# Impact of technostress on productivity and overall life satisfaction of managers working at a ferrochrome smelting company

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## DECLARATION

I, Daniël Jacques le Roux, hereby declare that the research reported in this mini-dissertation entitled **impact of technostress on productivity and overall life satisfaction of managers working at a ferrochrome smelting company** is my original work and any source used in the research has been acknowledged through references.

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## ABSTRACT

Information Communication Technology (ICT) is revolutionising how we do business. ICT advances (which includes technology like computers, tablets, and cell phones) allow for information flow like never before, both in speed and volume. Unfortunately, the characteristics of ICT, which makes the technology so alluring to individuals and organisations (i.e. reliability, presenteeism and accuracy), are also causing stress to the users, more specifically, "technostress". The term technostress was first used by clinical psychologist Craig Brod in 1984, who described it as "a modern disease of adaption caused by the inability to cope with new computer technologies healthily". It has been shown that technostress can affect productivity and overall life satisfaction. The central purpose of this research was to investigate the impact of technostress on the productivity and overall life satisfaction of managers working at ferrochrome smelters.

The following conceptual-theoretical frameworks were used to frame the research factors: a Transactional Model of Stress and Coping (TMSC) for technostress (which assisted in defining technostress as consisting of five techno-stressors), the Self-Determination Theory for life satisfaction and the Goal-Setting Theory for productivity. This research also aimed to: measure the validity and reliability of the technostress, productivity and life satisfaction measuring instruments in the South African context; establish the levels of technostress, productivity and life satisfaction of managers and determine if there are practically significant differences in the mean scores of technostress, productivity and life satisfaction between gender, age groups, operational units and management levels. The research was approached from a positivistic paradigm, utilising a cross-sectional research design. Google forms were used to administer the questionnaire, and 106 valid responses were received. The data were analysed using the IBM Statistical Package for the Social Sciences (SPSS).

The findings reveal that the instruments used to measure productivity and life satisfaction is reliable and valid in the South African context. The factorial structure of the technostress instrument was not perfectly aligned with the literature. All techno-stressors loaded as expected, except for techno-insecurity (two of the items loaded better to a sixth factor). Despite this, the instrument was still reliable, with a Cronbach alpha of 0.699. The results indicate that managerial employees experience low levels of technostress. They report high levels of IT-enabled productivity and also score above average for life satisfaction. No practically significant differences exist for any of the research factors between males and females. The degree to which techno-complexity and techno-uncertainty are experienced seems to be increasing with age. Practically significant differences exist between the research factors between the organisational units. From the results, it is clear that technostress does not affect productivity. Although a negative correlation exists, it is practically non-significant. The correlation coefficient between technostress and life satisfaction is -0.245. This result indicates that a negative relationship exists between technostress and life satisfaction, in that an increase in technostress leads to a decrease in life satisfaction. It is noted that this correlation is approaching the effect of being practically visible. These results are very much aligned with the existing literature.

**Keywords:** technostress, techno-stressors, productivity, life satisfaction, techno-complexity, techno-overload, techno-invasion, techno-uncertainty, techno-insecurity, managers, ferrochrome smelter.

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| ANOVA | Analysis of Variance |
| APA | American Psychological Association |
| AVE | Average Variance Extracted |
| COVID-19 | Coronavirus Disease of 2019 |
| D-A | Demand-Ability |
| EFA | Exploratory Factor Analyses |
| EMS-REC | Economic and Management Sciences – Research Ethics Committee |
| ICT | Information Communication Technology |
| IT | Information Technology |
| KMO | Kaiser-Meyer-Olkin |
| M | Mean |
| MIS | Management Information System |
| NASA | National Aeronautics and Space Administration |
| RLSS | Riverside Life Satisfaction Scale |
| SD | Standard Deviation |
| SDT | Social Determination Theory |
| SPSS | Statistical Package for the Social Sciences |
| S-V | Supplies-Value |
| SWLS | Satisfaction with Life Scale |
| TMSC | Transactional Model of Stress and Coping |

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# CHAPTER ONE: INTRODUCTION AND BACKGROUND TO THE RESEARCH

## 1.1 INTRODUCTION

This chapter aims to introduce the problem and give an overview of the research that was conducted. This will include a detailed background, clarification of the problem observed, and the research method to address the research questions. The chapter is concluded with an outline of the chapters in the remainder of the document.

## 1.2 BACKGROUND TO THE RESEARCH

ICT is revolutionising how we do business. ICT advances (including technology like computers, tablets, and cell phones) allow for information flow like never before, both in speed and volume. It takes little to no effort to forward an email to multiple recipients. Similarly, creating a WhatsApp group is only a few touches of the screen away, where a variety of content can be shared in an instant at any time of the day.

Unfortunately, the characteristics of ICT, which makes the technology so alluring to individuals and organisations (i.e., reliability, presenteeism and accuracy), are also causing stress to the users, more specifically, "technostress" (Ayyagari *et al.*, 2011:849). The term technostress was first used by clinical psychologist Craig Brod in 1984, who described it as "a modern disease of adaption caused by the inability to cope with new computer technologies healthily" (Van Eck, 2005:1). It has been shown that technostress can affect productivity and overall life satisfaction.

In the literature, there is contradictory evidence as to the effect of technostress on productivity. For example, Pirkkalainen et al. (2019:1203) found that increased technostress decreased productivity, whereas Lee *et al*. (2016:785) found that higher levels of strain increased productivity. According to Kazekami (2020:9) and Lee *et al.* (2016:786), an increase in technostress decreases overall life satisfaction.

Most research was conducted on employees who are exposed continuously to ICT as a regular part of their workday, such as "computer professionals" (Van Eck, 2005) and "IT consultants" (Ferziani *et al.*, 2018). The problem with this approach is that ICT has advanced to such a stage that it is filtering through and becoming an integral part of most business functions and, as a result, potentially affects employees who did not specialise in IT (Information Technology). The focus of this research is on such a sample of employees – managers working at ferrochrome smelters. In this research, the effect of technostress on both productivity and overall life satisfaction was investigated for managers working at ferrochrome smelters.

## 1.3 RATIONALE FOR THE RESEARCH

The first research gap identified was that little technostress research had been conducted in the African and South African context. According to Van Eck (2005:51), limited research has been conducted on technostress in a South African context. Bonnah (2015:2) makes a similar comment as it pertains to sub-Saharan Africa.

The second research gap relates to the occupation of the sample subjects. Most research was conducted on employees who are constantly exposed to ICTs as a normal part of their workday, such as "computer professionals" (Van Eck, 2005) and "IT consultants" (Ferziani *et al.*, 2018). The problem with this approach is that ICTs are proliferating throughout organisations, affecting people who are not ICT specialists. Therefore, this research focussed on non-ICT specialists (i.e. managers), but due to the nature of their work, it could still be reasonably expected that they are exposed to ICT as a normal part of their workday.

## 1.4 PROBLEM STATEMENT

Technological advancements over the past few decades have had a pronounced effect on how companies do business. These advancements have affected nearly all aspects of working life (Sowell, 1995). When laptops, cellular phones, the internet and video conferencing started emerging in the 1990s, people began reacting negatively towards technology (Hess, 2004). These adverse effects on attitudes, thoughts, and behaviour, either directly or indirectly through the use of technology, result from what was termed "technostress" (Weil & Rosen, 1997).

The literature has shown increased levels of technostress can lead to a decrease in productivity (Pirkkalainen *et al*., 2019) and overall life satisfaction (Lee *et al*., 2016).

Because the list of new technologies is growing daily (West, 2019), the research topic of technostress and its possible adverse effects on productivity and overall life satisfaction remains current and relevant. Besides the potential effects on productivity and overall life satisfaction, various international organisations such as the International Labour Organization and the World Health Organization have also voiced their concerns about the potential negative effects of technostress on employee health (Mahboob & Khan, 2016).

This study aimed to contribute to the technostress body of knowledge by addressing especially two identified research gaps. These research gaps related to the location and occupation of the target population. The research aimed to determine to what degree non-ICT specialists (in this case, managers working at a ferrochrome smelting company) experience technostress and its effect on their productivity and overall life satisfaction.

## 1.5 RESEARCH OBJECTIVES AND QUESTIONS

The objectives of this research were to:

- Measure the validity and reliability of the technostress, productivity and life satisfaction measuring instruments in the South African context.
- Establish the technostress, productivity and life satisfaction levels of managerial employees.
- Determine if there are practically significant differences in technostress, productivity and life satisfaction between gender, age groups, operational units and management level.
- Establish if there is a correlation between technostress, productivity and life satisfaction.

Based on the objectives, the following research questions were formulated:

- Are the technostress, productivity and life satisfaction measuring instruments valid and reliable in the South African context?
- What is the technostress, productivity and life satisfaction levels of managerial employees?

- Are there practically significant differences in the mean scores of technostress, productivity and life satisfaction between gender, age groups, operational units and management levels?
- Is there a correlation between technostress, productivity and life satisfaction?

## 1.6 PRELIMINARY LITERATURE REVIEW

In this brief literature review, the three main factors related to this research will be conceptualised and elaborated upon. These factors are technostress, productivity and life satisfaction. After that, an overview of previous studies that explored similar relationships will be provided.

The term "technostress" was coined by Craig Brod in 1984, who described it as "a modern disease of adaption caused by the inability to cope with new computer technologies in a healthy manner" (Van Eck, 2005:1). Technostress is stress brought about by the use of technology. This "dark side" of technology was already identified by 1984 in a technological landscape vastly different from the one we currently find ourselves in. If technostress was applicable then, how much more are users not exposed in the modern era where, for example, current hand-held devices are significantly more capable (Silverman, 2019) than the computers used by The National Aeronautics and Space Administration (NASA) to guide the first moon landings? Add to this computing power the internet and other communication technologies, a plethora of productivity-enhancing options exist, and it has had a significant effect on the way businesses conduct their work (Ferziani *et al.*, 2018).

Technology implementation encompasses a wide field. Different characteristics of technology implementation can cause different forms of technostress. It has been proposed that technostress can be divided into seven forms of technostress: communication technostress, society technostress, boundary technostress, time technostress, workplace technostress, learning technostress and family technostress (Weil & Rosen, 1997). A more intuitive approach was later formulated using the TMSC and has since become the predominant theoretical framework for understanding technostress (Pirkkalainen *et al.*, 2019:1181). According to this framework, an individuals' appraisal of the external environment can lead to stress. ICT usage alters the external environment and can lead to technostress creators. These technostress creators act as stressors and cause strain, otherwise known as technostress.

Different technostress creators are associated with different aspects of ICT. According to Tarafdar *et al.* (2014:55), the five most prominent include techno-overload, techno-complexity, techno-insecurity, techno-uncertainty and techno-invasion. These stressors have been aptly named and, "they describe respectively, the stress-creating aspects of application multitasking and information overload, technical problems, continual relearning and consequent job-related insecurities, frequent system upgrades and consequent uncertainty, and constant connectivity, associated with organisational use of information systems by individuals".

The second research factor, productivity, can be defined as "a measure of the efficiency of a person, machine, factory and system in converting inputs into useful outputs" (BusinessDictionary, 2020). In this research, the impact of technostress on the "efficiency of a person" was investigated. The definition guides further as to the meaning of productivity, stating that it is "a measure of converting inputs into useful outputs". Different jobs entail different ways of converting inputs into valuable outputs. Some jobs are task-orientated, whereas others involve more strategic thinking processes and the ability to be innovative.

This line of thought is reflected by a factor defined by Tarafdar *et al.* (2010:311), referred to as "end-user performance". They described it as "the degree to which individuals use ICT to enhance their work performance and outcomes – that is, the extent to which ICT use contributes positively to their (ICT-mediated) tasks. ICT helps users improve their work performance by increasing their task efficiency, productivity and innovation". To summarise, it will be important to choose the correct measuring instrument to capture the full dimension of this factor appropriately. It needs to capture productivity as it relates to different jobs and how it was affected by ICT usage.

The third research factor is life satisfaction. According to the American Psychological Association (APA, 2020), "life satisfaction" can be defined as "the extent to which a person finds life rich, full, or high of quality". In the literature, the terms "happiness", "life satisfaction" and "well-being" are often used interchangeably (Lachman *et al.*, 2018). According to Margolis *et al.* (2018:1), one of the most catalytic events in well-being science occurred in 1984 when Ed Diener formally defined subjective well-being. According to this definition, subjective well-being comprises both affective well-being and (overall) life satisfaction. Affective well-being includes both positive and negative affect and is related to emotional aspects of subjective well-being, whereas life satisfaction represents the cognitive part of subjective well-being (Lachman *et al.*, 2018).

As indicated, this research aims to investigate the impact of technostress on productivity and overall satisfaction with the life of managers working at ferrochrome smelters. The effect of technostress on productivity and overall life satisfaction will be discussed briefly concerning specific studies. Tarafdar *et al.* (2010:304) conducted research that focussed on end-user satisfaction when using ICT's and perceived productivity gains. The research population consisted of 233 ICT users from two different organisations. It was found that an increase in technostress decreased productivity (Tarafdar *et al.*, 2010:328). Pirkkalainen *et al.* (2019:1179) conducted research on a population of 846 organisational ICT users where they theorised and validated a model of deliberate proactive and instinctive reactive coping for mitigating the effects of technostress. It was confirmed that an increase in technostress leads to decreased productivity (Pirkkalainen *et al.*, 2019:1203).

Lee *et al.* (2016:775) conducted research investigating the effect of technostress on productivity and life satisfaction. The research population consisted of 267 Korean's, and the focus was on instant messaging after work hours. It was found that respondents who reported higher levels of technostress also reported higher productivity levels due to ICT usage (Lee *et al.*, 2016:785). Lee *et al.* (2016:785) found that an increase in technostress leads to decreased overall life satisfaction in Korean respondents using ICT after work hours. According to these authors, this result was in line with results reported by Adams *et al.* (1996). Kazekami (2020:1) investigated the effect of telework (i.e., working from home using ICT) on productivity and life satisfaction, amongst other factors. Although technostress was not measured directly, it was found that too long hours of telework increased the stress of balancing work and domestic chores, which lead to stress and decreased life satisfaction.

To summarise the relationship between technostress and productivity, it can be seen that some inconsistencies exist and that different studies reported different results.

Overall, the tendency seems to be that an increase in technostress decreases productivity. The literature on the effect of technostress on overall life satisfaction is not as abundant. All indications are that a strong negative relationship exists between technostress and overall life satisfaction, where an increase in technostress should lead to a decrease in life satisfaction.

## 1.7 RESEARCH METHODOLOGY

This section aims to give a brief overview of the research design and methods used to address the research questions.

### 1.7.1 Research philosophy

This research was approached from a positivistic viewpoint. In other words, the assumption was made that causal laws exist and govern the relationship between various factors in that a change in a variable X has a predictable and measurable effect on a variable Y (Business Research Methodology, 2020).

The aim of positivistic research is to prove causality. It is, unfortunately, not as easy as it seems. It is generally agreed the four observations below need to be valid to prove causality. The first three can be attributed to John Stuart Mill (Shadish *et al.*, 2002). Several philosophers discuss the fourth observation (Spector, 2019):

- Cause and effect are correlated.
- Proposed cause occurs before the effect.
- Feasible alternative explanations can be ruled out for the above two observations.
- Proposed cause works through an articulated mechanism.

### 1.7.2 Research approach

According to the positivistic research design, fundamental laws exist governing interactions between factors (Business Research Methodology, 2020). Factors, once reduced to their simplest form, can be numerically measured. Hence, positivistic research aims to uncover the causal relationships that exist between factors. Since the process involves measuring factors and processing data, it naturally lends itself to a quantitative research approach. According to Cresswell (2009:4), the quantitative research technique can be defined as "the process that involves collecting quantitative data together with analysis to answer the stated research questions".

### 1.7.3 Research design

This research used a cross-sectional design. In a cross-sectional research design, the sample population is surveyed only once at a specific point in time. Looking at the second requirement for causality (see 1.7.1), the shortcoming of this design is evident as it measures cause and effect variables at the same point in time. It was, however, identified as the most applicable for this specific research for the following reasons:

- It is an inexpensive and resource-efficient design (Cherry, 2019).
- There are contrasting results as to the impact of technostress on, especially productivity. According to Spector (2019:133), the cross-sectional design is ideal for determining covariance (i.e., to comply with the first requirement of causality).
- The time lag between independent and dependent variables are not known. There is a risk in conducting longitudinal studies if the time between cause and effect is unknown since it might lead to incorrect inferences being made.

According to Spector (2019:135), "no single study, no matter what the design, is in itself conclusive, but rather, it is a body of research across many researchers using a variety of methods that allow us to have confidence in our conclusions". For the researcher, it is crucial to be aware of the inherent flaws of the research design being utilised.

### 1.7.4 Population

The population of this research is "managers working at a ferrochrome smelting company". This population directly address the research gaps identified in this study.

### 1.7.5 Sample method and sample size

According to Haegele and Hodge (2015:64), "the larger group of people whom the researcher hopes to infer the findings from the study is referred to as the population".

Selecting the correct people from the population (known as sampling) is one of the most critical research elements (Fraenkel *et al.*, 2012). According to Haegele and Hodge (2015:64), the first step in formulating a sampling strategy is correctly defining the intended population of the research. In this case, the research population consists of "managers working at a ferrochrome smelting company". The research population size is approximately 200 individuals.

Sampling for quantitative research can be done in a random or non-random way. In random sampling, each member of the population has an equal chance of being selected for the sample. In non-random sampling, the idea is to incorporate units in the sample that possess specific characteristics applicable to the research.

For this research, it was decided to use non-random sampling. In line with the research gaps identified, this research focussed on managers working at ferrochrome smelters. The total population size was relatively small, at approximately 200 units, so it was decided to use a census to gather as much as possible information. Sampling units are extracted from the collective, whereas a census attempts to elicit information from each unit in the population (Walliman, 2011). This ensured that representative data was collected.

### 1.7.6 Measuring instruments

Three measuring instruments were used to measure the factors used in this research (technostress, productivity and life satisfaction). Permission was obtained from the original authors to use the instruments cited below. Please see Table 1-1 for a summary of the instruments and original authors and Appendix A for the questionnaire that was distributed. Each instrument is briefly discussed below.

**Table 1-1: Summary of measuring instruments**

| No | Factor | Source |
|---|---|---|
| 1. | Technostress | (Chen, 2015) |
| 2. | Productivity | (Tarafdar *et al.*, 2007) |
| 3. | Overall satisfaction with life | (Margolis *et al.*, 2018) |

**Technostress** - To measure technostress, an instrument developed by Chen *et al.* (2015) was used. This instrument is based on an instrument first developed by Tarafdar *et al.* (2007). Chen's version of the instrument was chosen because it was adapted for Chinese knowledge workers, whereas the original instrument was US-centric. Like China, South Africa is a developing country, and it was thought best to rather make use of Chen's version. The instrument consists of 23 items divided into five factors aimed at measuring the five techno-stressors. According to Chen *et al.* (2015), "all items have higher composite reliability coefficients than the benchmark value of 0.60 recommended by Bagozzi and Yi (1988). This suggests high internal reliability of the data. The Average Variance Extracted (AVE) values for all factors are higher than the threshold of 0.5, indicating that adequate discriminant validity exists".

**Productivity** - Recall from the brief literature review, it was concluded that care should be taken when measuring this factor. It was concluded that ICT's effect on productivity related to different types of jobs should be measured. In other words, ICT and, accordingly, technostress need to be incorporated when changes in productivity are assessed. Tarafdar *et al.* (2007) developed a factor they defined as "IT-enabled productivity", which comes close to meeting the above requirement. The face validity of the factor is clear with items such as, "This technology to improve my productivity" and "This technology helps me to perform my job better". A Cronbach alpha of 0.92 was calculated for the instrument. They concluded the instrument to have good reliability and validity.

**Life satisfaction** - The Riverside Life Satisfaction Scale (RLSS), developed by Margolis *et al.* (2018), was used in this research. The instrument is based on the Satisfaction with Life Scale (SWLS) developed by Diener *et al.* (1985), which has been the dominant measure of life satisfaction since its creation more than 30 years ago with more than 19,000 citations to date (Margolis *et al.*, 2018). The RLSS was chosen above the SWLS because it contains multiple indirect indicators of life satisfaction, increasing the effective bandwidth of the instrument. According to Margolis *et al.* (2018), the McDonalds ωt for the instrument ranges from 0.91 to 0.93.

### 1.7.7 Data collection

The measuring instruments described in 1.7.6 were used to compile the questionnaire. Google Forms were used as the platform to administer the questionnaires and collect the data. A link to the questionnaire was sent to all the managers forming part of the research population. Since COVID-19 lockdown restrictions were in place and most managers were working from home, one month was allocated for collecting data. One week before the questionnaire closing date, a reminder was sent out to ensure a reasonable response rate. Google Forms automatically compiles the data into an easy-to-use spreadsheet format.

### 1.7.8 Data coding and analysis

The data coding and analysis must address the research questions. Exploratory factor analyses (EFA) were used to determine whether measuring instruments are valid and reliable in the South African context. Descriptive statistics were used to represent the levels of various factors, and independent t-tests and ANOVA's (Analysis Of Variance) conducted to compare results between different groups. Furthermore, correlational coefficients were determined to establish the relationships between the various factors.

## 1.8 ETHICAL CONSIDERATION

As required by the NWU Business School, an ethics application to conduct this research was submitted and subsequently approved on the EMS-REC (Economic and Management Sciences – Research Ethics Committee) meeting of 31 July 2020 with an "A" number **NWU-00795-20-A4** (refer to Appendix B). A representative of the employer granted a request to obtain access to the research population (refer to Appendix C).

## 1.9 CLARIFICATION OF CONCEPTS

- **Technostress:** "Any negative impact on attitudes, thoughts and behaviours, or body physiology that is caused either directly or indirectly by technology and more specifically computers" (Weil & Rosen, 1997).
- **Productivity:** "A measure of the efficiency of a person, machine, factory and system in converting inputs into useful outputs" (BusinessDictionary, 2020). In this study, the impact of technostress on the "efficiency of a person" was investigated.
- **Life satisfaction:** "The extent to which a person finds life rich, full, or high of quality" (APA, 2020).
- **Managers:** In this context, "managers" refer to both middle and senior management. This is all employees with a job grading of D1 and higher on the Patterson scale (Diamond, 2019).

## 1.10 OUTLINE OF CHAPTERS

### Chapter One – Introduction and background to the research

Chapter One provides an introduction and background to the study. The chapter focuses on the rationale, problem statement, research objectives and questions, preliminary literature review and research methodology. Also, the ethical considerations, clarification of concepts and outline of chapters are discussed.

### Chapter Two – Literature review

In this chapter, the literature review was communicated, focusing on the relevant factors identified. Existing literature related to these factors were explored. The aim of the literature review was also to lay the foundation for the experimental design.

### Chapter Three – Experimental design

Using information gathered in Chapter Two, the questionnaire was developed, and relevant data analyses techniques identified to complete research objectives and ensure the reliability and validity of the results. The general process of issuing the questionnaires, collecting the responses were also be discussed.

**Chapter Four – Results and discussion**

Results of the data analyses were relayed in this chapter. This chapter aimed to ensure that all research objectives have been addressed sufficiently.

**Chapter Five – Conclusion and recommendations**

In this chapter, the research was finalised by summarising the results attained and confirming whether the research objectives have been met. The limitations of the research and managerial implications were discussed, followed by identifying areas for future research.

## 1.11 SUMMARY

In this introductory chapter, the problem investigated was introduced and elaborated upon. This research aimed to determine the levels of technostress experienced by managers working at ferrochrome smelting operations and what impact it has on their productivity and overall life satisfaction.

Research objectives were formulated and presented, followed by a preliminary literature review in which it was established that an increase in technostress should lead to a decrease in life satisfaction. The impact of technostress on productivity was not as clear, with different researchers reporting opposing results.

Finally, an overview of the research methodology was given, designed in such a manner to address the research objectives. A positivistic research approach was followed, employing quantitative research principles. The chapter was concluded by giving an overview of the remainder of the document.

# CHAPTER TWO: LITERATURE REVIEW

## 1.1 INTRODUCTION

The three primary factors related to this research will be conceptualised and elaborated upon in this literature review. These factors are technostress, productivity and life satisfaction. After conceptualisation, the factors will be investigated further based on previous studies. This will involve reflecting on the average levels attained for each factor, how it was affected by control variables such as gender and age, the instruments' psychometric properties, and correlations reported between factors. All this information will be required once the research results are discussed and research objectives addressed. The chapter concludes with a summary highlighting the key findings.

## 1.2 CONCEPTUAL-THEORETICAL FRAMEWORK OF TECHNOSTRESS

The term "technostress" was coined by Craig Brod in 1984, who described it as "a modern disease of adaption caused by the inability to cope with new computer technologies in a healthy manner" (Van Eck, 2005:1). Technostress can thus be thought of as the stress brought about by the use of technology. This "dark side" of technology was already identified by 1984 in a technological landscape vastly different from the one currently in existence. If technostress was applicable, imagine how much more users are exposed in the modern era. For example, current hand-held devices are significantly more capable (Silverman, 2019) than even the computers used by The National Aeronautics and Space Administration (NASA) to guide the first moon landings? Add to this computing power the internet and other communication technologies, a plethora of productivity-enhancing options exist. It has had a significant effect on the way businesses conducts their work (Ferziani *et al.*, 2018).

According to Ibrahim *et al.* (2007), technostress can lead to users experiencing adverse effects, including difficulties concentrating on a single issue, increased irritability and feelings of control loss. In conjunction with these effects, technostress may inhibit the users' ability to continue learning, negatively affecting their ability to adapt. This is critically important in a continuously changing ICT landscape (Wang *et al.*, 2008). According to Shu *et al.* (2011), it is essential to highlight the difference between computer anxiety and technostress. These two factors are often confused with one another. Computer anxiety manifests as a fear response when faced with computer usage. Even the possibility of having to use a computer can elicit this response.

On the other hand, technostress is a broader factor. It refers to the direct and indirect adverse effects of the user not meeting the cognitive and social requirements imposed by ICT usage. The authors give the following example to highlight the difference, "a professional IT programmer may have low computer anxiety because of his or her well-informed knowledge of and experience with the hardware and software. At the same time, he or she may have high technostress about the invasion of technology into his or her personal life" (Shu *et al.*, 2011:926).

Different theories serve as the theoretical foundation of technostress. Some examples of the theories used to study the factor in the past include the Chaos Theory, the Social Cognitive Theory, Person-Environment Fit Theory, and the TMSC. Each of these theories will be discussed briefly, followed by a detailed discussion of the TMSC, which formed the theoretical foundation for this research.

### 2.2.1 Chaos Theory

Chaos Theory found its beginnings in a field of study far removed from stress research. The person attributed to pioneering the field is Edward Lorenz (1993), who studied fluid flow dynamics at the time (Levy, 1994). In essence, according to chaos theory, seemingly chaotic behaviour as observed in various systems can be attributed to fundamental laws of interaction within the system. According to Levy (1994:168), "one of the major achievements of chaos theory is its ability to demonstrate how a simple set of deterministic relationships can produce patterned yet unpredictable outcomes". These interactions or "deterministic relationships" can be expressed as a set of differential equations in mathematical terms. What that entails, if all conditions are known at a point (t) in time, the state of the system can be determined at a time (t+1) by solving the set of differential equations (which are founded on the fundamental laws of interactions at play in the system). These types of analyses can be used to track the progression of a system as a function of time. To calculate the condition of a system at a predetermined time in the future, the starting state of the system needs to be defined exactly. Any small deviation here can have a massive impact on the progression of the system. The obvious question now is how can this theory be employed towards furthering knowledge in the social sciences domain and, more specifically, the technostress body of knowledge?

Levy (1994:169) had his reservations about chaos theory relevance, stating that "proponents of chaos theory enthusiastically see signs of it everywhere, pointing to the ubiquity of complex, dynamic systems in the social world..." Application of the theory itself, ironically, lends itself more to qualitative studies in the domain of social sciences. Asides from the obvious factor measurement constraints hampering quantitative research designs, there is the issue of determining whether a system is truly chaotic or simply random. There is considerable debate in especially finance and economic literature, about how one is to determine whether a series is chaotic or simply subject to random influences (Hsieh, 1991). The ability of some systems to move between chaotic and non-chaotic states adds to the complexity of the problem (Levy, 1994:169). Theoretically, even if the researcher knew the system is truly chaotic, deriving the underlying interaction relationships simply using a dataset is near impossible (Butler, 1990).

So although chaos theory is conceptually appealing in the way it proposes to explain the intricacies of human behaviour (which seems to be dynamic and non-linear), one cannot lose sight that it remains a theory with its foundations firmly in the natural sciences. This is a concern because natural sciences are fundamentally different from social sciences. Natural sciences are characterised by fundamental laws affecting the observed physical environment (Levy, 1994). Methods have been devised to measure these effects with a great degree of accuracy and reliability. These systems are solely a function of natural laws, and the system itself cannot change the natural laws. The social sciences differ from natural sciences in all the ways that matter related to the chaos theory. Factors in social sciences are challenging to measure in absolute terms (for a large part relying on self-report measures).

Furthermore, no "natural laws" exist governing the interaction between factors, thus not allowing for replicability and ultimately predictability. For example, specific stressors resulting from ICT usage may negatively affect one person, but that does not mean another person will necessarily be affected in the same way. Similarly, it also does not mean that the same person will be affected the same way on two different occasions when subjected to the same stressor (Jones, 1989). Unlike natural sciences, the possibility also exists for bi-directional causality (Levy, 1994:169). To a degree, an individual can alter their perceived environment and the relationships that exist. Think for a moment about emotion focussed coping behaviours such as avoidance behaviour. The stressor remains the same, but because the individual actively avoids it, the interaction cannot exist (on the contrary, imagine being able to remove the pull of gravity by simply ignoring its existence). In social sciences, all these interactions are highly susceptible to various other variables. To illustrate only the effect of time (from a multitude of variables), consider the opposing levels of strain you would experience when your work computer froze on a Monday morning, as opposed to the last hour of work on a Friday.

To summarise then, to utilise chaos theory the way it was intended, an extremely accurate measurement of the current state of a system is required and a set of differential equations completely describing all possible interactions within the system. Neither of these requirements can be met as soon as the transition is made to the social sciences domain, making the employment of the theory problematic. In a review Jones (1997) did, he comes to the same conclusion, stating that "… for the most part, chaotic dynamics are going to have its greatest influence on theory-building rather than empirics".

### 2.2.2 Social Cognitive Theory

This theory was developed in an attempt to explain general human behaviour (Edelgard, 2019). The first iteration of what we now know as Social Cognitive Theory was actually called Social Learning Theory. Albert Bandura (Edelgard, 2019) developed social Learning Theory in the 1970s. There were two leading schools of thought at that stage, diametrically opposed, that attempted to explain the mechanisms behind human behaviour. On the one hand, were the scholars that advocated psychodynamic theories. All human behaviour is governed by motivational forces operating in largely unconscious needs, impulses, and desires. Opposite to them was behaviourist theorists, who advocated that human behaviour are governed by the expected results of either punishment or reward (Edelgard, 2019). In other words, the individual acts in a certain way that leads to a specific outcome. If this outcome is favourable, the individual will repeat these actions to attain the favourable outcome once again. Conversely, if the actions lead to unfavourable outcomes, the individual will refrain from repeating those actions or behaviours.

Bandura did not agree with either of these exclusive schools of thought and postulated that both internal and external factors affect human behaviour via complex interactions (Edelgard, 2019). The main critique against the behaviourist theories was that human beings could learn by only observing others because of their superior cognitive abilities. This is the central premise of Social Learning Theory. In their personal capacity, individuals do not have to enjoy the rewards or suffer the consequences of making the action-reaction association. They merely need to observe it happening to someone else (Nabavi, 2012). This learning can occur through many sources such as social interactions, general media and personal experience. Learning then affects, to a degree, future behaviour by establishing outcome belief in individuals. That is the belief in outcomes as a result of certain behaviour. However, what Social Learning Theory failed to address, was why actual human behaviour regularly contradicted expected behaviour based on action-outcome pairs. In other words, why did individuals, when they know certain behaviours will lead to positive outcomes, not exercise those behaviours? To address this, the Social Cognitive Learning Theory was developed. A key component of Social Cognitive Theory is the concept of self-efficacy (Nabavi, 2012), defined as "an individual's belief in his or her capacity to execute behaviours necessary to produce specific performance attainments" (Bandura, 1977). Therefore, although the individual might believe that certain behaviours will lead to positive outcomes, this belief will only translate to action when the person also believes he/she is capable of achieving at the required level necessary to earn the positive outcomes.

Shu *et al.* (2011) applied Social Cognitive Theory in an article they wrote examining the impact of computer self-efficacy on technostress. They found that an increase in computer self-efficacy was negatively associated with technostress. In other words, the higher the computer self-efficacy of an individual, the less technostress they will experience. Intuitively this makes sense. However, it is crucial to distinguish what exactly was investigated because there are some fundamental restrictions on what can be learnt about technostress using the social cognitive theory. In this instance, Social Cognitive Theory was used to investigate how individuals with varying levels of computer self-efficacy experience technostress. Therefore, the focus of the research was not on technostress and its characteristics but rather on the users' self-efficacy and how it allowed them to moderate perceived levels of technostress. The social cognitive theory attempts to explain human behaviour, limiting what can be discovered about technostress as a factor because it only focuses on stress perception and not the source.

### 2.2.3 Person-Environment Fit Theory

The social cognitive theory focuses on the individual and especially self-efficacy as a means to moderate potentially stressful events; Person-Environment Fit Theory acknowledges the significant role of the environment in creating stress perceptions in individuals (Edwards & Cooper, 1990:293). In essence, this theory advocates that stress perception occurs due to a misfit between the person and the environment in which he/she is functioning. According to Edwards and Cooper (1990:293), the Person-Environment Fit Theory has a long-standing history in psychology, tracing it as basic tenets back to influential writers such as Lewin (1938) and Murray (1938). According to this theory, stress is not solely a function of individual characteristics, nor is it solely a function of the environment. Instead, it exists as a result of a misfit between the person and the environment. The larger the misfit, the greater the perception of stress (Edwards & Cooper, 1990:297).

"Misfit", or the "degree of fit", can be a difficult concept to understand. According to Edwards and Cooper (1990:295), there are basically two types of misfits, which can be anchored in the characteristics of the environment (because it is less complex than the other side of the equation, the person). The environment can either place demands on the person, or it can provide supplies. As an example, consider the work environment of a white-collar worker. He/she is employed to conduct certain work tasks. These work tasks can be considered as demands placed on the individual from the environment. Similarly, the employer made sure the employee has all he/she needs to conduct the work, like office space, dedicated time and necessary IT equipment. All these resources can be considered as supplies from the environment.

When there is a mismatch between the demands from the environment and the employee's ability and/or personal skills to meet those demands, a misfit occurs.

According to Edwards and Cooper (1990:295), these types of misfits are called D-A (Demand-Ability) misfits. The second type of misfit originates as a result of supplies from the environment. Suppose all necessary resources are available, and the employee values hard work, and one of his goals is to get promoted (for which he knows he will have to go the extra mile in terms of meeting work demands). Should this employee fail to utilise the supplies in the environment (which contradicts what he values), it will lead to internal strain. These misfits are called S-V (Supplies-Value) misfits. According to Edwards and Cooper (1990: 295), S-V misfit is a misfit between environmental supplies and personal motives, goals and values.

Application of Person-Environment Fit Theory poses various challenges. According to Edwards and Cooper (1990:294), "these problems include an inadequate distinction between different versions of fit, confusion of different functional forms of it, poor measurement of its components, and inappropriate analysis of the effects of fit". Interestingly, based on a literature review of the Person-Environment Fit Theory that these authors reported on in the same article referenced above, they make the following statement, "...these theoretical, traditional, and intuitive arguments for the person-environment approach are far more abundant than arguments based on empirical evidence" (1990: 293). Despite the aforementioned issues, the theory has a firm support base, although its application in positivistic-style research is debatable. To elaborate on this point, consider research conducted by Wang *et al.* (2020), where technostress experienced by university students in a technology-enhanced learning environment was studied using a multidimensional person-environment misfit approach.

According to these authors, prior studies that investigated technostress using Person-Environment Fit Theory focussed only on one dimension and failed to expand the holistic understanding of the factor (Wang *et al.*, 2020: 2). They attempted to bridge this gap by defining additional dimensions. Since the theory utilised focuses on the person and the environment (and how well they fit), one would expect one of these factors to be altered to provide additional dimensions to the analysis. It does seem that this is what they attempted to do (to a degree). They defined the following three additional dimensions: person-organisation fit, person-technology enhanced learning fit and lastly, person-people fit. The concern is the claim that additional dimensions add to our understanding of the factor, especially when considering the researchers chose these dimensions. It may very well be true that it does assist in our understanding of the factor, but to what extent will we can extrapolate the results to different scenarios? In other words, the subjectivity involved in defining the dimensions is a real concern, and if we rely solely on this theory to expand our knowledge of technostress, how many more "environments" (or dimensions) will we need to identify, measure and analyse? It is clear to see that this approach lacks the attributes needed to be used in multiple scenarios, making it almost impossible to compare results from different studies.

### 2.2.4 Transactional Model of Stress and Coping

The TMSC was developed by Lazarus and Folkman (1984). This model was chosen as the theoretical framework for this research for reasons that will be elaborated upon below. The TMSC can be seen as an extension of the Person-Environment Fit Theory. According to the Person-Environment Fit Theory, stress result when there is a perceived mismatch between the person and the environment. Two fundamental classifications of misfit were identified. A misfit either occurs due to an environmental demand and a perceived inability to meet the demand (D-A misfit) or as a result of an environmental supply not aligned with the person's values (S-V misfit). According to Edwards and Cooper (1990: 295), the TMSC effectively links these two fundamental sources of misfit, in that a D-A misfit will only lead to stress if it also infringes upon the value system of the individual, thus causing an S-V misfit.

Suppose a person is viewed as a system, isolated from the external environment. According to TMSC, such a person would not be able to experience stress. Similarly, if an environment is defined in terms of a system, stress cannot exist in this system. Stress can only (potentially) exist when these systems interact (Lazarus & Folkman, 1987: 142), hence the "transactional" in the name of the model. According to the same authors (1984:142), "we need a language of relationships in which the two basic subsystems, person and environment, are conjoined and considered at a new level of analysis. By this, we mean that in the relationship, their independent identities are lost in favour of a new condition or state".

When these systems interact, the characteristics of each system will affect the type of interaction. For example, although environmental conditions can be identical, it does not mean that different people will be perceived it similarly. That is because no two people are the same. People differ in how they were brought up, how they see the world, their religion, beliefs, values, past experiences and goal hierarchy. These influencers shape the lens through which the person views the environment and, resultantly, the transaction that takes place. The result of this is that similar environmental stimuli can potentially lead to a multitude of emotional responses. According to the TMSC, this initial observation of the stimuli by the individual is referred to as the "primary appraisal" (Lazarus & Folkman, 1987:145). According to these authors, "primary appraisal is concerned with the emotional relevance of what is happening, that is, whether something germane to our well-being is involved. Primary appraisals of stress are of three types: harm already experienced; threat, which is harm that is anticipated; and challenge, which is the potential for mastery or gain". They also added "benefit" to expand the model to one dealing more broadly with emotion.

The TMSC deals with person-environment interactions that lead to stress perceptions. The primary appraisal outcomes of harm and benefit will not result in lingering perceptions of stress. Oppositely, if a stimulus is perceived as either being a threat or a challenge, the individual will proceed to the second stage of cognitive evaluation, referred to as "secondary appraisal" (Perrewe & Zellars, 1999). Before discussing what a secondary appraisal means, briefly consider why only threat and challenge will lead to stress. It is easy to understand why a primary appraisal of threat will lead to stress because it most definitely will result in harm if not addressed. That makes it important for the individual to assess correctly and act appropriately. A primary appraisal outcome of the challenge, on the other hand, can lead to potential gain or harm. In the work environment, various stimuli (in the form of tasks) can lead to this outcome. Work tasks are challenging. For the population under investigation, tasks are primarily completed using ICT. So, it is clear to see how ICT forms part of the environment (especially with challenge outcomes) and the potential for the technology to alter demand perceptions. Depending on user proficiency, available hardware, software and support, the perceived demand can be exacerbated or nullified. Accordingly, for the individual, these challenge outcome results from primary appraisal represent high-stakes scenarios, requiring a secondary appraisal to determine what actions should be taken to reach a state of gain and avoid harm. ICT can lessen the perceived misfit or even increase it, which will lead to perceptions of technostress.

In simple terms, a secondary appraisal is "a judgement concerning what might and can be done" (Lazarus & Folkman, 1984: 53). During this process, the individual will evaluate different courses of actions, determine whether the actions are feasible and what will be the result of enacting the specific actions (Perrewe & Zellars, 1999). This decision-making process and the action that follows can be considered the coping mechanism employed. According to Beaudry and Pisonneault (2005: 494), coping "deals with the adaptational acts that an individual performs in response to disruptive events that occur in his/her environment". However, just because the decision-making process was completed and led to the specific behaviour to eliminate the person-environment misfit (i.e. coping) does not mean this conscious decision-making process will not be revisited. Suppose the coping mechanism and subsequent action employed do not resolve the perceived misfit. In that case, the individual will revisit this process, with the newly acquired knowledge from failure, and decide on a new course of action to eliminate the misfit leading to the stress experience.

Similar to the prior theories discussed, the question must now be asked how this model can be used to extend technostress knowledge? More specifically, in this case, why is this theory more applicable for this research than the others discussed?

From the theories discussed, Person-Environment Fit Theory seemed like the most applicable framework to conduct this research. However, the primary concern with Person-Environment Fit Theory was its suitability for conducting empirical research. This stems from various difficulties experienced in measuring "fit". Additionally, in a perfect world where fit could be measured, there is the question of how it must be applied to technostress as a separate factor? Fit, per definition, is a function of both the environment and the person because a change in any could potentially influence fit. Logically then, the results from a fit analysis cannot be superimposed on only one of the factors that influenced fit but must be seen as a function of both.

This is where the TMSC is more applicable for technostress research. As with Person-Environment Fit Theory, the TMSC acknowledges that perceived stress is both a function of the person and the environment. However, the focal point of this theory is not measuring the extent of fit but using the concept to identify specific aspects of the environment that could trigger threat or challenge outcomes that leads to stress. These specific aspects, or stimuli, are called stressors. According to Srivastava *et al.* (2015: 358), "stressors or stress creators are the factors that cause stress".

So this model allows for the investigation of stressors and their effect on people. ICT, which could lead to technostress, is a broad term. According to Ferziani *et al.* (2018: 1), "in the post-modern era, almost all human work has been computerised. Almost everything can be done with computerised technology systems to make it easier and more efficient". So how can such complexity be studied? TMSC provides a solution through the concept of "stressors".

Once the concept of stressors is employed, some common attributes can be identified that place demand on users' abilities in similar ways. To elaborate, consider for one moment the feelings experienced when confronted with a brand new phone (with its state of the art operating system) versus a new software package installed on the work computer. Although the type of technologies is different, the unknown and the complexity of the technology create stress. This complexity originating from ICT usage (called techno-complexity) is only one of five techno-stressors that is commonly referenced. The other four include techno-overload, techno-insecurity, techno-uncertainty and techno-invasion (Tarafdar *et al.*, 2014:55). These five techno-stressors are discussed below.

Different technostress creators are associated with different aspects of ICT. According to Tarafdar *et al.* (2014: 55), the five most prominent include techno-overload, techno-complexity, techno-insecurity, techno-uncertainty and techno-invasion. These stressors have been aptly named and, "they describe respectively, the stress-creating aspects of application multitasking and information overload, technical problems, continual relearning and consequent job-related insecurities, frequent system upgrades and consequent uncertainty, and constant connectivity, associated with organisational use of information systems by individuals" (Tarafdar *et al.*, 2010). Each of these five stressors will be briefly discussed, and the common characteristics of ICT usage to give rise to them.

"Overload" can be defined as "to give someone more work or problems than they can deal with" (Cambridge, 2020). Similarly, Cooper *et al.* (2001) define work overload as "the perception that assigned work exceeds an individual's capability of skill level". Various forms of ICT exist in the modern workplace and are often combined uniquely to facilitate work processes. This often includes laptops, cell phones and tablets (Pirkkalainen *et al.*, 2019: 1180). All three of these devices are also portable and can be connected to the internet, allowing instant communication. These characteristics (i.e., portability and connectivity) have made it very easy to communicate, and according to Tarafdar *et al.* (2010: 311), there is a tendency for managers to overshare information. This unnecessary flow of information can lead to feelings of techno-overload because the subordinate will not know whether it is of importance or not and will likely feel obliged to process the information. This is exacerbated by the fact that various forms of ICT are used, and hence various flows of information exist, each of which requires attention and potentially some action (and often times simultaneously). It has also been shown that ICTs, and especially cell phones, can impede an employee's ability to attain a state of "flow" at work (Montag & Walla, 2016). "Flow" can be defined as "a state in which we are fully absorbed by an activity, forgetting about space and time, while being very productive" (Csikszentmihalyi & Csikszentmihalyi, 1992). In recent research conducted by Markowetz (2015), participants were found to check their smartphones as frequent as every 18 minutes. This unproductivity and work not getting done can add to the feelings of overload. Lastly, according to Hind (1998), "the use of ICTs has created a perpetual urgency and creates expectations that people need, or are obliged, to work faster".

There is a general complexity to ICT's that users find difficult to understand, which can lead to incompetence (Atanasoff & Venable, 2017: 328). This complexity forces users to spend time and energy to attain the necessary knowledge and skills to effectively use the new technology, something that they are sometimes unable or unwilling to do (Tarafdar *et al.*, 2010: 312). To fully understand the potential effect on the user, it must be taken into account that the time required to learn the new technology is offset against existing organisational tasks. Tarafdar *et al.* (2010) hypothesise as to the effect of techno-complexity on the performance of ICT-mediated tasks, "as they try to apply existing solutions to the new technologies unsuccessfully, initial errors get transmitted, and their effects are magnified, leading to reduced performance on ICT-mediated tasks". It is not only ICT hardware and software that can contribute to the complexity of the environment. As an example, D'Arcy *et al.* (2014) studied moral disengagement as a coping strategy to deal with the complexity associated with ICT security policies.

"Insecurity" can be defined as "a feeling of lacking confidence and not being sure of your own abilities or of whether people like you" and/or "a feeling of not being fixed or safe" (Cambridge Dictionary, 2020). Employees experience techno-insecurity when they feel they can lose their jobs to either new technology or to employees who are better equipped to handle newer technologies (Atanasoff & Venable, 2017: 328). "Job insecurity", on the other hand, can be described as the threat of losing one's job. This can be a real threat or a perceived threat stemming from feelings of inadequacy (Mauno & Kinnunen, 1999). These feelings of inadequacy are subjective, and each employee might experience the same situation differently (Van Vuuren, 1990). When exposed to job insecurity for an extended period, it can lead to burnout (De Witte, 1999), which is defined as "emotional exhaustion, and negative attitudes and feelings toward one's co-workers and job role. Burnout is associated with job dissatisfaction, low commitment to the job and absenteeism" (Wilson, 2020). In other words, "techno-insecurity" can be thought of as similar to "job insecurity" but originating specifically from the use of ICT's. Chen *et al.* (2015: 76) further postulated that employees experience a greater sense of techno-insecurity when they are the primary providers within their households. Employees who experience techno-insecurity reportedly have lower confidence in the use of ICT's, which negatively affects their performance when forced to use the technology (Heinssen *et al.*, 1987).

"Uncertainty" can be defined as "a situation in which something is not known, or something that is not known or certain" (Cambridge Dictionary, 2020). According to Tarafdar *et al.* (2010: 310), "techno-uncertainty refers to contexts where continuing changes and upgrades in ICT unsettle users and create uncertainty for them in that they worry about constantly learning and educating themselves about new ICT". Techno-uncertainty emanates from continuous changes in ICT's. This is not the same as techno-complexity, where the stressor was a result of difficulty understanding ICT. In this instance, the stressor is simply due to the volume of new technologies expected to be learnt. In other words, the employee can learn new technologies, but because it takes time, it acts as a stressor because it prevents other work from being completed.

Also, note the difference between techno-uncertainty and techno-overload. Techno-overload as a stressor resulted from the volume of work afforded by the new technology (and subsequent pressure on time). In contrast, techno-uncertainty is due to time pressures as a result of learning new technologies.

"Invasion" can be defined as "an action or process that affects someone's life in an unpleasant and unwanted way" and/or "the act of entering a place by force, often in large numbers" (Cambridge Dictionary, 2020). Techno-invasion is perhaps the most distinct of the techno-stressors. According to Tarafdar *et al.* (2010: 310), "techno-invasion describes the invasive effect of ICT in terms of creating situations where users can potentially be reached any time, employees feel the need to be constantly 'connected', and there is a blurring between work-related and personal contexts". Looking at the definition of techno-invasion, it is clear that laptops, tablets and smartphones will cause an increase in this stressor. For an aspiring person, the lines between work and family life can easily become blurred when time away from work is being used to complete work tasks. Due to the nature of the ferrochrome smelter industry, where it is the norm to operate furnaces on a 24/7 basis, techno-invasion may be of particular concern.

At first glance, the first four techno-stressors seem to overlap to a large extent. Some of the differences were highlighted. Although no such similar differentiation could be found in literature, it is perhaps convenient to firstly consider the first two techno-stressors (techno-overload and techno-complexity) due to how ICT's affected the nature of work itself. In other words, the implementation of ICT's lead to an increase in the volume and complexity of work. The third through fifth techno-stressors (techno-insecurity, techno-uncertainty and techno-invasion) are related to the nature of technology and how it infringes on the employees' perceived security and available time.

These five techno-stressors are representative of the primary person-environment mismatches. As can be seen, most of these mismatches result from the cognitive ability of the end-user. If end-users had all the required knowledge and infinite mental processing abilities, it would eliminate stressors associated with overload, complexity, uncertainty and insecurity. Stressors due to the invasive nature of ICT would likely persist. Aside from these mismatches originating from lacking cognitive abilities, it has been proposed that the physical environment could also contribute to technostress. As an example, Van Eck (2005:18) states, "technostress may be environmental in origin, poor ergonomics at computer work stations, for example, may leave staff feeling drained”. This potential source of technostress has been omitted in this research. The research population consists of management employees, so it can be reasonably expected that their offices have been set up to their liking, especially considering that each plant has its own IT department.

Therefore, by following the TMSC approach, the factor of technostress can be researched by reducing it to its resulting stressors (called techno-stressors) and investigating the effect of these stressors on the individual and, in doing so, also elaborate our understanding of the overarching factor which is technostress. If these stressors are adequately defined, it leaves open very little space for misinterpretation, solving one of the many problems associated Person-Environment Fit Theory. By measuring specific sub-factors, it adds improved validity and accuracy (as opposed to measuring "fit").

To summarise, the TMSC acknowledges that the same stressors can have varying effects on different people. What it allows the researcher to do, however, is to identify if there are stressors in the ICT environment that have a significant effect on the stress experienced by users. The TMSC has become the predominant framework for understanding technostress (Pirkkalainen *et al.*, 2019: 1181) and allows more readily comparisons between research.

## 2.3 CONCEPTUAL-THEORETICAL FRAMEWORK OF LIFE SATISFACTION

According to the APA (2020), “life satisfaction” can be defined as “the extent to which a person finds life rich, full, or high of quality”. In the literature, the terms “happiness”, “life satisfaction”, and “well-being” are often used interchangeably (Lachman *et al.*, 2018). According to Margolis *et al.* (2018), one of the most catalytic events in well-being science occurred in 1984 when Ed Diener formally defined subjective well-being. According to this definition, subjective well-being comprises both affective well-being and (overall) life satisfaction. Affective well-being includes both positive and negative affect and is related to emotional aspects of subjective well-being, whereas life satisfaction represents the cognitive part of subjective well-being (Lachman *et al.*, 2018).

There are predominantly two approaches/theories to life satisfaction that have been discussed intensely in recent years: the bottom-up versus top-down approaches (Lachman *et al.*, 2018). According to the bottom-up theory supporters, overall life satisfaction is a complex function of various aspects affecting life satisfaction, weighted according to what each individual deems important. An achievement-driven individual will experience more life satisfaction when reaching challenging goals. Similarly, an individual who places high importance on family life will experience more life satisfaction when family relationships are healthy. Different theories serve as the theoretical foundation of life satisfaction. Some examples of the theories used to explain the factor in the past include Lay Theory, Judgement-Type Theories and Self-Determination Theory (SDT). These theories will be discussed briefly with a more detailed discussion of SDT, which formed the theoretical foundation of this research.

### 2.3.1 Lay Theory

According to the Lay Theory, all people have certain lay (i.e. "implicit") theories about themselves (Dweck, 1999). That is, they see themselves in a particular manner. They perceive themselves as having a specific personality and personal attributes (such as intelligence, humour, honesty and ability to speak in public). According to Dweck *et al.* (1995), two types of lay theories are typically delineated: Incremental Lay Theory and Entity Theory. In the case of Incremental Lay Theory, this means that some people believe that their characteristics and attributes are malleable. They believe they have power over changing these attributes with time. For example, a person who believes himself to be of average intelligence might start playing chess to improve intelligence. Entity Theory is the opposite of this. These individuals believe a person is born with a set of attributes and abilities that remain fixed over time, and no amount of action can alter these attributes.

It is clear to see how these opposing views will affect behaviour. People who believe they have control will purposefully direct action to bring characteristics in alignment with what they value. These people will set goals and work towards the achievement of these goals. Individuals who believe in Entity Theory, on the other hand, will not work towards goals directed at improving themselves because they believe it will not change their current state of being. As such, the individuals who ascribe to Incremental Lay Theory are more likely to reach goals, achieve success, and experience increased levels of life satisfaction (Yeager *et al.*, 2014).

The question must now be asked how this theory can be applied to this research? Lay Theory speaks to the fundamental beliefs of a person as it pertains to their perceived ability to change personal attributes through directed behaviour. This research aims to determine what impact technostress will have on life satisfaction. A person who believes in Incremental Lay Theory will not react the same to stressors arising from ICT use as a person who believes in Entity Theory. A person who believes that he/she can develop the skills/attributes required to manage ICT demands will identify what is required to achieve this and work towards attaining the identified goals, thereby addressing the demands placed on their resources. Once reaching this stage, the person will consider it as a success which will increase life satisfaction. Oppositely, a person who does not believe in goal-directed behaviour will struggle to cope with the demands placed on their resources by ICT usage. This represents a no-win scenario, and the failure will decrease life satisfaction.

To summarise, this specific theory cannot be used effectively for this research because life satisfaction, according to this theory, is primarily a function of the individual and not the demands the person is exposed to. This research is interested in technostress (and techno-stressors) and how it affects life satisfaction.

### 2.3.2 Judgement-Type Theories

According to Meadow *et al.* (1992: 25), "the central postulate in all judgement theories of life satisfaction is that the degree of life satisfaction experienced by a person at any given moment in time is a direct function of a cognitive comparison between some standard and actual conditions". "Actual conditions", as per this definition, can refer to other people, or it can even refer to the individual himself. So, when a person judges himself to better and/or better off than the people around him (relatively speaking), this person will experience higher levels of life satisfaction (Carp & Carp, 1982). Similarly, if the person compares his current state with a state in the past, and there was an improvement, the person might experience higher levels of life satisfaction. This comparison to a previous-self is known as Range Frequency Theory (Parducci, 1982). According to Meadow (1992: 25), "Range Frequency Theory posits the standard used in judging one's current life is the person's own past life. If the individual judges that his/her current life exceeds this standard, the person is expected to be satisfied with life".

Another theory that can be classified as belonging to Judgement-Type Theories is Aspiration-Level Theory. According to this theory, life satisfaction is a function of the degree to which individual desires are being met (Emmons *et al.*, 1983). According to this theory, it is proposed that life satisfaction can, in mathematical terms, be expressed as a ratio of fulfilled desires divided by total desires. This means life satisfaction can be increased by either fulfilling more desires or having less, to begin with. Judgement-Type Theories is not applicable for this research because it does not allow for the detailed investigation of technostress as a factor and its effect on life satisfaction. According to this theory, life satisfaction is a result of cognitive judgement processes. For example, how does an actual situation compare to the ideal state? The closer aligned these two states, the higher the perceived levels of life satisfaction. The problem with this theory, in this application, is that the ideal situation itself can be a function of various variables and is not determined solely by the degree of technostress experienced. Varying technostress levels will not necessarily elicit the same emotional responses in different people because the net effect is judged differently.

### 2.3.3 Self-Determination Theory

As indicated, the SDT formed the theoretical foundation for this research. Richard Ryan and Edward Deci, from the University of Rochester in New York, started with the development of the SDT in the 1980s with a book they published by the name of "Intrinsic motivation and self-determination in human behaviour" (Centre for SDT, 2020). According to Ryan *et al.* (1997), "SDT is an approach to human motivation and personality that uses traditional empirical methods while employing metatheory that highlights the importance of humans' evolved inner resources for personality development and behavioural self-regulation".

One of the primary aims of this theory is to understand human motivation in the broader context. Why do people choose to act the way that they do? Why is it that some people can expend extraordinary amounts of discretionary effort to attain the unattainable, while others waste their lives away in front of television screens? Can these differences in behaviour be ascribed to innate personality differences, or is the person a product of his/her environment? This theory attempts to explain these vast differences in behaviour. Behaviour is driven by motivation, making motivation a key concept to understand if one wishes to understand why people choose to behave in a particular manner (Ryan & Deci, 2000).

A key assumption of this theory is that most people have an internal drive towards self-improvement, always striving to reach higher goals (Ryan & Deci, 2000:68). This innate drive by the majority of the population has resulted in favourable outcomes for society in general, but on a personal level, also for the individuals. It has been shown that these people, who aspire to improve, are more likely to experience success. They exhibit increased levels of effort, achieve higher performance levels, and experience more well-being than their counterparts (Ryan & Deci, 2000: 69). Within the context of this theory, the driving forces (i.e. motivation) behind these positive outcome behaviours can be conceptualised and, in doing so, also address why people would fail to exhibit these behaviours. A firm understanding of the underpinnings would theoretically allow for purposeful modification of the environment to increase the percentage of the population engaging in these positive behaviours.

According to SDT, motivation drives behaviour. These drivers, however, can be placed on a continuum based on the regulatory processes involved (Ryan & Deci, 2000: 72). At the one extreme is behaviour driven by intrinsic motivation. With these behaviours, no external regulatory processes are necessary because people will revert to these behaviours because they find them inherently satisfactory in nature (i.e., they enjoy doing it). It is these behaviours that a person will opt to do out of free will, with all other options being available. Intrinsic motivation is the only form of motivation where internal processes completely determine behaviour.

On the other hand, extrinsic motivation is a form of external influence impacting exhibited behaviour. People are engaging in certain behaviours as a result of happenings/regulations in their environment. The regulatory process could be as simple as rewards and punishment. In this instance, there are known causal relationships between behaviour and outcome. If I steal and get caught, I will go to prison. So, behaviours are actively engaged, which will lead to rewards and avoid punishment. If you were to take away the prospect of punishment (or reward), the person might engage in the behaviour or not.

Certain behaviours people engage in are not inherently enjoyable, but people believe in the behaviours (i.e., it is aligned with their values); hence, they will be more prone to exhibiting these behaviours. For example, a person who has a great love for nature and chooses to pick up litter during their free time does not do so because they find the activity inherently enjoyable but does so because it aligns with their values. From these two examples, it is clear that extrinsic motivation is a more complex phenomenon than intrinsic motivation. SDT recognises four types of extrinsic motivation, divided based on the regulatory process involved, as well as the perceived locus of causality (Ryan & Deci, 2000: 72). These four types of extrinsic motivation are integrated regulation, identified regulation, introjected regulation and external regulation. These four types of extrinsic motivation fit onto the continuum described above, with integrated regulation being closest to intrinsic motivation and external regulation being the furthest away from intrinsic motivation. Each of the four types will be briefly discussed, starting with integrated regulation, which is the extrinsic motivation form closest to intrinsic motivation.

The perceived locus of causality is internal. This type of extrinsic motivation is very closely related to intrinsic motivation. This type of extrinsic motivation is characterised by a complete integration of regulations to the self. So regulatory processes are not seen as external in source, but rather originate from internal sources. According to Ryan and Deci (2000: 73), "actions characterised by integrated motivation share many qualities with intrinsic motivation, although they are still considered extrinsic because they are done to attain separable outcomes rather than for their inherent enjoyment". The perceived locus of causality for identified regulation is somewhat internal. According to Ryan and Deci (2000:72), "identification reflects a conscious valuing of a behavioural goal or regulation, such that the action is accepted or owned as personally important". For example, people who frequently exercise because they believe in the value thereof for their future health are doing so due to identified regulation. Introjected regulation has a somewhat external perceived locus of causality. Regulations are not accepted as one's own, and behaviours are performed to avoid guilt or anxiety or to attain ego enhancements such as pride (Ryan & Deci, 2000: 72). With external regulation, the perceived locus of causality is external. Regulations are not necessarily agreed with and are complied with due to known causal relationships between behaviour and outcome (Ryan & Deci, 2000: 72).

The locus of causality is primarily determined by the degree of internalisation. Internalisation can be defined as "people's 'taking in' a value or regulation, and integration refers to the further transformation of that regulation into their own so that, subsequently, it will emanate from their sense of self" (Ryan & Deci, 2000: 71). To summarise then, the mode of extrinsic motivation that will prevail when faced with regulations is determined mainly by the degree to which the person internalises the regulations. This is important because the various extrinsic forms of motivation lead to different outcomes. When people are externally regulated, they tend to show less interest in the task at hand and generally tend to expend less effort towards successful completion. Opposite to this, people who have internalised external regulations and behave as a result of identified regulation tend to exhibit more interest in the task at hand; they are more engaged and expend discretionary effort towards completing tasks (Ryan & Deci, 2000:73). The question can now be asked, what affects the degree of internalisation since it has such a profound effect on the way regulations are dealt with? The short answer to this is the situational context, regulation characteristics and the degree to which it facilitates meeting basic psychological needs. According to Ryan and Deci (2000:74), “a psychological need, is an energising state that, if satisfied, conduces toward health and well-being but, if not satisfied, contributes to pathology and ill-being”.

According to Ryan and Deci (2000:73), behaviours that require extrinsic motivation are by definition unappealing to the person, as opposed to behaviours that are inherently enjoyable and that the person is internally driven to do. These unappealing behaviours and activities are executed nonetheless, for various reasons, one of them being as a result of the psychological need of wanting to feel associated (Ryan & Deci, 2000:73). People do certain things and act in certain ways to be included in the collective. Ryan and Deci (2000:73) call this psychological need "relatedness". Behaviours that enhance feelings of relatedness will be more readily internalised.

The second psychological need is for feelings of competence. A person who feels competent in doing certain work or exhibiting particular behaviour will more readily internalise the associated regulations. Lastly, autonomy plays a key role. People like having free choice in deciding how to act. People who are extrinsically motivated via external regulation and introjected regulation cannot experience autonomous motivation (Ryan & Deci, 2000:73). Regulations, which provide a degree of autonomy, will more readily be internalised. To summarise, when regulations promote relatedness, allow for autonomy, and the person has competence in dealing with the requirement, it will more readily be internalised, leading to either identified regulation or integrated regulation, both of which have advantages in terms of how the person approaches the requirements and outcomes that could be expected. According to Ryan and Deci (2000: 74), “basic needs for competency, autonomy, and relatedness must be satisfied across the life span for an individual to experience an ongoing sense of integrity and well-being”.

To conclude this section on life satisfaction, SDT was chosen as the most applicable for conducting this research. Lay Theory and Judgement-Type Theories fail to explain why technostress would lead to a decrease in life satisfaction. If SDT is used to view life satisfaction, it is conceivable how techno-stressors would impact life satisfaction. The use of ICT could potentially impact the three basic psychological needs that determine the mode of extrinsic motivation and, indirectly, satisfaction with life. Some examples include the rapidly changing ICT requirements that could lead to feelings of incompetence. The wide adoption of IT and communication technologies paves the way to a digitalised world, where person-to-person contact is ever decreasing, which might lead to feelings of loneliness (i.e., less relatedness), which will decrease life satisfaction. Lastly, feelings of autonomy might be diminished due to increased demands originating from various sources and enabled by ICT usage.

## 2.4 CONCEPTUAL-THEORETICAL FRAMEWORK OF PRODUCTIVITY

Productivity can be defined as “a measure of the efficiency of a person, machine, factory and system in converting inputs into useful outputs” (BusinessDictionary, 2020). In this research, the impact of technostress on the "efficiency of a person" will be investigated. It must be noted that the focus of this research is on the impact of technostress on productivity and overall life satisfaction and not the impact as a result of ICT usage.

According to Sineriz (2019:1), "the importance of employee performance is hard to understate; great employees improve your business, while poorly performing employees could leave you and your customers frustrated". This is a topic that has been studied extensively due to the substantial impact it could have on business sustainability. Subsequently, various theories have been postulated in an attempt to explain employee productivity, such as the Systems Theory, Job Demands-Resources Theory and Goal-Setting Theory. A brief overview was given of how the Systems Theory and Job Demands-Resources Theory are related to productivity. Thereafter, it will be explained why the Goal-Setting Theory was chosen as the theoretical framework for productivity.

### 2.4.1 Systems Theory

No matter where the focus is cast, complexity abounds. From the natural world to societal factors to human behaviour (to name but a few), more common than not is the fact that whatever is being studied is the result of various other factors and complex interdependencies between these factors. The approach typically followed is to remove complexity by zooming in on certain minute aspects and investigating how one affects the other. This approach to dealing with complexity is known as reductionism (Acaroglu, 2020). The assumption is that the total is the sum of its parts, so we can understand the larger factor by understanding the relationship between the parts.

Systems Theory is diametrically opposite to reductionism. The fundamental tenet of Systems Theory is that the sum is not equal to its parts. According to Shorrock (2019), "A system does something that none of its parts can do, so the essential properties of a system cannot be inferred from its parts. The performance of a system depends more on how its parts interact than how they function independently". To better understand, it is necessary to step back and have a more holistic view of the subject. Instead of thinking linearly, as an example, a more circular approach should be followed, where the seemingly independent variable can become dependent due to its fluctuations.

Meadows (2008:12) describes a system as "a set of elements or parts that is coherently organised and interconnected in a pattern or structure that produces a characteristic set of behaviours, often classified as its 'function' or 'purpose'". Within this definition of a system, key concepts can be identified and elaborated upon further.

The first concept found in the definition is that of an "element". According to Meadows (2008:12), "the elements of a system are often the easiest parts to notice because many of them are visible, tangible things". Dalto (2019:2) uses the following example to explain elements, "the traffic system where you live includes elements, such as people, cars, pedestrians, bikes and roads".

The second concept from the definition of a system is "interconnected in a pattern or structure that produces a characteristic set of behaviours". This second concept is more generally referred to as "interconnections". Returning to the example Dalto (2019) uses for elements (i.e., elements of a traffic system), he describes interconnections as follow, "these elements are interrelated, at least in part, by the rules and laws that govern behaviour on the road, by different methods of communication, and by people's decision-making".

The third concept from the definition of a system is that of "purpose". Returning to Dalto's (2019) example for the last time, the purpose of the system is "to help move people, vehicles, and economic goods from place to place".

Where you can identify these three concepts (elements, interconnections and purpose), a system exists. According to Dalto (2019), there are three important aspects for understanding systems and not directly from the definition. That is stock, flow and feedback loops. It is critically important to understand these three aspects if one wishes to understand certain systems' behaviour. According to Meadows (2008:17), "a system stock is just what it sounds like: a store, a quantity, an accumulation of material or information that has built up over time". According to Dalto (2019), stocks are emptied by flows. Inflows feed stocks and cause them to grow; outflows drain stocks and cause them to shrink. Within systems are certain monitoring capabilities that take overall purpose into consideration. When flow occurs, and stocks are affected, feedback loops can result in certain behaviour that reinstates original stock levels. The feedback loop can enhance flow, draining the stock even faster, depending on the purpose of the system.

To test the approach, consider life at work. This consideration is especially applicable to this research because the primary aim of this research is to determine to what degree managers at a ferrochrome smelter experience technostress and what impact it has on their productivity and life satisfaction. Systems are a social construct and malleable. Various systems can be identified, overlapping extensively and affecting one another to various degrees (Shorrock, 2019). So, at work, the manager could be considered as a complete system, operating within the larger system, which is work. Understanding the work system is arguably more intuitive. There are various elements, including finance, marketing, production, ICT capabilities and employees, all having various interactions with each other and with certain purposes. The valuable product being produced could be considered as stock, while production and selling activities result in flow, increasing and decreasing stock, respectively. Depending on the purpose of the system, feedback loops could be activated at various levels of stock levels, causing the system behaviour to alter. However, the focus of this research is on the manager and potential changes in productivity as a result of technostress. Technostress could be considered as the interaction between an expanding ICT element and the manager. This could affect how the system (which is the manager) operates based on the purposes of the system. Suppose the purpose of the system is to maintain energy levels and/or good relationships with family. In that case, less effort will be expended towards meeting ICT demands which might lead to a decrease in productivity. Oppositely, suppose a key purpose of the system is to achieve high productivity. In that case, technostress might cause the system to undertake certain actions to lessen the impact of the interactions (by becoming more proficient in dealing with ICT's, as an example), ultimately increasing productivity.

To summarise, systems theory is a useful theoretical lens that aids in the explanation of complex behaviour. The ability of the system to produce valuable results depends on the interplay between system elements, interconnections and purpose. When ICT elements are increased and techno-stressors arise, it may impede overall productivity, but it might also cause the system to evolve, reaching a state of superior productivity as ICT elements are better utilised. For this specific research, however, systems theory is not suitable. The main reason for this stems from the difference in research approach. The primary aim of this research is to study the impact of one variable (technostress) on two other variables (productivity and life satisfaction). This can be considered a reductionist approach, whereas systems theory advocates a more holistic approach to dealing with complexity. When systems theory is utilised as the conceptual framework, measurement becomes a problem and ascribing system behaviours to singular causal links. To elaborate, the researcher might introduce techno-stressors to measure the effect on productivity. Still, a decrease in productivity (as an example) might be due to the techno-stressors, but it also may not. This is because the system, with all its complexity (and a multitude of interconnections), is studied as a collective.

### 2.4.2 Job Demands-Resources Theory

The Job Demands-Resources Theory has the same point of departure as several other models in the occupational health literature, positing that job strain results from a mismatch between demands placed on employees and the resources they have at their disposal (Bakker & Demerouti, 2007). The main difference of this theory, compared to the others, is that it is broader in scope and thus more widely applicable to various work settings. According to Bakker and Demerouti (2007:310), "the job demands-resources model can be applied to a wide range of occupations, and can be used to improve well-being and performance".

The Job Demands-Resources Theory makes use of two general classifications: job demands and job resources. According to this theory (Bakker & Demerouti, 2007:312), job demands refer to "those physical, psychological (cognitive and emotional) effort or skills and are therefore associated with certain physiological and/or psychological costs. Examples are high work pressure, an unfavourable physical environment, and emotionally demanding interactions with clients". Job resources, on the other hand, refer to (Bakker & Demerouti, 2007:312), "those physical, psychological, social, or organisational aspects of the job that are either/or: functional in achieving work goals, reduce job demands and the associated physiological and psychological costs and stimulate personal growth, learning and development. The theory is granted its broad applicability as a result of these exhaustive definitions.

According to this theory, two different underlying psychological processes are responsible for developing strain and motivation. The presence of job demands, dominating exchanges lead to a depletion of energy. Oppositely, comparatively more job resources lead to work engagement, low cynicism, and excellent performance (Bakker & Demerouti, 2007: 313). Please see Figure 1-1 for a summary of the job demands-resources model.

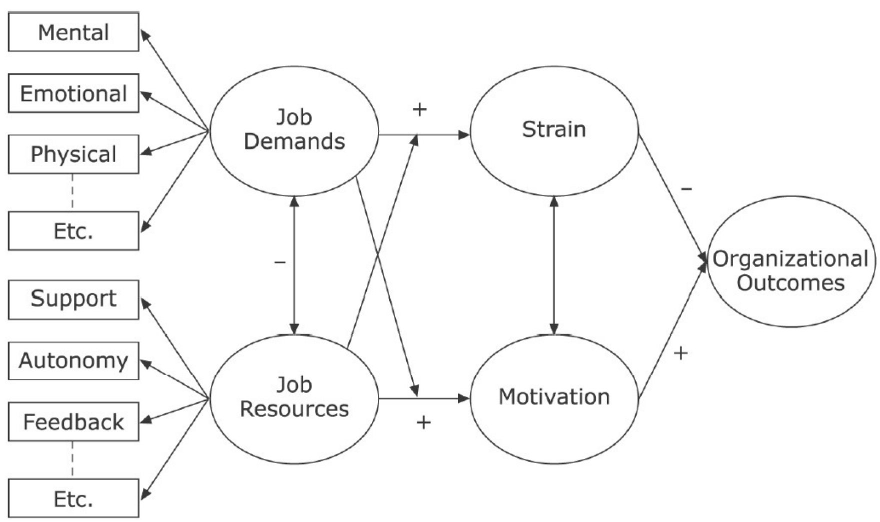


**Figure 1-1: Job Demands-Resources theoretical model (Bakker & Demerouti, 2007:313)**

This research aims to establish the impact of technostress on productivity and life satisfaction. The TMSC is used to conceptualise technostress and relies on the concept of techno-stressors. Superimposing this method of factor measurement to the Job Demands-Resources Theory, it is evident that only the job demands side of the theory is addressed. The advantage of the Job Demands-Resources Theory is its broad applicability, and within this context, each techno-stressor finds meaning, and its possible effect can be theorised. For example, techno-overload and techno-complexity will be job demands because cognitive capacity is placed under strain, ultimately negatively impacting productivity (via a decrease in motivation). Similarly, techno-uncertainty will result in emotional strain, impacting negatively on productivity.

To summarise, according to this theory, stressors by their very definition will increase strain, resulting in decreased productivity. Within this framework, it will be difficult to explain how technostress can lead to increased productivity, should that be the case from the results of the research.

### 2.4.3 Goal-Setting Theory

As indicated, the Goal-Setting Theory formed the theoretical foundation for employee productivity. Goal-Setting Theory is also known as Locke and Latham's Goal-Setting Theory, after Edwin A. Locke and Gary Latham (Locke & Latham, 1990). Latham was the author of one of the best known early empirical studies (1968) on goal-setting, where he studied the productivity of pulpwood crews working for the American Pulpwood Association. During this research, he found that workgroups assigned production goals were far more productive than the control group, who was simply told to do their best (Locke & Latham, 2019). It was during this research that the first tenets of the Goal-Setting Theory emerged. According to this initial conceptualisation, goal-setting will lead to improved performance. At the same time, Locke was busy with his work exploring similar relationships. The two researchers decided to join forces in 1975 after meeting the year before at the annual meeting of the APA (Locke & Latham, 2019).

Later they discovered that not all goals are the same. It was observed that a linear relationship exists between goal difficulty and performance, in that the more difficult the goal, the higher the performance (Locke & Latham, 2019). It was also seen that there is a limit to this difficulty. Setting unachievable goals initially lead to high performance as the individual attempts to reach the goal, but soon performance falters as the individual realises the goal is unrealistic. It was also observed how set-class goals that are set participatively (i.e., not enforced by the manager but decided upon together) lead to more difficult goals being set and result in higher levels of goal commitment and, ultimately, performance. Four moderators of the goal-performance relationship were identified (Locke & Latham, 2019:98):

- The degree to which feedback is provided. It was found that providing feedback allows the individual to better gauge performance and make adjustments where necessary to improve performance. Where performance was good and feedback favourable, it also serves as a reward.

- Goal commitment is the second moderator. If the person does not believe in the goal and is not committed to achieving the goal, no effort will be expended towards achieving the goal.
- The third moderator has been identified as abilities, which includes skills and knowledge. This is similar to setting unachievable goals. If self-efficacy is low, a poor attempt will be made at reaching the goal.
- The fourth moderator, which has been identified, is situational factors, including available resources and support.

At first glance, the potential applicability of this theory to this specific research context is questionable. This research aims to establish the impact of technostress on productivity and life satisfaction. Yet, productivity is portrayed by this theory due to cognitive, conscious processes (not as a function of, or being potentially impacted by, external stressors). However, later theory developments propose that prime goals, which are unconsciously set goals, affect behaviour and performance similarly to conscious set goals and are subject to similar effect moderators (Latham, 2019:111). In other words, the identified moderators could affect the subconscious goal-setting process of the person, thereby affecting performance. Looking at the five techno-stressors, it is clear how they could unconsciously affect performance via the four identified moderators. Techno-overload, techno-complexity and techno-uncertainty cause strain due to low self-efficacy and may result in decreased productivity via the third identified moderator, which deals with a lack of ability and skills. Techno-insecurity may be perceived as a lack of support (fourth moderator), potentially negatively impacting productivity. The potential effect of techno-invasion is not as apparent, nor is a techno-stressor that would directly impact goal commitment. As a moderator of prime goals, goal commitment might help explain how it might be possible for techno-stressors to be associated with increased productivity.

Goal-Setting Theory was chosen as the conceptual-theoretical framework for this research, not because it perfectly explains productivity in the context of this research, but it was deemed as the most appropriate from the alternatives investigated. Systems theory does not lend itself to this research design, whereas Job Demands-Resources Theory gives a one-sided approach to productivity when strain is introduced.

## 2.5 LITERATURE REVIEW RELATED TO THE OBJECTIVES OF THE RESEARCH

The objectives of this research were to measure the validity and reliability of the technostress, productivity and life satisfaction measuring instruments in the South African context, establish the technostress, productivity and life satisfaction levels of employees, determine if there are practically significant differences in the mean scores of technostress, productivity and life satisfaction between gender, age groups, operational units and management level and establish if there is a correlation between technostress, productivity and life satisfaction. The literature focuses firstly on the psychometric properties of the same measuring instruments used in other studies. Secondly, to report on similar studies that have investigated the technostress, productivity and life satisfaction levels of employees. Thirdly, to report if there were practically significant differences in the mean scores of technostress, productivity and life satisfaction between demographic variables in similar studies. Fourthly, to establish if there is a correlation between the three factors in similar studies.

### 2.5.1 Psychometric properties of the measuring instruments

In this research, three factors are of importance: technostress, life satisfaction and productivity. This section aims to explore the reliability and validity of the instruments.

For the technostress factor, this will be a relatively simple task because the same measuring instrument was used throughout. This measuring instrument is based on the work of Tarafdar *et al*. (2007) and basically conceptualises technostress as the sum of five techno-stressors, which are measured separately. However, the instrument used in this research was developed by Chen *et al*. (2015) and was adapted from Tarafdars' version. Reliability values obtained from prominent studies are listed in Table 1-1. Some researchers used Cronbach alpha's, whereas others opted to use composite reliability.

**Table 1-1: Summary of Technostress factor reliability from previous studies**

| **Researchers** | **(Tarafdar *et al.*, 2010)** | **(Tarafdar *et al.*, 2015)** | **(Pirkkalainen, *et al.*, 2019)** | **(Brooks, 2015)** |
|---|---|---|---|---|
| Context | American | American | American | American |
| Sample size | 233 | 237 | 846 | 209 |
| Reliability Measure | Cronbach alpha | Cronbach alpha | Composite reliability | Composite reliability |
| Techno-overload | 0.89 | 0.90 | 0.90 | 0.92 |
| Techno-invasion | 0.81 | 0.91 | 0.87 | |
| Techno-complexity | 0.84 | 0.92 | 0.88 | |
| Techno-insecurity | 0.84 | 0.90 | 0.90 | N/A |
| Techno-uncertainty | 0.82 | N/A | N/A | N/A |

A Cronbach alpha value between 0.8 and 0.9 is very good, and between 0.9 and 0.95 represents an excellent strength of association (Hair *et al.*, 2011). As can be seen from Table 1-1, based on the Cronbach alphas, the technostress instrument has sufficient reliability. The composite reliability needs to exceed 0.7 in order for the instrument to be considered reliable (Nunnally & Bernstein, 1994). Both studies that reported composite reliabilities in Table 1-1 easily comply.

The next factor under discussion is productivity. The measuring instrument that was used in this research was developed by Tarafdar *et al*. (2007). This is a frequently used measuring instrument in technostress research. Table 1-2 illustrates some prominent studies that used the instrument and subsequent reliabilities reported. Similar to technostress, some researchers reported Cronbach alpha's, whereas Pirkkalainen *et al.* (2019) chose to use composite reliability.

**Table 1-2: Summary of Productivity factor reliability from previous studies**

| **Researchers** | **(Tarafdar *et al.*, 2010)** | **(Pirkkalainen *et al.*, 2019)** |
|---|---|---|
| Context | American | American |
| Sample size | 233 | 846 |
| Reliability Measure | Cronbach alpha | Composite reliability |
| Productivity | 0.91 | 0.89 |

For productivity, the Cronbach alpha is excellent, being between 0.9 and 0.95 (Hair, *et al.*, 2011). The composite reliability also exceeds the 0.7 threshold (Nunnally & Bernstein, 1994).

As mentioned in the previous section, there is limited research exploring the impact of technostress on life satisfaction. As far as could be established, the measuring instrument that was used in this research (RLSS) to measure life satisfaction has not been utilised before in technostress research. The three studies that were reported on in the previous section used instruments based on the work of Huebner (1991), Rosenberg (1965) and Hills and Argyle (2002). The RLSS (Margolis *et al.*, 2018) is based on the well-known SWLS developed by Diener *et al.* (1985), which in turn is one of the most extensively used life satisfaction measuring instruments; the original work is cited more than 19,000 times (Margolis *et al.*, 2018). According to Margolis *et al.* (2018:8), “our three studies support the construct validity of the RLSS by correlating it with the associated constructs, locating it in a nomological network. As one would expect, the RLSS is highly correlated with other measures of well-being. However, disattenuated correlations between 0.68 and 0.97 in magnitude imply that there might be important differences between these constructs”. Reliability needs to be confirmed in this research.

### 2.5.2 Technostress, life satisfaction and productivity levels of employees

Tarafdar *et al.* (2010) investigated the impact of technostress on end-user satisfaction and performance. Similar to this research, they utilised the TMSC as their theoretical-conceptual framework. Hence, they made use of techno-stressors to measure the degree to which employees experience technostress. To measure technostress, they adopted a measuring instrument from Tarafdar *et al.* (2007). To measure productivity, they adopted a measuring instrument from Torkzadeh and Doll (1989). The research involved 233 ICT users. The average mean scores for the techno-stressors were as follow: techno-overload 2.97, techno-invasion 1.91, techno-complexity 2.54, techno-insecurity 2.00 and lastly, techno-uncertainty was 3.15. To summarise, the techno-overload and techno-uncertainty stressors contributed most to feelings of technostress, whereas the remaining three techno-stressors had little to no effect. Techno-invasion and techno-insecurity were scored below average, indicating that these stressors did not contribute to the perception of technostress. The average mean score obtained for productivity was 3.8.

Pirkkalainen *et al.* (2019) researched the effect of coping behaviours on levels of technostress experienced and the effect thereof on productivity. Their sample consisted of 846 organisational IT users from the United States of America. They used the same measuring instrument as Chen (2015), except for techno-uncertainty, which they decided to omit. This measuring instrument is based on the TMSC and uses the same five techno-stressors discussed earlier, measured using a five-point Likert scale. The average for techno-overload was 2.94, for techno-invasion 2.54, for techno-complexity 2.51 and techno-insecurity 2.34 (Pirkkalainen *et al.*, 2019). The measuring instrument used for productivity was the same as used by Tarafdar *et al.* (2007). A five-point Likert scale was used to measure IT-enabled productivity. The average mean score attained was 4.06. To summarise the results, the participants experienced only moderate levels of techno-overload. They were neutral with regards to the effect of techno-invasion and techno-complexity. The average for techno-insecurity shows that this was also not a genuine concern to the respondents. The respondents did, however, report high levels of IT-enabled productivity.

Both studies listed above utilised the same measuring instruments to measure technostress and productivity, making it ideal for comparison's sake. Both of these studies were conducted in America. The current research also used the same measuring instrument for productivity and technostress, making the results directly comparable. To clarify, to measure technostress (for this research), a measuring instrument developed by Chen (2015) was used, which in turn was based on the same measurement instrument used in the two studies above. As can be seen, this research is very closely related to the two studies referenced above. The only significant difference is that this research also attempts to establish the impact of technostress on perceived life satisfaction.

The literature on the effect of technostress on life satisfaction is not as abundant as with productivity. La Torre *et al.* (2019) did a systematic review of available technostress research in 2019. They used three databases and identified a total of 345 research articles related to technostress. After removing the duplicates and articles otherwise not fulfilling the inclusion criteria, they narrowed down the number of valid research articles to 107. From these 107 research articles, only five addressed the topic of life satisfaction (alternatively well-being or happiness).

Lee *et al.* (2016) defined technostress as slightly different but identified techno-stressors that lead to strain and, in turn, theoretically affects life satisfaction. They used a three-item measure of life satisfaction based on the work of Huebner (1991). Although they did not report the average level of life satisfaction, they report a practically significant relationship between strain and life satisfaction. An increase in strain leads to a decrease in perceived life satisfaction. Choi and Lim (2016) investigated, amongst others, the effect of technology overload on the psychological well-being of 419 college students in South Korea. Note the difference between technology overload and technostress. In fact, in this research, they used the "techno-overload" factor to measure technology overload - from the technostress measuring instrument developed by Tarafdar *et al.* (2007). To measure psychological well-being, they used seven items from the Rosenberg Self-Esteem Scale (Rosenberg, 1965). They could not find evidence that techno-overload impacts psychological well-being (Choi & Lim, 2016: 250). The mean score for psychological well-being was 3.806. The standard deviation was 1.443. The measuring instrument used a 7-point Likert scale, so overall, the results indicated that the overall psychological well-being was rated as being only slightly above neutral.

The last research under discussion is that of Brooks (2015), who investigated the effect of social media usage on efficiency and well-being. The sample consisted of undergraduate students from a large Western US university. The same measure of technostress was used in previous studies, based on the work of Tarafdar *et al.* (2007). To measure well-being, they used a combination of the Oxford Happiness Questionnaire (Hills & Argyle, 2002), which is the condensed version of the Oxford Happiness Index and the Happiness Measures (Fordyce, 1988). The Happiness Measures consists of only two items. By combining these two instruments, the author attempted to gather a more robust estimation of the factor (Brooks, 2015: 32). A 6-point Likert scale was used to answer the items. An average score of 4.67 was attained, with an average standard deviation of 1.14. In general terms, it can be stated that this particular sample showed higher than average levels of life satisfaction, especially compared to Choi and Lim (2016).

Because Brooks (2015) used the same measuring instrument for technostress, the results obtained can also be compared to those discussed previously. Please see Table 1-3 for a summary of the results relating to technostress levels and productivity (life satisfaction was omitted from this table because different instruments were used).

**Table 1-3: Average Technostress and Productivity mean scores from similar research**

| **Researchers** | **Tarafdar *et al.* (2010)** | **Pirkkalainen *et al.* (2019)** | **Brooks (2015)** |
|---|---|---|---|
| Context | American | American | American |
| Sample size | 233 | 846 | 209 |
| Techno-overload | 2.97 | 2.94 | 3.20 |
| Techno-invasion | 1.91 | 2.54 | 2.98 |
| Techno-complexity | 2.54 | 2.51 | 2.45 |
| Techno-insecurity | 2.00 | 2.34 | - |
| Techno-uncertainty | 3.15 | - | - |
| IT-enabled Productivity | 3.8 | 4.06 | - |

### 2.5.3 Differences in the mean scores of technostress, life satisfaction and productivity between demographic variables

Van Eck (2005: 37) studied the levels of technostress experienced by both computer professionals and computer users in the Vaal Triangle area in South Africa. She found no significant effects on technostress experienced as a result of age, qualification or gender. According to Riedl *et al.* (2012), men experience more physiological stress than women when exposed to similar ICT breakdowns designed to increase time pressure. In research conducted by Chen (2015) on a sample of 221 Chinese knowledge workers, it was found that males experienced significantly higher levels of technostress. Ragu-Nathan *et al.* (2008) obtained a similar result using a sample of American managers. In contrast, according to La Torre *et al.* (2020: 63), women experience more technostress than men. They found that women experience significantly more techno-overload, techno-invasion and techno-complexity compared to men.

According to Weil and Rosen (1997), the level of computer-related experience has a mitigating effect on the level of technostress experienced. The more experienced a person is, the less technostress they will experience. Kouvonen *et al.* (2005) obtained results to the contrary. According to these researchers, computer professionals with relatively more computer-related knowledge and experience will experience more technostress when faced with the challenges of working with ICT's.

Tams (2011) investigated how adults of varying ages experience workplace stress originating from IT use. The results obtained indicated that younger adults experience relatively less technostress than their older counterparts. The researcher offered an explanation of the results that younger adults, generally speaking, have higher levels of IT experience and higher levels of computer self-efficacy. Shu *et al.* (2011) studied the effect of computer self-efficacy and computer-dependency on technostress experienced using the Social Cognitive Theory. They found that a practically significant relationship exists between age and technostress, where an increase in technostress accompanied an increase in age. Similar to Tams (2011), they posited that this result could be ascribed to the high computer self-efficacy of younger employees. Some contradictory results do exist in the literature. Setyadi *et al.* (2017: 334) found support for their research hypothesis that stated chronological age has no effect on the degree of technostress experienced. Similarly, La Torre *et al.* (2020: 64) found no effect of age on perceived technostress.

According to Ferrer-I-Carbonell and Gowdy (2007), a non-linear relationship exists between age and life satisfaction, generally following a U-shape trend. Young people experience relatively higher levels of life satisfaction, which decreases over time as they age. The lowest levels of life satisfaction are reported between the ages of 30 and 50, after which it starts increasing again. In the South African context, Powdthavee (2005) found similar results. According to research conducted by Hinks and Gruen (2007), however, no such relationship exists in the South African context. According to Clark and Oswald (1994), men and women generally differ in the levels of life satisfaction reported. The general trend is for men to report lower levels of life satisfaction compared to women. According to both Hinks and Gruen (2007) and Mahadea and Rawat (2008), however, no such trend exists in the South African context, where both genders report similar levels of life satisfaction. Craik and

Salthouse (2000) postulated that older employees might be less productive than younger employees due to decreasing cognitive and perceptual abilities due to the ageing process. According to Hursh *et al.* (2006: 46), “if declines in performance or functional ability occur, they may be offset by accommodations or experience and as such may have little or no impact on productivity”.

McEvoy and Cascio (1989) did a meta-analysis of 96 independent studies that reported age and performance. This meta-analysis had a total sample size of 38,938 units. They reported a correlation of only 0.04 and concluded that "all mean correlations for overall samples were relatively small". Additionally, no evidence could be found that the type of job (professional vs nonprofessional) influences the relationship between age and performance to any great degree. Shoushtary *et al.* (2012) investigated the effect of ICT on the Iranian National Oil Company's human resource productivity. The sample exceeding 11,000 units concluded that productivity was not affected by age (2012: 935). According to Pirkkalainen *et al.* (2019: 1205), "none of the three control variables (gender, age, and IT experience) were found to have a significant effect on IT-enabled productivity in Model 1 and, by themselves, were able to explain practically none (0.0 percent) of the variance in IT-enabled productivity".

Kazekami (2020) studied the mechanisms that influence the productivity of employees performing telework. With regards to the control variables, he found lower productivity levels associated with females. He also found that increased age was associated with increased productivity (Kazekami, 2020: 8). Zhao *et al.* (2020) studied the impact of technostress on productivity from the theoretical perspective of appraisal and coping, involving 513 respondents from across China. They found their control variables (age, gender and education) to have no significant impact on ICT-enabled productivity (Zhao *et al.*, 2020: 8).

### 2.5.4 Relationship between technostress, life satisfaction and productivity

The effect of technostress on productivity and overall life satisfaction will be discussed briefly regarding specific studies. Tarafdar *et al.* (2010: 304) conducted research that focussed on end-user satisfaction when using ICT’s and perceived productivity gains. The research population consisted of 233 ICT users from two different organisations.

It was found that an increase in technostress decreased productivity (Tarafdar *et al.*, 2010: 328). Pirkkalainen *et al.* (2019: 1179) conducted research on a population of 846 organisational ICT users where they theorised and validated a model of deliberate proactive and instinctive reactive coping with mitigating the effects of technostress. It was confirmed that an increase in technostress leads to decreased productivity (Pirkkalainen *et al.*, 2019: 1203). According to both La Torre *et al.* (2020) and Waizenegger *et al.* (2016), knowledge workers experience technostress due to techno-invasion, especially. Consequences may also extend beyond the individual level. If a climate is created that fosters the factors that increase technostress, it may decrease productivity on an individual level. However, by virtue of multiple individuals being affected, it will also potentially have a negative impact on group level and accordingly organisational performance as a whole.

Lee *et al.* (2016: 775) conducted research that investigated the effect of technostress on productivity and life satisfaction. The research population consisted of 267 Korean's, and the focus was on instant messaging after work hours. It was found that respondents who reported higher levels of technostress also reported higher productivity levels as a result of ICT usage (Lee *et al.*, 2016: 785). Lee *et al.* (2016: 785) found that an increase in technostress leads to decreased overall life satisfaction in Korean respondents using ICT after work hours. According to these authors, this result was in line with results reported by Adams and King (1996). Kazekami (2020:1) investigated the effect of telework (that is, working from home using ICT) on productivity and life satisfaction, amongst other factors. Although technostress was not measured directly, it was found that too long hours of telework increased the stress of balancing work and domestic chores, which lead to stress and decreased life satisfaction. In research conducted by La Torre *et al.* (2020), they investigated the impact of technostress on productivity and an individual's life (similar to this research). They found productivity only to be affected by educational level, with higher educated employees reporting higher productivity levels. None of the five techno-stressors had a practically significant effect on self-reported productivity (La Torre *et al.*, 2020: 62).

To summarise the relationship between technostress and productivity, it is evident that some inconsistencies exist and that different studies reported different results. Overall, the tendency seems to be that an increase in technostress decreases productivity.

The literature on the effect of technostress on overall life satisfaction is not as abundant. All indications are that a strong negative relationship exists between technostress and overall life satisfaction, where an increase in technostress should lead to a decrease in life satisfaction.

## 2.6 SUMMARY

In this chapter, the three factors related to the research were investigated and elaborated upon. Various theoretical frameworks were reviewed to frame research factors. The TMSC was chosen for technostress, Self-Determination Theory will be used to frame life satisfaction, and Goal-Setting Theory will be used to frame productivity.

From the literature reviewed, techno-overload and techno-uncertainty seem to be contributing the most to the perception of technostress, both scoring at higher-than-average levels. The average of techno-invasion and techno-complexity scores seem to indicate that there is no net effect arising from these stressors. From the studies reviewed, techno-insecurity scored below average levels, indicating that this stressor might not contribute as extensively to technostress as the others. Regarding mean levels of life satisfaction, the general trend seems to be for scores ranging from average to slightly above average. The productivity factor was rated high in both studies identified.

The effect of demographics (specifically age and gender) on the three research factors could not be determined, with various researchers reporting opposing results. The majority leaned towards the following effects: Men and older employees report higher levels of technostress. Life satisfaction follows a U-shape relationship, with employees between the ages of 30 and 50 reporting the lowest levels of life satisfaction. At relatively younger and older levels, life satisfaction seems to increase. Productivity does not seem to be affected by either age or gender.

Although contradicting results were found, the general trend seems to be for increased technostress to lead to a decrease in both productivity and life satisfaction. With regards to the reliability and validity of measuring instruments, there seems to be a high probability that the instruments will yield acceptable levels of reliability based on the results of previous studies.

In Chapter Three, the experimental design will be discussed, including the research paradigm, measuring instruments to be used, sampling technique, data collection, and processing method.

# CHAPTER THREE: RESEARCH METHODOLOGY

## 3.1 INTRODUCTION

The main research objective is to determine the impact of technostress on life satisfaction and productivity of managers working at ferrochrome smelting plants in South Africa. In the literature review, the theoretical underpinning of each factor was elaborated upon, and potential mechanisms of interaction discussed. This chapter aims to elaborate on the research method used in this research. This means elaborating on the research paradigm and the inherent assumptions made in terms of the nature of knowledge and how it can be expanded. This guide, to a great degree, the research approach and whether qualitative or quantitative methods will be appropriate. In line with the main objective of the research, the population can be defined as "managers working at ferrochrome plants in South Africa". In this chapter, this boundary is set more clearly, as well as the method used to select sample units for the research. Once there is a clear understanding of the compilation of the sample, the next step is to clarify what measuring instruments were used to measure the factors. The validity and reliability of measuring instruments are always a concern and will be addressed. In this chapter, there is also a detailed discussion on how the data collected is analysed to answer the research questions. The chapter concludes with a discussion dealing with the ethics of the research and subsequent precautions taken to ensure all respondent rights are upheld. These considerations are important because it assists the respondents in giving true and accurate feedback, assisting with the overall validity of the research.

## 3.2 RESEARCH PARADIGM

According to Brand (2009: 430), "paradigm" is used to connote "a group of basic beliefs that is concerned with 'ultimates' or 'first principles' and that delineates for a person their understanding of the world they inhabit, including their place in that world". Having a clear understanding of the research paradigm is important. According to Guba and Lincoln (1994: 116), "paradigm issues are crucial; no inquirer, we maintain, ought to go about the business of inquiry without being clear about just about what paradigm informs and guides his or her approach".

The paradigm of this research can be described as positivistic. Brand (2009: 432) describes positivism as "a belief system arising out of practices in the natural sciences that assume that the subject of research is susceptible to being investigated objectively and that their veracity can be established with a reasonable degree of certainty". To elaborate on this, a key assumption that positivists make is that reality exists independent of humans (Rehman & Alharti, 2016: 53). In other words, reality will function in the same predictable manner, regardless of whether humans are observing it or not. Subsequently, positivists believe that all knowledge can be attained through rigorous experiments and observations (Rahi, 2017). Once causal relationships are uncovered, they can be used to predict the future. A positivistic paradigm was utilised upon considering the objectives of this research, primary amongst them whether technostress impacts productivity and life satisfaction (i.e., do causal links exist and to what extent).

## 3.3 RESEARCH APPROACH

The research approach can be defined as the "plans and the procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation" (Creswell, 2014: 3). Three primary research approaches can be distinguished: quantitative, mixed methods and qualitative. These approaches should not be thought of as distinct, rigid categories. Quantitative and qualitative studies can be seen as the two extremes on a continuum of approaches, where the mixed method is more or less in the middle (Newman & Benz, 1998). According to Streefkerk (2019:2), "quantitative research deals with numbers and statistics, while qualitative research deals with words and meanings".

This research was approached from a positivistic viewpoint. According to this world view, the path to knowledge is through experiments, observations, measurements and determining causal relationships. None of these steps would be possible without numbers and statistical analyses. Hence, this current research can be classified as following a quantitative approach. Creswell (2014:4) defines quantitative research as "an approach for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analysed using statistical procedures".

## 3.4 RESEARCH DESIGN

Stone-Romero and Rosopa (2010:697) define research design as "an overall plan for conducting the study". According to Shadish *et al.* (2002), the research design should consider the aspects of internal validity, external validity, factor validity and statistical conclusion validity. This will be achieved in the remainder of this chapter by looking at the different aspects of the research separately.

The primary objective of this research is to determine the impact of technostress on productivity and life satisfaction. Hence, the research aims to determine whether technostress is correlated with productivity and life satisfaction. Not only is it correlated or not, but also the direction of the interaction and the severity of the effect. To ensure these research objectives are adequately addressed, it has been decided to make use of a correlational research design. According to Dziak (2020:3), "correlational research is a method by which people study how two or more variables are related. These variables may be statistics, behaviours, or other measurable or observable factors". Correlational research is also classified as non-experimental research (Anon, 2020). The researcher relies on the natural fluctuations within the variables to determine correlations, and no manipulation occurs. In this research, the levels of technostress were not manipulated, so it also grants additional insights into the mean levels of technostress experienced by the sample. The same applies to the mean levels of reported productivity and life satisfaction.

## 3.5 POPULATION OF THE RESEARCH

According to Nicholas (2011:175), research population is "a collective term used to describe the total quantity of cases of the type which are the subject of the study. It can consist of objects, people or even events". According to Haegele and Hodge (2015:64), "the larger group of people whom the researcher hopes to infer the findings from the study is referred to as the population". The focus of this research is on managers working at ferrochrome smelting plants in South Africa. There must be a connection between the population of the research and the research objectives. To use this research as an example, because technostress is studied which originates as a result of ICT usage, there would be no point in surveying the employees on the shop floor because they do not make use of ICT's. This population has also been specifically selected to address the research gaps identified.

## 3.6 SAMPLING METHODS

Nichols (2011: 117) defines a sample as "the small part of a whole (population) selected to show what the whole is like". Selecting the correct people from the population (known as sampling) is one of the most critical research elements (Fraenkel *et al.*, 2012). Sampling for quantitative research can be done in a random or non-random way. In random sampling, each member of the population has an equal chance of being selected for the sample. In non-random sampling, the idea is to incorporate units in the sample that possess specific characteristics applicable to the research.

For this research, it was decided to use non-random sampling. This research focused on managers working at ferrochrome smelters (from a specific organisation) in line with the research gaps identified. The total population size was relatively small, at approximately 200 managers. To facilitate the data analyses phase of the research, it was decided to use a census to gather as much as possible information. With sampling, units are extracted from the collective, whereas a census attempts to elicit information from each unit of the population (Walliman, 2011). Data collection relied on the willing participation of respondents.

## 3.7 PROCEDURES FOR DATA COLLECTION

Data collection can be defined as "the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes" (Anon, 2020). One cannot, however, simply approach the research population and start collecting data. The first step was getting the research proposal approved by both the NWU and the relevant organisation involved. After that, the research proposal was reviewed and approved by the EMS-REC of the NWU. The purpose of the committee mentioned above is to review the ethical aspects of the research.

Once this approval was received, the three instruments identified for measuring the research factors were transferred into a Google Forms template (refer to Appendix D). A consent letter was also transferred into the Google Forms template, preceding the instrument items (refer to Appendix E). The purpose of the consent letter was to explain the research, assure respondents of their anonymity and confirm that they could opt-out at any point. It was also clearly stated that by continuing to the items, the respondent is giving consent to the researcher to use the data.

After completing the consent letter in Google Forms, the questionnaire as a whole was tested for correctness and functionality. After that, a hyperlink was sent out to the research population via email. The email was sent to 192 recipients, and 106 valid responses were received. The response rate equates to 55.2%.

## 3.8 DATA COLLECTION INSTRUMENT

The three factors related to this research are technostress, productivity and life satisfaction. Applicable measuring instruments have been identified from the literature to measure these variables reliably and validly. These three instruments were added together to form a single instrument that was distributed to the research population. Additionally, a section was added to collect demographic information. Besides determining the correlations between the factors, the research objectives also called for determining whether differences exist in the mean values of the factors between different genders, age groups, operational units and levels of management.

Google Forms was used to collect the data, primarily due to its ease of use, multi-platform availability and the assurance that it offered respondents that their answers would indeed be anonymous. To summarise, the data collection instrument consisted of four sections:

- Demographics
- Technostress
- Productivity
- Life Satisfaction

Each section will now be discussed briefly, elaborating upon the measuring instrument the section was based on, the number of items and the scale used for measurement.

Section 1 of the questionnaire contained four items to determine the demographics of the respondents. This included items to determine gender, age group, operational unit and the level of management.

The second section of the questionnaire aimed to determine the perceived level of technostress of the respondent. The instrument used for this was developed by Chen *et al.* (2015) and is based on the well-known instrument developed by Tarafdar *et al.* (2007), which has been discussed at length earlier in this document.

The instrument is divided into five sub-sections to address the five techno-stressors. In total, there are 23 items, all of which made use of a five-point Likert scale. A value of one represented "Strongly Disagree", whereas five meant "Strongly Agree".

- Techno-overload: items 2.1 to 2.5
- Techno-invasion: items 2.6 to 2.9
- Techno-complexity: items 2.10 to 2.14
- Techno-insecurity: items 2.15 to 2.19
- Techno-uncertainty: items 2.20 to 2.23

Section three of the questionnaire measure the IT-enabled productivity levels of the respondents. The measuring instrument utilised in this section is based on the work of Tarafdar *et al.* (2007). The instrument consists of four items (3.1 to 3.4), using the same Likert scale as the Technostress measuring instrument.

The last section of the questionnaire collects data regarding the life satisfaction of respondents. The measuring instrument used to measure life satisfaction was developed by Margolis *et al.* (2018), who based it on the well-known SWLS (Diener *et al.*, 1985), which has been cited more than 19,000 times since inception. The measuring instrument consists of six items, utilising the same Likert scale as the previous factors.

## 3.9 DATA ANALYSIS

This research utilised a quantitative research approach. The measuring instrument distributed to respondents consisted of 37 items, and 106 valid responses were received. The data points represent the information available to be used to answer the research questions. To achieve this, specific statistical methods and techniques were employed to extract meaning from the data. According to Sachdeva (2009: 195), “the main purpose of statistics is to summarise the data into easily interpretable fewer numbers accurately”. Data analyses were carried out using IBM SPSS v26 (IBM, 2020).

The first objective of the research was to measure the validity and reliability of the technostress, productivity and life satisfaction measuring instruments in the South African context. To this end, an EFA was performed for each separate factor (Technostress, Productivity, and Overall Satisfaction with Life) to confirm the factorial structure. The Cronbach alpha (Cronbach, 1951) was calculated for each of the uncovered factors to determine the instrument's reliability in measuring the respective factors. According to Hair *et al.* (2011), a value between 0.7 and 0.8 is considered good, between 0.8 and 0.9 is considered very good, and one above 0.9 is excellent.

The second objective of the research was to establish the technostress, productivity and life satisfaction levels of managers. To this end, descriptive statistics were calculated for all items in the questionnaire. Categorical variables were reported as frequencies and percentages. Means and standard deviations were reported for items measured on a Likert scale. The mean score represents the central tendency of a dataset, whereas the standard deviation indicates the dispersion of the individual values around the mean (Levine *et al.*, 2014: 143).

The third objective of the research was to determine if there are practically significant differences in the mean scores of technostress, productivity and life satisfaction between gender, age groups, operational units and management level. Mean factor scores were calculated for each factor. These factor scores were summarised by reporting means and standard deviations. To attain the third research objective, factor scores were compared between various independent groups. In the case of two independent groups (gender), independent t-tests were performed. For three or more independent groups (age, operational unit, and management level) one-way ANOVAs were performed. Cohen's d was calculated to determine practical significant differences between standardised means. Cohen's (1988) guideline values were used where an effect size of 0.2 indicates a small effect or practical non-significant difference, an effect size of 0.5 indicates a medium effect or practical visible difference and 0.8 a large effect or practical significant difference.

The fourth objective of the research was to establish if there is a correlation between technostress, productivity and life satisfaction. Spearman rank-order correlational analysis was conducted to determine the correlation coefficients between the factors identified. The absolute value of the correlations was used to determine the practical significance. Interpretations are based on Cohen's (1988) guidelines: 0.1 small effect or practically non-significant relationship; 0.3 medium effect or practically visible; and 0.5, a large effect or practically significant relationship.

All statistical tests were two-tailed, and type I error rate was set to $\alpha=0.05$. However, due to the nature of the sample, p-values were only reported for completeness' sake. In this research, effect sizes were used for interpretation purposes.

## 3.10 VALIDITY AND RELIABILITY OF THE MEASURING INSTRUMENTS

According to Wienclaw (2019), "to be useful for scientific research, data collection instruments need to have two characteristics: they must be both reliable and valid". Reliability can be thought of as the degree to which a measuring instrument will repeat the same results when measuring the same object/phenomenon repeatedly (Pruzan, 2016: 122). The reliability of a measuring instrument refers to the consistency in the measurements (Kabir, 2018: 112). According to Price *et al.* (2017), "validity is the extent to which the scores from a measure represent the variable they are intended to". The reliability of an instrument can be calculated, but to determine the validity is not as simple. Before an instrument can be deemed valid, it needs to be reliable. In other words, before the researcher can be assured that he/she measures the correct variable, the instrument being used must be able to return the same result when measuring the same object/phenomenon.

Recall the first objective of this research "(to) measure the validity and reliability of the technostress, productivity and life satisfaction measuring instruments in the South African context". Accordingly, the measuring instruments were reviewed and discussed at length in the literature review. Three instruments were used to measure the three research factors (technostress, productivity and life satisfaction). These three instruments were chosen because they are well-established and have been shown to have good validity and reliability in the past. In this research, the reliability was measured again using Cronbach alpha values.

To measure technostress, a measuring instrument was used developed by Chen *et al.* (2015), who adapted it from an instrument developed by Tarafdar *et al.* (2007). Cronbach alphas reported from earlier studies range between 0.81 (Tarafdar *et al.*, 2010) and 0.92 (Tarafdar *et al.*, 2015). In all instances above, the cut-off value of 0.8 as proposed by Hair *et al.* (2011). Composite reliability values range from 0.866 (Pirkkalainen *et al.*, 2019) to 0.919 (Brooks, 2015), in all instances above 0.7, the cut-off value as proposed by Nunnally and Bernstein (1994).

Productivity was measured using an instrument developed by Tarafdar *et al.* (2007). The instrument has not been used widely. Tarafdar *et al.* (2007) reported a Cronbach alpha of 0.91 and Pirkkalainen *et al.* (2019) composite reliability of 0.891. In both instances exceeding the cut-off values to prove reliability using Cronbach alpha (Hair *et al.*, 2011) and composite reliability (Nunnally & Bernstein, 1994), respectively.

The RLSS, as developed by Margolis *et al.* (2018), was used to measure life satisfaction. No example could be found where this instrument was used in the technostress literature. The instrument is based on the well-known SWLS developed by Diener *et al.* (1985), which has been cited more than 19,000 times to date (Margolis *et al.*, 2018). It is the aim of this research, amongst others, to confirm the reliability of this instrument in the South African context.

## 3.11 ETHICAL CONSIDERATIONS

The purpose of this research was clearly explained to the participants. As required by the NWU Business School, an ethics application to conduct this research was submitted and subsequently approved at the EMS-REC meeting of 31 July 2020 with A number NW-00795-20-A4 (refer to Appendix B). A representative of the employer granted a request to obtain access to the research population (refer to Appendix C).

Furthermore, Google Forms was used to collect data that reassured respondents that their feedback was confidential and anonymous. Also, it was explained to the participants that it was not to their disadvantage if they choose not to participate. It was stated that participation was entirely voluntary, and they can withdraw from the research at any time. The questionnaire has been structured in such a way that it facilitates quick and easy completion. The time limit to complete the questionnaire was between 20 and 30 minutes to complete. Clear instructions were provided on how to complete the questionnaire. The researcher informed the participants that the summary findings would be presented to the participating organisation. The overall results of the research will be published in the form of an MBA mini-dissertation. The researcher confirmed the consent by stating to the respondents that participants consent that this information can be used for research purposes by completing this questionnaire.

## 3.12 SUMMARY

This chapter was used to elaborate on the method used to conduct the research. It was explained why this research was approached from a positivistic viewpoint, and subsequently, why the research lends itself to a quantitative approach. Managers working at ferrochrome smelting plants were the focus of the research. Since the overall population is quite limited, a census was used to gather as much as possible information. The relevant measuring instruments used to measure each of the research factors were briefly discussed and reported reliability reviewed. After that, how they were combined and the electronic platform utilised to administer the questionnaires was discussed. The ethical considerations of the research received due attention, and lastly, the statistical analyses planned to address the research questions.

In the next chapter, the results of the statistical analyses will be relayed and duly discussed as it pertains to the research objectives.

# CHAPTER FOUR: RESULTS AND DISCUSSION

## 4.1 INTRODUCTION

The research methodology was developed and elaborated upon in the previous chapter. The research methodology developed aims to ensure that the research questions are answered validly and reliably. The purpose of this chapter is to relay the results of the analyses conducted. This research aimed to answer the following questions:

- Are existing technostress, productivity and life satisfaction measuring instruments valid and reliable in the South African context?
- What are the technostress, productivity and life satisfaction levels of managerial employees?
- Are there practically significant differences in the mean scores of technostress, productivity and life satisfaction between gender, age groups, operational units and management levels?
- Is there a correlation between technostress, productivity and life satisfaction?

The results for each objective will be communicated in the order listed above. So the results of the various analyses conducted will be in the following order: demographics; the EFA and calculation of Cronbach alpha's to address the first research objective; descriptive statistics to evaluate the technostress, productivity and life satisfaction levels of the managers; t-tests and ANOVA's to determine whether practically significant differences exist in the mean scores of technostress, productivity and life satisfaction between the various demographic groups and lastly, Spearman rank-order correlational analyses to determine the correlations between the various factors. Results are compared to existing literature where applicable.

## 4.2 DEMOGRAPHIC CHARACTERISTICS

The first section of the measuring instrument was used to gather demographic information from the respondents. The four demographic variables of interest to the research were: gender, age, management level and operational unit. Below sub-sections summarise the frequency distribution for each demographic variable.

The first results under investigation are the demographics of the respondents (see Figure 4-1). A total of 106 valid responses were received. Two age groups represented the bulk of the respondents. That is the managers between 31 and 40 years of age, who made up 34.0% of the sample and the 41 to 50-year-old managers, who made up 35.8% of the sample. Together these two groups represent 69.8% of the respondents. Managers between 20 and 30 years of age made up about a tenth of the sample (11.3%). Managers between 51 and 60 years of age make up 16% of the sample, and managers above 61 are only 2.8%. This distribution represents a good balance between youth and experience.

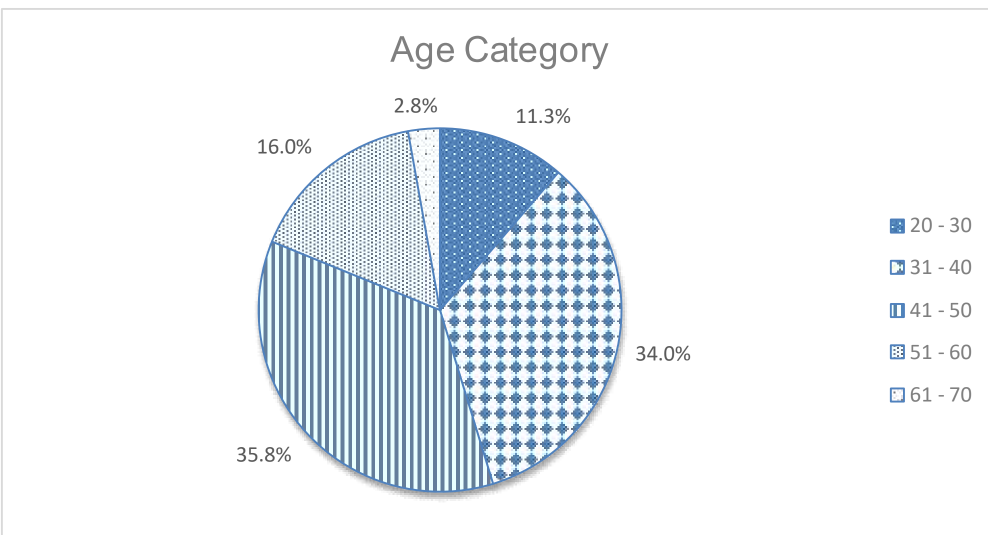


**Figure 4-1: Age distribution of respondents**

Slightly more than two-thirds of the respondents were male (70.8%). Females made up 28.3% of the sample (see Figure 4-2), and there was also one respondent who opted not to answer the question. In a recent report released by the Minerals Council of South Africa (2018), women represent 16% of top management and 17% of senior management in the mining industry. Overall, this is a good result for the organisation, operating at levels almost twice that of the industry mean.

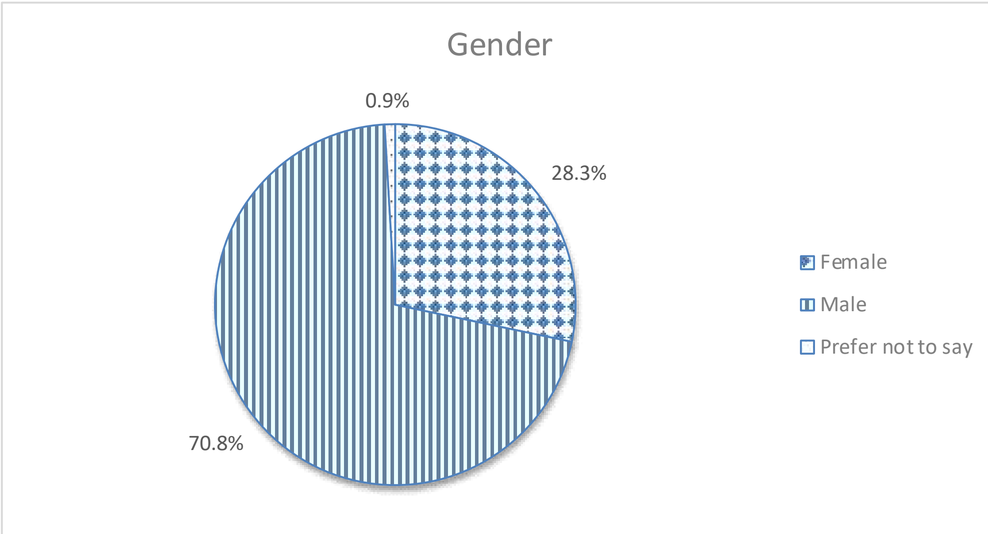


**Figure 4-2: Gender distribution of respondents**

The Patterson job grading scale (Diamond, 2019) is used to rank the level of management in the company. All the operational units make use of the same job grading system. The lowest management level is a D1 level (typically junior engineers), and subsequent numerical increases present an increase in management level. As an example, a D3 management employee is one level above a D2 management employee. The highest D-level management employee has a D5 grading, after which the E-level managers start, following the same principle. The biggest proportion of the respondents (see Figure 4-3) fell in the D2-D3 level (38.7%). The next largest group was the D1 managers at 23.6%. Together, these two groups, representing all the D1-3 managers, make up almost two-thirds of the respondents. The D4-5 managers were the smallest group, making up only 7.5% of the sample. E1 managers, who typically also carry the title of "Manager" in the organisation, made up 19.8% of the sample. Senior management will report in the "E2 and up" group and made up 10.4% of the sample. These individuals are typically responsible for the operation as a whole or large, grouped sections thereof.

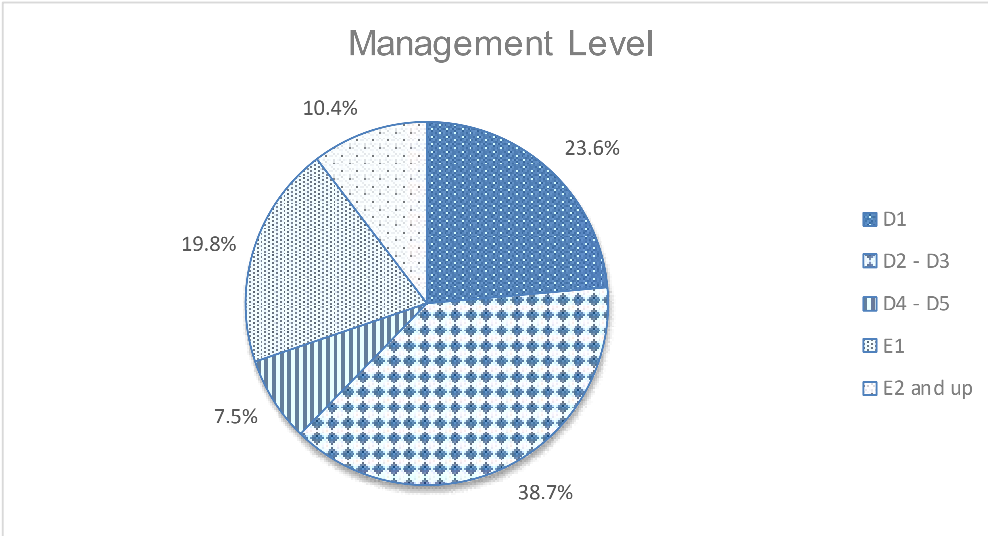


**Figure 4-3: Management level distribution of respondents**

The organisation owns and operates five ferrochrome smelting plants in South Africa (see Figure 4-4). Three of the plants are located in the west near Rustenburg. The other two plants are situated in the east near Steelpoort (Lion) and Lydenburg, respectively (Glencore, 2020).

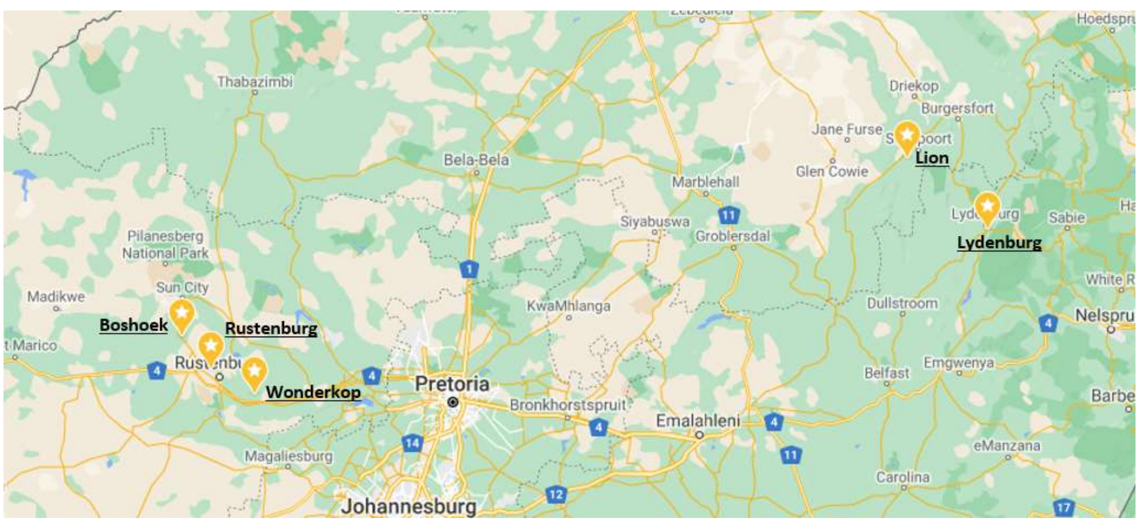


**Figure 4-4: Geographical location of operational units**

The responses received were quite equally distributed between the five plants (see Figure 4-5). Wonderkop represented the largest group at 30.2%, and Boshoek was the smallest group at 11.3%.

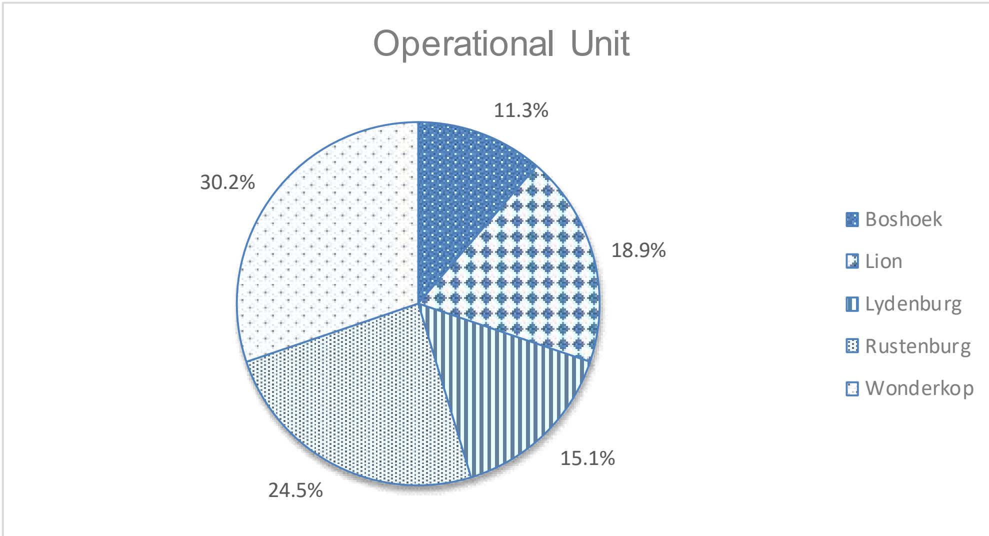


**Figure 4-5: Operational unit distribution of respondents**

## 4.3 EXPLORATORY FACTOR ANALYSIS AND RELIABILITY

This section aims to answer the first research question and relates to the reliability and validity of the measuring instruments used in the questionnaire. The questionnaire distributed to respondents was an amalgamation of three measuring instruments compiled by other researchers, as discussed earlier. Recall the first objective of this research, to "measure the validity and reliability of the technostress, productivity and life satisfaction measuring instruments in the South African context". To this end, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was utilised in conjunction with Bartlett's test of sphericity to determine whether an EFA would be a suitable method to analyse the instruments. For all three measuring instruments, this proved to be the case.

Subsequently, three EFA's were conducted (coinciding with the individual measuring instruments) to uncover the factorial structure. The results obtained for each of the factors will be discussed separately. This involves reporting on factor loadings, commonalities and reliability. The following guidelines were used to interpret the results:

- **Factor loadings -** as a rule of thumb, variables should have a rotated factor loading of at least 0.4. (Rahn, 2014).

- **Communalities -** according to Costello and Osborne (2005), "more common magnitudes in the social sciences are low to moderate communalities of 0.40 to 0.70. If an item has a commonality of less than 0.40, it may either a) not be related to the other items, or b) suggest an additional factor that should be explored".
- **Reliability -** the Cronbach alpha (Cronbach, 1951) will also be calculated for each of the uncovered factors to determine the instrument's reliability in measuring the respective factors. According to Hair *et al.* (2011), a value between 0.7 and 0.8 is considered good, values between 0.8 and 0.9 is considered very good, and those above 0.9 is regarded to be excellent.

The factors' mean scores (mean based on the items included in the factor) and standard deviations will also be discussed as it relates to research objectives.

### 4.3.1 Technostress

Items Q2.1 through Q2.23 were used to measure technostress. The KMO measure of sampling adequacy measured 0.810. According to Williams *et al.* (2010), values above 0.5 are considered adequate to conduct an EFA. Bartlett's p-value of sphericity was calculated to be smaller than 0.001. This result indicates a sufficiently large correlation between items to conduct an EFA (Williams *et al.*, 2010).

The EFA uncovered six distinct factors (see Table 4-1). From literature, the expectation was for only five factors, coinciding with the five techno-stressors (techno-overload, techno-invasion, techno-complexity, techno-insecurity and techno-uncertainty). The results of the EFA will be discussed based on the five theoretical factors. To elaborate on this point, the sixth factor that was formed will be discussed with the fifth factor (techno-insecurity) because the items that formed the sixth factor theoretically belongs to the techno-insecurity factor.

All communalities exceeded the 0.40 guideline (Costello & Osborne, 2005). The item with the lowest communality measured 0.556. Factor loadings and reliability will be discussed based on the five techno-stressors.

**Table 4-1: Results of the Exploratory Factor Analyses (Technostress)**

| Statement | Factor1<br>Techno-complexity | Factor2<br>Techno-overload | Factor3<br>Techno-invasion | Factor4<br>Techno-uncertainty | Factor5<br>Techno-insecurity | Factor 6 | Communalities |
|---|---|---|---|---|---|---|---|
| Q2.11 | 0.872 | | | | | | 0.698 |
| Q2.14 | 0.786 | | | | | | 0.714 |
| Q2.10 | 0.746 | | | | | | 0.777 |
| Q2.13 | 0.699 | | | | | | 0.608 |
| Q2.12 | 0.627 | | | | | | 0.715 |
| Q2.3 | | 0.831 | | | | | 0.703 |
| Q2.1 | | 0.802 | | | | | 0.707 |
| Q2.5 | | 0.723 | | | | | 0.719 |
| Q2.2 | | 0.720 | | | | | 0.775 |
| Q2.4 | | 0.592 | | | | | 0.661 |
| Q2.6 | | | 0.743 | | | | 0.795 |
| Q2.9 | | | 0.820 | | | | 0.615 |
| Q2.7 | | | 0.797 | | | | 0.613 |
| Q2.8 | | | 0.738 | | | | 0.721 |
| Q2.21 | | | | 0.858 | | | 0.791 |
| Q2.22 | | | | 0.796 | | | 0.752 |
| Q2.23 | | | | 0.753 | | | 0.723 |
| Q2.20 | | | | 0.730 | | | 0.819 |
| Q2.17 | | | | | 0.765 | | 0.747 |
| Q2.15 | | | | | 0.764 | | 0.556 |
| Q2.16 | | | | | 0.726 | | 0.837 |
| Q2.18 | | | | | | 0.837 | 0.677 |
| Q2.19 | | | | | | 0.634 | 0.591 |
| Cronbach's Alpha | 0.845 | 0.895 | 0.868 | 0.818 | 0.699 | | |
| Factor Mean | 2.07 | 3.18 | 3.19 | 3.27 | 2.03 | | |
| Factor Standard Deviation | 1.08 | 1.32 | 1.41 | 1.11 | 1.16 | | |

#### *4.3.1.1 Factor 1: Techno-complexity*

The first factor uncovered was represented by items Q2.10 to Q2.14. These items corresponded perfectly with the techno-complexity factor from the original instrument. All items had acceptable factor loadings, exceeding 0.6 (cut-off set at 0.4). Q2.12 cross-loaded to Factor 3, but with a value of 0.383 was deemed non-significant; thus, it was decided to group it with its theoretical factor. The Cronbach alpha for this factor was 0.845, indicating very good reliability. The mean score for this factor was 2.07, with a factor standard deviation of 1.08. This is a low mean score. In fact, it is lower than all three American studies reviewed in Chapter 2 (see Table 1-3). The lowest mean score from these studies was 2.45. It means the respondents disagree with the notion that ICT complexity is leading to stress. The low standard deviation also indicates that respondents feel similar about this, with little deviation in scores recorded. The focus of this research was on management employees. The majority have a tertiary education as a prerequisite to employment. This result makes sense when taking into consideration their relatively high level of education and experience.

#### *4.3.1.2 Factor 2: Techno-overload*

The second factor uncovered was represented by items Q2.1 to Q2.5. These items coincide with the techno-overload factor from the original instrument. Q2.4 had a factor loading of 0.592, whereas the other items all exceeded 0.70. Q2.4 loaded quite well to Factor 3 as well, with a value of 0.410. It was decided to group this item with its theoretical factor. The Cronbach alpha for this factor of 0.895 indicated very good reliability. The mean score for this factor was 3.18, with a factor standard deviation of 1.32. Compared to the first factor, opinion is a bit more divided with a standard deviation of 1.32. The mean score is 3.18, which means the respondents experience a slight degree of techno-overload. The mean score for this factor from the American studies reviewed in Chapter 2 was 3.04, indicating that the South African sample might be experiencing slightly more techno-overload.

#### *4.3.1.3 Factor 3: Techno-invasion*

The third factor uncovered was formed by items Q2.6 to Q2.9. This factor also corresponded with the original measuring instrument for techno-invasion. All items had acceptable factor loadings exceeding 0.70. Four other items cross-loaded onto this factor. Three of them had factor loadings below 0.40, and one of them (Q2.4) had a factor loading of 0.410. However, all these items loaded better to their respective theoretical factors, and it was thus decided not to include them in the techno-invasion factor. The Cronbach alpha for this factor of 0.868 indicated very good reliability. The mean score for this factor was 3.19, with a standard deviation of 1.41. This factor standard deviation was the highest of all of the technostress factors, meaning respondents were the most divided when answering these items. A mean score of 3.19 entails that respondents, overall, felt ICT's were contributing to feelings of stress as a result of techno-invasion. There is a stark difference between this result and the mean score attained from the American studies reviewed in Chapter 2. The mean score for this factor from the American studies is only 2.48, compared to 3.19 for the South African sample. Various possibilities exist that might explain these results. The South African sample consists of managers, of whom it is expected to be available after hours since the ferrochrome plants are operated 24 hours a day. Instant messaging services have also proliferated over the past years, also finding application in the work environment to ease communication.

#### *4.3.1.4 Factor 4: Techno-uncertainty*

The fourth factor was formed by items Q2.20 to Q2.23. This factor corresponded with the techno-uncertainty factor from the original instrument. Factor loadings for all four items exceeded 0.7. The Cronbach alpha of 0.818 indicated very good reliability. The mean score for the factor was 3.27, with a factor standard deviation of 1.11. Compared to the previous factor, the relatively lower standard deviation points toward more agreement between the respondents, in that the techno-uncertainty is somewhat contributing towards feelings of being technostressed. Only one of the three American studies reported on this factor. Tarafdar *et al.* (2010) reported a factor mean score of 3.15. This result compares well with the result obtained from this research, indicating that both American and South African respondents experience a slight degree of techno-uncertainty.

#### *4.3.1.5 Factor 5: Techno-insecurity*

The first four factors uncovered corresponded as expected with the original measuring instrument. All items loaded best on the appropriate factors. The fifth factor did not correspond perfectly with the original instrument. Items Q2.15 to Q2.17 loaded as expected on the fifth factor, which represents the techno-insecurity techno-stressor. Q2.18 loaded onto a sixth factor, with no cross-loading to Factor 5. Q2.18 was phrased as follow, "I do not share my knowledge with my co-workers for fear of being replaced". At face value, one would have expected this item to load correctly. Indeed, when the original instrument was developed, a factor loading of 0.752 was obtained (Tarafdar *et al.*, 2007: 313). Chen (2015: 72), who later validated the instrument in the Chinese context, also obtained a factor loading of 0.70. The last items (Q2.19) also loaded better onto Factor 6 than Factor 5 (0.634 vs 0.458). This item was phrased as "I feel there is less sharing of knowledge among co-workers for fear of being replaced". In the development of the original measuring instrument, a factor loading of 0.76 was obtained, and when Chen (2015:72) validated the instrument in the Chinese context, they obtained a value of 0.56 for these items. There are some similarities between the results obtained in this research and the results reported by Chen (2015). In the results reported by Chen (2015), Q2.19 had the lowest factor loading of all the items making up the techno-insecurity factor. The results indicate that the techno-insecurity factor is not valid and reliable in the South African context. To conduct the remainder of the analyses, it was decided to group these two items with their theoretical factor. The Cronbach alpha for the techno-insecurity factor (which included Q2.18 and Q2.19) of 0.699 indicated good reliability. The mean score for the factor was 2.03, with a standard deviation of 1.16. Overall, a relatively small standard deviation indicating respondents answered these items similarly. The mean score is low at 2.03, indicating that techno-insecurity is not contributing towards feelings of technostress for these respondents. This result is similar to the results obtained in the American studies reviewed in Chapter 2. For the American sample, the mean score was 2.17.

When omitting Q2.18 and Q2.19 from this factor, a Cronbach alpha of 0.802 is attained, indicating very good reliability. The mean score changes to 2.08 (versus 2.03) and the standard deviation to 1.15 (versus 1.16).

#### *4.3.1.6 Technostress*

Together these five factors form technostress as a single factor. The Cronbach alpha, which was calculated to be 0.897, indicates very good reliability. The mean score for the factor was 2.71, with a standard deviation of 1.35. The mean score indicates a neutral opinion, leaning towards not experiencing technostress. The standard deviation is quite large, indicating a wide range of opinions. Some individuals are experiencing high levels of technostress, whereas some are experiencing low levels of perceived technostress.

*4.3.1.7 Total Variance*

A principal component analysis was used as the extraction method. Varimax with Kaiser Normalization was used as the rotation method. An Eigenvalue of 1.0 was used as the cut-off value for selecting factors (Field, 2009: 660). Table 4-2 shows the results of the analysis. Six factors were identified, explaining an acceptable cumulative variance of 70.93%.

**Table 4-2: Total variance of the Technostress factor**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings |
|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total |
| 1 | 7.314 | 31.799 | 31.799 | 7.314 | 31.799 | 31.799 | 3.407 |
| 2 | 2.956 | 12.851 | 44.650 | 2.956 | 12.851 | 44.650 | 3.394 |
| 3 | 2.404 | 10.452 | 55.103 | 2.404 | 10.452 | 55.103 | 3.231 |
| 4 | 1.396 | 6.071 | 61.173 | 1.396 | 6.071 | 61.173 | 2.829 |
| 5 | 1.165 | 5.067 | 66.240 | 1.165 | 5.067 | 66.240 | 2.255 |
| 6 | 1.077 | 4.685 | 70.925 | 1.077 | 4.685 | 70.925 | 1.196 |

### 4.3.2 Productivity

Items Q3.1 to Q3.4 were aimed at measuring productivity. The instrument used to measure productivity was developed by Tarafdar *et al.* (2007).

The KMO measure of sampling adequacy measured 0.837. This value is deemed sufficiently large to conduct an EFA (Williams *et al.*, 2010:5). Bartlett's p-value of sphericity was calculated to be smaller than 0.001. These results support an EFA approach. Table 4-3 shows the results of the EFA.

**Table 4-3: Results of the Exploratory Factor Analyses (Productivity)**

| Statement | Factor1 Productivity | Communalities |
|---|---|---|
| Q3.2 | 0.938 | 0.857 |
| Q3.4 | 0.934 | 0.880 |
| Q3.1 | 0.926 | 0.812 |
| Q3.3 | 0.901 | 0.872 |
| Cronbach's Alpha | 0.943 | |
| Factor Mean | 4.04 | |
| Factor Standard Deviation | 0.86 | |

#### *4.3.2.1 Factor 1: Productivity*

All items had suitable commonalities, above 0.4. All four items loaded exceptionally well on this factor, with factor loadings exceeding 0.9 in all instances. The Cronbach alpha of 0.943 indicated excellent reliability. The mean score for the factor was 4.04, with a factor standard deviation of 0.86. The standard deviation calculated is very low, which indicates that all respondents similarly answered these items. The mean score of 4.04 is relatively high, meaning that, on average, respondents agreed that their productivity increased due to ICT usage. This result is similar to the results of the American studies reviewed in Chapter 2. The mean score for American studies was 3.93. In both contexts, users feel ICT is contributing to their productivity.

#### *4.3.2.2 Total variance*

A principal component analysis was used as the extraction method. An Eigenvalue of 1.0 was used as the cut-off value for selecting factors (Field, 2009:660). An Oblique, Oblimin rotation was used with the Kaiser Normalization. However, this approach did not but yielded a suitable solution because only one component was extracted. Table 4-4 shows the results of the analysis. One factor was identified, explaining an acceptable cumulative variance of 85.537%.

**Table 4-4: Total variance of the Productivity factor**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 3.421 | 85.537 | 85.537 | 3.421 | 85.537 | 85.537 |
| 2 | 0.292 | 7.312 | 92.849 | | | |
| 3 | 0.161 | 4.037 | 96.886 | | | |
| 4 | 0.125 | 3.114 | 100.000 | | | |

### 4.3.3 Overall satisfaction with life

Items Q4.1 to Q4.6 were aimed at measuring overall satisfaction with life. The instrument was developed by Margolis *et al.* (2018) and is based on the SWLS, a well-known life satisfaction measuring instrument developed by Diener *et al.* (1985). The instrument consists of six items, three of which have been stated negatively (Q4.2, Q4.4 and Q4.6).

The KMO measure of sampling adequacy measured 0.754. This value is deemed sufficiently large to conduct an EFA. Bartlett's p-value of sphericity was calculated to be smaller than 0.001. Both these results point to the suitability of an EFA (Williams *et al.*, 2010:5). Table 4-5 shows the result of the EFA.

#### *4.3.3.1 Factor 1: Life satisfaction*

The EFA uncovered one factor. All items in the section measuring life satisfaction had suitable commonalities in excess of 0.4. Negative factor loadings arise due to negatively stated items. In this instance, the statistical analysis programme considered the negatively stated items as normal. Hence, they were assigned positive factor loadings, and the positively stated items were assigned negative factor loadings. According to Kline (1994), the signs of factor loadings only indicate the correlation's direction and do not affect the interpretation of the magnitude. What is important is that all values loaded onto one factor. The absolute value of all factor loadings was sufficiently large, exceeding 0.60. The Cronbach alpha value of 0.815 indicated very good reliability. When accounting for the negatively stated items, the mean score for the factor was calculated to be 3.46 with a standard deviation of 0.82. This is a relatively low standard deviation which indicates that respondents answered this item consistently. The mean score of 3.46 indicates that respondents are satisfied with their lives, even more so than the studies reviewed in Chapter Two.

**Table 4-5: Results of the Exploratory Factor Analyses (Life satisfaction)**

| Statement | Factor1<br>Life Satisfaction | Communalities |
|---|---|---|
| Q4.1 | -0.815 | 0.664 |
| Q4.6 | 0.776 | 0.492 |
| Q4.2 | 0.701 | 0.458 |
| Q4.4 | 0.678 | 0.460 |
| Q4.3 | -0.677 | 0.433 |
| Q4.5 | -0.658 | 0.602 |
| Cronbach's Alpha | 0.815 | |
| Factor Mean | 3.46 | |
| Factor Standard Deviation | 0.82 | |

*4.3.3.2 Total Variance*

A principal component analysis was used as the extraction method, and the Oblique, Oblimin method of rotation extracted only one factor. The Kaiser Normalization was also used. The results are unsatisfactory because it yielded a very limited solution because only one component was extracted. An Eigenvalue of 1.0 was used as the cut-off value for selecting factors (Field, 2009: 660). Table 4-6 shows the results of the analysis. One factor was identified, explaining an acceptable cumulative variance of 51.813%.

**Table 4-6: Total variance of the Life satisfaction factor**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 3.109 | 51.813 | 51.813 | 3.109 | 51.813 | 51.813 |
| 2 | 0.921 | 15.349 | 67.161 | | | |
| 3 | 0.728 | 12.130 | 79.291 | | | |
| 4 | 0.602 | 10.035 | 89.326 | | | |
| 5 | 0.359 | 5.979 | 95.304 | | | |
| 6 | 0.282 | 4.696 | 100.000 | | | |

## 4.4 DESCRIPTIVE ANALYSIS OF VARIABLES

In this section, the answers to the various items are analysed. The analyses involve calculating the mean score (denoted as "M") for each item and the standard deviation (denoted as "SD"). How each item was answered will also be analysed by calculating the frequencies or percentage distribution between the points on the Likert scale. Technostress will be discussed first by considering each of the five techno-stressors separately. After that, productivity and overall life satisfaction will be discussed. To simplify the discussion, the fraction of respondents who agreed with the various statements are compared to those who disagreed.

### 4.4.1 Technostress

Technostress will be divided into its five comprising techno-stressors, and each discussed separately.

#### *4.4.1.1 Techno-overload*

The first techno-stressor assessed was techno-overload. See Table 4-7 for a summary of the results. Slightly more than half of the respondents (52.8%) agreed that technology is forcing them to work much faster (M = 3.34; SD = 1.27). Relatively more respondents disagreed rather than agreed with the statement that technology is forcing them to do more work than they can handle (49.1% vs 37.7%). This neutral response is reflected in the mean score and standard deviation for the statement (M = 2.81; SD = 1.32). Important to note is that the scale starts at one (1) and not zero (0), so three (3) represents a neutral answer and not 2.5. The third statement is closely related to the first, measuring the degree to which respondents felt time pressure as a result of working with technology. More respondents agreed with the statement that they are being forced to work with very tight time schedules as a result of the technology (46.2% vs 34%). The overall result for the statement is neutral (M = 3.19; SD = 1.33). Almost two-thirds of the respondents (65.1%) agreed that technology has caused them to adapt their work habits. This is the one statement that most respondents agreed on (M = 3.53; SD = 1.26). The item within this factor showed the least amount of variance between answers (SD = 1.26). The next statement measured the perceived work overload as a result of technological complexity. Respondents were divided, 39.6% disagreeing with the statement and 44.3% agreeing that technological complexity adds to feelings overload. The overall results reflect this split opinion (M = 3.01; SD = 1.33).

**Table 4-7: Descriptive analysis of techno-overload**

| | **Techno-overload** | **M** | **SD** | **Strongly Disagree** | **Disagree** | **Unsure** | **Agree** | **Strongly Agree** |
|---|---|---|---|---|---|---|---|---|
| Q2.1 | I'm forced by this technology to work much faster | 3.34 | 1.27 | 10.4 | 17.9 | 18.9 | 33.0 | 19.8 |
| Q2.2 | I'm forced by this technology to do more work than I can handle | 2.81 | 1.32 | 18.9 | 30.2 | 13.2 | 26.4 | 11.3 |
| Q2.3 | I'm forced by this technology to work with very tight time schedules | 3.19 | 1.33 | 13.2 | 20.8 | 19.8 | 26.4 | 19.8 |
| Q2.4 | I'm forced to change my work habits to adapt to new technologies | 3.53 | 1.26 | 11.3 | 10.4 | 12.3 | 44.3 | 20.8 |
| Q2.5 | I have a higher workload because of increased technology complexity | 3.01 | 1.33 | 17.0 | 22.6 | 15.1 | 31.1 | 13.2 |

#### 4.4.1.2 *Techno-invasion*

The second techno-stressor measured was techno-invasion. See Table 4-8 for a summary of the results. The first statement enquired about the time spent with family. 44.4% of respondents agreed that technology infringes upon their time with family, whereas 43.4% disagreed. The overall result was very much neutral (M = 3.02; SD = 1.37). The majority of respondents agreed (65.1%) that they felt obligated to be in touch with work, even when on vacation. This statement contributed the most to feelings of techno-invasion and was also scored the most consistently (M = 3.63; SD = 1.35). When asked about the need to stay abreast with new technologies during vacation time, most respondents reported it not to be a concern (M = 2.90; SD = 1.38). The last statement gauged whether people felt that technology is invading their personal lives. Respondents had polarizing views (SD = 1.45). Overall, the result was neutral (M = 3.20; SD = 1.45).

**Table 4-8: Descriptive analysis of techno-invasion**

| | Techno-invasion | M | SD | Strongly Disagree | Disagree | Unsure | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|---|
| Q2.6 | I spend less time with my family due to this technology | 3.02 | 1.37 | 16.0 | 27.4 | 12.3 | 27.4 | 17.0 |
| Q2.7 | I have to be in touch with my work even during my vacation due to this technology | 3.63 | 1.35 | 12.3 | 9.4 | 13.2 | 33.0 | 32.1 |
| Q2.8 | I have to sacrifice my vacation and weekend time to keep current on new technologies | 2.90 | 1.38 | 20.8 | 19.8 | 22.6 | 19.8 | 16.0 |
| Q2.9 | I feel my personal life is being invaded by this technology | 3.20 | 1.45 | 18.9 | 17.9 | 9.4 | 32.1 | 21.7 |

#### *4.4.1.3 Techno-complexity*

The third techno-stressor measured was techno-complexity. See Table 4-9 for a summary of the results. Overall, respondents did not seem to be daunted by this aspect of technology use. The first item enquired whether respondents felt they knew enough about the technology to handle their jobs satisfactorily. The vast majority of respondents disagreed (74.5% vs 5.6%) with the notion that they do not know enough about technology to handle their jobs satisfactorily. The mean score for this statement was M = 1.86, with a standard deviation of SD = 0.96. The second item stated that a long time is required to understand new technologies. Similar to the first item, the vast majority of respondents were in disagreement (79.2% vs 4.7%). This result reflected in the overall score for the item (M = 1.76; SD = 0.92). The third statement measured the number of time respondents have available to upgrade their technological skills. The majority of the respondents disagreed with the statement that they do not have enough time available (55.7% vs 21.7%). The mean score for this statement was M = 2.42, with a standard deviation of SD = 1.13. The fourth statement measured whether respondents thought that new managerial employees to the organisation knew more about technology. Once again, self-perceived technology efficacy was on display, with the majority of respondents (54.7% vs 27.4%) disagreeing with the sentiment that new managerial employees knew more about computer technology. This was exhibited in the results for this statement (M = 2.49; SD = 1.27). The last item aimed at measuring the techno-complexity stressor asked whether managerial employees found it too complex to understand and use new computer technologies. The vast majority of respondents (80.2% vs 4.7%) were in disagreement that new technologies are too complex to understand and use. This statement was most consistently answered in this factor, with a standard deviation of only SD = 0.86. The mean score for this statement was M = 1.81.

**Table 4-9: Descriptive analysis of techno-complexity**

| | Techno-complexity | M | SD | Strongly Disagree | Disagree | Unsure | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|---|
| Q2.10 | I do not know enough about this technology to handle my job satisfactorily | 1.86 | 0.96 | 45.3 | 29.2 | 18.9 | 4.7 | 0.9 |
| Q2.11 | I need a long time to understand and use new technologies | 1.76 | 0.92 | 50.0 | 29.2 | 16.0 | 3.8 | 0.9 |
| Q2.12 | I do not have enough time to study and upgrade my technological skills | 2.42 | 1.13 | 25.5 | 30.2 | 21.7 | 19.8 | 1.9 |
| Q2.13 | I find new employees to this organisation know more about computer technology than I do | 2.49 | 1.27 | 29.2 | 25.5 | 17.9 | 21.7 | 5.7 |
| Q2.14 | I often find it too complex for me to understand and use new technologies | 1.81 | 0.86 | 43.4 | 36.8 | 15.1 | 4.7 | 0.0 |

#### *4.4.1.4 Techno-insecurity*

The fourth techno-stressor measured was techno-insecurity. See Table 4-10 for a summary of the results. As with techno-complexity, respondents did not seem to be daunted by this stressor. The first item measured the perceived threat to job security as a result of new technologies. The vast majority (79.2% vs 2.8%) of respondents indicated that they do not experience feelings of threat to job security due to new technologies. The mean score for this statement was M = 1.76, with little variance between answers (SD = 0.88). The responses to the next item were not as one-sided and asked whether respondents felt a need to update their technological skills to avoid being replaced constantly. 52.9% Of Respondents disagreed with this, and 26.4% agreed with this notion. The mean score for this item was M = 2.55 with a standard deviation of SD = 1.30. The third item measured the perceived threat to job security posed by managerial employees with better technological skills. The majority of respondents did not note this as a concern (76.4%). The mean score for this item was M = 1.92 with a standard deviation of SD = 1.11. The fourth item asked whether respondents would refrain from sharing knowledge due to the threat of possible replacement. 94.4% of respondents indicated that they disagree with this and will continue sharing information. This opinion reflects in the mean score and standard deviation (M= 1.45; SD = 0.83) attained for the item. The last item asked respondents whether they thought their colleagues were busy withholding information for fear of being replaced. The majority of respondents disagreed with this (56.6% vs 24.5%). This is a good result for the organisation. It seems a non-threatening atmosphere exists where managerial employees feel safe sharing knowledge.

**Table 4-10: Descriptive analysis of techno-insecurity**

| | Techno-insecurity | M | SD | Strongly Disagree | Disagree | Unsure | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|---|
| Q2.15 | I feel constant threat to my job security due to new technologies | 1.76 | 0.88 | 48.1 | 31.1 | 17.9 | 1.9 | 0.9 |
| Q2.16 | I have to constantly update my technology skills to avoid being replaced | 2.55 | 1.30 | 27.4 | 25.5 | 20.8 | 17.9 | 8.5 |
| Q2.17 | I'm threatened by co-workers with newer technology skills | 1.92 | 1.11 | 47.2 | 29.2 | 11.3 | 9.4 | 2.8 |
| Q2.18 | I do not share my knowledge with my co-worker's for fear of being replaced | 1.45 | 0.83 | 67.0 | 27.4 | 1.9 | 0.9 | 2.8 |
| Q2.19 | I feel there is less sharing of knowledge among co-worker's for fear of being replaced | 2.49 | 1.24 | 25.5 | 31.1 | 18.9 | 17.9 | 6.6 |

#### *4.4.1.5 Techno-uncertainty*

The last techno-stressors measured was techno-uncertainty. See Table 4-11 for a summary of the results. Overall, it seems this techno-stressor might be contributing to increased feelings of technostress. The first item was a bit more general and measured the degree to which new technology developments are implemented in the organisation. The majority of respondents agreed that there are always new developments in technologies being used by the organisation (65.1% vs 17%). The mean score for this statement was M = 3.66, with a standard deviation between scores of SD = 1.05. The remaining three items were more specific and related to software, hardware and computer networks. The second item made the statement there are constant computer software changes in the organisation, to which more respondents agreed (43.4% vs 26.5%) than disagreed. The mean score for the item was neutral (M = 3.2) with a standard deviation of SD = 1.06. Interesting to note that about a third (30.2%) of the respondents were unsure. The third item dealt with hardware changes. The majority of respondents disagreed that there are constant hardware changes (41.5% vs 27.4%) rather than agreed. The mean score for this item was neutral (M = 2.76) with a standard deviation of SD = 1.07. Similar to the previous item, numerous respondents were unsure. The last item related to the frequency of network upgrades in the organisation. As was the case with software changes, the majority of respondents agreed that the computer networks are being upgraded frequently (55.7% vs 20.7%). The means core for this item was M=3.44 with a standard deviation of SD = 1.07.

**Table 4-11: Descriptive analysis of techno-uncertainty**

| | Techno-uncertainty | M | SD | Strongly Disagree | Disagree | Unsure | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|---|
| Q2.20 | There are always new developments in the technologies we use in our organisation | 3.66 | 1.05 | 2.8 | 14.2 | 17.0 | 45.3 | 19.8 |
| Q2.21 | There are constant changes in computer software in our organisation | 3.21 | 1.06 | 5.7 | 20.8 | 30.2 | 34.0 | 9.4 |
| Q2.22 | There are constant changes in the computer hardware in our organisation | 2.76 | 1.07 | 13.2 | 28.3 | 31.1 | 23.6 | 3.8 |
| Q2.23 | There are frequent upgrades in computer networks in our organisation | 3.44 | 1.07 | 4.7 | 16.0 | 23.6 | 41.5 | 14.2 |

### 4.4.2 Productivity

Productivity was measured using a measuring instrument developed by Tarafdar *et al.* (2007). See Table 4-12 for a summary of the results. The first item of the measuring instrument enquired whether respondents felt the quality of their work improved when using the technology. The vast majority agreed that the technology improved the quality of their work (82% vs 4.7%). Almost a third of respondents selected "strongly agree" with this statement. The mean score for this item was M = 4.05, with a standard deviation of only SD = 0.84. The next item enquired about perceived changes in productivity. Once again, the results were very much in favour of technology, with 77.4% of respondents agreeing with the statement that technology utilisation improves productivity. The mean score for this item was M = 3.98, with a standard deviation of 0.88. The respondents also agreed extensively with the third statement, which read, "this technology helps me to accomplish more work than would otherwise be possible". In fact, a third of respondents strongly agreed with this statement. The mean score for this item was M = 4.05, with a standard deviation of 0.89. The last item was worded more broadly and enquired whether the technology was assisting respondents in executing their jobs better. 84.9% of respondents indicated that technology assists them in performing their jobs better. Only 5.7% of respondents indicated that that technology is not assisting them in performing their jobs better. The mean score for this item was M = 4.08, with a standard deviation of SD = 0.85.

**Table 4-12: Descriptive analysis of productivity**

| | Productivity | M | SD | Strongly Disagree | Disagree | Unsure | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|---|
| Q3.1 | This technology helps me to improve the quality of my work | 4.05 | 0.84 | 1.9 | 2.8 | 13.2 | 52.8 | 29.2 |
| Q3.2 | This technology helps to improve my productivity | 3.98 | 0.88 | 1.9 | 3.8 | 16.0 | 50.0 | 27.4 |
| Q3.3 | This technology helps me to accomplish more work than would otherwise be possible | 4.05 | 0.89 | 0.9 | 5.7 | 14.2 | 46.2 | 33.0 |
| Q3.4 | This technology helps me to perform my job better | 4.08 | 0.85 | 1.9 | 3.8 | 9.4 | 53.8 | 31.1 |

### 4.4.3 Overall satisfaction with life

Life satisfaction was measured using an instrument developed by Margolis *et al.* (2018). See Table 4-13 for a summary of the results. The instrument consists of six items and measures overall life satisfaction through direct items, such as "I like how my life is going" and indirect items, such as "I want to change the path my life is on". Unlike the previous instruments, this instrument also makes use of negatively stated items. In other words, an answer of "strongly agree" does not necessarily entail an increase in the factor being measured.

The first item was stated positively and enquired how respondents felt their lives were going. 67% of respondents agreed with the statement, "I like how my life is going". Only 15.1% disagreed with this statement. So overall, it seems the management employees being investigated like the way their life is going (M = 3.67, SD = 1.08). The second item was stated negatively and prompted the respondents to reflect on their past with the following statement, "If I could live my life over, I would change many things". 39.6% of respondents agreed with this statement, and 37.7% disagreed with this statement. The mean score for this item was M = 3.08 with a standard deviation of SD = 1.24. Overall a very neutral response. The third item was stated positively. Like the first item, the statement was more general and not focused on a specific time period in the lives of the respondents. The statement read, "I am content with my life". Approximately two-thirds (66.1%) of the respondents agreed with this statement, and only 9.4% disagreed. The fourth item was stated negatively and is based on the judgement-type theories of life satisfaction. The statement read, "those around me seems to be living better lives than my own". Only 14.2% of respondents agreed with this statement. 59.4% of respondents disagreed with this statement. The mean score for this item was M = 2.45, with a standard deviation of SD = 0.98. So for the larger part, the respondents feel that they are living better lives than the people around them, which contributes to feelings of well-being. The fifth item is very similar to the first and third, measuring overall feelings of life satisfaction with the following statement, "I am satisfied with where I am in life right now". As with the first and third items, very similar results were observed. Some 53.8% of the respondents agreed they are satisfied with where they are currently in life. 26.4% of respondents disagreed with the statement. The mean score was M = 3.33, with a standard deviation of SD = 1.15. The last item was stated negatively and had a forward-looking focus. The statement read, "I want to change the path my life is on". 39.6% of respondents agreed with the statement. 38.7% of respondents disagreed with the statement. This split view could also be observed from the mean score and standard deviation (M = 2.98, SD = 1.20).

**Table 4-13: Descriptive analysis of life satisfaction**

| Overall life satisfaction | | M | SD | Strongly Disagree | Disagree | Unsure | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|---|
| Q4.1 | I like how my life is going | 3.67 | 1.08 | 5.7 | 9.4 | 17.9 | 46.2 | 20.8 |
| Q4.2 | If I could live my life over, I would change many things | 3.08 | 1.24 | 9.4 | 28.3 | 22.6 | 23.6 | 16.0 |
| Q4.3 | I am content with my life | 3.75 | 0.93 | 1.9 | 7.5 | 24.5 | 45.3 | 20.8 |
| Q4.4 | Those around me seem to be living better lives than my own | 2.45 | 0.98 | 13.2 | 46.2 | 26.4 | 10.4 | 3.8 |
| Q4.5 | I am satisfied with where I am in life right now | 3.33 | 1.15 | 7.5 | 18.9 | 19.8 | 40.6 | 13.2 |
| Q4.6 | I want to change the path my life is on | 2.98 | 1.20 | 12.3 | 26.4 | 21.7 | 30.2 | 9.4 |

## 4.5 TESTING FOR DIFFERENCES IN THE MEAN SCORES OF RESEARCH FACTORS BETWEEN DEMOGRAPHIC VARIABLES

The third objective of the research was to determine whether there are practically significant differences between the mean scores of the techno-stressors, productivity, life satisfaction and the mean score of the techno-stressors between gender, age, organisational unit and management level. Independent t-tests were done to compare the mean scores between gender groups, while ANOVAs were done to compare the mean scores between age groups, organisational units and management levels. For completeness, p-values will be reported but not interpreted since a census was used and not random sampling. The results are discussed separately for each demographic variable.

An independent samples t-test was used to determine whether there is a practically significant difference between the mean scores of the two different gender groups. Three groups were formed: male, female and a group that preferred not to answer the item. The last group consisted of only one respondent and was omitted for the sake of this analysis. Please see Table 4-14 for a summary of the results.

The largest effect size recorded was only 0.150 (for Techno-overload). Therefore only practically non-significant differences were found between the means of the eight factors when comparing males and females. This means there are no discernible differences in opinion between males and females.

**Table 4-14: Mean, SD and effect sizes for male and female respondents**

| Factor | Gender | N | M | SD | p-value | Effect Size |
|---|---|---|---|---|---|---|
| Techno-overload | Female | 30 | 3.03 | 1.23 | 0.440 | 0.150 |
| | Male | 75 | 3.21 | 1.02 | | |
| Techno-complexity | Female | 30 | 2.02 | 0.95 | 0.479 | 0.070 |
| | Male | 75 | 2.08 | 0.78 | | |
| Techno-invasion | Female | 30 | 3.25 | 1.19 | 0.720 | 0.070 |
| | Male | 75 | 3.16 | 1.20 | | |
| Techno-uncertainty | Female | 30 | 3.18 | 0.84 | 0.743 | 0.130 |
| | Male | 75 | 3.29 | 0.86 | | |
| Techno-insecurity | Female | 30 | 2.07 | 0.85 | 0.738 | 0.050 |
| | Male | 75 | 2.03 | 0.68 | | |
| Productivity | Female | 30 | 4.01 | 0.77 | 0.737 | 0.050 |
| | Male | 75 | 4.05 | 0.82 | | |
| Life satisfaction | Female | 30 | 3.42 | 0.91 | 0.558 | 0.060 |
| | Male | 75 | 3.48 | 0.72 | | |
| Technostress | Female | 30 | 2.71 | 0.74 | 0.554 | 0.060 |
| | Male | 75 | 2.76 | 0.62 | | |

There were only three respondents in the 61-70 group; hence they were included with the 51-60 group. See Table 4-15 for a summary of the results.

The mean score for techno-overload increased as the age of the respondents decreased. However, the largest effect size recorded was only 0.21, meaning all these differences are practically non-significant.

For techno-complexity, more significant differences were observed. The mean score for the 20-30 age group was 1.93 (SD = 1.00), and for the 31-40 age group, it was 1.85 (SD = 0.82). The mean for the 41-50 age group was 2.11 (SD = 0.71). Between these three age groups, no practically significant differences exist (d = 0.09 – 0.32). Considering that respondents from the younger age groups have been exposed more extensively to technological advancements, this result makes sense. The mean score for the 51-70 age group was 2.47 (SD = 0.83). Practically visible differences exist between this age group and the 20 - 30 as well as 41 – 50 groups, with effect sizes 0.54 and 0.43. Between the 31-40 age group and the 51-70 age group an effect size of 0.75 was recorded, meaning a practically significant difference exist.

Although the oldest group of respondents reported higher levels of perceived techno-complexity than the other age groups, the mean value was still below 3.00 (M=2.47), which means they do not perceive techno-complexity to be adding to overall feelings of technostress. The education level and experience of the respondents might have contributed to this result.

No significant effect sizes were recorded for techno-invasion. The largest effect size was 0.28, recorded between the 41-50 (M = 3.38, SD = 1.11) and 51-70 (M = 3.01, SD = 1.28) age groups. This result means the respondents are experiencing slight levels of techno-invasion, which are adding to perceived levels of technostress.

The mean scores for techno-uncertainty were 2.83 (SD = 0.81) for the 20-30 age group, 3.17 (SD = 0.88) for the 31-40 age group, 3.41 (SD = 0.90) for the 41-50 age group and 3.43 (SD = 0.67) for the 51-70 age group. The 20-30 age group is the only group with a mean score of less than 3.00. The other three groups, and especially the older two groups, scored above 3.00. This means the two older age groups, in particular, perceive techno-uncertainty, and it is contributing to feelings of technostress. The effect size between the 20-30 age group and the 41-50 age group was 0.64, indicating a practically visible difference. Similarly, the effect size between the 20-30 age group and the 51-70 age group was 0.73, meaning that the difference is leaning towards being practically significant.

For techno-insecurity, the largest effect size measured between the groups was only 0.31. This result means there are practically no significant differences between the mean scores of the four age groups.

For productivity, the largest effect size recorded was 0.34. This result indicates there are no practically significant differences between the mean scores of the four age groups.

For life satisfaction, the largest effect size measured was 0.24, indicating practically no significant differences in the mean scores of the four age groups.

Mean scores from the five techno-stressors were combined to calculate the aggregate technostress score. The largest effect size measured was only 0.20, indicating practically non-significant differences between the age groups.

**Table 4-15: ANOVAs for age groups**

| Factor | Age Groups | N | M | SD | p-values | | Effect Size | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | ANOVA | Welch | 20 - 30 | 31 - 40 | 41 - 50 |
| Techno-overload | **20 - 30** | 12 | 3.32 | 1.37 | 0.874 | 0.887 | | | |
| | **31 - 40** | 36 | 3.23 | 1.05 | | | 0.06 | | |
| | **41 - 50** | 38 | 3.14 | 1.08 | | | 0.13 | 0.09 | |
| | **51 - 70** | 20 | 3.03 | 1.04 | | | 0.21 | 0.19 | 0.10 |
| | **Total** | 106 | 3.17 | 1.09 | | | | | |
| Techno-complexity | **20 - 30** | 12 | 1.93 | 1.00 | 0.050 | 0.079 | | | |
| | **31 - 40** | 36 | 1.85 | 0.82 | | | 0.09 | | |
| | **41 - 50** | 38 | 2.11 | 0.71 | | | 0.18 | 0.32 | |
| | **51 - 70** | 20 | 2.47 | 0.83 | | | 0.54 | 0.75 | 0.43 |
| | **Total** | 106 | 2.07 | 0.82 | | | | | |
| Techno-invasion | **20 - 30** | 12 | 3.04 | 1.38 | 0.666 | 0.678 | | | |
| | **31 - 40** | 36 | 3.15 | 1.17 | | | 0.08 | | |
| | **41 - 50** | 38 | 3.38 | 1.11 | | | 0.24 | 0.19 | |
| | **51 - 70** | 20 | 3.01 | 1.28 | | | 0.02 | 0.11 | 0.28 |
| | **Total** | 106 | 3.19 | 1.19 | | | | | |
| Techno-uncertainy | **20 - 30** | 12 | 2.83 | 0.81 | 0.150 | 0.142 | | | |
| | **31 - 40** | 36 | 3.17 | 0.88 | | | 0.39 | | |
| | **41 - 50** | 38 | 3.41 | 0.90 | | | 0.64 | 0.27 | |
| | **51 - 70** | 20 | 3.43 | 0.67 | | | 0.73 | 0.29 | 0.01 |
| | **Total** | 106 | 3.27 | 0.85 | | | | | |
| Techno-insecurity | **20 - 30** | 12 | 2.08 | 1.05 | 0.704 | 0.639 | | | |
| | **31 - 40** | 36 | 2.09 | 0.74 | | | 0.01 | | |
| | **41 - 50** | 38 | 2.06 | 0.67 | | | 0.02 | 0.04 | |
| | **51 - 70** | 20 | 1.86 | 0.63 | | | 0.21 | 0.31 | 0.30 |
| | **Total** | 106 | 2.03 | 0.73 | | | | | |
| Productivity | **20 - 30** | 12 | 4.21 | 0.77 | 0.766 | 0.778 | | | |
| | **31 - 40** | 36 | 4.08 | 0.77 | | | 0.16 | | |
| | **41 - 50** | 38 | 4.02 | 0.83 | | | 0.23 | 0.08 | |
| | **51 - 70** | 20 | 3.91 | 0.86 | | | 0.34 | 0.20 | 0.12 |
| | **Total** | 106 | 4.04 | 0.80 | | | | | |
| Life satisfaction | **20 - 30** | 12 | 3.32 | 0.73 | 0.889 | 0.883 | | | |
| | **31 - 40** | 36 | 3.48 | 0.76 | | | 0.21 | | |
| | **41 - 50** | 38 | 3.51 | 0.79 | | | 0.24 | 0.03 | |
| | **51 - 70** | 20 | 3.42 | 0.83 | | | 0.12 | 0.08 | 0.11 |
| | **Total** | 106 | 3.46 | 0.77 | | | | | |
| Technostres s | **20 - 30** | 12 | 2.64 | 0.87 | 0.814 | 0.838 | | | |
| | **31 - 40** | 36 | 2.70 | 0.62 | | | 0.07 | | |
| | **41 - 50** | 38 | 2.82 | 0.63 | | | 0.20 | 0.19 | |
| | **51 - 70** | 20 | 2.76 | 0.64 | | | 0.14 | 0.09 | 0.09 |
| | **Total** | 106 | 2.75 | 0.65 | | | | | |

Table 4-16 shows the results of the ANOVA analysis for the organisational units. A practically visible difference exists between Lydenburg (M = 3.01, SD = 0.94) and Lion (M = 3.44, SD = 0.91) with an effect size of 0.45. A practically visible difference exists between Rustenburg (M = 2.83, SD = 1.15) and Lion (M = 3.44, SD = 0.91), with an effect size of 0.53. A practically visible difference exists between Rustenburg (M = 2.83, SD = 1.15) and Wonderkop (M = 3.37, SD = 1.19), with an effect size of 0.45.

For techno-complexity, a practically visible difference exists between Wonderkop (M = 2.26, SD = 0.90) and Lydenburg (M = 1.85, SD = 0.74) with an effect size of 0.46. A practically visible difference exists between Wonderkop (M = 2.26, SD = 0.90) and Rustenburg (M = 1.90, SD = 0.73) with an effect size of 0.41.

For techno-invasion, a broad range of effect sizes were noted (d = 0.08 – 1.25). A practically significant difference exists between Lion (M = 3.91, SD = 0.92) and Boshoek (M = 3.04, SD = 1.02) with an effect size of 0.86. A practically significant difference exists between Lion (M = 3.91, SD = 0.92) and Rustenburg (M = 2.59, SD = 1.06) with an effect size of 1.25. A practically visible difference exists between Lion (M = 3.91, SD = 0.92) and Wonderkop (M = 3.13, SD = 1.21) with an effect size of 0.65. A difference approaching practically visible exists between Rustenburg (M = 2.59, SD = 1.06) and Boshoek (M = 3.04, SD = 1.02) with an effect size of 0.43. Similarly, a difference approaching practically visible exists between Rustenburg (M = 2.59, SD = 1.06) and Wonderkop (M = 3.13, SD = 1.21) with an effect size of 0.45.

Lastly, a difference approaching being practically significant exists between Lydenburg (M = 3.52, SD = 1.29) and Rustenburg (M = 2.59, SD = 1.06) with an effect size of 0.72.

For techno-uncertainty, the largest effect size measured was only 0.29. Practically no significant differences exist between the mean scores of the organisational units.

For techno-insecurity, a practically visible difference exists between Lion (M = 2.18, SD = 0.77) and Boshoek (M = 1.75, SD = 0.51) with an effect size of 0.56. A practically visible difference exists between Wonderkop (M = 2.13, SD = 0.78) and Boshoek (M = 1.75, SD = 0.51) with an effect size of 0.48.

For IT-enabled productivity, a practically visible difference exists between Lydenburg (M = 3.91, SD = 0.60) and Boshoek (M = 4.21, SD = 0.50) with an effect size of 0.51.

For life satisfaction, a practically significant difference exists between Lion (M = 2.99, SD = 0.83) and Boshoek (M = 3.63, SD = 0.79) with an effect size of 0.76. A difference approaching being practically significant exists between Lion (M = 2.99, SD = 0.83) and Rustenburg (M = 3.57, SD = 0.61) with an effect size of 0.70. A practically significant difference exists between Lion (M = 2.99, SD = 0.83) and Wonderkop (M = 3.65, SD = 0.73) with an effect size of 0.79. A practically visible difference exists between Lion (M = 2.99, SD = 0.83) and Lydenburg (M = 3.36, SD = 0.81) with an effect size of 0.45.

For technostress, a practically visible difference exists between Lion (M = 2.97, SD = 0.68) and Boshoek (M = 2.60, SD = 0.44) with an effect size of 0.54. A practically visible difference exists between Lion (M = 2.97, SD = 0.68) and Lydenburg (M = 2.69, SD = 0.59) with an effect size of 0.41. A practically visible difference exists between Lion (M = 2.97, SD = 0.68) and Rustenburg (M = 2.54, SD = 0.54) with an effect size of 0.63.

### Table 4-16: ANOVAs for the organisational unit

| Factor | Organisational unit | N | M | SD | p-values | | Effect Size | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ANOVA | Welch | BHK | Lion | LYD | RTB |
| Techno-overload | Boshoek | 12 | 3.13 | 1.02 | 0.269 | 0.292 | | | | |
| | Lion | 20 | 3.44 | 0.91 | | | 0.30 | | | |
| | Lydenburg | 16 | 3.01 | 0.94 | | | 0.12 | 0.45 | | |
| | Rustenburg | 26 | 2.83 | 1.15 | | | 0.26 | 0.53 | 0.16 | |
| | Wonderkop | 32 | 3.37 | 1.19 | | | 0.20 | 0.06 | 0.30 | 0.45 |
| | Total | 106 | 3.17 | 1.09 | | | | | | |
| Techno-complexity | Boshoek | 12 | 1.95 | 0.52 | 0.288 | 0.324 | | | | |
| | Lion | 20 | 2.23 | 0.98 | | | 0.28 | | | |
| | Lydenburg | 16 | 1.85 | 0.74 | | | 0.13 | 0.39 | | |
| | Rustenburg | 26 | 1.90 | 0.73 | | | 0.07 | 0.34 | 0.06 | |
| | Wonderkop | 32 | 2.26 | 0.90 | | | 0.35 | 0.03 | 0.46 | 0.41 |
| | Total | 106 | 2.07 | 0.82 | | | | | | |
| Techno-invasion | Boshoek | 12 | 3.04 | 1.02 | 0.002 | 0.002 | | | | |
| | Lion | 20 | 3.91 | 0.92 | | | 0.86 | | | |
| | Lydenburg | 16 | 3.52 | 1.29 | | | 0.37 | 0.31 | | |
| | Rustenburg | 26 | 2.59 | 1.06 | | | 0.43 | 1.25 | 0.72 | |
| | Wonderkop | 32 | 3.13 | 1.21 | | | 0.08 | 0.65 | 0.30 | 0.45 |
| | Total | 106 | 3.19 | 1.19 | | | | | | |
| Techno-uncertainy | Boshoek | 12 | 3.15 | 0.45 | 0.681 | 0.631 | | | | |
| | Lion | 20 | 3.10 | 1.02 | | | 0.04 | | | |
| | Lydenburg | 16 | 3.16 | 0.98 | | | 0.01 | 0.06 | | |
| | Rustenburg | 26 | 3.39 | 0.87 | | | 0.28 | 0.29 | 0.24 | |
| | Wonderkop | 32 | 3.38 | 0.80 | | | 0.29 | 0.27 | 0.22 | 0.02 |
| | Total | 106 | 3.27 | 0.85 | | | | | | |
| Techno-insecurity | Boshoek | 12 | 1.75 | 0.51 | 0.494 | 0.342 | | | | |
| | Lion | 20 | 2.18 | 0.77 | | | 0.56 | | | |
| | Lydenburg | 16 | 1.94 | 0.83 | | | 0.22 | 0.29 | | |
| | Rustenburg | 26 | 2.00 | 0.65 | | | 0.38 | 0.23 | 0.07 | |
| | Wonderkop | 32 | 2.13 | 0.78 | | | 0.48 | 0.07 | 0.22 | 0.16 |
| | Total | 106 | 2.03 | 0.73 | | | | | | |
| Productivity | Boshoek | 12 | 4.21 | 0.50 | 0.468 | 0.429 | | | | |
| | Lion | 20 | 3.85 | 0.95 | | | 0.38 | | | |
| | Lydenburg | 16 | 3.91 | 0.60 | | | 0.51 | 0.06 | | |
| | Rustenburg | 26 | 4.23 | 0.92 | | | 0.02 | 0.40 | 0.35 | |
| | Wonderkop | 32 | 4.02 | 0.77 | | | 0.25 | 0.17 | 0.14 | 0.23 |
| | Total | 106 | 4.04 | 0.80 | | | | | | |
| Life satisfaction | Boshoek | 12 | 3.63 | 0.79 | 0.027 | 0.069 | | | | |
| | Lion | 20 | 2.99 | 0.83 | | | 0.76 | | | |
| | Lydenburg | 16 | 3.36 | 0.81 | | | 0.32 | 0.45 | | |
| | Rustenburg | 26 | 3.57 | 0.61 | | | 0.07 | 0.70 | 0.25 | |
| | Wonderkop | 32 | 3.65 | 0.73 | | | 0.03 | 0.79 | 0.35 | 0.11 |
| | Total | 106 | 3.46 | 0.77 | | | | | | |
| Technostress | Boshoek | 12 | 2.60 | 0.44 | 0.164 | 0.159 | | | | |
| | Lion | 20 | 2.97 | 0.68 | | | 0.54 | | | |
| | Lydenburg | 16 | 2.69 | 0.59 | | | 0.15 | 0.41 | | |
| | Rustenburg | 26 | 2.54 | 0.54 | | | 0.12 | 0.63 | 0.26 | |
| | Wonderkop | 32 | 2.85 | 0.77 | | | 0.32 | 0.15 | 0.20 | 0.40 |
| | Total | 106 | 2.75 | 0.65 | | | | | | |

There were only eight respondents in the D4-D5 management level group. Because these are quite senior members in the organisation, they were grouped with the E1 managers as opposed to the D2-D3 group. Table 4-17 shows the results of the ANOVA analysis for the various levels of management.

The largest effect size measured for techno-overload was only 0.26. All the differences are practically non-significant.

For techno-complexity, a practically visible difference exist between the E1 managers (M = 2.44, SD = 0.85) and the D1 managers (M = 1.99, SD = 0.81) with an effect size of 0.53. A practically visible difference exists between the E1 managers (M = 2.44, SD = 0.85) and the D2-D3 managers (M = 1.87, SD = 0.82) with an effect size of 0.67. Lastly, a practically visible difference exists between the E1 managers (M = 2.44, SD = 0.85) and the managers E2 and up (M = 2.02, SD = 0.51) with an effect size of 0.50.

For techno-invasion, a practically visible difference exists between the D1 managers (M = 2.66, SD = 1.25) and the D2-D3 managers (M = 3.20, SD = 1.16) with an effect size of 0.43. A practically visible difference exists between the D1 managers (M = 2.66, SD = 1.25) and the E1 managers (M = 3.53, SD = 0.94) with an effect size of 0.69. A practically visible difference exists between the D1 managers (M = 2.66, SD = 1.25) and the managers E2 and up (M = 3.50, SD = 1.41) with an effect size of 0.60.

The largest effect size measured for techno-uncertainty was only 0.30. All the differences are practically non-significant.

For techno-insecurity, a practically visible difference exists between managers E2 and up (M = 1.64, SD = 0.43) and D1 managers (M = 2.05, SD = 0.72) with an effect size of 0.57. A practically visible difference exists between managers E2 and up (M = 1.64, SD = 0.43) and D2-D3 managers (M = 2.07, SD = 0.79) with an effect size of 0.55. A practically visible difference exists between managers E2 and up (M = 1.64, SD = 0.43) and E1 managers (M = 2.12, SD = 0.72) with an effect size of 0.67. These results make sense. For the upper echelons of management, IT proficiency only makes up a small portion of the skill and knowledge required to be successful; hence a lack of IT ability is not seen as debilitating.

The largest effect size measured for productivity was only 0.30. All the differences are practically non-significant.

For life satisfaction, a practically visible difference exists between D1 managers (M = 3.26, SD = 0.73) and E1 managers (M = 3.57, SD = 0.73), with an effect size of 0.42. A practically significant difference exists between D1 managers (M = 3.26, SD = 0.73) and managers E2 an up (M = 3.86, SD = 0.58), with an effect size of 0.83. A practically visible difference exists between D2-D3 managers (M = 3.40, SD = 0.83) and managers E2 an up (M = 3.86, SD = 0.58), with an effect size of 0.56.

For technostress, the is a practically visible difference between D1 managers (M = 2.56, SD = 0.70) and E1 managers (M = 2.92, SD = 0.56) with an effect size of 0.51. All other differences are practically non-significant.

**Table 4-17: ANOVAs for management level**

| Factor | Management Level | N | M | SD | p-values | | Effect Size | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | ANOVA | Welch | D1 | D2 - D3 | E1 |
| Techno-overload | **D1** | 25 | 3.02 | 1.22 | 0.741 | 0.773 | | | |
| | **D2 - D3** | 41 | 3.27 | 1.08 | | | 0.21 | | |
| | **E1** | 29 | 3.23 | 0.98 | | | 0.18 | 0.03 | |
| | **E2 and up** | 11 | 2.98 | 1.11 | | | 0.03 | 0.26 | 0.23 |
| | **Total** | 106 | 3.17 | 1.09 | | | | | |
| Techno-complexity | **D1** | 25 | 1.99 | 0.81 | 0.034 | 0.060 | | | |
| | **D2 - D3** | 41 | 1.87 | 0.82 | | | 0.15 | | |
| | **E1** | 29 | 2.44 | 0.85 | | | 0.53 | 0.67 | |
| | **E2 and up** | 11 | 2.02 | 0.51 | | | 0.03 | 0.18 | 0.50 |
| | **Total** | 106 | 2.07 | 0.82 | | | | | |
| Techno-invasion | **D1** | 25 | 2.66 | 1.25 | 0.042 | 0.059 | | | |
| | **D2 - D3** | 41 | 3.20 | 1.16 | | | 0.43 | | |
| | **E1** | 29 | 3.53 | 0.94 | | | 0.69 | 0.28 | |
| | **E2 and up** | 11 | 3.50 | 1.41 | | | 0.60 | 0.21 | 0.02 |
| | **Total** | 106 | 3.19 | 1.19 | | | | | |
| Techno-uncertainy | **D1** | 25 | 3.10 | 0.87 | 0.674 | 0.715 | | | |
| | **D2 - D3** | 41 | 3.34 | 0.86 | | | 0.27 | | |
| | **E1** | 29 | 3.27 | 0.77 | | | 0.20 | 0.08 | |
| | **E2 and up** | 11 | 3.41 | 1.06 | | | 0.30 | 0.07 | 0.13 |
| | **Total** | 106 | 3.27 | 0.85 | | | | | |
| Techno-insecurity | **D1** | 25 | 2.05 | 0.72 | 0.292 | 0.047 | | | |
| | **D2 - D3** | 41 | 2.07 | 0.79 | | | 0.03 | | |
| | **E1** | 29 | 2.12 | 0.72 | | | 0.10 | 0.06 | |
| | **E2 and up** | 11 | 1.64 | 0.43 | | | 0.57 | 0.55 | 0.67 |
| | **Total** | 106 | 2.03 | 0.73 | | | | | |
| Productivity | **D1** | 25 | 3.88 | 0.89 | 0.638 | 0.700 | | | |
| | **D2 - D3** | 41 | 4.15 | 0.83 | | | 0.30 | | |
| | **E1** | 29 | 4.03 | 0.71 | | | 0.17 | 0.13 | |
| | **E2 and up** | 11 | 4.05 | 0.77 | | | 0.19 | 0.12 | 0.01 |
| | **Total** | 106 | 4.04 | 0.80 | | | | | |
| Life satisfaction | **D1** | 25 | 3.26 | 0.73 | 0.134 | 0.070 | | | |
| | **D2 - D3** | 41 | 3.40 | 0.83 | | | 0.17 | | |
| | **E1** | 29 | 3.57 | 0.73 | | | 0.42 | 0.20 | |
| | **E2 and up** | 11 | 3.86 | 0.58 | | | 0.83 | 0.56 | 0.40 |
| | **Total** | 106 | 3.46 | 0.77 | | | | | |
| Technostres s | **D1** | 25 | 2.56 | 0.70 | 0.263 | 0.260 | | | |
| | **D2 - D3** | 41 | 2.75 | 0.68 | | | 0.27 | | |
| | **E1** | 29 | 2.92 | 0.56 | | | 0.51 | 0.25 | |
| | **E2 and up** | 11 | 2.71 | 0.62 | | | 0.21 | 0.06 | 0.34 |
| | **Total** | 106 | 2.75 | 0.65 | | | | | |

## 4.6 CORRELATIONAL ANALYSIS

The fourth objective of the research was to establish if there are correlations between technostress, productivity and life satisfaction. Spearman rank-order correlational analyses were conducted to determine the correlation coefficients between the factors identified. Please note that the analyses were extended to include the techno-stressors. The aim of this was to garner a better understanding of what techno-stressors are adding and detracting from the observed correlations. Knowing which stressors affect productivity and life satisfaction most severely will allow for targeted workplace interventions.

According to Wienclaw (2019), “correlation may be positive (i.e., as the value of the one variable increases the value of the other value increases), negative (i.e., as the once variable increases the other variable decreases), or zero (i.e., the values of the two variables are unrelated)” Interpretations are based on Cohen's (1988) guidelines: 0.1 small effect or practically non-significant relationship; 0.3 medium effect or practically visible; and 0.5, a large effect or practically significant relationship. The p-value is reported for completeness’ sake but will not be interpreted since a census was used and not a random sample.

Table 4-18 shows the results obtained for the correlational analysis involving all techno-stressors, productivity and life satisfaction. The correlation coefficient between technostress and productivity is only -0.112. There is a practically non-significant relationship between technostress and productivity. The literature reviewed pointed towards a negative relationship between these two factors. The results of this research points toward a negative relationship, albeit practically non-significant.

The correlation coefficient between technostress and life satisfaction is -0.245. This result indicates that a negative relationship exists between technostress and life satisfaction, in that an increase in technostress leads to a decrease in life satisfaction. The relationship is approaching a practically visible effect. This result coincides with existing literature.

The impact of individual techno-stressors on productivity and life satisfaction will be discussed separately. The correlation coefficient between techno-overload and productivity is -0.049. Techno-overload does not seem to impact productivity. The correlation coefficient between techno-overload and life satisfaction is -0.155. An increase in techno-overload will lead to a decrease in life satisfaction, but the effect is practically non-significant.

The correlation coefficient between techno-complexity and productivity is -0.361. An increase in techno-complexity leads to a decrease in self-reported productivity. The effect is practically visible. The correlation coefficient between techno-complexity and life satisfaction is -0.197. An increase in techno-complexity leads to a decrease in life satisfaction. The effect is small, approaching practically visible levels.

The correlation coefficient between techno-invasion and productivity is -0.150. An increase in techno-invasion leads to a decrease in self-reported productivity. The effect is small and practically non-significant. The correlation coefficient between techno-invasion and life satisfaction is -0.207. An increase in techno-invasion leads to a decrease in life satisfaction. The effect is small, approaching practically visible levels.

The correlation coefficient between techno-uncertainty and productivity is 0.306. An increase in techno-uncertainty leads to an increase in self-reported productivity. The effect is medium and practically visible. This result is somewhat unexpected. Constant improvements in the technology used increases techno-uncertainty but seem to be associated with increased productivity. The correlation coefficient between techno-uncertainty and life satisfaction is -0.058. An increase in techno-uncertainty leads to a decrease in life satisfaction. The effect is small, approaching a level of being practically visible.

The correlation coefficient between techno-insecurity and productivity is -.108. An increase in techno-insecurity leads to a decrease in self-reported productivity. The effect is small and practically non-significant. The correlation coefficient between techno-insecurity and life satisfaction is -0.245. An increase in techno-insecurity leads to a decrease in life satisfaction. The effect is medium and approaching levels of being practically visible.

To summarise, productivity is best correlated with techno-complexity and techno-uncertainty. The other three techno-stressors are weakly correlated with productivity. Increases in techno-complexity decrease self-reported productivity, whereas increases in techno-uncertainty increases productivity. Life satisfaction is best correlated with techno-complexity, techno-invasion and techno-insecurity. In all three instances, an increase in the respective techno-stressor leads to a decrease in life satisfaction.

**Table 4-18: Correlational analysis of research factors**

| | | | 1. Techno overload | 2. Techno complexity | 3. Techno invasion | 4. Techno uncertainy | 5. Techno insecurity | 6. Technostress | 7. Productivity | 8. Life Satisfaction |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Techno overload | Correlation Coefficient | 1.000 | | | | | | | |
| | | p-value | | | | | | | | |
| 2 | Techno complexity | Correlation Coefficient | .366** | 1 | | | | | | |
| | | p-value | 0.000 | | | | | | | |
| 3 | Techno invasion | Correlation Coefficient | .603** | .404** | 1 | | | | | |
| | | p-value | 0.000 | 0.000 | | | | | | |
| 4 | Techno uncertainy | Correlation Coefficient | .377** | 0.117 | 0.177 | 1 | | | | |
| | | p-value | 0.000 | 0.233 | 0.069 | | | | | |
| 5 | Techno insecurity | Correlation Coefficient | .398** | .486** | .191* | .313** | 1 | | | |
| | | p-value | 0.000 | 0.000 | 0.050 | 0.001 | | | | |
| 6 | Technostress | Correlation Coefficient | .818** | .656** | .743** | .541** | .619** | 1 | | |
| | | p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | |
| 7 | Productivity | Correlation Coefficient | -0.049 | -.361** | -0.150 | .306** | -0.108 | -0.112 | 1 | |
| | | p-value | 0.617 | 0.000 | 0.126 | 0.001 | 0.273 | 0.252 | | |
| 8 | Life Satisfaction | Correlation Coefficient | -0.155 | -.197* | -.207* | -0.058 | -.245* | -.245* | .247* | 1 |
| | | p-value | 0.112 | 0.043 | 0.034 | 0.554 | 0.011 | 0.011 | 0.011 | |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

## 4.7 SUMMARY

This chapter aimed to relay the results of the analyses conducted to address the research objectives. The demographics were analysed, followed by an EFA to uncover the factorial structure of the questionnaire. Following the EFA, the factor means and standard deviations were calculated. For each statement, the answers were analysed using descriptive statistics and determining the percentage distribution between the points on the Likert scale. An independent samples-test was completed to determine whether practically significant differences exist between genders. ANOVA's were completed to compare the mean scores between factors for the remaining demographic variables. The chapter was concluded with a correlational analysis to determine whether research factors are correlated. The next chapter aims to conclude the research by addressing each research question separately. The limitations of the research will be discussed, as well as the managerial implications of the results. The chapter will conclude by identifying areas for future research.

# CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

## 5.1 INTRODUCTION

The purpose of this chapter is to conclude this research. Consideration will be given to individual research questions and addressed based on the results of the analyses conducted. Theoretical contributions will be highlighted and contextualised by also considering the limitations of the research. Managerial implications are discussed for this specific organisation. This involves reviewing positive results but also isolating areas of possible improvement. The chapter finally concludes by taking all relevant information into account and proposing areas of future research.

## 5.2 DISCUSSION OF THE MAIN FINDINGS IN RESPONSE TO EACH OF THE RESEARCH QUESTIONS

The purpose of this research was to investigate the technostress levels of non-ICT specialists in the South African context and to what degree varying technostress levels affect productivity and life satisfaction. To this end, four research questions were formulated:

- Are the technostress, productivity and life satisfaction measuring instruments valid and reliable in the South African context?
- What are the technostress, productivity and life satisfaction levels of managerial employees?
- Are there practically significant differences in the mean scores of technostress, productivity and life satisfaction between gender, age groups, operational units and management levels?
- Is there a correlation between technostress, productivity and life satisfaction?

Each research question will now be addressed briefly, based on the analyses conducted in the previous chapter.

### 5.2.1 Validity and reliability of the technostress, productivity and life satisfaction measuring instruments in the South African context

First, conceptual-theoretical frameworks were established for each research factor. The questionnaire used as a data collection tool was an amalgamation of three separate measuring instruments. Technostress and it is five comprising techno-stressors were measured using an instrument developed by Chen (2015). Productivity was measured using an instrument developed by Tarafdar *et al.* (2007), and life satisfaction was measured using an instrument developed by Margolis *et al.* (2018). According to the literature (Chen, 2015), the technostress instrument consists of five separate factors, corresponding with five techno-stressors. The remaining two instruments to measure productivity and life satisfaction were supposed to load onto one factor each.

The statements intended to measure productivity loaded onto one factor as expected, with an excellent Cronbach alpha value of 0.943 being measured. This result correlated well with findings from Tarafdar *et al.* (2007) and Pirkkalainen *et al.*(2019), who reported a Cronbach alpha value of 0.91 and a composite reliability value of 0.891, respectively. The statements intended to measure life satisfaction also loaded onto one factor as expected, with a very good Cronbach alpha value of 0.815 being measured. The factorial structure of the technostress instrument was not perfectly aligned with the literature. All techno-stressors loaded as expected, except for techno-insecurity. Q2.18 and Q2.19 loaded better to a sixth factor. However, for the research, these statements were included with the techno-insecurity factor to complete the remaining analyses. The Cronbach alpha value for techno-insecurity measured 0.699, which is slightly lower compared to Tarafdar's *et al.* (2010) finding of 0.84 and Pirkkalainen's *et al.* (2019) finding of 0.90. According to Hair *et al.* (2011), a value between 0.7 and 0.8 is good. So it is clear to see this result is borderline acceptable. The remaining four technostressors had very good reliabilities, with Cronbach alpha values exceeding 0.8 in all instances. Overall, the results were well correlated with existing literature. The Cronbach alpha value for techno-complexity measured 0.845, similar to Tarafdar's *et al.* (2010) finding 0.840 and slightly lower than Tarafdar's *et al.* (2015) finding of 0.92. The Cronbach alpha value for techno-overload measured 0.895, similar to Tarafdar's *et al.* (2010) finding of 0.89 and Tarafdar's *et al.* (2015)

finding of 0.90. The Cronbach alpha value for techno-invasion measured 0.868, in the middle between Tarafdar's *et al.* (2010) finding of 0.81 and Tarafdar's *et al.* (2015) finding of 0.91. The Cronbach alpha value for techno-uncertainty measured 0.818, similar to Tarafdar's *et al.* (2010) finding of 0.82.

To summarise, the instruments to measure productivity and life satisfaction is valid and reliable in the South African context. The technostress instrument developed by Chen (2015) can be used in the South African context, but the researcher should consider excluding Q2.18 and Q2.19. The remaining five factors will still explain an acceptable cumulative variance of 66.24%, with these two statements excluded. It is unclear why these results were obtained. Both statements had an ethical implication, so it is surmised that some respondents did not care to admit the truth because of this fact. As an example, Q2.18 read, "I do not share my knowledge with my co-workers for fear of being replaced". The implication is that the person is placing his/her interest above that of the organisation.

### 5.2.2 Technostress, productivity and life satisfaction levels of managerial employees

All the statements consisted of a Likert scale utilising natural numbers between one and five. A value of one represented "strongly disagree" whereas a value of five represented "strongly agree". A mean score of three for a specific factor would be considered a neutral opinion (neither agree nor disagree). The technostress instrument consisted of five factors. Each factor will be discussed briefly, followed by the mean score of the techno-stressors (i.e., technostress as a single factor). Following technostress, the mean levels of productivity and life satisfaction for the managerial employees will be summarised.

The mean score for the techno-complexity factor was only 2.07, which is significantly lower compared to the findings of Tarafdar *et al.* (2010) (M = 2.54); Pirkkalainen *et al.* (2019) (M = 2.51) and Brooks (2015) (M = 2.45). This result shows that the complexity of ICT is not adding to perceptions of stress. The respondents are on the management level, meeting competency requirements related to education level and experience.

The mean score for the techno-overload factor was 3.18, indicating a slight agreement that ICT usage is causing feelings of overload. This correlated with the finding of Brooks (2015) (M = 3.20). The mean score for techno-invasion was 3.19, meaning there is a slight agreement that techno-invasion contributes to perceptions of stress. The mean score for techno-uncertainty was 3.27 (close to neutral), slightly higher than Tarafdars' *et al.* (2010) finding of 3.15. This result shows that techno-uncertainty are contributing most to feelings of technostress for managerial employees. The mean score for the techno-insecurity factor was 2.03 compared to 2.00 of Tarafdar *et al.* (2010) and 2.34 of Pirkkalainen *et al.* (2019). The managerial employees seem to have high self-efficacy as related to dealing with demands arising from ICT usage. Both in terms of techno-complexity and techno-insecurity, their abilities and competency are decreasing perceived levels of technostress. The mean score across all the technostress statements was 2.71. This result reveals that managerial employees, on average, experience low levels of technostress. The factor mean for productivity was 4.04, similar to the 4.06 of Pirkkalainen *et al.* (2019) and slightly higher than the 3.8 found by Tarafdar *et al.* (2010). The mean score shows that ICT usage contributes considerably to the productivity levels of managerial employees. The mean score for this life satisfaction was 3.46. This result reveals that the managers, on average, are satisfied with their lives.

### 5.2.3 Practically significant differences in the mean scores of technostress, techno-stressors, productivity and life satisfaction between different demographic groups

The key results are summarised for each demographic variable. Key results will comprise those factors where practically significant differences exist (i.e. an effect size approaching 0.80). The following factors were considered for each demographic variable: techno-overload, techno-complexity, techno-invasion, techno-uncertainty, techno-insecurity, productivity, life satisfaction and the mean score of the techno-stressors (i.e., technostress).

No practically significant differences exist for any of the factors between males and females. This correlates with the results of Van Eck, while Riedl *et al.* (2012), Ragu-Nathan (2008) and Chen (2015) found that males experienced higher levels of technostress. However, La Torre *et al*. (2020, p. 63) found that women experience more techno-overload, techno-invasion, and techno-complexity than men. Managerial employees between 31 and 40 years of age scored only 1.85 for techno-complexity, whereas their colleagues between the ages of 51 and 70 years of age scored 2.47. The degree to which techno-complexity is experienced seems to be increasing with age. Managerial employees between 20 and 30 years of age scored only 2.83 for techno-uncertainty, whereas their colleagues between the ages of 51 and 70 years of age scored 3.42. The degree to which techno-uncertainty is experienced seems to be increasing with age. Shu et al. (2011) found similar results that an increase in age is associated with increased technostress. Tams (2011) findings showed that younger adults experience less technostress than their older counterparts do, while Setyadi *et al.* (2017, p. 334) and La Torre *et al.* (2020, p. 64) found no effect of age on perceived technostress. Similar to this study, Zhao *et al.* (2020, p. 8), Shoushtary *et al.* (2012) and Pirkkalainen *et al*. (2019, p. 1205) found that gender and age had no significant impact on ICT-enabled productivity. Hinks and Gruen (2007) and Mahadea and Rawat (2008) correlate with the findings of this study that gender had little to no effect on life satisfaction levels.

The managerial employees at Lion scored techno-invasion at 3.91, considerably higher than both Boshoek (M=3.04) and Rustenburg (M=2.59). The managerial employees at Lion attained a mean score of 2.99 for life satisfaction. The managerial employees at Boshoek (M=3.63), Rustenburg (M=3.57) and Wonderkop (M=3.65) scored considerably higher, leading to practically significant differences between the organisational units. The mean score for E1 managers relating to techno-complexity was 2.44, whereas D2-D3 managers scored 1.87. This was a practically significant difference. E1 managers scored 3.53 for techno-invasion, whereas the D1 managers only scored 2.66. It is clear that E1 managers are experiencing considerably more techno-invasion because of their seniority. Managers E2 and up scored 3.86 for life satisfaction, whereas D1 managers only scored 3.26. Life satisfaction seems to increase as seniority within the organisation increases.

### 5.2.4 Correlations between research factors

One of the primary objectives of this research was to establish the impact of technostress on productivity and life satisfaction. From the results, it is clear that technostress does not affect productivity. Although a negative correlation exists, it is practically non-significant. These results correlate with La Torre et al. (2020, p. 62) findings, which revealed that none of the five techno-stressors had a practically significant effect on self-reported productivity. However, Lee et al. (2016, p. 775) found that higher technostress leads to higher productivity levels and decreased overall life satisfaction.

The correlation coefficient between technostress and life satisfaction is -0.245. This result indicates that a negative relationship exists between technostress and life satisfaction, in that an increase in technostress leads to a decrease in life satisfaction. Adams and King (1996) and Kazekami (2020, p. 1) also found that long hours of telework (ICT) lead to stress and decreased life satisfaction. It is noted that this correlation is approaching the effect of being practically visible. These results are very much aligned with the existing literature discussed in Chapter 2. The techno-stressors were also analysed separately to determine their correlations with productivity and life satisfaction. Productivity is best correlated with techno-complexity and techno-uncertainty. Increases in techno-complexity decrease self-reported productivity, whereas increases in techno-uncertainty increases productivity. Life satisfaction is best correlated with techno-complexity, techno-invasion and techno-insecurity. In all three instances, an increase in the respective techno-stressor leads to a decrease in life satisfaction.

## 5.3 LIMITATIONS OF THE RESEARCH

A particular research population characterises this research. Therefore, although this allows for a detailed and population-specific investigation, it limits the degree to which the results can be extrapolated to other populations. A cross-sectional research design was utilised, inheriting the advantages and disadvantages associated with this approach. One of these disadvantages is the inability to determine cause and effect relationships. This means that although it was found that a negative correlation exists between technostress and life satisfaction, it is not sufficient evidence to conclude that technostress is indeed leading to reduced life satisfaction. The last limitation worth noting is the broad definition of ICT's used. Respondents were prompted to consider the ICT device they use most often when answering the items. This inclusive approach allowed respondents to make specific items relevant to their unique situations but limits the researcher's ability to extrapolate results to specific devices. Because the devices are inherently different, they might potentially affect users in varying ways.

## 5.4 MANAGERIAL IMPLICATIONS

Techno-uncertainty and techno-complexity seem to be more prevalent in older managerial employees. From the correlation analyses conducted, techno-complexity is decreasing self-reported levels of productivity. Strategies to reduce techno-complexity, especially for older managerial employees, should be considered. This might involve additional training and providing more assistance.

The managerial employees at Lion are reporting high levels of techno-invasion. Techno-invasion is highly correlated with life satisfaction. As expected, they are also reporting low levels of life satisfaction. The difference is practically significant compared to the other organisational units. Strategies should be investigated and employed to decrease perceived techno-invasion, leading to higher levels of life satisfaction.

Lastly, especially between E1 and D1 levels, a significant gap exists in terms of techno-invasion. This gap warrants further research because age does not seem to factor in. So, it might be due to varying levels of responsibility, in which case a concerted effort is required to have D1 level managers more involved and shedding some of the load from the E1 managers.

## 5.5 RECOMMENDATIONS FOR FUTURE RESEARCH

There is one result that stands out as being unexpected - the correlation between techno-uncertainty and productivity. According to the results, increased techno-uncertainty increases productivity, and the result is practically visible. The techno-uncertainty factor is supposed to measure the incremental technostress experienced due to the stress of being constantly exposed to technological updates. Looking at the statements within this sub-factor, it only measures the rate of new technology introduction, whether in hardware, software or network upgrades. The inherent assumption is made that new technologies necessarily increases perceived technostress. This is not necessarily true. The introduction of new technologies might also decrease perceived technostress. Future research should critically evaluate this factor for applicability. Limited measuring instruments exist for technostress. The assumption is made that the technostress experienced is the aggregate of the scores for the individual techno-stressors. Mathematically, each techno-stressor contributes to the overall technostress score in proportion to the number of questions. These contributions might distort the outcome. It is suggested to explore this question further, which techno-stressors are contributing the most to feelings of being technostressed. Lastly, it is recommended to evaluate the scope of future studies critically. In this research, the focus was on managerial employees, for whom technostress does not seem to be a major concern. Employees not on managerial levels might be more exposed to the effects of technostress for various reasons. To get a better reflection of reality, it is proposed that lower employment levels (those levels slotting in between managers and floor staff) be involved and that specific technology be targeted with the questionnaire (not ICT in general). This will also assist significantly in developing targeted organisational interventions.

## 5.6 CONCLUSIONS

Internationally sourced measuring instruments for technostress, productivity, and life satisfaction seem reliable and valid for the South African context. Only the techno-insecurity factor in the technostress measuring instrument needs to be reviewed before being utilised again. Managerial employees do not experience significant levels of technostress. ICT's are greatly assisting them in attaining higher levels of productivity, and overall, they are experiencing satisfaction with life. Technostress has a limited effect on productivity, but evidence has been found that increased technostress levels lead to decreased levels of life satisfaction.

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## APPENDIX A – QUESTIONNAIRE

**Instructions:** Please complete all the questions in the questionnaire. The questionnaire is divided into four sections. The first section is to determine demographics. The remaining three sections are to measure the three relevant constructs of this study: perceived technostress, productivity and overall life satisfaction. Please answer all questions truthfully. Submissions are completely anonymous. There is no way to trace back responses to individuals. You may opt out at any time. Please mark the most applicable response with a "X".

### Section1: Demographics

**Q1.1 – Your gender?**

| a) Male | b) Female | c) Not specified |
|---|---|---|
| | | |

**Q1.2 – Your age category?**

| a) 20 - 30 | b) 31 - 40 | c) 41 - 50 | d) 51 - 60 | e) 61 -70 |
|---|---|---|---|---|
| | | | | |

**Q1.3 – Operational Unit?**

| a) Wonderkop | b) Rustenburg | c) Boshoek | d) Lydenburg | e) Lion |
|---|---|---|---|---|
| | | | | |

**Q1.4 – Management Level (Patterson Grading)?**

| a) D1 | b) D2 – D3 | c) D4 – D5 | d) E1 | e) E2 and up |
|---|---|---|---|---|
| | | | | |

## Section 2: Technostress

In the following statements, the term “this technology” refers to the day-to-day computer applications you use in your job, such as e-mails, office automation systems, database systems, cellphones and any other job-related information technologies.

**Q2.1 – I am forced by this technology to work much faster**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.2 – I am forced by this technology to do more work than I can handle**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.3 – I am forced by this technology to work with very tight time schedules**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.4 – I am forced to change my work habits to adapt to new technologies**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.5 – I have a higher workload because of increased technology complexity**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.6 – I spend less time with my family due to this technology**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.7 – I have to be in touch with my work even during my vacation due to this technology**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.8 – I have to sacrifice my vacation and weekend time to keep current on new technologies**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.9 – I feel my personal life is being invaded by this technology**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.10 – I do not know enough about this technology to handle my job satisfactorily**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.11 – I need a long time to understand and use new technologies**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.12 – I do not have enough time to study and upgrade my technology skills**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.13 – I find new employees to this organisation know more about computer technology than I do**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.14 – I often find it too complex for me to understand and use new technologies**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.15 – I feel constant threat to my job security due to new technologies**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.16 – I have to constantly update my technology skills to avoid being replaced**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.17 – I am threatened by co-workers with better technology skills**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.18 – I do not share my knowledge with my co-worker's for fear of being replaced**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.19 – I feel there is less sharing of knowledge among co-worker's for fear of being replaced**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.20 – There are always new developments in the technologies we use in our organisation**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.21 – There are constant changes in computer software in our organisation**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.22 – There are constant changes in computer hardware in our organisation**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q2.23 – There are frequent upgrades in computer networks in our organisation**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

## Section 3: Productivity

**Q3.1 – This technology helps to improve the quality of my work**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q3.2 – This technology helps to improve my productivity**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q3.3 – This technology helps me to accomplish more work than would otherwise be possible**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

**Q3.4 – This technology helps me to perform my job better**

| 1) Strong Disagree | 2) Disagree | 3) Unsure | 4) Agree | 5) Strongly Agree |
|---|---|---|---|---|
| | | | | |

## Section 4: Overall Life Satisfaction

**Q4.1 – I like how my life is going**

| 1) Strongly Disagree | 2) Moderately Disagree | 3) Slightly Disagree | 4) Neither Agree nor Disagree | 5) Slightly Agree | 6) Moderately Agree | 7) Strongly Agree |
|---|---|---|---|---|---|---|
| | | | | | | |

**Q4.2 – If I could live my life over, I would change many things**

| 1) Strongly Disagree | 2) Moderately Disagree | 3) Slightly Disagree | 4) Neither Agree nor Disagree | 5) Slightly Agree | 6) Moderately Agree | 7) Strongly Agree |
|---|---|---|---|---|---|---|
| | | | | | | |

**Q4.3 – I am content with my life**

| 1) Strongly Disagree | 2) Moderately Disagree | 3) Slightly Disagree | 4) Neither Agree nor Disagree | 5) Slightly Agree | 6) Moderately Agree | 7) Strongly Agree |
|---|---|---|---|---|---|---|
| | | | | | | |

**Q4.4 – Those around me seem to be living better lives than my own**

| 1) Strongly Disagree | 2) Moderately Disagree | 3) Slightly Disagree | 4) Neither Agree nor Disagree | 5) Slightly Agree | 6) Moderately Agree | 7) Strongly Agree |
|---|---|---|---|---|---|---|
| | | | | | | |

**Q4.5 – I am satisfied with where I am in life right now**

| 1) Strongly Disagree | 2) Moderately Disagree | 3) Slightly Disagree | 4) Neither Agree nor Disagree | 5) Slightly Agree | 6) Moderately Agree | 7) Strongly Agree |
|---|---|---|---|---|---|---|
| | | | | | | |

**Q4.6 – I want to change the path my life is on**

| 1) Strongly Disagree | 2) Moderately Disagree | 3) Slightly Disagree | 4) Neither Agree nor Disagree | 5) Slightly Agree | 6) Moderately Agree | 7) Strongly Agree |
|---|---|---|---|---|---|---|
| | | | | | | |

# APPENDIX B – ETHICAL CLEARANCE

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

Economic and Management Sciences Research
Ethics Committee (EMS-REC)

17 August 2020

Prof PA Botha
*Per e-mail*
Dear Prof Botha,

**Student: Le Roux, DJ (21063990)(NWU-00795-20-A4)**
**Applicant / Study leader : Prof P A Botha – MBA**
**Impact of technostress on productivity and overall life satisfaction of managers working at a ferrochrome smelting company**

Your ethics application on, *Impact of techno stress on productivity and overall life satisfaction of managers working at a ferrochrome smelting company*, which served on the EMS-REC meeting of 31 July 2020, refers.

**Outcome:**

Approved as a minimal risk study. A number NW-00795-20-A4 is given for one year of ethics clearance.

Due to the Covid-19 lock down ethics clearance for applications that involve data collection or any form of contact with participants are subject to the restrictions imposed by the South African government.

Kind regards,

Mark
Rathbone
Digitally signed by Mark Rathbone
DN: cn=Mark Rathbone, o=North-West University, ou=Business management,

Prof Mark Rathbone
Chairperson: Economic and Management Sciences Research Ethics Committee (EMS-REC)

# APPENDIX C – PERMISSION TO CONDUCT THE RESEARCH

**De Wet, Francois (Wonderkop - ZA)**

| | |
|---|---|
| **From:** | Le Roux, Danie (Wonderkop - ZA) |
| **Sent:** | Saturday, 30 May 2020 4:47 PM |
| **To:** | De Wet, Francois (Wonderkop - ZA) |
| **Cc:** | Grobler, Hennie (Wonderkop - ZA) |
| **Subject:** | 21063990_ResearchProposal |
| **Attachments:** | 21063990_ResearchProposal_053001534.docx |
| **Categories:** | Important |

Afternoon Francois,

As you are aware, I'm busy with my MBA at the NWU. One of the requirements to attain the degree is to complete a Mini-Dissertation.

Please find attached the latest version of my research proposal. There might still be one or two small changes, but I don't foresee the concept changing.

Before my study leader can submit it to the Scientific Committee I need to have a consent letter (I believe just signing below and scanning back should suffice) from an authorised Glencore representative granting me permission to conduct the research. The working title of the mini-dissertation: Impact of technostress on productivity and overall life satisfaction of managers working at a ferrochrome smelting company.

From the title I think it is quite evident that the focus is not on Glencore, but rather on the employees being surveyed, hence there is little chance of results reflecting badly on Glencore. I will make sure to not refer to "Glencore", but rather "the smelting company". I must note that the questionnaire will be made available with the rest of the document, so for the reader it will be easy to determine which company is being referred to.

May you please approve this request, or alternatively forward to the applicable person? If required, I can also submit the final version of the mini-dissertation to Glencore for approval prior to submittal to the NWU.

Thanking you in advance,
Danie le Roux

Approve

I, Francois de Wet *[name of company representative]*, herewith give my
the study to be conducted in ____________________ *[organisation name]*.

[signature]
**Signature**

3/6/2020
**Date**

Manager Furnace 5+6

# APPENDIX D – CONSENT FORM

NWU®

## Informed Consent

## North West University – South Africa

## Master in Business Administration

**Title of study:** Impact of technostress on productivity and overall life satisfaction of managers working at a ferrochrome smelting company

**Researcher:** Danie le Roux

Dear Participant

This informed consent form is to request permission from you to take part in this research project.

The information gathered in this study will be used in a mini-dissertation to complete my MBA degree. The information gathered in this questionnaire will be **confidential and anonymous.** All the data gathered will only be used for this research project.

The questionnaire consists of three sections measuring the three constructs being investigated in this research. The primary objective of this study is to investigate the impact of technostress on productivity and overall satisfaction with life of managers working at ferrochrome smelters.

There will be no incentive given to any participants and all participants complete the questionnaire on a voluntary basis. By completing the questionnaire you give your consent for the researcher to use the data. Participation can be terminated at any time.

Should you have any concerns or require assistance please contact me at:

Cell: 079 675 7188

E-mail: danie.leroux@glencore.co.za

Your participation in my research will be much appreciated. It will take 5-10 minutes.

Kind regards,

Danie le Roux

# APPENDIX E – LANGUAGE EDITORS LETTER

Dynamic Language &
Translation Specialists

Antoinette Bisschoff
*71 Esselen Street,*
*Potchefstroom*
*Tel: 018 293 3046*
*Cell: 082 878 5183*
*Language@dlts.co.za*
*CC No: 1995/017794/23*

Sunday, 28 March 2021

To whom it may concern

**Re: Confirmation of language edit, typography and technical precision**

The MBA dissertation "**Impact of technostress on productivity and overall life satisfaction of managers working at a ferrochrome smelting company**" by **DJ le Roux** (2106399) was edited for language and technical precision. The referencing and sources were checked and comply with the APA guidelines specified by the 2020 NWU Reference guide.

Final, last-minute corrections remain the responsibility of the author.

**Antoinette Bisschoff**

**BA Languages (UPE – now NMU); MBA (PU for CHE – now NWU); Translation and Linguistic Studies (NWU)**

Officially approved language editor of the NWU since 1998
Member of SA Translators Institute (no. 100181)

Precision ... to the last letter

# APPENDIX F – LETTER FROM NWU STATISTICAL CONSULTATION SERVICES

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

**Statistical Consultation Services**
Tel: +27 18 299 2651
Fax: +27 0 87 231 5294
Email: erika.fourie@nwu.ac.za

11 March 2021

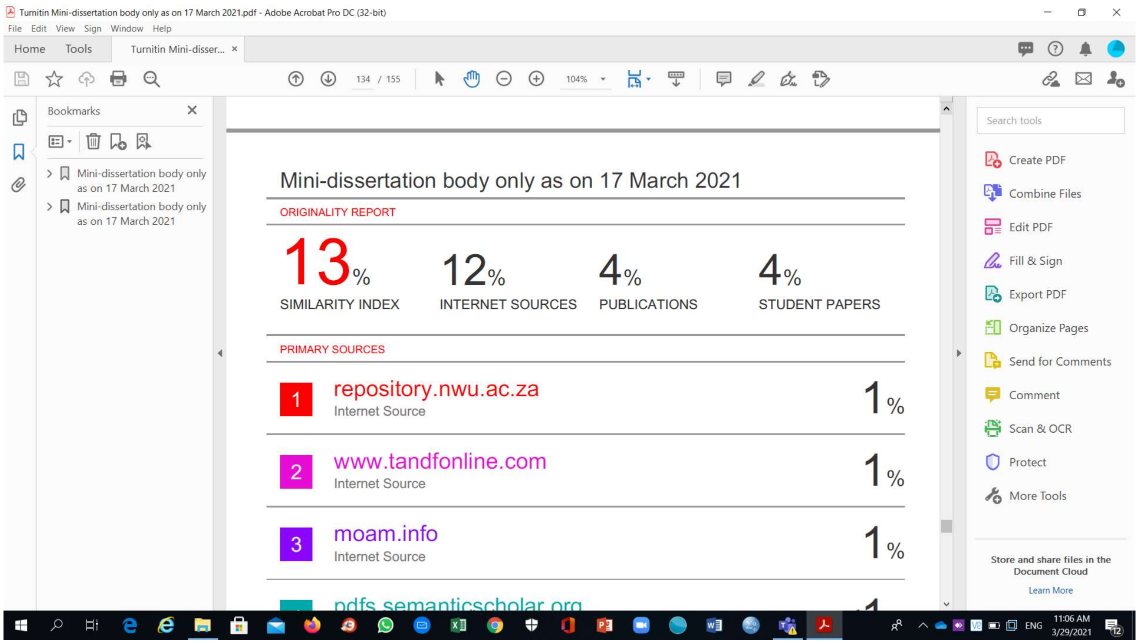
**Re: Thesis, Mr DJ Le Roux, student number: 21063990**
**Impact of technostress on productivity and overall life satisfaction of managers working at a ferrochrome smelting company**

We hereby confirm that the Statistical Consultation Services of the North-West University analysed the data of the above-mentioned student and assisted with the interpretation of the results. However, any opinion, findings or recommendations contained in this document are those of the author, and the Statistical Consultation Services of the NWU (Potchefstroom Campus) do not accept responsibility for the statistical correctness of the data reported.

Kind regards

**Dr E Fourie**
**Senior Consultant: Statistical Consultation Services**

# APPENDIX G: TURNITIN SUMMARY REPORT



Mini-dissertation body only as on 17 March 2021

ORIGINALITY REPORT

| 13% | 12% | 4% | 4% |
| --- | --- | --- | --- |
| SIMILARITY INDEX | INTERNET SOURCES | PUBLICATIONS | STUDENT PAPERS |

PRIMARY SOURCES

| | | |
| --- | --- | --- |
| 1 | repository.nwu.ac.za<br>Internet Source | 1% |
| 2 | www.tandfonline.com<br>Internet Source | 1% |
| 3 | moam.info<br>Internet Source | 1% |
| | pdfs.semanticscholar.org | |