular, the framework developed by the LNS Research company suggested a possible fit or integration to the research and was subsequently pursued. This approach realised the objectives and the major hypothesis to support the research question was: "H1: The Quality 4.0 concept facilitates optimisation of the customer quality complaints of the traditional QMS." A survey questionnaire was adopted to support the research and the primary and secondary information analysed to form the opinion that is structured in Chapter 6 of this dissertation.

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GLOSSARY OF TERMS

Term	Description
Industry 4.0	Industry 4.0 refers to the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of Things, cloud computing and cognitive computing. Industry 4.0 creates what has been called a "smart factory". (Rajarajeshwari, 2016: **Online**)
Quality 4.0	It is suggested that Quality 4.0 includes the digitalization of quality management. This refers to the impact of that digitalization on quality technology, processes and people. (LNS Research, 2017: **Online**)
Customer Complaints	This refers to the formal dissatisfaction that is voiced to the organisation in written form. Defective produce leads to potential sources of complaints. (Juran, 1962)
Cost of Quality	This is considered as an important tool for monitoring and directing required action (Pyzdek, 1996).
Quality Management System (QMS)	Quality Management System (QMS) is a formal system that includes documenting the structure, responsibilities and processes required to achieve effective quality management (ASQ, 2013: **Online**).
Quality Culture	Quality culture is a set of group values that guide how improvements are made to everyday working practices and consequent outputs (Harvey, 2014).
Quality Maturity	Maturity implies *knowing*. At a low level of maturity, I might try something, but when the chips are down and the panic sets in, I will drop the method because I have not yet been fully convinced of its value to me in all situations (Changing Minds, 2017: **Online**).
Operations/ Business Excellence	Refers to the ability of the staff compliment and see the flow of value to the customer, and fix that flow when it breaks down (Duggan, 2007: **Online**).

CHAPTER 1
SCOPE OF RESEARCH – QUALITY 4.0: REDUCING CUSTOMER QUALITY COMPLAINTS

1.1 Introduction

Businesses today face many challenges and many organisations face changes through forced downsizing, right-sizing, mergers among other forms of transformation. All of this is required for the business to stay competitive and to survive in the industry (Leatherman, 2008). Due to the pressure exerted on organisations in this form, it is of utmost importance that operational functions, such as quality, remain effective to achieve the established organisational objectives. Studies conducted by Fisher (1992) have confirmed that there is a direct relationship between high-quality products and operational performance. In this regard, customer complaints have an inherent effect on business excellence. This research relates to such an environment, with specific reference to the packaging industry. The packaging industry is particularly challenging, as this commodity is considered secondary to the primary product, but an important component to the food industry (Ernst & Young Quality Group, 2013: **Online**). As such, organisations are always looking for better and cheaper alternatives to improve their secondary packaging option (PACSA, 2015). It is therefore imperative that the organisation supply the customer and more importantly the consumer with high-quality products. This continuous push from customers for high-quality products translates in more pressure to the business.

Nampak Ltd., as the largest packaging company in Africa, faces these challenges on a day-to-day basis. The organisation supplies metal, glass and plastic packaging products to various companies in South Africa. For this organisation to remain competitive, it has to ensure the supply of good quality products to its customers. The organisation also has to ensure that its manufacturing processes are done in the most cost-effective manner. In Nampak, challenges in the quality function, specifically the metals cluster, have resulted in high levels of product complaints about the organisation's products in recent years. These complaints challenges will form the basis of the research. Juran (2013) argues that customer complaints could be observed as an assertion of defective products or service. These complaints

impact directly on business performance and the profit margins of the business. Yeung et al (2014) suggest that there is a direct relationship between customer satisfaction and profit margins of a business operation. In the day-to-day activities of the operation, this will include rework, freight and all costs of waste associated with the value chain in the manufacturing of the product. In the view of Zinzi (2011), the quality function is an integral part of the business, and this function which is observed and approached in different forms has progressed over the years. Quality gurus have emerged over the years and introduced different approaches over time (Gidey, Beshah and Kitaw, 2014). For example, Gidey et al. (2014) noted that the history of quality as a key function of production stems from the primeval period in the past through the three industrial revolutions.

Recent publications have suggested that some organisations have embarked on the inception of the Fourth Industrial Revolution, abbreviated 4IR or Industry 4.0 (Jacob, 2017: **Online**). An article published by Deloitte Insight (2017: **Online)** articulates that "*The Fourth Industrial Revolution is here and executives need to be ready. It is clear that the old way of doing things isn't enough anymore, and those who make the most impact will be the ones who embrace all facets of Industry 4.0 and the opportunities it will bring*". The same article continues to explain that value creation through implementation of Industry 4.0 is discussed in many articles and is perceived as the best way forward for businesses in the contemporary global dispensation. A short description of Industry 4.0 as described by Aldag (2008) is that it is an extension of the digital impact of the third industrial revolution.

According to Peressotti (2016), Industry 4.0 is observed as a new economic model for the industrial world. This model seeks to advance the Industrial 3.0 model of computer, PLC (Programmable Logic Controller) and digital machines to convergence IT (Internet Technology), autonomous machines and advanced robotics through the incorporation of Big Data, the Internet of Things, cyber-physical systems (Baldassare, Ricciardi & Campo, 2016: **Online**). The key aspect coming out of the Industry 4.0 research so far is that the business environment will realise a "smart" environment where "smart" technology will allow people to operate in a "smart" way, thus making life easier for all and enabling organisations to operate efficiently. This will be dealt with in more detail in the relevant chapters.

Emerging from Industry 4.0 is the concept of Quality 4.0. According to Pedersen (2017: **Online**), Quality 4.0 is an advertence of Industry 4.0. Quality 4.0 entails the digitalisation of quality management and compliance systems. The purpose of Quality 4.0 is not to replace the current quality systems that are in place but to improve the overall quality by incorporating new technology. LNS Research has done extensive inquiries on Quality 4.0 and has developed a framework for Quality 4.0. This framework forms an integral part of the research and is discussed later in the dissertation. The framework describes the process of applying the technologies used in Industry 4.0 to the traditional quality environment.

According to Jacob (2017: **Online**), Quality 4.0 is not a narrative about technology, but rather how the concept can assist in improving culture, collaboration, competency and also leadership. The primary aim of the framework developed by LNS Research is to facilitate the optimisation of the quality management process. This in particular relates to the research topic of the optimisation of customer complaints. Jacob (2017: **Online**) argues that the framework will help with attaining the required level of operational excellence in the ambit of Industry 4.0. In the context of the research statement, this study seeks to explore the opportunity of learning more about the proposed framework with the expected outcome of assessing how this framework can optimize the current business situation.

1.2 Motivation

The primary objective of establishing a business is to supply a product or to deliver a service (Atkinson, 1990). Products or services are supplied to an internal or external customer based on pre-agreed requirements. To achieve or exceed the expectations of the customer, many organisations have implemented Quality Management Systems (QMS) in the business to support the business strategy. In most cases, the quality fraternity employs the methodologies of gurus such as Phillip Crosby, Edward Deming and Ishikawa among others, as part of the strategy to ensure high quality products, services and processes in the organisation. Crosby alluded to the importance of getting it right the first time for a business organisation to meet customer requirements (Crosby, 1984). He pointed out that customer complaints are indicative of the performance of the quality management system of the organisation. The current situation of the Nampak DivFood quality, particularly

the magnitude of customer complaints, necessitates the need for an intervention to ensure an improvement and business continuity. The reasons for this statement are the following:

- The data suggests that the number of customer complaints has increased over the last three calendar years.
- Financial reports confirm that the market share for the business has continued to decrease year on year for the same period. Marketing reports also support the statement.
- The financial position of the organisation has also deteriorated over the last 3 years and the gross profit margins declared in the relevant financial reports confirms the statement.

Chapter 2 reviews this statement in more detail, but for the sake of research motivation, the analysis conducted indicates that the number of customer complaints in Nampak DivFood has reached unacceptable levels. The approach of Quality 4.0 and in particular, the framework developed by the LNS research (2017: **Online**) facilitates an opportunity to investigate the current situation experienced and could assist in developing avenues to achieve optimisation.

Deloitte Insight (2017: **Online**) explains that the implementation of Industry 4.0 is a long process and indeed certain pre-requisites need to be fulfilled before this can be attained within an organization. The same premise could be used for attaining full Quality 4.0 in any organisation. The research conducted thus far suggests that this framework could facilitate improvement in the areas of concern. The researcher suggests that this framework could be beneficial to the current inquiry. The framework supports the investigation through addressing the current challenges experienced by businesses in adopting Industry 4.0. The minimum expected outcome from this research would be to prove or disprove the hypothesis developed on whether this framework would facilitate an improvement of the traditional quality.

In conclusion, the research will yield benefits in the following ways:

- **Personal**: An opportunity to expand knowledge in a field that is relatively new and providing theoretical academic growth through conducting research methodically and through a structured approach.

- **Business**: The opportunity to address the current challenges concerning high levels of quality complaints as well as to assess and understand the current situation within the ambit of the research. The research also enables an exploration of ways of enhancing current methods and frameworks, together with offering the opportunity to grow knowledge of current trends of industrial revolution and alignment with technology.
- **Institution**: To grow individual and group theoretical knowledge and academic prowess. The research also fosters the growth of an institutional knowledge base and support future candidates in studies through learning

1.3 Background to the Research Problem

1.3.1 Introduction

The aim of a background to the study is to introduce the reader to the research environment (Saunders, Lewis and Thornhill, 2016). This research focuses on the reduction of product quality complaints within the ambit of a fast consumer goods manufacturing organisation. A key element in the research is to establish how the new Quality 4.0 model and to what extent the Quality 4.0 framework can facilitate the reduction of customer complaints.

1.3.2 Problem

Contextualising the content necessitates a clear definition of the problem to address the root cause. An explanation of the following two topics seeks to address the aforementioned:

- Current situation elaborated.
- An analysis conducted to determine key components (Ishikawa model).

1.3.3 Current situation elaborated

Staiculescu (2012) expresses the opinion that the provision of a high-quality product or service is key to business excellence. Burrill and Ledolter (1998) support this statement by depicting that rules and formal instructions should be in place to realise these requirements. According to the business dictionary (2018: **Online**) “quality in manufacturing is a measure of excellence or a state of being free from defects, deficiencies and variations.” This statement is key to the adoption of this

research project within the Nampak environment. In support of dissecting the problem, information was obtained from the relevant databases. This process resulted in the adoption of Figure 1.1 that seeks to illustrate the issue on hand in graphical terms.

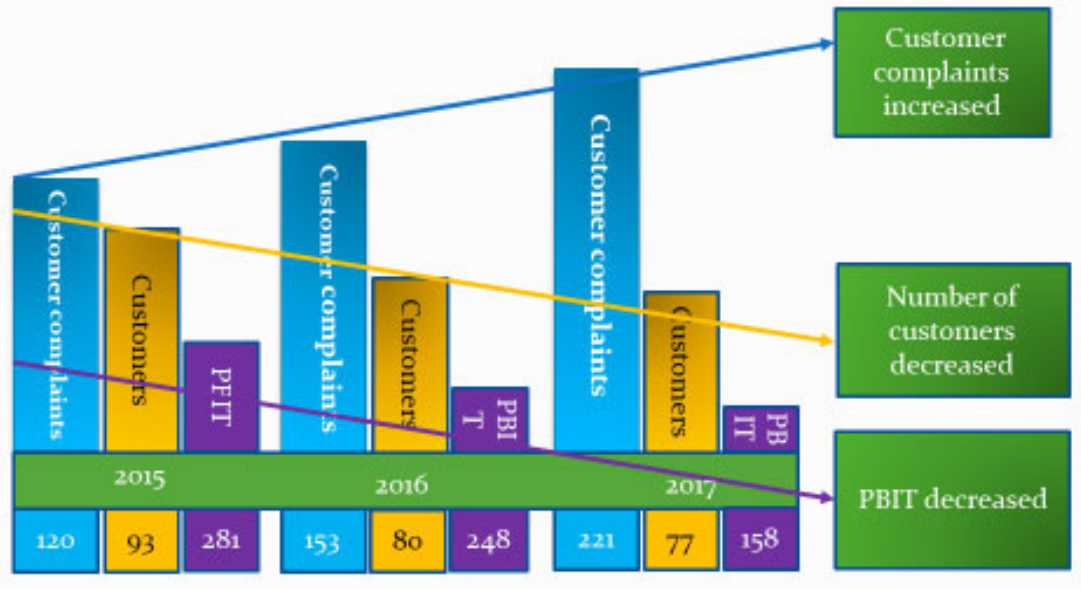

Figure 1.1: DivFood customer complaints 2015 to 2017

*(**Source**: Own construct)*

Figure 1.1 is the researcher's illustration of what has transpired in the calendar years of 2015 to 2017 within DivFood, with regards to customer complaints. It should be noted that this is not a causal relationship between the variables used, but rather a depiction of trends based on the information that was made available. The illustration also includes information about the number of customers and the organisational finances for the same period. The following key features are illustrated on the graph:

- The first element in the graph illustrates the number of product customer complaints for the three-year period. This number increased over this period and this trend indicates ineffectiveness.
- The second element in the graph indicates that the number of customers over the same period declined.
- The third element in the graph relates to the finances in the form of profit before interests and tax for the same period.

1.3.4 Analysis conducted

The collected data on customer complaints mentioned in the previous section was analysed using the Ishikawa model. The variables used in the analysis were the actual complaint, corrective action and preventative actions recorded on the internal system. Some of the findings points towards the causes related to the labour section of the diagram. Chapter 2 contains more in-depth details on the cause and effect diagram. This model was used in the initial research on the premise that the key elements of the cause and effect diagram will be incorporated into the Quality 4.0 framework. Through this approach, the research will address the research objectives.

1.3.5 Scope summary

The analysis of the data suggested that the organisations will have to address the problems as highlighted in chapter 2 of this dissertation. All indications are that the key elements in the organisation are heading in the wrong direction. It is important to acknowledge that these problems are addressed by the different operations on a day-to-day basis. The research realises an opportunity to address these challenges away from the manufacturing environment with a different approach and scientific reasoning. Through the reduction of customer complaints, the expectation is that the number of returns and spoilage can be reduced and the profit margin can be increased.

1.4 Research design framework

The research design framework used in this research is the hypothesis framework as illustrated in the figure below:

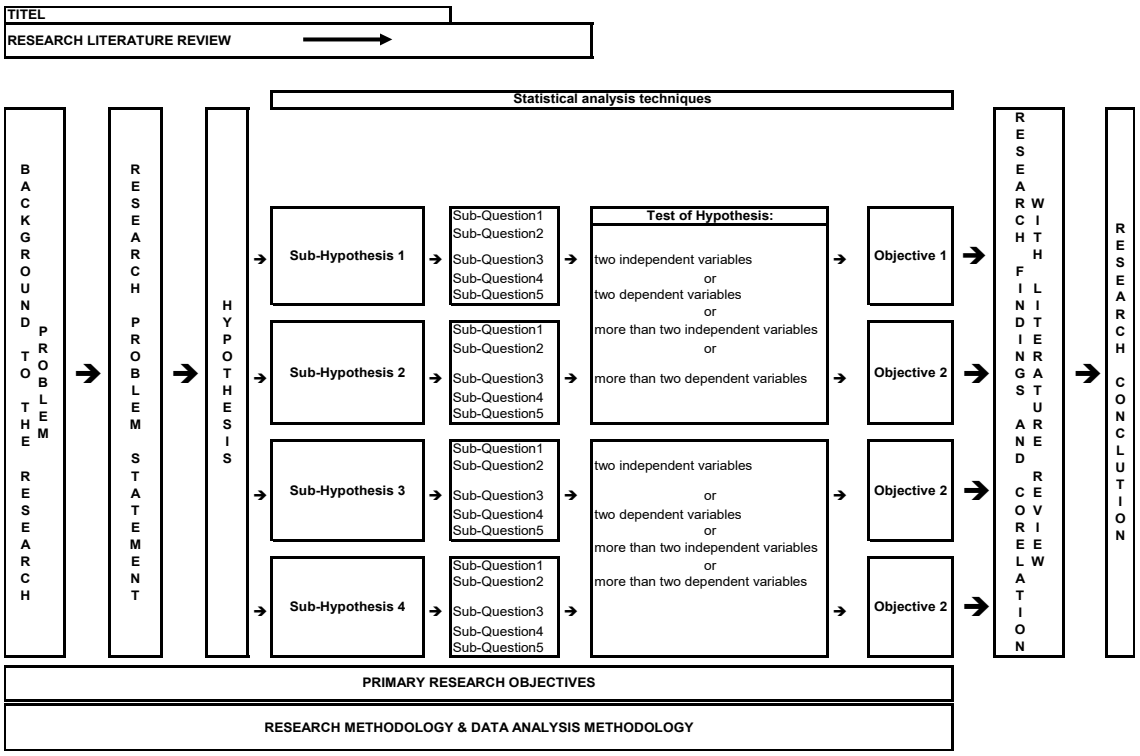

***Figure 1.2**: Hypothesis design framework* (**Source**: Own construct)

De Vaus (2011) argues that the function of a research design is to secure substantial proof that will support the research and confirm a systematic approach to the research problem. The above design is a systematic approach to the study which aims to address all the relevant areas required for the investigation. As seen in the illustration in Figure 1.2, the research starts with the background of the problem, which prompted the research in the first place, followed by addressing the remaining areas in a logically constructed manner. It is also important to note how the literature review, research methodology and data analysis methodology are described, depicting the importance of those categories throughout the research process. The research methodology underpins the framework as it gives direction to the research and supports the analysis of the data collected. The objectives of the framework are positioned strategically towards the end of the framework and are key for the researcher to ensure that he/she does not veer off in the wrong direction. The final area of concern is the validation of the data and the depiction of the findings. This all leads up to the conclusion or the recommendations required for the dissertation.

1.4.1 Statement of the research problem

The problem statement in the ambit of this study is centred on the reality that despite the efforts made by the quality management fraternity to ensure excellence in quality, high levels of product quality complaints still impede operations excellence within the organisation.

1.4.2 The research question

The area of concern identified for the research is the high levels of product customer complaints experienced within the organisation. These levels reflect the ineffectiveness of the Quality Management System or some quality control elements within the system. This leads to the research quest to advance an appreciation of how the Quality 4.0 concept can facilitate customer complaints optimisation within the organisation.

1.4.3 Hypotheses

The following major hypothesis and sub-hypotheses were formulated from the research question.

- **Major Hypothesis**

H1: The Quality 4.0 concept facilitates an optimisation of the customer quality complaints of the traditional QMS.

- **Sub-Hypotheses**

Sub-H1: Digitalisation as a key element of Quality 4.0 relates positively to the optimisation of product customer complaints.

Sub-H2: Quality culture as a key element of Quality 4.0 positively affects the optimisation of product customer complaints.

Sub-H3: Competency as a key element of Quality 4.0 positively affects the optimisation of product customer complaints.

Sub-H4: Leadership as a key element of Quality 4.0 relates positively to the optimisation of product customer complaints.

1.4.4 Research objectives

1.4.4.1 Primary objective

The primary objective of this research study is to provide a comprehensive overview of how Quality 4.0 can facilitate the optimisation of customer complaints.

1.4.4.2 Secondary objectives

The secondary objectives are as follows:

- To determine how digitalisation in Quality 4.0 can positively optimise customer complaints.
- To determine if the Quality 4.0 cultural elements exist within the current quality system of DivFood, and if so, to what extent.
- To establish what level of competency is required to better facilitate the optimisation of product customer complaints.
- To establish the correlation between leadership and the escalation of customer complaints.

1.5 Abbreviated Literature Review: Quality 4.0 - Optimising product quality customer complaints.

1.5.1 Introduction

The aim of reviewing the abbreviated literature is to demonstrate that the researcher is aware of previous academic work concerning the topic of investigation (Mouton, 2000). He also added that the literature review enables the incumbent researcher to assess the work performed in the field and the tools used in the study. In this regard, this research aims to assess the factors to reduce customer complaints. The research is in the ambit of Industry 4.0 with the focus on Quality 4.0 to affect assistance with the research problem.

1.5.2 Review

Industry 4.0 is a relatively new venture for many companies and indeed for many countries. In the South African context, Industry 4.0 and Quality 4.0 are in the early stages of study and invariably needs to be understood further (Deloitte, 2017: **Online**). Similarly, Quality 4.0, as a new concept, is a reference to Industry 4.0

(Pedersen, 2017: **Online**). It is in the interest of all organisations (or at least should be) to keep abreast with what is happening globally and more importantly, lessons that can be drawn from the rest of the world and incorporate them into the organisation to optimise operational excellence and ultimately improve the bottom line. To demonstrate compliance with the research protocol, the following topics will be briefly discussed in this section:

- Industry 4.0
- Quality 4.0
- Customer complaints
- QMS systems and framework
- QMS effectiveness
- Quality culture
- Quality maturity
- Competency
- Digitalisation

1.5.3 Industry 4.0

The work published by Aldag (2018) suggests that Industry 4.0 is a result of the natural progression of the industrial revolution over the last millennium. Figure 1.3 below illustrates and briefly describes the evolution of Industry 4.0 (LNS Research, 2017: **Online**). Industry 4.0 was referred to as the technological evolution from embedded systems to cyber-physical systems. It represents the Fourth Industrial Revolution on the road to an Internet of Things, Data and Services with decentralised intelligence in manufacturing and production processes (I-Scoop, 2016: **Online**). Today, Industry 4.0 has a broader industrial scope in the sense of the Industrial Internet (De Clerk, 2017: **Online**). De Clerk (2017: **Online**) emphasises that the important phrase to use in this revolution is “smart” as all the technology is designed around having everything done smartly.

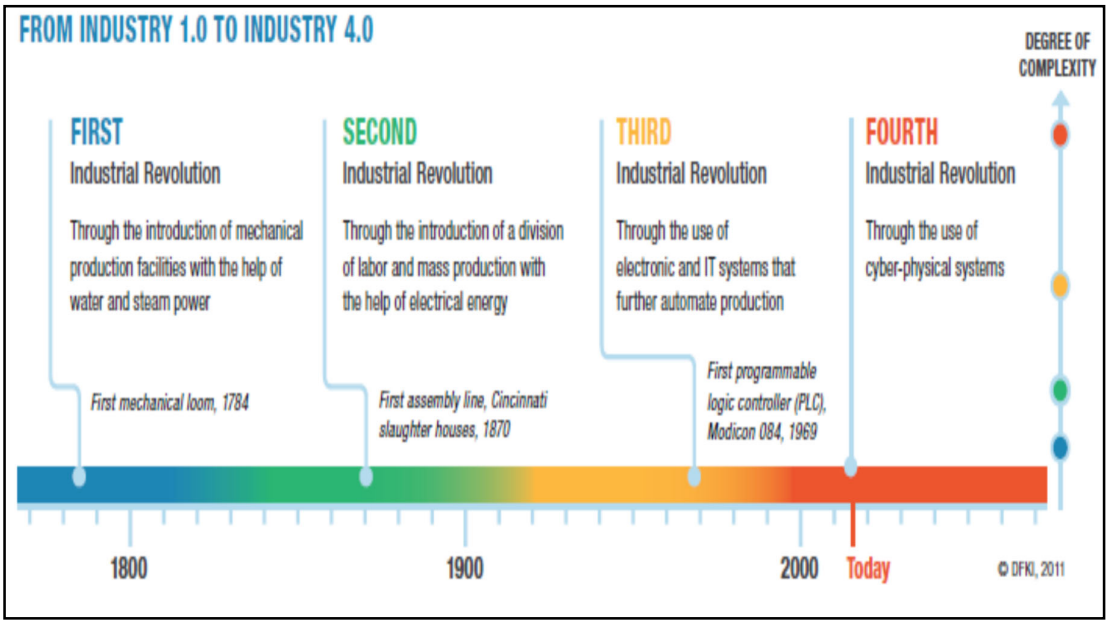

***Figure 1.3**: Industry progression* (**Source**: LNS Research)

1.5.3.1 Origin

Rathfelder and Lanting (2014) argue that the evolution of Industry 4.0 started around 2011. They further alluded that the term, Industry 4.0, originated in Germany *(hence 'Industrie 4.0').* In this research, the production and manufacturing function in the organisation will be the focal point of the Industry 4.0 concept. This is so because of the belief that there is keen interest from the rest of the world in this phenomenon.

1.5.3.2 Progression

The publication by De Clerk (2017: **Online**) and many other publications show that the trend of Industry 4.0 is localised to the departmental functions. This resulted in the initiation of terms such as Quality 4.0. The LNS Research group has done extensive research on the topic and has subsequently released a comprehensive handbook for Quality 4.0 (LNS Research, 2017: **Online**). This handbook thoroughly explains the suggested quality framework used in this research. De Clerk (2017: **Online**) continues to elaborate that functions in all areas of the operation have also been developed. For this reason, the trend is to focus on the current developments in functional departments. The LNS Research realised the new terms such as Logistics 4.0, Engineering 4.0 and so forth, which are now also coming to the fore.

1.5.4 Quality 4.0

Quality 4.0 is described as the digitalisation of the quality management function, which supports the agenda of Industry 4.0 (Pedersen, 2017: **Online**). There is a strong belief that traditional quality methods have lost their effectiveness and businesses should apply innovative new quality management approaches (Urbach and Roglinger, 2017). The aim of Quality 4.0 is not to replace the traditional quality approach, but to enhance the current quality management methods (Jacob, 2017: **Online**). Figure 1.4 illustrates the traditional approach in blue and the green part focuses more on the functions that will enhance the traditional quality management approach. The framework will be embedded in the research and will be used extensively to realise ideas for improvement which enables the business to reduce the current customer complaints situation in the organisation.

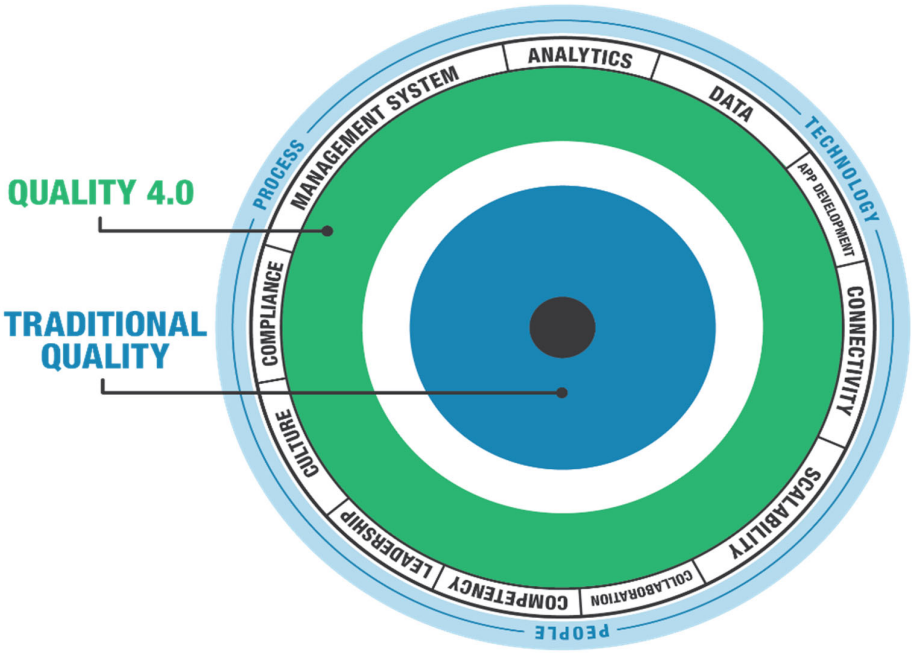

***Figure 1.4**: LNS Research Quality 4.0 Framework*

(**Source**: LNS Research)

1.5.5 Customer Complaints

According to Drucker (1973), the purpose of a business is to create a customer to provide a product or a service to. On the other hand, a complaint can be termed as an expression of the quality deficiency by the same customer (Juran, 1990). Customer complaints are unwelcomed in any business from a customer as well as

a manufacturer point of view. Customer dissatisfaction is greatly influenced by the expectations of the customer (Keiningham *et al.*, 2007). In many businesses, systems and procedures have been put in place to record and address customer complaints. In the case of Nampak, these systems and procedures exist. In this respect, the problem that will be addressed through the research is the determination of why these complaints have increased and what can be done to effectively reduce the number of complaints.

1.5.6 QMS Systems and Framework

A Quality Management System (QMS) is a formal framework designed to manage documents, regulate responsibilities and guide processes to achieve effective quality management (ASQ, 2013: **Online**). Over the years, quality gurus have introduced different quality control techniques to assist the quality management systems (Gilmore, 1974). Quality gurus such as Edward Deming, Joseph Jura and Philip Crosby were instrumental in developing such tools:

- Deming developed the 14-point knowledge and system approach, and statistical approach.
- Juran developed the 3 focal points: quality processes, quality planning, quality control (P hyphen LAN-DO-CHECK-ACT).
- Crosby believes in zero defects, and conformance to operational requirements/standards.

Frameworks such as Total Quality Management (TQM), Lean Manufacturing and Six Sigma, have been adopted by many organisations and with successful implementation in some areas. Further to this, many tools were developed to assist the quality management functions and again, many organisations used it successfully, whilst some could not. In the ambit of the research, the framework developed by LNS Research constitutes such a tool, which could be used on the same premise as the abovementioned.

1.5.7 QMS Effectiveness

1.5.7.1 What is QMS?

A QMS is a formal process that companies use to review the its operations, its products and services with a specific view to identifying areas of quality improvement (Synergos, 2018: **Online**). The effectiveness of the QMS system is directly related to the number of customer complaints.

1.5.7.2 What is QMS effectiveness?

Neyestani (2016) suggests that the effectiveness of the QMS system is paramount for the success of the organisation. He found that the effective implementation of a QMS system can improve customer satisfaction, followed by cost, and time respectively. This finding confirms that there is a definite link between QMS effectiveness and product quality complaints from customers. This statement is aligned with the core of the research and as such will be investigated further. The ISO 9001 Audit Group (2009: **Online**) created the cyclical method to determine the gap of effectiveness in QMS. This model can be examined in more depth and used to determine QMS effectiveness and will be investigated further in this research.

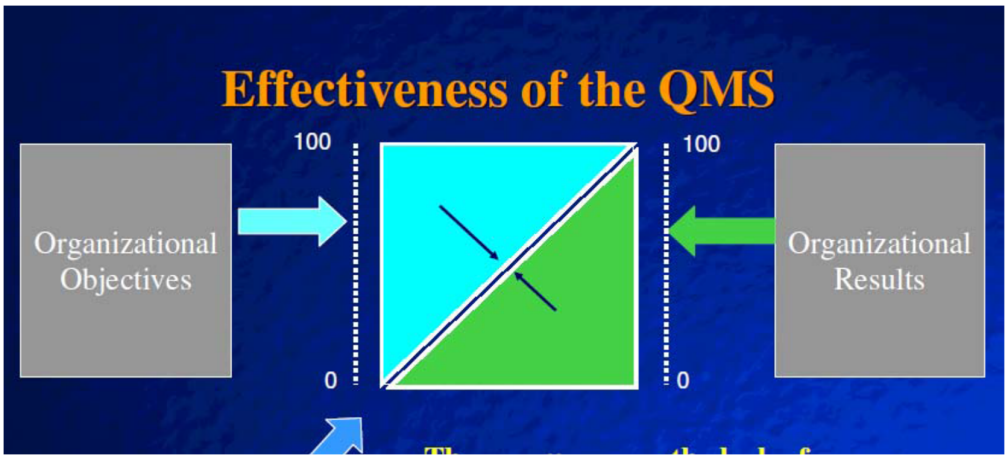

***Figure 1.5**: Gap analysis technique* (**Source**: 9001 Auditing Practices Group)

1.5.8 Quality Culture

"Quality culture is a set of group values that guide how improvements are made to everyday working practices and consequent outputs in a business organisation" (Harvey, 2014: **Online**). Robbins (2001) argues that a quality culture is the glue that

holds organisations together. The statement by Harvey and Green (1993) captures it very well by saying: “a culture of quality is one in which everybody in the organisation, not just the quality controllers, is responsible for quality.” Indeed, quality culture is a very important trait in the organisation and as such demands the desired attention for operational excellence to be achieved. This function should be on the top of the agenda of QA managers purely because of its importance. Powell (2017, **Online**), a leadership advisor, suggests that seven important elements should be in place to create a solid quality culture and these are:

- Consistency
- Usefulness
- Learning
- Truthfulness
- Utilitarianism
- Respect
- Empowerment

These elements should build a strong foundation for a respectable and effective quality culture in a business organisation. Baird (2011) advises that the cultural dimension of teamwork and respect can be seen as crucial factors to enhance Total Quality Management (TQM) practices. These elements form part of the functions that can also be used in the organisation to assess the current situation.

1.5.9 Quality Maturity

Maturity implies knowing. At a low level of maturity, I might try something, but when the chips are down and the panic sets in, I will drop the method because I have not yet been fully convinced of its value to me in all situations (Changing Minds, 2017: **Online**). A dimension of maturity is an understanding of each employee, combined with adequate information about his or her responsibility within the quality management system (Patti, Hartman and Fok, 2001). The conclusion made from the above is that intrinsic values are important to achieve an acceptable level of maturity within the organisation. As the originator of the concept in quality maturity in the quality environment, Crosby (1979) developed a maturity grid, which the researchers argue is very insightful in understanding quality management practices.

The maturity grid comprises the five stages that an organisation and individual go through and these are as follows:

- Uncertainty - 'Quality problems are the fault of the Quality Department only.'
- Awakening - 'Quality management might fix problems properly.'
- Enlightenment - 'Management and quality people are working together to fix problems.'
- Wisdom - 'Quality management integrates into the way we do things.'
- Certainty - 'We do not have quality problems because we understand everything.'

This maturity grid will be incorporated into the research to determine the maturity level of the organisation. The research also concluded that there are more grids available and these will be subsequently investigated. If found fit, they will also be incorporated into the research.

1.5.10 Competency

According to Tobergte and Curtis (2013) competency is the ability to apply skills learned and capabilities acquired to effectively perform a certain function. In the ambit of Quality 4.0 and Industry 4.0, competency is a crucial requirement for success. As alluded to previously in this dissertation, the digitalisation of quality and the automation of systems in Industry 4.0 will require exceptional competence. The traditional quality framework also requires competent people in the organisation to ensure that products or services rendered are of good quality. The impact of low competence will be assessed in the research and the direct relationship to customer complaints will be focused on.

1.5.11 Leadership

Ciulla (1998) suggested that leadership is not a person or a position. She further explained that “it is a complex moral relationship between people and this relationship is based on trust, obligation, commitment, emotion and a shared vision of the good”. Leadership in quality is crucial to organisational existence and survival. Leatherman (2008) notes that an important attribute of a good manager is to have good values and ensure that values are present in all of the workers. The

importance of certain elements of the leadership function forms part of the research with particular focus on the current state of affairs in the organisation.

1.5.12 Conclusion

The literature review is important to ensure that the researcher is aligned with the scope of the research. In this regard, the review must demonstrate, in abbreviated form, that the research question and the subsequent sub-questions are adequately covered. This protocol assists the researcher in the formulation of the research and acts as a guide throughout the investigation process. The abbreviated literature review can also be seen as a “snapshot” to the work that will be conducted in the dissertation. The abbreviated literature review does address the key questions of the research, but it is clear to the researcher that there are areas that require more attention. This will be addressed in the ensuing chapters of the dissertation as required.

1.6 The Research Process

1.6.1 Introduction

This section gives insight into the process of “how” the research will be conducted as suggested by Dudovskiy (2017: **Online**). He depicts the research process as encompassing the following:

- Selecting the research area.
- Formulating the research aim, objectives and/or developing hypotheses.
- Conducting the literature review.
- Selecting methods and tools of data collection.
- Collecting the primary data.
- Data analysis.
- Reaching conclusions.

1.6.2 Selecting the research area

This process starts with the expression of professional or personal interest in the subject matter. It also captures the true motives of the research. One can also conclude that if it is beneficial for the researcher in itself, it will motivate the researcher even more. In the ambit of this research, the area of concern relates to

the existence, continuation and the survival of the organisation in a very competitive business environment. The area of this research is in the realm of the quality environment and specifically related to the reduction of customer complaints.

1.6.3 Formulating research aim, objectives and research questions or developing hypotheses

The objective of this research is to formulate suggestions on how to improve the current situation concerning high levels of customer complaints in the organisation. Initial research led to the discovery of a framework that could assist to achieve this objective. A hypothesis was developed and will be supported by additional sub-hypotheses in the research that will address the objective.

1.6.4 Conducting the literature review

Literature review is the process of ascertaining what research has already been conducted on the topic. It also enables the researcher to assess what tools were used by previous researchers. This allows the researcher to use different or new tools in investigating the same subject matter. The topic chosen for this research is still relatively new and this is an opportunity to increase the literature pool for academics. Some of the supporting topics in the research have been researched and the results are used to support the investigation. Textbooks, journals and electronic research engines will primarily be used in the study.

1.6.5 Selecting methods of data collection

Data are classified as primary and secondary data (Kothari, 2004). The collection of data can be done in several ways. Some researchers believe that interviews and observing are traditionally used more frequently than any other method (Kohn and Christiaens, 2013). Kohn and Christiaens (2013) also suggest the four major data collection methods used are as follows:

- Semi-structured individual interview: Searching for data through questioning using conversational techniques.
- Focus groups: Consist of a series of group discussions facilitated by the researcher.

- Observation: Used amongst other things to understand what people say around complex situations.
- Delphi Survey: Aims to reach consensus amongst expert panelists.

These methods should be assessed and evaluated to establish which one or more are the most suitable for the preferred research design.

1.6.6 Collecting the primary data

Primary data are data that are collected as “fresh” data and can also be termed as original whilst secondary data are depicted as data that are available or have passed through the statistical or analysis process by other researchers (Kothari, 2004). He further states that in research, primary data are collected through experiments, observations and interviews.

1.6.7 Data analysis

Analysis of data plays an important role in the achievement of research aims and objectives. Culén (2010) explains that the purpose of analysing data is to generate usable and useful information that can support the researcher’s point of view. Culén continues to explain that the analysis of the data assists the researcher in making meanings and interpretations from both qualitative or quantitative data. Research has indicated that the steps taken for analysing the data are applied differently by researchers. Marshall and Rossman (2011) explained that there are five basic steps used in data analysing as captured by Miles and Huberman (1994). Other researchers of this topic, such as Mauthner and Doucet (2003), Wolcott (1994) and Lewis-Beck (2003) address the concept of data analysis slightly differently. The figure below will serve as a brief explanation of the steps suggested by Miles and Huberman (1994).

Table 1.1: Stages of Data Analysis

Techniques at various stages of analysis		
Steps	Description	
1.Narrative	Make metaphors Note reflection on collected data	
2.Coding	Note patterns and themes Cluster data Partition the variables	Relationships between variables Find intervening variables

	Factor	Follow up surprises
	Develop codes and apply to and textual data relationships	Identify patterns, themes
	Conduct investigation of common/ different aspects	Categorise and sort data
	Order and reorder data by chronology and importance	
3.Interpretation	Look for plausibility	Build a logical evidence chain
	Make theoretical coherence	Weigh the evidence
	Check the meaning of outliers	Use extreme cases
	Make if-then tests	Rule out spurious relations
	Develop interpretations	Develop hunches
	Restate question to fit data	
4.Confirmation	Triangulate	Count
	Contrast and compare	Check representativeness
	Check for researcher effects	Look for negative evidence
	Replicate a finding	Check out a rival explanation
	Get feedback	Verify interpretations
	Constantly compare data	
5.Presentation	Use visual displays	

(**Source**: Miles and Huberman, 1994)

1.6.8 Conclusion

Conclusions of the abbreviated literature relate to the level of achievement of research aims and objectives. The areas covered in this section give more insight into the research, particularly giving clarity on whether the topic material is available and what was researched in the past. The literature review also gives insight on which tools and techniques accompanied the previous studies. Much more information is available and will be used, but this section will be concluded here.

1.7 Research Design and Methodology

1.7.1 Introduction

Libguides (2018: **Online**) suggests that the premise of research design entails planning the overall strategy to be used by the researcher to conduct the study logically. The article further states that the research design is fundamentally the blueprint for the collection, measurement, and analysis of data. The Business Dictionary (2018: **Online**) defines the research methodology as the process used to collect data which assists decision-making. Figure 1.5 above describes the research conducted by Saunders, et al. (2015), in which they created the research 'onion' for simplification of understanding research design and methodology. In their model, the layers of the research 'onion' simplify the researcher's decision on where or how the research will be contextualised.

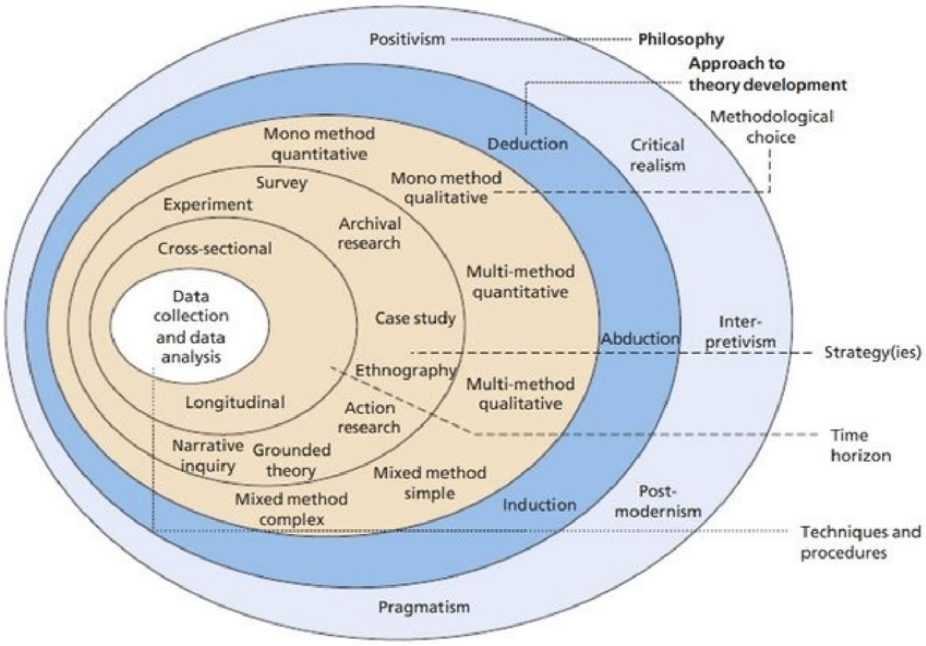

***Figure 1.6**: Research "Onion"*

(**Source**: Saunders, Lewis, & Thornhill, 2015)

1.7.2 Research philosophy

Saunders et al. (2016) describe the research philosophy as a system of convictions and underlying assumptions for the construct of knowledge. Five research philosophies exist and according to Rahman (2016), there are two major camps of

researchers. These paradigms are Positivism and Interpretivism. Below, the five philosophies are listed and the two major philosophies defined:

- Positivism
- Critical realism
- Interpretivism
- Postmodernism
- Pragmatism

1.7.2.1 Positivism

Positivism is the philosophical interpretation of the natural scientists and it entails working with an observable social reality to produce plausible generalisations (Saunders et al, 2016). Bryman (1988) suggests that positivism usually includes the following:

- The methods employed in the natural sciences are appropriate for the study of social phenomena.
- Only those phenomena that are observable can be counted as knowledge.
- Knowledge is developed inductively through the accumulation of verified facts.
- Hypotheses are derived deductively from scientific theories to be tested empirically.
- Observations are the final arbiter in theoretical disputes.

1.7.2.2 Interpretivism

Interpretivism differs from positivism in that researchers form beliefs from a subjective perspective (Saunders et.al, 2016). The authors further elaborate that humans are different from physical phenomena because they create meaning. Ritchie, and Lewis, (2003) cited Kant, who proposed the following assumptions about interpretivism:

- Perceptions not only relate to the senses but to human interpretations of what our senses tell us.

- Our knowledge of the world is based on an understanding that arises from thinking about what happens to us, not just from simply having had particular experiences.
- Knowing and knowledge transcend basic empirical enquiry.

1.7.3 Research approach to theory development

The research approach can be defined as the plans and procedures for research that depict the steps derived from assumptions, to detailed methods of data collection, analysis and interpretation of the data. The approach to theory development consists of three classifications, namely the deductive, abductive and inductive approaches. The information below is a short description of each of these approaches of theory development.

- **Deductive**: In its most simplistic form, deductive reasoning begins with the general and works through the approach to the specific. It is also commonly known as the the-top down approach to theory development (Marshall and Rossman, 2011).
- **Inductive:** Inductive reasoning works directly in the opposite direction from deductive. Inductive inquiry uses the specific and seeks to generalise the topic (Marshall and Rossman, 2011).
- **Abductive:** This describes a process of logical inference that begins with the observation of phenomena, then dissects the information to realise the simplest and most likely explanation (Josephson, and Susan, 1994).

1.7.4 The methodological choice

This section deals with the approach that guides the study. Six methods or approaches are available, of which the researcher mostly used three. These are qualitative, quantitative and mixed-method. Silverman (2010) comments "…if you are concerned with exploring people`s life histories and everyday behaviour, then qualitative methods may be favoured". On the other hand, Ritchie, and Lewis, (2003) argue that quantitative research deals with numbers and everything that is measurable in a systematic way of investigation and their relationships. The mixed-method is a combination of qualitative and qualitative methods. Researchers have established that in research, quantitative approaches to research are used more.

This approach is followed the mixed-method and lastly the qualitative approach (Adat, 2014). Since the mixed-method is a combination of the two approaches, one can conclude that it will overlap invariably in certain areas of the research. Table 1.2 below gives more insight on how the two approaches differ.

Table 1.2 Comparison of quantitative and qualitative research approaches

	Quantitative	Qualitative
General framework	Seek to confirm hypotheses about phenomena	Seek to explore phenomena
	Instruments use more rigid style of eliciting and categorizing responses to questions	Instruments use more flexible, iterative style of eliciting and categorizing responses to questions
	Use highly structured methods such as questionnaires, surveys, and structured observation	Use semi-structured methods such as in-depth interviews, focus groups, and participant observation
Analytical objectives	To quantify variation	To describe variation
	To predict causal relationships	To describe and explain relationships
	To describe characteristics of a population	To describe individual experiences
		To describe group norms
Question format	Closed-ended	Open-ended
Data format	Numerical (obtained by assigning numerical values to responses)	Textual (obtained from audiotapes, videotapes, and field notes)
Flexibility in study design	Study design is stable from beginning to end	Some aspects of the study are flexible (for example, the addition, exclusion, or wording of particular interview questions)
	Participant responses do not influence or determine how and which questions researchers ask next	Participant responses affect how and which questions researchers ask next
	Study design is subject to statistical assumptions and conditions	Study design is iterative, that is, data collection and research questions are adjusted according to what is learned

(**Source**: Research Field Guide)

1.7.5 Research Strategy

Saunders, et al. (2016) define a research strategy as a plan of how the researcher will conduct his research to answer the research question or address the

hypothesis. These strategies are listed briefly described in the table below. The definitions used below are cited from Saunders et al (2016).

Table 1.3: Research strategies described

Research Strategies	
Strategy	**Description**
Experiment	A type of research that uses natural resources. Features strongly in psychological and natural sciences.
Survey	Usually associated with deductive reasoning. Frequently used to answer 'what', 'who', 'where', 'how much' and 'how many'.
Archival and Documentary	The digitalisation of data has made it easy for researchers to conduct online research. Access available around the world.
Case Study	In-depth inquiry into a topic within its real-life setting. "Case" can refer to a person, group, organisation etc.
Ethnography	A written account of a group of people or ethnic group. Used to study the culture or social world of a group.
Action Research	An emergent and iterative process of inquiry that is designed to develop solutions to real organisational problems through a collaborative and participative approach.
Narrative Inquiry	A story or personal account which interprets an event or a logical sequence of events.

(**Source**: Saunders et al., 2015)

1.7.6 Techniques and procedures

Each research has techniques and procedures that constitute the manner in which the collection of data and the analysis of the collected data is done (De Vos, Fouche and Delport, 2005). In Section 9.1.4 of this dissertation, the researcher cited several researchers to explain the types of methods for data collection. Culén (2010), Marshall and Rossman's (2011) views on the steps of data analysis are explained in Section 9.1.6. Further techniques used as part of the research methods of the dissertation are as follows:

- Units of analysis
- Sampling methods
- Variables

1.7.7 Conclusion

In this research, an inductive research through a mixed-method approach supports the aim of the research. Saunders et al. (2015) suggest that inductive research aims to develop a thorough understanding of the collected data to realise a plausible theory. This suggestion is aligned to the scope of the research, where data is collected, analysed. The measurement of data through scientific research will support the research, and the testing of hypotheses will lead to plausible conclusions.

1.8 Data Collection Design and Methodology

1.8.1 Introduction

The data collection design and methodology types are addressed in detail in Chapter 4 of this dissertation. The information has been analysed and a decision made as to which methods will be suitable for the collection of data in the context of this research and the research environment.

1.8.2 Methods of Data Collection

There are two data collection methods chosen for this research and these are briefly discussed below.

i. **In-depth surveys:** The reason for selecting this data collection method is that this research is conducted at a divisional level. The group used for this research will consist of quality managers, quality engineers, quality system managers, quality system auditors and quality supervisors. This will allow for knowledgeable participation in the process of data collection.

ii. **Questionnaires:** This option can also be seen as an extension of the survey. Saunders et al. (2016) suggest that a questionnaire is a technique of data collection in which all the participants are required to respond to the same questions in a predetermined order. In the ambit of this research, the questionnaire will support the collection of data as this could be directed at

the rest of the quality group. In this event, two or more members of each plant can be selected to represent their plant.

1.8.3 Units of analysis

According to Mouton (2001), the unit of analysis refers to what is being studied in a research. The unit of analysis for this research will entail the following:

- Leadership
- Competence
- Culture
- Digitalisation

1.8.4 Sampling method

Sampling is an important element of the data collection process and as such, it is described as ~~a~~ the selection of a small collection of units from a larger population (Wurtz, 1960). Non-probability sampling in the form of the purposive sampling technique was used in this study.

1.8.5 Variables

The variables used in this research are individuals. More specifically, the senior functions directly responsible for the QMS in the organisation under study. The other variables used are the maturity, culture and effectiveness of the QMS.

1.8.6 Conclusion

The data collection design and methods alluded to in this section is used to assist the study to reach its objectives. The researcher takes cognisance of the fact that other factors may come into play during the research. This may necessitate the introduction of a method not mentioned in this section. The sampling design that fits this research is non-probability sampling. The type of non-probability sampling considered for this research is purposive sampling. It is still possible that other research techniques may be required during the investigation.

1.9 Data Validity and Reliability

1.9.1 Validity

Active Research blog (2016: **Online**) explains that validity speaks to how much the research departs from its originally intended claim. They further argue that "Validity in this sense is a concept drawn from the positivist scientific tradition and needs specific interpretation and usage in the context of qualitative research" (2018: **Online**). According to the blog, the following types of validity in the context of qualitative research exist as explained in the table below.

Table 1.4: Types of validity

Types of validity	
Face validity	Concerned with whether the researcher measures what has been claimed to be the target measurement. It assesses how valid a measure appears on face value and makes subjective judgements based on the claim.
Content validity	Verifies whether the content of a measure covers the full domain of the content.
Construct validity	A construct represents a collection of behaviours that are associated in a meaningful way to create an image or an idea invented for a research purpose.
Internal validity	This refers to the extent to which the independent variable can accurately be stated to produce the observed effect.
Statistical conclusion validity	A determination of whether a relationship or co-variation exists between cause and effect variables.
External validity	This refers to the extent to which the results of a study can be generalised beyond the sample.
Criterion-related validity	Can alternatively be referred to as instrumental validity. It states that the accuracy of a measure is demonstrated by comparing it with a measure that has been demonstrated to be valid.

(**Source**: Active blog, **Online**)

1.9.2 Reliability

Reliability refers to the repeatability of a particular set of research findings; that is, how accurately they would be replicated in a second identical piece of research (Active campaign, 2018: **Online**). Changing Minds.org classifies reliability in the following manner:

- "Inter-rater: Different people, same test.
- Test-retest: Same people, different times.
- Parallel-forms: Different people, same time, different test.
- Internal consistency: Different questions, same construct" (2018: **Online**).

Research on reliability highlights the importance of accuracy and making sure in your research that the central idea of the same data is articulated in the same way by different researchers. A perfect everyday illustration of reliability is demonstrated in archery. This sport illustrates that if the archer shoots the arrows in the same area every time from the same place, then it depicts consistency. If the inverse happens, then consistency or reliability is compromised.

1.9.3 Ethics

Saunders et al. (2009) define ethics in the ambit of investigation as the researcher`s responsibility to ensure that all relevant people linked to the research be treated in accordance to the stipulated rules for proper research and scientific investigation conduct. Research ethics are based on the principle that researchers should at all times be mindful of how they conduct their research. Saunders et al. (2009) further state that in ethics, the privacy of the interviewee is of utmost importance and that all work should be done in line with the principle of confidentiality whilst deception should be non-existent. Andre Samuel remarks that, "Ethics is all about the participants." He further states how a researcher can safeguard him or herself as well as what to avoid in the research process. These safeguards and issues to avoid are as follows:

i. **Safeguards:**

- Explain the study benefits.
- Explain participation rights and protections.

- Obtain informed consent.

ii. **Avoid:**

- Deception
- Infringement of privacy
- Confidentiality breaches

1.9.4 Research assumptions

Marilyn Simon, an Associate Faculty Member at Walden University, suggests that assumptions in research are somewhat out of the researchers' control, but if they disappear, then the research becomes irrelevant (Simon and Goes, 2011: **Online**). Further to this, Leedy and Omrod (2001) notes that, "Assumptions are so basic that, without them, the research problem itself could not exist". Based on the insight from the literature, the following assumptions are pertinent in the research:

- Management buy-in to participate in the research study.
- The information or data received from different factions in the organisation is accurate and has been recorded timeously.
- The data capturers are all qualified and have some level of knowledge pertaining to the organisation's products and the classification of defects.
- The participants are all willing to participate in the research study without being forced.
- The participants, more specifically those in the quality department, are skilled and have a certain level of experience in the required industry.
- A certain level of scholastic and computer literacy is present.
- All participants in the study experience the research in a positive light and the study is in the interest of the organisation.

1.9.5 Research constraints

Research constraints can either be in the form of limitations or delimitations. Collis and Hussy (2003), suggest that limitations are the weaknesses in the research, while de-limitation explains how the study was only focused on one area as opposed to a wider or holistic approach.

1.9.5.1 Limitations

The main limitation in this research is that the research question is specific to an organisation that is experiencing certain challenges relating to the centre of this research. In some areas, the research may be deemed biased, but in the context of the research, the information may be of importance to other organisations. More specifically, the organisations that experience similar challenges can find the information useful.

1.9.5.2 De-limitations

The main delimitations in this research are as follows:

- Availability of participants.
- Willingness to participate.
- The information required limited to the organisation.

1.10 Chapter and Content Analysis

The chapter and content analysis applicable to this dissertation are as follows:

- **Chapter 1: Scope of the research**

This chapter will address the reason for the research and motivate why it should be done from multiple perspectives.

- **Chapter 2: Background to the research environment**

This chapter will focus on the area in which the research will be conducted. Information or data required for the research will be obtained in this environment and will ultimately be applied in this environment as well.

- **Chapter 3: Literature review**

In this chapter a literature review will be conducted on the primary theme of the dissertation, providing an empirical underpinning to the research problem. More specifically, the literature review will provide academic context to the unique aspects that would mitigate the research problem.

- **Chapter 4: Data collection, analysis, and interpretation of results**

From a qualitative perspective, this chapter reflects on the approach to data collection. It also focussed on the analysis and interpretation of the collected data.

- **Chapter 5 & 6: Problem mitigation, recommendations and conclusion**

In this concluding chapter, key aspects of the research will be revisited. Research findings will be brought into the context of the overall research, recommendations will be made, and final analogies will be drawn.

1.11 Significance of the Research

The significance of the research in the opinion of the researcher is explained from three perspectives and these are described as follows:

1.11.1 Personal

From a personal point of view, the research allows for the expansion of knowledge in the ambit of research area as well as the understanding of the topic. It also opens up the hypothetical door to what is happening in the current business environment and gives a little more insight into the global experience.

1.11.2 Organisational

From an organisational point of view, this research could potentially point out what is done incorrectly in the organisation. It can expose lessons from observing what others are doing in the industry and determine the correct levels of benchmarking for operation in the organisation. This research could potentially optimise the current situation. The optimisation is crucial for increasing the bottom line as companies need to deliver for the survival of the business and to satisfy all stakeholders and clients.

1.11.3 Institutional

The institution works on a “give and take” premise as students are equipped with the knowledge of how to conduct proper research. The expectation from this is that the obtained information will be shared with the institution to be made available to other students. Through closing the loop in this manner everyone benefits at the end.

CHAPTER 2
BACKGROUND TO THE RESEARCH PROBLEM – QUALITY 4.0: REDUCING CUSTOMER COMPLAINTS

2.1 Introduction

The objective of this chapter is to explain the context in which the research took place. In addressing this objective, the researcher considered and captured the following points:

- Background.
- Current customer complaint situation.
- Quality management systems in DivFood.
- Competition in the current and previous context.
- Significance of research.
- Conclusion.

2.1.1 Background to the research problem

The global agenda is placing organisations under pressure to deal with the complexities of the business environment (Slack et al., 2007). This includes the reduction of overheads and increasing operational effectiveness whilst sustaining quality output. This equates to the exertion of more pressure to all the different functions in the organisation. As a result, departmental managers have challenging decisions to make, which include the sharing of responsibilities and controlling resources in their areas of responsibility. Regarding the subject title, the reduction of customer quality complaints is a crucial component in the sustainability of any organisation. In the ambit of this research, the same requirements apply to the organisation under investigation.

Nampak Ltd., as the biggest packaging company on the African continent, has experienced and is still facing the same challenges (See Figures 2.2 and 2.3.) As part of the operation`s continuous improvement efforts, the organisation started introducing different strategies and incorporated different methodologies to deal with these challenges. Recently, operation excellence strategies emerged in the organisation through the methodology of “Buy better, make better and sell better” Nampak, DivFood (2018). The basic requirement of the methodology is to develop

new strategies to improve in these three areas. The fundamental requirement remains to reduce cost whilst the organisation is safely managed for profitability. With this objective in mind, the organisation still needs to deliver quality products in full and to ensure sustainability through continuous growth. Nampak as a packaging organisation currently operates in three major sectors in the industry, namely metals, glass and plastics. The R&D function supports the organisation as a separate entity from the manufacturing functions. Figure 2.1 below illustrated the divisional structure for Nampak.

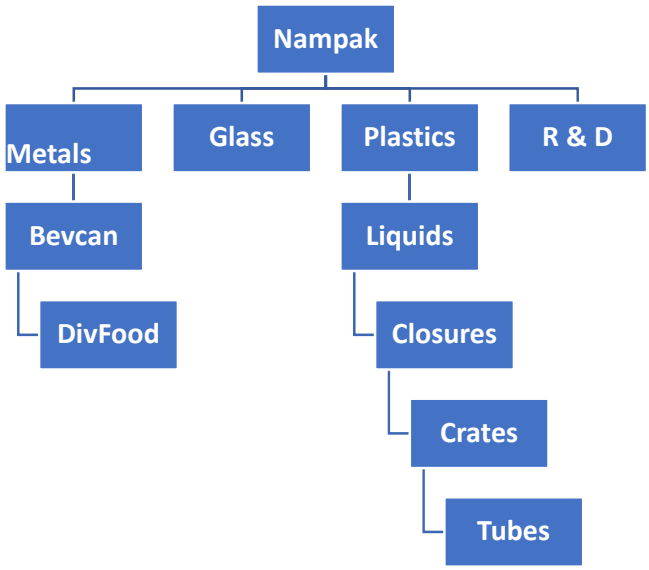

***Figure 2.1**: Nampak Divisional Structure*

(**Source**: Own construct)

2.1.1.1 Metals division

The metals sector of Nampak consists of two divisions, Bevcan and DivFood. Bevcan manufactures aluminium cans for beverage products whilst DivFood focuses on manufacturing tinplate food packaging and diversified products in the form of 2 and 3-piece cans. Plants are located throughout South Africa.

2.1.1.2 Glass division

The glass division manufactures glass containers for different industries, amongst which the biggest customers include the beer industry, which fills large volumes of different shapes and sizes of glass containers.

2.1.1.3 Plastics division

The plastics cluster includes Nampak Crates, Closures and Tubes, Liquid, and Liquid Cartons. This division also has an international interest in the form of a plant in the United Kingdom. The focus of this investigation will be on the metals cluster. More specifically, it will deal with the food section of the DivFood division in the metals cluster.

2.1.2. Current customer complaints situation

The metals division has been through a challenging period in the last couple of years with regards to customer complaints (DivFood Internal Report, 2018). Despite the use of Quality Management Systems in the division, the data analysed indicates that there is no significant reduction in customer quality complaints over a three-year period. With the appointment of the new CEO, a new strategy emerged to steer the group towards operational excellence. As alluded to earlier, the high-level strategy simply states that the organisation should “Buy better, make better and sell better”. In line with this strategic objective, the research falls in the “Make better” section of this organisational strategy.

Nampak DivFood has spent over R400 million over the last five years to improve technology in the metals division. All of the plants in this division have Quality Management Systems in place with various ISO accredited systems. The plant quality manager directs the QMS and has a dotted line reporting responsibility to a divisional quality manager. The QMS consists of a divisional electronic document system; called Q-Pulse, which is responsible for electronic uploads of all relevant divisional quality related documents. The electronic document system employs a function that allows for the capturing of all customer complaints. This function in return allows for updated statistics about customer complaints. This information has been made available for the research as part of an effort to address the current situation. Phillip Crosby (1979) alerted researchers to the fact that at least the price of non-conformance should get the attention of top management.

This alert provides organisations with a clue on the need for quality improvement and pinpoints the areas where improvement is required. An analysis of the data retrieved from the database indicated that the current situation in the organisation

constitutes a more in-depth investigation and for this reason, the topic chosen for this research matches the needs of the organisation. Graph 2.2 and 2.3 below illustrates the current situation within the organisation regarding customer complaints. The first graph depicts the divisional status and the second graph demonstrates the food section within the division. The food section will be the primary area of focus for this investigation.

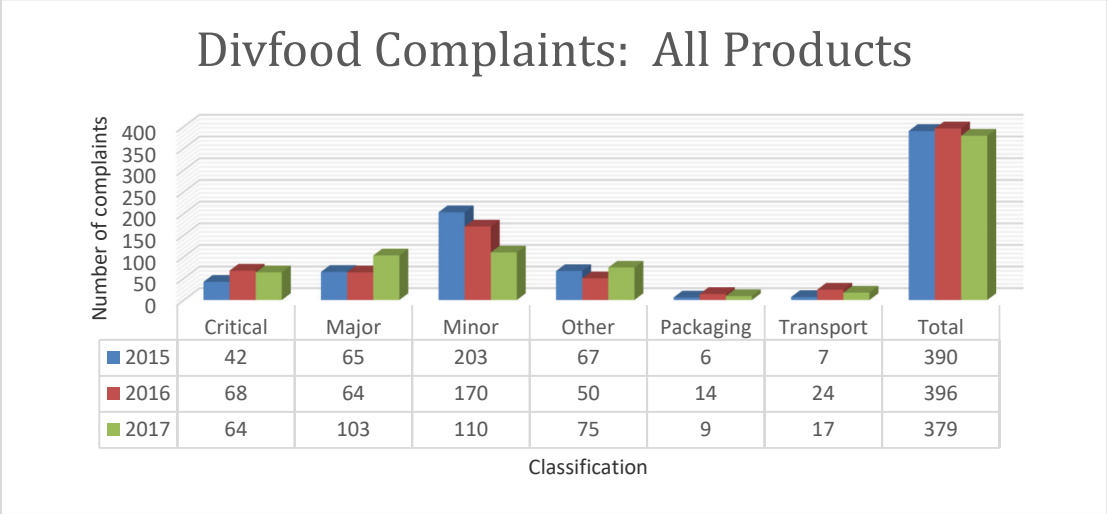

***Figure 2.2**: DivFood Customer Complaints - All Products*

(**Source**: Own construct)

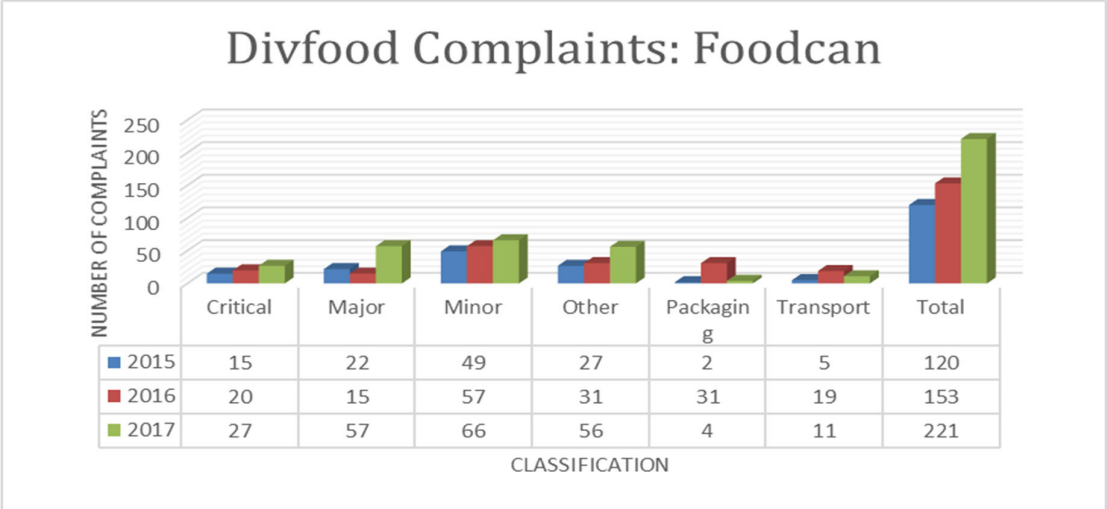

***Figure 2.3**: DivFood Customer Complaints – Food Cans*

(**Source**: Own construct)

The illustrations above are open to different ways of interpretation. In this regard, the validity of the information supplied will be dealt with in more detail in Chapter Four of this dissertation. The objective of this chapter is only to indicate the levels of customer complaints currently experienced in the organisation in support of the research question. Some of the information retrieved from the above images shows that the increasing trend in the number of customer complaints is visible on both levels in the organisation. As part of the Nampak “making better” strategy, DivFood has started a process to improve the current situation through the initiation of a quality council.

The divisional quality manager drives this initiative with the assistance of all the relevant stakeholders. The premise of this research is to work parallel with the programme that is currently underway in this business. The expected outcome of the research is to assist the organisation in improving quality so that the customer complaints can be reduced. The research intends to look at this situation from a different perspective and seek a different approach, perhaps a more scientific approach to holistically look at the problem and make recommendations to further improve the situation about customer quality complaints.

2.1.3 QMS in DivFood

The American Society for Quality (ASQ) defines a Quality Management System as a formalised system that documents processes, procedures and responsibilities for achieving quality policies and objectives (ASQ, 2013). In the history of DivFood, great effort has realised the accreditation of all the DivFood plants on ISO. These accreditations of the ISO systems are a crucial part of the business objectives, as they yield many benefits for the organisation. The assumption, based on the information, is that the current QMS in place is ineffective. The quality function in any organisation is straightforward and acts as a “go, no go” gauge for products. If one imagines the “go, no go” function of the QMS as a boom gate, the following questions remain:

- How do the incorrect products go through the boom gate?
- Who opened the gate?
- Did someone make a hole in the fence to let these products through?

2.1.4 Competition in the current and previous business context

George (2000) suggests that business leaders today have to respond to intense competition in the environments they operate in. He continues to describe how the business leaders of today are challenged to seek ways to become more competitive in a rapidly changing business world. The history of DivFood indicates that the can-making portion of the organisation has enjoyed the monopoly in the market for many years. Competition became a reality to the food and beverage packaging industry in South Africa recently and this brought some challenges to the organisation.

In the DivFood context, this reality “hit home” when the organisation started losing sales to the business rivals or competitors. One of the plants for example, lost 90 million units in one season to a competitor. This reality forced operations to radically reduce cost and improve effectiveness within the organisation. The context and importance in which one view customer quality complaints becomes more apparent when considering the angle of the competition. Good business practises suggest that a decline in customers should equate to a decline in customer complaints. Initial investigations suggest that the inverse happened and may still be happening in the organisation.

2.1.5 Significance of the research

The research aims to contribute towards the reduction of the number of customer quality complaints currently experienced within the organisation. This research will enable the researcher to look at the methodology employed to address the problem currently, and further explore what other methods are available and apply a scientific research approach to assist. The research also allows the organisation to stay relevant to external trends in the area of this research and compare what others are doing concerning the future of quality-related issues. Developments in the realm of Industry 4.0 have realised alternative views for organisations to approach business strategies. In particular (and with reference to the research topic), Industry 4.0, Quality 4.0 has emerged as a strategy to help businesses to achieve this (Pedersen, 2017: **Online**).

2.1.6 Conclusion

This chapter briefly described the context or background in which the research will take place. The chapter illustrates how the current situation is not conducive to the sustainability of the organisation from the perspective of the researcher. The researcher suggests that the emerging of competition into the packaging industry forces the organisation to review current practices and if needed, align practises and strategies to ensure a leading approach in the industry. In this regard, it is leant from Einstein himself where he illustrates that one cannot expect a different outcome whilst still doing the same things. With the abovementioned philosophy in mind, the current way of doing things in the operation must change to produce a different or positive outcome. The aim of the research is to achieve an outcome that can contribute to the overall improvement of the business as this will ensure existence and sustainability of the organisation.

CHAPTER 3

LITERATURE REVIEW – QUALITY 4.0: REDUCING CUSTOMER COMPLAINTS

3.1 Introduction

This chapter attempts to illustrate compliance of the research process through reviewing the literature that is available on the topic under investigation. The research topic chosen for this research study is currently still considered relatively "new" in the ambit of research. As such, the literature review includes sections that adopt an explanatory approach. The literature review includes the following topics:

- Introduction to Industry 4.0
- Introduction to Quality 4.0
- Digitalisation as a key element of Quality 4.0
- Quality culture as a key element of Quality 4.0
- Competency as a key element of Quality 4.0
- Leadership as a key component of Quality 4.0
- Customer quality complaints.

3.2 Introduction to Industry 4.0

3.2.1 Industry 4.0 defined

> *"The factory of the future will have two employees: a human and a dog. The task of the human will be to feed the dog. The dog will have the task to dissuade the human to touch the automated system."* - Mr Warren G. Bennis

According to Piccarozzi and Aquilani (2018), Germany coined and first used the term Industry 4.0 in 2011 as part of a new proposal by the government. Mrugalska and Wyrwicka (2017) confirmed this statement and continued to elaborate that the rest of the economic world latched onto this term and which is now globally used. They argue that even though there is great interest around the world on this topic, there is no formally respected definition for it. Renjen (2018) suggests that organisations who wish to improve should consider the integration of digital and physical technologies across all areas of business, production, mobility and communication. These requirements are critically important in the current environment as a base to start from and exceptionally more for the future. Past

research indicates that well-known German organisations such as Siemens and General Electric have been involved since the inception of this phenomenon and have already started selling products on the premise of Industry 4.0 (Vaidya, Ambad and Bhosle, 2018 and Zezulka et al., 2016). Stock and Seliger (2016) state in their conference paper that the development towards Industry 4.0 currently has a substantial influence on manufacturing industries. They continue to elaborate that this influence imposed is based on the establishment of smart factories, products and services embedded on the industrial internet.

“The term Industry 4.0 can be applied to three different situations, that is: when people, machines and industrial processes are intelligently networked and interact with each other; when components interact independently with a plant whenever necessary; and when feedback is captured digitally and incorporated across the value chain, automatically triggering new events” (Pantser, 2018, **Online**). Renjen (2018) illustrates that Industry 4.0 will affect four major areas in the future. They classify these four areas as the society, strategy, talent and technology. They conclude that businesses will not be in a position to shape society in terms of readiness for Industry 4.0. This will require a fundamental change, which will include legislation and all other affected areas and encompasses the social aspect of the aforementioned. The study refers to the strategy as the vision of the leaders to recognise the importance of change and the responsibility of the drive and to give direction to the leaders and everyone in the organisation.

On the talent aspect, the urgency to ensure competency for the future in all aspects of business becomes more important and it is a critical requirement in the future plans of the organisation. Lastly, the technology part of the study simply confirms the area that will transform businesses from the “old” industry into the modern era. Similarly, Nagy et al. (2018) note that the key strategy of Industry 4.0 is to be more operationally effective. The suggestion is that the emerging Industry 4.0 concept is an umbrella term for the new industrial revolution that will support and direct future developments in all sectors of industry and society. These developments include Cyber-Physical Systems (CPS), the Internet of Things (IoT), Robotics, Big Data, Cloud Manufacturing and Augmented Realities. These are considered as the pillars of Industry 4.0 (Erboz, 2018). The table below aims to explain the pillars of the

Industry 4.0 concept as depicted by Erboz (2018). Table 3.1 attempts to briefly describe some of the keywords/pillars used in the realm of Industry 4.0 with a short history of the elements within.

Table 3.1: Pillars and History of Industry 4.0

Pillars and History of Industry 4.0	
Pillar	**Description**
Big Data	Data that contains greater variety arriving in increasing volumes and with ever-higher velocity. The earliest record of data dates back 7000 years to Mesopotamia, where it was used for the growth of crops and handling livestock herds. John Graunt continued in London in 1963 with the concept whilst Herman Hollerith invented the first computing machine that could read holes in 1887. The first data-processing machine, called the Colossus, appeared in 1943 during World War 2 (Rijmenam, 2019).
Robotics	This is powered by a concept referred to as the “Internet of Things” and the idea of harnessing a connected mesh of objects, devices and computers that can talk to each other. History traced to 3000 BC. It is a Czech word that means “slave” that Carl Capek used in a play and Isaac Asimov coined the word in 1942 (Stanford, 2019).
Cyber-Physical Systems	An integration of computation with physical processes whose behaviour is defined by both cyber and physical parts of the system. According to Greer et al. (2019), the coining of the phrase is ascribed to Helen Gill of the US National Science Foundation in 2006. They also suggest that trends indicate a significant increase in articles on the topic. Articles available increased from 35 in 2006 to over 1000 in 2017.

Industrial Internet of Things	This refers to an industrial framework whereby a large number of devices or machines are connected and synchronised using software and tools. Rose et al (2015) cited the Internet Architecture Board with the following definition: “a trend where a large number of embedded devices employ communication services offered by the Internet protocols.” The term was first used in 1999 by Kevin Ashton to describe how physical objects can be connected to the Internet through connected sensors (Rose et al, 2015).
Cloud Manufacturing	This describes a new manufacturing paradigm based on networks. It uses the network, cloud computing, service computing and manufacturing enabling technologies to transform manufacturing resources and manufacturing capabilities into manufacturing services. The ERP software blog (2016) defines cloud manufacturing as the process of utilising well-established manufacturing resources through the cloud.
Augmented Reality	An enhanced version of reality where live direct or indirect views of physical real-world environments are augmented with superimposed computer-generated images over a user`s view of the real world, thus enhancing one`s current perception of reality. According to Poetker (2019), augmented reality was invented in 1968 by Ivan Sutherland who developed the first head-mounted display system. The Boeing researcher Tim Candell though coined the term in 1990.

(**Source**: Own construct)

3.2.2 Industrial Progression

According to Aldag (2008), the natural progression of industry led to the realisation of Industry 4.0. Figure 3.1 below illustrates the natural progression of the industry.

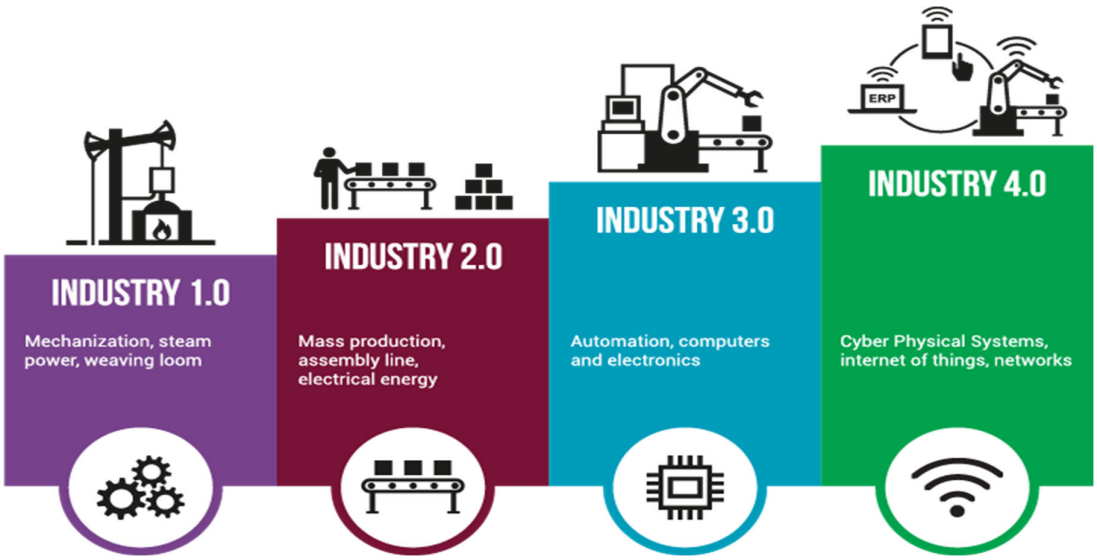

***Figure 3.1**: Industrial progression* (**Source**: Simio.com [accessed 10.03.2019])

Piccarozzi and Aquilani (2018) interpret the industrial progression as a move from steam power to electricity. Their narrative suggests that steam power acted as a transformative force in the ninetieth century and electricity as the transformative force in the twentieth century. The twenty-first century realised the development of the Internet of Things, use of Big Data, cyber-physical systems and interconnected networks, which helped shape the Industry 4.0 revolution.

3.2.3 Future of Industry 4.0

The research has brought to light that there are many similarities on the views of researchers in journals and articles, but also highlighted different opinions within the ambit of Industry 4.0. The opinions expressed are more specific to the future of Industry 4.0. Wahl (2015) suggests that Industry 4.0 will challenge how to re-invent jobs in a world where machines will take people's jobs. This also captures the skill requirements and competencies that industry will need and how it will dramatically change training specifications in learning and vocational institutions. According to Vuksanovi (2017), the use of digital technology will lead to drastic changes in the business model. The author further stresses that vertical and horizontal integration of the creation chain becomes crucial for a business to succeed in the Industry 4.0 arena. Whilst countries and more specifically organisations are coming to grips concerning Industry 4.0, some individuals and organisations are already speculating on Industry 5.0. The internet is already flooded with articles related to Industry 5.0.

Articles such as the one posted by Schelzer (2017) who attempts to articulate the difference between Industry 4.0 and Industry 5.0. Schelzer claims the Industry 5.0 is the brainchild of Michael Rada, president of the International Business Centre of Sustainable development. The objective of Michael Rada`s claim to Industry 5.0 is to ensure that the human element is brought back into the industry. The modus operandi is to ensure that human and machine elements can communicate and work together. The abovementioned literature is but one of the actual number of articles available on various websites on Industry 5.0. The discussion/arguments on Industry 5.0 will surely continue far into the future and will be an interesting topic. In this study, it was important to note these, but they will not be discussed further in this dissertation.

3.3 Introduction to Quality 4.0

Jacob (2017: **Online**) suggests that Quality 4.0 is a new approach to quality management as it blends new technology with traditional quality methods to achieve new optimums in operations excellence, performance and innovation. Angel (2019: **Online**) describes Quality 4.0 as the state of manufacturing for quality professionals and uses real-time data from technologies of Industry 4.0. Figure 3.2 below is an illustration of how, according to Angel (2019), Quality 4.0 fits into the realm of Industry 4.0.

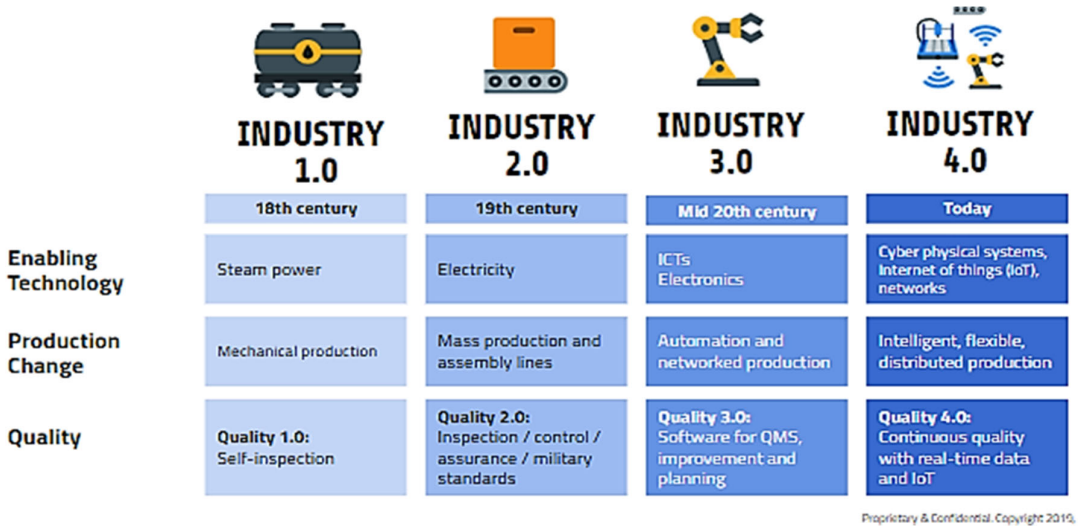

***Figure 3.2**: Industry 4.0 and Quality 4.0 fit*

(**Source**: Tulip, 2019: Online)

Following the remark by Jacob (2017: **Online**), operational excellence is key to this investigation and in the ambit of the research, it speaks directly to the topic as well as the organisational strategy. It is important to note that literature on Quality 4.0 and Industry 4.0 is not currently available in the form of textbooks or journals, but discussed in quality conferences (Aldag, 2018). Quality institutions such as the American Society for Quality, LNS Research and Quality Digest are at the forefront in exploring this phenomenon. Progress and updates on Quality 4.0 are available online from the aforementioned institutions' webpages. LNS Research in particular has released e-books on various facets of Quality 4.0, which form an integral part of this research. The American Society for Quality has also launched a video channel on its website, which includes videos that demonstrate why it is important to embrace Quality 4.0. They also interview leaders in companies to demonstrate the need for organisations to adopt it.

Further to this, Aldag (2018) also describes Quality 4.0 as a reference to Industry 4.0. In the same vein, Pedersen (2017: **Online**) alluded that Quality 4.0 ensures alignment between quality management with Industry 4.0. Seebo (2018, **Online**) states that "Quality 4.0 describes a new approach to manufacturing, where production is not just gauged based upon output rate and cost, but on the quality of the product, the quality of the process, and the quality of the services provided surrounding the product". The above-mentioned quality institutions believe that Quality 4.0 will become more and more important in the future (Zott, Amit and Massa, 2010, Radziwill, 2018, **Online**, Deloitte, 2015, **Online**).

The Quality 4.0 premise speaks directly to the need for transforming the current situation experienced in the organisation. The researcher suggests that many organisations are in the same situation where many systems are in place, but not yielding the required results. In particular, Quality 4.0 does not intend to change traditional quality, but to enhance the current practices. For this research, the researcher has opted to latch onto the information made available from LNS Research. In particular, the handbooks and available data will support the investigation.

3.3.1 LNS Research Company Background

LNS Researches provides leaders with information which enables transformation in their respective businesses. Their analysts focus on identifying the metrics, leadership, business processes, and technology capabilities effecting change. The company prides itself on research integrity, supported by proper research methodologies, which forms the bases of their results. Their areas of focus include but are not limited to the following:

- Quality leaders
- Digital transformation
- Quality 4.0/Industry 4.0
- Environment health and safety leaders
- Manufacturing and operation leaders
- Maintenance, reliability, and engineering leaders

LNS Research has also invested in research on Quality 4.0. Their focus on quality has led them to release insightful information around traditional quality and the way forward in this regard. LNS Researchers pride themselves in the fact that they assist business leaders through their research and give direction on future demand. The researches they conduct led to the development of a Quality 4.0 handbook for organisations to use (Jacob, 2017, **Online**). This handbook illustrates a newly developed framework that explains how the traditional quality aligns with the Quality 4.0 requirements. The framework also presents eleven axes to consider for the business to obtain Quality 4.0 alignment. The framework plays a pivotal role in the literature review and as such requires in-depth investigation.

3.3.2 LNS Quality 4.0 Framework Overview

The research framework suggested by LNS Research consists of eleven axes. Figure 3.3 below illustrates on a high level the components or axes that organisations need to focus on to realise quality improvement and alignment with Industry 4.0. Key to the framework is the classification of traditional quality and Quality 4.0 as depicted in the illustration. In the figure, the middle blue circle represents the traditional quality section and the outer green circle that encapsulates both illustrates the Quality 4.0 requirement. It is important to reiterate

that according to Jacob (2017: **Online**), Quality 4.0 does not replace traditional quality. Rather, it seeks to support and improve on traditional quality and align the quality function with Industry 4.0.

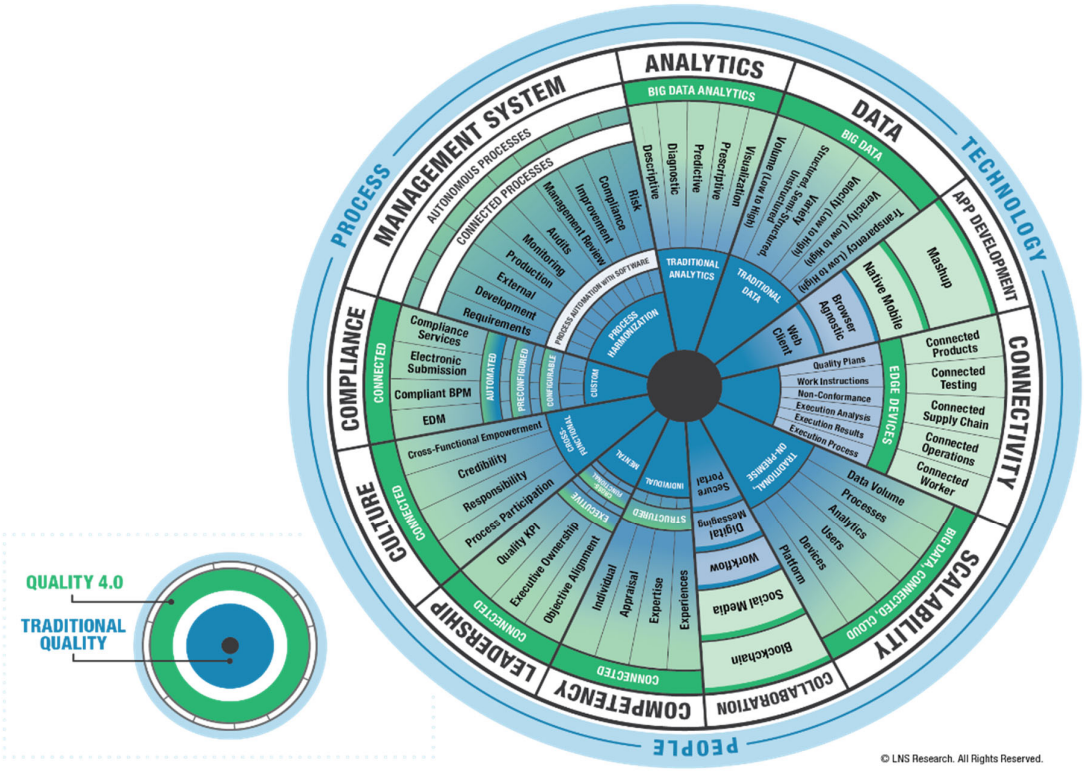

***Figure 3.3**: LNS Research framework* (**Source**: Jacob, 2017)

In Section 3.3, it is mentioned that Quality 4.0 seeks to blend new technology with traditional quality. The premise of Quality 4.0 is not to replace traditional quality, but to enhance it. The suggestion is that traditional quality practices must be optimised to move towards Quality 4.0. The implementation of Quality 4.0 is also dependent on the willingness of the organisation to invest. The research attempts to use indicators or elements from the framework to assist with the identification of problems in the organisation. As such, the eleven axes form an integral part of the literature, but only a few of the selected axes will be used to address the research question. The approach also seeks to pick the low-hanging fruits on offer and use these to illustrate the art of the possible for conviction.

3.3.3 Eleven Axes of LNS framework

Pedersen (2017: **Online**) notices the work conducted by LNS Research in which she mentions that they have identified eleven components of Quality 4.0. Some of the components are familiar concepts and some are relatively new for leaders in different organisations. Jacob (2017) also notes that the understanding of the axes will help organisations to take the first steps towards the adoption of Quality 4.0. According to Figure 3.3 above, the LNS framework consists of the following elements: Data, Analytics, App Development, Connectivity, Scalability, Collaboration, Competency, Leadership, Culture, Compliance and Management Systems. These elements are briefly described below.

3.3.3.1 Data

According to Kelly (2002), as element number one, data consists of symbols that represent objects, events observed by either people or instruments. The Business Dictionary (2019: **Online**), describes data as information in a raw and unorganised form that refers to conditions, ideas or objects. Kotler and Keller (2009) suggest that data can be categorised into primary and secondary data, where primary data can be described as “fresh” data and secondary data as that which already exists. Over the years, the protocol for collecting data has been carefully observed and recorded. Institutions such as universities and other research groups are very meticulous concerning the gathering of data, validation, the analysis and use of data. Many types of data exist in many forms and they apply to specific areas of research. Edward Deming, one of the quality gurus remarked that “In God we trust; all others bring data”.

In the context of this research, the above refers to traditional data, whilst in the realm of Industry 4.0, this kind of data is referred to as “Big Data.” Big Data is referred to by Ciruelo and Sienes (2011) as the next frontier for innovation, competition and production. They classify “Big Data” as large pools of data that can be captured, communicated, aggregated, stored and analysed. Many articles written about Industry 4.0 and specifically on Big Data, emphasise that Big Data and the Internet of Things can bring positive change to industry (Yurcan, 2012). This, according to Yurcan (2012) will only be possible if the infrastructure to facilitate the correct use of Big Data is in place. The significance that Big Data brings to Quality 4.0 is that it

supports the process of decision-making. In this regard, Jacob (2017: **Online**) states that data-driven decisions have been at the heart of quality improvements for decades. Whilst some continue to struggle with evidence-based information, more mature organisations have mastered traditional data and are now leveraging Big Data. For one to master Big Data or to place oneself in a position to leverage Big Data, one has to understand the classifications of Big Data first. LNS Research (Jacob, 2017: **Online**) explains the classification through the illustration in the figure below:

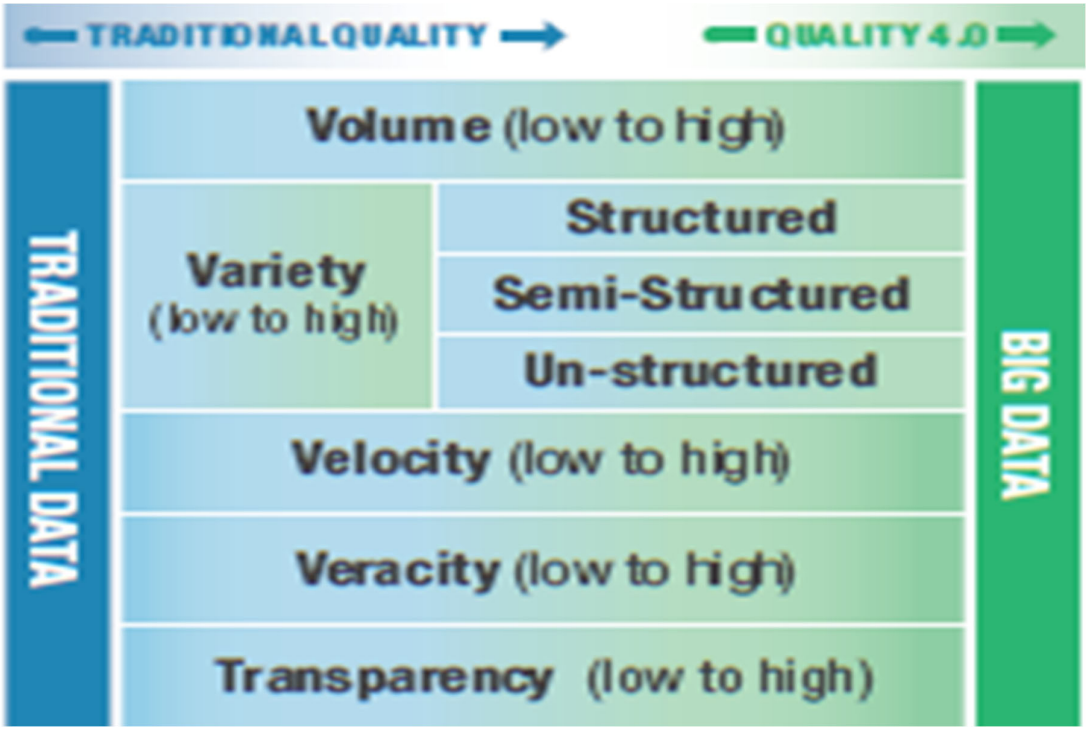

***Figure 3.4**: Transition from Traditional to Quality 4.0*

(**Source**: LNS Research, 2017: Online)

3.3.3.1.1 Volume

According to Jacob (2017: **Online**), traditional systems have large quantities of volume in the form of corrective actions and preventative actions data in the workplace. The quality department in particular usually drives the capturing of information. To this extent, Jacob (2017: **Online**) suggests that the Quality 4.0 drive should be driven by the quality function.

3.3.3.1.2 Variety

In the ambit of Big Data, “Variety refers to the many types of data that are available” (Normandeau, 2017: **Online**). The variety of data is classified as either structured, semi-structured and unstructured (Jacob, 2017: **Online**). Typically, structured data fits neatly into a relational database. As an example, QMS is designed to receive structured information. Unstructured and semi-structured types of data would be presented in the form of text, audio and video, for example (Normandeau, 2017: **Online**).

3.3.3.1.3 Velocity

In general, velocity refers to the speed at which an object travel at any given point. Within the ambit of Big Data, velocity also speaks to the fast rate at which data is received and acted upon (Normandeau, 2017: **Online**). With current data capturing systems, internet-enabled smart products operate in real-time and will require real-time evaluation and action.

3.3.3.1.4 Veracity

“Veracity refers to the accuracy of the data” (Jacob, 2017: **Online**). In the analysis of organisational data, the accuracy is crucially important for corrective action and root cause analysis.

3.3.3.1.5 Transparency

Jacob (2017: **Online**) stated that information in the workplace should be transparent in terms of user-friendliness and ease of access. Preferably, the system should be capable of including a common data model that can combine structured business systems and conduct financial transactions. The system must also include data alarms, process parameters, and quality events.

3.3.3.2 Analytics

3.3.3.2.1 Analytics defined

“Computing data of a very large size, typically to the extent that its manipulation and management presents significant logistical challenges” (Miranda, 2014). What we can derive from this statement is that the capturing and analysis of data present some challenges as well and must be controlled by the operation. In this regard,

Jacob (2017: **Online**) suggests that analytics unlock the insight captured within the data. Agrawal (2015) also explains that analytics is used as an information management technique to make better business decisions.

3.3.3.2.2 Analytics history

Agrawal (2015) argues that analytics have been part of the business environment since the inception of the business. Figure 3.5 below seeks to illustrate the timeline when analytic models were introduced and the information demonstrates more or less when Industry 4.0 (in the form of Big Data) also came to the fore.

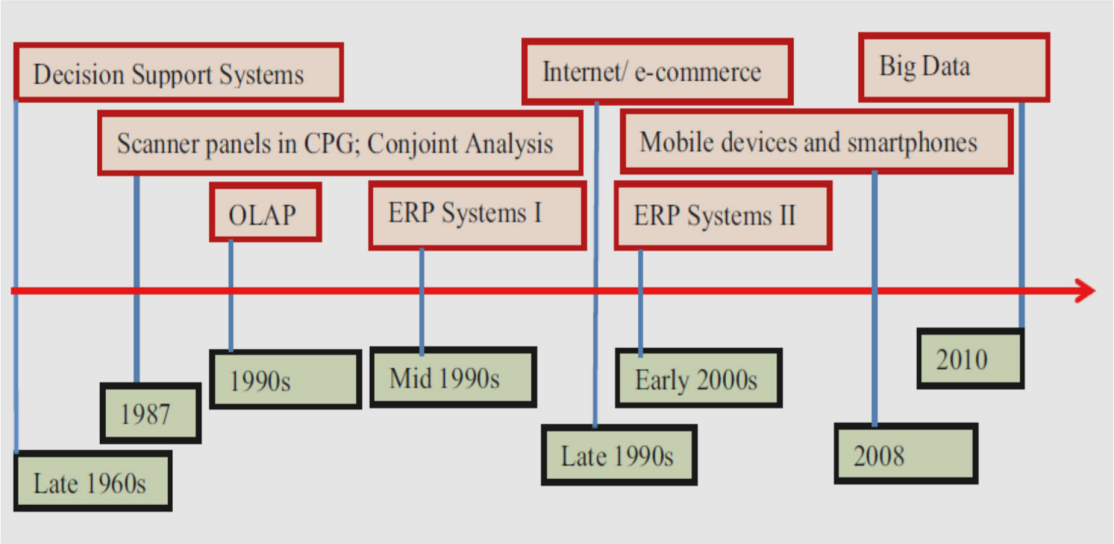

***Figure 3.5**: Analytic timeline* (**Source**: Agrawal, 2015)

3.3.3.2.3 Analytic framework

LNS Research (2017: **Online**) developed an analytic framework in order to describe the different phases in analysing information to support decision making. To understand the framework, it is important to note that descriptive, diagnostic and prescriptive analytics form part of the phases in traditional quality management of traditional data. The predictive phase of analysis allows insight into machine and line-specific performance. This in turn allows for rapid decision making to prevent possible failures. The analytics framework is illustrated in figure 3.6 below.

***Figure 3.6**: Analytics Framework* (**Source**: LNS Research)

Lee et al (2017) support the theory and include the following benefits for predictive analysis:

- Real-time visualisation of the data.
- Advanced visualisation of data, which includes the creation of benchmarking tables offering flexibility.
- Descriptive statistics of processes and detection of production anomalies.

3.3.3.2.4 Analytic techniques

Analytical techniques have improved over the years and everyday new examples are available (Agrawal, 2015). One of the familiar forms of data analytical techniques is called correlation. Built on the concept of correlation are also familiar techniques such as the following:

- Regression
- Discrimination
- Factor analysis
- Multi-dimensional scaling
- Conjoint analysis

Agrawal (2015) suggests that different types of softwares have been developed to support the analysis of data. Softwares such as Minitab, Matlab and Stata have been used successfully to analyse data. In the manufacturing environment, software such as Minitab is used to analyse manufacturing quality.

3.3.3.3 Connectivity

"Connectivity can be viewed as the connection between business information technology and operational technology" (Jacob, 2017: **Online**). In this scenario, business information technology will include Enterprise Quality Management Software (EQMS), enterprise resource planning (ERP) and Product Lifecycle Planning (PLP). Operational technology refers to the technology used in laboratories as well as in the manufacturing and services industry. Rojas et al., (2017) cited Lin et al., (2015) who developed a conceptual framework to illustrate the interconnectivity within the ambit of Industry 4.0 as illustrated in the figure below.

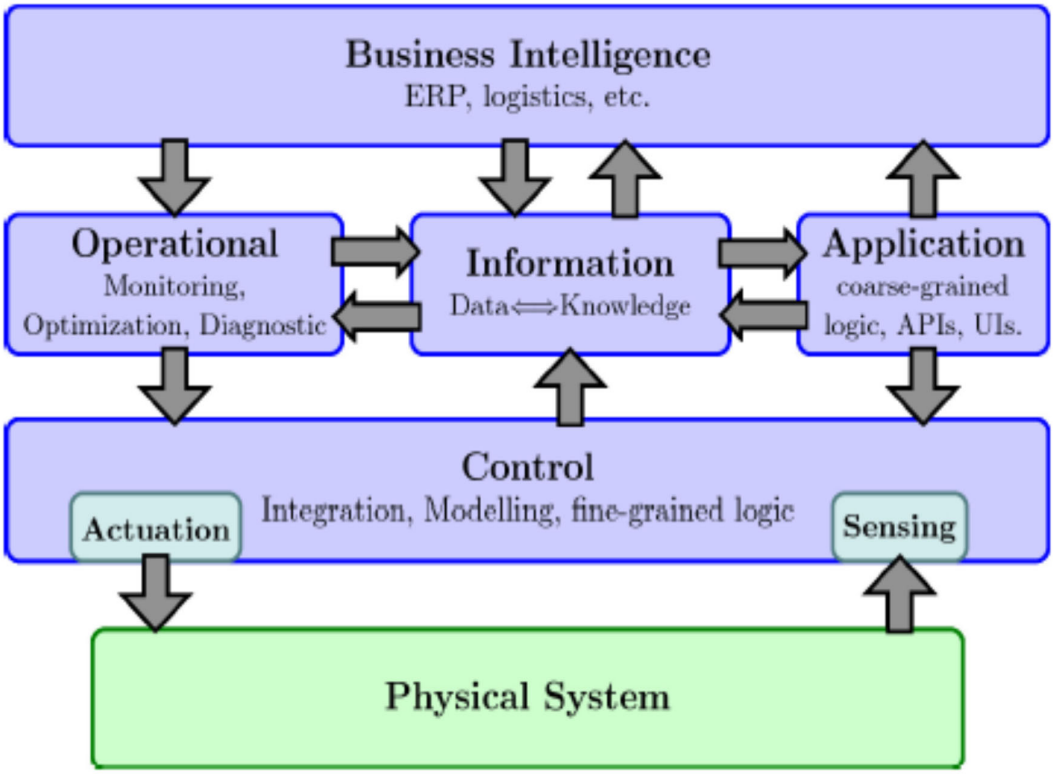

***Figure 3.7**: The functional domains* (**Source**: Lin et al., 2015)

Rojas et al., (2017) stress that for a business to achieve coordination and orchestration of their cyber-physical capabilities, it is crucial to have the correct structure and proper communication channels. The benefits of good connectivity in the ambit of Quality 4.0 according to Jacob (2017: **Online**) are as follows:

- Connected people – Leverage personal smart devices. Connected workers typically have goals of increased efficiency and safety.

- Connected products – Can provide feedback on performance; communicate use conditions and failure to perform.
- Connected edge devices – Efficiently connect sensed equipment. This approach helps to avoid overburdening central operating systems as it streams large volumes of sensory data. This enables edge devices to perform analytics with the device.
- Connected processes – Provides feedback from connected people, products, and equipment into processes.

3.3.3.4 Collaboration

Jacob (2017: **Online**) suggests that collaboration is critical for quality management. Wikipedia (2017: **Online**) interprets collaboration as the process of functions or employees that are in sync with organisational strategies and goals. It is also considered as the powerful fuel for innovation and quality improvement. Jacob (2017: **Online**) further points out that collaboration has been profoundly transformed by some of the other Quality 4.0 axes such as connectivity, data and analytics. Collaboration as a key function of quality improvement improves the traditional quality and constitutes the recipe for success in the ambit of Quality 4.0. Research has indicated that different kinds of collaborations are developed or required for different functions. For this research, the researcher will conclude on this topic that collaboration is required between different functions to ensure effective communication and to realise the strategic objectives of the organisation.

3.3.3.5 App development

According to Karsh (2019: **Online**), an app is the common term used for a software application or a software programme that can be used on a computer or device to accomplish tasks more easily and efficiently. Jacob (2017: **Online**) extends the notion by remarking that app development is something that everyone can relate to. In the context of this research, the statement would refer to people in the business environment. Apps are mechanisms through which organisations fulfil processes, collect and expose data, visualise analytics, and establish collaboration (Jacob, 2017: **Online**). Most of the applications in organisations are web-based with the emphasis on mobility. The author emphasises that mobility and interactive apps improve quality management systems.

In this research, this statement underscores the need to compare the traditional methods used versus the benefits that Quality 4.0 could contribute to the improvement of quality in general and more specifically to the optimisation of customer quality complaints. LNS Research (2017: **Online**) has put together the illustration in Figure 3.8 below to demonstrate how apps are used within the organisation and how important the inter-connectivity between the different functions can be. Important to note is that the figure includes the supplier as well as the customer or end- user. It is observed that the reciprocation of information along the value chain is crucial for the organisation and it supports accurate planning of work activities.

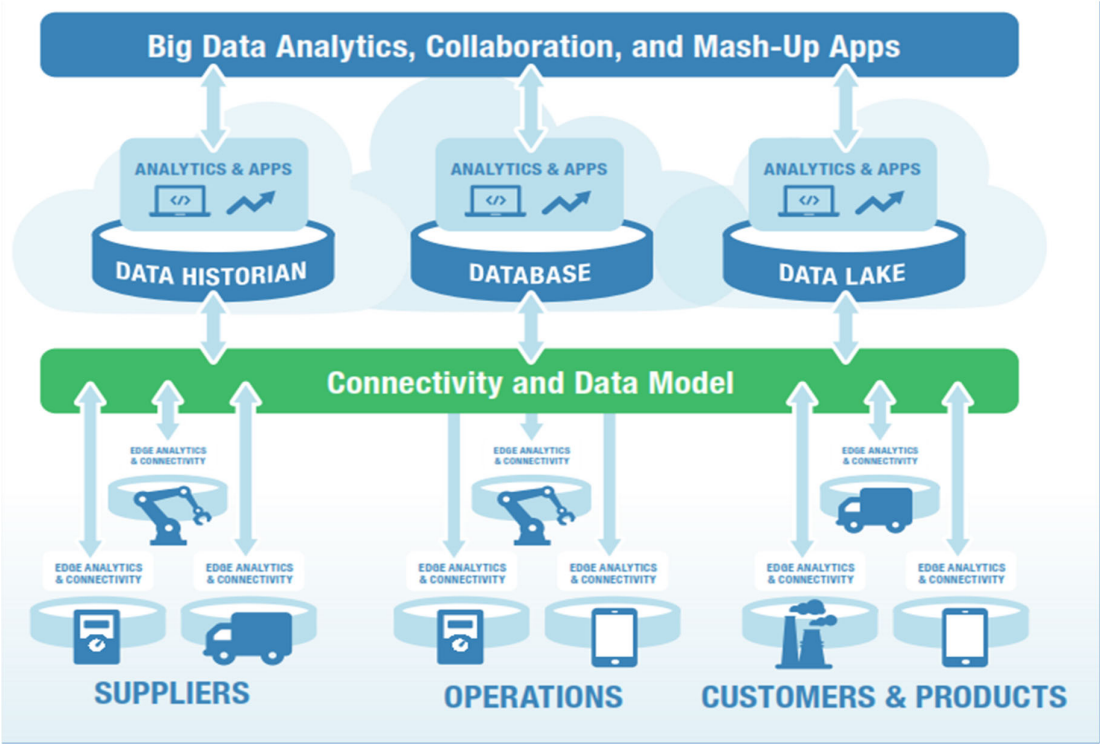

***Figure 3.8**: Connectivity Model* (**Source**: LNS Research, 2017)

"Mobility provides greater accessibility, participation, adoption and efficiency" Jacob (2017: **Online**). This statement relates directly to the research question which is centred on optimisation and efficiency. Efficiency in in the context of the research question refers to the reduction of customer complaints, which in turn suggests that the operation should be doing things right in the first time. The figure also emphasises the inter-working relationships of the axes or processes within Quality 4.0. The salient points in the figure include features discussed in the previous topics

as part of this chapter. In this, it demonstrates that the framework is inter-connected and speaks to the premise of quality control and improvement in which silos are not permissible. Further to this, Jacob (2017: **Online**) indicates that apps can be much more than just a simple web-based interface. This implies that the developments and improvements of apps play an important role in the delivery of real-time data which can result in decisions being made faster. This can result in action taken sooner which support efficiency in manufacturing.

3.3.3.6 Scalability

Vaughan-lee and Bremaud (2018) define “scaling up” as the expansion or the physical spread of activities, structures and materials as well as practices, behaviours and norms within an organisation. Falatah and Batarfi (2014), on the other hand, refer to scalability as the ability of a particular system to fit a problem as the scope of that problem increases with special reference to a number of elements, objects, or growing volume of work. In the form of service, scalability is the desirable property of a service, which provides the ability to handle growing amounts of service growth. Jacob (2017: **Online**) suggests a more simplified definition in defining scalability as the ability to support data volume, users, device, and analytics at a global scale. The objective of scalability according to Vaughan-lee and Bremaud (2018) is twofold, as represented by following:

- Quantitative growth – Increasing numbers.
- Qualitative aspects – Changes to behaviours and norms.

In the sphere of Industry 4.0, Falatah and Batarfi (2014) give more insight into the function or levels that must be considered with respect to the issue of scalability. This is an important function to understand if one considers the enormous rate of growth within the area of digitalisation and the Internet of Things. The functions are as follows:

- Server scalability.
- Scaling of the network.
- Scaling of the platform.

According to Jacob (2017: **Online**), cloud computing is a trend that is becoming more popular in efforts to address scalability challenges, as the benefits in this function include the ability to acquire, install and manage data without having to install extra devices. This statement does not exempt organisations from ensuring that scalability on devices is adequate. In the contrary, connected devices should be carefully looked after as this is crucial for information flow and growth.

3.3.3.7 Management Systems

According to Alavi and Leidner (2001), a Quality Management System (QMS) consists of a set of rules, standards and policies in an organisational system to ensure that the product manufactured conforms to the specifications of the customer and that the product is safe and fit for purpose. Jacob (2017: **Online**) also explained that the QMS is the hub of quality management activities. With Quality 4.0, the QMS structure can be significantly improved. It seeks to provide a scalable solution to automate workflow, connect processes, improve data veracity, provide centralised analytics and ensure compliance. It also fosters collaboration within a common app. Figure 3.9 below illustrates how the QMS evolved in the realm of Quality 4.0 and in which direction it is moving towards. The aim of this model is to incorporate all the functions of the organisation into one hub (EQMS).

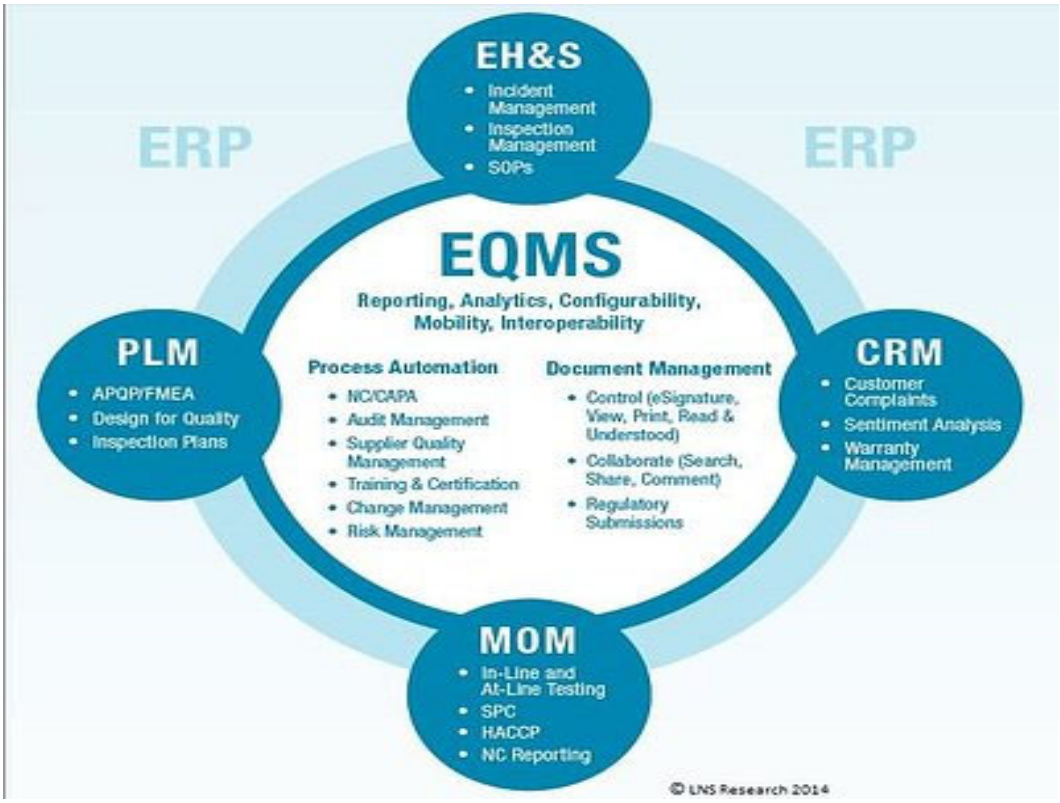

***Figure 3.9**: Single source of truth* (**Source**: LNS Research, 2014)

3.3.3.8 Compliance

3.3.3.8.1 Compliance defined

"Compliance can be defined as either a state of doing something in accordance with a set of specific guidelines or specifications or the process of becoming so" (Search data management, 2015: **Online**). Edwards et al. (2006) refer to compliance in general terms as the adherence to rules and regulations stipulated by those in authority. They continue to elaborate that the concept of compliance generally includes the following aspects:

- Obedience – When people do what they were told/instructed to do.
- Observance – When someone obeys a law/instruction.
- Deference – Respect and politeness.
- Governability – To have a controlling influence over something.
- Amenability – Willing to accept or be influenced by a suggestion.
- Passiveness – Allowing other people to be in control.
- Non-resistance – When someone or something does not resist.

The main terms of duty that are also linked to the compliance concept are as follows:

- Moral obligation – Standard of good behaviour.
- Accountability – Complete responsibility.
- Property – Relating to ownership.
- Fitness – Capability of someone or something.
- Answerability – To be responsible for something that happens.
- Acting ethically – Doing the right thing.

3.3.3.8.2 Compliance in manufacturing

According to Taylor (2005), the term compliance appears to have originated in the United States and referred to the need to comply with the 1930 security laws. The term came into use in the United Kingdom around 1985 when a financial bill went through Parliament. In the opinion of the researcher, the term may have become popular as illustrated, but compliance has always been part of everyday life. Jacob (2017: **Online**) explains that compliance activities include conforming to regulatory, industry, customer and internal requirements. All functions in manufacturing must comply with certain regulations within the area of responsibility. In Quality, for example, the Quality Management System dictates the regulations to comply with such as ISO 9001-2015 and others.

3.3.3.8.3 Benefits and challenges in compliance

According to Wilcock, Boys and Wilcock (2017), there are many benefits for organisations that comply with the ISO 9001 standard. These benefits are also relevant to other functions of any organisation. Compliance as a standard is crucial to all functions of the organisation. This also pertains to all the relevant stakeholders in the value chain. Table 3.2 below illustrates some of the possible benefits yielded from compliance. The second column in the table briefly explains how it addresses the business strategy.

Table 3.2: Compliance benefits

Compliance Benefits	
Benefit	**Strategic Objective**
Competitive advantage in local and international markets	Increase market share and sustainability

Meet global requirements	Reach more potential customers internationally
Improved customer confidence/ relationship	Customer retention and sustainability
Improve the quality of products/services	Customer satisfaction and retention
Continual improvement in process performance	Continuous improvement towards reducing operating cost
Increase productivity	Addresses business vision to manufacture at the lowest cost
Increase profitability	Addresses shareholder confidence in the business
Improve corporate image	Addresses sustainability and market growth

(**Source**: Own construct)

The challenges in an organisation have always been around the cost required to ensure compliance. Jacob (2017: **Online**) refers to this phenomenon when organisations postpone these initiatives as “version lock.” A good example of this is the current challenges experienced with BPA (Bisphenol A), which according to the experts is an oestrogen-imitating chemical used to produce plastics. Reports suggest that BPA is found in food-related to coating products. This phenomenon led to the introduction of a BPA-NI (Bisphenol A-Non-Intend) or BPA-free product. This, however, is more costly in terms of the chemical composition that had to be enhanced and, in some businesses, this is equated to the reduction of the product shelf life. It is in this environment where a business strategy has to be very clear with regards to the business direction to ensure compliance at a minimal cost.

3.3.3.9 Culture

In this part of the literature review, the focus is to expand on organisational and quality culture to advance a thorough understanding and the context of the study. This section forms an integral part of the study as it aims to assist the hypothesis developed.

3.3.3.9.1 Organisational culture defined

According to Evans (2008), culture is a set of beliefs and values shared by all the people in an organisation. He elaborates on how culture binds employees in the organisation together and how it helps to make sense to the employees of what happens in the business. A very important note that Evans (2008) made is that culture is a powerful influence on people`s behaviour. He substantiates the notion with a very good example, as he states that “Employees at IBM would never wear anything other than a white shirt, whereas most people at Apple wouldn`t be caught dead in one.” Atkinson (1990) also described culture as the values, norms and behaviours that make an organisation tick. Handy (1993) argued that organisational culture directly influences the quality culture as well.

Clutterbuck and Crainer (1990) on the other hand describe culture as a set of attitudinal and behavioural norms that members of an organisation subscribe to and share. These behaviours can be conscious or subconscious and exert a strong influence on how people resolve problems, make decisions or carry out their daily tasks. The research conducted by Liu (2009) cited the culture perspectives popularised by Schein (2010), Hofstede (1980), Handy (1983) and Denison (1990). These researchers conducted extensive research in the field of organisational culture and the link between organisational culture and organisational effectiveness. In this research, their findings support the investigation as there is a direct relationship between organisational culture and quality culture (Handy, 1993). To substantiate this statement, their perspectives are briefly discussed below.

i. Schein`s perspective

Schein (2010) explains that the forces created by social and organisational culture are extremely powerful. He elaborates that the forces are so powerful because they lie outside of awareness of the individual employee. He is also of the opinion that culture could be analysed on three levels as illustrated in Figure 3.10 below.

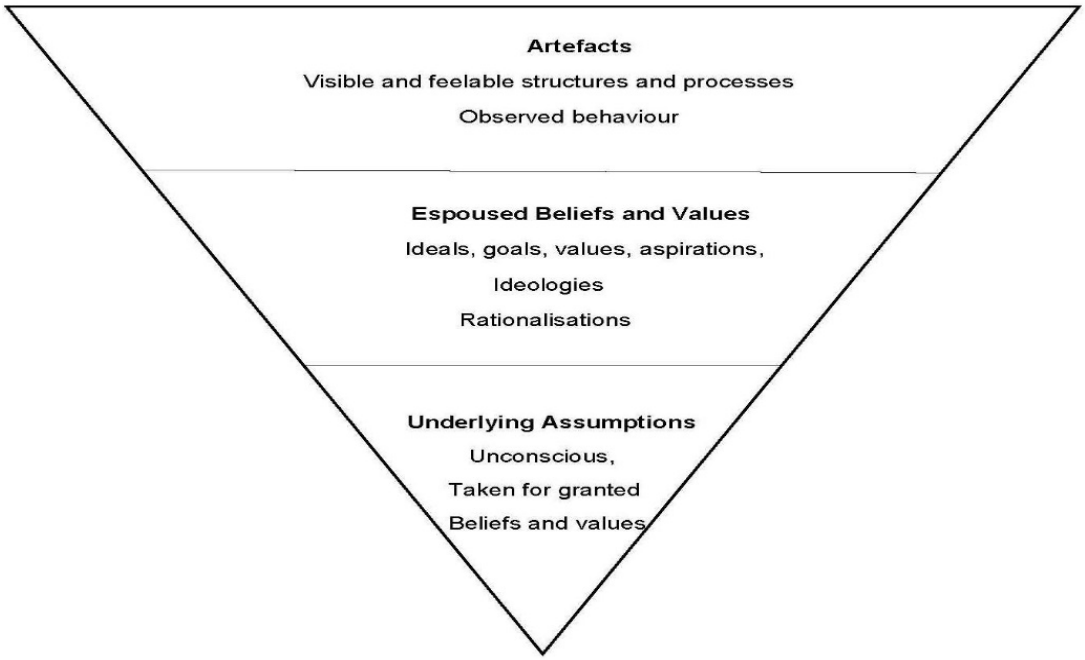

***Figure 3.10**: Three levels of culture according to Schein (2010)*

(**Source**: Schein 2010)

Schein`s three levels of culture illustrate the importance of understanding culture in the business environment. In particular, it shows the work that is required on the bottom tier of the triangle in which organisations must work to bring about effective change in the remaining tiers.

ii. Hofstede`s perspective

Hofstede (1980) focused on national culture and recognised its four dimensions:

- **Power distance** – Boss-subordinate relationship. Measures the extent of inequalities between bosses and subordinates.
- **Individualism/Collectivism** – Concepts used to describe how individuals deal with relationships within their groups.
- **Masculinity/Femininity** – The degree to which society values behaviours such as assertiveness, success, fortune, ambition, gaining of wealth and quality of life.
- **Uncertainty avoidance** – Concerned with the uncertainties that people have to face in everyday life.

iii. Handy`s perspective

Handy (1993) also classifies culture in four basic types:

- **Power culture** – The dominance a leader holds through an influential position in the organisation.
- **Role culture** – Operation controlled by rules, regulations and procedures.
- **Task culture** – Structures formed based on various tasks.
- **Person culture** – Individuals at the centre of the organisation. Difficult to manage and tend to work independently.

iv. Denison`s perspective

Denison and colleagues developed a framework that describes a theory of organisational culture that is linked to organisational effectiveness (Denison & Fey, 2003). The model is divided into four cultural traits and each heading is sub-divided as illustrated in the figure below.

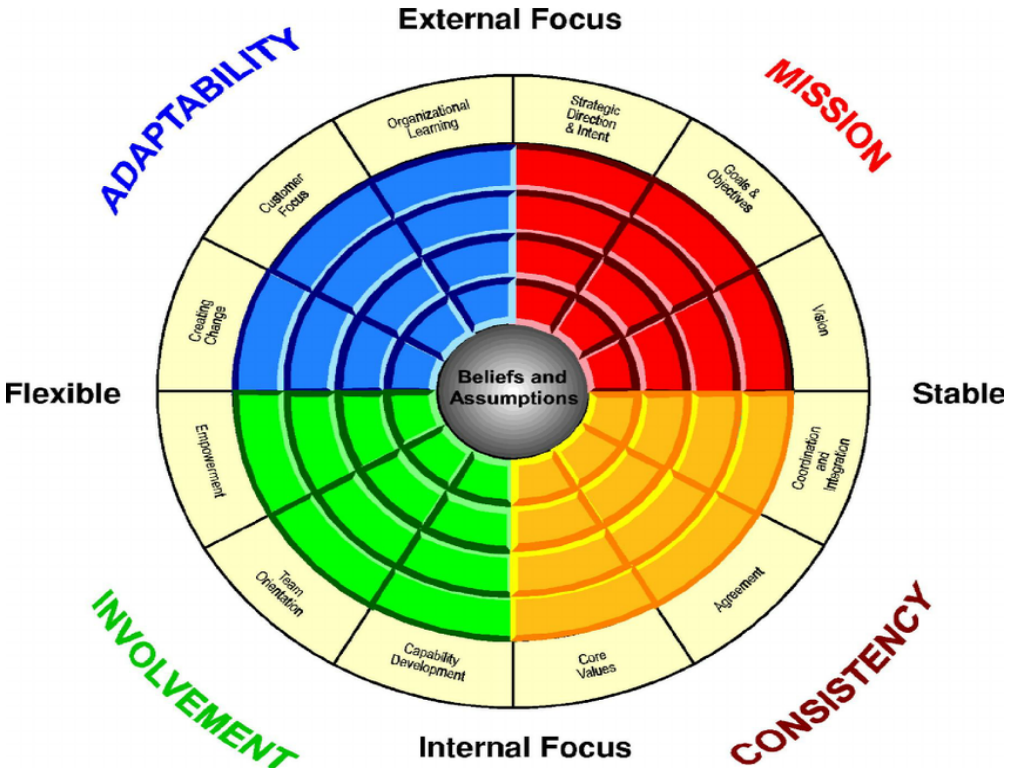

***Figure 3.11**: Denison Organisational Culture Model* (**Source**: Denison & Fey. 2003)

The four high-level traits as illustrated in the figure above refer to the following:

- **Involvement** – Refers to the level at which the organisation involves employees in the management process. The theory suggests that involvement will develop ownership, responsibility and loyalty towards the organisation.
- **Consistency** – Organisations with a high level of consistency, conformity and consensus can generally achieve agreement amongst members at all levels.
- **Adaptability** – This cultural trait focusses on the organisation's ability to adapt quickly to signals from the external environment such as demand from clients and customers.
- **Mission** – This cultural trait examines whether organisations have a clear sense of vision, strategic direction, goals and objectives.

3.3.3.9.2 Quality culture

"In a quality culture, the managerial imperative is not how to make do, but to do" (Drummond, 1993). Jacob (2017: **Online**) explained that a company that has a quality culture exhibits the following four key elements:

- **Process participation** – Active participation of all employees at all levels in the process are crucial to business strategy and creating the required culture.
- **Responsibility** – Ownership of an area of responsibility equates to an increase of responsibility across functions.
- **Credibility** – Good quality culture practices enhance external belief in the organisation.
- **Empowerment** –The competency to perform quality plus ownership of quality success.

Bowen (2011) explains the need for development programmes and improved training in his article entitled "The Need for Quality Culture". This was a response to the industrial trend where some businesses believed that de-skilling is the way forward based on the premise that jobs should be simplified. He continues to emphasise that this belief is unsuitable for quality culture. Adebanjo and Kehoe (2011) researched quality culture from a Total Quality Management (TQM)

approach and identified seven areas in a culture that are problematic at times and which are critically important to establish the right culture. These areas are as follows:

- **Senior management leadership** - Commitment from senior management has been described as the most important determining factor of TQM and as such will be for culture. In this regard, Nakamura (1992) explains that unless leadership demonstrates intent, it will be challenging to get the rest of the team on board.
- **Employee involvement and empowerment** – This refers to the mechanism of converting an organisation's culture to allow employees to be creative in problem solving and improvement (Gufreda and Maynard, 1992).
- **Teamwork** – Teamwork in general refers to the process in which members of the team working together to achieve a common goal. Kehoe (1996) argues that that teamwork acts as the medium to affect change in organisations.
- **Customer focus** – The reason for the existence of any organisation and as such, the culture in the organisation should be directed accordingly (Bergman and Klefsjo, 1994).
- **Partnership with suppliers** – Relationships with suppliers based on the price used to be the practices in many organisations in the past.
- **Effect of chief executive** – Leadership, and more specifically direction, in TQM as well as the culture remains paramount. Dean and Evans (1994) accentuate this by arguing that "…the chief executive should be the focal point, providing perspective, vision, encouragement and recognition to members of the organisation."
- **Open corporate culture** – The ability of an organisation to demonstrate a culture of transparency throughout the organisation, where employee fears are overcome and required change in the organisation is accepted.

In line with these areas of a culture, Jacob (2017: **Online**) states that Quality 4.0 makes a culture of quality more attainable through better connectivity, visibility, insights and collaboration. The premise of the attainability is based on the incorporation and use of connected data, automated processes, analytics and the

use of apps. This should be underlined through ensuring that cross-functional teams are all involved and participate in the process from the start. This is important as Jacob (2017) states in his research that only thirteen percent of cross-functional teams clearly understand how quality and indeed the quality culture contributes to the strategic success of the organisation.

3.3.3.9.3 The relationship between culture and optimisation of customer complaints

In this research, the relationship between culture and customer complaints is a very important aspect. It has been determined, however, that research studies completed reflect the same objectives as set out through the research objectives. Thus, in the opinion of the researcher, the rationale of the research exhibits alignment. Liu (2009) researched on the relationship between organisational culture and effectiveness. The researcher hypothesised that there is a positive relationship between organisational culture and organisational effectiveness. The sub-hypothesis indicated that involvement, consistency, adaptability and a clear mission are cultural traits that positively relate to organisational effectiveness. Using Denison's organisational cultural model (Denison, 1990), the researcher conducted a thorough investigation to determine where banks in South Africa are lagging when it comes to culture. Liu (2009) concluded that there is a positive relationship between organisational culture and organisational effectiveness. Below is some definitional overview of these two concepts:

- **Organisational culture**: Deal and Kennedy (2000) stated that organisational culture is "the way things are done around here". Needle (2004) builds further on this by stating that "culture includes the organisation's vision, norms, systems, symbols, language, assumptions, beliefs and habits." The above-mentioned statements apply to all the functions in the organisation. A quality culture thus forms part of the organisation's overall culture.
- **Organisational effectiveness**: Morales (2014) suggests that organisational effectiveness is the degree to which organisations can meet their respective objectives. With this in mind, one can expand the goals to include the organisation's quality goals. This research examines the extent to which Nampak has set goals or targets for external customers for all its divisions.

From the above, it can be concluded that the relationship between culture and organisational effectiveness also reflects a positive relationship between quality culture and customer complaints.

3.3.3.10 Leadership

3.3.3.10.1 Leadership defined

Ciulla (1998) suggests that leadership is not a person or a position, but a complex moral relationship between people. Kotter (1995) also argues that leadership is about embracing change and that change exerts a higher demand for effective leadership. Verma (2016) interprets leadership as the quality to lead others to achieve a set of goals within the organisation. In the research conducted, experts have differences in opinion as to what the criteria or competencies a good leader should exhibit and it is clear that defining leadership is often very complex and difficult. Hersey and Blanchard (1988) argue that a leader should exhibit at least the following three basic competencies:

- Ability to interact and understand the situation.
- Ability to change behaviour.
- Ability to communicate.

Research indicates that further investigations should be conducted into the personal traits required by organisations to employ the most suitable candidate as leaders (Nichols, 2016). As mentioned earlier in this chapter, the criteria for a good leader is very complex. Nichols and Cottrell (2014) suggest that there is a link between the positive outcome of results and the personality of the leader desired by the subordinates.

3.3.3.10.2 Leadership in Quality and Quality 4.0

It has been argued that quality leadership depends neither on charisma nor on personality traits as Dwight Eisenhower, George Marshall and Harry Truman were quality leaders, yet none possessed charisma (Spinks and Wells, 2006). Lord et al. (1984) indicated that people want to follow an effective leader, hence leadership is important in all spheres of business. Lord et al. (1984) further explain that no leader or manager can explain to the board of directors how much leadership contributes

to the bottom line, although this is a crucial function in business. Knowles (2011) differentiates between management and leadership by explaining that management is concerned with budgeting, planning and organising, whilst leadership is concerned with producing change and movement in the desired direction.

Leadership in quality is required to achieve desired results and achieve change or positive transformation. Change is a key and constant variable within the quality environment as the business has to be flexible enough to adapt, particularly in the Quality 4.0 environment where continuous upgrading of electronics is dominant. Jacob (2017: **Online**) suggests that Quality 4.0 is the digitalisation of quality and the ability to leverage the technologies of Quality 4.0. The result of this statement implies the leadership of quality and indeed Quality 4.0 should be at the forefront of technological advances and position themselves to harness the benefits of digitalisation. This implies that leaders of Quality 4.0 should prioritise Quality 4.0 plans for them to stay abreast of the requirements.

3.3.3.10.3 Communication in leadership

Communication in leadership is key to business strategy and it ensures that the intended communication spreads to the lowest level of the organisation. According to Zulch (2014), leadership styles also affect communication within an organisation. Table 3.3 below describes the different leadership styles that positively affect communication in an organisation.

Table 3.3: Leadership styles

Leadership styles that positively affects communication	
Style	**Description**
Leadership style according to the situation	Concerned with the practice and use of diverse leadership styles under unlikely situations.
Goal-orientated leadership style	The leader has a clear vision and goals for the team. He effectively communicates this so that others can clearly understand what is expected of them.

Directive leadership style	The leader helps team members to achieve their targets by assisting them with the methods and showing them the right direction.
People-centric or employee-orientated leadership style	The leader analyses the work ethic of employees and is regularly in touch-based on the findings.
Leadership style according to the intellectual level	The leader adjusts style based on the intellectual level of employees in terms of maturity, work stability, potential and ability to solve problems.
Behavioural leadership style.	Accomplishments, inspiration, readiness, aptitude and knowledge blends this style.
Action-based leadership style	This style recommends that leaders should emphasise 3 main duties which are assignment, group and individual.

(**Source**: Own construct)

In line with these leadership styles, Luthra and Dahiya (2015) argue that there are certain communication principles that a leader should exhibit to become an excellent leader. Some of the principles are as follows:

- A leader must be confident.
- A leader must clearly communicate the rules and follow them himself.
- A great leader must be energetic and self-motivated when communicating.
- A great leader must be steady and trustworthy while he communicates.
- A good leader must be easy to approach without barriers.
- A good leader must have a transparent communication system.
- A good leader must communicate with an open mind.

Figure 3.12 below illustrates a conceptual framework developed by Zulch (2014) to demonstrate the effects or results of good communication logically. The framework shows that communication is key to addressing the research question concerning the optimisation of customer quality complaints.

***Figure 3.12**: Conceptual framework for effective leadership communication*
(**Source**: Zulch, 2014)

3.3.3.10.4 The relationship between leadership and customer complaints

The relationship between leadership and customer complaints addresses the fourth secondary objective of this study. In the literature review section, it came to the fore that there is scant literature directly linked to this section. Typically, the secondary data available focus on leadership behaviour and customer satisfaction. In the context of the study, customer satisfaction has a direct bearing on the optimisation of customer complaints. It will therefore suffice and be used to address the objective accordingly. Suriyankietkaew (2016) researched on effects of Sustainable Leadership (SL) on customer satisfaction and hypothesised the following:

- H1. There is a significant association between SL practices and customer satisfaction.

- H2. A positive relationship between SL practices and customer satisfaction exists.

Suriyankietkaew (2016) concluded that there is a positive relationship between sustainable leadership and customer satisfaction. He notes that satisfied customers help firms to sustain business growth and sustain competitive advantage over their business rivals. Verma (2016) conducted a study on the importance of leadership in Total Quality Management. The researcher notes that the partial aim of TQM is to ensure customer satisfaction. In this study, customer satisfaction equates to the optimisation of customer complaints. This assumption is consonant with the observation by Verma (2016) who notes that "Quality improvement in an organization is related to improving the efficiency of individuals, groups and the organization as a whole".

The central idea of the research is to focus on the optimisation of customer complaints. The literature review conducted did not focus directly on the optimisation of customer complaints. The material gathered did however analyse some topics that are aligned and one can conclude that there is a relationship between leadership and customer complaints. The relationship between leadership and customer complaints will be further dealt with as the researcher will attempt to integrate the suggestions on Quality 4.0, on leadership, into the analysis in Chapter 4. The aim is to address the suggested elements by using instruments that can assist.

3.3.3.11 Competency

3.3.3.11.1 Competency defined

Competency is the eleventh and last element of the LNS framework. According to past researchers, the concept of competence is described differently in various countries around the world (Cheng et al. 2003; Ashworth and Saxton, 1990; Heinen, 2011). Cheng et al. (2003) indicate that the terms "competence" and competency are used interchangeably. Tobergte and Curtis (2013) describe competence as the ability to apply skills learned and capabilities acquired to perform a certain function effectively. On the other hand, Thompson (1995) defines competence as the attributes needed by an individual to perform his/her tasks. Blanchard and Thacker

(2005) claim that competence is a cluster of related knowledge, skills and attitudes that differentiate high performers from average performers. Hashim and Wok (2014) suggest that competency has emerged as an important factor in the business environment because it is linked more to the individual than to the job.

In research conducted by Meyer et al. (2015), it was apparent that the future of the manufacturing will be very much centred around the competence of the individual. Research has also been conducted on competencies about age and gender in the workplace, and many theories emerged from these investigations. In this research, the latter will not be discussed as it has no bearing on the investigation. It is however important to point out that the common denominator in the theory around competency definition is that it refers to the ability of the individual to perform to the minimum requirement of the given task. As alluded to earlier, manufacturing in the future will also be very much dependent on the competency of individuals for the business to be successful.

In the Quality 4.0 concept, the skills differ or change from machine technology to Internet-based technology. Analyses conducted by Cheng et al. (2003) suggested that a combination of education, training and workplace practices would be required to attain the correct standard for organisations to be competitive. During the investigation, after having looked at the different definitions available, Meyer et al. (2015) decided to opt for the German, Erpenback (2003) version, which defines competency as the "Dispositions of self-organisation of human activities, which include creative thinking and self-organisation arrangements. Competencies, in contrast to other constructs such as skills, knowledge and other abilities, express the existing self-organisation capabilities of the specific individual."

3.3.3.11.2 Types of competencies

Kauffeld (2006) suggests that competencies are categorised into four facets. These facets are briefly discussed below:

- **Professional** – Refers to the attributes or skills that an employee needs to perform his or her duties as part of the greater organisational requirement. The employee must also be able to assist with improvement initiatives and problem-solving.

- **Methodological** – The ability of a worker to advance his ~~own~~ methodological way of contributing to solutions.
- **Social** – The skills to be able to competently interact with various levels within the organisation.
- **Self-competence** – The ability of the employee to allow for personal growth and assessment to develop and measure personal performance against individual set targets.

According to the editorial team at Exforcys (2015) many types of competencies have been identified over the years and these are briefly discussed below:

i. **Individual competency** – In its simplest form, this refers to the skills, knowledge and attitude a person needs to demonstrate or acquire in order to contribute to the organisational strategy. This type of competence includes elements such as problem-solving, decision making and commitment, which will elevate the individual to the required level of individual performance.
ii. **Business competency** – This refers to the knowledge and skills required in a particular business or industry. In the business environment, the individual should be able to demonstrate the ability to function properly in areas such as service, ethics and accountability in order to communicate effectively.
iii. **Management competency** – Competencies associated with people in senior positions. In this study, this will include superintendents, production managers and operation managers. This would equate to the individual's role to have good judgement, be results orientated, build relationships, and have a good level of stress tolerance.
iv. **Leadership competency** – Competencies for leadership roles such as that of a team leader. This type of competency assists with the grooming of an individual to ensure effectiveness in their position as a leader. A typical leader must possess the ability to communicate effectively, influence subordinates and be resourceful.
v. **Functional competency** – This type of competency is specific to a certain job. For example, a computer programmer must be knowledgeable and skilled when it comes to various programming languages such as Java,

Python, and C++. In addition to the above, knowledge of data analysis and the latest technologies will be an advantage in such a functional role.

vi. **Core competency**– In this study, a core requirement, for example, of a canmaker would be to have the technical skills to set up the equipment to safely manufacture good quality cans. The individual will benefit from the key element in core competence if he/she stays abreast with the latest technologies and trends in the specific field.

3.3.3.11.3 Level of competence

Besides the types of competencies that are important to know, Drejer (2007) notes that individuals operate at a specific level in their development process. Figure 3.13 below illustrates the development process of an individual, and how this person would typically progress, and the desired level of competence required. In this illustration, it is observed how the individual moves from a conscious incompetent level to a conscious competent level as he acquires the required knowledge.

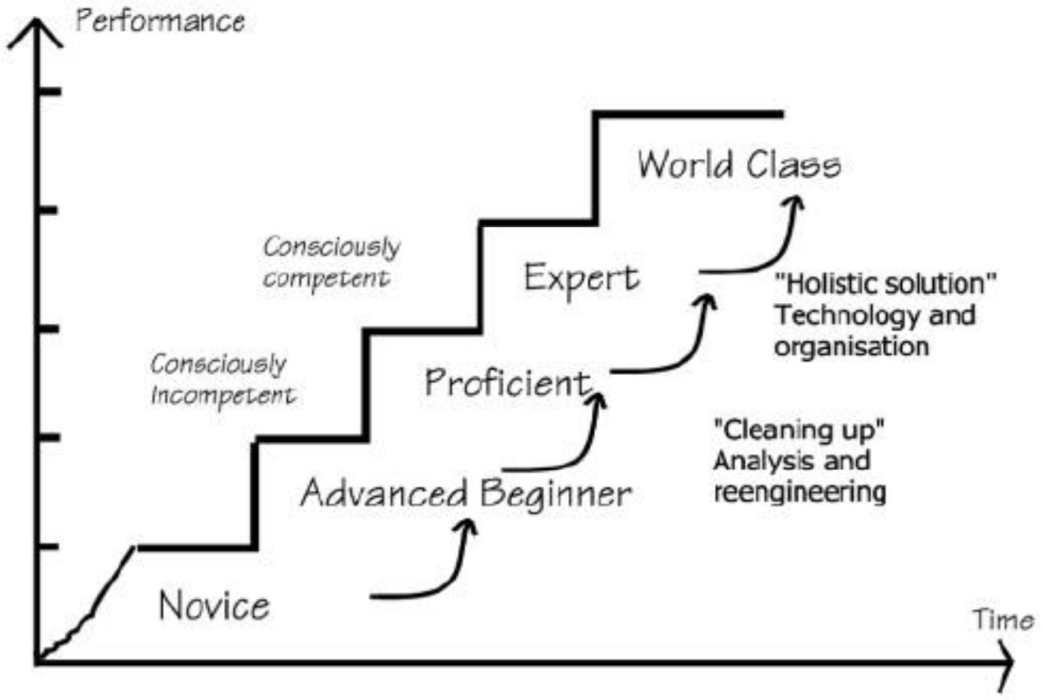

***Figure 3.13**: Level of competence development* (**Source**: Drejer, 2007)

3.3.3.11.4 Competency challenges

The revolution of industry resulted in changes in the requirement of competencies in the manufacturing environment. Industry demands more from employees to ensure effectiveness and profitability. The latest developments in industry require a level of competency that supports the business to enable it to compete globally. Mansfield (2006) refers to the requirements of competency as “the new need”. In his research, Mansfield (2006) investigates what changed in the competence requirements for changes in the industrial revolution and unpacks some of its consequences. Table 3.4 below addresses the change as depicted by Mansfield.

Table 3.4: Industrial Changes as depicted by Mansfield.

Changes in Industry	
A decline in …	**An increase in …**
The manual control of manufacturing operations using traditional “craft” skills	Monitoring and managing complex manufacturing systems, usually with high IT and knowledge content.
Continuous “mass” production – Resulting in the fragmented division of labour into small tasks	Small batch and” batch-of-one” production – resulting in far less division of labour and increased responsibilities.
Externally imposed quality control systems designed to identify defects	Internally managed quality assurance systems designed to improve products and processes continuously.
Manufacturing systems determined by the needs of the product and the production process (the “engineering logic”)	Manufacturing systems determined by the needs of the customer and the market (the “customer logic”).
Low-cost, marginal-quality, low-margin products	High-cost, high-quality, high value-added products.
Limited product ranges to maximise cost-effectiveness and ease system management	Large and constantly changing product ranges to maximise customer satisfaction

	– resulting in complex system management.
Slow response to change – long product life with long planning and lead times	Rapid response to change, the anticipation of change, innovation to force change – short product life with decreasing lead times.
An economy based on product manufacture, direct and control management hierarchy	An economy based on service delivery, "flatter" organisational structures with fewer management levels and greater responsibility devolved to practitioners.

(**Source**: Mansfield, 2006)

The changes that were pinned in 2006 already underline the rapid changes that have been ongoing since the advent of Industry 4.0. As already indicated earlier in this research, and as also reiterated by Renjen (2018), the fourth Industrial Revolution promises digital and physical integration that will support optimisation and productivity growth in businesses. It also holds the promise of exponential growth in innovation. From Figure 3.13, one can envision how flexible the skills will have to be and the level of competency required for sustainability. The consequences of the changing world, as encapsulated by Mansfield (2006), are as follows:

- More multi-skilled workers are required in the industry.
- Fewer low-skilled workers are required in the industry.
- The improved ability plus the theoretical knowledge to support and exceed the management of equipment developed in the Industry 4.0 environment.
- Unskilled workers and old technologies are "exported" to developing economies with low labour cost.
- Employees are increasingly becoming more responsible for quality assurance, improvements and control over their activities.
- There is an increase in direct contact with customers and clients.

- As systems become more complex, coordination of work activities is required at every occupational level.

The findings on the consequences of Mansfield (2006) speak directly to what is currently experienced in the ambit of Quality 4.0. Jacob (2017: **Online**) concurs that flexibility in terms of competence will be key to Quality 4.0. Companies will have to invest in continuous training to keep the competency level high. Many methods for the development of competencies have been articulated over the years (Wilcox, 2012). The methods for evaluating and development started in the fifties with proponents such as Fleishman (1953) and Flanagan (1953). Most recent researches include Anastacia and Urbina (1997) and Shippmann et al. (2000).

3.4 Digitalisation

3.4.1 Digitalisation defined

For one to grasp the concept of digitalisation, the terms digitisation and digitalisation have to be defined and distinguished first. Burkett (2017: **Online**) defines the two terms in the following way:

- **Digitisation:** Digitisation is the process of converting information from a physical format into a digital one.
- **Digitalisation:** Digitalisation is the process of leveraging digitisation to improve business processes.

Legner et al. (2017) concur ~~in~~ that whilst digitisation covers the conversion of analogue signals to digital format, digitalisation is the process of adopting and using digital technologies in broader individual, organisational and social contexts. Dewa et al. (2018) also remark that digitalisation can be viewed as the implementation of the current Internet Communication Technologies to improve production processes, efficiency and productivity. In line with these definitions, Schwab (2016) argues that digitalisation encompasses a range of diverse but complementary technological developments, making up the Fourth Industrial Revolution.

3.4.2 Benefits of digitalisation

The benefits derived from digitalisation are experienced in different ways. Lam et al. (2017) noted the following as some of the benefits companies can attain through digitalisation implementation:

- A more efficient assessment process through optimised use of video interviewing technology.
- Improved candidate quality using validated off-the-shelf personality and cognitive ability assessments.
- A process that is flexible and scalable (to increase and decrease) in demand and location of roles.
- Cost reductions in the assessment process as well as assessor hours from the business.

3.4.3 Challenges of Digitalisation

Digitalisation offers benefits for the industry, but for business to succeed, they need to understand that there will be challenges attached to it. Hoch (2017) offers certain points that businesses should be aware of when acquiring digitalisation. The points are as follows:

- Employee pushback.
- Lack of expertise to lead digitalisation initiatives.
- Organisational structure.
- Lack of overall digitalisation strategy.
- Limited budget.

The following three sections on the research hypotheses, are addressed in detail above and can be located as referred to below.

3.5 Quality Culture

In the literature review, Section 3.3, the eleven axes of Quality 4.0 include quality culture. See Section 3.3.3.9.2.

3.6 Competence

In the literature review, Section 3.3, the eleven axes of Quality 4.0 include competence. See Section 3.3.3.11.

3.7 Leadership

In the literature review, Section 3.3, the eleven axes of Quality 4.0 include leadership. See Section 3.3.3.10.

3.8 Customer quality complaints

3.8.1 Customers defined

To understand what a customer complaint is, one needs to understand what a customer is. Juran et al. (2007) describe a customer as “anyone who is affected by the service, product, or process.” In the ambit of this research environment, a customer refers to the companies that receive the products in the form of containers that have to be placed in the customer’s filling process. This customer is also referred to as the external customer as described by Juran et al. (2007). The two types of customers in business are as follows:

3.8.1.1 Internal customer

This customer includes other divisions or departments within the organisation that receive information or components for assembly from departments earlier in the internal supply chain. An example of this function would be the procurement department, which supplies the production department with raw material to manufacture the product. Albrecht and Bradford (1990) suggest that these customers are willing to keep on coming back simply because they have nowhere else to go.

3.8.1.2 External customer

This refers to the ultimate user of the products as well as the intermediate processors and retailers. In this research, the customer will be the intermediate processors. According to Finn et al. (1996), this is the type of customer that can at any point decide to use a different supplier depending on the quality of the service from that supplier. It is important to note that the consumer of these products will be

indirectly the organisation`s customer as any complaint related to the manufacture of the container will be referred to the organisation.

3.8.2 Customer quality complaints defined

The European Regulators (Regulators et al., 2010: **Online**) define a customer complaint as an expression of customer dissatisfaction regarding a product or services delivered. Similarly, Juran et al. (1998) suggest in simpler terms that the term complaint is an assertion of quality deficiency. In the same vein, Goodman (2006: **Online**) reiterates that complaints, like taxes and death, are some of the sources of customer complaints that are inevitable. These complaints are communicated through the various mediums such as e-mails, phone calls, letters or physical claims. In the context of the research environment, customer quality complaints refer specifically to those about product quality.

The objective of any organisation is to supply products to the customer free of defects. However, according to Vos, and Huitema, (2008), researchers should take cognisance of the fact that this is a phenomenon that is a fact of life and organisations need to deal with these facts. To eliminate product failures, organisations can incorporate Quality Management Systems (QMS) to control the manufacture of products and services within the business. Caplin (1982) supports this statement by arguing that when the organisation say they have something (the process) under control, then they know what they intend to do. Through the effective use of Quality Management Systems, organisations intend to eliminate or as far as possible reduce the risk of supplying defective products to the customer.

The research conducted depicts a trend in the shift of focus from complaint recording and reporting to the management of complaints (Barlow and Møller, 1996; Tax and Brown, 1998; Johnston and Mehra, 2002). This research expands on the research conducted by Vos and Huitema (2008) who found that the organisation should incorporate Organisational Learnings (OL) into their complaints management systems. Many organisations view the management of complaints as a waste of time in terms of overhead count and as such are not as customer orientated as would be required. The establishment of a complaint management

system with an integrated OL platform that will greatly reduce the possibility of producing defective products.

3.8.3 Customer complaints in Quality 4.0

In the ambit of Quality 4.0, customer complaints are dealt with through an integrated Customer Relationship Management system (Jacob, 2017: **Online**). As mentioned earlier, this system integrates into the Enterprise Quality Management Software (EQMS) programme. Through the availability and subsequent online analysis of real-time data, the system seeks to react fast and the information will lead to a quicker response ~~of~~ through root cause analysis before giving feedback to the customer (Sussman, 2018**: Online**). The Industry 4.0 premise allows companies to add sensors in the production environment and apply machine-learning analytics to equipment, which will help to reduce the number of quality complaints from the customers.

3.8.4 Customer complaint opportunities

Reid (2019: **Online**), a statistical process control expert for Infinity QS, suggests in Table 3.5 below, the areas that the organisation should focus on to improve quality complaints in the company.

Table 3.5: Quality Complaint Improvement

Quality Complaint Improvement	
Improve	**Description**
Make it right the first time.	If organisations spend the same amount of money they waste on rework, recalls, and so forth on the front end — using statistical process control (SPC) — they will save money throughout the entire manufacturing process.
Catch it before it gets to the customer.	Prevent a defective product from leaving the building: If not, intercept before it gets to the customer.

Do not allow suppliers to dictate your quality.	Set a standard that both you and your suppliers agree on, and hold them to it.
Apply the team concept.	Everyone is going to play a part in quality.
Educate your customers about your product.	Don’t just sell the product; inform the customer how to use it.
Communicate between sites.	Share the knowledge across the organisation. If there is a problem, let other sites know because they might have the same issue.
Listen to the customer if there is a complaint.	Listen — do not take the complaint personally. The customer is providing valuable and useful information.
Do not send a replacement without checking it first.	If you send the customer some more of the same problem, they will go somewhere else.
Track the complaints.	Collect the data around the complaints and run Pareto analyses on them. Identify the frequency and duration of the issues.
Think about quality from a customer perspective.	Try to anticipate the customer’s needs.

(**Source**: Reid, 2019)

In the context of Industry 4.0 and Quality 4.0, Table 3.5 above addresses the basic requirements of the suggested Quality 4.0 framework for businesses. As mentioned earlier in this investigation, the framework suggests that traditional quality be effectively sustained to acquire Quality 4.0 in an organisation. The movement towards Quality 4.0 will include the adoption of features such as digitalisation, cyber-physical systems and real-time data analytics. In their PricewaterCooper paper,

Geissbauer et al. (2015: **Online**) suggest the key aspects for a successful business model within the realm of Industry 4.0 as shown in the table below.

Table 3.6: Key aspects of business models in Industry 4.0

Key aspects of successful business models in Industry 4.0			
Aspect	Importance %		
	Important	Neither	Not Important
Stronger digital networking with customers and partners.	72	24	4
Provision of "solutions/systems" instead of products.	66	20	14
Expansion of digital services with additional customer benefits.	64	24	12
Efficient and safe cloud technologies.	44	31	25
Development/expansion of value service. (E.g., Apps.)	46	29	25
More direct business with end customers.	45	31	24
Strengthening own position with regards to new digital players.	39	31	30

(**Source**: Geissbauer, 2015)

Understanding the important aspects and the implementation of the prioritisation of these functions will yield benefits for the organisation and this will improve the organisation's quality management processes and more specifically reduce customer complaints. Geissbauer (2015: **Online**) articulates these benefits in the following manner:

- Better satisfaction of customer complaints.
- Faster time to market.
- More efficient division of labour.
- Greater flexibility.
- Higher innovation speed/rate.
- Access to know-how/expert knowledge.
- Risk minimisation.

3.8.5 Customer complaint challenges

Customer complaints are what any manufacturing organisation do not want, but they are inevitable. De Vos et al. (2008) explain that customer complaints are a reality that organisations have to deal with. In Quality 4.0, customer complaints also exist and they must be addressed. Since the premise of Quality 4.0 is concerned with the use of cyber-physical systems, connectivity and augmented reality (Jacob, 2017), the challenge within Quality 4.0 will relate to these issues. Geissbauer (2015: **Online**) alluded to these challenges within the context of Industry 4.0. Since Quality 4.0 is a reference to Industry 4.0 (Pedersen, 2017: **Online**), the same challenges will affect Quality 4.0. These challenges are as follows:

- Unclear economic benefits such as excessive investment – Organisations and specifically those outside ~~of~~ Europe have tough decisions to make on the adoption of Quality 4.0, which is accompanied by investment requirements.
- Insufficient qualified employees – The adoption of Quality 4.0 requires skills that traditional functions have not focused on in the past.
- Low maturity levels of required technologies – Companies seeking to adopt Industry 4.0 strategies should be willing to invest in technology that supports this approach.
- Support by top management – Quality 4.0 should be driven by top management.
- Insufficient network stability/data backup – The economic infrastructure should support the initiative to adopt Quality 4.0.

The research indicated that challenges to adopting the Quality 4.0 approach do exist. Thus, it is up to organisations to collaborate with all the relevant stakeholders to assess what could be done to be able to move to the required industrial level.

3.9 Quality 4.0 Framework Use Cases

The LNS Quality 4.0 framework included in this study is a relatively “new” concept to readers and requires more information to demonstrate plausibility. To achieve this, the real-life applications and the areas where it was used needs scrutiny. IQS (2019: **Online**) states that Quality 4.0 provides a number of use cases that create a

strong foundation to understand quality in the light of disruptive technologies. LNS Research (2019) released some successful use cases on the application of some of the axes or elements employed from the framework. These use cases are presented in Table 3.7 below.

Table 3.7: LNS Research Framework Use Cases

LNS Research Quality 4.0 Framework Use Cases	
Functional Area	**Description**
Manufacturing	A leading consumer goods manufacturer applied machine learning and artificial intelligence to manufacturing process data to perform quality testing as an inherent part of the production processes. This investment leveraged existing manufacturing systems and data to drive new insights and higher levels of efficiency and in-service performance.
Supply Chain	A North American technology manufacturer deployed a system to gain near-real-time visibility into Asian supplier inspection data. This visibility virtually eliminated weeks of delay in quality analysis and alerts attributed to gathering and processing data. This had a considerable impact on the size of quality escapes and supplier development.
In-Service	Many case studies exist of manufacturers that use connected devices to improve performance against Service Level Agreements (SLAs) or even convert business models from product-based to service-based (e.g., selling power-by-the-hour rather than selling an engine). A pharmaceutical manufacturer added temperature sensors to vaccines in transit to healthcare facilities. Vaccines must be temperature-controlled to ensure their effectivity. Through real-time monitoring of vaccine sensors, the manufacturer could identify at-risk vaccines and either prevent them from being compromised or quarantine those that were.

(**Source**: LNS Research, 2019: Online)

The research suggests that several successful use cases of the framework have been recorded. What is clear from the research is that the approach by all reported use cases was systematic. The organisations that used the framework only used some of the axes or elements to address a particular area of concern. The premise of the research is based on the same approach. As alluded to earlier in this dissertation, the approach to this research is to use the analysis of the data received from the organisation to conduct root causes analysis and find a place in the framework where it will fit in. The top four areas that are found to indicate the highest number of incidents will be prioritised and handled accordingly. The methodology and research design will be adopted to address the need.

3.10 Literature Review Summary

The objective of this literature review was to gain more insight into researches previously conducted on the topic in light of the research question presented in this dissertation. The review highlighted three sections related to the research statement. These sections are briefly discussed below:

3.10.1 Industry 4.0

The literature review confirmed the existence of the new industry paradigm (Industry 4.0) and specifically the seriousness of the European countries to move forward with the concept. The Fourth Industrial Revolution awareness is globally growing, but the adoption of the concept is picking up at a very low rate globally. Through the research, it became clear that organisations that wish to move in this direction need a firm platform. This requires in short that the Industry 3.0 parameters be at a level that is acceptable for Industry 4.0.

3.10.2 Quality 4.0

Many quality institutions consider Quality 4.0, a reference of Industry 4.0, as the future of quality as we know it. This in its simplest form is the digital transformation of traditional quality. The research suggests that above other things the digital transformation supports the operational excellence of an organisation. The reviewed literature explained how this is attainable.

3.10.3 Customer complaints

The reduction of customer complaints through the Quality 4.0 approach is key to the study. The literature review addressed this component and the results suggest that this is plausible. Chapter 4 will address the methodology and research design to support the statement above. The literature review also addressed some of the objectives conclusively as will be pointed out further in this dissertation.

CHAPTER 4
RESEARCH DESIGN AND METHODOLOGY – QUALITY 4.0: REDUCING CUSTOMER COMPLAINTS

4.1 Introduction

The objective of this chapter is to outline the research design and methodology, guiding the investigation. Figure 4.1 below is the researcher`s attempt to explain through visualisation the strategy or high-level plan for the investigation. Leedy (1989) notes that nothing helps research to be successful as the proper planning of the research design. Research design is concerned with the overall strategy that the researcher chose to integrate (Libguides, 2018: **Online**).

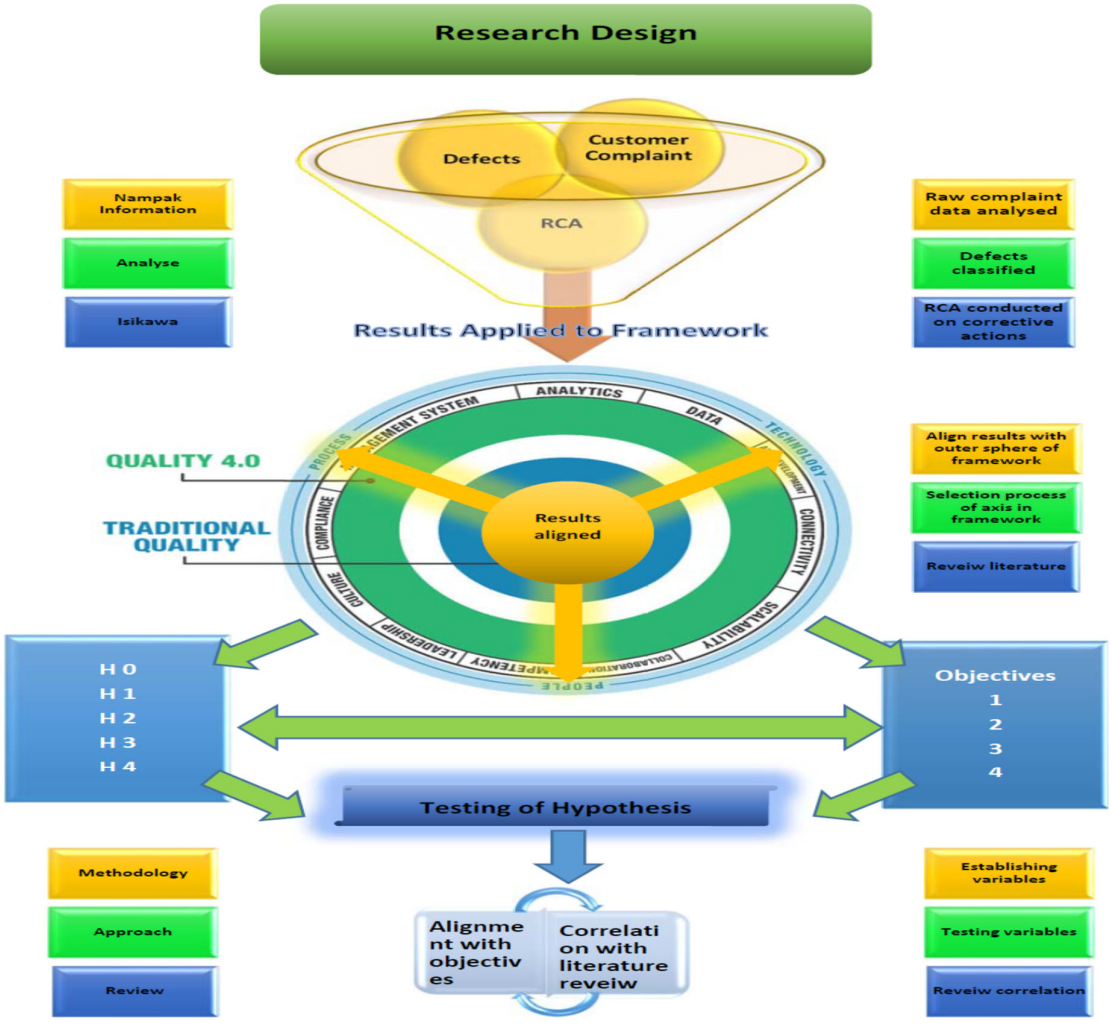

***Figure 4.1**: Research Plan* (**Source**: Own construct)

The research shows that the higher levels of customer complaints has not changed over a period of three years. Figure 4.1 attempts to illustrate how this information was filtered and analysed. The data received from the internal Nampak database was scrutinised (Nampak Divfood Internal database, 2017). The first phase of the data scrutiny included segregation of the food section in the division from the rest (See Annexure B). This information ensured that all the non-food cans manufactured over this period were excluded from the investigation. The next step in the segregation process involved the segregation of the process-related complaints from the rest of the complaints (See Annexure C). Subsequently, the process-related complaints were divided into the process functions (See Annexure D).

This step identified the end-making process as the function that contributed the most customer complaints in the process. Annexure E illustrates the different complaints received from this function. This led to an investigation of the information recorded on the Nampak database where all the customer complaints are captured and all the departments are required to complete a root cause analysis and update the information on the database. The Quality Manager then signs off this information and gives feedback to the customer. A root cause analysis using the Ishikawa model was conducted for this research on all the completed customer complaints (See Annexure F). According to Ishikawa (1991), the Ishikawa diagram or cause and effect diagram can be used for analysing any problem. It is a tool that can help to identify, sort and display the causes of a specific problem.

The second phase in Figure 4.1 illustrates the use of the information in relation to the LNS Research framework. The objective is to ascertain where the results will fit into the framework. The information gathered from this investigation points to the people section of the LNS framework. It refers in particular to the following aspects:

- Competency
- Leadership
- Culture

This information paved the way for the hypothesis, sub-hypotheses and helped in formulating the objectives. Through the literature review, it became evident that the

digitalisation of the quality process in the ambit of Quality 4.0 is a crucial part of complaint optimisation and for this reason, it is included in the research.

4.2 Research Hypothesis

4.2.1 Research Question

How can the Quality 4.0 concept facilitate an appreciation for the reduction of customer complaints within the organisation?

4.2.1.1 Major Hypothesis

H1: The Quality 4.0 concept facilitates the optimisation of the customer quality complaints of the traditional QMS.

4.2.1.2 Sub-Hypotheses

Sub-H1: Digitalisation as a key element of Quality 4.0 relates positively to the optimisation of product customer complaints.

Sub-H2: Quality culture as a key element of Quality 4.0 positively affects the optimisation of product customer complaints.

Sub-H3: Competency as a key element of Quality 4.0 positively affects the optimisation of product customer complaints.

Sub-H4: Leadership as a key element of Quality 4.0 relates positively to the optimisation of product customer complaints.

4.3 Research Objectives

4.3.1 Primary objective

1. The primary objective of this study is to provide a comprehensive overview of how Quality 4.0 can better facilitate the optimisation of customer complaints.

4.3.2 Secondary Objectives

The secondary objectives are as follows:

1.1 To determine how digitalisation in Quality 4.0 can positively optimise customer complaints.

1.2 To determine if Quality 4.0 cultural elements exist within the current quality system of DivFood, and if so, determine its extent.

1.3 To establish what level of competency is required to better facilitate the optimisation of product customer complaints.

1.4 To establish the correlation between leadership and the escalation of customer complaints.

4.4 Methodological alignment with objectives

This section aims to illustrate the methodological choice that fits the research to address the research hypothesis. It also demonstrates the approaches used for the secondary objectives. Section 4.1 of this chapter gives a brief explanation of the overall plan of the study and how the data gathered diffuses in context with the research. Table 4.1 illustrates the methodological choices and approaches selected for the study.

Table 4.1: Methodology used in research

	Primary objective	**Secondary Objective 1**	**Secondary Objective 2**	**Secondary Objective 3**	**Secondary Objective 4**
Objective	**How Quality 4.0 facilitates complaints optimisation**	**How digitalisation affects optimisation**	**Establish the relationship between Quality 4.0 culture and complaints**	**Competency required for optimisation**	**Establish the relationship between leadership and optimisation**
Approach to theory development	Inductive	N/A	Inductive	Inductive	Inductive
Methodological choice	Mixed - Method	N/A	Qualitative	Quantitative	Qualitative
Strategy	Explanatory Sequential	Derive from Literature	Explanatory	Explanatory	Explanatory
Sampling	N/A	N/A	Purposive	Purposive	Purposive
Research instruments	Ishikawa Diagram/ LNS	Digital Selection framework	Questionnaire	Questionnaire	Questionnaire

	Research Framework				

(**Source**: Own construct)

4.4.1 Approach to theory development: Inductive reasoning

According to Creswell (2008), inductive reasoning is better suited to use when the researcher needs to use qualitative and quantitative data to realise a full understanding of a certain phenomenon. Saunders et al. (2012) elaborate that inductive reasoning starts with a comprehensive observation of the research environment, which acts to abstruse conclusions. This study refers to an approach that primarily uses raw data from the customer complaints information, to derive concepts and models through the researcher's interpretation of these data. Strauss and Corbin (1998) note in support that an inductive researcher will begin with a study and aim to generate a theory from the collected data. Inductive reasoning fits well with this research as the approach aligns with the overall research plan as indicated in Section 4.1 of this dissertation. This entails the use of raw data captured on the Nampak database. The analysis of the secondary data suggested certain patterns. This information consisted primarily of quantitative data, but after filtering, the information could be applied as qualitative data.

4.4.1.1. Advantages of inductive reasoning

According to Jordan (2019: **Online**), the strength of inductive reasoning lies in establishing probability. He continues to elaborate that inductive reasoning allows the researcher to be wrong. It is only through more observations that one can determine whether the premise is true. The minimum value derived from this reasoning is that it will at least give direction to future researches.

4.4.1.2. Disadvantages of inductive reasoning

The disadvantage of using inductive reasoning according to Jordan (2019: **Online**) is that it is limited in terms scope. He suggests that the data can be compromised if the observations made are incorrect. This may in turn affect the conclusion of the study.

4.4.2 Methodological approaches

4.4.2.1 Mixed methods

Bain (2019: **Online**) cites Creswell and Plano Clark (2011) in his definition, which suggests mixed methods as a method, which focuses on collecting, analysing data by combining both quantitative and qualitative techniques in a single and series of studies. Bain (2019: **Online**) continues to elaborate that the central premise of the use of quantitative or qualitative approaches, in combination, is that they provide a better understanding of the studied phenomena as opposed to using them separately.

4.4.2.2 Quantitative approach

According to Curwin and Slater (2008: **Online**), the quantitative approach in research is about using statistical information to help define, describe and resolve several problems. They note that the quantitative process is much more than doing mathematical and statistical calculations, but that the numbers will have to make sense in the context of the research.

4.4.2.3 Qualitative approach

Denzin and Lincoln (1994) define qualitative research as “a situated activity that locates the observer of the world”. This type of research consists of a set of interpretive and material practices that makes the world visible through lived experiences. This equates to the ability of this approach to turn the world into a series of representations, which include field notes, interviews, conversations, recordings etc. A different way to describe this approach is that qualitative researchers seek to study phenomena in its natural settings and attempt to make sense of it making interpretations from the meaning that people connect to it.

4.4.2.4 Mixed-method approach in the context of the study

The mixed-method approach was selected for this study, as it is the one most appropriate for the research in the opinion of the researcher. Figure 4.1 above explains the overall strategic plan of the study and the top section refers to the use of secondary data. This data consists of numerical quantities supplied from the Nampak database and this is quantitative data. Table 4.1 above illustrates how the primary objective will require a mixed-method approach. In addition, Figure 4.2

below demonstrates the process of using the mixed-method approach as suggested by Creswell and Plano Clark (2011). This method uses a qualitative approach to explain quantitative results.

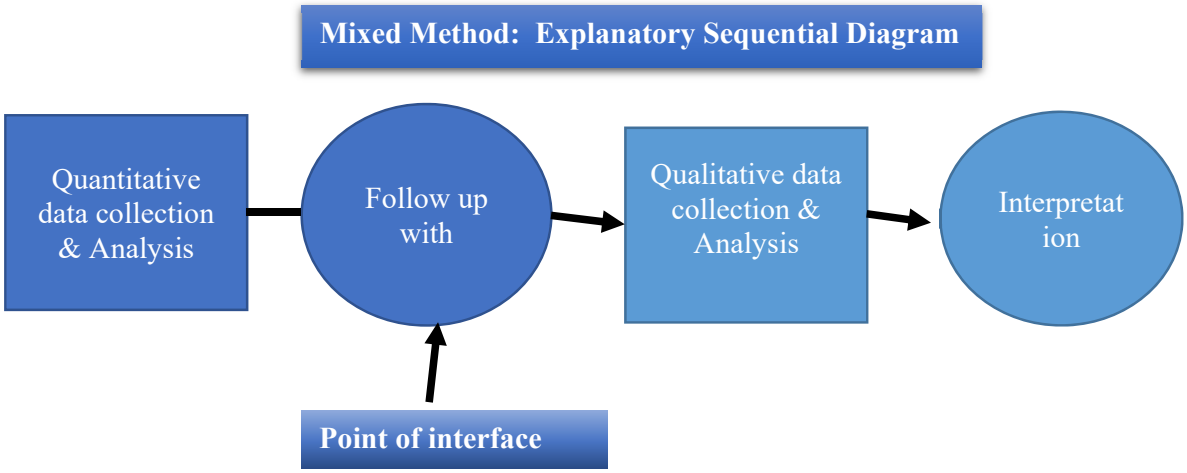

***Figure 4.2**: Mixed-method explanatory diagram*
(**Source**: Creswell & Plano Clark, 2011)

Figure 4.3 below is a modified version of the explanatory diagram that explains the flow in the context of the study.

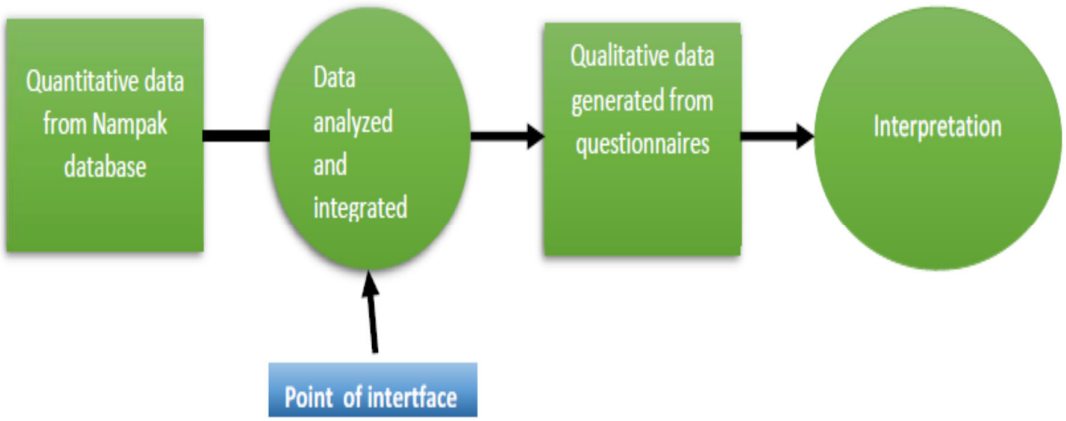

***Figure 4.3** Mixed method explanatory diagram modified*
(**Source**: Creswell & Plano Clark; 2011)

In both Figure 4.2 and Figure 4.3, reference is made to the point of interface. This relates according to Creswell and Plano Clark (2008) to the point where the two strands (qualitative and quantitative approaches) are mixed in one study. In the ambit of the study, this equates to the area where the data on customer complaints

are analysed and categorised or aligned to fit into the LNS Research framework. (See Figure 4.1, Figure 3.3 and Annexure H.)

Table 4.2: Elements identified on the LNS Research framework using Ishikawa Model

Elements identified on LNS Research framework using Ishikawa Model			
Framework Segments	Framework Axis Identified	Axis traditional requirements	Axis Quality 4.0 requirements
Process	_	_	_
Technology	_	_	_
People	Competency	Structured	Individual
		Individual	Appraisals
			Expertise
			Experiences
	Leadership	Mental	Quality KPI
		Cross-functional	Executive ownership
		Executive	Objective alignment
	Culture	Cross-functional	Cross-functional empowerment
			Credibility
			Responsibility
			Process participation

(**Source**: Own construct)

4.4.2.5 Limitations of mixed-method approach

Doyle et al. (2009) note that although it is clear that employing mixed-methods in research has more benefits, there have been many criticisms about this approach. There is a belief from certain researchers that the quantitative and qualitative methods cannot be used simultaneously in research because of their ontological and epistemological origins. Some of the limitary concerns raised are as follows:

- The researcher requires sufficient knowledge of both quantitative and qualitative methods independently.

- The researcher should know how to mix these methods appropriately to achieve a good study outcome.
- There is a claim that the use of mixed-methods in research is time-consuming when applied concurrently.
- Mertens (2003) argues that basing methodological choices only on pragmatics is inadequate.

In this research, the limitations described above are countered respectively in the following manner:

- The programme requirements for research of the institution dictates in-depth research on the subject matter, which will allow the researcher to undertake the study systematically.
- The mixing of the methods is something that students are not working with on a full-time basis and as such will require research of the topic, but more importantly would require guidance from the supervisor.
- This statement is plausible, as the research has experienced the timeframe required for the first phase of data collection. In this research, this phase of the study was conducted well in advance.
- The inadequacy of the pragmatics is debatable as other researchers have different views. The outcome of this study will determine if the method is plausible or not.

4.4.3 Sampling

According to Salant and Dillman (1994), a sample is a group of people, objects or items taken from a larger population to measure the studied phenomena. Sampling, on the other hand, is the process, act or technique of selecting suitable samples that are representative of the population for determining parameters or characteristics of the entire population. Blaxter, Hughes and Tight (2006) suggest that the level of knowledge of the participants in the process influences the sample type. Leyman (1983) also notes that the purpose of sampling is to compensate for practicality and economical reasoning. Jackson (2008) suggests that there are two categories of sampling techniques used to sample individuals and these are:

- Probability sampling.

- Non-probability sampling.

There are different sampling techniques within each of these categories. The technique chosen for this study is purposive sampling which is a subdivision of non-probability sampling. Gribben (2002) states that with purposive sampling, the researcher recognises that there may be variation in the chosen population. The researcher will control this by using selective judgement to ensure a representative sample.

4.4.4 Research instruments

The research instruments used in this research as illustrated in Table 4.1 are discussed in this section. They are as follows:

- Ishikawa diagram.
- LNS Research framework.
- Digitalisation selection framework.

4.4.4.1 Ishikawa diagram – the primary objective

In Section 4.1, the Ishikawa diagram is defined. This instrument was selected because it can convert quantitative data into qualitative data. In this research, the number of incidents of customer complaints was identified, categorised and plotted on the Ishikawa diagram. According to Ishikawa (1991), the use of the diagram can yield the following benefits:

- Display relationship clearly and logically.
- Show all causes simultaneously.
- Facilitate brainstorming.
- Stimulate problem-solving.
- Help maintain team focus.

4.4.4.2 LNS Research framework – the primary objective

The LNS framework is discussed in detail in Chapter 3, in of this study. This framework forms an integral part of the study as it connects elements of Quality 4.0 in this study with traditional quality. The framework and the work conducted by LNS Research in the sphere of Quality 4.0 is a relatively new topic in research. The

framework starts in the core with traditional quality as the base and builds on with elements that should be included in the realm of Industry 4.0. The inclusion of these elements suggests a new way of quality improvement that aims to optimise operational excellence. This similarly equates to customer complaint optimisation. The objective of including the framework in the study is to determine if the suggestions put forward can yield benefits if used in the current situation in the organisation. The steps taken to include the framework are as follows:

- Step one – Assessing the secondary data as supplied by the Nampak database.
- Step two – Grouping customer complaint data according to related defects (See Annexure E).
- Step three – Categorising the root cause supplied to the customer (See Annexure F).
- Step four – Applying the Ishikawa model to categorised data (See Annexure G).
- Step five – Aligning Ishikawa results with the LNS framework (See Table 4.2).

The axes/elements identified in the framework through the results of the Ishikawa model are highlighted in Table 4.2. After some careful consideration, it is observed that the elements identified coincide with the objectives of this study. The elements in the Quality 4.0 requirements column in Table 4.2 will be used in the questionnaires as part of secondary objectives number two, three and four of this research. It must be observed at this stage of the study that secondary objective number one, which is the digitalisation, will not require further work as the required information to address this objective will be derived from the literature.

4.4.4.3 Digital selection framework

In Table 4.2 the digital selection framework is referred to as an instrument as used by Dewa et al. (2018). In Section 4.4.4.2, the researcher noted that no further research is required for this in this specific section. It is however important to note that the objective is to advance a broad context of digitalisation towards the organisation. As such, the researcher deemed it necessary to include this framework in the research as part of the compliance requirements with the research objective. The option of modifying the framework to fit in with the researcher's

operational agenda will be investigated in Chapter 5. The framework developed by Dewa et al. (2018) describes the decision-making platform for the introduction of digital technologies within the ambit of the South African tool-making industry. The researcher suggests the need for an investigation into the possible modification of this framework for the fast consumer goods production environment. The premise of this investigation is to address the objective of advancing the context of digitalisation within the organisation.

4.5 Data collection process

This section will focus on the instruments used for the collection of primary data that supports the study. According to Bhat (2019), data collection is defined as the process of collecting, measuring and analysing accurate insights for research using standard validated techniques. He maintains that researchers can evaluate their hypothesis based on data collected. In this study, the following collection methods fit the research criteria for the chosen secondary objectives:

- **Questionnaire** - Secondary objective 2: To establish the relationship between Quality 4.0 culture complaints optimisation.
- **Questionnaire** - Secondary objective 3: To establish the competency requirements in Quality 4.0.
- **Questionnaire** - Secondary objective 3: To understand the relationship between leadership and customer complaints.

A covering letter that briefly explains the reason for the questionnaire, inclusive of a confidentiality portion, accompanied the e-mails that were sent individually to the respondents. The target group for the questionnaires was the divisional middle management, quality personnel and team leaders of the respective plants. These people were targeted because they deal with the quality and customer complaints daily. They are also the group responsible for completing the quality complaints, defining the root cause analysis and the administration thereof. The questionnaire communication was conducted via e-mail and the researcher contacted the heads of departments telephonically. The objective of the research was discussed with the heads of departments. The questionnaire was accompanied by a letter which gave a brief explanation of the aim of the research and what potential benefits it can generate. The period given to complete the questionnaire was a month and it would

take around 15 minutes to complete. The frequency to follow up on this was every 10 days.

4.5.1 Data collection instruments and demographic

Marshall (2018: **Online**) defines questionnaires as a set of questions on a topic or a group of topics designed to be answered by the respondents. It is also considered as a vehicle used to pose the questions that the researcher wants the respondents to answer. Some of the advantages of using a questionnaire include less time to complete, anonymity and the relatively low cost to administer the instrument. Its disadvantages include less control, possibility of errors and unreliability. To overcome these challenges, the questions posed must be user friendly and easy to understand, and constantly follow up is required to meet the desired deadline. The questions on the questionnaire and the survey were included in one document and distributed to the respondents via e-mail and hand posted for those who were not digitally connected.

Table 4.3: Questionnaire distribution

Questionnaires distributed divisionally				
Number of questionnaires distributed	112			
Plants	VDBP	Paarl	Durban	Epping
Total distributed per plant	50	50	10	40
Total returned per plant	31	49	2	32
Percentage returned	62%	98%	20%	80%

(**Source**: Own construct)

Table 4.3 above illustrates how the questionnaires were distributed between the various plants in the division. The target group within the group included the quality and production departments. The levels targeted included the functions directly related to the manufacturing of the products, from the supervisor to mechanics and quality inspectors.

4.5.2 Questionnaire breakdown

The questionnaire aimed to to establish the objectives as indicated earlier in this research. It must be noted that the literature review has already indicated positive relationships for objectives 2 and 3 of this study. However, the aim of the questionnaire is to determine whether there is a positive resolve for the variables illustrated in Table 4.2, which refers to the Quality 4.0 aspect of this research. The aim is to add the results to those already established through the literature review. The three sections covered in the questionnaire are as follows:

i. Section 1 – Culture

The elements and statements in this section are as follows:

- **Cross-functional empowerment**
  1. DivFood supports individual decision-making.
  2. Strategies to improve decision-making are in place.
  3. Effective decision-making in DivFood affects customer complaints.
  4. Employee empowerment exists in DivFood.
  5. Employee empowerment is directly related to customer complaints.

- **Credibility**
  6. DivFood employees are trained adequately in regards to quality.
  7. The quality function in DivFood is credible.
  8. Customer complaints discredit the DivFood quality function.
  9. DivFood can trust the current effectiveness of the quality systems.
  10. Customers are happy with the current DivFood quality.

- **Responsibility**
  11. Quality is the Quality Manager's responsibility.
  12. Quality is everyone's responsibility.
  13. Ownership of quality exists in DivFood.
  14. DivFood promotes ownership of quality.
  15. Quality improvement techniques are used in DivFood.

- **Process participation**
  16. Process participation is encouraged in DivFood.

17. Quality objectives are discussed frequently in team meetings.
18. Customer complaints are discussed in all team meetings.
19. Process participation is encouraged in the company's operations.
20. Quality focus areas are visible on the production floor.
21. Quality improvement teams are active within the organisation.

ii. Section 2 – Competency

The elements and statements in this section are as follows:

- **Individual**
  22. Current levels of competency in DivFood are adequate.
  23. Individual incompetency levels could contribute to complaints.
  24. Competency training in DivFood is effective.
  25. Performance review on competence is conducted timeously.

- **Appraisals**
  26. Appraisals are conducted according to the frequency in DivFood.
  27. Individual performance appraisals include empowerment strategy.
  28. Appraisals include competency discussion and plan.
  29. The expected level of ownership around quality is included in the appraisal.
  30. Measurement for all appraisal parameters is discussed and agreed upon.

- **Expertise**
  31. Expert support is readily available in DivFood.
  32. The support of experts can have a positive effect on the optimisation of customer complaints.
  33. Expert transfer of knowledge platforms exists in DivFood.

- **Experiences**
  34. Process-related experiences are recorded.
  35. Recorded process experiences assist with customer complaint optimisation.

iii. Section 3 – Leadership

The elements and statements in this section are as follows:

- **Quality KPI**
  36. KPIs on quality are included for all staff in the operation.
  37. Quality KPIs are agreed upon by all team members and management.
  38. Quality KPIs are also included for production staff.

- **Executive ownership**
  39. Executive quality ownership is discussed in team meetings.
  40. Employees are encouraged to exercise executive ownership.
  41. Employees understand the concept of executive ownership.

- **Objective alignment**
  42. Management objectives are communicated to all team members.
  43. Team members' quality objectives are aligned with management objectives.
  44. Measurements for quality targets are in place.
  45. Quality KPIs are visually displayed.

4.6 Conclusion

This chapter focused on the methodologies used in the research and elaborated on how the objectives of the study will be addressed through the research. In summary, this research adopts a mixed-methodology design with an explanatory approach. The questionnaire used in the research consists of three main categories, which are subdivided and comprises of forty-five statements altogether. The researcher employed the five-option Likert scale type. The closed-ended questions used relate to the elements identified through the research, which are crucial for the optimal performance of the quality function within the constraints of Quality 4.0.

The questionnaire sought to understand the relationship between the Quality 4.0 requirement and the status in the organisation to help address the hypotheses. The assumption is that the respondents are aware of quality since all Nampak DivFood employees are trained through quality awareness training sessions that are frequently held in all the plants. In addition to this, specialised product defect training

is compulsory for all employees in the production and quality departments within this organisation. Further to this, specialised ISO and food safety specific training forms part of the certification requirements. Subsequently, all the results of the data collection processes will be analysed in Chapter 5 as discussed accordingly hereunder.

CHAPTER 5
DATA ANALYSIS AND INTERPRETATION OF RESULTS: QUALITY 4.0: REDUCING CUSTOMER COMPLAINTS

5.1 Introduction

This chapter focuses on the analysis and the interpretation of the data collected in this research. In Chapter 4, the researcher, focused on the research questionnaire among other variables towards the identified elements of the framework relevant to Quality 4.0. These elements form part of the people segment of the LNS Research framework (Annexure H) and in the opinion of the researcher, this constitute the need for investigating the possible reduction of customer complaints. The aim of the questionnaire is to assess extent to which the organisation is employing these elements in its quality management processes. The literature review in this study addressed the gap between traditional quality and Quality 4.0 as prescribed through the LNS Research. The information gathered from the questionnaire and the information researched in this study through the literature review will help with the decision on the acceptance or rejection of the hypotheses. In summary, the outline of the research that is concluded in this analysis, as described in Figure 4.1 of Chapter 4, entails the following sequence:

- Using the secondary data of customer complaints and analysis through the Ishikawa model.
- The integration of the results into the LNS Research framework.
- The people segment of the framework selected for further investigation.
- The identified elements of the Quality 4.0 section of the people segment.
- The questionnaire designed to determine the extent of the organisation's inclusion of the identified elements.
- Analysis of variables and interpretation of the results.
- Address of the hypotheses.
- Conclusion and recommendations.

5.2 Variables

This section refers to the variables used in the data analysis. The variables are specific to the area of investigation. According to Kothari (2004), the key in research is to identify the variables relevant to the study and only concentrate on them. In this study, the LNS Research framework was chosen as part of this research guiding models. The independent variables referred to will be the elements as indicates in Chapter 4 and these include the following:

- Culture
- Competency
- Leadership

These elements are specific to secondary objectives 2, 3 and 4 of this research. The remaining variables of this research are digitalisation for secondary objective 1 and the main hypothesis is Quality 4.0. In this study, the customer complaint constitutes the dependent variable, also known as the effect. Sarikas (2018) suggests that the dependent variable is also what is being studied or measured. She further notes that the independent variable is the element that changes in the research process.

5.3 Data Reliability

According to Shuttleworth and Wilson (2019: **Online**), data reliability refers to the degree of consistency of a measure. They continue to elaborate that consistency in reliability also defines the consistency in the results delivered in a test. The reliability test used for this research is Cronbach Alpha. In the study, 11 constructs were developed for the research questionnaire. Leggett (2011: **Online**) describes a construct as concepts or ideas about an object, attribute or phenomenon that are worthy of measurement. The average Cronbach Alpha coefficient achieved in this analysis is 0.94. According to Cortina (1993), a coefficient of 0.7 is acceptable, but a coefficient of 0.8 and higher is preferred (See Annexure K).

5.4 Data Analysis

5.4.1 Introduction

This section aims to illustrate the results obtained from the survey. The survey tools used during the analysis were the Likert scale type questionnaire and MS Excel to dissect the information. The reliability test developed by Del Siegle was employed to determine the Cronbach Alpha coefficient for the 11 constructs of the research questionnaire. To fulfil the requirements of the reliability test, the questionnaire Likert style qualitative responses had to be adapted. Table 5.1 below illustrates the conversion.

Table 5.1: Reliability code conversion

Code conversion for reliability test					
Likert Code	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Reliability Code	1	2	3	4	5

(**Source**: Own construct)

5.4.2 Descriptive Analysis

This section aims to illustrate the descriptive analysis conducted by observing and analysing the questionnaires. A complete descriptive analysis is attached as Annexure I of this research. Table 5.2 below illustrates a portion of the descriptive analysis, which demonstrates the frequency and the percentages attained for each of the questions/statements of the survey.

Table 5.2: Descriptive analysis (partial)

Variables	**Categories**	**f***	**%****
Culture – Cross-functional Empowerment			
Q1 - DivFood supports individual decision-making.	Strongly agree	10	8.77
	Agree	51	44.73
	Neutral	29	25.43
	Disagree	20	17.54
	Strongly Disagree	4	3.50

(**Source**: Own construct)

The descriptive statistics indicate that the overall majority agrees with the statements posted in the questionnaire. The concerning part thus far is the number of neutral and disagreeing responses. This will be discussed in more detail in Chapter 6 of this study. As part of the descriptive analysis, the researcher suggests that the following figures would be beneficial to the research. In an effort to make more sense of the information gathered, the questionnaire was analysed more and the information was subdivided into categories or functions as described in Table 5.3 below.

Table 5.3: Functional response

Functional response		
Function	**Total**	**Description**
Canmakers	24	Artisans responsible for making products
Production Mechanics	26	Provide assistance to canmakers
QA Inspectors	17	Responsible for checking products
QA Auditors	6	Responsible for QA systems
Specialists	18	Superintendents, production engineers
Other	23	Include raw material supply and warehouse
Questionnaires Issued	114	

(**Source**: Own construct)

The rationale behind this approach is to provide a better understanding of the thinking towards quality per department. The functions as described in Table 5.4 are all directly involved with the manufacturing of the product. Understanding how the functions approach the variables could potentially assist with understanding how each function contributes to customer complaints. The below figures represent the responses of the key functions in the manufacturing processes.

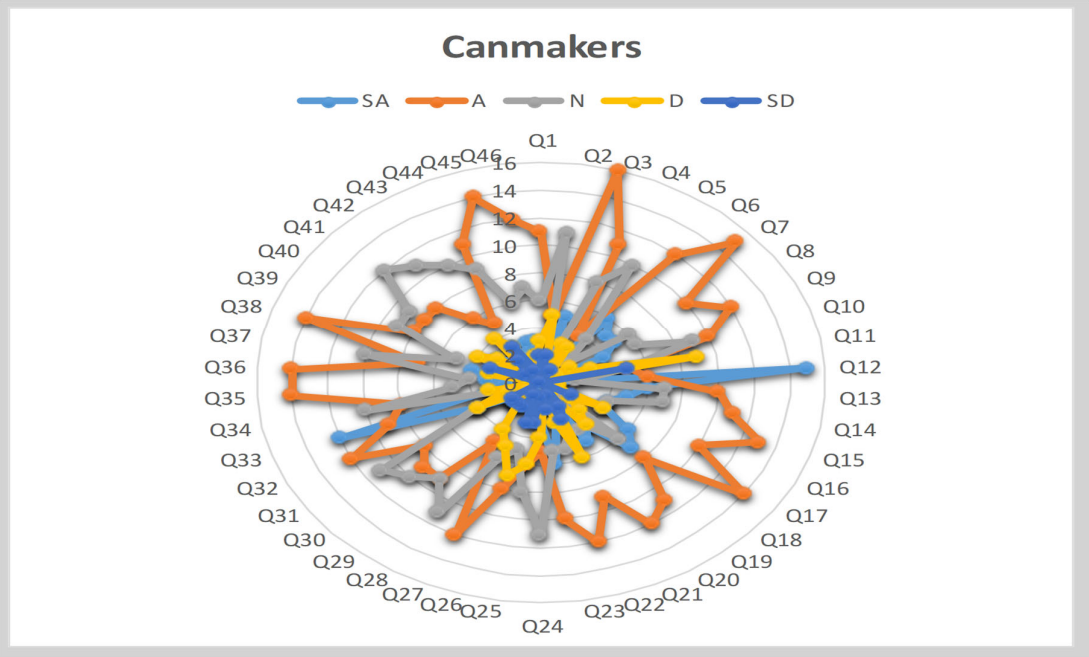

***Figure 5.1**: Canmakers' response* (**Source**: Own construct)

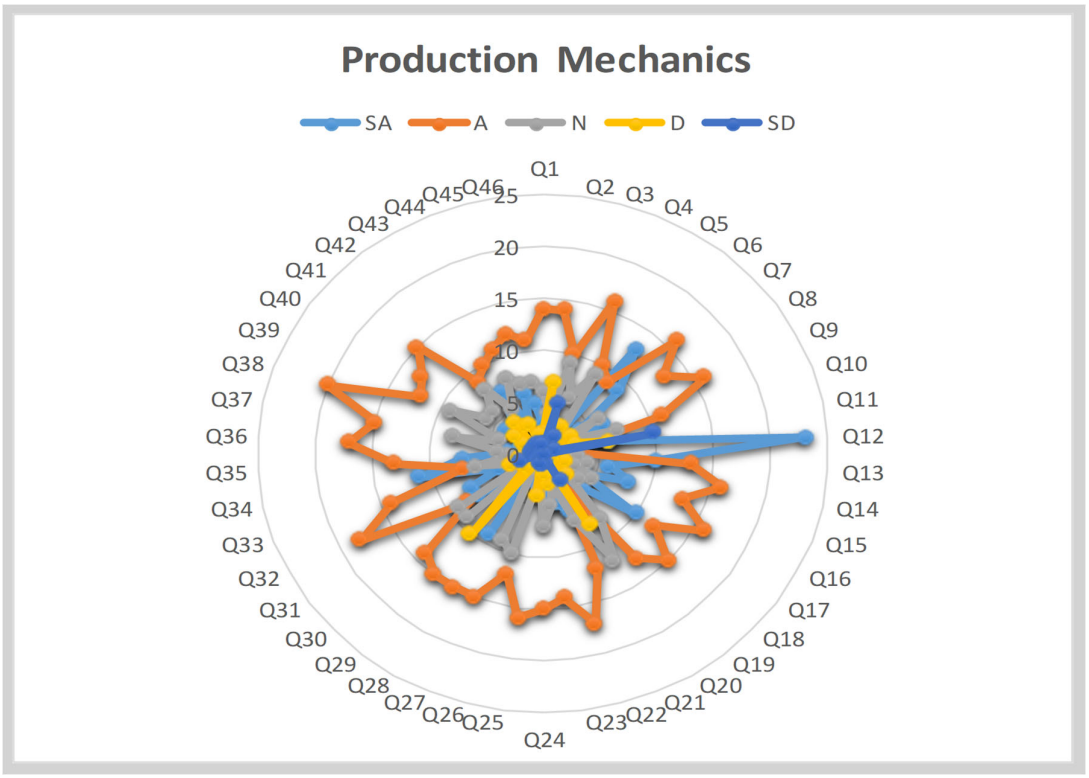

***Figure 5.2**: Production mechanics' response* (**Source**: Own construct)

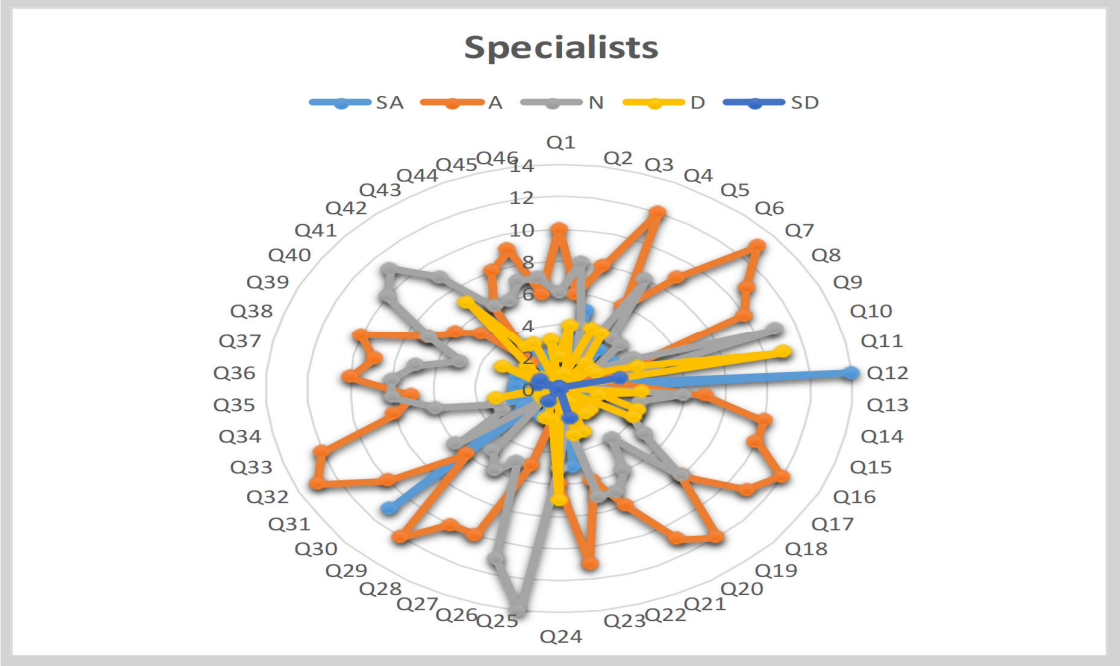

***Figure 5.3**: Specialists' response* (**Source**: Own construct)

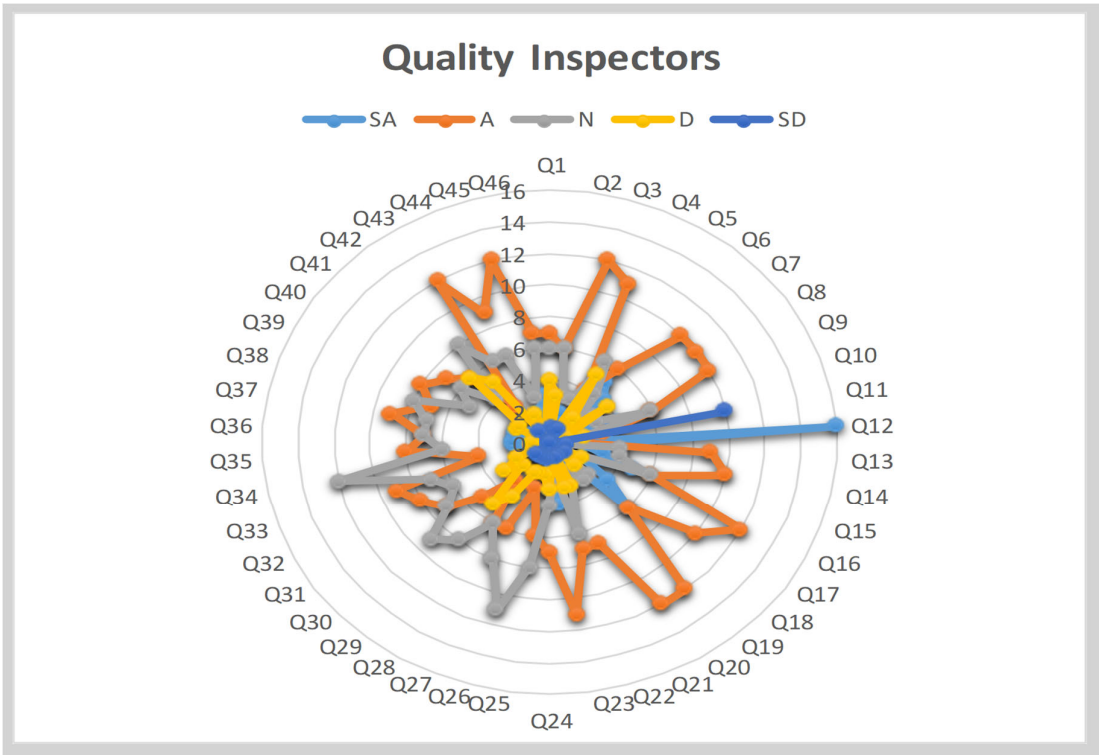

***Figure 5.4**: Quality inspectors' response* (**Source**: Own construct)

This information gives a different perspective on the questionnaire. Below are some of the observations made from the analysis of Figures 5.1 to 5.4 above:

- The first observation derived from the figures is that all the respondents are aligned to statement twelve of the questionnaire, which is “Everyone is responsible for quality.”
- In relation to other functions, the canmakers and the specialists agree more with the statements of the questionnaire.
- The production mechanics have fewer neutral remarks than all of the other functions.
- The specialists seem to be unsure about statement twenty-five, a question that relates to platforms used to discuss plant competency effectiveness.
- In the way the statements were structured, the ideal response would have been for the “agree” lines to be more distinct towards the outer parameter of the radar graph.

5.4.3 Analysis of data in relation to objectives

5.4.3.1 Objective 1

Objective 1 sought to provide a comprehensive overview of how the Quality 4.0 LNS Research framework can better facilitate the optimisation of customer complaints. The primary objective of this study constitutes a culmination of the four secondary objectives as presented in this chapter. As indicated, the primary objective of this study aims to provide an alternative to current proceedings to realise the optimisation of customer complaints in the organisation under study. In this regard, the optimisation required refers to customer complaints. The elements identified in Chapter 2 of this study through the Ishikawa model and the elements identified using the LNS Research framework present an investigative opportunity. Thus, the amalgamation of these elements develops an opportunity within the organisation and constitutes the creation of the secondary objectives to address the elements identified. The research plan includes revisiting this objective in Chapter 6 of this study and recommendations concerning this will follow.

5.4.3.2 Objective 1.1

This objective is about determining how digitalisation in Quality 4.0 can positively optimise customer complaints. The literature review advanced a broad concept of digitalisation and illustrated the advantages and disadvantaged of affecting a digital platform to conduct quality processes. In addition to the advancement of the context, the researcher latched onto the work conducted by Dewa et al. (2018). These scholars developed a framework for establishing the digital need of the toolmaking industry, based on digital platforms available. As a process of collecting opinions around this framework, suggestions were discussed with key members in the organisation. The first observation made suggested that the framework could be adapted for different industries.

The group agreed that although the manufacturing process of the dies is a much slower process than the Fast-Moving Consumer Goods (FMCG) space, the value chain remains the same. In this regard, the process of movement of products is much slower than the manufacture of dies. However, the process for both manufacturers includes the ordering of raw material and all related processes of manufacturing and the distribution of the product to the customer. In this value chain, the optimum effectiveness of the logistics is crucial and the digitalisation approach will assist with smooth operation. The team members also suggested the breakdown of this process specifically for the purpose of a quality environment. The important aspect of this is the willingness of the organisation to buy into this idea. Table 5.4 below illustrates what the framework could potentially look like for the manufacturing industry.

Table 5.4 Digital technology selection framework

Available digital technologies	Application domain	**Derived system requirements**					
		Collaborative or distributed data collection	Flexibility in the face of changes	Ease in data-collection	Preservation of knowledge	Real-time tracking of orders	Genera- tion of reports and real-time alerts
IoT platforms	Process level	√	√	√	√	√	√
Location detection technologies	Supply chain	o	o	o	o	o	o

Advanced human machine interfaces	Supply chain	o	o	o	o	o	o
Authentication and fraud detection technologies	Process level	o	o	o	o	√	o
Smart sensors	Product level	√	√	√	o	√	o
Mobile devices	Process level	√	√	√	o	√	√
Big data analytics and advanced algorithms	Process level and product level	o	o	o	o	o	o
Multilevel customer interaction and customer profiling technologies	Supply chain	o	o	o	o	o	o
Cloud computing platforms	Process level	√	√	o	√	√	√
Augmented reality wearables	Process level	o	o	o	o	√	o

(**Source**: Adapted from Dewa et al: 2018)

5.4.3.2 Objective 1.2

In this objective, the aim was to determine if the Quality 4.0 cultural elements exist within the current quality system of DivFood, and if so, to what extent. In this regard, the aim of the questionnaire in this section is to establish the extent to which cross-functional empowerment, credibility and responsibility exist in the organisation. This can help to address a possible gap that could potentially exist concerning decision-making at various stages of the process. In this research, this relates specifically to decision-making around defects that could potentially lead to increased customer complaints. The figures below describe these scenarios.

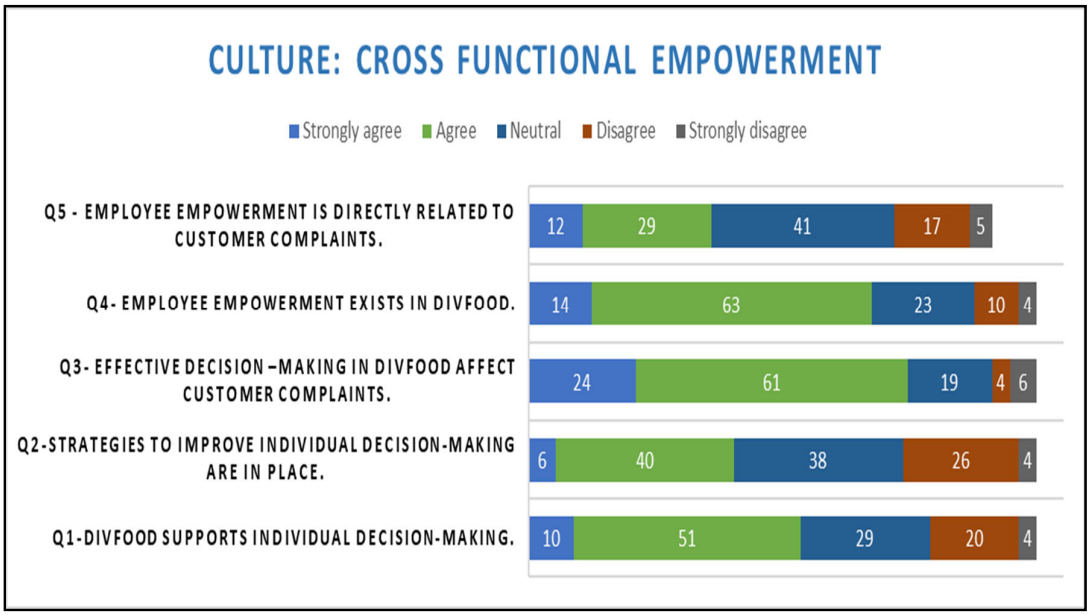

***Figure 5.5: Culture**: Cross-functional empowerment questionnaire results*

(**Source**: own construct)

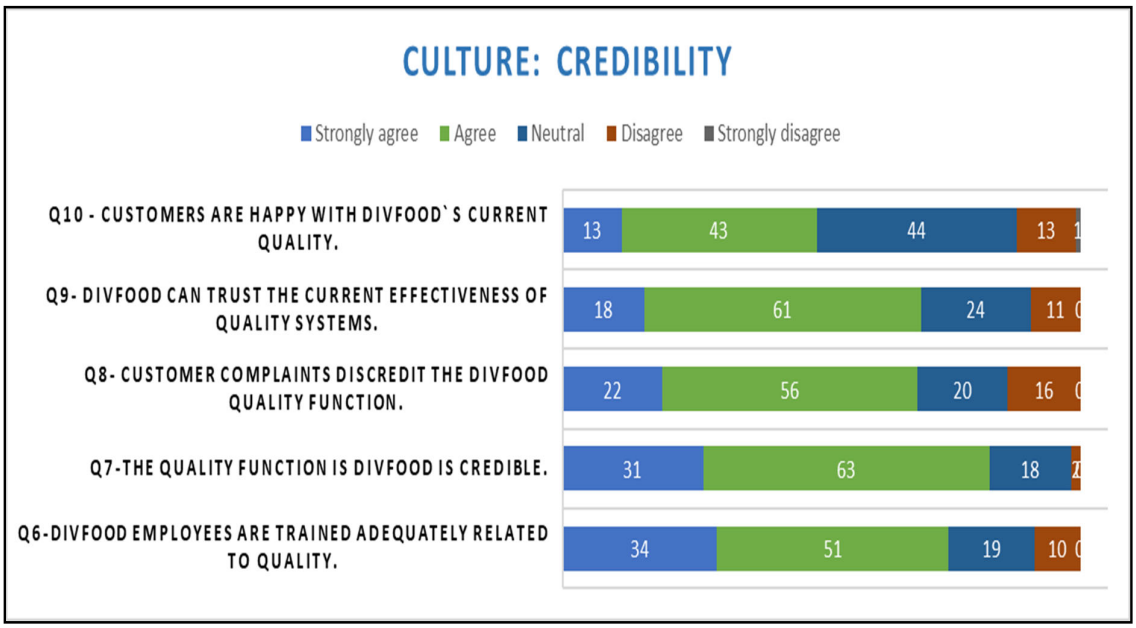

***Figure 5.6**: Culture: Credibility questionnaire results*

(**Source**: own construct)

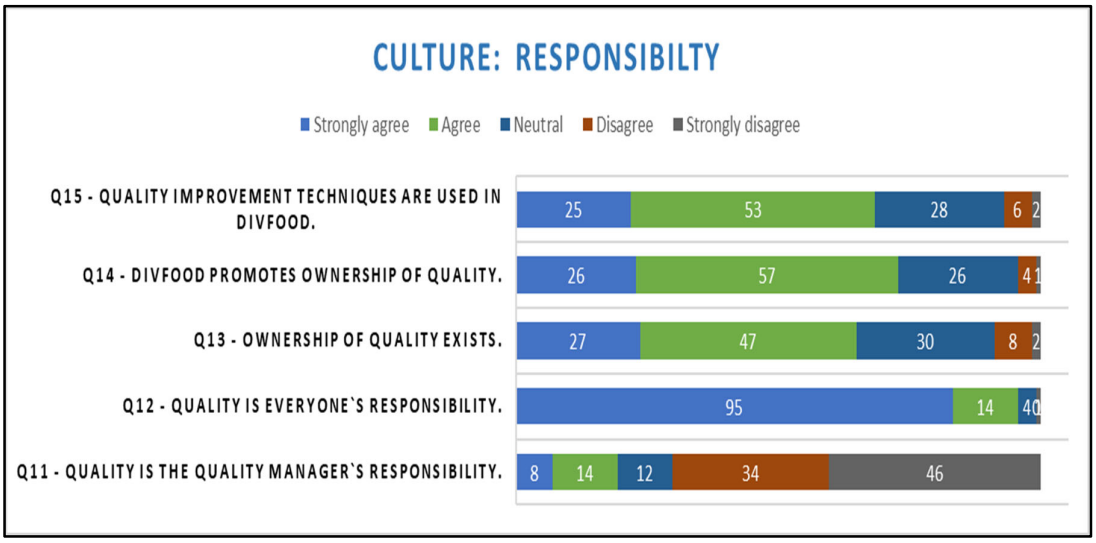

***Figure 5.7**: Culture: Responsibility questionnaire results*

(**Source**: own construct)

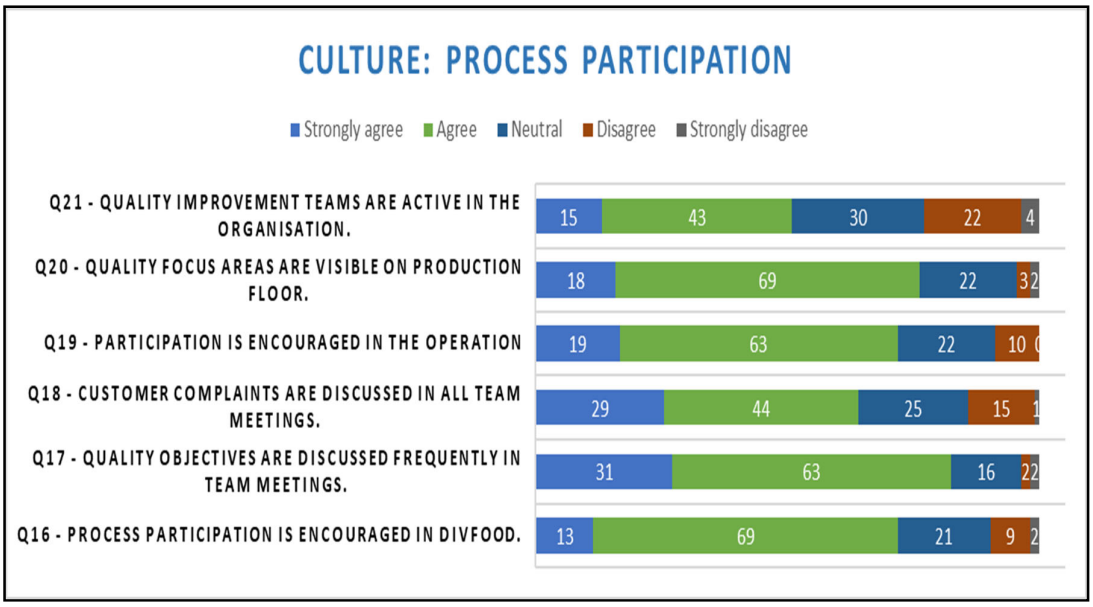

***Figure 5.8**: Culture: Process participation questionnaire results*

(**Source**: own construct)

The responses from the questionnaires suggest positive as well as negative aspects that require interpretation. From Figures 5.4, 5.5, 5.6 and 5.7, the researcher suggests the following comments:

- The majority of respondents agree that effective decision-making affects customer complaints. To this extent, the majority of the respondents confirmed that quality is everyone's responsibility.
- The information reveals that a big percentage of the respondents cannot make a connection or correlation between employee empowerment and customer complaints.
- The response to statement 11 of the questionnaire raises a concern in the mind of the researcher as 22% of the respondents suggested that the quality manager is responsible for quality in the organisation. A further 34% did not know how to respond to the question, with 95% of the respondents strongly agreeing that quality is everyone's responsibility. The researcher acknowledges that the other possibilities could relate to the construction of the question.
- From the responses, the observation is that elements of quality culture are visible and, in some areas, more emphasised than in others. However, it is concerning that a vast quantity is not on par with the quality initiatives.

Derived from the information presented, a certain percentage of the respondents are aware of the elements as described in this research regarding culture. It is however concerning that a certain percentage is neutral in this regard. A concerning percentage also strongly disagree with this observation. This percentage necessitates, in the opinion of the researcher further investigations on this subject matter.

5.4.3.3 Secondary Objective 1.3

This objective was premised to establish the level of competency that is required to better facilitate the reduction of product customer complaints. It is acknowledged that competency is a key element of any operation and directly related to the performance of the organisation. As such, it influences the situation of customer complaints in the organisation. In this research, competency applies to all the industrial phases. The objective of this session is to review the competency function of the organisation, and then compare it with the recommendations and identify the possible gaps. The figures below describe these scenarios.

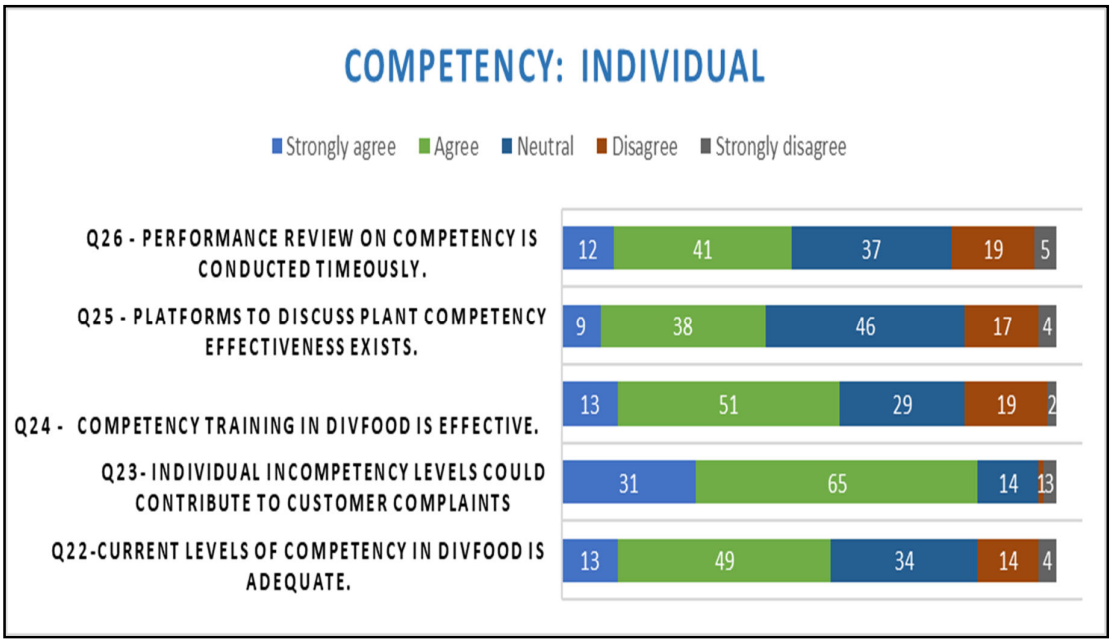

***Figure 5.9**: Competency: Individual questionnaire results*

(**Source**: own construct)

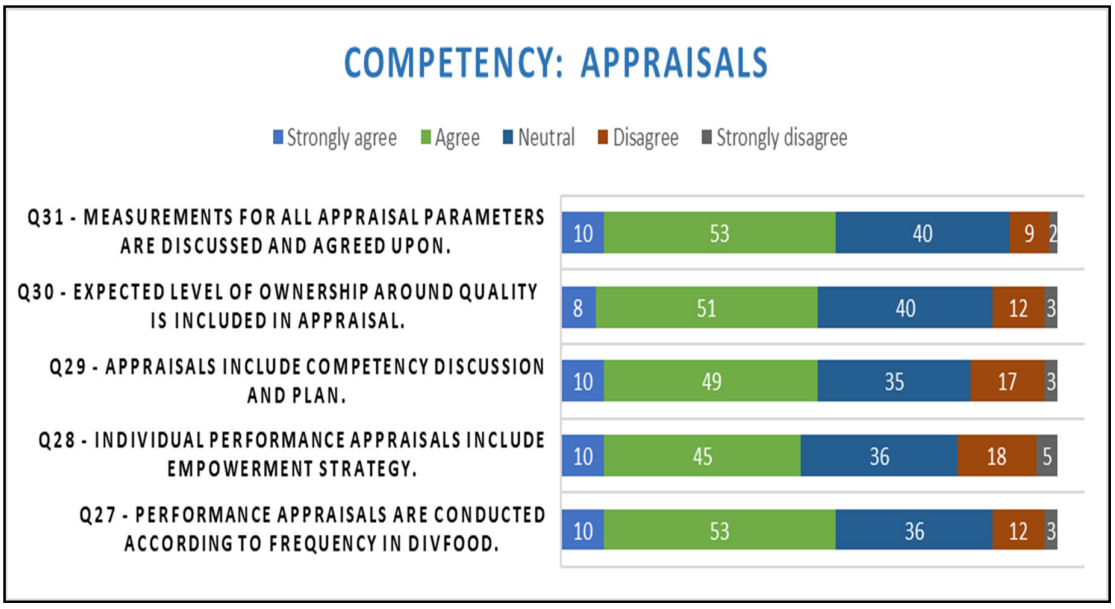

***Figure 5.10**: Competency: Appraisals questionnaire results*

(**Source**: Own construct)

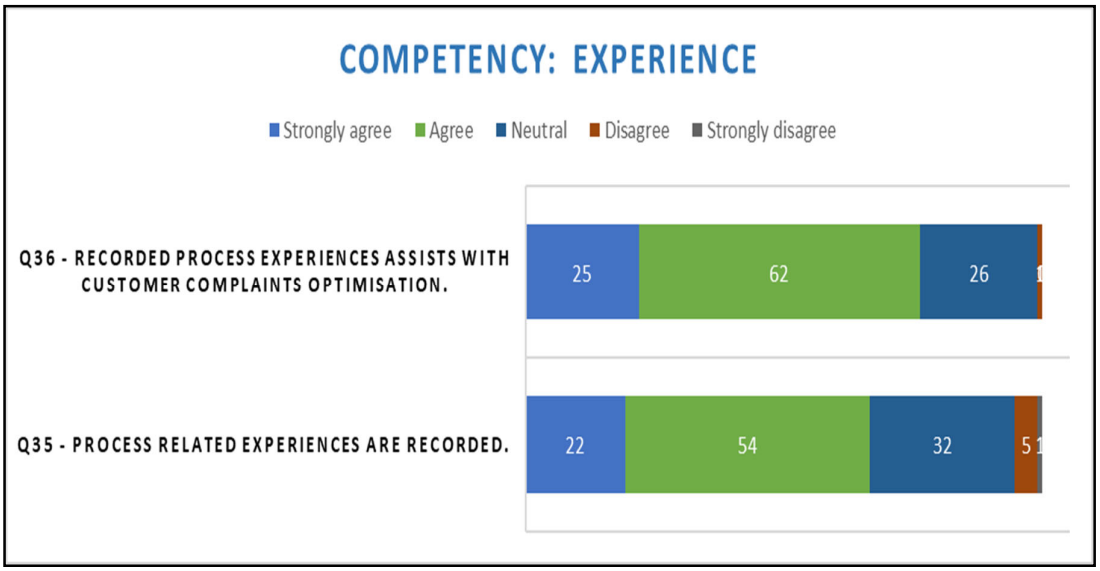

***Figure 5.11**: Competency: Expertise questionnaire results*

(**Source**: own construct)

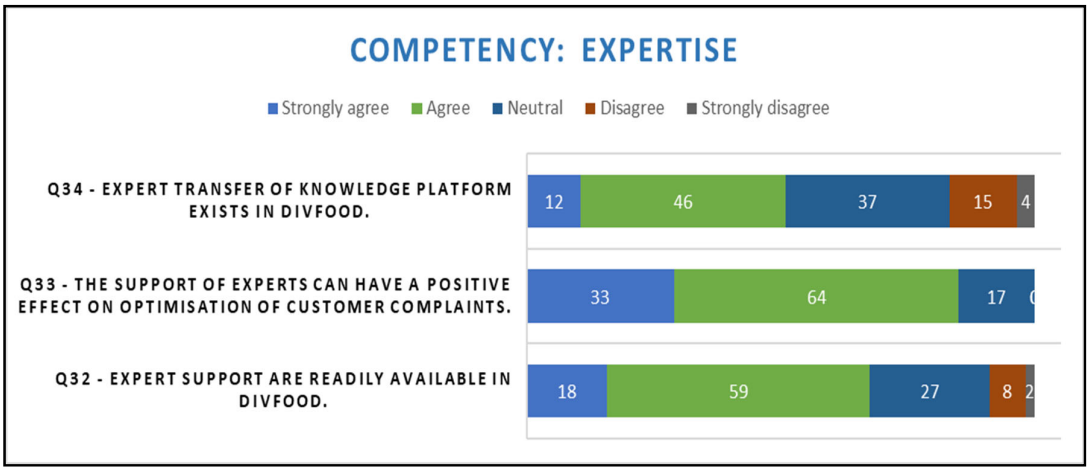

***Figure 5.12**: Competency: Experience questionnaire results*

(**Source**: Own construct)

In Figures 5.9 to 5.12, the data represented displays the competency part of the questionnaire. The information gathered portrays a mixed picture on the perception of where the organisation fits in regards to competency. The following can be derived from the information depicted:

- Responses on individual competency suggests that a gap is present in the current manufacturing environment of the organisation. Almost half of the respondents agree with the statements presented in the questionnaire. The

majority of the balance remains neutral. The interpretation of these results is open for comments, but it also indicates that a gap and an opportunity for improvement exists. On a positive note, 84% of the respondents agreed with the statement that “Individual incompetency levels could contribute to customer complaints”.

- Performance appraisals present mixed results from the questionnaire responses. Further investigation in this regard revealed that only the senior members represented in this questionnaire underwent performance appraisals in this period. It also indicates that there are other conditions linked to the performance. This leaves 95% of the group interviewed without a measuring device to demonstrate individual performance. One also has to keep in mind that the group consulted constitute the core of operational excellence.
- The respondents reacted positively to the statements regarding the assistance of experts. The results, however, suggest that a formal platform for capture of information is not available in the organisation.

5.4.3.4 *Secondary Objective 1.4*

The premise of this objective was to establish the correlation between leadership and the escalation of customer complaints. Thus, this section of the questionnaire aims to address the correlation between leadership and customer complaints within the organisation. It also seeks to identify the relationship between the existing conditions versus the recommendations set out for Quality 4.0.

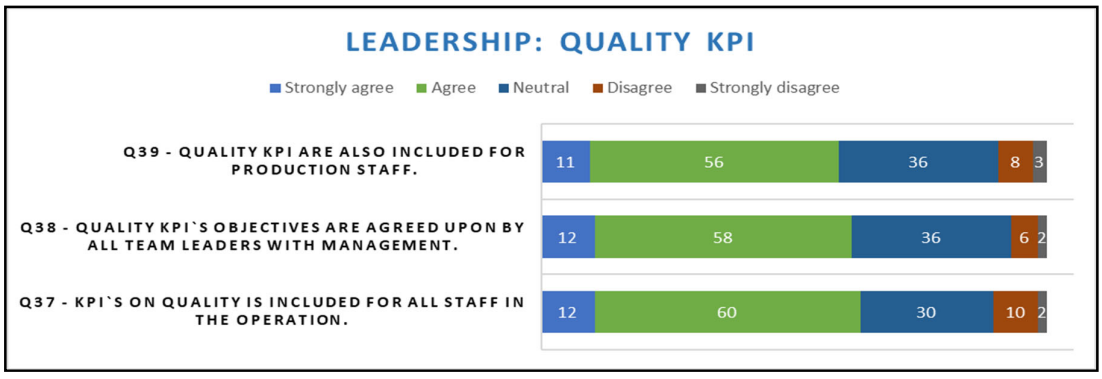

***Figure 5.13**: Leadership: Quality KPI questionnaire results*

(**Source**: Own construct)

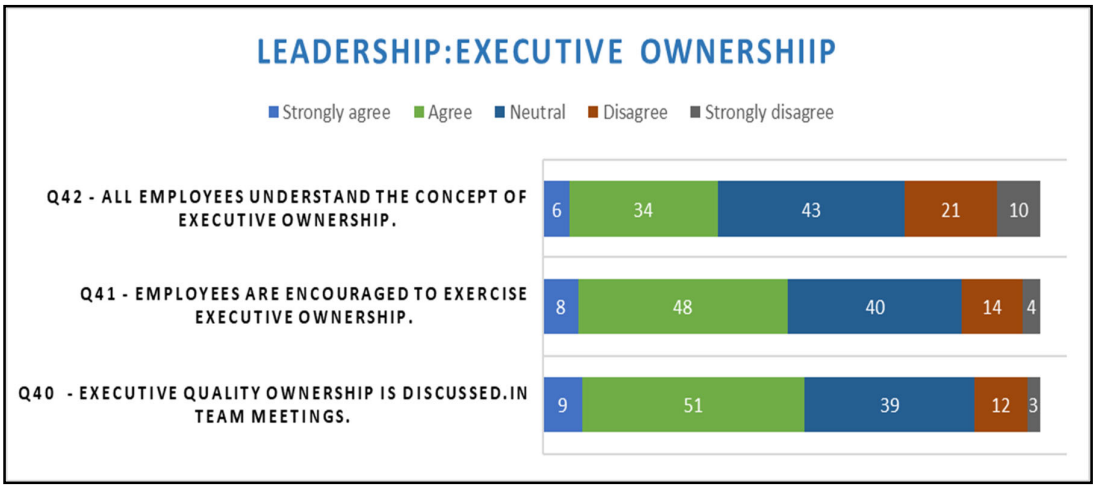

***Figure 5.14**: Leadership: Executive ownership questionnaire results*

(**Source**: Own construct)

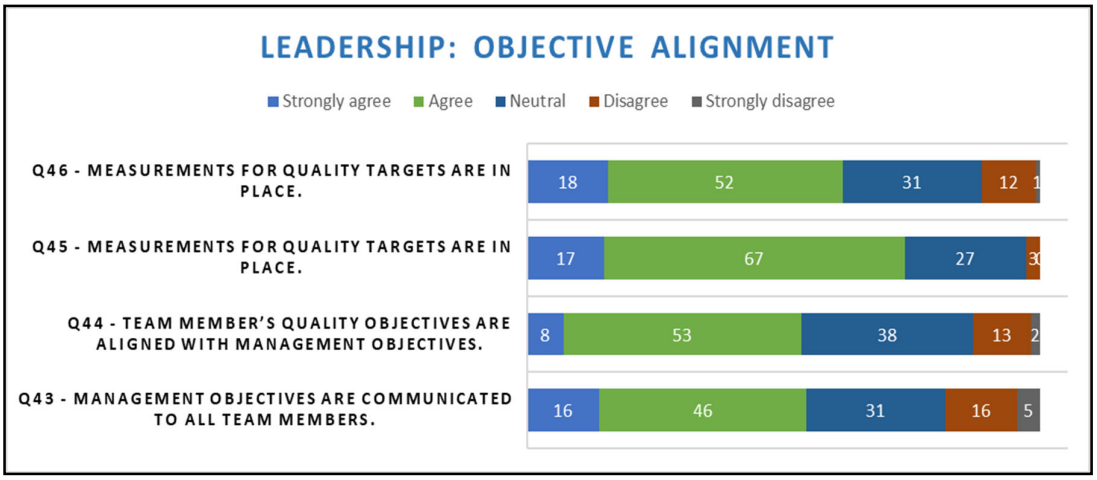

***Figure 5.15**: Leadership: Objective alignment questionnaire results*

(**Source**: Own construct)

The data depicted in Figures 5.13 to 5.15 are open for discussion or interpretation, but in the opinion of the researcher the following points stand out:

- Quality KPIs are not included for all the respondents. The questionnaire was distributed to production personnel and quality teams specifically. The result indicates a gap and opportunity to address this shortcoming. This will equate to the optimisation of customer complaints.

- The understanding of ownership of quality presents a challenge. The response to the statement that “all employees understand the concept of executive ownership” suggests that 49% of the respondents do not understand the concept.

5.5 Conclusion and a synopsis of Chapter 5

The chapter discussed four main aspects underpinning the study and these are the research variables, data reliability descriptive statistics and questionnaire analysis. The dependent variable in this research is the customer complaints. The independent variables are leadership, competence, culture and digitalisation. The expectation, based on the literature, is that a change to the independent variable will effect a change to the dependent variable. In this research, the required change is to affect possible optimisation of customer complaints.

Data reliability was also discussed in the chapter. In this research, the reliability calculator, developed by Del Siegle, was used to determine the Alpha Cronbach coefficient for the data that was collected through the questionnaire. The coefficients for all the constructs were within the required specification. Descriptive statistics was done to analyse the numerical data collected. The descriptive analysis conducted indicated that the mixed results are an indication of or reflect contradiction within the organisation. Questionnaire analysis was also done to extract meanings from survey responses. The results from the questionnaire through the responses of the respondents suggest that a gap exists in the understanding amongst employees concerning different aspects of quality. The alarming factor in the results is that a huge component of respondents remained neutral to all of the statements.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS
QUALITY 4.0: REDUCING CUSTOMER COMPLAINTS

6.1 Introduction

The objective of Chapter 6 is to action a summary of the study and present conclusions and recommendations. The major observation in this chapter is that the reduction of product customer complaints from a Quality 4.0 perspective as experienced through this research negotiates a new paradigm shift for the organisation.

6.2 Chapters Review

In this section, I review the discussions and contents of the previous five chapters as these constitutes the basis upon which the conclusions in the current chapter are made.

6.2.1 Chapter 1 in Summary

In this chapter, the scope of the study is defined and the following headings were briefly discussed to ensure an acceptable appreciation of what the study entails.

- Introduction and motivation that introduced the reader to the study and explained what motivated the research.
- The background briefly captured the environment in which the research takes place and identified the actual research problem.
- The problem statement was presented and it relates specifically to the area that requires improvement. The research questions support the research question in the literature review and are aligned with the study objectives.
- The hypotheses presented are divided into a major hypothesis supported by sub-hypotheses.
- The rest of the chapter discussed the research scope the ethics protocol, assumptions, constraints and the significance of the study. This was all concluded in a specific timeframe required for the study.

6.2.2 Chapter 2 in Summary

In this chapter, the researcher attempts to advance a thorough context of the environment in which the research takes place. The study conducted manifests in a fast-moving consumer goods setting within the packaging industry. Context is provided based on data that was collected from three calendar years concerning the situation of product customer complaints. A graph depicting an increase in customer complaints in this period and the decline of customers in the same period is illustrated in this chapter to explain to the reader visually, the real extent of the problem.

6.2.3 Chapter 3 in Summary

This chapter focussed on the literature review that advances a comprehensive context of the subject matter and attends to the research question. The following concepts were discussed in this literature review chapter:

- Industry 4.0
- Quality 4.0
- Quality culture
- Leadership
- Competency
- Digitalisation
- LNS Research framework
- 11 Axes of the LNS Research framework

6.2.4 Chapters 4 & 5 in Summary

These chapters presented the research design and methodology that form the basis of Chapter 4. Chapter 4 presented the data collection premise and is subsequently followed by Chapter 5, which addresses the analysis of all the data collected. All of the above culminates in the conclusion and recommendation section of the current chapter.

6.3 Problem statement Revisited

The problem statement of this study reads as follows:

“Despite the efforts made by the quality management fraternity to ensure excellence in quality, high levels of product quality complaints still impede operations excellence within the organisation.” In the background to the research problem in Chapter 2, the problem was attended to in detail and the research findings supports the statement. For organisations to excel in their operations the number of defects produced must conform to or exceed the expectations. In this regard, effective organisations focus on leading indicators as customer complaints are perceived by them as a lagging indicator. Through the research conducted the elements identified in the study offer an opportunity for the organisation to focus on leading indicators for them to reduce or eradicate the lagging indicators.

6.4 Research question revisited

The research question of this research study is: “Advance an appreciation of how the Quality 4.0 concept facilitates customer complaints optimisation within the organisation.” The researcher is of the opinion that a broad context was advanced through the research. A key aspect of the Quality 4.0 concept is that it does not replace the current traditional quality. It is imperative that the fundamentals of the traditional quality be executed appropriately as a prerequisite for Quality 4.0.

6.5 Sub-questions revisited

The sub-questions constructed in this study support the literature review as described in the research. Twenty sub-questions were put together and are portrayed in Annexure A of this dissertation. In the opinion of the researcher, the questions are addressed in the literature review.

6.6 Objectives revisited

The objectives of this research study are as follows:

6.6.1 Main Objective

“The primary objective of this research study is to provide a comprehensive overview of how Quality 4.0 can better facilitate the reduction of customer complaints.” In the opinion of the researcher, the study advanced a broad context of Quality 4.0. As Pedersen (2017) suggested, Quality 4.0 is a reference to Industry 4.0, and this research articulated how it fits into the realm of Industry 4.0. The

research also suggested that there is a new development concerning the naming convention in Industry 4.0. From the study, it appears that the Industry 4.0 environment is now subdivided into operational functional segments. This started with Quality 4.0 and subsequent articles started appearing about Engineering 4.0, Supply 4.0 and Manufacturing 4.0.

Quality 4.0 also considers the digitalisation of quality in the manufacturing process. This digitalisation realises real-time availability of data concerning the process. In the case of the organisation's high-speed can-manufacturing process, the real-time data will realise immediate remedial action to out of control parameters. In a high-speed process where defective production accumulates very quickly, this will reduce inefficiencies significantly. Digitalisation also offers the process trend ability which when coupled with alarm systems, can detect, alert and allow for immediate intervention to eliminate defective products. Fewer or no defective products in the process equates to fewer or no defective products on receipt by the customer.

In this research, LNS Research's Quality 4.0 framework realised a new perspective or approach to quality. Jacob (2017: **Online**) explained in his article that Quality 4.0 does not replace traditional quality, but entails a transition of traditional quality to the realm of Industry 4.0. Analysis conducted in Chapter 2 of this research on customer complaints in the division highlighted certain areas of concern. These functions were plotted on the LNS Research framework and the axes that were identified through this process were chosen as a starting point for this investigation. This equated to the components on these axes that are not focused on the traditional quality function being highlighted. The results obtained through the data collection suggested that there is a discrepancy amongst functions concerning these components. Quality 4.0 advances a new perspective on the traditional quality that is worth further investigation pertaining to how these components could assist the current situation of the organisation.

6.6.1.1 Sub-Objective 1.1

This sub-objective is premised at determining how digitalisation in Quality 4.0 can positively optimise customer complaints. From the literature review, it is observed that digitalisation can positively influence customer complaints in the following ways:

- Better decision-making - Real-time data realise faster decision-making. This is so because data equals knowledge and knowledge assists with decisions.
- Digitalisation improves efficiency and productivity - Improved efficiency equates to reduced defects, which leads to fewer defects ending up at the customer.
- Digitalisation improves communication and makes teamwork easier. Through correct or efficient networking, all team members are immediately aware of working in the manufacturing environment.
- Digitalisation helps organisations to realises a more efficient assessment process.
- Digitalisation results in cost reduction in the assessment process as well as in labour hours for the organisation.

6.6.1.2 Sub-Objective 1.2

The premise of this sub-objective was to determine if the Quality 4.0 cultural elements exist within the current quality system of DivFood, and if so, to what extent. The data collected from the questionnaires suggests the lack of some cultural elements in the organisation's current quality system. It is particularly interesting to observe that in Figures 5.1 to 5.4 of Chapter 5, the specialists and canmaker groups are more aware of the cultural elements. The research found that in manufacturing, it is important that the entire team functions on an acceptable aptitude level towards an effective quality culture. As mentioned previously, the data collected can be interpreted in different ways, but in this study, the secondary aim is to assess how the cultural elements contribute to high levels of customer complaints.

Concerning this sub-objective, it was observed from the questionnaires that cultural elements do exist within the organisation. It is also observed that a vast number of employees chose to remain neutral to this line of statement. It is possible that the respondents do not know the answer or neutrally chose not to implicate themselves. The concern is that if they do not know the answer to the statement, they require proper training to assert an acceptable level of cultural knowledge in the realm of quality. It should be recognised that the respondents in question are directly involved with the manufacturing of the products.

6.6.1.3 Sub-Objective 1.3

This sub-objective sought to establish what level of competency is required to better facilitate the optimisation of product customer complaints. The results of the questionnaire painted a controversial picture in this regard. Key in the results regarding competency is that 84% of the respondents agree that competency is related to customer complaints. A different angle would suggest that incompetence leads to an increase in customer complaints. The researcher is aware of core competency training in the organisation that is conducted. However, concerning the statement of whether a platform exists to discuss competence effectiveness, 18% of the respondents said no, but 40% remained neutral. This translated into 50% of the respondents, suggesting that this platform does not exist.

Another concerning factor to this statement is that the entire specialist group remained neutral. As a recommendation to the leaders of the manufacturing group, this action needs to be rectified. Mansfield (2008) reiterates the need to increase competency levels as employees are becoming more responsible for quality assurance. The level of competence that is required for optimisation includes the understanding of competency levels apart from the core competencies themselves. Concerning the sub-objective, the competency level required to operate in a Quality 4.0 environment involves the inclusion of the different levels of competence apart from the core competencies as conducted within the organisation.

6.6.1.4 Sub-Objective 1.4

This sub-objective was premised as establishing the correlation between leadership and the escalation of customer complaints. In this regard, the literature review highlighted the work conducted by Suriyankietkaew (2016), who penned a study on leadership behaviour and customer complaints. In his research, he accepted the hypothesis that there is a direct relationship between leadership and customer complaints. In this study, leadership refers to the immediate managers in the manufacturing environment, which include the team leaders, supervisors and superintendents of all the relevant functions. Given the findings mentioned above, it is imperative that leaders in the organisations drive optimisation of customer complaints. It was observed from the data analysis that 50% of the respondents do not know the meaning of executive ownership. In addition, more than 50% of the

respondents agree that there is an objective alignment between the leaders and the employees, yet the evidence suggests that this is not the true reflection of the practice in the manufacturing environment. Concerning the sub-objective, the reviewed literature confirmed that there is a relationship between leadership and customer complaints. In the opinion of the researcher, this is also evident in the results obtained from the questionnaire.

6.7 Hypotheses

In this research, the major hypothesis and sub-hypotheses were tested and the results were in the affirmative. The major hypothesis (H1) of this study is: “The Quality 4.0 concept facilitates the optimisation of the customer quality complaints of the traditional QMS.” The literature review and the data collected in this study, provided enough information and critical evidence to support the acceptance of this major hypothesis. The first sub-hypothesis (Sub-H1), second sub-hypothesis (Sub-H2), the third sub-hypothesis (Sub-H3) and the third sub-hypothesis (Sub-H4) all included in the major hypothesis and as standalone hypotheses were supported by the evidence obtained in the research.

6.8 Conclusions and Recommendations

The aim of the research was to address the current issues experienced in the organisation concerning customer complaints, as well as to assess how this can be addressed. The study also sought to put forward recommendations for improving the problematised situations. Through the research, a new approach in the form of Quality 4.0 was identified and subsequent investigations conducted revealed possible avenues to pursue. The section below briefly summarises the salient points of the research accompanied by the recommendations drawn from empirical evidence, literature review and data analysis:

6.8.1 Background analysis results

The information obtained from the DivFood database suggested the following trends:

- The number of customer complaints is increasing every year.

- In the same period of analysis, the number of customers decreased significantly.
- The financial position deteriorated over the same period although the division has established a Quality Council at an executive level to address quality-related issues within the organisation.

In the opinion of the researcher, this situation requires a more direct approach as this is directly impeding the sustainability and profitability of the organisation. The following recommendations are made for improving the situation.

6.8.2 Recommendations from Empirical evidence

The recommendation concerning this issue is to review the approach to quality with regards to the elements as described in this research. The following needs consideration:

- Effective use and analysis of data. A different illustration of the data creates new perspectives on old data. The study found that the use of the Quality 4.0 framework in conjunction with the traditional data realised a new perspective on old data. It is recommended that consideration for new methods of analysing information be observed.
- A value proposition study needs to be conducted with regards to the headcount ratio between employees in manufacturing versus data analysers.

6.8.3 Recommendations from Literature review

The review of literature introduced new concepts regarding the approach to quality and the research unearthed fresh ideas which can be considered for optimisation of customer complaints. In this regard, Quality 4.0 brings a fresh approach to the quality environment. The LNS Research framework offers such an opportunity to rejuvenate the operational practices around quality. Key in this statement is to realise that Quality 4.0 does not replace traditional quality, but seeks to improve practices. The crucial part of the movement towards Quality 4.0 is to ensure that the traditional function is done effectively. The approach towards the investigation on the LNS Research framework is to establish whether some elements of the identified axes can be incorporated in traditional quality to improve the current situation. The different approach itself should realise a different perspective, thus

realising urgency to the customer complaint challenge. The following recommendations made to achieve this:

- The results of the research suggest that the implementation of these elements will yield benefits for the organisation.
- The approach itself should take a different perspective, thus realising urgency to the increasing customer complaints challenge.
- The current practises should be reviewed and integration of the new approach should be considered. Albert Einstein himself alluded to the fact that people cannot do the same things repeatedly and expect a different outcome.
- The study attempted to bring forward a different approach to the way the organisation is doing things and highlighted possible areas to be investigated. These would include the framework presented in this study. The recommendation would be for the organisation to study the framework and more specifically the axis. This would assist the organisation to realise benefits and an improvement in its quality management processes.

6.8.4 Recommendations from Data analysis results

An analysis of the survey data revealed several concerns and gaps that need to be addressed in the organisation under study. The following are some of the recommendations in response to these gaps and concerns:

- The first observation from the survey was the number of respondents who remained neutral to statements on the questionnaire. This was alarming as all the employees who participated are on a level of the organisation where trust is crucial for business excellence. The recommendation would be to use the results of the survey or do a new survey, and include qualified institutions to assess how this situation can be addressed.
- Further to this, the specialist group is also a concern for the organisation. This group forms part of the management structure and is required to express leadership in the manufacturing environment. The recommendation for this is that this group be reassessed and leadership training be conducted to improve the situation. Second to that, a form of measurement should be integrated to assert the level of expectancy from the leaders in this sphere.

- Competency in Quality 4.0 takes on a different approach to the traditional environment. Different types of competencies are articulated in the literature review section of this study. It is recommended that the organisation review the competencies it requires and strategize around the requirements of competencies to reduce customer complaints and increase business excellence.
- In the context of Industry 4.0 and Quality 4.0, the organisation needs to understand that for it to move in this direction, there is need to understand the fundamental requirements to do so. This study underlines the notion and offers a small part in developing such plans. It is recommended that the organisation use this layout as a starting point to digitalise quality management.
- Maturity has been highlighted as a gap in most of the functions. In this regard, it is recommended that the organisation develop a gap analysis on maturity for the various functions in order to take the business forward.

6.9 Areas for Further research

Below I suggest some areas for further research with regards to the concept of Quality 4.0 in relation to organisational management processes.

- **Culture**

The literature reviewed unearthed a mass of information, articles, journals and textbooks on quality culture. Several researchers and authors suggest how to improve the quality of culture within the organisation. Often these types of consultation include frameworks and matrices such as maturity models to improve the culture of the organisation. Typically, these types of consultation and training receive a certain “flavour of the month” kind of treatment and are most of the time not fully implemented as intended. The suggestion in this research is that the safety fraternity introduce a Behavioural Based Safety (BBS) programme that keeps safety alive within organisations. In this regard, all departments are required to hand in a certain number of BBSs per month. This requirement also becomes part of the HOD’s Key Performance Indicators. In this way, the HOD will distribute this requirement to his or her constituency. The high-level approach to the above-

mentioned suggests a type of “Behaviour Based Quality (BBQ)” to the organisation. Through this application, the quality drive will be kept alive and ultimately the quality culture will be improved, which will lead to operational effectiveness.

- **Quality 4.0 in the South African Context**

As indicated earlier in this research, Quality 4.0 is a relatively new subject for many South African states and other countries around the world as well. Many countries have adopted the Industry 4.0 principles and past research has indicated that in some of these countries, governments have supported these initiatives. As an extension of this research, the researcher suggests that further research on this topic should centre on steps in the South African workplace required to prepare for the inception or adoption of Industry 4.0.

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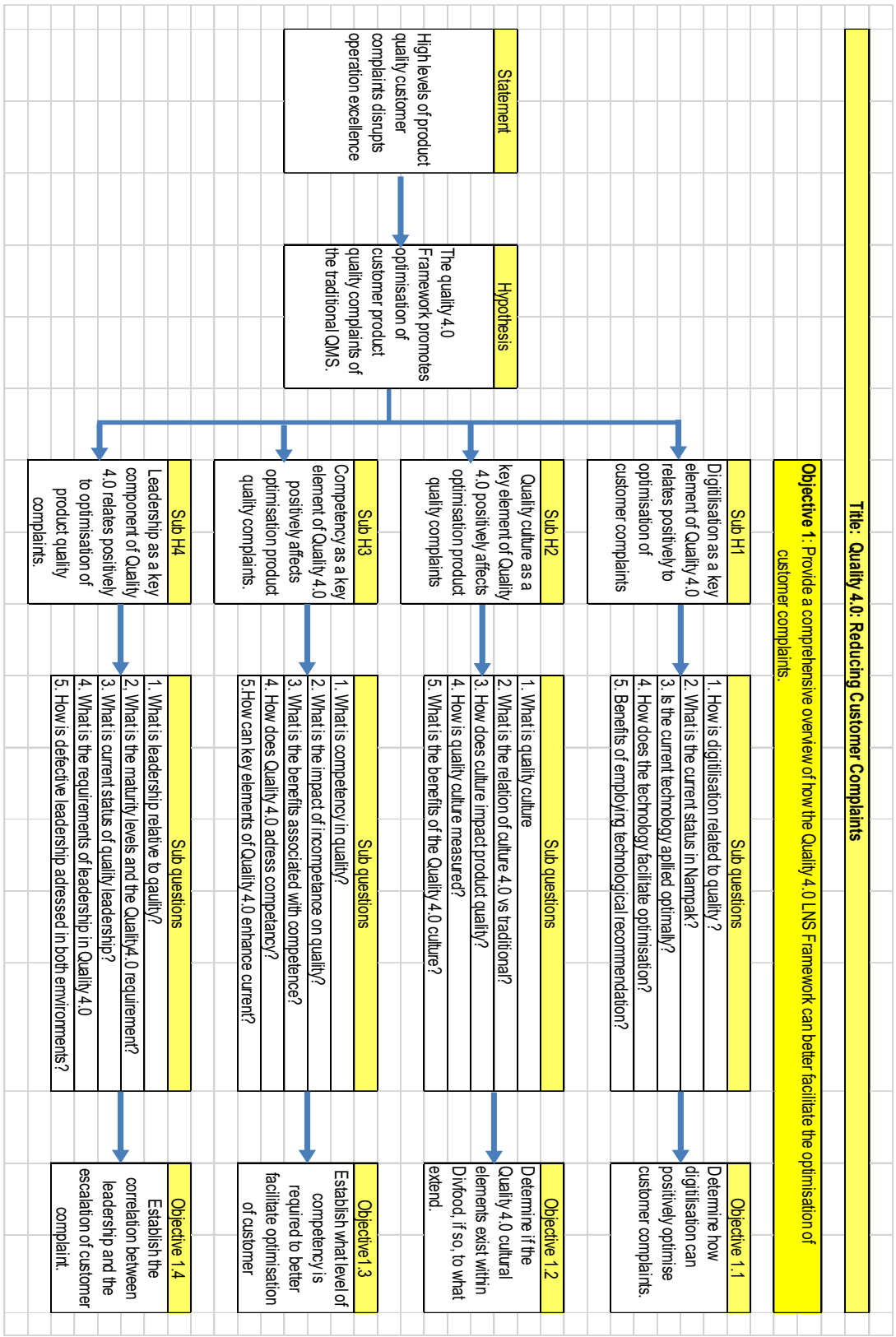
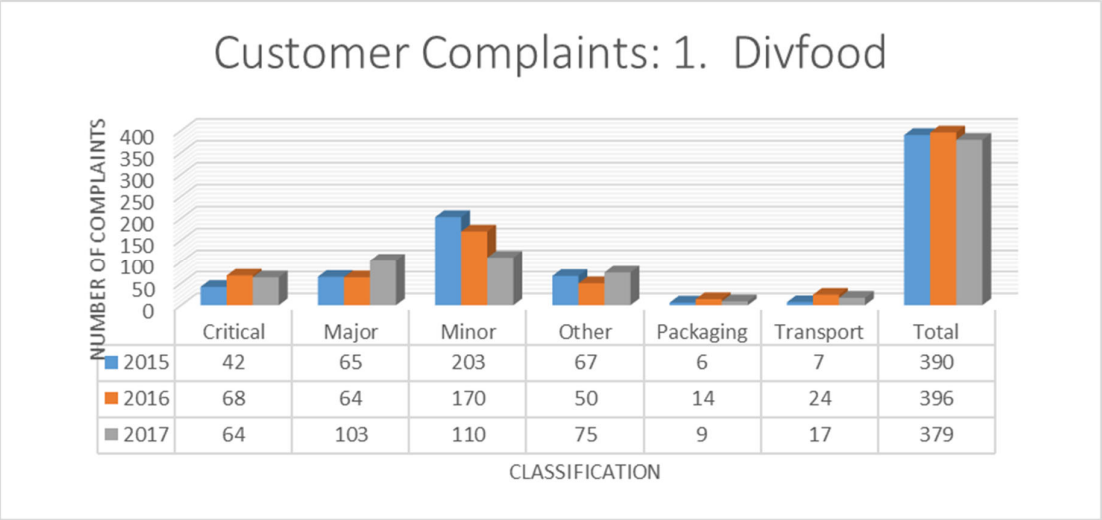
List of Annexures

Annexure A: Research Framework

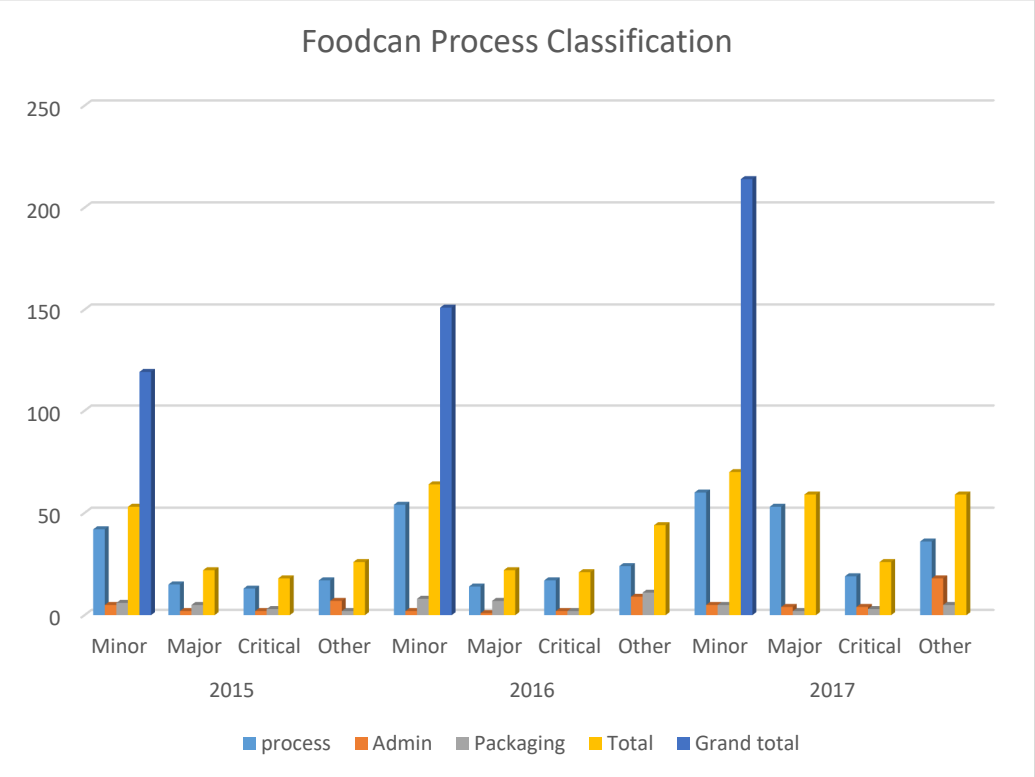


Annexure B: Divisional Customer Complaints Categorised

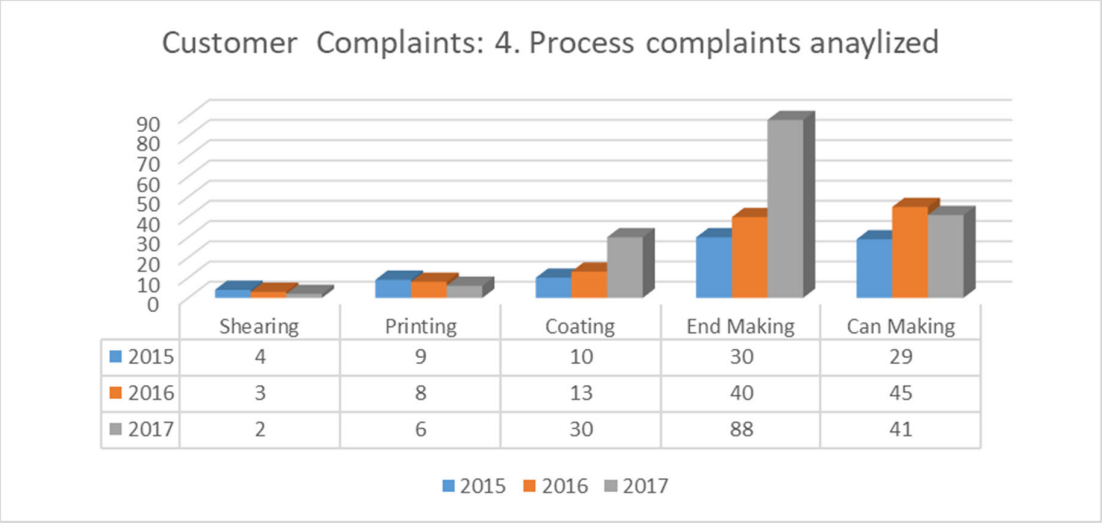


	Critical	Major	Minor	Other	Packaging	Transport	Total
2015	42	65	203	67	6	7	390
2016	68	64	170	50	14	24	396
2017	64	103	110	75	9	17	379

Annexure C: Foodcan Customer Complaints Classified

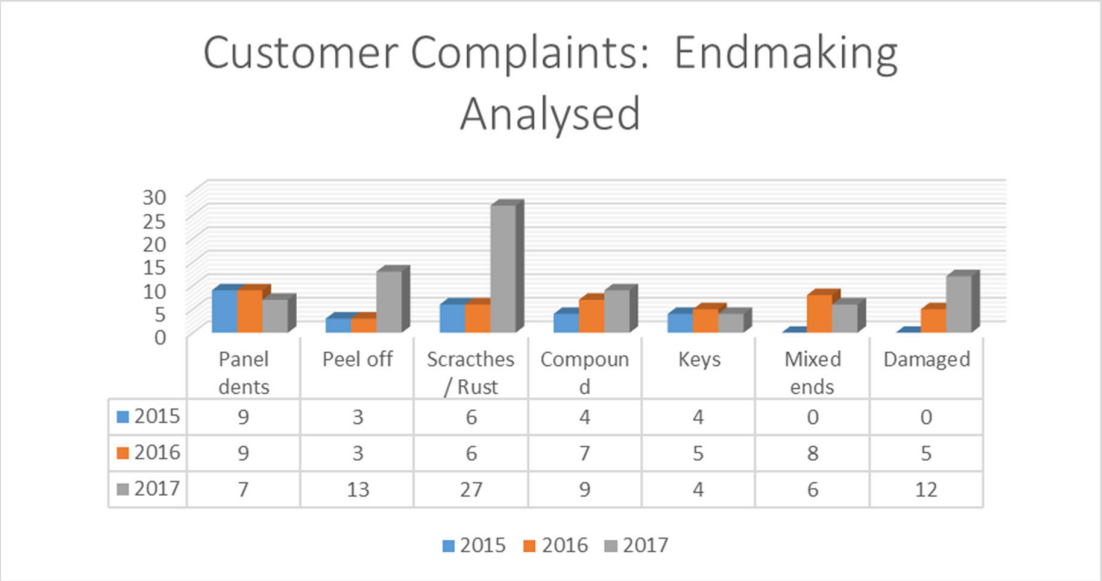


Annexure D: Process related complaints analysed



	Shearing	Printing	Coating	End Making	Can Making
2015	4	9	10	30	29
2016	3	8	13	40	45
2017	2	6	30	88	41

Annexure E: Highest contributor analysed



	Panel dents	Peel off	Scracthes / Rust	Compound	Keys	Mixed ends	Damaged
2015	9	3	6	4	4	0	0
2016	9	3	6	7	5	8	5
2017	7	13	27	9	4	6	12

Annexure F: Root Cause Analysis conducted on biggest contributor

1	CCV2718	Camera and air tester not working
18	CCV2759	Inconsitant flux- supplier
2	CCV2780	Centralisation of sheet
3	CCV2795	Squareness from previous process
4	CCV2798	Can transfer problematic
19	CCV2799	Inconsistant flux
5	CCV2823	Centralisation variation of sheet
6	CCV2853	Blunt matrix
20	CCV2859	Tight around chuck
7	CCV2862	Could not find evidence
8	CCV2863	Lacquer build up
9	CCV2865	Worn die
10	CCV2866	Scrap in die
11	CCV2873	Scrap in die
12	CCV2884	Bent up / Centralisation
13	CCV2885	Could not find root cause
20	CCV2889	Bow plate
14	CCV2894	Scrap in die
13	CCV2896	Dirty chuck
21	CCV2902	Packaging
1	CCV2923	OEM Adjusted
15	CCV2924	Clipped end / bent plate
14	CCV2935	Unknown
	CCV2938	Exposure to bad weather

16	CCV2957	Tongue not opening
17	CCV2961	feed table button worn
1	CCV2968	No corrective action
1	CCV2979	sheet size variation
18	CCV2981	feed table button worn
1	CCV2989	Grippers not retracting
2	CCV3011	dimensional problems

2	CCV3262	510 not curing properly
3	CCV3261	different measuring techniques
3	CCV3260	valcro tape used
19	CCV3255	Scrap in die
4	CCV3242	keyfeed jamming
20	CCV3241	Excessive spil
2	CCV3233	Improper wire feeding
5	CCV3232	Piece of solder got stuck
3	CCV3228	Camera issues
21	CCV3226	No evidence
22	CCV3219	Slow build up of tin
23	CCV3215	Absenteesm
24	CCV3214	Scrap in die
4	CCV3212	finger caused scratches
24	CCV3211	friction set too loose
26	CCV3197	No root cause
27	CCV3188	Uneven setting

Legend	
21	Material
20	Machine
97	Man
14	Method
2	Environment
3	Measurement

6	CCV3321	Alternative supplier
90	CCV3322	Seamer setting cust.
10	CCV3323	Scrathes by machine
7	CCV3325	Scrathes on plate
91	CCV3326	Unknown
8	CCV3327	Scrathes on plate
9	CCV3328	Scrathes on plate
10	CCV3330	Scrathes on plate
11	CCV3331	Scrathes on plate
92	CCV3338	Tin build up
11	CCV3348	Old machine
12	CCV3349	Tinplate and lacquer
12	CCV3352	key solder machine
13	CCV3353	key solder machine
93	CCV3354	Unknown
14	CCV3355	key solder machine
94	CCV3366	Wrong label
95	CCV3367	Scrap in die
96	CCV3369	Unknown
97	CCV3370	Scrap in die

2	CCV3187	Uneven distribution
28	CCV3178	Reject go past
6	CCV3176	Awaiting pallet detail
29	CCV3175	No problem
30	CCV3147	Not true
7	CCV3142	Poor placement
31	CCV3135	Mixed in sorting bay
32	CCV3120	worn embossing tool
33	CCV3116	scrap in die
34	CCV3110	causedby sheet handling
5	CCV3102	caused by magnetic wheels
35	CCV3086	End moving in lining station
8	CCV3078	Could not determine
36	CCV3073	End placement slipping
37	CCV3064	not all defects removed
38	CCV3055	Not sure
39	CCV3054	Scrap in die
40	CCV3045	Magnetic wheel
41	CCV3043	Unclear
42	CCV3037	Packing station settings
9	CCV3515	Contamination
43	CCV3517	Set incorrectly
44	CCV3520	Set incorrectly
45	CCV3529	Scrap in die
46	CCV3541	Mixed lanes

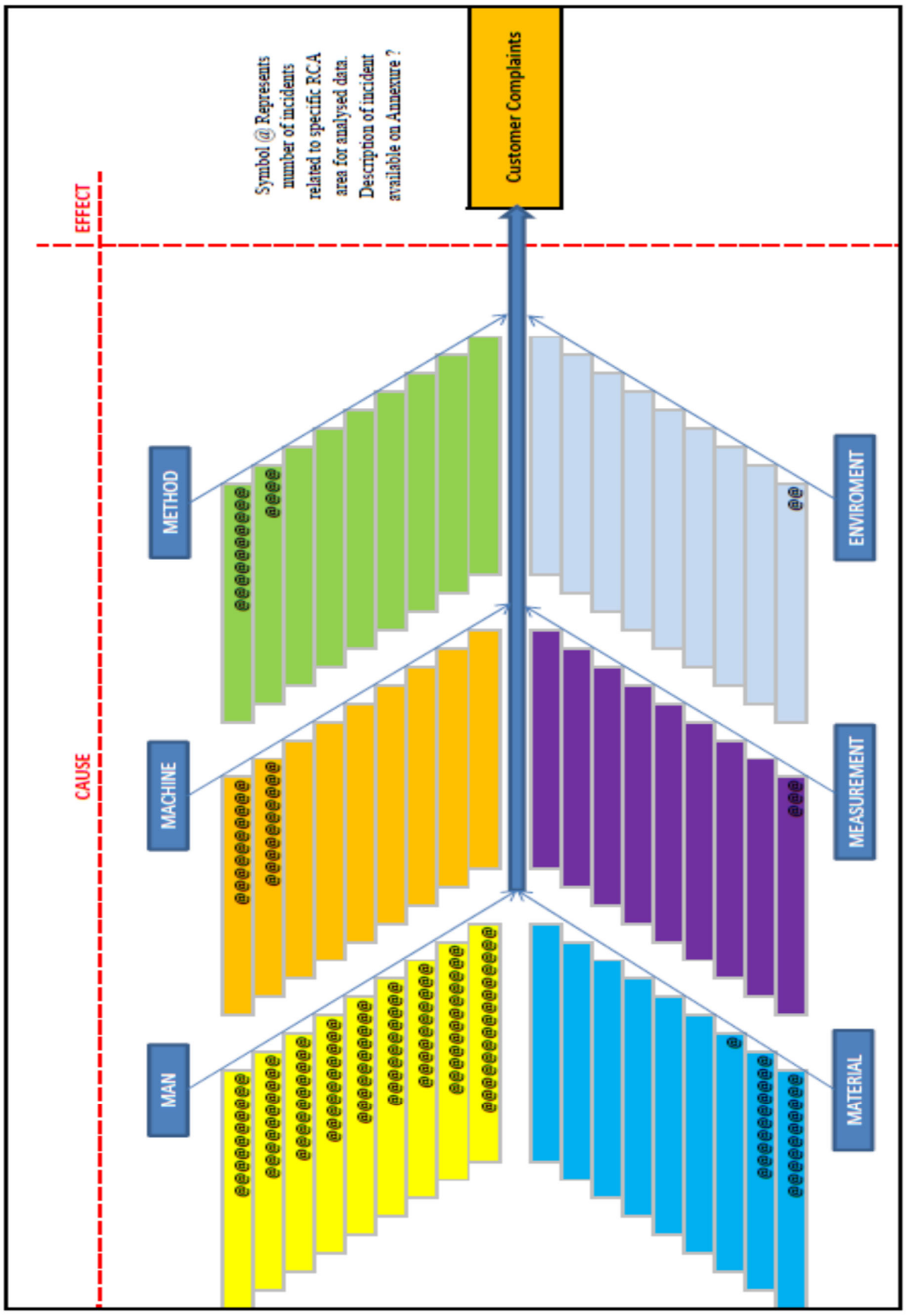
47	CCV3371	Less ends in sleeve
48	CCV3372	Scrap in die
49	CCV3373	Damage by forklift
50	CCV3380	Scrap in die
51	CCV3383	Unknown
15	CCV3384	Stuck open nozzle
52	CCV3385	Scrap in die
53	CCV3392	Tin buid up
16	CCV3395	Program fault
13	CCV3397	strip length vary
17	CCV3400	scuffing by curlers
14	CCV3402	Coating related
54	CCV3403	Unknown
55	CCV3410	Unknown
56	CCV3413	Mixed lanes
57	CCV3420	Damage to former tool
58	CCV3422	Score out of spec
59	CCV3428	Unknown
60	CCV3429	Unknown
61	CCV3434	Scrap in die

10	CCV3023	Not sure- design?
11	CCV3014	Design change
62	CCP90	Scrap in die

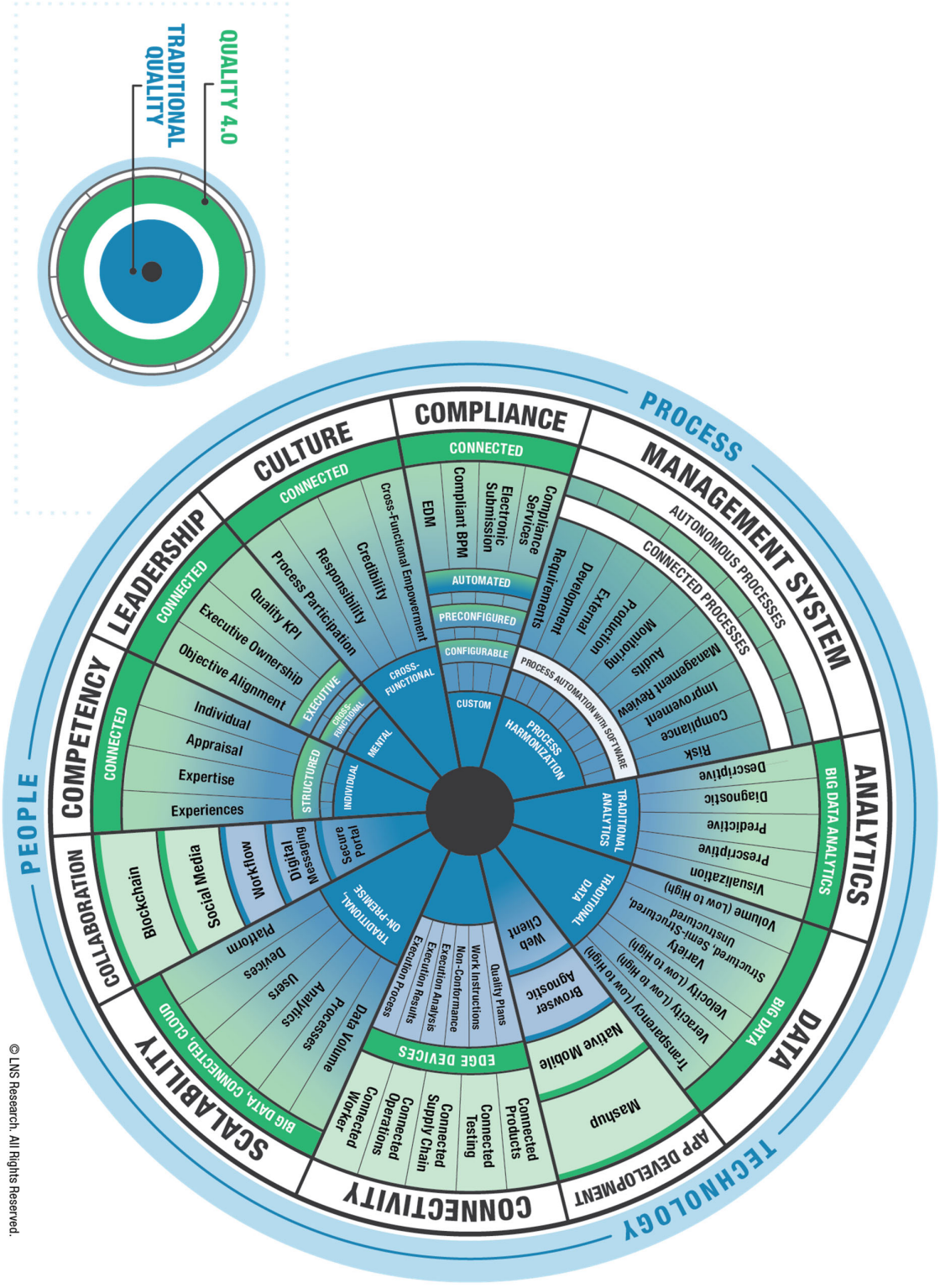
63	CCB56	No root cause
64	CCP121	No problem
65	CCP127	No root cause
3	CCV3276	supplier
66	CCV3290	No root cause
67	CCV3291	No root cause
6	CCV3293	misfiring
7	CCV3294	solder splatter
8	CCV3295	sticky top pad shaft
9	CCV3296	Leaking compound gun
68	CCV3297	metal frictions
69	CCV3299	blunt upper punch
70	CCV3301	No root cause
4	CCV3304	Scratches on material
71	CCV3305	No root cause
72	CCV3308	mistake
5	CCV3531	Material
73	CCV3534	Inconclusive
	CCV3537	Atmospheric condition
74	CCV3538	Unknown
75	CCV3544	Scrathed during fix

76	CCV3435	Unknown
77	CCV3443	Misfeed
78	CCV3456	Unknown
15	CCV3459	Material
79	CCV3461	Unknown
80	CCV3462	Unknown
16	CCV3463	Bow plate
81	CCV3464	Burr on end
82	CCV3465	Unknown
83	CCV3470	Unknown
84	CCV3481	Unknown
17	CCV3483	Material
12	CCV3487	Old compound
85	CCV3496	Unknown
18	CCV3498	Solder method
86	CCV3499	Scrap in die
87	CCV3500	Low temp
88	CCV3504	Quantity mark method
89	CCV3507	Mixed ends
19	CCV3509	Arms worn out

Annexure G: Root Cause Analyses Result



Annexure H: LNS Research Framework



Annexure I: Descriptive Statistics

Variables	Categories	Frequency	Percentage
Culture – Cross functional Empowerment			
Q1-Divfood supports individual decision-making.	Strongly agree	10	8.77
	Agree	51	44.73
	Neutral	29	25.43
	Disagree	20	17.54
	Strongly Disagree	4	3.50
Q2-Strategies to improve individual decision-making are in place.	Strongly agree	6	5.26
	Agree	40	35.08
	Neutral	38	33.33
	Disagree	26	22.80
	Strongly Disagree	4	3.50
Q3- Effective decision –making in Divfood affect customer complaints.	Strongly agree	6	5.26
	Agree	61	53.50
	Neutral	19	16.66
	Disagree	4	3.50
	Strongly Disagree	6	5.26
Q4- Employee empowerment exists in Divfood.	Strongly agree	14	12.28
	Agree	63	55.26
	Neutral	23	20.17
	Disagree	10	8.77
	Strongly Disagree	4	3.50
Q5 - Employee empowerment is directly related to customer complaints.	Strongly agree	12	10.52
	Agree	29	25.43
	Neutral	41	35.96
	Disagree	17	14.91
	Strongly Disagree	5	4.38
Variables	Categories	Frequency	Percentage
Culture - Credibility			
Q6-Divfood employees are trained adequately related to quality.	Strongly agree	34	29.82
	Agree	51	44.73
	Neutral	19	16.66
	Disagree	10	8.77
	Strongly Disagree	0	0
Q7-The quality function in Divfood is credible.	Strongly agree	31	27.19
	Agree	63	55.26
	Neutral	18	15.78
	Disagree	2	1.75
	Strongly Disagree	0	0
Q8- Customer complaints discredit the Divfood quality function.	Strongly agree	22	19.29
	Agree	56	49.12
	Neutral	20	17.54
	Disagree	16	14.03
	Strongly Disagree	0	0
Q9- Divfood can trust the current effectiveness of Quality systems.	Strongly agree	18	15.78
	Agree	61	53.50
	Neutral	24	21.05
	Disagree	11	9.64
	Strongly Disagree	0	0
	Strongly agree	13	11.40

Q10 - Customers are happy with Divfood` s current quality.	Agree	43	37.71
	Neutral	44	38.59
	Disagree	13	11.40
	Strongly Disagree	1	0.87
Culture - Responsibility			
Q11 - Quality is the Quality Manager`s responsibility.	Strongly agree	8	7.01
	Agree	14	12.28
	Neutral	12	10.52
	Disagree	34	29.82
	Strongly Disagree	46	40.35
Q12 - Quality is everyone`s responsibility.	Strongly agree	95	83.33
	Agree	14	12.28
	Neutral	4	3.50
	Disagree	0	0
	Strongly Disagree	1	0.87
Q13 - Ownership of quality exists.	Strongly agree	27	23.68
	Agree	47	41.22
	Neutral	30	26.31
	Disagree	8	7.01
	Strongly Disagree	2	1.75
Q14 - Divfood promotes quality ownership of quality.	Strongly agree	26	22.80
	Agree	57	50.0
	Neutral	26	22.80
	Disagree	4	3.50
	Strongly Disagree	1	0.87
Q15 - Quality improvement techniques are used in Divfood.	Strongly agree	25	21.92
	Agree	53	46.49
	Neutral	28	24.56
	Disagree	6	5.26
	Strongly Disagree	2	1.75
Culture – Process Participation			
Q16 - Process participation is encouraged in Divfood.	Strongly agree	13	11.40
	Agree	69	60.52
	Neutral	21	18.42
	Disagree	9	7.89
	Strongly Disagree	2	1.75
Q17 - Quality objectives are discussed frequently in team meetings.	Strongly agree	31	27.19
	Agree	63	55.26
	Neutral	16	14.03
	Disagree	2	1.75
	Strongly Disagree	2	1.75
Q18 - Customer complaints are discussed in all team meetings.	Strongly agree	29	25.43
	Agree	44	38.59
	Neutral	25	21.92
	Disagree	15	13.15
	Strongly Disagree	1	0.87

Q19 - Participation is encouraged in the operation	Strongly agree	19	16.66
	Agree	63	55.26
	Neutral	22	19.29
	Disagree	10	8.77

	Strongly Disagree	0	0
Q20 - Quality focus areas are visible on production floor.	Strongly agree	18	15.78
	Agree	69	60.52
	Neutral	22	19.29
	Disagree	3	2.63
	Strongly Disagree	2	1.75
Q21 - Quality improvement teams are active in the organisation.	Strongly agree	15	13.15
	Agree	43	37.71
	Neutral	30	26.13
	Disagree	22	19.29
	Strongly Disagree	4	3.51
Competency - Individual			
Q22-Current levels of competency in Divfood is adequate.	Strongly agree	13	11.4
	Agree	49	42.98
	Neutral	34	29.82
	Disagree	14	12.28
	Strongly Disagree	4	3.51
Q23- Individual incompetency levels could contribute to customer complaints	Strongly agree	31	27.19
	Agree	65	57.02
	Neutral	14	12.28
	Disagree	1	0.88
	Strongly Disagree	3	2.63
Q24 - Competency training in Divfood is effective.	Strongly agree	13	11.4
	Agree	51	44.74
	Neutral	29	25.44
	Disagree	19	16.67
	Strongly Disagree	2	1.75
Q25 - Platforms to discuss plant competency effectiveness exists.	Strongly agree	9	7.89
	Agree	38	33.33
	Neutral	46	40.35
	Disagree	17	14.91
	Strongly Disagree	4	3.51
Q26 - Performance review on competency is conducted timeously.	Strongly agree	12	10.53
	Agree	41	35.96
	Neutral	37	32.46
	Disagree	19	16.67
	Strongly Disagree	5	4.39
Competency - Appraisals			
Q27 - Performance appraisals are conducted according to frequency in Divfood.	Strongly agree	10	8.77
	Agree	53	46.49
	Neutral	36	31.58
	Disagree	12	10.53
	Strongly Disagree	3	2.63

Q28 - Individual performance appraisals include empowerment strategy.	Strongly agree	10	8.77
	Agree	45	39.47
	Neutral	36	31.58
	Disagree	18	15.79
	Strongly Disagree	5	4.39
Q29 - Appraisals include competency discussion and plan.	Strongly agree	10	8.77
	Agree	49	42.98
	Neutral	35	30.70
	Disagree	17	14.91

	Strongly Disagree	3	2.63
Q30 - Expected level of ownership around quality is included in appraisal.	Strongly agree	8	7.02
	Agree	51	44.74
	Neutral	40	35.09
	Disagree	12	10.53
	Strongly Disagree	3	2.63
Q31 - Measurements for all appraisal parameters are discussed and agreed upon.	Strongly agree	10	8.77
	Agree	53	46.49
	Neutral	40	35.09
	Disagree	9	7.89
	Strongly Disagree	2	1.75
Competency - Expertise			
Q32 - Expert support are readily available in Divfood.	Strongly agree	18	15.79
	Agree	59	51.79
	Neutral	27	23.68
	Disagree	8	7.02
	Strongly Disagree	2	1.75
Q33 - The support of experts can have a positive effect on optimisation of customer complaints.	Strongly agree	33	28.95
	Agree	64	56.14
	Neutral	17	12.22
	Disagree	0	0
	Strongly Disagree	0	0
Q34 - Expert transfer of knowledge platform exists in Divfood.	Strongly agree	12	10.53
	Agree	46	40.35
	Neutral	37	32.46
	Disagree	15	13.16
	Strongly Disagree	4	3.51
Competency – Experiences			
Q35 - Process related experiences are recorded.	Strongly agree	22	19.29
	Agree	54	47.37
	Neutral	32	28.07
	Disagree	5	4.39
	Strongly Disagree	1	0.88
Q36 - Recorded process experiences assists with customer complaints optimisation.	Strongly agree	25	21.93
	Agree	62	54.39
	Neutral	26	22.81
	Disagree	1	0.88
	Strongly Disagree	0	0

Leadership – Quality KPI			
Q37 - KPI`s on quality is included for all staff in the operation.	Strongly agree	12	10.53
	Agree	60	52.63
	Neutral	30	26.32
	Disagree	10	8.77
	Strongly Disagree	2	1.75
Q38 - Quality KPI`s objectives are agreed upon by all team leaders with management.	Strongly agree	12	10.53
	Agree	58	50.88
	Neutral	36	31.58
	Disagree	6	5.26
	Strongly Disagree	2	1.75
Q39 - Quality KPI are also included for production staff.	Strongly agree	11	9.65
	Agree	56	49.12
	Neutral	36	31.58

	Disagree	8	7.02
	Strongly Disagree	3	2.63
Leadership – Executive ownership			
Q40 - Executive quality ownership is discussed.in team meetings.	Strongly agree	9	7.89
	Agree	51	44.74
	Neutral	39	34.21
	Disagree	12	10.53
	Strongly Disagree	3	2.63
Q41 - Employees are encouraged to exercise executive ownership.	Strongly agree	8	7.02
	Agree	48	42.11
	Neutral	40	35.09
	Disagree	14	12.28
	Strongly Disagree	4	3.51
Q42 - All employees understand the concept of executive ownership.	Strongly agree	6	5.26
	Agree	34	29.82
	Neutral	43	37.72
	Disagree	21	18.42
	Strongly Disagree	10	8.77
Leadership – Objective alignment			
Q43 - Management objectives are communicated to all team members.	Strongly agree	16	14.04
	Agree	46	40.35
	Neutral	31	27.19
	Disagree	16	14.04
	Strongly Disagree	5	4.39
Q44 - Team member's quality objectives are aligned with management objectives.	Strongly agree	8	7.02
	Agree	53	46.49
	Neutral	38	33.33
	Disagree	13	11.40
	Strongly Disagree	2	1.75
Q45 - Measurements for quality targets are in place.	Strongly agree	17	14.91
	Agree	67	58.77
	Neutral	27	23.68
	Disagree	3	2.63
	Strongly Disagree	0	0

Q46 - Measurements for quality targets are in place.	Strongly agree	18	15.79
	Agree	52	45.61
	Neutral	31	27.19
	Disagree	12	10.53
	Strongly Disagree	1	0.88

Annexure J: Research Questionnaire

Name:
Surname:
Dept.:

QUESTIONNAIRE: QUALITY 4.0 CULTURE –OPTIMISATION OF CUSTOMER COMPLAINTS

To help us understand what is required to affect customer complai
complete this survey and return it to Gerrit Isaacs (Gerrit.Isaacs@nampak.com) by August 15, 2019.

Questionnaire: Culture	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Culture: Cross functional empowerment					
Divfood supports individual decision-making.					
Strategies to improve individual decision-making are in place.					
Effective decision –making in Divfood affect customer complaints.					
Employee empowerment exists in Divfood.					
Employee empowerment is directly related to customer complaints.					
Culture: Credibility					
Divfood employees are trained adequately related to quality.					
The quality function is Divfood is credible.					
Customer complaints discredit the Divfood quality function.					
Divfood can trust the current effectiveness of Quality systems.					
Customers are happy with Divfood` s current quality.					
Culture: Responsibility					
Quality is the Quality Manager`s responsibility.					
Quality is everyone`s responsibility.					
Ownership of quality exists.					
Divfood promotes quality ownership of quality.					
Quality improvement techniques are used in Divfood.					
Culture: Process Participation					
Process participation is encouraged in Divfood.					
Quality objectives are discussed frequently in team meetings.					
Customer complaints are discussed in all team meetings.					
Participation is encouraged in the operation					
Quality focus areas are visible on production floor.					

Quality improvement teams are active in the organisation.					
Additional Comments:					

Questionnaire: Quality 4.0 Competency –Optimisation of customer complaints

To help us understand what is required to affect customer complaint optimisation, please complete this survey and return it to Gerrit Isaacs (Gerrit.Isaacs@nampak.com) by August 15, 2019

Questionnaire: Competency	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Competency: Individual					
Current levels of competency in Divfood is adequate.					
Individual incompetency levels could contribute to customer complaints					
Competency training in Divfood is effective.					
Platforms to discuss plant competency effectiveness exists.					
Performance review on competency is conducted timeously.					
Competency: Appraisals					
Performance appraisals are conducted according to frequency in Divfood.					
Individual performance appraisals include empowerment strategy.					
Appraisals include competency discussion and plan.					
Expected level of ownership around quality is included in appraisal.					
Measurements for all appraisal parameters are discussed and agreed upon.					
Competency: Expertise					
Expert support is readily available in Divfood.					
The support of experts can have a positive effect on optimisation of customer complaints.					
Expert transfer of knowledge platform exists in Divfood.					
Competency: Experiences					
Process related experiences are recorded.					
Recorded process experiences assist with customer complaints optimisation.					

Additional Comments:					

QUESTIONNAIRE: QUALITY 4.0 LEADERSHIP –OPTIMISATION OF CUSTOMER COMPLAINTS

To help us understand what is required to affect customer complaint optimisation, please complete this survey and return it to Gerrit Isaacs (Gerrit.Isaacs@nampak.com) by August 15, 2019

Questionnaire: Leadership	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Leadership: Quality KPI					
KPI`s on quality is included for all staff in the operation.					
Quality KPI`s objectives are agreed upon by all team leaders with management.					
Quality KPI are also included for production staff.					
Leadership: Executive Ownership					
Executive quality ownership is discussed.in team meetings.					
Employees are encouraged to exercise executive ownership.					
All employees understand the concept of executive ownership.					
Leadership: Objective Alignment					
Management objectives are communicated to all team members.					
Team member's quality objectives are aligned with management objectives.					
Measurements for quality targets are in place.					
Measurements for quality targets are in place.					
Additional Comments:					

Annexure K: Cronbach Alpha results

Questions	# of items	Construct	Coefficient	Strength
Culture				
Q1 – Q5	5	Cross-functional empowerment	1.16	Excellent
Q6 – Q10	5	Credibility	1.16	Excellent
Q11 - Q15	5	Responsibility	1.16	Excellent
Q16 – Q21	6	Process participation	1.11	Excellent
Competency				
Q22 – Q26	5	Individual	1.16	Excellent
Q27 – Q31	5	Appraisals	1.16	Excellent
Q32 – Q34	3	Expertise	1.39	Excellent
Q35 – Q36	2	Experiences	1.85	Excellent
Leadership				
Q37 – Q39	3	Quality KPI	1.39	Excellent
Q40 – Q42	3	Ownership	1.16	Excellent
Q43 – Q45	4	Alignment	1.23	Excellent

Annexure L: Research Questionnaire Covering Letter

Subject: Questionnaire - Quality 4.0: Optimisation of customer complaints

Dear Sir/Madam,

I am a MEng in Quality student at the Cape Peninsula University of Technology. One of the requirements of the course is to conduct research study. To do this I am conducting research on Quality 4.0: Optimisation of customer complaints.

I would be grateful if you would assist me by completing the attached questionnaires.

The results of the questionnaires will be used purely for academic purposes and will not affect your current jobs in any way or form. All information obtained will be treated with the strictest confidence. Your response will remain anonymous. Respondents will be guaranteed that their names will not be used in the final report.

I appreciate your feedback and thank you for taking the time to share your opinions with me.

Best regards,

Graduate student: Gerrit Isaacs

Cape Peninsula University of Technology

Email: Gerrit.Isaacs@nampak.com

Cell phone No: 0834988249