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# Ethical, governance and sustainability considerations for using the industrial internet of things to collect big data in a manufacturing environment in South Africa

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# Ethical, governance and sustainability considerations for using the Industrial Internet of Things to collect big data in a manufacturing environment in South Africa

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**A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration**

**Johannesburg, 2019**

# ABSTRACT

The South African manufacturing sector has seen challenging times in recent years, and this will most certainly continue in the foreseeable future.

This research aims to identify and improve the implementation of emerging technologies; these being the internet of things and big data. The research identifies any challenges or obstacles experienced by the stakeholders in an organisation. It is centred on the effect on industrial conditions when viewed through the lenses of ethics, governance and sustainability applicable when new technology is introduced to operations.

Qualitative data collection took place in the form of semi-structured interviews which were conducted with a broad set of questions defined in an interview schedule.

The key findings of this research were a set of important principles that are important to consider during the planning and implementation of technology within an organisation. These dominant principles were identified through thematic analysis of the qualitative data gathered during the interviews. The important principles for the planning and implementation of technology were identified as the well-being of both stakeholders and the organisation, trust between stakeholders, individual and organisational performance, inclusion in planning an implementation, sufficient planning taking place, and an “invisible partnership” being present between all stakeholders.

# DECLARATION

I, Bradley Angus Bennett, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.



Bradley Angus Bennett

Signed at **Greenstone Hill, Johannesburg**

On the **28th** day of **March** 20**19**

# DEDICATION

For Dad,

My Hero, my Best Friend, my Rock; you are sorely missed. I'm sorry you never got to see this through with me; I hope this makes you proud.

Rest in Peace, until we meet again…

Forti Nihil Difficilius

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My thanks go out to each and every individual who supported and motivated me during this process. Completing this research report simply would not have been possible without you.

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- My classmates for the discussions and lessons along this journey,

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# CHAPTER 1. INTRODUCTION

## 1.1 Purpose of the study

The purpose of this research is to identify and analyse the effects of potentially collecting big data in a South African manufacturing operation by using the internet of things (IoT). For the purpose of this study, the Industrial Internet of Things (IIoT) is focused on exclusively.

IoT, as an emerging technology, offers the possibility and opportunity to transform the role that systems play within an operation and the operation of the systems (Atzori, Iera, & Morabito, 2010). This research is being done in the interest of identifying and assessing the potential impacts that the implementation of technology may have within a manufacturing operation.

## 1.2 Context of the study

Big data, in many ways, can be considered to be an abstract concept (George, Haas, & Pentland, 2014). When considered in a general sense, big data can be seen to be datasets which previously could not be perceived, acquired, processed or managed due to the overwhelming size of their datasets and the impractical lead time in processing which traditional Information Technology (IT) infrastructure offered (George et al., 2014).

Big data is a concept which is growing in popularity due to the myriad benefits it offers to those who can collect, analyse and make informed decisions based upon it. These benefits can be enjoyed by any person or organisation that has the ability to gather and analyse big data. Although big data is becoming increasingly commonplace when used as a business term, there remain very few published scholar articles regarding the management, challenges or opportunities relating to big data (George et al., 2014).

It is important that any big data that is collected is widely available within an organisation so that all departments and components within the organisation can

benefit from whatever insights may arise from the analysis of the big data. There has been an attempt by manufacturers to use big data to gain a more cohesive approach to data collection in their operations by integrating existing systems and gathering data which is both applicable and useful to all entities within the organisation (Brown, Chui, & Manyika, 2011). Although the collection of big data in manufacturing is considered to be of ease with a low magnitude of potential (Brown et al., 2011); it is still both applicable and valuable to those manufacturers operating in the South African economy.

The South African manufacturing sector has fallen on hard times in recent years showing negative growth (year-on-year % change, unadjusted) in February 2018 with a slight growth from April 2018 to June 2018 (see Table 1). More concerning, however, is the negative growth (3-month % change, seasonally adjusted[1]) between March 2018 and June 2018 (see Table 1).

**Table 1 - Key growth rates in the volume of manufacturing production (Statistics South Africa, 2018)**

| | Jan-18 | Feb-18 | Mar-18 | Apr-18 | May-18 | Jun-18 |
|---|---|---|---|---|---|---|
| Year-on-year % change, adjusted | 2,3 | 0,5 | -1,8 | 1,0 | 2,0 | 0,7 |
| Month-on-month % change, seasonally adjusted | -1,8 | -2,4 | 0,6 | -0,7 | 1,3 | 0,3 |
| 3-month % change, seasonally adjusted[1] | 1,7 | 0,2 | -2,2 | -3,0 | -1,6 | -0,1 |

[1] Percentage change between the previous 3 months and the 3 months ending in the month indicated.

IoT is an extension of the internet to include physical objects and devices (Barnaghi, Wang, Henson, & Taylor, 2012). This is a growing trend in the business arena, and the full benefits and effects are being realised as time goes by. The bridge between IoT and big data is achieved in part and most importantly, by physical objects being able to collect and analyse important information about their surroundings. This is manifested by incorporating electronic sensors or actuators into physical objects (Madakam, Ramaswamy, & Tripathi, 2015).

IoT facilitates the collection and delivery of big data from the environment within which it operates; this being in the interest of providing actionable data on an *ad hoc* basis to the organisation. The interpretation of this big data is made with the primary aim of the organisation gaining an in-depth understanding of its data (see

Figure 1) in the interest of having meaningful information, valuable knowledge and actionable intelligence (Barnaghi et al., 2012).

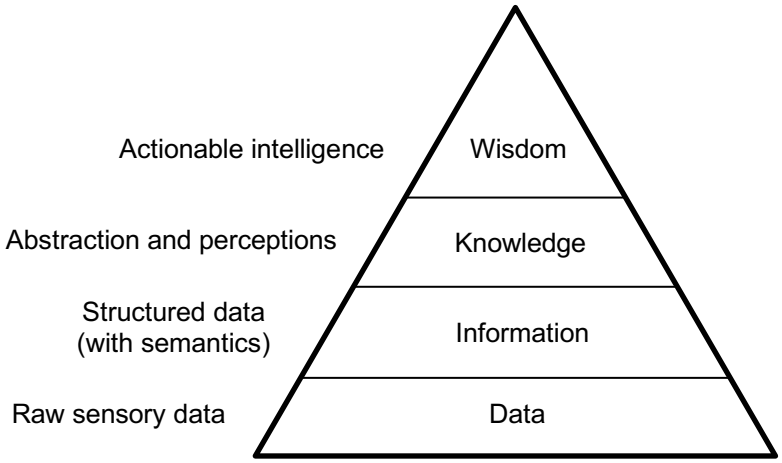


**Figure 1 "Knowledge Hierarchy" in the context of IoT (Barnaghi et al., 2012)**

The critical component to IoT is that it is these sensor-rich internet-connected devices that will enable organisations to measure what they could not measure before, such as employee performance, in greater detail for example, which ultimately enables the ability for high-resolution management from this additional information (Uckelmann, Harrison, & Michahelles, 2011).

## 1.3 Problem statement

### 1.3.1 *Main problem*

The main problem at the core of this research is to identify and describe the ethical, governance and sustainability issues that may arise when IIoT is being introduced into a manufacturing organisation to collect big data and identification of dominant themes which aim to guide management decisions.

### 1.3.2 *Sub-problems*

The first sub-problem is to identify and describe the ethical issues that may arise when IIoT is being introduced into a manufacturing organisation to collect big data.

The second sub-problem is to identify and describe the governance issues that may arise when IIoT is being introduced into a manufacturing organisation to collect big data.

The third sub-problem is to identify and describe the sustainability issues that may arise when IIoT is being introduced into a manufacturing organisation to collect big data.

## 1.4 Significance of the study

The study should provide guidance to managers in the South African manufacturing sector. The ability to collect and analyse big data in a cost-effective manner by using IIoT may provide benefits to companies operating in the manufacturing sector in South Africa.

Currently, data is collected and occasionally analysed in a retrospective manner. This study aims to quantify the benefits of making informed decisions based on live data; therefore an organisation that will become a data-driven organisation.

This study could benefit any operator in the South African manufacturing sector utilising skilled and semi-skilled labour. For the purpose of this research, labour classifications have been identified and referred to as per the grouping utilised by Statistics South Africa in their Quarterly Labour Force Survey (QLFS) (Statistics South Africa, 2014).

This research could provide academia with a better business understanding of the internet of things (IoT), the role IoT plays in the effective collection of big data and the effects IoT may have on productivity and efficiency. In addition, IoT and the potential benefits highlight the need for a possible new approach to business

model thinking in order to incorporate a more end-to-end value flow built firmly on big data (Westerlund, Leminen, & Rajahonka, 2014).

Furthermore, future research can be done in the field of machine control, based on business rules which may be implemented from the knowledge gained from the analysis of the big data being collected.

## 1.5 Delimitations of the study

- This research is limited to a specific number of South African manufacturers within which this research was conducted.
- This research applies only to manufacturing organisations where both skilled and semi-skilled labour is utilised.
- This research being conducted applies on a macro level for the organisation.
- This research applies specifically to the perceptions surrounding the broader context of big data being monitored and analysed within an organisation.
- This research covers general operations within a South African manufacturing operation.

## 1.6 Definition of terms

**Big Data:** the collection and analysis of large amounts of data pertaining to a particular concept/topic. The analysis thereof can provide managers with more data with which to analyse and make better management decisions. The analysis and translation of big data is done in the interest of translating it into knowledge.

**Industrial Internet of Things (IIoT):** the industrial internet of things (IIoT) is a subset of the concept of the internet of things (IoT). It relates specifically to the

industrial implementation of an IoT infrastructure. and improved decision making into the future (McAfee, Brynjolfsson, Davenport, Patil, & Barton, 2012).

**Internet of Things (IoT):** an emerging technology whereby inanimate objects/things are connected to the internet. It can be considered to be a network infrastructure whereby physical items are seamlessly integrated into any information based network (Atzori, Iera, & Morabito, 2010).

**Manufacturing:** Manufacturing is a large-scale industrial operation which produces goods. The manufacturing context for this research is selected industrial manufacturers operating within the South African manufacturing sector.

**Semi-skilled Labour:** clerks, sales and service personnel, craft and trades personnel and plant and machinery operators are grouped together and referred to as such for the purpose of this research, according to their skills level (Statistics South Africa, 2014).

**Skilled Labour:** managers, professionals and technicians are grouped together and referred to as such for the purpose of this research, according to their skills level (Statistics South Africa, 2014).

## 1.7 Assumptions

- Production and efficiency levels across the organisation were already running at an optimum, given the information on hand without the implementation of IoT.
- Each company, within which interviews took place, nominated a balanced, dependable and credible cross-section of their management and staff to be interviewed.
- The data being collected during interviews was assumed to be objective.
- Management and staff within the organisation were working to the best of their ability and responses were based on such.

# CHAPTER 2. LITERATURE REVIEW

## 2.1 Introduction

In the 2018 Budget Review conducted by the National Treasury, it was indicated that the Real GDP Growth for 2018 is projected to be 1.5%, this being 0.5% up from the 2017 estimate at the time (Treasury, 2018). Although marginal growth has been projected, this is still well below the Consumer Price Index (CPI) of 5.4% (Treasury, 2018). Furthermore, as of September 2017, the South African manufacturing sector was the sector showing the most significant decline with a negative growth of 1.2% which reduced GDP growth by 0.2% (Treasury, 2018). This decline has been attributed to weak domestic demand and a low level of business confidence (Treasury, 2018). The South African manufacturing sector was one of only three sectors in the South African economy showing negative growth in 2017. The other two sectors were Trade, Catering and Accommodation with negative growth of 1% and Electricity, Gas and Water with negative growth of 0.6% (Treasury, 2018).

With such financial challenges on the immediate horizon, it becomes critical for the manufacturing sector to explore new ways in order to ensure their survival. Given these circumstances, Industry, therefore, requires accurate information on which to base strategic management decisions. Technology has influenced the pace at which information is gathered and processed, and this has ultimately affected the way in which work is conducted (Shore et al., 2004). Furthermore, globalisation has significantly increased the complexity of the environment within which business operates; ultimately organisations seek more flexibility in this rapidly changing and competitive environment (Shore et al., 2004).

If manufacturers are to remain competitive, they need to seek out and embrace emerging technologies to improve both efficiency and productivity (Lee, Lapira, Bagheri, & Kao, 2013). IoT is one such technology which could assist. Some examples of such assistance would be in the optimisation of operations and energy consumption; so maximum efficiency is achieved in a highly volatile

environment (Bojanova, Voas, & Hurlburt, 2015). IoT is used in this manufacturing context in the collection of big data.

If big data is used in both a creative and effective way, it has the potential to improve both efficiency and quality (Chen, Mao, & Liu, 2014). In light of the challenges currently facing the South African manufacturing sector, the aforementioned advantages would be most beneficial.

In the context of this research, the following extensions to the definitions of IoT and Big Data are applicable:

> **The Internet of Things (IoT):** The practice whereby physical objects and sensors are seamlessly integrated into an information network (such as the internet) and form an aggregate of a larger system (Weber, 2013).
>
> **Big Data:** The collection, structuring and analysis of large amounts of data. It is considered to be research intensive and is done in order to have a stepped change in the scale and scope of knowledge in a given area of knowledge (Schroeder & Cowls, 2014).

The literature review explores the considerations surrounding the gathering of big data using IoT; this is done, considered and evaluated from ethics, governance and sustainability perspectives. These themes are examined individually. Thereafter, relationships between the organisation's management, staff and the technology are explored.

## 2.2 Background discussion.

### 2.2.1 *The implementation of IoT*

The primary goal for realising the Internet of Things is the creation of situational awareness in such a way that machines and humans better understand each other and their surrounding environments (Barnaghi et al., 2012). However, when

considering the realisation of the Internet of Things, there is no doubt that there will be a tremendous disruption to the way of living for individuals, businesses and society at large (Jun, Simplot-Ryl, Bisdikian, & Mouftah, 2011). There is a considerable concern considering that ethical considerations surrounding IoT and Big Data have come to light at a comparatively late stage in its conceptual evolution (Weber, 2013). Furthermore, previous literature has pointed out the need for regulatory oversight and governance when these technologies are used (Weber, 2013).

Should the implementation of IoT in an organisation not be managed correctly, there exists a clear danger from an ethical perspective for organisations and the individuals who work within them (Popescul & Georgescu, 2014). The potential infringement of employee rights is one such danger. In addition, further methodical research is required on interventions required to prevent IoT from being perceived and feared as an intrusive Big Brother (Popescul & Georgescu, 2014).

### 2.2.2 *The identification and definition of relationships*

The speed at which information is transmitted in the work environment has increased since the technology was introduced (Shore et al., 2004). Building on this, globalisation has increased the complexity of the environment within which business is required to operate (Shore et al., 2004). Organisations have subsequently found alternative sources of information in order to ensure a high level of knowledge of the environment within which they operate. Therefore, the study of employee-organisation relationships are becoming increasingly critical (Shore et al., 2004).

This study proposes the existence of three key relationships within the manufacturing operations where the research was conducted:

1. **The management-staff relationship**
   For the purpose of this study, this relationship was defined as the relationship that exists within the context of the study between the management resources and the staff.

2. **The management-technology relationship**
   For the purpose of this study, this relationship was defined as the relationship that exists within the context of the study between the management resources and the technology.
3. **The staff-technology relationship**
   For the purpose of this study, this relationship was defined as the relationship that exists within the context of the study between the staff and the technology.

## 2.3 Ethical considerations when implementing IoT

### 2.3.1 *Ethical considerations*

IoT is an emerging technology and is, therefore, in addition, disruptive. Whilst the technology has been around for years, it is only in recent years that the technology has become readily available and practical to implement. In light of this, there is a limited body of knowledge surrounding the concept as a whole.

Concerns and paradigms raised around the ethics of big data are considered when looking into IoT. It is, therefore, a reasonable consideration that the ethics and governance of both big data and IoT are mutually constitutive. In this research, big data and IoT are considered to be directly involved in the knowledge production surrounding the industrial application wherein it is being utilised.

Some argue that the traditional look into the ethical considerations surrounding knowledge production using both Big Data and IoT, tend to overlook how human autonomy risks being undermined by the growth of scientific knowledge (Schroeder & Cowls, 2014). This is a considerable area of concern considering that the issue of ethics has been addressed at a comparatively late stage in its conceptual evolution (Weber, 2013). However, it is essential that there was an acknowledgement that ethical standards are likely to differ when it comes to the implementation of IoT to collect Big Data in industrial vs societal contexts (Weber, 2013).

It is important that there is no confusion regarding the lines on how and where Big Data is being collected. This is because not all societal-based ethical considerations would apply in an industrial context and vice versa. This is not to say that ethical considerations in the societal context should not at the very least be considered when reviewing ethics in an industrial context. In fact, considering that the issue of ethics has been addressed comparatively later than usual (mentioned above); it would be necessary to, at the very least, consider those societal, ethical concerns and to use them as a guideline when considering and defining the ethical considerations in an industrial context. With an estimation of over 75 billion objects being connected via this technology by the year 2020 (Popescul & Georgescu, 2014), the need for ethical guidelines to be established is of paramount importance. Unfortunately, current policies and research programmes are just too slow and too instrumental to manage the current challenges being identified (Popescul & Georgescu, 2014).

In a 2013 report from the European Commission (R. Weber et al., 2013), the characteristics of IoT which could possibly cause ethical problems for consideration were identified. Some of these are as follows:

- ***Ubiquity, omnipresence*** – if IoT devices become so common and widespread that users no longer have a reasonable choice as to whether to participate or not, this should form part of any management decisions regarding the implementation of IoT.
- ***Miniaturisation, invisibility*** – if IoT devices are seemingly transparent within the environments in which they operate, careful consideration should take place.
- ***Ambiguity*** – should the distinction between devices which are connected to the internet (IoT-based) and those that are not become difficult to distinguish, careful consideration is necessary.
- ***Ultra-connectivity*** – when a critical mass is reached, and the size and nature of the data being collected pose serious risks should malicious use arise thereof; careful consideration is necessary.
- ***Autonomous and unpredictable behaviour*** – a consideration when people and IoT devices operate in the same environment and the behaviour of the

two is hybrid in nature. IoT devices run the risk of behaving unpredictably; this introduces risk to the people involved.

When taking the characteristics listed above into consideration and viewing them through the lens of industrial application, it is essential to consider all parties involved in order to make sure that ethical considerations are done in a manner which considers all parties involved (R. Weber et al., 2013). It is paramount that any implementation of this form of technology and the collection of Big Data, as a result, is done for the benefit of everyone. This inclusive approach will ultimately derive benefit for all stakeholders involved. Viewing the above considerations in a deontological light will ultimately ensure that the ethical considerations made are the correct ones. This is because when one considers the employment landscape in South Africa, it is fundamentally based on the premise of being fair, upholding one's responsibilities, fulfilling mandates and respecting the rights of others. In converse, any dishonesty or disrespect for rules set out in employment contracts also cannot be tolerated.

It is, therefore, reasonable to state that any decisions and considerations on an ethical basis with regards to the implementation of IoT and the collection of Big Data have to be done on a deontological basis. A deontological approach here would ensure that any ethical decisions are made to ensure that obligations would ultimately affect the decisions made from both the employer and employee aspects.

From the aforementioned detail, it can be concluded that although IoT and the collection of Big Data may well not have a clear ethical framework, there is an opportunity for a newly defined approach when defining the ethical considerations moving into the future. The distinct possibility exists that this is a watershed moment for the future of technology from an ethical point of view. With the volume of internet-connected devices growing exponentially, the effects (positive or negative) will be widespread. It should, therefore, be a priority to investigate and define all ethical considerations required in the future.

### 2.3.2 *Research Proposition 1*

The ethical issues that may arise when IIoT is introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

## 2.4 Governance considerations when implementing IoT

### 2.4.1 *Governance*

When one considers that ethics have come to the forefront of discussions regarding IoT at a comparatively late stage (Weber, 2013), it becomes increasingly apparent that a well-defined system for the governance of these devices has not come into being, as yet. Accordingly, a list of principles has been identified to assist in the analysis of conduct.

The principles which have been identified are as follows (Weber, 2013):

- ***Legitimacy and representation*** – any system which is implemented using IoT technologies, like any other, needs to operate legitimately and within current laws.
- ***Transparency*** – systems which incorporate IoT technology and gather data should be designed and implemented in such a way that the information collected, to a certain degree, should not negatively affect any party involved if they are not aware that it could do so. Transparency would ensure that any/all parties involved in the governance of IoT can evaluate and make decisions in an informed manner.
- **Accountability** – The implementation of standards will need to be governed by an accountable body and information which allows this body to make decisions (such as sanctioning) will be possible, providing the aforementioned transparency is in effect.

However, the principles outlined above are only useful once an authority on IoT is required to evaluate or enforce the governance thereof. A set of guidelines is required to assist stakeholders when Big Data is involved and more specifically, when IoT is implemented. If one was to be mindful of the balance of power, rights and interests (Hamann, Woolman, & Sprague, 2008), all key stakeholders could be considered to be in an “invisible partnership”. This would further reinforce the use of the Five Capitals Model, which is covered in detail in a forthcoming section.

Fisher and Ury (1987) introduced the topic of interest-based negotiation. Although more related to sustainability and not directly related to governance, when one considers that negotiation will form part of many situations involving IoT, many of their guiding principles and conditions are applicable in this context and could be followed as overarching guidelines. Negotiations will form part of the implementation of an IoT system between the stakeholders; also, between many/all parties involved in the various capitals of the Five Capitals Model and lastly, between the organisation and their labour around which IoT devices will be gathering Big Data. Parties involved in such negotiations should not do so from entrenched positions, and attention should be paid to all underlying interests (Hamann et al., 2008).

Fisher and Ury identified the following four conditions (Hamann et al., 2008), which will form, although indirectly, healthy partnerships between key stakeholders:

1. ***Balancing power*** – should all parties involved negotiate and comment, based on common interest, then the ultimate solution will be likely to benefit all involved.
2. ***Acknowledgement of Critical Rights*** – The explicit acknowledgement of the critical rights of all stakeholders will ensure that they are identified and documented early to avoid any of these rights being violated.
3. ***Negotiate both converging and conflicting interests*** – by taking an approach of interest-based negotiation, the stakeholders may be likely to find creative solutions. It is important to note that all parties involved have a responsibility to communicate concerns and interests to ensure their consideration and acknowledgement.

4. ***Manage relations with stakeholders*** – negotiators have a responsibility to proceed in this process, keeping the interests and perspectives of other stakeholders in mind.

While the abovementioned conditions may not initially appear to be related to the topic being discussed, they provide healthy and responsible guidelines in an area which lacks experience and governance. Whilst they most certainly are not to be considered as concrete rules or laws, they provide a healthy landscape or context from which to proceed when considering the topic of governance regarding IoT.

### 2.4.2 *Research Proposition 2*

The governance issues that may arise when IIoT is introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

## 2.5 The effects of IoT on sustainability

### 2.5.1 *The Five Capitals Model*

When considering sustainability with regards to IoT and the collection of Big Data, it should be through the lens of what the possible impacts on sustainability would be should these concepts be implemented. The most effective way of doing so is to evaluate the effect that implementing IoT and Big Data collection will have on each one of the five sustainable capitals. Many businesses do not have a meaningful or effective way of understanding the myriad issues which they face these days. These issues continue to grow and become more complex in nature, making them incredibly difficult to identify or quantify *("The Five Capitals Model – a framework for sustainability," 2016*). The implementation of IoT and the collection of Big Data could possibly provide valuable insights into some of these issues.

**Natural Capital:** This is most certainly the most important of all the capitals because, without natural capital, none of the other four capitals are possible *("The Five Capitals Model – a framework for sustainability," 2016)*. Companies can implement IoT devices to monitor energy usage, track carbon emissions and safe monitoring of volatile substances. These would be only a few of the possible benefits. However, these could be considered to be the most important. Furthermore, it is also important to consider that natural capital can also have effects on industrial operations that may not typically be considered. The monitoring of environmental variables such as temperature, humidity, wind, light, etc. could possibly provide the industry with new insights. These insights could possibly be used to drive efficiencies and monitor industrial operations more closely.

**Human Capital:** This is another one of the capitals which will derive incredible benefits from the implementation of IoT devices into daily industrial operations. The health of employees can be protected by the monitoring of harmful substances, such as gases, for example. Furthermore, when one looks beyond the health benefits to human capital, the real mettle of IoT begins to reveal itself. The enhancement of human capital relies on the advancement of the people involved in the system *("The Five Capitals Model – a framework for sustainability," 2016).* The insights which can be gained from the collection and analysis of Big Data will have substantial benefits to the education and training of labour. Moreover, it will provide the industry with a better understanding of the dynamic production environment which relies so heavily on human capital. Whilst it may be incredibly idealistic to mention, the possibility of a better understanding between organisations and the labour they employ is quite possible. Given South Africa's labour unrest in recent years, this would be most beneficial.

**Social Capital:** This is one of the capitals where IoT really has the ability to make a substantial social change. In the industrial context, the implementation of IoT devices to monitor working conditions affect the internal social capital of the organisation. When devices such as these are implemented externally, they can facilitate the building of trust and the social licence to operate for the manufacturer. By implementing these both internally and externally, huge

advances can be made to the provision of safe and supportive living and working conditions for those involved; herein lies the benefit to social capital *(*"The Five Capitals Model – a framework for sustainability," 2016).

**Manufactured Capital:** The implementation of IoT for the monitoring and reporting of production processes makes it possible for the organisation to make efficient use of all manufactured capital. This makes it possible for the organisation to be more flexible and innovative and possibly decrease the time it takes to get products to market *("The Five Capitals Model – a framework for sustainability," 2016).* Furthermore, IoT devices can make it possible for operations to be as lean as possible by minimising the resources required to achieve its objectives.

**Financial Capital:** The ultimate net-effect of the implementation of IoT devices within the organisation could be that the organisation operates in the most efficient and effective manner possible. The myriad benefits illustrated in the previous four capitals above would collectively lead to the organisation being in a far stronger or stable financial position *("The Five Capitals Model – a framework for sustainability," 2016).*

### 2.5.2 *Research Proposition 3*

The sustainability issues that may arise when IIoT is introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

## 2.6 Conclusion of Literature Review

IoT is an emerging technology and is, therefore, in addition, disruptive. It is only in recent years that the technology has become readily available and practical to implement. In light of this, there is a limited body of knowledge surrounding the concept as a whole.

With an estimation of over 75 billion objects being connected via this technology by the year 2020 (Popescul & Georgescu, 2014), it is imperative that attention is paid to the ethics, governance and sustainability regarding the implementation of emerging technology, such as IoT. Unfortunately, current policies and research programmes are simply too slow and too instrumental to manage the current challenges being identified (Popescul & Georgescu, 2014).

The primary goal for the realising of the Internet of Things is the goal of situational awareness in such a way that humans and machines fully understand each other and their surrounding environments (Barnaghi et al., 2012). It is also important to note that this realisation will bring along with it the risk of tremendous disruption for individuals, businesses and society at large (Jun et al., 2011). With ethical considerations coming to the fore at a comparatively late stage in its conceptual evolution (Weber, 2013), the importance of such a study is further reinforced.

There are three key relationships which have been identified between the stakeholders involved. These were the relationships between the organisational management, the staff and the technology which is to be implemented.

Table 2 summarises the key elements of the literature by categorising the key references into the relationships which were identified and discussed. These form the basis of the interview schedules conducted with the management and staff within the organisation (discussed in Chapter 3).

**Table 2 Summary of references to key interest areas in the study**

| | Relationships | | |
|---|---|---|---|
| | **Management-Staff** | **Management-Technology** | **Staff-Technology** |
| **Ethics** | Is the technology feared or welcomed? Is it viewed as obtrusive or non-obtrusive? (Popescul & Georgescu, 2014)<br><br>What effects has the implementation of technology had on trust? | Can this technology undermine human autonomy? (Schroeder & Cowls, 2014)<br><br>Characteristics of IoT which could possibly cause ethical problems (R. Weber et al., 2013):<br>- Ubiquity, omnipresence<br>- Miniaturisation, invisibility<br>- Ambiguity<br>- Ultra-connectivity<br>- Autonomous and unpredictable behaviour<br><br>Are all parties involved being considered? (R. Weber et al., 2013) | Can this technology undermine human autonomy? (Schroeder & Cowls, 2014)<br><br>Characteristics of IoT which could possibly cause ethical problems (R. Weber et al., 2013):<br>- Ubiquity, omnipresence<br>- Miniaturisation, invisibility<br>- Ambiguity<br>- Ultra-connectivity<br>- Autonomous and unpredictable behaviour<br><br>Are all parties involved being considered? (R. Weber et al., 2013) |

| | Relationships | | |
|---|---|---|---|
| | **Management-Staff** | **Management-Technology** | **Staff-Technology** |
| **Governance** | Applicable principles in the analysis of conduct (Weber, 2013):<br>- Legitimacy and representation<br>- Transparency<br><br>The presence of an “invisible partnership” where all stakeholders are considered? (Hamann et al., 2008)<br><br>Evaluate if either party entrenched when negotiating or discussing? (Hamann et al., 2008) | | |
| **Sustainability** | Applicable Capitals as per The Five Capitals Model ("The Five Capitals Model – a framework for sustainability," 2016):<br>- Natural Capital<br>- Human Capital<br>- Social Capital<br>- Manufactured Capital<br>- Financial Capital | Applicable Capitals as per The Five Capitals Model ("The Five Capitals Model – a framework for sustainability," 2016):<br>- Natural Capital<br>- Human Capital<br>- Social Capital<br>- Manufactured Capital<br>- Financial Capital | Applicable Capitals as per The Five Capitals Model ("The Five Capitals Model – a framework for sustainability," 2016):<br>- Natural Capital<br>- Human Capital<br>- Social Capital<br>- Manufactured Capital |

| | Relationships | | |
|---|---|---|---|
| | **Management-Staff** | **Management-Technology** | **Staff-Technology** |
| **General** | Evaluate the four conditions for healthy stakeholder partnerships (Fisher et al., 1987):<br>- Balancing power<br>- Acknowledgement of Critical Rights<br>- Negotiate both converging and conflicting interests<br>- Manage relations with stakeholders | Does management understand the technology? (Barnaghi et al., 2012)<br><br>Is the technology disruptive? (Jun et al., 2011) | Does the staff understand the technology? (Barnaghi et al., 2012)<br><br>Is the technology disruptive? (Jun et al., 2011) |

### 2.6.1 *Research Proposition 1:*

The ethical issues that may arise when IIoT is potentially introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

### 2.6.2 *Research Proposition 2:*

The governance issues that may arise when IIoT is potentially introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

### 2.6.3 *Research Proposition 3:*

The sustainability issues that may arise when IIoT is potentially introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

# CHAPTER 3. RESEARCH METHODOLOGY

## 3.1 Introduction

This study uses a qualitative approach to investigate and address the research problem via the three research objectives. The first research objective is to identify the ethical issues that may arise when IIoT is introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology. The second research objective is to identify the governance issues that may arise when IIoT is potentially introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology. The third research objective is to identify the sustainability issues that may arise when IIoT is potentially introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology. The research will be conducted via semi-structured interviews whereby with the results are to be coded, and dominant themes will be identified where possible.

## 3.2 Research methodology /paradigm

This chapter details the methodology selected for this research and details the design of the research. The research was conducted by collecting qualitative data by conducting semi-structured interviews with managers and semi-skilled labourers in the South African manufacturing industry.

The nature of this research study was to identify and improve the implementation of emerging technology, such as IoT and big data. The nature of this research

report was to identify any challenges or obstacles experienced by the stakeholders in an organisation. The explicit goal was to identify, understand and rectify these challenges and obstacles in such a way that would assist the stakeholders in decisions and/or interventions which may be required. This study was centred on the effect on industrial conditions when viewed through the lenses of ethics, governance and sustainability applicable when new technology is introduced to operations.

The primary aim was to keep the data and subsequent findings as generic as possible to the manufacturing context to ensure that other manufacturing operations could benefit from the research which was conducted.

Qualitative research bases its concern more on words rather than on numbers (Bryman, 2015). Qualitative research methods focus on observations of an interviewee and the words used in order to attempt to understand and express reality as perceived by the interviewee (Amaratunga, Baldry, Sarshar, & Newton, 2002). Qualitative research often begins from an open-minded perspective and undergoes a process of gradually narrowing-down the research questions and problems identified (Bryman, 2015). Qualitative research can, therefore, be described as explorative in nature. This provides an element of flexibility to the research being conducted and therefore allows for adjustments in response to any new information that may emerge from interactions during an interview. It does, however, present a risk of the interview unknowingly influencing the interviewee. It is therefore imperative that careful attention is shown to the interview method and that it is carried out in a consistent manner.

Some features of gathering data using qualitative methods are identified as (Amaratunga et al., 2002):

- There is a deliberate attempt to consider and explore any differences observed between people.
- Theory and concepts are able to develop alongside each other due to the lack of structure to the research being conducted and are therefore flexible by nature.

- The results are considered to be “deep, rich and meaningful” due to the research seeking to describe and understand, analyse and describe the culture and behaviour of those being observed and interviewed.

## 3.3 Research Design

The study was conducted by means of semi-structured interviews which were based on interview schedules. The interview schedules consisted of a set of broad questions which were put forward to the interviewees. Interview candidates were encouraged to express their views so that any perceptions or themes could be explored either during the interview or at a later stage. Amaratunga et al. (2002) point out that the goals of a qualitative interview are to consider the research topic from the perspective of the person who is being interviewed; furthermore, it is important to understand just how or why the interviewee came to have the relevant perspective.

The following are some of the advantages that have been identified from using qualitative methodologies for gathering data (Amaratunga et al., 2002):

- Data gathering methods are considered to be more natural in contrast to quantitative methodologies.
- Due to the interpretive nature, there is an ability to understand the meaning interviewees apply to criteria.
- The flexibility allows the researcher to adjust to new issues or ideas should they emerge during the interview process.

Conversely, the following disadvantages have been identified when using this methodology (Amaratunga et al., 2002):

- Data collection can be tedious in nature with the possibility of requiring more resources.
- Due to the interpretive nature of this methodology, the analysis and interpretation of the gathered data may be difficult.
- There is a possibility that policymakers may consider the results of a qualitative approach to lack credibility.

The interviews were conducted by scheduling sufficient time in advance with each of the interviewees. Where possible, verbatim quotes from interviewees were included when presenting results, interpretations and recommendations from this research. Should the problem have arisen that the sample size was not sufficient, additional interviews would have been conducted in order to address any problems that might have arisen during this process.

## 3.4 Population and sample

### 3.4.1 *Population*

The research population in this study comprised various participants from each of the stakeholders who had been identified. These were members from management within the organisation and staff members who were operating within the environment of the technology.

### 3.4.2 *Sample and sampling method*

Due to the introductory nature of this context and the use of emergent technologies, the sample which was utilised was kept to a minimum at the start of the study. However, in order to enrich the quality and volume of the data being collected, where possible, more than one candidate from management and labour was interviewed. It was the aim of this research to conduct interviews with multiple representatives from both management and labour within a minimum of three and a maximum of five South African manufacturing operations. The breakdown of potential candidates is detailed below.

**Table 3: Distribution of interview candidates**

| Description of entity | The number to be sampled |
|---|---|
| Management within the organisation | 1 candidate |
| Labour within the organisation | 1 candidate |

| | |
|---|---|
| Manufacturing companies | 3 |

It is important to note that there was a risk of convenience affecting the sampling from an organisational perspective when this research was conducted, that is, organisations participating in this research would be making the decision of who participates in this research.

The three qualifying organisations were chosen based on availability and access. Furthermore, the three organizations provided a useful cross-section of candidates within the manufacturing sector. In addition, when considering the lack of research undertaken in the past in relation to this topic; the three participating organizations provided a base upon which this research, and any further research based on its outcomes, could be undertaken.

## 3.5 The research instrument

The instrument for this research was in the form of semi-structured interviews which were conducted following a broad set of questions defined in an interview schedule. Due to two different roles of employees being interviewed, these being management and semi-skilled labour, the interview schedule was drawn up and probed in different ways for each type of interviewee. It was, therefore, possible to enable the researcher to draw direct comparisons from the results.

The interview schedule consisted of questions derived from the literature review performed previously in chapter 2. These were outlined and defined in Appendix A.

## 3.6 Procedure for data collection

The research in this study was conducted by the research practitioner authoring this research report. Interviews were scheduled at a convenient time for all parties involved. Where possible, with permission from interviewees, the interviews

being conducted were recorded in order to enable more accurate transcription and reliable analysis to be performed.

## 3.7 Data analysis and interpretation

The data collected during the semi-structured interviews was analysed by means of transcripts which were written up following the interview. These transcripts were collected per candidate type and were analysed as such.

The analysis and interpretation of the data was done in accordance with the principles of contemporary research ethics protocols and standards as defined by Stacey and Stacey (2012).

Furthermore, a documented analysis of all findings and recommendations was evaluated to ensure that any negative consequences were dealt with accordingly should they have arisen (Stacey & Stacey, 2012).

## 3.8 Limitations of the study

It was important to note that the possibility of various limitations to this study is evident. These potential limitations were as follows:

- Respondents may have provided inaccurate information
- Respondents may not have understood the nature of the technology or the potential benefits associated with the technology being implemented
- Stakeholder subjectivity may not have been timeously or accurately identified
- This study was limited to the manufacturing operations within which the study was performed

## 3.9 Validity and reliability

Validity is only possible with the presence of reliability (Janse van Rensburg, 2006). It, therefore, stands that a valid test is reliable, however, a reliable test is not necessarily valid (Janse van Rensburg, 2006). Reliability is based on whether

the instrument being used to measure is, in fact, measuring that which it is supposed to (Janse van Rensburg, 2006). In addition, the measurement utilised can only be considered to be reliable should it provide the same result continuously (Cohen, Manion, & Morrison, 2000). This study aimed to achieve reliability and validity by means of defined interview schedules conducted in a semi-structured nature where candidates were encouraged to explore thoughts and perceptions on the topic to test its robustness.

This study planned to utilise triangulation for improving the validity and reliability of the data which was collected. Triangulation is defined as a strategy/test which is used in improving the validity and reliability of research being conducted or in the evaluation of the findings thereof (Golafshani, 2003).

In addition to triangulation, this study considered the knowledge gained by the inclusion of all stakeholders as socially constructed and that this might change depending on circumstance (Golafshani, 2003). According to Golafshani (2003, p. 604), “An open-ended perspective in constructivism adheres with the notion of data triangulation by allowing participants in research to assist the researcher in the research question as well as with the data collection.“ On the basis of this constructivism, triangulation was achieved through a process of engagement, semi-structured interviews and periodic observation of the stakeholders in the workplace.

### 3.9.1 *External validity*

External validity tests research results to determine whether the results of a particular set of research results can be generalised over research conducted using a different sample at a later point in time (Calder, Phillips, & Tybout, 1982). Although this study is valid only to the extent to which the nature and configuration of the operations, to which the research findings were to be applied, match the context within which the research was conducted. It is important to note that due to the broad scope of both the South African manufacturing industry and the semi-skilled nature of the labour employed therein, there was an assumption that the results obtained from this research could possibly be applied to similar industries within the South African context.

### 3.9.2 *Internal validity*

Internal validity is a measure of the extent to which the research design and data collected therein allow the researcher to conclude cause-and-effect relationships within the data collected (Leedy & Ormrod, 2005). That is, internal validity is achieved through the way in which data is collected, analysed and acted upon during the action research process.

### 3.9.3 *Reliability*

The collection and analysis of data can only be considered to be reliable should it provide the same result continuously (Cohen et al., 2000). For the purpose of this study, the semi-structured interviews were conducted in accordance to interview schedules in such a way that ensured consistency across the topics discussed in the interviews. Furthermore, respondents were given a fair chance to respond to each component of the interview.

## 3.10 Conclusion

In conclusion, the research problem and research objectives will be sufficiently addressed via the chosen methodology. The qualitative data collected from the conducting of semi-structured interviews will allow the researcher to identify any dominant themes which may emerge following the coding of the results. While respondents may not directly identify themes, the interview schedule and coding of the results will provide ample opportunity for the researcher to identify and explore any dominant themes which may emerge.

The reliability and validity, both external and internal, have been addressed and will be achieved using the chosen methodology.

# CHAPTER 4. PRESENTATION OF RESULTS

## 4.1 Introduction

This chapter presents the results of the responses which were collected during semi-structured interviews with candidates from three different operations operating within the South African manufacturing sector. A total of six interviews were conducted with an individual member of management and labour from each of the three manufacturing operations. The data was collected in accordance with the process defined and outlined in chapter three.

Interviews were conducted in a semi-structured manner and were based upon a predefined interview schedule, as defined in Appendix A of this document. The interviews were opened by discussing general concepts regarding the research topic. This was done to determine each of the candidate's general knowledge and overall sentiments towards the use of this technology as a whole. Thereafter, questions pertaining to each of the research propositions were asked and discussed.

## 4.2 Description of Population

Interviews were conducted with representatives from both management and labour within each of the three organisations who participated in this research. For the sake of anonymity, respondents are referred to as either a worker or manager from each of the respective companies. The details of each respondents are described in Table 5. Furthermore, the participating organisations will be referred to as companies A through C. The details of each of the participating companies are described in Table 4.

**Table 4 - Participating Company Details**

| Company | Description | Company Scale |
|---|---|---|
| **Company A** | Small scale family business supplying engineering and manufacturing services for small to medium scale South African manufacturers. | **Small** (less than 10 employees) |
| **Company B** | Small to medium scale South African company owned by a multi-national company based in Germany. This company manufactures its own products in South Africa which are distributed both locally and internationally for use in large scale industrial operations. | **Medium** (less than 50 employees) |
| **Company C** | Large scale manufacturing facility owned by a group of multi-national companies; all of which are based in Germany. This company manufactures turbine components which are distributed both locally and internationally for use in large scale industrial operations. | **Large** (150+ employees) |

**Table 5 - Participating Respondents**

| Company | Respondent | Description |
|---|---|---|
| **A** | **Worker** | Machine Operator |
| | **Manager** | Senior management and company owner |
| **B** | **Worker** | Machine Operator and Programmer |
| | **Manager** | Middle management responsible for production |
| **C** | **Worker** | Machine Operator and Programmer |
| | **Manager** | Middle management responsible for engineering operations |

## 4.3 Results pertaining to general questions on the research topic

The interviews were opened by means of questions being discussed pertaining to the general concepts covered by this research report. The researcher did this in order to gain an understanding of the general knowledge and sentiment of each of the candidates to the research topic as a whole.

The questions pertaining to general topics and concepts about the research topic were derived directly from the literature reviewed. The researcher identified key issues and concepts in the literature, and these were summarised in Table 2 of this research report. The results to the questions in the interview schedule are discussed by means of exploring themes which emerge from the results in Chapter 5 of this research report.

The responses to the questions conducted during this section of the interview are discussed individually in sub-sections below.

### 4.3.1 *Conceptual Understanding of Technology*

**Interview Question:** What do you understand about the concept of using technology to gather big data within an organisation?

Table 6 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents displayed an understanding of technology. Furthermore, all respondents welcomed the implementation of technology that would provide benefits for members of the organisation and for the organisation as a whole. Respondents from management typically showed a better understanding of the technology with the exception to the respondent who was a worker from company C.

### 4.3.2 *Perceptions surrounding the implementation*

**Interview Question:** Do you think this technology would be disruptive or beneficial to the organisation?

Table 7 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents welcomed the implementation of the technology on the provision that the implementation was done correctly. All respondents from management indicated that the technology would be disruptive initially; this being the case until the workers understood the technology. All workers welcomed the potential opportunity to learn more about the technology and enhance their skills.

### 4.3.3 *Perceptions surrounding the possible effects on stakeholder rights*

**Interview Question:** Do you believe this technology could benefit the rights of all stakeholders involved?

Table 8 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents welcomed the implementation of the technology and believed that stakeholder rights would benefit. Management respondents believed that the management within the organisation would benefit more from the implementation of the technology, however, the rights of all stakeholders would be enhanced.

### 4.3.4 *Thoughts on the implementation of such technology*

**Interview Question:** Should such technology be implemented within the organisation; what are your thoughts on implementing such technology?

Table 9 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All worker respondents responded that they welcomed the technology on the provision that there were no negative effects. The workers from company B and company C both displayed concern and understanding for the organisation as a whole. The management respondents displayed more concern for the general well-being of the organisation as a whole; they did not, however, dismiss any concern for the workers within the organisation.

### 4.3.5 *Expectations of the technology*

**Interview Question:** Should such technology be implemented within the organisation; do you have any expectations of this technology?

Table 10 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents believed that technology not only would, but also should, show benefits for all stakeholders involved. The worker respondents displayed concern for fellow stakeholders from both a safety and an holistic perspective. Management respondents expected the technology to benefit all stakeholders from a general perspective. Furthermore, the management respondents believed that technology should aid the organisation from productivity, efficiency and problem-solving perspectives.

### 4.3.6 *Concerns about the technology*

**Interview Question:** Should such technology be implemented within the organisation; do you have any concerns about the implementation of technology?

Table 11 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

The worker respondents believed that stakeholder rights and job security were important; the correct implementation of the technology was also stressed. The worker respondents all displayed excitement about the potential benefits that the technology would possibly bring. Management respondents believed that the organisation, as a whole, would benefit the most; thereafter the workers would derive benefit. Management concerns mentioned were those of problems during the initial phases of implementation and the technology becoming a hindrance due to extra processes to be followed.

### 4.3.7 *Conclusion to general questions on the research topic*

All respondents were all aware of technology and how implementing it in various contexts in daily life could result in direct benefits. From a work perspective, all respondents believed the technology would be beneficial; this being with a few

concerns. The concerns illustrated were for the general well-being of workers, their health and safety and for the organisation as a whole. All respondents were aware that the potential benefits of the technology would outweigh any concerns they highlighted. There were no responses which differed significantly from their fellow respondents from either management or worker perspectives. The results are explored further in Chapter 5 through the identification and analysis of common themes which are derived from the respondents' answers.

## 4.4 Results Pertaining to Ethical Issues

***Research Proposition 1:*** The ethical issues that may arise when IIoT is introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

The questions pertaining to research proposition 1 were derived directly from the literature reviewed. The researcher identified key issues and concepts in the literature, and these were summarised in Table 2 of this research report. The results to the questions in the interview schedule are discussed by means of exploring themes which emerge from the results in Chapter 5 of this research report.

The responses to the questions conducted during this section of the interview are discussed individually in sub-sections below.

### 4.4.1 *Sentiment*

**Interview Question:** Would you consider this technology to be feared or welcomed within the organisation?

Table 12 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents, in spite of having various concerns, welcomed the implementation of the technology within the organisation. All worker respondents welcomed the implementation of the technology but hoped that management would consider all stakeholders' best interest. Management respondents believed that workers might initially be concerned regarding the implementation of any technology but would welcome the technology once it was understood and the potential benefits could be seen.

### 4.4.2 *Possible impacts of the technology (obtrusive or non-obtrusive)*

**Interview Question:** Would you consider the implementation of such technology to be obtrusive or non-obtrusive?

Table 13 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents believed that the implementation of the technology should not and would not necessarily be obtrusive to individuals or the organisation as a whole on the provision that the implementation is planned and managed correctly. No respondents displayed concern or belief that the technology would be obtrusive to stakeholders.

### 4.4.3 *Management-Labour relationship effects*

**Interview Question:** Do you think the implementation of such technology could enhance the relationship between management and labour within the organisation?

Table 14 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents believed that the implementation of the technology would enhance the management-labour relationship within the organisation. None of

the respondents were concerned with the technology having any negative effect on the management-labour relationship.

### 4.4.4 *Perceived risk of Automation*

**Interview Question:** Do you think the implementation of technology could undermine human autonomy within the organisation?

Table 15 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents did not believe that workers would be replaced by the implementation of technology to automate manufacturing. While some respondents acknowledged that some tasks and jobs could be automated; all believed that technology would never be able to replace human beings fully. Company C's worker respondent highlighted that even though some jobs would become redundant; this would open up opportunities for workers to gain skills and do other tasks within the organisation.

### 4.4.5 *Effects on organisational performance*

**Interview Question:** Do you think technology could be implemented to assist and enhance performance within the organisation?

Table 16 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents believed that the implementation of the technology would have positive effects on the performance of the organisation.

### 4.4.6 *Advantages of implementation of the technology*

**Interview Question:** What do you think the advantages are of implementing this technology within the organisation?

Table 17 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents believed that technology would benefit both the workers and/or the organization, as a whole. All worker respondents believed that it would assist them in their daily lives and in some cases would benefit the organisation from a productivity and efficiency perspective, too. All management respondents believed that the implementation of the technology would benefit the organisational performance and therefore the workers, too.

### 4.4.7 *Disadvantages of implementation of the technology*

**Interview Question:** What do you think the disadvantages are of implementing this technology within the organisation?

Table 18 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

Worker respondents, with the exception of company A's worker, are concerned about their fellow workers' job security. Company C's respondent, however, although concerned with fellow workers jobs, believed that opportunities for workers to gain new skills would be possible. All management respondents displayed concern over the implementation of the technology. Concerns varied from information not being shared across the organisation to the risk of the organisation becoming too reliant on the technology, should it fail.

### 4.4.8 *Pre-implementation considerations*

**Interview Question:** What considerations do you think should be taken into account should such technology be implemented within the organisation?

Table 19 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents had considerations which they believed should be addressed prior to the technology being implemented. The responses all inferred an holistic approach to the implementation of the technology; this being the consideration of all stakeholders and the organisation as a whole.

### 4.4.9 *Conclusion of results pertaining to Ethical Issues*

All respondents believed the technology would be beneficial to stakeholders and the organisation as a whole. The respondents were aligned in their responses, although the context from which they were responding may have differed. There were no responses which differed significantly from their fellow respondents from either management or worker perspectives. The results are explored further in Chapter 5 through the identification and analysis of common themes which were derived from the respondent's answers.

## 4.5 Results pertaining to Governance Issues

***Research Proposition 2:*** The governance issues that may arise when IIoT is introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

The questions pertaining to research proposition 2 were derived directly from the literature reviewed. The researcher identified key issues and concepts in the literature, and these were summarised in Table 2 of this research report. The results to the questions in the interview schedule are discussed by means of exploring themes which emerge from the results in Chapter 5 of this research report.

The responses to the questions conducted during this section of the interview are discussed individually in sub-sections below.

### 4.5.1 *Stakeholder Transparency*

**Interview Question:** Do you think that transparency between all involved stakeholders is important when implementing such technology within the organisation?

Table 20 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

While some respondents believed that transparency was only possible to a point; all respondents believed transparency was important. Furthermore, all respondents viewed transparency as a tool to ensure that all stakeholders could be aligned with the implementation and use of technology.

### 4.5.2 *Stakeholder Partnership*

**Interview Question:** Do you think it is possible for an “invisible partnership” to exist between all stakeholders involved when implementing technology such as this within the organisation?

Table 21 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

While all worker respondents welcomed the concept and possibility of an invisible partnership between management and labour within the organisation; the majority of worker respondents did not feel that a partnership was present at this point. Conversely, all management respondents welcomed the possibility of an invisible partnership existing between management and labour within the organisation. Only one management respondent believed that an invisible partnership already existed within the organisation.

### 4.5.3 *Stakeholder Input*

**Interview Question:** What level of input do you think all stakeholders within the organisation should have when implementing such technology?

Table 22 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents believed that all stakeholders involved should have input into the planning and implementation of the technology. All worker respondents wished to have a reasonable level of input into planning and implementation. All management respondents welcomed the input of worker input into the planning and implementation of the technology; however, the majority of worker respondents believed that worker input should be considered to a reasonable level and on the provision that any input was reasonable and justifiable. Conversely, worker respondents did not indicate that they considered the reverse of management.

### 4.5.4 *Stakeholder Accountability*

**Interview Question:** Do you think various stakeholders should be held accountable from any situations, should they arise, from the information or knowledge derived from implementing such technology?

Table 23 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

All respondents believed that both management and workers within the organisation should be held accountable for anything that may be highlighted by the technology. The majority of respondents believed that the technology while holding stakeholders accountable, should be used to learn from and make improvements to operations as a whole.

### 4.5.5 *Conclusion of results pertaining to Governance Issues*

All respondents displayed an understanding of the context within which the technology was being implemented. Governance considerations were of importance to all respondents. The respondents were aligned in their responses; although the context from which they were responding may have differed. There were no responses which differed significantly from their fellow respondents from either management or worker perspectives. The results are explored further in Chapter 5 through the identification and analysis of common themes which are derived from the respondent's answers.

## 4.6 Results pertaining to Sustainability Issues

***Research Proposition 3:*** The sustainability issues that may arise when IIoT is introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

The questions pertaining to research proposition 3 were derived directly from the literature reviewed. The researcher identified key issues and concepts in the literature, and these were summarised in Table 2 of this research report. The results to the questions in the interview schedule are discussed by means of exploring themes which emerge from the results in Chapter 5 of this research report.

The responses to the questions conducted during this section of the interview are discussed individually in sub-sections below.

### 4.6.1 *Manufactured Capital*

**Interview Question:** What advantages/disadvantages do you think the implementation of this technology could have on the organisations as a whole?

Table 24 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

None of the respondents was aware of what manufactured capital was. However, once the concept was explained to the respondents, all respondents welcomed the technology and the benefits that the organisation can derive from the implementation of it.

Company B's manager displayed concern that workers may assume that automation is taking place in the organisation; thus, job losses would be perceived to be imminent. He did, however, go on to share the welcoming thought that implementing the technology may have on the productivity and efficiency of the organisation. All respondents displayed awareness that the well-being of the workers is mutually dependent on the well-being of the organisation; the same applies to the reverse of that relationship.

### 4.6.2 *Natural Capital*

**Interview Question:** What advantages/disadvantages do you think the implementation of this technology could have on the organisation's impact on things such as the environment and natural resources?

Table 25 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

None of the respondents was aware of what natural capital was. However, once the concept was explained to the respondents, all respondents welcomed the technology and the benefits that the environment can derive from the implementation of it.

While some respondents, namely company A's management respondent and company C's worker respondent, displayed an initial lack of concern for the changes that the technology could make to the environment, when probed further, these respondents indicated that the reason for this was because they

believed that their respective organisation was already operating with a minimal impact on the environment due to previous projects. All respondents believed that protecting the environment and minimising the environmental impact of their organisation was important.

### 4.6.3 *Human Capital*

**Interview Question:** What advantages/disadvantages do you think the implementation of this technology could have on the organisation's impact on things such as the safety, health and well-being of staff within the organisation?

Table 26 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

None of the respondents was aware of what human capital was. However, once the concept was explained to the respondents, all respondents welcomed the technology and the benefits that the management and workers could derive from the implementation of it.

All respondents welcomed the improvements that could be made to the safety and well-being of management and workers within the organisation. While the management respondent from Company C displayed frustration with previous happenings with safety inspectors, when asked to elaborate, the respondent indicated that this was due to experiences with safety inspectors which resulted in minimal or no change to the safety of the workers.

### 4.6.4 *Social Capital*

**Interview Question:** What advantages/disadvantages do you think the implementation of this technology could have on the organisation’s social role with people both internal and external to the organisation?

Table 27 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

None of the respondents was aware of what social capital was. However, once the concept was explained to the respondents, all respondents welcomed the technology and the benefits that the social community could derive from the implementation of it.

The majority of the worker respondents displayed a limited understanding of the social capital aspects of the organisation, and how this affects the community at large. Company C's worker respondent displayed an in-depth awareness of the organisation's potential with regards to making positive changes to the community within which the organisation operates. Management respondents, with the exception of the manager from Company A, displayed an awareness for the organisation operating within a broader community and that positive effects could be afforded to the community as a whole from changes made by the organisation.

### 4.6.5 *Financial Capital*

**Interview Question:** What advantages/disadvantages do you think the implementation of this technology could have on the organisation's impact on things such as the productivity and efficiency of the organisation?

Table 28 shows a summary of the interview responses to the interview question by the various respondents across the three companies. Where possible, respondents were requested to elaborate on their answers.

None of the respondents was aware of what financial capital was. However, once the concept was explained to the respondents, all respondents welcomed the technology and the benefits that the organisation could derive from a financial perspective from the implementation of the technology.

All respondents welcomed the potential changes that the implementation of the technology could have on the financial capital of the organisation. Furthermore, all respondents believed that the well-being of the organisation would directly influence their own well-being and benefits in the future.

### 4.6.6 *Conclusion of results pertaining to Sustainability Issues*

All respondents displayed an understanding of the context within which the technology was being implemented. Sustainability considerations were of importance to all respondents. The respondents were aligned in their responses; although the context from which they were responding may have differed. There were no responses which differed significantly from their fellow respondents from either management or worker perspectives. The results are explored further in Chapter 5 through the identification and analysis of common themes which are derived from the respondent's answers.

## 4.7 Summary of the results

The results of the findings above are broadly and briefly summarised in this section. The results are explored and used further against the literature review in Chapter 5.

All respondents displayed an understanding of both the technology and the potential benefits for both the stakeholders involved, and the organisation as a whole. Importantly, any concerns that various respondents had were reasonable concerns for the greater well-being of fellow workers and management within their respective organisations.

Respondents from both management and worker perspectives all displayed a welcoming approach to the implementation of the technology. In addition, none of the respondents displayed an entrenched viewpoint and always considered their fellow workers and management.

While in some cases, governance perspectives, for example, respondents were not aware of the broader context of each of the capitals in the five capitals model. However, once a brief description was provided, each of the respondents displayed an understanding and concern for each of the five capitals. Furthermore, the respondents understood the potential benefits and welcomed them.

It is important to note, that while each of the respondent types had different rationale and approaches to their answers, each of the respondents displayed a willingness to be transparent and express their thoughts and concerns with the various stakeholders. Furthermore, each respondent was not only aware of but also considered, the broader context of the organisational well-being as a whole.

Each of the research propositions is explored in detail in Chapter 5.

# CHAPTER 5. DISCUSSION OF THE RESULTS

## 5.1 Introduction

In this chapter, the results presented in the previous chapter are explored through identifying and exploring themes which emerged during the various interviews. The identified themes are discussed and explained with reference to the literature review conducted. The general questions and topics are discussed first in order to understand the context within which the respondents are working and the sentiment of the respondents to the broader research topic. This is followed by the discussion and analysis of the results pertaining to each one of the research propositions.

## 5.2 Philosophical Approach

All research, both qualitative or quantitative, has underlying assumptions as to what is considered to be valid research and which research methods are appropriate (Myers, 1997). For the purpose of this research report, the researcher acknowledged that an interpretive philosophical approach to the research was to be practised. Interpretive researchers assume that access to reality is obtained and defined by constructs such as language, consciousness and shared meanings (Myers, 1997).

In light of the research methodology, research instrument and thematic analysis being chosen; an interpretive approach was the philosophical approach deemed to be the most applicable approach to be adopted by the researcher. An interpretive study of qualitative data attempts to understand phenomena through the meaning which interviewees place on them (Myers, 1997). The aforementioned details, in addition to the nature of the research methodology and instrument, provided the synergy required for the research to be conducted. Furthermore, it is important to note that prior to the gathering, analysis or coding of data, the researcher evaluated, identified and acknowledged an acceptable philosophical approach to the research being conducted.

## 5.3 Thematic Analysis

An inductive approach to the analysis and coding the qualitative data which had been collected was chosen. The primary purpose of this approach is to allow the researcher to allow findings to emerge from the data via frequent, dominant or significant themes (Thomas, 2006). This approach was chosen due to qualitative research basing its concern more on words rather than on numbers (Bryman, 2015). In addition, qualitative research methods focus on observations of an interviewee and the words used in order to attempt to understand and express reality as perceived by the interviewee (Amaratunga et al., 2002).

As described in Chapter 3, qualitative data was collected through the researcher conducting semi-structured interviews with respondents. The interviews conducted with each of the respondents were, with permission, recorded for reference purposes. Summarised transcripts of each of the interviews were collated into a single document for analysis and coding by the researcher. Thereafter, responses were inductively analysed to identify dominant themes. This enabled the researcher to map themes which had been identified back to individual responses given to each of the interview questions.

A total of six themes were identified and are introduced individually in order of most prevalent to least prevalent; thereafter the applicable themes are ranked and referenced to during the discussions pertaining to general concepts on the research topic and each of the research propositions later in this chapter. Table 29 shows the frequency of each of the dominant themes.

**Table 6 – Overall ranking of themes identified through inductive coding**

| Theme | Frequency in responses |
|---|---|
| Well-being | 70 |
| Trust | 52 |

| | |
|---|---|
| Performance | 45 |
| Inclusion | 39 |
| Planning | 22 |
| Partnership | 21 |

Thereafter, key concepts which were identified in the literature review of this research report are discussed and reviewed in accordance with the frequency of the themes which have been identified. The key concepts pertaining to general discussion as well as each of the three research propositions are listed in Table 2, included in the literature review portion of this research report.

### 5.3.1 *Well-being*

Well-being was identified as the most significant factor to each of the respondents; each of the six respondents referred to well-being during their interviews. Furthermore, the well-being of both workers, management, staff (collective) within the organisation, the organisation itself and the community as a whole, was referred to by respondents during the interviews. Whilst each of these was not mentioned by each of the respondents, the overarching concept of well-being was referred to multiple times by each of the respondents during their interviews. When commenting on well-being from the perspective of workers, management and the collective staff of the organisation; the respondents spoke from the perspective of job security, safe working conditions, as well as the potential self-improvement from a skills perspective for both themselves and their colleagues. From an organisational well-being perspective, respondents described how any improvements to organisational performance realised from the implementation of technology would result in the organisation being able to

be more competitive within the market and therefore have more secure financial stability and growth.

### 5.3.2 *Trust*

Trust was identified as one of the most significant factors for respondents; each of the six respondents referred to trust during their interviews. It is important to note that respondents spoke of both the technology and the relationship between management and workers within the organisation when the concept of trust was directly or indirectly inferred. Furthermore, it is important to note that trust was inferred in both positive and negative lights, regarding both the technology and the relationship between management and workers. Each respondent displayed trust that the implementation of technology would result in improvements for staff and the organisation as a whole. From a technological trust perspective, respondents trusted that the technology would result in a nett improvement for all involved. Management respondents from both Company A and Company B did, however, comment that becoming too reliant on technology could pose potential risks for all stakeholders should the technology fail.

### 5.3.3 *Performance*

Performance was also identified as a significant factor for each of the six respondents. When referring to performance, respondents identified both the individual performance of workers or management as well as organisational performance as a whole. Furthermore, it was widely acknowledged that performance had a direct effect on the well-being of both the individual and the organisation as a whole.

### 5.3.4 *Inclusion*

Inclusion was identified as another important factor for each of the six respondents. The concept was referred to in the context of stakeholder inclusion during discussions pertaining to the implementation of the technology as well as stakeholder inclusion during any planning regarding the management or

implementation of the technology. As a concept, inclusion was regarded as an important contributing factor to both trust and partnership for stakeholders.

### 5.3.5 *Planning*

Planning was referred to by each respondent with the exception of company A's worker respondent. When referring to planning, respondents did so in the context of the importance of sufficient planning taking place prior to the implementation of the technology within the organisation. The respondents considered the concept of importance due to the possible negative effects which implementing the technology in the incorrect way could have on both stakeholders and the organisation as a whole.

### 5.3.6 *Partnership*

Partnership was an important factor for both worker and management respondents; with each of the six respondents referring to the theme. Furthermore, it is important to note the concept of a partnership existing between management and the workers were inferred in both positive and negative lights. In addition, the concept of a partnership was inferred in a non-formal light; that is, workers and managers were not referring to a legal partnership but rather the hope that an "invisible partnership" would be possible; an "invisible partnership" as referred to in the literature review of this report.

## 5.4 Discussion pertaining to general questions on the research topic

In order to gain an understanding of each of the respondents' understanding and sentiment towards the implementation of technology, interviews were opened with questions pertaining to general concepts regarding the technology. This was done in order to ascertain what level of understanding the respondents had on the research topic. In order to gain an overview of which themes were of the most

importance to the respondents, the responses to each of the interview question were coded, and dominant themes were identified where possible. The frequency of each of the dominant themes across this section of the interview is shown in Table 30.

**Table 7 - Ranking of themes identified through inductive coding of general questions on the research topic**

| Theme | Frequency in responses |
|---|---|
| Well-being | 21 |
| Trust | 12 |
| Inclusion | 10 |
| Performance | 8 |
| Planning | 7 |
| Partnership | 5 |

The most significant factor to each of the respondents, when questioned regarding the research topic in general, was the well-being of the organisation's staff as a whole; this is inclusive of both workers and management. It is important to note that the well-being of the organisation, as a whole, was also of importance to each of the respondents.

Thereafter, the themes of trust and inclusion were further dominant themes with each of the respondents who were interviewed; the frequency of each being comparable to that of the other. It is important to note that each of the remaining

three themes, which were identified during the interviews, were also identified in the responses gathered during each of the interviews.

The discussion surrounding general questions regarding the implementation of technology to gather big data was centred around key concepts identified in the literature review of this research report. Each of these key concepts is discussed below.

### 5.4.1 *Understanding the technology*

Respondents were asked to comment on their understanding of the concept of using technology to gather big data within their organisation. While none of the respondents had knowledge of the concept of big data; each of the respondents had knowledge of the concept of technology in general. Furthermore, each of the respondents did not react negatively to technology being implemented within their organisation in order to gather big data. It is important to note these responses were consistent across both worker and management respondents. Themes identified in the responses were those of trust for technology, organisational performance and the well-being of both the organisation and its staff.

The primary goal for the realising of the Internet of Things is the goal of situational awareness in such a way that humans and machines fully understand each other and their surrounding environments (Barnaghi et al., 2012). Whilst the responses do not build on this concept, respondents did display a broad understanding of technology and its potential benefits within their respective working environments. Furthermore, any implantation of technology within the organisation which enhances the well-being of the organisation and its staff would be welcomed by the stakeholders involved.

### 5.4.2 *Potential impacts of the technology*

The realising of the Internet of Things is the goal of situational awareness in such a way that humans and machines fully understand each other and their surrounding environments (Jun et al., 2011). When considering the potential impacts of the implementation of technology, respondents were asked to discuss

whether they believed the technology would be disruptive or beneficial to the organisation.

Each of the respondents welcomed technology and believed it would be beneficial to the organisation. All respondents displayed trust in technology; the majority of respondents referring directly to trusting the technology. Thereafter respondents believed that sufficient planning would need to take place prior to the implementation of any technology within the organisation. The manager from Company C displayed concern for the lack of a partnership between stakeholders within his organisation. When probed for further details, the respondent indicated that this was the sentiment from previous technology being implemented within the management context of the organisation. The respondent did, however, welcome the potential benefits that the technology could provide. Thereafter, respondents indicated that the well-being of both the organisation and its staff were of importance.

In conclusion, when considering the potential disruption that could take place within the organisation from the implementation of the technology. It is important to note that none of the respondents displayed concern or belief that the technology would be disruptive. Management respondents did, however, believe that the technology had the potential of being disruptive initially. However, each management respondent believed that this could be resolved through sufficient planning and communication during the initial period of adoption of the technology.

It is important to note that while the respondents did not fully understand the technology as a whole, as described in the previous section, the respondents believed that technology would be beneficial to the organisation. Therefore, the responses can be considered to be in support in the realising of the Internet of Things and its goal of gaining situational awareness in such a way that humans and machines fully understand each other and their surrounding environments (Jun et al., 2011).

### 5.4.3 *Stakeholder partnership*

The balance of discussion regarding general concepts regarding the research topic was done in order to determine the possibility of a healthy partnership between stakeholders, either already existing, or having the potential of existing within the organisation.

Fisher and Ury identified that the following four conditions (Hamann et al., 2008), which will form, although indirectly, healthy partnerships between key stakeholders. While it is not important for each of the four conditions to be present, it is important that each is considered and explored in order to determine the health of the stakeholder partnership. Each of these four conditions is, therefore, discussed.

1. ***Balancing power*** – Respondents did not display consideration for the balancing of power amongst stakeholders. However, the well-being of all stakeholders was highlighted by the majority of respondents with planning and inclusion being mentioned.
2. ***Acknowledgement of Critical Rights*** – Respondents believed that the implementation of technology would benefit the rights of all stakeholders involved. Furthermore, the majority of respondents highlighted the importance of the well-being of all stakeholders involved as well as that of the organisation. Respondents displayed no lack of trust in the technology and the need for planning prior to implementation was highlighted.
3. ***Negotiate both converging and conflicting interests*** – The majority of respondents highlighted the importance of the well-being of all stakeholders involved, as well as that of the organisation.
4. ***Manage relations with stakeholders*** – Respondents did not show awareness or concern regarding the relations between stakeholders. It is important to note that the concern of respondents for the well-being of stakeholders and the organisation of a whole implies that relations between stakeholders are favourable and management thereof should be easy in the future.

As previously mentioned, Table 30 highlights the frequency of themes identified in the responses gathered during the interviews with the various respondents.

The dominant themes of well-being, trust and inclusion were highlighted most in the responses pertaining to the questions regarding the evaluation of the stakeholder partnerships. When commenting on well-being, respondents consistently highlighted its importance; especially with regards to the staff within the organisation. The respondents displayed trust in the technology and its implementation within the organisation. However, inclusion was an important theme identified in the responses captured. The respondents displayed the sentiment that inclusion in the planning and implementation of technology within the organisation would be necessary.

It can, therefore, be concluded, that while the presence of a strong partnership between stakeholders may not be evident at present, there most certainly exists the potential for one to exist.

### 5.4.4 *Conclusion to discussion pertaining to general questions on the research topic*

The respondents displayed sufficient understanding of the potential benefits that the implementation of technology could have on both the organisation and those who work within it. Furthermore, respondents displayed trust in technology. Those respondents who did not refer directly to the theme of trust did not respond negatively regarding trusting the technology. The possibility of a healthy stakeholder relationship further enhances the possibility of successful implementation of the technology. The responses above both build on and are in support of concepts identified in the literature review of this research report.

## 5.5 Discussion Pertaining to Ethical Issues

**Research Proposition 1:** The ethical issues that may arise when IIoT is introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

With an estimation of over 75 billion objects being connected via this technology by the year 2020 (Popescul & Georgescu, 2014), therefore the identification of ethical risks and guidelines to curb these, should be of critical importance. Unfortunately, current policies and research programmes are simply too slow and too instrumental to manage the current challenges being identified (Popescul & Georgescu, 2014). The collection and analysis of the data regarding this research proposition aim to identify potential ethical risks and considerations prior to potential problems occurring when implementing the technology.

When considering ethical considerations surrounding IoT and big data, it is important that there was an acknowledgement that ethical standards are likely to differ when it comes to the implementation of IoT to collect Big Data in industrial vs societal contexts (Weber, 2013). It is in this light that a broad approach was taken when discussing the topic with respondents.

In order to gain an overview of which themes were of the most importance to the respondents from an ethics perspective, the responses to each of the interview question were coded, and dominant themes were identified where possible. The frequency of each of the dominant themes across this section of the interview is shown in Table 31.

**Table 8 - Ranking of themes identified through inductive coding of responses relating to research proposition 1**

| Theme | Frequency in responses |
|---|---|
| Trust | 25 |
| Performance | 21 |
| Well-being | 18 |
| Inclusion | 8 |

| | |
|---|---|
| Partnership | 7 |
| Planning | 6 |

The most significant factor to each of the respondents, when questioned regarding research proposition 1, was that of trust; this including both trust in the technology and the benefits that it could potentially provide as well as the trust within the management-worker relationship. It is important to note that overwhelming mention of trust was in the trust of the technology as a whole; thereafter trust within the management-worker relationship was also of importance to each of the respondents.

Thereafter, the themes of performance (organisational) and well-being of workers were further dominant themes with each of the respondents who were interviewed; the frequency of each being comparable to that of the other. It is important to note that each of the remaining three themes, which were identified during the interviews, were also identified in the responses gathered during each of the interviews.

The discussion surrounding ethical considerations regarding the implementation of technology to gather big data was centred around key concepts identified in the literature review of this research report. Each of these key concepts is discussed below.

### 5.5.1 *Stakeholder sentiment*

The sentiment of stakeholders towards the implementation of technology was evaluated from the perspective of sentiment, that is, respondents were questioned as to whether the technology would be feared or welcomed by both themselves and their fellow staff members.

Each respondent welcomed the technology being implemented within their organisation. However, it is important to note that while the technology was

overwhelmingly welcomed, there were points of concern indicated by various respondents. For example, with the exception of the management respondent from Company C, the majority of management respondents believed that workers would initially be cautious towards the implementation of the technology and may fear it to a certain degree. However, these respondents added that the process of implementation, if managed carefully, would address worker concerns and result in a positive sentiment from workers.

Worker respondents welcomed the potential for learning and self-improvement within their jobs. Any caution displayed by these respondents was secondary to their welcoming of the potential benefits that could be realised as a result of the implementation technology.

In conclusion, and as discussed in the literature review, methodical research is required on interventions required to prevent IoT from being perceived and feared as on intrusive Big Brother (Popescul & Georgescu, 2014). When considering the respondents' sentiment with the presence of each of the dominant themes identified, the researcher concluded that the data is therefore in support of this.

### 5.5.2 *Perceived impact of technology*

The perceived impact of technology within the work environment of the respondents was evaluated from the perspective of whether the technology would be perceived to be obtrusive or non-obtrusive. That is, would the technology be noticeable in such a way that would be unwelcome or intrusive to the respondents.

The majority of respondents, with the exception of those from Company C, welcomed the implementation and displayed trust in the technology and that benefits would be derived therefrom. The respondents from Company C welcomed the technology but did so from perspectives other than on trusting the technology. While the worker respondent from this company displayed no lack of trust in the technology, he rather highlighted the potential benefits to the worker and organisational performance and therefore the well-being of his fellow workers. Furthermore, the potential personal and professional growth was

highlighted as the perceived impact as the result of the implementation of technology. The management respondent, however, welcomed the implementation of technology, but displayed a lack of trust in the broader concept of technology as a whole. When asked to elaborate, the respondent indicated that this was the result of previous technological implementations within the management office not being successful. The respondent did, however, acknowledge the technology being used in the big data concept would be welcomed if it benefited all stakeholders involved.

### 5.5.3 *Effects on trust*

The perceived impact of trust in the management-worker relationship within the organisation was evaluated by asking respondents to comment directly on what they believed would be the nett effect on trust following the implementation of technology. All respondents responded favourably with some concerns being highlighted by both management and worker respondents. The concerns highlighted were that sufficient planning needs to take place prior to any implementation of technology.

Worker respondents displayed trust in their management counterparts but highlighted that being included in the planning was desirable, and implied to a certain extent, in the decision-making process too. It is important to highlight that trust was the dominant theme which was identified in all of the questions pertaining to research proposition 1. When one considers that this research proposition centres around ethics, the responses gathered indicate there was support for positive effects on the management-worker relationship from a trust perspective.

### 5.5.4 *Human autonomy*

The perceived risk of human autonomy being undermined was evaluated by asking respondents to comment directly on whether they believed that human autonomy was at risk with the implementation of technology. That is, respondents were asked to discuss their perceptions regarding automation in their workplace.

The traditional look into the ethical considerations surrounding knowledge production using both Big Data and IoT, tend to overlook how human autonomy risks being undermined by the growth of scientific knowledge (Schroeder & Cowls, 2014). This is a considerable area of concern considering that the issue of ethics has been addressed at a comparatively late stage in its conceptual evolution (Weber, 2013). While some management respondents welcomed the possibility of automation to an extent into the future; management respondents, with the exception of Company C's management respondent, acknowledged although there would be benefits to automation in the area of organisational performance; these respondents also acknowledged that it is impossible to replace workers in the manufacturing context completely. When asked to elaborate, these management respondents acknowledged that there will always be a need for workers who have a trained eye; these workers would detect what technology would not be able to. The worker respondents all welcomed the implementation of technology with the caveat that there were no job losses for workers. It is important to note that worker respondents, in general, welcomed the implementation of the technology and were welcoming of skills which would be learnt as a direct benefit thereof.

Importantly, as with the effects on trust, the dominant theme in the responses from both a worker and management perspective was that of trust. The responses are in support of the implementation of technology. There was clear evidence that risks to human autonomy are not being overlooked by either management or worker respondents.

### 5.5.5 *Consideration of stakeholders*

The perception of respondents regarding the consideration of stakeholders was evaluated by examining responses across various topics discussed within the interview of each respondent. That is, respondents were observed to identify which stakeholders were considered and commented on.

It is important to consider all parties involved in order to make sure that ethical considerations are done in a manner which considers all parties involved (R. Weber et al., 2013). The observations regarding the consideration of respondents

to various stakeholders were inclusive. This conclusion was derived due to inclusion being identified as a dominant theme across all responses gathered during interviews. Furthermore, both management and worker respondents acknowledged that sufficient planning would need to take place and that all stakeholders should play a part in that process.

### 5.5.6 *Awareness of potential ethical problems*

The perception of respondents regarding the consideration of characteristics of the technology which could potentially cause ethical problems were evaluated by examining responses across various topics discussed within the interview of each respondent, that is, respondents were observed to identify if any the potential causes of ethical problems, as identified in the literature review, were identified or discussed.

The characteristics identified in the literature review were taken from a 2013 report from the European Commission (R. Weber et al., 2013) that the characteristics of IoT could possibly cause ethical problems. These characteristics are discussed below.

- ***Ubiquity, omnipresence*** – it was found that no respondents, management or worker, were aware of or concerned about ubiquity or omnipresence of the technology either directly or indirectly in their responses.
- ***Miniaturisation, invisibility*** – it was found that no respondents, management or worker, were aware of or concerned about miniaturisation or invisibility of the technology either directly or indirectly in their responses.
- ***Ambiguity*** – it was found that no respondents, management or worker, were aware of or concerned about ambiguity regarding the technology either directly or indirectly in their responses.
- ***Ultra-connectivity*** – it was found that no respondents, management or worker, were aware of or concerned about ultra-connectivity regarding the technology either directly or indirectly in their responses.
- ***Autonomous and unpredictable behaviour*** – respondents displayed concern regarding potential job losses which could occur due to the

implementation of technology. However, all respondents, as previously discussed, commented that there will always be a need for human intervention. Furthermore, some respondents identified that over-reliance and failure of the technology, which was interpreted in this case as the technology potentially being unpredictable, could result in risk to both operations and organisational performance.

### 5.5.7 *Conclusion to discussion pertaining to Ethical Issues*

In conclusion, respondents displayed a healthy awareness of the potential impacts of implementing the technology. While there were elements of concern regarding an over-reliance in technology and the potential risks thereof, it is important to note that the themes of trust (in both technology and within the management-worker relationship), organisational performance and the well-being of both the organisation and all who work therein were of importance to each of the respondents.

While respondents did not directly identify characteristics of the technology that would potentially cause ethical issues, there was sufficient awareness and acknowledgement of risks. Furthermore, respondents were accepting of the technology being used within their working environment. There was no identified risks or negative effects to the labour relations within the organisation and management showed no indication of abdication of responsibility to issues which may arise due to the implementation of technology.

Furthermore, there is insufficient evidence to identify clear ethical issues which may arise. In addition, the collective responses and themes identified therein appear to be in support of a healthy management-worker relationship within the organisation. It is also important to note that no evidence or sentiment was displayed to highlight any abdication of management responsibility pertaining to concepts discussed in research proposition 1.

## 5.6 Discussion pertaining to Governance Issues

**Research Proposition 2:** The governance issues that may arise when IIoT is introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

As discussed in the literature review of this research report, governance has come to the forefront of discussions regarding IoT at a comparatively late stage (Weber, 2013), it becomes incredibly clear that a well-defined system for the governance of these devices has not come into being as yet. The collection and analysis of the data regarding this research proposition aim to identify potential governance risks and considerations prior to potential problems occurring when implementing the technology.

In order to gain an overview of which themes were of the most importance to the respondents from a governance perspective, the responses to each of the interview question were coded, and dominant themes were identified where possible. The frequency of each of the dominant themes across this section of the interview is shown in Table 32.

**Table 9 - Ranking of themes identified through inductive coding of responses relating to research proposition 2**

| Theme | Frequency in responses |
|---|---|
| Inclusion | 17 |
| Well-being | 8 |
| Partnership | 7 |
| Performance | 7 |

| | |
|---|---|
| Planning | 7 |
| Trust | 4 |

The most significant factor to each of the respondents, when questioned regarding research proposition 2, was that of inclusion. Worker respondents displayed a willingness to be involved in both the planning and implementation of technology; furthermore, worker respondents displayed an element of hoping for such inclusion to take place. Management respondents displayed a willingness to include workers wherever possible during the planning and implementation of technology. Respondents believed this to be of importance in order for all stakeholders to be on the same page regarding the technology within the organisation.

Thereafter, the balance of the dominant themes was evenly distributed; displaying that while inclusion was the dominant theme, all other themes were of considerable importance to the respondents too.

The discussion surrounding governance considerations regarding the implementation of technology to gather big data was centred around key concepts identified in the literature review of this research report. Each of these key concepts are discussed below.

### 5.6.1 *Applicable principles in stakeholder conduct*

As previously discussed in the literature review, a list of principles has been identified to assist in the analysis of stakeholder conduct.

The principles which have been identified are as follows (Weber, 2013):

- ***Legitimacy and representation*** – both worker and management respondents displayed no sentiment to lead the researcher to believe that any technology implemented would operate illegitimately or not conform with

current laws. When considering the sentiment of respondents regarding the technology, one could safely assume that the best interest of all stakeholders would be of paramount importance.

- ***Transparency*** – while transparency was indicated to be of importance to all respondents; it is important to note that all respondents, worker and management respondents alike, welcomed transparency being present between all stakeholders. Furthermore, the majority of management respondents identified the need for a staged input of the technology, coupled with the involvement of key workers. Transparency would be the conduit to ensure that these key resources understood and communicated the potential benefits to their fellow workers. Most important to note is that multiple respondents, from both management and workers alike, indicated that the use of big data within the organisation should first and foremost be used with the aim of improving worker performance and experience. The use of big data in a negative light, such as disciplinary action, should be a last resort for management.
- **Accountability** – adequate accountability would enable stakeholders to make decisions (such as sanctioning); providing the aforementioned transparency is in effect. Accountability was considered to be important for all respondents who were interviewed. It is important to note that each respondent further justified their response with the underlying theme of organisational and personal performance within the organisation. The reason for this is that accountability would lead to management and workers being held accountable for their work and general conduct. The direct benefit derived would be a positive change to organisational performance. The worker respondent from Company C indicated that the reason for accountability being of paramount importance was to provide stakeholders with the ability to improve themselves; this includes both workers and management alike. From a management perspective, the sentiment was displayed that accountability would assist management to identify and resolve operational issues which may occur. Most importantly, this was not to be done with the intent of disciplinary action, but rather as a vehicle to resolve problems more rapidly and potentially have a positive effect on the organisational performance.

When considering the results pertaining to the principles discussed above, stakeholder conduct would appear to be healthy regarding processes of planning and implementation of technology within their organisation. Furthermore, this would most likely result in a healthy management-worker relationship due to the results of the principles discussed above.

### 5.6.2 *The "invisible partnership."*

If one was to be mindful of the balance of power, rights and interests (Hamann et al., 2008); all key stakeholders could be considered to be in an "invisible partnership". While all respondents welcomed the concept of an "invisible partnership" existing between management and workers within the organisation, it is important to note that the sentiment towards the concept differed in nature when comparing management and worker responses.

Fisher and Ury identified four conditions (Hamann et al., 2008), which will form, although indirectly, healthy partnerships between key stakeholders. These four conditions are discussed below.

1. ***Balancing power*** – it was found that all respondents, management or worker, were welcoming of inclusion in both the planning and implementation of the technology, either directly or indirectly in their responses. No respondents displayed any negative sentiments or implied being entrenched. This would most likely ensure that the final result would be an implementation of technology which would most likely benefit all stakeholders.
2. ***Acknowledgement of Critical Rights*** – it was found that all respondents, management or workers, acknowledged both stakeholder rights and well-being as a direct benefit thereof, either directly or indirectly in their responses.
3. ***Negotiate both converging and conflicting interests*** – when considering that the dominant theme which was identified during respondent discussions, it was found that all respondents, management

or worker, acknowledged both stakeholder rights and well-being as a direct benefit thereof, either directly or indirectly in their responses.

4. ***Manage relations with stakeholders*** – whilst not all respondents responded directly to the management of relations between stakeholders; it is important to note that all management respondents, at some point in their responses, indicated that close management of worker sentiment would need to take place. Worker respondents, with specific mention of the worker respondent from Company C, highlighted the need for adequate communication and inclusion. The direct benefit thereof would be healthier stakeholder relations.

When considering the aforementioned conditions, the respondents were most certainly in support of the presence of such an "invisible partnership" between management and workers.

### 5.6.3 *Negotiation styles*

The perception of respondents regarding the negotiating styles was evaluated by examining responses across various topics discussed within the interview of each respondent. That is, respondents were observed to identify how they would potentially negotiate. When considering the dominant themes regarding research proposition 2 being those of inclusion first and foremost, it would be implied that both management and workers consider the inclusion of all stakeholders of importance, with the subsequent dominant themes being those of well-being, partnership, performance and planning.

As discussed in the literature review, stakeholders involved in such negotiations should not do so from entrenched positions, and that attention should be paid to all underlying interests (Hamann et al., 2008). When considering the dominant themes identified, the responses are believed to be in support of stakeholders most likely not negotiating from entrenched positions.

### 5.6.4 *Conclusion to discussion pertaining to Governance Issues*

In conclusion, from a governance perspective, respondents displayed a healthy sentiment regarding the potential implementation of technology within their workspace. While some concern was displayed regarding the level of input each of the various stakeholders would have, it was evident that all stakeholders were willing to be included in both the planning and implementation of technology. Considering that the dominant theme was that of inclusion of stakeholders in the planning and implantation of the technology; the sentiment is most certainly in support of technology being used within the respective organisations.

While respondents did not directly identify governance issues which could potentially result in problems occurring within the organisation as a direct result of the implementation of technology, there is sufficient evidence that the principles and conditions which would minimise such risks are present. It would, therefore, be safe to assume that should risks, or negative issues arise, there is sufficient intention of involvement and commitment to resolving anything which may arise as a direct result of the implementation of technology.

Furthermore, there is insufficient evidence to identify clear governance issues which may arise. In addition, the collective responses and themes identified therein appear to be in support of a healthy management-worker relationship within the organisation. It is also important to note that no evidence or sentiment was displayed to highlight any abdication of management responsibility pertaining to concepts discussed in research proposition 2.

## 5.7 Discussion pertaining to Sustainability Issues

**Research Proposition 3**: The sustainability issues that may arise when IIoT is introduced into a manufacturing organisation to collect big data are the acceptability of using technology to monitor operational performance, the potential changes in the nature of labour relations between management and employees and the risk of abdication of management responsibility to technology.

Many businesses do not have a meaningful or effective way of understanding the myriad issues which they face these days. These issues continue to grow and become more complex in nature making them incredibly difficult to identify or quantify (*"The Five Capitals Model – a framework for sustainability," 2016)*. As discussed in the literature review of this research report, in the context of this research, sustainability should be viewed and analysed through the lens of what the possible impacts on sustainability would be, should the technology be implemented. It was decided that the most effective way of doing so would be to evaluate the effect that implementing IoT and Big Data collection will have on each one of the five sustainable capitals of the Five Capitals Model. Each of these five sustainable capitals is explored in subsequent sections of this chapter.

In order to gain an overview of which themes were of the most importance to the respondents from a sustainability perspective, the responses to each of the interview question were coded, and dominant themes were identified where possible. The frequency of each of the dominant themes across this section of the interview is shown in Table 33.

**Table 10 - Ranking of themes identified through inductive coding of responses relating to research proposition 3**

| Theme | Frequency in responses |
|---|---|
| Well-being | 23 |
| Trust | 11 |
| Performance | 9 |
| Inclusion | 4 |
| Partnership | 2 |

| | |
|---|---|
| Planning | 2 |

The most significant factor to each of the respondents, when questioned regarding research proposition 3, was the well-being of the organisation's staff as a whole; this is inclusive of both workers and management. It is important to note that the well-being of the organisation as a whole, was also of importance to each of the respondents. When considering that research proposition 3 is centred on the sustainability of not only the organisation as a whole, but also on the well-being of workers within the organisation and the community surrounding the organisation too, this displays support and acknowledgement of the importance of each of the sustainable capitals explored as part of the Five Capitals Model.

Thereafter, the themes of trust and performance were further dominant themes with each of the respondents who were interviewed; the frequency of each being comparable to that of the other. It is important to note that each of the remaining three themes, which were identified during the interviews, were also identified in the responses gathered during each of the interviews.

The discussion surrounding sustainability considerations regarding the implementation of technology to gather big data was centred around key concepts identified in the literature review of this research report. Each of these key concepts is discussed below.

### 5.7.1 *Manufactured capital*

The implementation of technology for the monitoring and reporting of production processes makes it possible for the organisation to make efficient use of all manufactured capital. As a direct result, it is possible for the organisation to be more flexible and innovative and possibly decrease the time it takes to get products to market *("The Five Capitals Model – a framework for sustainability," 2016).* Respondents were questioned on what they believed the advantages and disadvantages of this technology would be within their working environment. The

dominant theme in the responses gathered aligned with the dominant themes of research proposition 3, as a whole. The well-being of both staff within the organisation and the well-being of the organisation as a whole was referred to both directly and indirectly by each of the respondents. Furthermore, there was an indication of trust that the technology would result in positive changes within the work environment for each of the respondents.

Worker respondents welcomed the changes that technology could have on their productivity whilst making their job less challenging where possible. While this approach to the concept risks being myopic; it is possible that the well-being of workers will be changed for the better as a direct result of a more engaging work environment. The worker respondent from Company C further added that workers might be able to benefit directly from a remuneration and bonus perspective; he highlighted that this could be a possibility if workers and managers alike are both looking at the same data and can use it to motivate themselves further.

Management respondents, on average, shared the sentiment of the worker respondents with the exception that management respondents arrived at a similar conclusion but rather approached it more from operational efficiency and performance perspective.

### 5.7.2 *Natural capital*

In the literature review of this research report, it was pointed out that natural capital is most certainly the most important of all the capitals because, without natural capital, the none of the other four capitals are possible *("The Five Capitals Model – a framework for sustainability," 2016).* The implementation of technology makes it possible for companies to monitor and prevent negative effects on natural capital.

The majority of respondents displayed trust in technology that it would have the potential to have positive effects with regards to natural capital, while some respondents, the management respondent from Company A, for example, displayed no concern for the potential benefits. When asked to elaborate, he

indicated that because their manufacturing operation was small in scale, it made it possible for him to manage potential pollution closely without the use of technology. He did, however, welcome technology being used as a tool to assist him in ensuring that the effects to natural capital were minimised. The management respondent from Company B welcomed the potential benefits and further indicated that any negative effects on natural capital which may be highlighted by the technology, would be dealt with. It is important to note that the theme of well-being was a dominant one in the responses associated with natural capital. Respondents were all aware that organisations should minimise or eliminate any negative effects their operations have on the environment.

### 5.7.3 *Human capital*

When one considers that the dominant theme identified in the responses for research proposition 3 was that of staff and organisational well-being, it is feasible to identify human capital as the most important of the five sustainability capitals.

The health of employees can be protected by the monitoring of harmful substances, such as gases, for example. The majority of management respondents highlighted the health and safety of workers in their responses. Again, this links directly to the theme of well-being as a dominant one.

Furthermore, the insights which can be gained from the collection and analysis of Big Data will have substantial benefits to the education and training of labour. The worker respondents from both Company B and Company C highlighted just this. The training and skills development of stakeholders was highlighted as being of importance. The enhancement of human capital relies on the advancement of the people involved in the system *("The Five Capitals Model – a framework for sustainability," 2016).* In addition to this, as previously discussed in this research report, worker respondents highlighted that automation was not a dominant concern for them due to the belief that there will always be a need for a trained human eye in manufacturing operations. Building on this concept, it was highlighted that workers would need to adapt and learn new skills. In addition, the technology could potentially provide manufacturers with a better understanding

of the dynamic production environment which relies so heavily on human capital. The respondent's sentiment was in support of this.

### 5.7.4 *Social capital*

When asked to discuss social capital, all respondents, excepting management respondents from Company A and Company B, believed that any positive changes which could be realised by social capital as a result of technology being implemented would be welcomed. Once again, the well-being of the staff within the organisation, the organisation as a whole and the greater community surrounding the organisation were highlighted. In the industrial context, the implementation of IoT devices to monitor working conditions affect the internal social capital of the organisation. When technology is implemented externally to the organisation, they can facilitate the building of trust and the social licence to operate for the manufacturer. This would essentially reinforce the organisation's social licence to operate within a given community. Respondents, in this case, highlighted job creation and lowered pollution levels as direct benefits to the community surrounding the organisation.

As indicated in the literature review, implementing technology both internally and externally, huge advances can be made to the provision of safe and supportive living and working conditions for those involved; herein lies the benefit to social capital *("The Five Capitals Model – a framework for sustainability," 2016)*. The respondent's sentiment was in support of this.

### 5.7.5 *Financial capital*

When discussing financial capital, respondents once again, mentioned the theme of well-being. When referred to in the financial capital model, the point of reference was for the financial stability of the organisation as a whole. Ultimately, any improvement to the financial capital of the organisation would result in more stability and therefore better job security for both workers and management staff within the organisation.

Trust and performance were the other dominant themes in the responses gathered. When respondents discussed their answers further, the indication was that the implementation of technology would have a net effect which would favour organisational performance. When considering that worker respondents indicated in previous discussion that they trusted the technology would enhance the management-worker relationship, the result of such would be enhanced organisational performance.

The myriad benefits illustrated in the previous four capitals above would collectively lead to the organisation being in a far stronger or stable financial position *("The Five Capitals Model – a framework for sustainability," 2016)*. The responses gathered were in support of this.

### 5.7.6 *Conclusion to discussion pertaining to Sustainability Issues*

In conclusion, from a sustainability perspective, respondents displayed a healthy sentiment regarding the potential implementation of technology within their workplace. The respondents responded positively when asked to comment on each of the sustainability capitals of the Five Capitals Model. Considering that the dominant theme was that of well-being, the sentiment is most certainly in support of technology being used within the respective organisations. Furthermore, when considering the respondents' view on sustainability, there is sufficient evidence to show that technology would be welcomed for the potential benefits to each of the sustainability capitals.

While respondents did not directly identify alternative sustainability issues which could potentially result in problems occurring within the organisation as a direct result of the implementation of technology, there is sufficient evidence that awareness and consideration of the general concept of sustainability is not only present, but also important to the respondents.

Furthermore, there is insufficient evidence to identify clear governance issues which may arise. In addition, the collective responses and themes identified therein appear to be in support of a healthy management-worker relationship within the organisation. It is also important to note that no evidence or sentiment

was displayed to highlight any abdication of management responsibility pertaining to concepts discussed in research proposition 2.

## 5.8 Conclusion

In addition to the conclusions already discussed within this chapter, the responses gathered as well as the dominant themes identified throughout the data are either in support of, or build on the topics and research propositions discussed and identified in the literature review of this research report.

Furthermore, the dominant themes identified serve as the considerations for ethics, governance and sustainability when implementing IoT to gather big data within a manufacturing operation. When considering that ethical considerations surrounding IoT and Big Data have come to light at a comparatively late stage in its conceptual evolution (Weber, 2013), the discussion points and considerations identified during the discussion pertaining to each section within this chapter, with close consideration of the dominant themes identified, would serve as guidelines for consideration prior to the implementation of technology within the organisation.

# CHAPTER 6. CONCLUSIONS & RECOMMENDATIONS

## 6.1 Introduction

In this chapter, the main conclusions and recommendations based on the outcomes of this research are discussed. The findings are summarised for each of the three research propositions contained within this research report. Thereafter, recommendations based on the outcomes of this research are discussed, and suggestions for future research related to this research topic are highlighted.

## 6.2 Conclusions of the study

The purpose and objectives of this research were to establish ethical, governance and sustainability issues which may arise if IIoT is introduced into a manufacturing organisation to collect big data. Qualitative data was collected by conducting semi-structured interviews with three South African manufacturing operations. The perceptions surrounding the use of technology to monitor operational performance, the changes in the nature of labour relations between management and labour and the potential abdication of management responsibility to technology were examined.

Through the process of thematic analysis using inductive coding, six dominant themes were identified. Table 34 shows the overall ranking of themes and ranks them according to the frequency with which they appeared in the responses.

**Table 11 - Overall ranking of themes identified through inductive coding**

| Theme | Frequency in responses |
|---|---|
| Well-being | 70 |
| Trust | 52 |
| Performance | 45 |
| Inclusion | 39 |
| Planning | 22 |
| Partnership | 21 |

### 6.2.1 *General*

From a general perspective regarding the research topic, respondents displayed sufficient conceptual understanding that technology would result in benefits for all stakeholders involved. Furthermore, respondents displayed trust in both the technology and their fellow stakeholders, although some concerns were highlighted by both management and worker respondents. This was, however, believed to be secondary to the potential of a healthier management-worker relationship within the organisations.

From the perspective of general topics discussed with each of the respondents, it was identified that well-being was the dominant theme. In the context of this research, well-being was discussed as the well-being of both workers, management, staff (collectively) within the organisation, the organisation itself and the community as a whole. Although all six themes were identified in the

responses regarding general topics discussed on the research topic, there were two dominant themes other than that of well-being. These were trust and inclusion.

Speaking generally, the conclusion to be drawn is that all stakeholders, regardless of role, place importance on the well-being of all parties involved and believe that trust between and the inclusion of all stakeholders is of considerable importance. The responses to the questions in this portion of the research were in support of the concepts identified in the literature review which were used to derive the interview schedule.

### 6.2.2 *Ethical Issues*

Research proposition 1 centred around ethical issues which could possibly arise in the manufacturing context when technology is introduced to collect big data within an organisation. From an ethical perspective, respondents displayed a healthy awareness of the potential impacts of implementing the technology. While there were elements of concern regarding an over-reliance in technology and the potential risks thereof, the themes of trust (in both technology and within the management-worker relationship), organisational performance and the well-being of stakeholders and the organisation were highlighted by respondents.

It was found that respondents did not directly identify characteristics of the technology that would potentially cause ethical issues; there was, however, sufficient awareness and acknowledgement of risks. In addition, respondents were accepting of the technology being used within the context of their work and organisation. No risks were identified to the labour relations within the organisation and management showed no indication of abdication of responsibility to issues which may arise due to the implementation of technology.

When considering research proposition 1, the conclusion to be drawn is that all stakeholders, regardless of role, place importance on the trust between all parties involved and believe that organisational performance and the well-being of all stakeholders is of considerable importance. The responses to the questions in

this portion of the research were in support of the concepts identified in the literature review which were used to derive the interview schedule.

### 6.2.3 *Governance Issues*

Research proposition 2 centred around governance issues which could possibly arise in the manufacturing context when technology is introduced to collect big data within an organisation. From a governance perspective, respondents displayed a healthy sentiment regarding the potential implementation of technology within their workspace. While some concern was displayed regarding the level of input each of the various stakeholders would have, all stakeholders were willing to be included in both the planning and implementation of any technology. The sentiment is most certainly in support of technology being used within the respective organisations.

It was found that respondents did not directly identify governance issues which could potentially result in problems occurring within the organisation as a direct result of the implementation of technology, there is sufficient evidence that the principles and conditions which would minimise such risks, as identified in the literature review, are present. It was, therefore, concluded that should risks, or negative issues arise, there is sufficient intention of involvement and commitment to resolving any issues which may arise as a result of the implementation of technology.

In addition, insufficient evidence was present to identify any clear governance issues which may arise. The collective responses and themes identified therein appeared to be in support of a healthy management-worker relationship within the organisations. It is also important to note that no evidence or sentiment was displayed to highlight any abdication of management responsibility pertaining to concepts discussed in research proposition 2.

The dominant theme identified with regards to research proposition 2 was that of inclusion of stakeholders in both the planning and implementation of technology. Thereafter, the frequency of the remaining five themes was comparable.

When considering research proposition 2, the conclusion to be drawn is that all stakeholders, regardless of role, place importance on the inclusion of all parties involved. The responses to the questions in this portion of the research were in support of the concepts identified in the literature review which were used to derive the interview schedule.

### 6.2.4 *Sustainability Issues*

Research proposition 3 centred around sustainability issues which could possibly arise in the manufacturing context when technology is introduced to collect big data within an organisation. From a sustainability perspective, respondents displayed a healthy sentiment regarding the potential implementation of technology within their workspace. Respondents acted positively when commenting on each of the sustainability capitals of the Five Capitals Model. When considering the respondents' view on sustainability, there is sufficient evidence to show that technology would be welcomed for the potential benefits to each of the sustainability capitals.

While respondents did not directly identify alternative sustainability issues which could potentially occur, there is sufficient evidence that awareness and consideration to the general concept of sustainability are not only present, but also important to all respondents.

In addition, it was found that there is insufficient evidence to clearly identify governance issues which may arise. The collective responses and themes identified therein appeared to be in support of a healthy management-worker relationship within the organisation. It is also important to note that no evidence or sentiment was displayed to highlight any abdication of management responsibility pertaining to concepts discussed in research proposition 2.

When considering research proposition 3, the conclusion to be drawn is that all stakeholders, regardless of role, place importance on the well-being of all parties involved and believe that trust between stakeholders and the performance of the organisation is of considerable importance. The responses to the questions in

this portion of the research were in support of the concepts identified in the literature review which were used to derive the interview schedule.

## 6.3 Recommendations

### 6.3.1 *Significance of the research*

The implementation of technology within any organisation poses both operational and management-labour relationship risks when operating within the South African context. It is therefore imperative that when considering the implementation of technology, such as IIoT, to gather big data and monitor operations within a manufacturing operation, that the organisation and stakeholders involved consider potential risks to both the individual stakeholders and the organisation as a whole. The dominant themes identified within this research, through inductive coding of interview responses, aim to serve as dominant principles which should be considered during the planning and potential implementation of technology within a South African manufacturing organisation.

It is therefore the most important recommendation of this research that all stakeholders consider and discuss the following principles during the process of planning and implementing of technology within the organisation:

- **Well-being:** Consideration of the well-being of both workers, management, staff (collectively) within the organisation, the organisation itself and the community as a whole was identified as the most dominant theme.
- **Trust:** Consideration and monitoring of trust in both the technology and the relationship between management and workers within the organisation is of considerable importance. Trust can be identified in both positive and negative lights, regarding both the technology and the relationship between management and workers.
- **Performance:** Both the individual performance of workers or management as well as organisational performance as a whole, requires consideration and sufficient analysis; both during the planning of implementing

technology as well as within any processes following the implementation of technology. Performance of both individual stakeholders and the organisational performance as a whole have a direct effect on the well-being of both the individual and the organisation.

- **Inclusion:** Stakeholder inclusion during discussions pertaining to the implementation of the technology as well as stakeholder inclusion during any planning regarding the management or implementation of the technology can be considered of significant importance. As a concept, inclusion has important contributions to both the trust and sense of partnership between stakeholders.
- **Planning:** It is important that sufficient planning takes place prior to the implementation of the technology within the organisation; this is due to the potential negative effects which implementing the technology incorrectly could have on both stakeholders and the organisation as a whole.
- **Partnership:** The concept of a partnership existing between management and the workers should be considered and discussed. There are both positive and negative effects which could occur as a direct result thereof. The concept of a partnership can be approached in a non-formal manner, that is, the concept need not be a legal partnership but an informal "invisible partnership".

### 6.3.2 *Recommendations for stakeholders*

The recommendations for stakeholders involved can be considered as one and the same when one considers that the important principles identified in the previous section were identified and explored through the responses of both managers and workers within the participating organisations.

The upfront and deliberate acknowledgement of stakeholder rights considered in conjunction with the risks and expectations of all stakeholders involved is of utmost importance. Stakeholders should therefore communicate thoughts and intentions early and often in both the planning and the implementation of technology within the organisation.

It is through this deliberate approach to the inclusion of all stakeholders, where possible and within context, that negotiations and discussions between stakeholders would make an “invisible partnership” not only feasible but possible. In addition, should sufficient trust exist between stakeholders, an attention to the well-being of these stakeholders and a focus on stakeholder and organisational performance be present; the implementation of technology within the organisation would not be beneficial, but would also minimise any potential risks which could arise from ethical, governance and sustainability perspectives.

## 6.4 Suggestions for further research

This study provides organisations in the South African manufacturing sector with insights as to ethical, governance and sustainability considerations when considering and planning the implementation of technology. Furthermore, this research also aims to provide recommendations for further research which could potentially be explored. This would most certainly be necessary when one considers the rapid pace at which technology changes and is being adopted in industry and society as a whole.

The following have been identified as potential topics for future research:

- Considering the lack of research conducted on the topic of ethical considerations regarding the use of IIoT. This research report could be used as a basis for further research.
- Considering the lack of research conducted in the topic of governance considerations regarding the use of IIoT. This research report could be used as a basis for further research.
- Considering the lack of research conducted on the topic of sustainability considerations regarding the use of IIoT. This research report could be used as a basis for further research.
- Similar research can also be conducted over an extended period of time to test the outcomes of this research.

- The research can be conducted using a larger research sample than contained within this research report. This would result in enhanced reliability of the results.
- Similar research can be conducted within different industries within which IoT may be used to gather big data.
- The research topic can be explored from a quantitative or mixed methodology perspective.

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# APPENDIX A: INTERVIEW SCHEDULE

1. **Introduction**
    a. Presentation of company and employee letters from the University of the Witwatersrand endorsing the research being conducted.
    b. Explanation of the research and the interview process.
    c. Introduce the key concepts involved in this research (e.g. Internet of Things, Big Data, ethics, governance & sustainability)
    d. Address any concerns the interviewee may have.
2. **General Questions**
    a. What do you understand about the concept of using technology to gather big data within an organisation?
    b. Do you think this technology would be disruptive or beneficial to the organisation?
    c. Do you believe this technology could benefit the rights of all stakeholders involved?
    d. Should such technology be implemented within the organisation:
        i. What are your thoughts on implementing such technology?
        ii. Do you have any expectations of this technology?
        iii. Do you have any concerns about the implementation of technology?
3. **Ethics**
    a. Would you consider this technology to be feared or welcomed within the organisation?
    b. Would you consider the implementation of such technology to be obtrusive or non-obtrusive?
    c. Do you think the implementation of such technology could enhance the relationship between management and labour within the organisation?
    d. Do you think the implementation of technology could undermine human autonomy within the organisation?

e. Do you think technology could be implemented to assist and enhance performance within the organisation?
f. What do you think the advantages are of implementing this technology within the organisation?
g. What do you think the disadvantages are of implementing this technology within the organisation?
h. What considerations do you think should be taken into account should such technology be implemented within the organisation?

**4. Governance**

a. Do you think that transparency between all involved stakeholders is important when implementing such technology within the organisation?
b. Do you think it is possible for an “invisible partnership” to exist between all stakeholders involved when implementing technology such as this within the organisation?
c. What level of input do you think all stakeholders within the organisation should have when implementing such technology?
d. Do you think various stakeholders should be held accountable from any situations, should they arise, from the information or knowledge derived from implementing such technology?

**5. Sustainability**

a. What advantages/disadvantages do you think the implementation of this technology could have on the organisation as a whole?
b. What advantages/disadvantages do you think the implementation of this technology could have on the organisation's impact on things such as the environment and natural resources?
c. What advantages/disadvantages do you think the implementation of this technology could have on the organisation's impact on things such as the safety, health and well-being of staff within the organisation?
d. What advantages/disadvantages do you think the implementation of this technology could have on the organisation’s social role with people both internal and external to the organisation?

e. What advantages/disadvantages do you think the implementation of this technology could have on the organisation's impact on things such as the productivity and efficiency of the organisation?

# APPENDIX B: SUMMARY OF INTERVIEW RESPONSES

**Table 12 - Summary of respondent's conceptual understanding of the technology**

| Company | Respondent | Answer |
|---|---|---|
| A | Worker | Respondent showed little understanding of the technology in his context. However, the respondent displayed complete faith in the broader concept of technology and believed it could make work within the organisation both safer and more efficient. |
| | Manager | Respondent understands the technology and would appreciate the potential benefits that could be derived from the implementation. Most important to the respondent was the ability of the technology to provide live metrics on operations and the ability to make future improvements to the operations. |
| B | Worker | Respondent was aware of technology being used to collect data in order to be analysed in the interest of gaining insights. The respondent displayed a purely conceptual understanding of data being collected in this context but was not aware of how technology would be used in order to do so. It is important to note that the respondent was made aware of this through a newspaper article read previous to the interview being conducted. |
| | Manager | Respondent welcomed the concept and believed that the introduction of such technology would only be beneficial to workers, management and the company as a whole. The respondent was most interested in the potential impact such technologies would have on management's ability to control, measure and react to situations during daily operations. |
| C | Worker | Respondent showed a strong conceptual understanding and trusts the implementation of such technologies. When questioned, the respondent indicated that the main benefit of being able to gather data within the organisation would be that all employees of the company would be afforded |

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| | | the ability and opportunity to improve and be better, not only on an individual level, but also on a company level too. |
| | **Manager** | Respondent showed a strong understanding of the concept following a short discussion regarding the manner in which the technology would be used. |

**Table 13 - Summary of respondent's perceptions surrounding the implementation of technology**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | Respondent believes that technology will help the workers in the organisation because working conditions are difficult. The respondent welcomes the implementation of technology in order for working conditions to be safer and easier. The respondent trusts that technology will be of benefit to all workers within the organisation. |
| | **Manager** | The respondent believes that the technology, when implemented, will be disruptive at first. The respondent added that whenever new practices or technology were implemented in the past, there was always a period of learning which followed. The respondent referred to this as a "teething" phase. In addition, the respondent believes that once the workers within the organisation have adopted the technology, there will be long term benefits. |
| **B** | **Worker** | Respondent answered that the implementation of technology would be a positive change with the caveat that no jobs were lost or made redundant as a result. Respondent displayed awareness that anything that is done which will benefit the company or the economy as a whole is welcomed. |
| | **Manager** | The respondent believes that because the implementation of technology may be seen as being disruptive at first but will be welcomed in the long term. The respondent answered that it would most certainly be beneficial from a |

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| | | company perspective; the respondent has only seen benefits derived from the implementation of any technology during his career. The respondent welcomes the collection of big data and the insights that may be derived from it. |
| **C** | **Worker** | Respondent believes that the implementation of technology would assist machine operators and enhance their interest and engagement with their daily tasks. Respondent added that if the implementation is done properly; then it will most certainly be of benefit. He added that the information and lessons that may be derived from the implementation could assist in workers being mentored and improving. Furthermore, the respondent welcomed potential improvements to reliability within the organisation and added that he would like to see a paperless environment as a result of the implementation of technology. |
| | **Manager** | Respondent believes that the implementation of technology would be beneficial provided that the implementation is done properly. The company currently operates three facilities in Oberhausen (Germany), Zurich (Switzerland) and Johannesburg (South Africa). Although these three facilities are able to share data and insights, this does not occur. The respondent mentioned a level of frustration with senior management and prohibitive processes. The respondent believes that the implementation of technology could assist in sharing data between these three facilities in order to learn and improve as an organisation. The respondent mentioned that although the implementation would be a large-scale project; he added that it would be hugely beneficial. |

**Table 14 - Summary of respondent's perception surrounding the possible effects on stakeholder rights**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | Respondent believes the implementation of technology would help workers and their rights in the workplace. Respondent commented further on trusting technology |
| | **Manager** | Respondent believes that everybody involved will benefit from the implementation of technology; the life of management will benefit the most and be made easier from a day-to-day perspective. Respondent welcomes the feedback that will be made possible by the implementation of technology. Company A already has monitoring systems which notify management of failures and/or concerns regarding operations. However, the respondent believes that a big data system, which is internet connected, would be far more beneficial. |
| **B** | **Worker** | Respondent trusted the implementation of technology and commenting on the need for data gathering to take place from the right places within the organisation. |
| | **Manager** | Respondent believes that the technology would benefit the rights of all stakeholders involved. Respondent also acknowledged the need to consider the legal rights of all stakeholders. Furthermore, the respondent commented that any stakeholder who is being monitored by the technology should derive benefit from it. The respondent did not believe that anonymity is an important factor to consider because the accountability of a stakeholder would result in the protection of the rights of the other stakeholders involved. |
| **C** | **Worker** | Respondent believes the rights of stakeholders will definitely benefit from the technology. The technology enables stakeholders to manage and monitor themselves in addition to management doing so. The respondent said that clear guidelines must be drawn up before implementing the technology; if these guidelines are considered, then it will most certainly benefit the rights of all involved. Furthermore, he commented that fairness is |

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| | | important, and technology should assist in creating equal opportunities for stakeholders. The respondent believes that technology will help organisations engage with younger job seekers. The respondent trusts the technology will assist in understanding fellow stakeholders. |
| | **Manager** | Respondent said he does not take stakeholders rights into consideration; the reason for this being that he has to operate within a larger corporate governance framework and trusts that stakeholders' rights are considered and protected by that framework. The respondent showed little to no concern of being held accountable in a situation of stakeholder rights being violated; this is because he is expected to operate in accordance with the corporate governance guidelines in question. |

**Table 15 - Summary of respondent's thoughts of implementing such technology**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent's initial thoughts about implementing technology were that of the safety of workers. Thereafter, the respondent believes that making daily tasks and life at work easier was of importance. |
| | **Manager** | The respondent stressed that efficiency and productivity are of major concern. The management within the organisation is a single resource; therefore, any efficiencies achieved would result in direct benefits to management. The respondent stated that there was a possibility of scaling the business further if certain production levels and efficiencies were achieved. The respondent believes that technology would provide a more accurate metric as to the outcome of adding further resources within the organisation. |

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| **B** | **Worker** | The respondent failed to respond as he believes he had already covered his thoughts surrounding the implementation of technology in previous responses. The respondent previously answered that the implementation of technology would be a positive change with the caveat that no jobs were lost or made redundant as a result. Respondent displayed awareness that anything that is done which will benefit the company or the economy as a whole is welcomed. |
| | **Manager** | The respondent reiterated that an holistic approach was important and that everything has to be considered when implementing the technology. |
| **C** | **Worker** | The respondent believes that once everything within the work environment is connected and various stakeholders were made aware of problems earlier then it would only be beneficial to those involved. |
| | **Manager** | The respondent failed to respond as he believes he had already covered his thoughts surrounding the implementation of technology in previous responses. The respondent previously responded that the implementation of technology would be beneficial provided that the implementation is done properly. The company currently operates three facilities in Oberhausen (Germany), Zurich (Switzerland) and Johannesburg (South Africa). Although these three facilities are able to share data and insights, this does not occur. The respondent mentioned a level of frustration with senior management and prohibitive processes. The respondent believes that the implementation of technology could assist in sharing data between these three facilities so as to learn and improve as an organisation. The respondent mentioned that although the implementation would be a large-scale project; he added that it would be hugely beneficial |

**Table 16 - Summary of respondent's expectations of the technology**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | Respondent expects safety to be the primary concern when implementing new technology. Thereafter, the respondent believes in making workers' day-to-day life and tasks easier. |
| | **Manager** | The respondent commented that efficiency and productivity are the only major concern from a production management perspective. The respondent does not consider health and safety of importance when implementing the technology. The rationale provided for this response was that the operations are small enough for management to work closely to monitor health and safety in the workplace. The respondent added that if the technology could save time, then it would be most welcomed by management. The broader context provided was that the organisation would be happy to scale and create more jobs if certain efficiencies and a greater level of consistency were possible. The respondent believes that implementing technology would make this possible. Furthermore, should a staff member have to be dismissed, it would be beneficial to have accurate and reliable data in order to justify management's decision in this regard. The respondent was open to the technology being used to highlight management problems or poor decisions on their behalf. |
| **B** | **Worker** | The respondent has few expectations of the technology other than the prerequisite that the implementation should be beneficial to all stakeholders. He believes it is important that every stakeholder benefit in some way. |
| | **Manager** | The respondent believes it is important that everything from finished products, production levels and problem resolution should be considered prior to integrating technology. A holistic view of the entire organisation is critical. Furthermore, it is important to consider both positive and negative feedback from each of the aforementioned considerations. |

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| **C** | **Worker** | The respondent displayed concern over potential reluctance to the changes that may come about following the implementation of technology. He added, however, that once the various stakeholders understand the technology and the potential benefits that could be achieved, stakeholders would be welcoming of the technology. |
| | **Manager** | The respondent emphasised the importance of data sharing across the organisation; including the international production facilities. Furthermore, transparency is critical in order for the organisation to be able to learn from historical mistakes. The respondent displayed concern regarding the scarcity of skills within the South African manufacturing sector. The respondent indicated that the implementation of technology could provide a mechanism for speeding up the learning curve of new staff; ultimately resulting in a far more robust organisation. |

**Table 17 - Summary of respondent's concerns about the technology**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent showed no concern regarding the technology being implemented within their organisation. The respondent did, however, express concern for fellow workers and the potential risk to their job security. The respondent trusts that if the technology is implemented in the correct way, then workers would be content. |
| | **Manager** | The respondent expressed concern regarding the initial phase of implementing the technology. The concern was centred on the learning curve that the various stakeholders would have to undergo. |
| **B** | **Worker** | The respondent's concern centred around the privacy of workers. The respondent acknowledged that complete privacy was not the cause for the concern but rather that |

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| | | privacy will need to be respected where it has to be. In addition, the respondent believes that it is important for the various stakeholders to understand what the big data being gathered will be used for. |
| | **Manager** | The respondent expressed no concern and was welcoming of the technology and added that implementing technology to gather big data would only be beneficial to all stakeholders. |
| **C** | **Worker** | The respondent expressed no concern about technology. Furthermore, the respondent expressed excitement of the potential growth and lessons which could be made possible. The respondent believes that technology should be implemented to help humans improve their quality of life. |
| | **Manager** | The respondent was concerned that implementing technology would become a hindrance; the concern being centred around the possibility that implementing technology could result in additional tasks on a daily basis. However, the respondent added that as long as transparency is ensured and all stakeholders are aware of expectations, then the results should be beneficial to all stakeholders. He did, however, display a level of doubt in senior management's potential approach and decision-making surrounding implementing the technology. |

**Table 18 - Summary of the sentiment of respondent's regarding the technology**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent said that he trusts management will make the right decision when implementing the technology. The respondent indicated that he and his fellow workers appreciate the care shown for them by the management of the organisation. |

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| | **Manager** | Respondent believes that the technology would be feared across the organisation by the workers. He added that the technology would be welcomed by management because, in this organisation, management is more technically inclined than the workers; the respondent added that he is happier that this is the situation. The respondent went further to say that they believe is that once the workers see the benefits of the technology, then they will start to trust the technology. There was concern shown by the respondent regarding which information would be available to which stakeholder. The respondent would be more open to the technology if the organisation had more control over the technology; this was regarding parties external to the organisation. The respondent believes that anonymity, from an internet perspective, would be critical. |
| **B** | **Worker** | The respondent believes that the technology will be welcomed by all who would be involved on the provision that all stakeholders involved would need to understand and trust that the technology is being implemented with everyone's best interest at heart. The respondent went on to add that it is critical that all stakeholders are on the same page. |
| | **Manager** | Respondent welcomed the implementation and believed that all stakeholders would welcome it too, but the process of implementation would need to be managed. The respondent added that less experienced workers would question the technology upon implementation but that this could be managed on the provision that adequate explanations are provided up front. |
| **C** | **Worker** | The respondent fears that those workers with a lower level of education and less experience in the industry would not understand the decision to implement the technology; the biggest risk being that the workers may fear job losses because of the perception of automation. The respondent described experiencing similar in the past. The respondent was clear that technology should not be used to replace staff; empowerment, training and upliftment of staff were important to the respondent. The respondent further believes that the older generation of workers will not understand the technology and would, therefore, resist the implementation. The respondent believes that with the proper management of the older workers, it would be |

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| | | possible to train them and therefore include them in the process. The respondent did, however, accept that the older workers would most likely take longer to adopt and become used to the technology. The respondent went on to add that as long as any fears or concerns are addressed early on in the process, then confidence in the implementation would be more than possible. The respondent added the younger workers, who have yet to enter the job market, would most likely be comfortable with technology because they have grown up with it and will therefore not resist any technology being implemented. |
| | **Manager** | The respondent believes that workers across the organisation would welcome the implementation of technology. The biggest reason for this is due to a history of mistakes being made. The respondent hopes that the implementation of technology could pre-empt or possibly prevent such mistakes. |

**Table 19 - Summary of possible impacts of the technology**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent showed no concern regarding the possible impact the technology would have. The respondent added that he welcomed the use of technology. |
| | **Manager** | The respondent believes that the implementation of technology should be non-obtrusive to operations and should involve minimal involvement from both a worker and a management perspective. The respondent acknowledged that initially, the use of technology would be obtrusive, but this would only be in the initial time period following the implementation. |
| **B** | **Worker** | The respondent does not believe the technology would be obtrusive at all on a daily basis. |

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| | **Manager** | The respondent was not concerned that the technology would be obtrusive at all. Experience has taught him that the changes will be adopted and worked around. The respondent added that there would be challenges while the technology is being adopted, but these challenges will be dealt with by management. The respondent added further that from a worker perspective, the technology should be non-obtrusive |
| **C** | **Worker** | Respondent did not believe anything further could be added to his response to the previous question (covered in section 4.4.1) |
| | **Manager** | The respondent showed concern over how previous implementations of technology had taken place within the organisation in the past. The respondent did, however, indicate that these previous implementations were within the management office and did not involve the workers. The biggest concern regarding previous implementations was the burden of processes which needed to be adopted. The respondent welcomed any new technology on the provision that it did not result in any undue processes and was non-obtrusive. |

**Table 20 - Summary of effects on the management-labour relationship**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | Respondent has a very good relationship with management and would welcome any technology which would make the workers work environment safer and easier. He added that this would further enhance the relationship with management. |
| | **Manager** | The respondent responded that it would definitely enhance the relationship with workers. The respondent relies heavily on feedback to be provided by workers in order to manage the business. Inaccurate feedback has been a problem in the past and welcomed the effect that |

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| | | technology would have on this. The respondent is primarily concerned with solving problems which may occur on a daily basis as opposed to using the technology to dismiss staff members. |
| **B** | **Worker** | The respondent is sure that it will benefit the management-staff relationship on the provision that all stakeholders are on the same page. |
| | **Manager** | The respondent believes that only positive effects on the relationship between management and staff would be experienced. He added that the technology would enable management to take a more humane approach to worker performance; the respondent acknowledged that the productivity of workers is affected by life outside of the work environment. The respondent highlighted that accurate performance metrics would enable him to discuss and possibly assist with any stresses in the worker's life in general. |
| **C** | **Worker** | The respondent believed that it would benefit the relationship between management and workers. |
| | **Manager** | The respondent indicated that he believes that technology and big data could possibly put all stakeholders on the same page. He further added that this was on the provision that the technology was non-obtrusive. |

**Table 21 - Summary of respondent's perceived risks of automation**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent believes that workers cannot be replaced and that people will always be needed in the workplace. The respondent pointed out that even though people could not be replaced, he welcomed the benefits which could be derived from implementing the technology. The respondent does not worry about automation and rather |

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| | | displayed concern for the well-being and safety of his fellow workers and management. |
| | **Manager** | The respondent does not believe that technology could replace workers and rather sees technology as a tool to make life at work easier for all involved. The respondent mentioned needing more workers in the organisation but is nervous to hire more workers due to past experiences with labour unions. He believes that technology would make it far easier to expand and hire more workers if a better understanding and more accurate monitoring of productivity were possible. The rationale for this is that the effects on the output of new workers would be seen clearly in the metrics. The respondent does not believe that people could ever be completely replaced; this is mostly due to the costs involved and because technology would not be able to replace the human touch. |
| **B** | **Worker** | The respondent believes that if automation begins to take place in the workplace, then it will be a major concern for workers. He acknowledged that the pace of change with technology makes it important for technology to be implemented so as not to be left behind from both a personal perspective as well as an organisation operating within the economy. The respondent believes that people and technology should be moving forward together and not oppose each other in any way. |
| | **Manager** | The respondent believes that initially, any technology implemented would need to be explained clearly to the workers; if that takes place, then the workers should not feel threatened by the technology. The respondent would, however, definitely consider replacing people with technology to some degree in the future. The reason for this is the higher and more reliable productivity of technology and the belief that technology would bring with it more predictable costs, provided the correct maintenance is done. The respondent indicated that technology is more consistent and predictable and displayed a major trust for technology. However, holistically it is impossible to replace humans. |
| **C** | **Worker** | The respondent indicated that workers could never really be replaced. The respondent believes that although some tasks may be made redundant by the implementation of |

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| | | technology; he believes that this would open up other spaces for workers to be used and this could ultimately result in workers gaining skills they would never have had without the implementation of technology. The respondent believes that people must adapt and learn in order not to be replaced by technology. The respondent indicated that technology should help workers do their jobs better; this could result in jobs being created instead of lost. |
| | **Manager** | The respondent believes that human intervention will always be required in manufacturing. He indicated that automation would always be idealistically welcomed due to labour relations being problematic at times. The respondent indicated that labour unrest would be a certainty if automation began to take place; this would also result in social problems for the organisation. The respondent welcomed the possibility that technology could assist in helping workers achieve higher productivity on average. The respondent did, however, welcome automation from the perspective that it would minimise the risk of workers trying to "hold the company to ransom" by threatening the company. |

**Table 22 - Summary of effects on organisational performance**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | Respondent responded that he believes everyone will work better if the technology was implemented. He further commented that technology could assist the company in making better products. |
| | **Manager** | The respondent believes that technology would definitely assist the organisational performance but reiterated that there would still be a need for the trained human eye. |
| **B** | **Worker** | The respondent believes that all stakeholders, the organisation and the economy, as a whole, would benefit from the implementation of technology. The respondent would like to see both the workers and the company able |

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| | | to benefit in some way from the technology. Furthermore, he believes that technology should assist stakeholders and not replace them. |
| | **Manager** | Respondent believed that technology would assist in organisational performance. |
| **C** | **Worker** | Respondent believes that technology will assist in the production aspect of organisational performance. He added that the scrap rate would be far less, and products will benefit from more precision. The respondent believes that reliability from a production perspective will be possible from both an output level and reliability of machinery level. |
| | **Manager** | Respondent believed that technology would assist in operational performance. Furthermore, sharing the insights gained from the big data across international operations would assist the organisation, as a whole to improve. |

**Table 23 - Summary of advantages of the technology**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent believes that with technology, daily tasks could be completed faster with far more accuracy. |
| | **Manager** | The respondent would like to be able to monitor production from remote locations using technology. This would enable management to look for new business due to not being physically tied to the production facility. He added that there would most likely be a better management-worker relationship; once again this being due to faster and more accurate problem solving being possible. |

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| **B** | **Worker** | The respondent believes that if work within the organisation is done more effectively, then costs can be reduced; this will result in better revenue for the organisation. The respondent hopes that if this was achieved, the workers could possibly benefit from it too. This could be in the form of remuneration and/or better working conditions. |
| | **Manager** | The respondent reiterated that consistency and higher production levels would be possible with big data being generated on an operational level. He believes that the technology would enable management to identify and resolve issues far quicker and therefore minimise their impact. He added that he believes that if the stakeholders put a lot into the technology, then they will derive huge benefits from the technology too. The respondent believes that technology will enable workers and the organisation, as a whole, to work smarter as opposed to working harder. |
| **C** | **Worker** | The respondent believed that technology would motivate workers' interest, and this will result in growth for each and every worker. |
| | **Manager** | Respondent believed that technology would assist in organisational performance. |

**Table 24 - Summary of disadvantages of the technology**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent did not comment on any disadvantages with implementing the technology. He added that this was due to trusting both technology and management within the organisation. |
| | **Manager** | The respondent showed concern over what could possibly happen to the organisation and/or production that may occur if the technology fails. The respondent believes |

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| | | there is a real risk of becoming too reliant on the technology; in addition, he stated that the savings achieved from the implementation of the technology could be lost if the technology failed. |
| **B** | **Worker** | The respondent reiterated his concern for possible job losses. |
| | **Manager** | The respondent answered neutrally. He believes that experience has shown him that technology can result in operational and labour problems within an organisation. |
| **C** | **Worker** | The respondent believes that there may be disadvantages in places within the organisation from implementing the technology. However, overall there will be advantages with the possibility of job creation. |
| | **Manager** | The respondent showed frustration that data is not shared across the organisation; commenting specifically with regards to the three production facilities. The respondent believes that his European counterparts do not trust South African operations with sensitive data. The respondent commented purely from a group perspective and not specifically with regards to the implementation of technology within his organisation. |

**Table 25 - Summary of pre-implementation considerations**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent answered that safety must be considered before anything else, from a pre-implementation perspective. Thereafter, productivity, speed and efficiency should be considered. |
| | **Manager** | The respondent felt that his responses to previous questions covered many of the considerations that should be taken into account. The respondent showed |

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| | | uncertainty on exactly what would be possible with the technology and how this would be achieved. The respondent commented that he had an overall view of the technology but did not know any specific details regarding the possibilities. Furthermore, the respondent reiterated that the technology is welcomed, provided sufficient analysis and planning took place prior to the implementation. |
| **B** | **Worker** | The respondent believes that if sufficient research is done prior to planning and implementing any technology, then he would be comfortable. |
| | **Manager** | The respondent believes that the human factor should be considered first and foremost. The respondent believes that workers should be made aware of what is happening and given sufficient explanation of what the objectives are from an organisational perspective. |
| **C** | **Worker** | Respondent considers training to be important prior to any implementation. This would prepare workers for the technology and would result in workers being far more welcoming of the changes that will occur due to the technology. The respondent explained that historically there has been a lack of communication regarding organisational changes. The respondent believes that if the workers are included in the process and their concerns are considered by management, then the workers will welcome any changes and will feel respected and result in the workers believing in the technology and the possible benefits. The respondent believes that if the workers are not considered, then there is a risk of tension between the workers and management. |
| | **Manager** | The respondent believes that potential risks should be identified. Furthermore, the organisation has been set up in such a way that risks such as this can be minimised. Furthermore, the respondent believes that members of management should be appointed to manage the technology and should also be held accountable. The respondent displayed concern over the organisation being too reliant on the technology too. |

**Table 26 - Summary of stakeholder transparency**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent indicated that he is happy to share his thoughts and views on the technology if he is approached to do so. The respondent is not concerned to approach management to discuss any suggestions or concerns that he may have. The respondent acknowledged the importance to discuss any concerns he may have. |
| | **Manager** | The respondent believes that honesty is of paramount importance. However, he believes that transparency is only possible to a certain degree; only applicable information can be shared with certain shareholders. If the transparency is monitoring workers without user input, then the data can be shared with all stakeholders. However, if user input is required by technology, then transparency would not be possible. The reason for this is that there is a need to minimise the risk of manipulation from a worker's perspective. |
| **B** | **Worker** | The respondent indicated that transparency would be important. The respondent indicated concern over being replaced by technology in the future. Furthermore, the respondent showed concern that technology could possibly be implemented without consultation or communication with the workers. This could result in tensions between workers and management. The respondent believes that all stakeholders involved should know about the technology prior to its implementation. |
| | **Manager** | The respondent believes transparency is important to enable all stakeholders to be on the same page. Furthermore, explanations of decisions and planning should be given to workers prior to any implementation. |
| **C** | **Worker** | The respondent indicated that transparency is very important. All stakeholders should know and understand their fellow stakeholders' thoughts and concerns at all times. The respondent acknowledged that not all information could be shared among all stakeholders. However, post-implementation, the respondent believes |

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| | | that the more information is shared with the workers on a daily basis pertaining to project planning and delivery dates would result in fewer issues. The respondent added that transparency assists in developing trust and this would encourage workers. The respondent believes that being open about production levels and targets could help justify fairness from a remuneration perspective. The respondent believes that if all stakeholders are included and transparency is present, the potential for negative impacts from the implementation of the technology would be minimised. |
| | **Manager** | The respondent responded that transparency is important. |

**Table 27 - Summary of the stakeholder partnership**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent believes that working together to achieve the same goals is very important within the organisation. The respondent, however, never feels excluded within the organisation and always gets considered in general. He added that when everybody works together, the work gets done faster and better. |
| | **Manager** | The respondent, while welcoming the concept of an invisible partnership between management and workers, believes that this is not always possible. The concept of the partnership would only be possible periodically. The respondent believes that the reason for this is that while relations are healthy between management and workers, there still exists a level of distrust. However, the respondent did believe that workers would not negotiate from an entrenched position and technology would therefore not cause problems in the long term. |
| **B** | **Worker** | The respondent welcomes the possibility of an invisible partnership between workers and management within the organisation. The respondent did, however, express doubt that this would occur and believes that management |

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| | | would make the decision long before the workers were aware of the decision or consulted. This would result in workers being uneasy. The respondent did acknowledge that the decision-making process and rationale to implement technology is not something that workers would typically consider. He believes that this would most likely result in a situation where workers would assume that the technology was being implemented in order to replace workers. The Respondent does, however, believe that discussions and consultation could take place early on in the decision-making process. |
| | **Manager** | The respondent believes that an invisible partnership already exists within the organisation and this could be further used to enhance the relationship between management and workers. He believes that staff and labour unions would be willing to negotiate. In addition, all stakeholders will ultimately have the same outlook regarding technology and have a bigger perspective. There will, however, be some workers who will resist the technology. |
| **C** | **Worker** | The respondent believes that as a country, South Africa has already come a long way and indicated that the country would not move forward if everybody is not considered. The respondent welcomes the concept of an invisible partnership but believes that it is not present currently. He wishes to have a workplace where everybody is considered; from the sweeper to upper management. Historically, he has seen a lack of motivation because workers have felt excluded in various processes; recognition is one such process. |
| | **Manager** | The respondent believes that it is possible for management and workers to sit down and discuss the technology prior to the implementation. He did, however, express concern that this process could possibly cause problems. The respondent believes that the solution to this would be to include key people from the workforce to be involved in the process. |

**Table 28 - Summary of stakeholder input**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent did not wish to add anything further to what he had already answered. |
| | **Manager** | The respondent believes that a staged level of input would be the most feasible approach to stakeholder input. This would involve certain stakeholders being considered in certain processes whereas management would exclusively decide on other processes. The respondent believes that it is important to note that the organisation does not have middle management. The respondent stated that more experienced workers would be considered prior to those less experienced ones. |
| **B** | **Worker** | The respondent did not wish to add anything further to what he had already answered. |
| | **Manager** | The respondent believes that worker input should be considered to a reasonable point. However, the negotiations will be done in good faith provided none of the stakeholders makes unreasonable demands. The management of the organisation would not consider enforcing anything on the workers. The workers would be welcome to dispute anything provided that adequate and reasonable justification is given; that is, everything and every stakeholder would be given fair treatment. The respondent believes that ultimately management and worker perspectives would be convergent. The ultimate goal is a happy workforce; because a happy workforce is a productive workforce. |
| **C** | **Worker** | The respondent strongly believes that every stakeholder should have adequate input into the process. The respondent believes that the person who is most experienced in the relevant area of the business should be considered first and have input into the process. The respondent believes that technology should also empower management and supervisors to make changes based on the output of the data. Every stakeholder's input should be |

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| | | considered and understood; the workers should be considered from a production perspective because they are the resources which are on the floor doing the work. The respondent pointed out that it is critical that those who have made a valuable input should be acknowledged; when people are included from the perspective of trust and giving them authority, then the workforce will ultimately work harder. |
| | **Manager** | The respondent did not wish to add anything further to what he had already answered. |

**Table 29 - Summary of stakeholder accountability**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent believes that if somebody, from management or a worker, is not doing their job then the information is important. The information would empower management to show somebody that they are not doing their job correctly. The respondent was not concerned about being highlighted by the data; he expressed a wish to learn from mistakes highlighted by the data. |
| | **Manager** | The respondent believed that both management and workers should be held to account should the data highlight them. It is important for all stakeholders to accept positive and negative situations which may arise. |
| **B** | **Worker** | The respondent believes that stakeholders should be held accountable as the data would be production-centric. The respondent went on to indicate that he believes that a worker who is not productive is ultimately a worker who is costing the company money unnecessarily. The knowledge derived should be used to make the work environment better, and every stakeholder should benefit from it; it is, therefore, reasonable to expect all stakeholders to be held to account. |

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| | **Manager** | The respondent believed that everybody should be held accountable for their actions. Importantly, this would be the case should management choose to implement the technology; they should then be held to account for any situations which may arise due to the implementation thereof. Ultimately, all stakeholders should be held accountable for anything that is highlighted by the data. |
| **C** | **Worker** | The respondent believes that there should be room for things to go wrong in daily operations due to the nature of manufacturing. Regarding the implementation of the technology, he believed that there should be a trial-and-error process initially to learn and correctly introduce the technology. Importantly, the data derived from the technology should be used to learn from and correct issues. Should any problems be detected which were the result of deliberate efforts to cause problems, then those staff members should be held accountable. The respondent also believed that if a worker or manager continually makes mistakes which have been highlighted previously, then that person must be held accountable. The respondent would like to see the information to be used primarily for people to improve themselves; this would result in positive effects on the organisation. |
| | **Manager** | The respondent believes that everyone involved, regardless of their level within the organisation, should be held accountable for their actions provided the data being collected is accurate. Primarily, the aim of data collection should be to identify problems to understand what went wrong and what can be done to ensure it never happens again. The data should not be used to drive disciplinary actions within the organisation though. The respondent believes in dealing with problems as opposed to dealing with people. |

**Table 30 - Summary of manufactured capital**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent believes that technology can only help all those involved. The respondent is not aware of any disadvantages or risk. |
| | **Manager** | The respondent believes that the advantages derived from implementation of the technology will far outweigh any disadvantages experienced. The respondent believes that this is because any improvements within the organisation can only be seen from a positive light for the organisation as a whole. Should the business become more profitable from the expected efficiencies and increase in productivity; then more money would be paid across to skills-development levies which will uplift people. |
| **B** | **Worker** | The respondent believes that as long as the technology includes and benefits everybody involved, then the concept should work; with time it can be made to work even if challenges are experienced. |
| | **Manager** | The respondent believes that one major disadvantage is that from a non-business perspective; people would tend to assume without knowing the facts, that automation is beginning to take place within the organisation. This is not always the case. The respondent believes that technology would result in people being upskilled and would assist in learning new jobs within the organisation. The organisation and the people working within it can only benefit from trusting the technology. The respondent would like to see workers who show potential with the technology to be used as examples to show others how beneficial it can be. The data derived from the technology should be accurate, so it can be used as a “north star” to which all workers can strive to move towards. The respondent indicated that it is important to consider all input from stakeholders from the bottom to the top of the organisation. |
| **C** | **Worker** | The respondent did not wish to add anything further to what he had already answered. |

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| | **Manager** | The respondent did not wish to add anything further to what he had already answered. |

**Table 31 - Summary of natural capital**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent believes that technology could assist the environment. He displayed concern for water pollution within the organisation and understood the impact this could potentially have on the environment. |
| | **Manager** | The respondent was neutral regarding environmental impact. The reason for this being that as a small operation, the impact is already monitored closely. The organisation considers itself to be carbon neutral. |
| **B** | **Worker** | The respondent welcomed any improvements that technology could make to the environmental impact of the organisation. Technology could assist in highlighting and educating workers as to the potential dangers. This would ultimately benefit everybody; even those external to the organisation. The respondent acknowledged that the environment is of utmost importance. |
| | **Manager** | The respondent welcomed the ability of the technology to highlight any damage being done to the environment by the organisation. He further commented that any damage to the environment which is detected would be actioned for resolution. The more data which is gathered can only result in improvements. The respondent is concerned that natural resources are not considered as they should be. |
| **C** | **Worker** | The respondent was not sure that many more improvements could be made within the organisation to minimise impacts on the environment further. The only |

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| | | area which he believed could be monitored and improved was in the area of emissions. |
| | **Manager** | The respondent did not believe that the organisation was guilty of excessive emissions; although he did acknowledge that their operation did require large amounts of electricity in order to function. The highest risk would be from oils used in the operations; incorrect disposal would result in catastrophic damages. The respondent wishes to see a paperless environment within the organisation and believes that this would be easily achievable. |

**Table 32 - Summary of human capital**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent believes that this is important and that the company should be monitoring everything from a safety perspective. If people are healthy, then they can work. |
| | **Manager** | The respondent welcomed any improvements which could be made to improve the health and well-being of staff members. He added that there would be more advantages derived from implementing technology than disadvantages. |
| **B** | **Worker** | The respondent noted that most organisations these days are moving towards obeying laws that are in place from a health and safety perspective. He believes that as long as everybody sticks to standards with the help of technology; this would be to the benefit of all involved. He further noted that companies should not do this just to conform to laws; it should rather be done because it is the right thing to do. |
| | **Manager** | The respondent believes that technology would most certainly benefit human capital within an organisation. It was noted that any actions made in this regard would benefit all involved and that this should be considered |

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| | | upfront when considering the implementation of technology. He stated once again that a healthy workforce is a happy workforce and morale is important. The more technology can assist in this regard; the more technology would be considered for implementation. |
| **C** | **Worker** | The respondent believes that the implementation of technology in this regard would only result in improvements to the lives of all involved. He noted that if people are more comfortable and operate within a healthier and safer environment, then it would only be beneficial. |
| | **Manager** | The respondent indicated that health and safety inspectors have been obstructive in the past. The respondent believes that technology could only assist to a certain extent in this regard. He did, however, acknowledge that technology could be hugely beneficial in certain situations; this was not the sentiment for any health and safety related issue though. He welcomed the possibility of technology being used to highlight and warn workers of dangerous situations. |

**Table 33 - Summary of social capital**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent believes that technology can help anything within the organisation, and this would help the company work better. The respondent hoped that this would help the organisation as a whole. |
| | **Manager** | The respondent was not concerned with a social capital perspective. The respondent believes that job creation, which the organisation has achieved, is the measure of success from a social perspective. |
| **B** | **Worker** | The respondent believes that as long as people have jobs, they are safe at work and there is a low impact on the |

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| | | environment then the organisation has been successful from a social capital perspective. |
| | **Manager** | The respondent believes that there is a possibility that positive impacts could be made from a social perspective. He did, however, indicate that he believes that the organisation is already doing what it could. |
| **C** | **Worker** | The respondent hopes to see technology being used to help people in the community surrounding the organisation. He added that beyond the technology being implemented, older technology such as computers could be distributed to nearby schools. He noted that the more people in the community that have access to technology, the more adopting the community and its contributing workers would be useful to the implementation of technology. This could potentially result in fewer issues when the company wishes to implement the technology. This would be hugely beneficial to the company's reputation too. The respondent noted that organisations existed to make a profit and provide jobs but noted that there should be a balance between making a profit and doing the best for the economy and the community as a whole. |
| | **Manager** | The respondent believes that it could assist with community upliftment in some form; this would result in positive changes from a social capital perspective. |

**Table 34 - Summary of financial capital**

| Company | Respondent | Answer |
|---|---|---|
| **A** | **Worker** | The respondent believed that technology could assist with anything within the organisation as long as people do not lose their jobs. |
| | **Manager** | The respondent believes that more stability is possible and therefore more confidence would be possible too. He added that any changes to efficiency and productivity would ultimately have a positive effect on financial capital within the organisation. |
| **B** | **Worker** | The respondent indicated that as long as live data being provided by the technology could be trusted, then everyone could evaluate themselves and make changes to use fewer materials and consumables. This would have a positive effect on financial capital for the organisation. He did, however, hope that there would be a possibility of using any data to defend himself in certain situations too. He believes that it is important that workers understand the technology and data in order to learn from their mistakes and make improvements. The respondent pointed out the potential of technology to assist new workers in speeding up their learning curve. The technology can also be used to test new processes within the manufacturing environment. The net effect of all of the above would be a positive change to financial capital within the organisation. |
| | **Manager** | The respondent believes that any changes that would reduce headaches within the production environment and result in work being less intensive would be beneficial to the organisation as a whole. He added that with time, production would be more efficient and seamless, and this would result in benefits to financial capital for the organisation. |
| **C** | **Worker** | The respondent believes that if people are considered and acknowledged, then they will work harder; this would have a positive effect on worker productivity and efficiency. He believed that things regarding this could only improve. An |

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| | example of this would be less raw materials being used and scrapped. He added that if everybody was on the same page, then other processes could be more informed and efficient within the organisation. He further added that technology might assist the organisation to help its customers solve their manufacturing problems too. All of the above have a positive effect on financial capital for the organisation. |
| **Manager** | The respondent believes that efficiencies could be achieved that typically would not be possible without the implementation of the technology. The organisation relies heavily on workers to write down and report on production. This includes the time which machines operate; ultimately affecting costing of jobs. Higher accuracy would result in better quoting and production planning. The respondent expressed concern that a large level of human input would still be required with the technology. |