



AN EXPLANATORY STRUCTURAL MODEL OF EMPLOYEE JOB PERFORMANCE IN THE SOUTH AFRICAN 3D PRINTING ENVIRONMENT

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DECLARATION

I, Sampson Afrifa Jnr, student number #####, declare that this research report submitted to Central University of Technology, Free State, for the degree PhD: Management Sciences (Business Management), is my independent work and has not previously been submitted by me to another university/faculty. I further cede the copyright of the thesis in favour of Central University of Technology, Free State.

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ABSTRACT

Studies on the 3D printing sector in South Africa have concentrated mainly on the engineering or technical dimension, while managerial-related research in this sector is scarce. The aim of this study was to contribute to effective management and enrich the theoretical understanding of the 3D printing sector by developing an explanatory structural model of employee job performance in the 3D printing environment in South Africa.

The study examined the direct relationships between leader emotional intelligence (EI) and employee job performance, leader emotional intelligence and leader emotional behaviour, leader emotional intelligence and organisational emotional climate, and also the moderating effect of organisational emotional climate on the relationship between leader emotional intelligence and employee job performance in the 3D printing environment in South Africa. The study adopted a deductive research approach, quantitative research method and a cross sectional explanatory correlational research design. A total of 148 employees who participated in the 23rd Rapid Product Development Association of South Africa (RAPDASA) conference were sampled for the study. Simple random sampling was used in the selection of participants. Questionnaires served as the data collection instruments. Data was gathered online using Google Forms. The Statistical Package for Social Sciences (SPSS) version 26 software was used for data coding, data entry, and descriptive statistics. Smart PLS 4 was used to conduct Partial Least Squares (PLS) Structural Equation Modelling to test the proposed seven hypotheses.

For direct effects, it was found that significant positive relationships exist between leader emotional intelligence and employee job performance and leader emotional intelligence and leader emotional behaviour. The results also revealed important positive relationships between leader emotional intelligence and organisational

emotional climate and also leader emotional behaviour and organisational emotional climate. Furthermore, organisational emotional climate and employee job performance were positively related, while a non-significant negative relationship existed between leader emotional behaviour and employee job performance. For moderating effects, it was found that organisational emotional climate positively moderated the relationship between leader emotional intelligence and employee job performance.

Based on the finding that positive relationships exist between leader emotional intelligence and employee job performance, the study recommends that the 3D printing industry in South Africa must place more emphasis on emotional intelligence as a strategic managerial asset that can improve employee job performance. In this regard, managerially inclined training programmes that inculcate emotional intelligence in leaders should be intensified. Furthermore, since organisational emotional climate positively moderated the relationship between leader emotional intelligence and employee job performance, the study recommends the need for more training and capacity building for leaders of 3D printing firms on developing and maintaining positive organisational emotional climates. Finally, the study recommends that 3D printing firms in South Africa adopt emotional intelligence as a prerequisite in recruiting employees and appointing leaders instead of focusing only on technical skills.



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ABBREVIATIONS AND ACRONYMS

AVE	Average Variance Extracted
CAD	Computer-Aided Design
CEES	Centre for Enterprise and Entrepreneurship Studies
CP	Contextual Performance
CRPM	Center for Rapid Prototyping and Manufacturing
CWB	Counterproductive Work Behaviour
DES	Differential Emotional Scale
ECI	Emotional Competence Inventory
ECS	Emotional Climate Scale
ECT	Emotional Competence Theory
EQI	Emotional Quotient Inventory
IWPQ	Individual Work Performance Questionnaire
JDRT	Job Demands and Resources Theory
JPS	Job Performance Scale
MLQ	Multifactor Leadership Questionnaire
MSCEIT	Mayer-Salovey-Caruso Emotional Intelligence Test
OECF	Organisational Emotional Climate of Fear
OECJ	Organisational Emotional Climate of Joy
OECL	Organisational Emotional Climate of Love
OECS	Organisational Emotional Climate of Sadness
OSA	Occupational Self-Assessment Scale
PLS	Partial Least Squares
RAPDASA	Rapid Product Development Association of South Africa
SDGs	Sustainable Development Goals
SEM	Structural Equation Modelling
SET	Social Exchange Theory



CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 Introduction

3D printing is one of the world's most contemporary and booming industries, and South Africa is at the forefront, especially in Africa (Rapid Product Development Association of South Africa (RAPDASA), 2019). Based on the most current data on the 3D printing industry in South Africa, the industry has grown from one 3D printing machine in 1991 to approximately 5,700 in 2018 (RAPDASA, 2019). According to Kretzschmar et al. (2018), successful implementation of 3D printing technology requires employees with advanced skills and experience to operate and manage the 3D printing machines to achieve optimum company performance. From the perspective of Sandstrom (2016), highly skilled workers are hard to come by. Therefore, it is imperative that as 3D printing firms employ these people, managers must possess and apply appropriate managerial practices to manage and create a conducive work environment that will ensure that employees perform their jobs according to expectations (Sandstrom, 2016). In other words, proper management is crucial to the job performance of 3D printing employees.

Amid this focus on the job performance of 3D printing employees, the role of leaders' emotional intelligence in promoting employee performance has emerged as a popular topic in contemporary organisational management research and practice (Pradhan, Jena & Singh, 2017). Emotional intelligence has gained research and practice attention because of its relevance to various employee-related outcomes, including job performance (Khan, Sony & Mekoth, 2016; Udofot & Ebitto, 2016).

Job performance is important due to the the relevance of job performance as a critical factor for ensuring the achievement of organisational performance (Leonard, 2019). In this regard, businesses, including 3D printing businesses, must thoroughly understand factors that promote and hinder employee performance. This would also enable them to identify managerial gaps and develop and adopt managerial organisational practices that enhance employee performance (Leonard, 2019).

Leadership emotional intelligence involves leaders leveraging emotions at the workplace for productive purposes; hence, organisational success (Goleman, 2014). Leaders' emotional intelligence and employee performance are therefore inextricably related and important to organisational success (Khan, Masrek & Nadzar, 2016; Sony & Mekoth, 2016; Udofot & Ebitto, 2016). Hence, fully comprehending the mechanisms through which leadership emotional intelligence could be used to improve the job performance of employees is deemed important for research.

This study is generally about understanding factors influencing the job performance phenomenon in the 3D printing environment in South Africa. In other words, the study aims at unearthing job performance predictors in this environment. To gain this understanding, it is proposed to investigate the influence of a leader's emotional intelligence on employee performance by using data from 3D printing firms in South Africa. The study will investigate the linkages among leaders' emotional intelligence, leaders' emotional behaviours, organisational emotional climate, and employee job performance.

This research contributes towards addressing Sustainable Development Goal (SDG) 8, which deals with decent work and sustained economic growth. A better understanding of the mechanism of a leader's emotional intelligence versus employee performance relationship will assist 3D printing organisations to develop and adopt

best practices that ensure employees are decently treated at the workplace. Employees, in turn, will perform as required so that the organisations can meet growth targets. Regarding Centre for Enterprise and Entrepreneurship Studies (CEES), the study falls under the thematic area of sustainable and ethical business practices.

1.2 Problem background

The 3D printing industry in South Africa has demonstrated noteworthy progress in recent times. Several scholarly investigations have revealed the crucial success factors facilitating the expansion of 3D printing technology in South Africa. Dzogbewu et al. (2022) analysed the critical success factors that have contributed to South Africa's success despite adoption barriers that are also widespread in numerous developing nations. The research identified several critical success factors for the growth and development of 3D printing in South Africa. These factors include visionary leadership, substantial investments, cultivating human capital through education and research, robust collaboration between industry and research, and a favourable national culture fostering the adoption of new technologies (Dzogbewu et al., 2022).

Notwithstanding the potential for expansion, the problems encountered by the South African 3D printing industry have been emphasised in various recent studies (Indrawati, 2020; Sutherland, 2020; Ahimien et al., 2020). One important issue is a lack of funding, which may impede research and development and the adoption of innovative technology (Indrawati, 2020). Sutherland (2020) highlighted a shortage of capital as a major impediment to the expansion of this sector, especially for small and medium-sized firms (SMEs). According to Aghimien et al. (2020), a skilled labour shortage is a major challenge, limiting firms' capacity to design and deliver high-quality products. Intellectual property problems are also a concern since the simplicity with which digital designs may be replicated and distributed raises concerns about

copyright and patent infringement. Aghimien et al. (2020) further contend that intellectual property difficulties are also a major challenge confronting the 3D printing sector in South Africa, hence the need for a legislative framework to safeguard the intellectual property rights of designers and producers.

According to Pacucci, Perna, Runfola and Gregori (2018), although 3D printing has gained much attention in research, the debates are more focused on its technical dimension and the economic implications at the institutional level. However, the managerial and business performance issues have been less explored (Pacucci et al., 2018). In an extensive literature review conducted on 3D printing research, four thematic areas were identified: technology adoption and use of 3D printing (Yeh & Chen, 2018; Murmura & Bravi, 2018; Sun & Zhao, 2017; Niaki & Nonino, 2017); how 3D printing impacts supply chain structures and processes (Ghadge et al., 2018; Durach et al., 2017; Rogers et al., 2016; Oettmeier & Hofmann, 2016); 3D printing and business models (Holzmann et al., 2017; Flammini et al., 2017; Bogers et al., 2016; Rayna & Strinkova, 2016); and 3D printing and sustainability (Garmulewicz et al., 2018; Umruh, 2018; Despeisse et al., 2017; Ford & Despeisse, 2016).

The construct of a leader's emotional intelligence consists of the concepts of leadership and emotional intelligence. Leadership can be defined as a process whereby individuals influence others to achieve a goal (Northouse, 2013). Organisations require leaders who can deal with the complexities and management problems they encounter in the workplace. This, in turn, necessitates the development of leadership theory and practices capable of assisting organisations in dealing with complexities and associated management issues. Emotional intelligence is an important leadership skill (Goleman, 1998; 2014). Emotional intelligence is defined as the ability to perceive, understand, and manage emotions for productive purposes in the workplace (Goleman, 1998; 2014). In other words, a person's emotional

intelligence can influence the emotions of other people (Purwaningrum, 2016). Therefore, leadership emotion intelligence can be defined as a leader's ability to perceive, understand, and manage emotions for productive purposes in the workplace (Goleman, 2017). Job performance, or "in-role performance," refers to the performance level displayed by an employee. According to Sauer, Rodgers and Baker (2018), job performance is a multifaceted employee behaviour subject to scrutiny by practitioners and academics. This is because it significantly impacts crucial organisational decisions such as promotions, pay raises, additional responsibilities, and even termination. Moreover, job performance is linked to organisational performance (Goleman, 2017). For these reasons, organisations track and observe job performance, making it one of the main research topics in the field of management.

While there are numerous predictors of job performance, they can conveniently be grouped into two broad categories: organisational and personal factors. Among others, organisational factors include corporate culture, treatment at the workplace, and job-related stress (Kashani, 2019). Individual elements may include but are not limited to employee cognitive (mental) ability, employee work attitude, personality, and so on (Purwaningrum, 2016). In this study, it is hypothesised that leaders' emotional intelligence determines their moods and behaviours towards employees, and this dictates the organisational emotional climate or culture, which in turn impacts employee job performance. In other words, a leader's emotional intelligence impacts directly and indirectly on employee performance.

To test this hypothesis, the researcher collected data from the 3D printing environment in South Africa and drew on the social exchange theory (SET), Goleman's (1998) emotional competency theory (ECT), and the job demands and resources theory (JDRT). A full explanation of these theories and their relevance is provided in a subsequent section. Suffice it to say that the social exchange theory has served as a

theoretical foundation to explain different situations in business and management practices.

1.3 Problem statement

Successful implementation of 3D printing technology requires employees with advanced scarce skills and experiences to achieve economic success (Sniderman, Monahan & Forsythe, 2016; Kretzschmar et al., 2018). At a time when highly skilled workers are hard to come by (Sandstrom, 2016), there is a high demand for skilled workers in the 3D printing industry (Columbus, 2015; Claborn, 2014). As a result, 3D printing businesses are struggling to find skilled workers, negatively impacting production, quality, innovation, and growth (American Society of Mechanical Engineers, 2015). Due to these problems, 3D printing firms need appropriate managerial skills to manage and retain their employees (Cotteleer et al., 2016). Leadership emotional intelligence has emerged as a potent organisational practice that can influence the job performance of employees by creating an appropriate work environment to perform optimally (Pradhan, Jena & Singh, 2017). This implies that 3D printing firms should pay attention to their leaders' emotional intelligence. Moreover, although 3D printing has grown over the years, research in the industry has focused on engineering, neglecting the managerial side (Pacucci et al., 2018). For all these reasons, there is a need for management-related research to bridge the research gap while providing an understanding of how to best manage these scarce skilled workers due to the belief that proper management is crucial to the job performance of 3D printing employees (Sandstrom, 2016).

The research question of the problem statement of this study is to examine the effect of leader emotional intelligence on employee job performance and the moderation effects of individual and organisational factors in the South African 3D printing

environment. In other words, the problem statement is to develop an explanatory structural model of employee job performance in the 3D printing environment.

1.4 Aim of the study

This study aims to enrich the literature on the managerial aspects of 3D printing. Practically, the findings of the study seek to contribute towards more effective management of 3D printing employees for them to produce optimally.

1.5 Research objectives

This section presents the main objective guiding the study and also subsidiary objectives.

1.5.1 Main objective

The main objective of this study is to assess the interactive effects of leaders' emotional intelligence, leaders' emotional behaviours and organisational emotional climate on employee job performance among 3D printing firms in South Africa.

1.5.2 Subsidiary objectives

1. To assess the relationship between leaders' emotional intelligence and employee job performance among 3D printing firms.
2. To examine the relationship between leaders' emotional intelligence and leaders' emotional behaviour among 3D printing firms.

3. To examine the relationship between leaders' emotional intelligence and organisational emotional climate among 3D printing firms.
4. To assess the relationship between leaders' emotional behaviour and organisational emotional climate among 3D printing firms.
5. To assess the relationship between organisational emotional climate and employee job performance among 3D printing firms.
6. To examine the relationship between leaders' emotional behaviour and employee job performance among 3D printing firms.
7. To develop and test a structural model for employee job performance based on emotional intelligence.

1.6 Hypotheses

This section presents the main research hypothesis and its subsidiary hypotheses.

1.6.1 Main hypothesis

Leader emotional intelligence, directly and indirectly, affects employee job performance in the 3D printing firms in South Africa.

1.6.2 Subsidiary hypotheses

H1: There will be a significant positive relationship between leaders' emotional intelligence and employee job performance among 3D printing firms.

H2: There will be a significant positive relationship between leaders' emotional intelligence and leaders' emotional behaviour among 3D printing firms.

H3: There will be a significant positive relationship between leaders' emotional intelligence and organisational emotional climate among 3D printing firms.

H4: There will be a significant positive relationship between leaders' emotional behaviour and organisational emotional climate among 3D printing firms.

H5: There will be a significant positive relationship between organisational emotional climate and employee job performance among 3D printing firms.

H6: There will be a significant positive relationship between leaders' emotional behaviour and employee job performance among 3D printing firms.

H7: Organisational climate will moderate the relationship between leaders' emotional intelligence and job performance among 3D printing firms.

1.7 Summary of research methodology

Research paradigm refers to the set of beliefs and assumptions that guide the researcher's approach to conducting research (Rehman & Alharti, 2016). Two prominent research paradigms within research philosophy are positivism and interpretivism (Kiwunja & Kuyini, 2017). Positivism is a research paradigm that emphasises objectivity, quantification, and empirical evidence (Khaldi, 2017). Interpretivism is a research paradigm that focuses on understanding the subjective meanings and interpretations individuals attach to their experiences and the social world (Alharasheh & Pius, 2020). In this study, the positivist research paradigm was employed, focusing on the objective understanding of reality (Densin & Lincoln, 2018). By adopting the positivist paradigm, the research examined the direct and indirect relationships between leaders' emotional intelligence, their emotional behavior, the organisational emotional climate, and employee job performance. To achieve objectivity, questionnaires were used to collect data, and statistical analysis was conducted to test the proposed hypotheses. The research design employed in this study was a cross-sectional explanatory correlational approach. This design was

chosen to shed light on the relationships between leader emotional intelligence, leader emotional behavior, organisational emotional climate, and employee job performance specifically within the context of 3D printing firms. Regarding research approach, the deductive research approach was adopted. According to Saunders et al. (2019), the deductive approach involves starting with a general theory or hypothesis and then proceeding towards specific observations or conclusions. This approach follows a top-down methodology, where researchers begin with a theoretical framework and subsequently design research methods to test or validate the theory. In this study, the choice of a deductive research approach was justified by formulating hypotheses based on existing theories, such as the job demands resources theory and social exchange theory to establish direct and indirect (moderation) relationships between leader emotional intelligence, leader emotional behavior, organisational emotional climate, and employee job performance within the context of 3D printing firms in South Africa. In this study, a quantitative research method was utilised to examine the relationships between leader emotional intelligence, leader emotional behavior, organisational emotional climate, and employee job performance in 3D printing firms in South Africa. The use of quantitative research method, allowed for the collection of numerical data, enabling the researcher to test hypotheses and analyze the data using statistical techniques.

The population of the study comprised of employees of 3D printing firms that participated in the 23rd Annual RAPDASA Conference in South Africa. A sample size of 161 employees was selected from a population of 275 using the simple random sampling technique. However, out of 161 employees selected to participate in the study, 148 returned their questionnaires, giving a response rate of 91.9%. Questionnaires served as the data collection instruments. Emotional intelligence was measured using the Emotional Competence Inventory (ECI), which consisted of 12 items. Employee job performance was measured using 18 items. Data gathered from

questionnaires were analysed using Statistical Package for Social Sciences (SPSS) version 26 and Smart PLS 4 software. Partial Least Squares (PLS) Structural Equation Modelling was used to assess the direct and moderating effects among the variables used for the study.

1.8 Significance/ contribution of the study

This study is significant as a result of the contributions that it made towards practice, policy, and theory.

1.8.1 Contribution to practice

The study has made a valuable contribution to managerial practices within the 3D printing industry in South Africa by shedding light on the significance of emotional intelligence, emotional behavior, and organisational emotional climate on employee job performance. Unlike previous research that primarily focused on the technical and engineering aspects of 3D printing, this study emphasises the importance of emotional intelligence as a strategic managerial asset that could contribute positively to employee job performance. By recognising the positive impact of leader emotional intelligence on employee job performance and the creation of a positive emotional climate within 3D printing firms, this research provides practical insights for industry practitioners.

The findings of the study also practically suggest that incorporating emotional intelligence as a critical managerial skill can effectively enhance employee job performance in 3D printing companies. Managers who possess high emotional intelligence can establish a positive emotional climate characterised by joy and love within their 3D printing organisations. The study therefore emphasises the need for

3D printing companies in South Africa to prioritise the development of emotional intelligence among their leaders to foster positive organisational and employee outcomes.

1.8.2 Contribution to policy

From a policy perspective, the research holds significant importance for various stakeholders in the 3D printing environment in South Africa, including organisations such as RAPDASA and CRPM. These policy stakeholders can utilise the study's findings to create awareness about emotional intelligence and its benefits within the industry. RAPDASA conferences, for instance, can incorporate themes centered on promoting emotional intelligence and use their unique platforms to popularise the concept among 3D printing industry professionals in South Africa.

Secondly, by advocating for the recognition of emotional intelligence as a key managerial asset for employee job performance, policy stakeholders can influence policy decisions within 3D printing companies. Therefore, encouraging the integration of emotional intelligence in managerial practices can lead to more positive organisational climates, enhanced employee well-being, and increased overall productivity. The study highlights the need for policy stakeholders to collaborate and take proactive steps to incorporate emotional intelligence into their policy frameworks and guidelines for the 3D printing industry.

1.8.3 Contribution to theory

In terms of theoretical contributions, the study demonstrates how emotional intelligence, as a key managerial asset, aligns with the principles of the job demand-resources theory. The findings of the study recognises emotional intelligence as a

resource that leaders can leverage to mitigate job demands and promote employee job performance. In this regard, by emphasising the positive impact of emotional intelligence on job performance and the creation of a positive emotional climate, the study supports the job demand-resources theory's assertion that resources play a crucial role in influencing employee outcomes.

Furthermore, the study incorporates the principles of social exchange theory to explore the social exchange processes between managers and employees within 3D printing firms. It highlights how leaders with high emotional intelligence can foster positive exchanges with employees, creating a supportive and trusting work environment. The study's findings that leader emotional intelligence contributes positively to employee job performance aligns with the social exchange theory's notion that positive social exchanges, characterised by mutual respect, reciprocity, and emotional support, contribute to enhanced employee job performance.

1.9 Limitations of the study

The study was limited in scope as the 3D printing industry in South Africa is relatively small so gathering data from employees in 3D printing firms was a key challenge for this study. However, good collaborative efforts with colleagues in South Africa who attended the RAPDASA conference held in November 2022 made it possible to gather emails from attendants that played an instrumental role in the data collection process. Another limitation that confronted this study was delays in the data collection process, which occurred at the initial stages. The online version of the questionnaire sent to the emails of participants in the RAPDASA conference did not receive the expected response rate. However, tracking respondents through phone calls made reaching an appropriate response rate possible.

1.10 Structure of the study

This thesis comprises seven chapters. The first chapter deals with the introduction, problem background, problem statement, research aim, research objectives, research questions, research hypotheses, an overview of research methodology, significance of the study, limitations and organisation of the study. The second chapter reviews the literature on employee job performance, while the third chapter discusses the literature on leader emotional intelligence in the workplace. The fourth chapter presents the empirical literature and conceptual framework. The fifth chapter sets out the methodology of the study, while the sixth chapter presents the results and discussions of the study. The seventh chapter draws the conclusions and recommendations of the study.

1.11 Chapter summary

To contribute to managerial research in the 3D printing sector in South Africa, this study was conducted to develop a structural equation model for job performance. Seven hypotheses were proposed and tested using the Partial Least Squares (PLS) Structural Equation Modelling using Smart PLS 4. This chapter constituted the introduction, problem background and statement, research aim, objectives and research questions, overview of the methodology, the significance of the study, limitations and organisation.



CHAPTER TWO

EMPLOYEE JOB PERFORMANCE

2.1 Introduction

This chapter reviewed the literature on job performance, which serves as the dependent variable in this study. The chapter delves into job performance, encompassing its three dimensions: task performance, contextual performance, and counterproductive work behaviours. Two theories were used to explain job performance: the social exchange theory and the job demand-resources theory. The next section of the literature review concerns factors influencing job performance, such as employee motivation, job design, working conditions and management style. The chapter then presents literature on how job performance is measured and the importance of the Individual Work Performance Questionnaire in measuring job performance based on the three dimensions (task performance, contextual performance and counterproductive behaviours). The final section presents literature on factors that affect job performance in the 3D printing environment which comprise knowledge management, employee empowerment, organisational communication, job enlargement, job rotation, employee training, creativity and innovation.

2.2 Defining work performance

Work performance may be defined as the actions directly linked to a job carried out by workers to achieve the objectives of the firm (Shin & Hur, 2020). Work performance is also defined as the actions, behaviours and results of workers at work that are connected to and contribute to the organisation's objectives (Rahiman & Kodikal, 2017). Work performance may also be described as the degree to which an employee

can complete the job that has been allotted to them as well as the way the completed task contributes to the fulfilment of the objective of the organisation (Johari, Shamsudin, Yean, Yahya & Adnan, 2019). Work performance is defined in another way by Shahzad et al. (2017) as the degree to which workers can carry out tasks allocated to them in conformity with quality, quantity and timescales. On the other hand, Huang et al. (2016) defined job performance as the degree to which workers are productive, effective and efficient in the fulfilment of their responsibilities in the workplace.

Based on the definitions, it is possible to conclude that employee work performance in an organisation is mainly concerned with the execution of tasks allocated to them to accomplish the objectives of the organisation. As a result, an employee's performance at work is evaluated based on their capacity to successfully fulfil the responsibilities delegated to them to contribute to accomplishing the organisation's objectives. This suggests that workers may be labelled as "under-performers" if they are unable to complete the assigned duties or if their activities do not contribute to achieving organisational objectives.

In the context of this study, work performance can be defined as the extent to which employees demonstrate competencies that make them effective and efficient in producing 3D-printed products that are of high quality and also meet the requirements of clients within specific timelines. In this regard, it is possible to evaluate how well employees in the South African 3D printing industry perform their jobs regarding the number of tasks they complete, the calibre of the finished products, and customer satisfaction ratings. Moreover, employee job performance in 3D printing enterprises comprises the individual's capacity to collaborate with other team members, participate in problem-solving, and demonstrate inventive talents to realise the organisation's objectives.

2.3 Typologies of work employee job performance

In this section, the researcher discusses three typologies of work employee job performance and its contextualisation to the 3D printing industry. The three typologies comprise task performance, contextual performance and counterproductive behaviours.

2.3.1 Task performance

Lee et al. (2021) define an individual's task performance as their capacity to carry out the obligations and responsibilities associated with their job effectively and efficiently. Task performance also refers to the work-related actions of workers, which often vary from one employee to another according to their job descriptions (Singh, 2019). For instance, the responsibilities that are included in a job description for a manager in the banking industry are different from the responsibilities that are included in a job description for a manager in a company that specialises in 3D printing. Therefore, the capacity of an employee to complete tasks assigned to them in line with their job descriptions, with the ultimate purpose of achieving organisational objectives, is a key factor in task performance (Yang & Wei, 2017). Landers et al. (2017) define a person's task performance as the effectiveness with which they carry out the technical aspects of their job.

Based on the definitions, this study defines employee task performance as the ability of employees to carry out the responsibilities that have been given to them, to meet the standards of performance that have been set in the organisation, and to contribute to the productivity of the organisation by doing efficient and effective work. Therefore, in the field of 3D printing in South Africa, task performance consists of employees' abilities to operate 3D printing machinery effectively, participate in the production of

3D-printed products of high quality, meet the production targets set by the organisation, and also contribute to organisational productivity through the completion of job duties in real-time.

2.3.2 Contextual performance

Contextual performance is defined as activities carried out by employees in support of organisational goals by enhancing the social and psychological climate of the firm (Saboor, Rehman & Rehman, 2018). Contextual performance also refers to activities that go beyond one's assigned responsibilities and contribute to the efficiency and productivity of the company as a whole (Sackett et al., 2017). According to Franco and Franco (2018), contextual performance involves the ability of workers to use their free will to participate in activities to achieve the organisation's overall objectives. Furthermore, it encompasses behaviours that contribute to organisational effectiveness by promoting interpersonal harmony, facilitating teamwork and supporting the organisation's mission and values (Pradhan, Jena & Bhattacharyya, 2018). According to Hartini, Fakhrorazi and Islam (2019), contextual performance is defined as behaviours demonstrated by workers in volunteering to ensure that corporate objectives are met.

In this study, contextual performance is defined as the voluntary and discretionary behaviours demonstrated by workers with the ultimate objective of supporting the success of the organisation above and beyond the official job requirements of their positions. Within the framework of the 3D printing industry, the concept of contextual performance may refer to employee behaviours such as actively participating in organisational initiatives, actively engaging in collaboration and teamwork to achieve corporate success, and providing support in accomplishing the organisation's values and mission. Hence, contextual performance in the work environment of 3D printing

is vital for fostering a pleasant work environment, which can boost organisational productivity.

2.3.3 Counterproductive work behaviour (CWB)

According to Dixt and Singh (2019), worker behaviour harmful to the success of the organisation constitutes counterproductive work behaviour. Hadlington, Binder and Stanulewicz (2021) define counterproductive work behaviour as actions that intentionally violate organisational norms and expectations and cause harm to both the organisation and its employees. Similarly, Bickes et al. (2020) define counterproductive behaviour as any employee activity that, when assessed from the organisation's viewpoint, conflicts with the organisation's legitimate interests. Griep and Vantilborgh (2018) defined counterproductive work behaviour as behaviour that violates significant organisational norms and threatens, or intends to threaten, the well-being of an organisation and its workforce. Counterproductive work behaviours are characterised by disengagement from tasks assigned to employees, presenteeism, performing tasks incorrectly, and abusing work environment privileges in the (Miharja, Sacipto, Nguyen, Nguyen & Usanti, 2020).

Based on the definitions of counterproductive behaviours, this study defines counterproductive behaviour as any behaviour that goes against the legitimate interests and goals of the organisation. Furthermore, counterproductive behaviour can be directed at the organisation or its stakeholders; it can violate organisational norms and expectations, and it can cause harm to the well-being of the organisation and its members. In the context of the 3D printing sector in South Africa, counterproductive behaviour can include actions such as damaging equipment or intentionally producing low-quality products. These actions can harm the organisation's reputation and financial performance and reduce employee morale and job satisfaction.

2.4 Job performance theories

This section presents literature on the job demands-resources theory and social exchange theory. These two theories were adopted for the study and the rationale for their adoption is duly explained in this section.

2.4.1 Job demand-resources theory (JDRT)

The Job demand-resources theory (JDRT), as proposed by Demerouti et al. (2001), was formulated to enhance understanding of the variables that influence employee burnout. The job-demand resources theory is a theoretical framework that endeavours to explain the mechanisms accountable for employee job performance and well-being outcomes (Bakker & Demerouti, 2017). The JDRT has an impact on their level of motivation and engagement, which consequently influences their overall job performance (Bakker & de Vries, 2021). According to the JDRT, job demands refer to the specific aspects of a job that require consistent physical or mental exertion and are consequently linked to distinct physiological and psychological consequences (Bakker & de Vries, 2021). As per the JDRT, an individual's performance capability may deteriorate due to exhaustion when the demands of their job are excessively high. The job requirements may have an adverse impact on an individual's physical and mental well-being, leading to exhaustion (Bakker & Demerouti, 2017).

On the other hand, job resources are those elements of a job that can effectively attain work-related objectives, reduce the level of work stress, or have physiological and psychological effects associated with them (Bakker et al., 2023). Receiving feedback, having control over one's employment and having access to social support are examples of job resources available to employees. The primary reasons why

employees view job resources as motivating are the provision of a sense of purpose, the satisfaction of their fundamental needs, and the positive contribution to worker engagement and performance (Bakker et al., 2023).

According to studies, high job demands and a lack of resources are the leading causes of burnout (Lee & Eissenstat, 2018). Lack of resources has been linked to disengagement, even though work demands are associated with fatigue (Garcia-Sierra et al., 2016). It has been argued that the JDRT predicts that the positive effect of job resources on employee performance could compensate for the adverse influence of work demands on employee performance (Schaufeli (2017). In other words, the influence of workplace expectations on employee burnout is accentuated in environments where employees have fewer employment resources (Van Steenberg et al. (2018). The impact of job demands on employee burnout is reduced when employees have access to a wider variety of services at their workplaces (Van den Broeck et al., 2017).

The JDRT primarily focuses on explaining burnout by analysing the dynamic interplay between job demands and resources. Schaufeli and Bakker (2004) introduced a new JDRT that described the positive impact of such interactions on employee engagement in their work. The decision was made based on the premise that the initial JDRT prioritised the understanding of burnout by examining the interplay between job demands and work resources. The JDRT formulated by Schaufeli and Bakker in 2004, encompasses a constructive psychological dimension of employee job engagement. Employee engagement can be described as a positive mental state linked to their work and distinguished by enthusiasm, commitment and complete involvement in the given responsibilities.

According to Andrianto & Alsada (2019), the terms vigour, dedication and absorption are defined as possessing a notable degree of physical and mental resilience, demonstrating a distinct motivation and passion for work, and being fully immersed in the current job. The allocation of job resources can serve as an extrinsic motivator, prompting personnel to exert additional effort to compensate for the benefits provided (Cooke et al., 2019). When the resources provided in the workplace align with an employee's expectations regarding their level of skill and independence, it motivates them to engage in their work actively (Cooke et al., 2019). As a result, there has been an increase in employee engagement and productivity. Siengthai and Pila-Ngarm (2016) have reported that the likelihood of employees experiencing job satisfaction is elevated. Providing constructive feedback can aid in developing knowledge and skills, ultimately resulting in improved job performance (Kim, 2017). In addition, providing job autonomy and social support can effectively meet an employee's needs for independence and interpersonal connections (Kim, 2017). Nielsen et al. (2017) found that job resources have the potential to foster a positive and satisfying psychological state that is associated with job engagement. Attainment of this objective can be realised by accomplishing job-specific goals or fulfilling fundamental prerequisites (Nielsen et al., 2017).

The JDRT provides a comprehensive approach to understanding the intricate and ever-changing relationship between job demands, job resources, employee well-being, and job performance, which is a notable benefit. According to Bakker and Demerouti (2017), a correlation exists between job demands, resources and performance. JDRT recognises that work-related demands, including workload and time limitations, may adversely affect both employee well-being and job performance. The JDRT shows that specific job resources, such as social support and job autonomy, can positively enhance employee engagement, motivation, and performance. Furthermore, the JDRT offers a valuable framework for organisations to

recognise and tackle concerns pertaining to job demands and resources that affect employee engagement, motivation, and well-being. Organisations may use the JDRT to identify job demands that lead to stress and burnout. They can then implement measures to alleviate those demands. Organisations can furnish their staff with work-related resources that amplify their involvement, drive, and holistic welfare. Bakker and Demerouti (2017) attest that organisations that adopt these measures could observe improvements in employee job performance, a reduction in employee turnover, and an overall improvement in organisational outcomes.

Although the JDRT has numerous advantages, it has also been criticised. A significant criticism of the JDRT is the absence of clarity regarding the mechanisms underlying the relationship between work demands, job resources, employee engagement, and job performance (Schaufeli & Taris, 2014). The JDRT does not provide convincing explanations for why certain work demands and resources affect the well-being and performance of employees while they are at work. Due to a dearth of specificity, organisations may struggle to identify and manage specific job requirements and resources pertinent to their particular circumstances. This is because the specifics of these needs and resources may vary substantially between organisations (Schaufeli & Taris, 2014).

2.4.2 Social exchange theory

The social exchange theory (SET) aims to explain the nature and dynamics of social connections in organisations (Cropanzano et al., 2017). The social exchange theory defines social connections as a sequence of social transactions in which people give and receive gains and rewards according to their views of the costs and benefits of the relationship (Cooper-Thomas & Morrison, 2018). In organisations, social interactions begin with either positive or negative initiating actions. Positive initiating

actions constitute organisational support or fairness for workers in the workplace (Chernyak-Hai & Rabenu, 2018). Negative initiating actions include abuse in supervision and employee bullying (Mullen et al., 2018). Depending on the circumstances, a subordinate may exhibit good or poor behaviour in response to a manager's initiating action (Yu & Duffy, 2021). Employees' responses based on initiating actions from managers or supervisors are called reciprocal responses (Yu & Duffy, 2021).

According to the social exchange theory, when managers or supervisors introduce a positive initiating action, workers prefer to respond by participating in more positive reciprocal actions (Ahmad et al., 2023). The theory further outlines how reciprocity creates and sustains workplace ties. It describes how an employee could feel and behave at work regarding a relationship with another person or the organisation. Before reacting appropriately, people must assess the rewards and costs of social relationships (Bakker & Dutton, 2017).

In his seminal work on the social exchange theory, Homans (1961) argues that social exchange is a two-person interchange of activity, whether physical or intangible, that is more or less fulfilling for both parties. Employees choose whether to engage in dyadic interactions based on a cost-benefit analysis (Homans, 1961). As a result, people weigh the advantages such partnerships will bring them against the expense of being in such relationships. In this sense, choices to get into dyadic relationships with others are founded on the assumption that the rewards exceed the risks. Business cultures, including the organisational emotional climate, are a byproduct of social interactions (BizShifts-Trends, 2015). The ability of the social exchange theory to describe the complexities of social connections and the reasons underlying social action is one of its key advantages (Cropanzano et al., 2018). Social connections entail a series of transactions in which people are driven by their views of the costs

and rewards of the relationship. A more nuanced view of social connections and conduct is given by considering the elements that impact people's perceptions of social exchanges, such as trust, reciprocity, and fairness. Another advantage of this theory is that it offers a helpful framework for explaining employee behaviour in terms of social interactions that occur in the workplace, such as turnover, job satisfaction, and organisational commitment (Cropanzano et al., 2018). Organisations, for example, might apply the social exchange theory to identify and solve the issues that impact employee perceptions of fairness and reciprocity in the workplace.

Notwithstanding its benefits, the social exchange idea has been criticised. One of the criticisms levelled against it is its focus on individual-level characteristics that impact social exchanges, such as fairness and reciprocity, while ignoring wider structural and cultural aspects that form social interactions (Tsvetkova et al., 2022). Power dynamics, social norms, and cultural values are not fully accounted for in the theory's analysis of social interaction. Because of this constraint, businesses may find it difficult to address the wider structural and cultural variables that impact social interchange in the workplace (Morris et al., 2015).

2.4.3 The adoption of job performance theories and rationale

For this study, both the social exchange theory and job demand-resources theory were adopted. This section justifies adopting the the theories for explaining the variables of this study.

2.4.3.1 Justification for job demand-resources theory

Linking the JDRT to this study, it is argued that exposure of employees in the 3D printing industry to job demands such as workload, time pressure and more complex

tasks could negatively affect the job performance of employees. However, with appropriate job resources, such as providing the right infrastructure and tools for employees and employee support, employees could become more engaged in their work and exhibit vigour, dedication, and absorption, enhancing their job performance positively. Thus, the exposure of employees to various forms of job demands could positively or negatively affect the job performance of employees in the 3D printing industry based on the availability and accessibility of appropriate job resources. In this regard, firms in the 3D printing industry may improve employee well-being and work performance if they properly manage the job demands and resources. For instance, companies may lessen the pressures of jobs by instituting flexible work arrangements, offering social support, and encouraging a healthy balance between work and personal life. They may also be able to provide employment resources such as access to opportunities for training and development, feedback and recognition, and work autonomy.

2.4.3.2 Justification for the social exchange theory

The social exchange theory is justified for this study because employee exchanges between leaders and their subordinates affect their job performance. Since the theory is based on cost-benefit analysis based on leader-subordinate relationships, employee job performance will be enhanced if employees perceive their relationships with their leaders as positive. In this regard, positive perceptions of leader-subordinate relationships could result in employees exhibiting both task and contextual performance in 3D printing firms in South Africa. However, when employees have a negative perception of their leader-subordinate relationships, it may have a cascading effect on employee job performance and may also encourage employees to engage in unproductive work practices. The social exchange theory also emphasises the significance of trust in the development and maintenance of social connections and in

allowing the exchange of resources. Trust is necessary for the 3D printing industry to facilitate partnerships and other forms of cooperation among the many stakeholders. For instance, trust may make it easier to share intellectual property, which is an essential resource in the process of developing new applications for 3D printing. The cultivation and upkeep of trust within the sector may also result in a rise in investments and collaborations, which, in turn, will propel growth and development.

2.5 Factors influencing job performance

This section discusses the factors influencing job performance in organisations and elaborated on their relevance to the 3D printing sector in South Africa. The factors discussed in this section comprises employee motivation, job design, working conditions and management style. The selection of employee motivation, job design, working conditions, and management style as key factors in the 3D printing sector in South Africa is grounded in existing literature highlighting their substantial impact on employee job performance across various industries. By drawing on established literature, this research aims to apply these findings specifically to the unique context of the 3D printing sector in South Africa, recognizing their proven relevance in enhancing overall employee job performance and contributing to the industry's success.

2.5.1 Employee motivation

According to Gagne and Deci (2021), employee motivation is an intrinsic drive that gives individuals the energy to attain organisational and personal objectives. Employee motivation may be classified into two categories: extrinsic and intrinsic motivation. Individuals driven by extrinsic motivation perform tasks to get extra incentives, such as compensation or promotions, as well as praise and appreciation

(Ryan & Deci, 2020). On the other hand, intrinsically motivated people do not need additional recognition, remuneration or other incentives to perform efficiently at work. However, they are inspired inwardly by their ability to perform assigned tasks and achieve organisational goals (Ryan & Deci, 2020).

In the 3D printing industry, where innovation and creativity are key to success, motivated employees can be more productive, creative, and efficient. One way motivation can influence performance is through the level of engagement that employees have with their work. When employees are motivated, they tend to be more engaged and committed to their work. Consequently, individuals may exhibit higher productivity levels and willingness to undertake challenging tasks and assignments. Furthermore, motivated employees tend to proactively seek opportunities to enhance their knowledge and acquire new skills. Highly motivated employees can aid companies in the 3D printing sector in staying abreast of the latest trends and advancements, which could prove crucial for success in a fiercely competitive market.

Furthermore, highly motivated employees tend to demonstrate increased ingenuity and innovation within their respective roles. Innovation is pivotal in achieving success within the industry, as firms frequently generate novel products and services. When employees experience a sense of motivation, they tend to exhibit a greater willingness to take risks and engage in creative thinking. This can lead to the emergence of innovative ideas and novel concepts that drive the progress of the business. Therefore, individuals may exhibit heightened productivity and a greater willingness to undertake challenging tasks and endeavours.

Ensuring employee motivation is critical to company human resource management, as stated by Riyanto, Endri and Herlisha (2021). Companies must prioritise the maintenance and management of employee motivation in the workplace to ensure a

sustained focus on organisational objectives (Riyanto et al., 2021). Sustaining employee motivation is of utmost significance as it propels every individual, which underlies their decisions to act and perform tasks (Haryono, Supardi & Udin, 2020). If employees lack intrinsic motivation to excel at work, their performance may not be optimal. According to Khan, Ahmed, Paul and Kazmi's (2017) research, the impact of motivation on employee performance is positive. A study conducted by Haryono et al. (2020) regarding the effects of motivation on employee performance revealed that motivation has a significant and favourable influence on employee performance.

2.5.2 Job design

Job design specifies a work's approaches, relationships, and contents to suit organisational, technical and the employees' social and personal demands (Lawrie, Tuckey & Dollard, 2018). According to Raharjo et al. (2018), the design of a job starts with a study of the task requirements before considering the attributes of responsibility, autonomy, and self-control. Although tasks are the fundamental and major components of employment, jobs are arranged with an extremely regulated relational system that affects not only the interpersonal interactions of employees but also their affiliations (Rogers, Miller, Flinchbaugh, Giddarie & Barker, 2021). According to Hernaus, Maric and Cerne (2019), employers consistently urge workers to follow job designs in which individuals are held accountable for the quality of their work. The link between goals and work planning may aid in increasing performance, and job design may improve employee performance and satisfaction (Rasheed, Jamad, Pitafi & Iqbal, 2020).

In the 3D printing industry in South Africa, job design is a key factor that may affect how well employees do their jobs. Job design may help employees do their jobs better by motivating and engaging them. Hackman and Oldham (1976) note that the

motivation and engagement of employees can be affected by five key work characteristics: skill diversity, task identity, task importance, autonomy, and feedback. Relating this to the context of 3D printing, it could be rightly inferred that jobs that involve designing and making prototypes may be more interesting to workers than jobs that just involve printing.

It could, therefore, be argued that the simplicity or complexity of job designs has implications for employee job performance in the 3D printing working environment. Thus, within this environment, if job designs are clearly defined, employees will have a better understanding of what is expected of them and be able to perform their tasks accordingly. On the other hand, if job designs are complex and ambiguous, it becomes difficult for employees to understand the content of their job descriptions, and performing their tasks to meet the expectations of their supervisors becomes difficult to achieve and reduces their job performance. In this regard, simplified job designs positively affect employee job performance within the 3D printing work environment, whereas complex and ambiguous job designs negatively affect employee performance.

2.5.3 Working conditions

Working conditions are established by workers' interactions with their organisational atmosphere (Lee & Park, 2021). Working conditions include psychological as well as physical components of the work. Employee well-being, motivation, and job satisfaction may all be influenced by the physical and psychological characteristics of the workplace, which in turn can affect employee job performance (Efawati, 2020). Physical working conditions relate to the workplace's physical environment, including temperature, lighting, noise, and air quality (Gunningham et al., 2016), and have been demonstrated to have a major influence on employee well-being and job performance

(Grawitch et al., 2006). Kozusznik et al. (2019) discovered that interior air quality, temperature and illumination were major determinants of employee work satisfaction and motivation.

Poor physical working conditions, such as excessive noise and insufficient ventilation, may create physical pain and health issues, resulting in lower job satisfaction and motivation among workers (Kelliher & De Menezes, 2019). As a result, it is critical for 3D printing firms to guarantee that physical working conditions are favourable for employee well-being and job performance.

Psychosocial working conditions are the social and psychological components of the workplace that include, among other things, job demands, social support, job autonomy, and organisational culture. According to research, psychosocial working environments may have a major influence on employee well-being and job performance. Rugulies (2019) states that work expectations, job control and social support are significant factors influencing employee well-being and job performance in the manufacturing sector, including the 3D printing industry. The presence of workload and time constraints in a workplace can lead to stress and burnout among employees. However, job autonomy and social support can effectively boost employee motivation and job satisfaction, as Francioli et al. (2016) suggests. Therefore, it is imperative for enterprises operating in the 3D printing industry to ensure that the psychosocial work environment is conducive to promoting the welfare and productivity of their workforce.

From the literature, the study argues that in the 3D printing working environment, employee perceptions about their working conditions have either positive or negative implications for their job performance. Thus, if employees hold positive perceptions about the working conditions in terms of their physical environment, health and safety

issues, as well as salaries and remuneration, it could spur positive job performance in terms of both task and contextual performance. Moreover, if employees perceive working conditions negatively, it could incite counterproductive work behaviours such as absenteeism, presenteeism, negligence, and low productivity.

2.5.4 Management style

Management style may be defined as a manager's approach to leadership to control a firm (Chan, 2019). Management includes controlling, mentoring and other techniques leaders use to inspire subordinates to obey their orders (Chan, 2019). Managers accomplish goals by directing and monitoring the activities of others, and being held responsible for attaining organisational goals (Carasco-Saul et al., 2015). According to Kotter (2017), three factors determine the kind of management style used: the qualities of the leader, the characteristics of subordinates, and the organisational environment. Individual backgrounds of managers, such as personalities, knowledge, beliefs and life experiences, impact their feelings about proper leadership, which influences their choice of a particular leadership style (Kotter, 2017). Workers' personalities, backgrounds, expectations and past job experiences may also vary. Additional factors influencing a leader's style include those affecting their organisation's environment. These factors include organisational atmosphere, values, work group makeup, and job type (Kotter, 2017). Managers have critical responsibilities in improving the job performance of their subordinates. According to Saleem (2015), managers contribute to employee performance by offering feedback on their completed tasks. Saleem (2015) further attests that managers are consistent in their conduct while influencing people, trusting them, and spending time with them.

Leaders' management styles may substantially impact employees' work performance in the South African 3D printing business. For instance, participatory leadership,

including workers in decision-making processes, may affect job performance. Employees may feel more motivated, committed, and happy if their managers actively participate in their growth. It may also develop a culture of creativity and invention, improving work performance and productivity.

Transformational leadership is another management style that can be important in the South African 3D printing sector. Transformational leadership entails encouraging and motivating individuals to work for the organisation's benefit rather than their own. This leadership style focuses on creating a common vision, cultivating strong connections, and empowering colleagues. According to research, transformative leadership may improve employee job satisfaction, dedication, and performance (Manzoor et al., 2019). The study suggests that the management style is a crucial factor that affects employee job performance. Specifically, it proposes that transformational leadership enhances employee job performance in a 3D printing working environment. The rationale is that transformational leadership supports visionary leadership, teamwork, problem-solving, and mentorship. With the recent advancements in the 3D printing industry, it is important to emphasise that transformational leadership style characteristics are critical building blocks for positively increasing employee job performance.

2.6 Measuring job performance

Job performance can be measured and described using appropriate research instruments. Two factors play a role in measuring job performance: the vast range of variances among raters and the extent of job-specificity required (Murphy, 2008). Both researchers and practitioners generally trust the rating scales when it comes to measuring job performance. However, the difference between these rating scales and their reliability depends on who fills them out (Murphy, 2008). It could be coworkers,

managers, supervisors, subordinates, or the employees themselves. Woehr (2008) asserts that the differences in rating scales could be due to how supervisors, coworkers, subordinates, or employees regard job performance. From the perspective of Adler et al. (2016), multi-rater assessments could help resolve the problem of differences in rating scales on job performance.

Other researchers argue that using a separate rater provides a new perspective on measuring employee job performance (Scullent, Mount & Goff, 2000). They observed that self-evaluations were less common in the real world since other evaluations were more favourable (DeNisi & Murphy, 2017). Unlike other stakeholders, employees can see all of their behaviours in their self-reports; peers and managers rate the employee's performance based on the employee's general impression, and this information can be collected easily, reducing problems with missing data and confidentiality issues. Therefore, it is still important to use self-reported performance measurements when measuring employee job performance (DeNisi & Murphy, 2017). Standardised questionnaires measure how well employees do their jobs, and each has pros and cons regarding validity and reliability. The Job Performance Scale (JPS), the Multifactor Leadership Questionnaire (MLQ), and the Occupational Self-Assessment (OSA) are three questionnaires that are often used.

The JPS is a 16-item questionnaire that measures overall job performance across different tasks and responsibilities. The JPS is used extensively in research studies because it has been shown to be reliable and valid. However, some studies (Mount et al., 2014) have raised concerns about the JPS's vulnerability to social desirability bias, which is when people answer in a way they think is socially desirable instead of honest.

The MLQ is a 45-item questionnaire designed to assess leadership styles and their influence on employee job performance. The MLQ is frequently used in leadership and job performance research due to its established reliability and validity. Nonetheless, certain research studies have contended that the MLQ excessively emphasises transformational leadership and fails to consider other leadership styles that may be effective in specific circumstances (Judge & Piccolo, 2004).

The OSA is a self-report questionnaire that measures job performance and satisfaction across various domains. The OSA is often used in vocational rehabilitation and occupational therapy settings because it has been found to be reliable and valid. Despite this, some studies (Schultz & Rogers, 2019) have claimed that the OSA is too subjective and that the respondent's experiences and beliefs may influence it.

According to Sluiter et al. (2003) and de Vries et al. (2012), the Individual Work Performance Questionnaire (IWPQ) exhibits favourable psychometric properties, such as strong internal consistency and test-retest reliability. The questionnaire has been applied in various occupational settings, including healthcare, education, and manufacturing, as documented by de Vries et al. (2012) and Mafini and Martins (2017). The IWPQ has undergone translation and testing in various languages, including Dutch, Spanish and Chinese, as documented by Sluiter et al. (2003) and Chen et al. (2017). The IWPQ was used to measure job performance for this study.

2.6.1 Individual work performance questionnaire (IWPQ)

Koopmans (2015) developed the IWPQ, an 18-item tool, to evaluate the three primary components of job performance: task performance, contextual performance and counterproductive work behaviour (CWB). The IWPQ employs a five-point Likert scale ranging from 0 (never) to 4 (always).

Research has been carried out to evaluate the psychometric characteristics of the IWPQ. Blomme et al. (2010) have reported that the IWPQ exhibits good internal consistency and test-retest reliability, with Cronbach's alpha coefficients ranging from 0.74 to 0.95 and intra-class correlation coefficients ranging from 0.74 to 0.87, respectively. According to De Gieter et al. (2011), the IWPQ demonstrates sound construct validity, criterion-related validity and predictive validity, and can effectively distinguish between high and low performers. Konradt et al. (2015) reported that the IWPQ shows sound convergent and discriminant validity and can effectively distinguish between task performance, contextual performance and counterproductive work behaviour.

The IWPQ has been used across diverse industries, including healthcare, education, and business, to evaluate an individual's work performance. De Gieter et al. (2011) employed the IWPQ to investigate the influence of goal orientation on the job performance of healthcare practitioners. Joo et al. (2019) used the IWPQ to examine the impact of employee engagement on work performance within the education industry.

The IWPQ has a significant benefit in its comprehensive nature. The study encompasses a broad spectrum of job performance aspects comprising task performance, contextual performance, and counterproductive work behaviour, as stated by Koopmans et al. (2011). This enables researchers to obtain a comprehensive perspective on employees' job performance and pinpoint areas that require enhancement. In the context of the 3D printing industry, it is pertinent that personnel exhibit proficiency not only in technical competencies but also in collaboration, effective communication, and adeptness in resolving issues. In this regard, the choice of the IWPQ is justified for measuring job performance in the 3D

printing industry in South Africa as it measures task, contextual and counterproductive behaviours.

2.7 Variables that can influence job performance in the 3D printing environment

This section provides literature and discusses the variables influencing job performance in the 3D printing environment including knowledge management, employee empowerment, organisational communication, job satisfaction, job enlargement, job rotation, employee training, creativity and innovation. These variables were chosen based on comprehensive literature that consistently highlighted their pivotal roles in shaping employee performance across diverse sectors. This is because, literature emphasised the significance of knowledge management (Dalkir, 2017; North & Kumta, 2018), employee empowerment (Saks & Gruman, 2018; Garca-Juan et al., 2019), organisational communication (Karanges et al., 2015; Walden et al., 2017), job satisfaction (Dinc, 2017; Ajala, 2017), job enlargement (Alias et al., 2018; Tumi et al., 2022), job rotation (Padula et al., 2017; Hedler & Lanza, 2018), employee training (Rodriguez & Walters, 2017; Armstrong & Landers, 2018) as well as creativity and innovation (Hughes et al., 2018; Ghosh, 2015) in contributing to employee job performance in organisational contexts. In this regard, the literature-backed selection of these variables aimed to apply well-established principles to enhance job performance in the unique context of the 3D printing environment.

2.7.1 Knowledge management

Knowledge management refers to the systematic generation, accumulation, dissemination and application of information and knowledge within an organisation (Hislop et al., 2018). The significance of knowledge management to organisational

performance is primarily attributed to its ability to enhance organisational learning, innovation, and decision-making (Dalkir, 2017). This can ultimately result in an enhancement of an organisation's overall effectiveness and efficiency. In recent years, knowledge management has garnered considerable attention due to the recognition by employees of its significance in managing information within a knowledge-based economy (Girard & Girard, 2015). According to North and Kumta (2018), knowledge management is a learning process encompassing knowledge exploration, exploitation and sharing, facilitated by appropriate technology and a cultural environment. On the other hand, Abubakar et al. (2019) define knowledge management as a concept that involves acquiring, auditing and disseminating information among a company's stakeholders, including workers, customers, and partners. According to Donate and De Pablo (2015), the employees of an organisation must exchange information and data to augment the company's operational efficiency and profitability.

Most studies have found a link between how well information is managed and how well employees do their jobs. This might be seen in a good light if one considers how the four stages of knowledge management—namely, the generation of knowledge, the storage of information, the sharing of knowledge, and the application of knowledge—increase the job performance of employees (Ferreira, Mueller & Papa, 2018). According to the findings of a study conducted by Soto-Acosta, Popa and Palacios-Marqués (2016), sharing skills, knowledge and experiences helped improve employee job performance by making them more imaginative in the workplace. Researchers concluded that, as a result, information sharing boosted the employees' effectiveness in their jobs. Since workers will be given aid in producing new information and encouraged to improve their learning capacities, an environment conducive to creativity and innovation will be nurtured inside the firm. Because of this, not only will the workers' attitudes be influenced, but also their actions, capabilities,

and overall performance (Jyoti & Rani, 2017). For businesses to see improvements in employee job performance, those businesses need to make investments in the infrastructure of knowledge management. This infrastructure includes organisational culture, information technology infrastructure, and organisational structure (Aalmajali & Al-Lozi, 2019). According to Abualoush, Masa'deh, Bataineh and Alrowwad (2018), the two key components of knowledge management infrastructure are technical and social infrastructure. The technical infrastructure comprises the tools (hardware) and the information technology infrastructure (software). Conversely, the social infrastructure includes the organisational culture, command structure, and human resources (Abualousch et al., 2018).

The 3D printing industry in South Africa is growing quickly and has much room for innovation and economic growth. Companies' success in this industry depends on their capacity to successfully manage knowledge, which may lead to improved organisational performance. Promoting innovation is one of the most important ways knowledge management may improve organisational performance in the industry. Knowledge management can support innovation by sharing knowledge and expertise, enabling collaboration and experimentation, and providing access to external sources such as suppliers, customers, and industry experts. This may result in the creation of new products, enhanced manufacturing processes and higher efficiency and productivity, all of which can boost organisational performance. Improving product quality is one way that knowledge management may boost organisational performance in the sector. Knowledge management can enhance the product quality by ensuring employees can access current knowledge and information regarding product design, materials, and production processes. This ensures that employees can make informed decisions about the products they design and produce.

In conclusion, implementing knowledge management strategies can enhance the operational efficiency of organisations operating in the 3D printing industry in South Africa by facilitating the development of new business prospects and markets. The implementation of knowledge management can facilitate the recognition of market prospects by allowing enterprises to track industry trends and advancements, pinpoint market deficiencies, and engage in cooperative efforts with other entities to create innovative products and services. This outcome has the potential to increase revenue and profitability, improve market standing and elevate competitiveness, thereby enhancing overall corporate performance.

2.7.2 Employee empowerment

Employee empowerment means giving employees a chance to make decisions and take actions that affect their work performance but also the success of their company as a whole (Saks & Gruman, 2018). When employees are given the authority to make their own choices, they are more likely to be enthusiastic, productive, and dedicated to their work, which eventually contributes to an improvement in the organisation's overall performance (Kinnie, Hutchinson, Purcell, Rayton & Swart, 2016). According to the findings of the study by Garca-Juan, Escrig-Tena and Roca-Puig (2019), there are two separate routes to empowerment. The first strategy is known as the structural approach, and it comprises a set of procedures and structures that let power and authority be dispersed across an organisation, beginning at the top levels of management and working their way down. The second strategy is psychological, and it examines how an employee's perspective changes in response to various management tactics (Garca-Juan et al., 2019). Lewis, Brown and Sutton (2019) came to the same conclusion, although they identified employee empowerment as both a structural and psychological phenomenon. The degree to which people are provided with guidance and decision-making limitations directly reflects the degree to which

organisational decision-making powers are delegated. These benefits are provided to workers via structural empowerment (Lewis et al., 2019).

In the current intense business competition characterised by global market dynamics, rapid market disruptions and heightened consumer expectations, empowering employees with decision-making authority and action-taking capabilities is imperative. To surmount these challenges, employees must be granted the authority to execute the required actions. This, in turn, calls for innovative and creative solutions (Shah, Khattak, Zolin & Shah, 2019). Effective communication between managers and employees is crucial to ensure the workforce is well-informed about the organisation's mission, vision values, and individual objectives (Shah et al., 2019). Consequently, there will be a rise in the implementation of empowerment within organisations.

Furthermore, the management team must emphasise in-person communication and integration initiatives throughout all tiers of the organisational structure to guarantee that staff members thoroughly understand the company's strategic objectives. Implementing this measure would enable the management to ascertain whether the employees thoroughly comprehend the organisational strategy, as per the research conducted by Baird, Su and Munir (2018). Empirical studies suggest that management can enhance employees' sense of empowerment by involving them in decision-making processes and encouraging their participation in accomplishing organisational objectives (Nayak, Sahoo & Mohanty, 2018).

In the 3D printing sector in South Africa, employee empowerment is of critical importance to the overall success of organisations. Empowering workers may result in higher levels of employee engagement, a rise in innovative ideas, superior service to customers, and an overall improvement in the organisation's efficiency. Employee empowerment may improve organisational performance in several ways, including

encouraging creativity. According to Maqbool and Khan (2018), employee empowerment may boost creativity by allowing workers the flexibility to experiment, take risks and share their ideas. This freedom encourages employees to collaborate and contribute to developing new ideas and may result in the creation of new goods, services and processes, all of which have the potential to increase the organisation's level of competitiveness. For instance, if an employee is free to experiment with various 3D printing materials and methods, they may develop an innovative strategy for producing complicated designs that the company could use to distinguish itself from other businesses in the industry.

Empowering workers in the 3D printing business in South Africa may also improve customer service, which is another way the sector's organisational performance can be boosted through employee engagement. According to the findings of research conducted by Nkhoma and Chirwa (2018), empowering workers means giving them the authority to make choices and find solutions to challenges posed by customers. This may lead to an improvement in customer service and may result in increased levels of client satisfaction, loyalty and retention, all of which would benefit the organisation's reputation and revenue. For instance, an empowered employee would be able to swiftly remedy a customer's problem with a 3D-printed product, resulting in a good experience for the consumer and improved loyalty from that customer.

Overall organisational effectiveness may also improve by empowering workers in the 3D printing business in South Africa, which in turn can boost organisational performance and performance metrics. According to the findings of research conducted by Hezam and AlBattat (2015), employee empowerment can potentially increase organisational performance by fostering improved decision-making, increased cooperation and enhanced communication among workers. This may result in enhanced productivity, efficiency, and effectiveness, improving the organisation's

profitability and capacity to remain in business. An example of this would be the ability of a group of 3D printing engineers to cooperate more effectively on difficult projects, which would ultimately result in output that is both quicker and more efficient.

2.7.3 Organisational communication

Effective communication within an organisation is a crucial determinant of employee job performance, as highlighted by Jaupi and Llaci (2015). Good communication helps cultivate a common understanding of organisational objectives and makes it easier for workers to collaborate and coordinate their efforts, all of which contribute to improved corporate results (Karanges et al., 2015). It has been argued that the success of message transmission is directly correlated to an individual's capacity for clear and convincing communication (Karanges et al., 2015). Communication within an organisation is critical for the success of any firm since it entails the dissemination of information and the flow of ideas from one person to another. It involves one party providing information to another, known as the receiver (Walden et al., 2017). Communication allows workers to improve their productivity and express their emotions with one another and with their management, such as whether they are satisfied or dissatisfied with their jobs (Kang & Sung, 2017).

Three main types of communication affect performance metrics (Kang & Sung, 2017). These are relational communication, informational communication and supportive communication. Relational communication builds good relationships between superiors and subordinates, increasing trust and confidence among all parties (Parker et al., 2015). The dissemination of work-related information and knowledge among workers and the promotion of supportive communication, are outcomes of effective informational communication (Kang & Sung, 2017). In addition, supportive communication helps to cultivate trust in management and supervisory efforts to

strengthen interpersonal connections, significantly contributing to the level of trust within an organisation (Kang & Sung, 2017).

Effective communication is a key part of coming up with new ideas in the South African 3D printing business, which is important for the overall success of a company. This is because effective communication between workers and management in the business can facilitate information sharing, cooperation, and knowledge exchange, which leads to greater innovation and enhanced organisational performance. For instance, a company that encourages its workers to share their ideas and cooperate on new initiatives is more likely to generate creative goods and services capable of meeting the shifting requirements of the market.

Furthermore, effective communication is crucial in the 3D printing industry, as it fosters employee engagement and job satisfaction, resulting in enhanced organisational performance. As per the research conducted by Ford et al. (2017), effective communication between managers and employees promotes transparency, trust, and constructive feedback, increasing job satisfaction and employee engagement. An organisation that proactively solicits input from its employees and values it is more likely to foster a highly engaged workforce motivated to work towards achieving the organisation's goals. This, in turn, can lead to enhanced organisational performance.

Lastly, efficient communication is crucial for promoting ethical conduct, which is vital for the performance of organisations. Yue et al. (2019) assert that efficient communication between managers and workers fosters an atmosphere of openness and responsibility, ultimately resulting in an organisation-wide culture that values ethical conduct. For instance, an organisation in the 3D printing industry that encourages open and honest communication between employees and management

is more likely to have a highly ethical workforce that adheres to the organisation's values and principles, leading to improved organisational performance.

2.7.4 Job satisfaction

Research has shown that job satisfaction is crucial in determining employee performance across different organisational contexts. According to Abdulkhaliq and Mohammadali (2019), job satisfaction plays a pivotal role in an employee's professional life, directly impacting their motivation, commitment, and engagement towards their work. Dinc (2017) supports the concept that satisfied employees tend to be more productive and committed and have a lower turnover rate than dissatisfied employees.

Numerous studies have investigated the relationship between job satisfaction and job performance, and findings suggest a positive correlation between these two variables (Shaju & Subhashini, 2017). According to Ajala (2017), there is a positive correlation between job satisfaction and positive work behaviours, such as increased job involvement, improved task performance and a greater willingness to engage in extra-role behaviours among employees. To provide further clarification, it can be stated that job satisfaction plays a significant role in fostering a conducive work environment that facilitates increased levels of employee engagement, creativity and innovation.

On the other hand, employee dissatisfaction can have a negative effect on job performance. According to the research conducted by Ampofo (2020), employees who communicate discontentment with their job tend to demonstrate diminished morale, decreased job involvement and lowered productivity. Abdulkhaliq and Mohammadali (2019) state that dissatisfied employees may exhibit counterproductive work behaviours such as absenteeism, turnover and reduced job performance. The

situation described above could lead to an unfavourable work environment, which may negatively impact employee engagement, lower productivity and ultimately hinder the organisation's overall success.

The potential implications of the correlation between job satisfaction and job performance for the 3D printing industry in South Africa are noteworthy. To enhance the job performance of employees, it is recommended that organisations in the industry prioritise the satisfaction of their workforce. Facilitating a favourable work atmosphere, fostering avenues for professional advancement, and offering competitive remuneration packages can enable the achievement of this objective. In South Africa, the 3D printing sector is still in its infancy and is growing rapidly. The sector's success will depend largely on the engagement and productivity of its employees. Therefore, organisations should prioritise employee job satisfaction to ensure the industry's success.

2.7.5 Job enlargement

As a strategy for improving employee job performance, job enlargement, involves increasing the number and variety of tasks employees perform. This approach is based on the assumption that adding new responsibilities might lead to increased role uncertainty and conflict of roles (Gichuki & Munjuri, 2018). However, according to Berdicchia et al. (2016), job enlargement also involves combining different jobs and adding accompanying obligations to work.

Research on the impact of job enlargement on employee performance has produced mixed results. Alias et al. (2018) attest that job enlargement could lead to lower job satisfaction and employee commitment due to increased work volume and reduced time for socialising. However, Tumi, Hasan and Khalid (2022) contend that job

enlargement can improve employee work performance while lowering overall organisational costs, particularly when employees are exposed to several additional tasks and can work at each level.

The concept of job enlargement can be expounded within the framework of the job demand-resources theory. Bakker and Demerouti's (2017) theoretical framework posits that job demands, including workload and role ambiguity, may impede employee job performance, while job resources, such as social support and autonomy, may enhance employee performance. The concept of job enlargement involves expanding the range of duties linked to a particular employee's role, which increases the level of expectations placed on them and generates a need for heightened performance. Insufficient job resources can result in unfavourable work behaviours among employees, adversely affecting their overall job performance.

According to Schaufeli et al. (2009), the augmentation of job responsibilities can positively influence employees' job performance as they exhibit eagerness, dedication and engagement. Providing appropriate job resources to employees is crucial for organisations to promote engagement in their work. The resources needed for a job may include suitable training, social support and opportunities for career growth. By providing the right job resources, organisations can cultivate favourable work behaviours and augment job performance.

Job enlargement could have implications for the 3D printing sector in South Africa. As the industry continues to evolve and grow, there may be opportunities for job enlargement to increase the work volume of workers by combining different jobs and adding accompanying obligations. This may result in increased efficiency and lower costs for the organisation. To ensure positive outcomes, organisations need to provide employees with the appropriate job resources, as suggested by the job demand-

resources theory. By providing the necessary resources, such as training and support, organisations can help employees feel more engaged and motivated, leading to positive work behaviours and performance outcomes.

Furthermore, in the 3D printing sector, where technology and processes are constantly evolving, job enlargement may be necessary to keep up with the pace of change. This could involve expanding the scope of an employee's job to include new technologies or processes, which can provide opportunities for growth and development. However, it is important to consider the potentially negative effects of job enlargement and to ensure that employees have the necessary resources and support to succeed in their roles.

2.7.6 Job rotation

Job rotation is a human resource strategy that allows employees to rotate from one job to another in a predetermined sequence (Yoon, Ko & Jung, 2016). Job rotation is perceived as a tool for learning within organisations, as it allows employees to perform various jobs and diverse tasks (Oparanma & Nwaeke, 2015). Padula et al. (2017) assert that job rotation could facilitate learning within an organisational context, and a properly designed and implemented job rotation can increase personnel capacity, resulting in improved job productivity and performance.

Studies have shown that job rotation has a positive impact on employee performance. Hochdorffer, Hedler and Lanza (2018) discovered that job rotation enhances sociability and information sharing, resulting in a more competent workforce. Additionally, job rotation can enhance employee participation and task dedication, thereby increasing effectiveness and efficiency and leading to increased workplace productivity (Kampkotter, Harbring & Sliwka, 2018).

The acquisition of varied skills within an organisational context is crucial for employee growth and development, and employee job rotation is a good strategy to achieve this goal. Furthermore, job rotation exposes employees to tasks different from their normal job descriptions, enhancing their job performance. As a result, job rotations positively affect employee tasks and contextual performance. (Hochdorffer et al., 2018).

This study comments on job rotation as a factor determining job performance and argues that employee job rotation could be a good strategy for acquiring varied skills within the working environment of 3D printing in South Africa. Again, job rotation can improve workers by giving them experience with tasks not usually part of their job descriptions. In this way, job rotations help employees at 3D printing firms to do their jobs well both on the job and in other situations. However, employees may not do their jobs well if the skills they need do not match the job rotation plans. For instance, mismatches can happen, when sales managers or operations managers, who do not know much about the technical side of 3D technology, are put to work with 3D designers or CAD modellers. These types of individuals may not be a good match for the team. The inappropriateness of a job rotation might result in unproductive work behaviours such as presenteeism, absenteeism, and bad morale at work, among others. Therefore, it is important for 3D printing firms to ensure that employee competencies are properly matched when implementing job rotation programmes to reap the maximum benefits.

2.7.7 Employee training

Human capital development through employee training is a critical investment for individuals and businesses, as it helps enhance the employees' skills and improve overall job performance (Armstrong & Landers, 2018). New hires should be put

through a training programme to enhance their skills and provide them with up-to-date information necessary to meet the global challenges of the market in which they operate (Armstrong & Landers, 2018). According to Hanaysha (2016), employees seek new skills to boost their job performance and share them with their colleagues. In addition, training programmes provide employees with specific skills and various strategies that help to address performance flaws (Hanaysha, 2016).

Organisations must provide training and skill development programmes that align with the skills and abilities they will require in the future (Rodriguez & Walters, 2017). These may include problem-solving, technology understanding, and interpersonal communication skills (Rodriguez & Walters, 2017). According to Diamantidis and Chatzoglou (2019), major manufacturing firms tend to conduct more training programmes than smaller firms since multinational organisations train their staff to achieve high performance or flexible production approaches.

Khan et al. (2016) assert that investing in employee training and development clearly indicates an organisation's dedication to its workforce. This, in turn, facilitates employee retention and attracts new talent. Leading organisations recognise the importance of offering comprehensive training opportunities and prioritising career and skill development to retain top talent. The variables mentioned above are instrumental in developing a flexible corporate approach that guarantees the triumph of highly skilled and technologically adept personnel in the marketplace (Khan et al., 2016). According to Sendawula et al. (2018), there is a negative correlation between the turnover rate and the level of training offered to employees in quality and quantity. This suggests that enhancing the amount and calibre of training initiatives could potentially result in a decrease in the rate of employee turnover.

Companies must prioritise resource investment in staff training and development to remain competitive in the South African 3D printing industry. Given the continuous progressions in technology, it is imperative to remain current with the latest methodologies and protocols in the 3D printing sector. Therefore, employee training and development in this sector must align with the specific skills and knowledge required to succeed. Practical examples of training that employees need may include software training, which involves teaching employees how to use software programs specifically designed for 3D printing. Technical training, such as instructing employees on maintaining and repairing 3D printers, is also essential. Other critical training areas may include the latest advances in materials science and engineering related to 3D printing, design skills and creativity, which are crucial for product innovation and differentiation.

2.7.8 Creativity and innovation

As numerous scholars have noted, innovation and creativity are crucial elements in the success of organisations in the modern business environment, (Hughes et al., 2018). Scholars use a similar framework to explain these concepts, defining creativity as the initial step of the process, which involves generating new ideas, and innovation as the subsequent phase, which consists of the adoption and implementation of new ideas to improve practices, methods, or products (Hughes et al., 2018; Ghosh, 2015). Creativity is regarded as discovering new solutions to an organisation's problems, while innovation is seen as applying or using new and beneficial ideas in the workplace (Sigala & Kyriakidou, 2015).

Various steps are necessary to promote innovation within an organisation, starting with deciding to innovate and allocating funds (Amabile & Pratt, 2016). The next stage involves commercialising original ideas based on the available human, physical, and

intellectual resources, followed by creating an appropriate work environment that stimulates employees to generate unique ideas (Amabile & Pratt, 2016). Creativity also undergoes various stages, including planning, concept generation and validation, and final product evaluation (Hon & Lui, 2016).

Encouraging innovation and creativity within the workplace can yield several advantages, such as shaping employee conduct, enhancing work output, and bolstering business competitiveness, while having a favourable impact on financial outcomes (Sarroghi, Libaers & Burkemper, 2015). An additional benefit is the enhancement of organisational sustainability through improving internal capabilities, which are based on employee performance, organisational structure, and learning methodologies (Harark et al., 2016). According to Lee et al. (2020), a work environment that cultivates emerging creativity and innovation positively impacts employees, enhancing job satisfaction, commitment, and performance. Furthermore, companies can gain a competitive advantage by fostering a creative work environment and empowering their staff to think and act innovatively (Lee et al., 2020).

In the highly competitive 3D printing industry in South Africa, creativity and innovation are crucial factors for companies to achieve success and remain sustainable. One example of innovation is the development of 3D-printed prosthetic limbs that are affordable and accessible to people who otherwise would not have access to them. This innovation helps address the underserved population's needs while promoting social responsibility and goodwill for the company.

Another example of innovation is using 3D printing technology in the construction industry to create building components such as walls and floors. This innovation can potentially revolutionise the construction industry by reducing costs, increasing the speed of construction, and promoting sustainability. In terms of creativity, 3D printing

companies have been experimenting with new materials to expand the possibilities of 3D printing, such as using recycled materials. This type of creativity not only promotes sustainability but also provides an opportunity for companies to differentiate themselves in a crowded market by offering unique and environmentally friendly products.

2.8 Chapter summary

This chapter reviewed the literature on employee job performance. The study concludes that task performance, contextual performance and counterproductive behaviours are the three dimensions of job performance which will be measured using the IWPQ. The study also concludes that the social exchange theory and job demand-resources theory are important for explaining job performance from the perspective of leader-employee exchanges (cost-benefit), job demands and availability of job resources. Variables such as employee motivation, job satisfaction, job design, job enlargement, job rotation and working conditions are key determinants of employee job performance in organisations. Within the 3D printing industry, the study concludes that factors that affect job performance comprise knowledge management, employee empowerment, organisational communication, employee training, creativity and innovation.



CHAPTER THREE

LEADERSHIP EMOTIONAL INTELLIGENCE IN THE WORK CONTEXT

3.1 Introduction

This chapter presents literature on leaders' emotional intelligence in the work context. The chapter is important to the aspect of the thesis that looks at the role of leadership and leaders' emotional intelligence and organisational emotional climate/ culture affecting employees' job performance within the 3D printing industry. The chapter commences with explanations of the concept of emotion and also defines emotional intelligence. Emotional intelligence is categorised from the interpersonal and intrapersonal perspectives. Literature on the models of emotional intelligence, namely, Mayer and Salovey's model, Reuven Bar-On's model and Goleman's model, are presented. Furthermore, the researcher presents literature on emotional behaviour, definitions of leadership and the role of leadership in organisations. Literature is also shown on emotional intelligence in leadership with sub-divisions such as leader emotional intelligence, leader emotional behaviour and determinants of leaders' emotional intelligence. Organisational emotional climate/culture is also explored, and finally, measures for emotional intelligence, emotional behaviour and organisational emotional culture/ climate are presented.

3.2 Explaining the concept of emotion

According to Sartre (2015), emotions are mental states that stand out due to subjective experiences, physiological reactions, and behavioural manifestations. A stimulus or event triggers emotions, which involve sophisticated cognitive and motivational processes that affect how we perceive the outside world (Sartre, 2015).

Rojo (2017) defines emotions as integrated patterns of physiological, cognitive, and behavioural reactions structured around the management of the body's internal state. From the point of view of Ashkanasy and Dorris (2017), emotions are adaptive responses to environmental problems. They also play a big role in how we perceive, remember, and make decisions. Ortony, Clore and Collins (2022) define emotions as predictions created by the brain in response to incoming sensory information. These predictions are based on previous experience and connections acquired over time (Ortony et al., 2022).

This study defines emotions as subjective experiences, cognitive processing, physiological arousal and behavioural reactions to either external or internal stimuli. Emotions allow individuals to adjust to new situations, keep internal states under control, and communicate effectively with others. Putting this description into the context of the 3D printing business in South Africa, it could be rightly inferred that emotions play a crucial role in affecting the behaviour and decision-making of employees and managers. For instance, designers, engineers, and business owners may be driven to innovate, create, and be entrepreneurial by their emotions of enthusiasm, curiosity, and passion. On the other hand, emotions such as fear, worry and frustration may emerge when confronted with technological challenges, limited resource availability, or unpredictable market conditions. These emotions have the potential to affect the acceptance and spread of 3D printing technology. Emotions also play a part in the interactions between the many stakeholders in the sector, such as customers, vendors, and regulators, and they can potentially impact the level of communication, trust and collaboration that takes place between these parties.

3.3 Defining emotional intelligence

According to Goleman (2015), emotional intelligence is the ability to perceive, interpret, and manage one's own emotions as well as the emotions of others. On the other hand, Mayer and Salovey (2016) define emotional intelligence as the ability to perceive, analyse, and manage one's own emotions and those of others and use this knowledge to guide one's cognitive processes and activities. Moreover, Dhani and Sharma (2016) define emotional intelligence as a set of non-cognitive talents, aptitudes and proficiencies that influence an individual's ability to handle the stresses and difficulties of their work environment.

From the definitions, it could be rightly inferred that some definitions prioritise an individual's cognitive capacity to comprehend and regulate personal emotions and the emotions of others as emotional intelligence (Goleman, 2015; Mayer & Salovey, 2016), whereas others place more emphasis on an individual's non-cognitive attributes (Dhani & Sharma, 2016). The current study defines emotional intelligence as the ability to perceive and understand both individual and other people's emotions and use this knowledge to manage emotions to achieve personal and firm objectives successfully.

3.4 Categorising emotional intelligence

Using Goleman's model of emotional intelligence, two dimensions of emotional intelligence exist: the intrapersonal and interpersonal dimensions.

3.4.1 Intrapersonal dimension of emotional Intelligence

According to Goleman's model, the intrapersonal dimension of emotional intelligence pertains to an individual's capacity to recognise and comprehend their own emotions and regulate them effectively (Goleman, 2015). In this regard, the dimension of self-awareness, which involves recognising one's own emotions and self-management, involves regulating one's emotions and comprises the intrapersonal aspect of emotional intelligence exhibited by leaders.

3.4.2 Interpersonal dimension of emotional intelligence

According to Goleman's model, the interpersonal dimension of emotional intelligence pertains to a leader's capacity to recognise and acknowledge the emotions of their subordinates (Goleman, 2015) and to effectively regulate their emotions (Goleman & Narvez, 2018). The interpersonal dimension of emotional intelligence in leaders encompasses social awareness, which involves being cognisant of the subordinates' emotions and relationship management and effectively managing their emotions.

3.5 Models of emotional intelligence

In this section, the various models of emotional intelligence are examined.

3.5.1 Mayer and Salovey model

The Mayer and Salovey model of emotional intelligence was first introduced in 1990 and later elaborated upon in their publication titled *Emotional Intelligence* (Campa,

2020). The Mayer and Salovey model has garnered substantial recognition as a prominent emotional intelligence model (Mayer & Salovey, 2016). This model encompasses four discrete dimensions: perceiving, utilising, comprehending and regulating emotions.

Perceiving emotions: This dimension involves recognising and telling the difference between various emotions (Carusso et al., 2015). It also means figuring out how strong an emotion is and how long it lasts (Carusso et al., 2015). According to research, those who are good at perceiving emotions are better able to interpret facial expressions and speech tones, and they are also better able to identify when someone is deceiving them (Mayer et al., 2016). Lopes (2016) have found a link between recognising emotions and better social functioning, such as better interactions with others and a greater capacity for empathy.

Using emotions: This dimension is about using emotions to guide one's thoughts and actions to make good decisions to solve difficult problems (Ackley, 2016). It also means using good emotions to set goals and stay motivated and dealing with bad emotions so that one does not do something harmful or impulsive when upset (Elfenbein & MacCann, 2017). Individuals who are good at using their feelings can better deal with stressful circumstances, keep their positive connections and get through challenging situations (Elfenbein & MacCann, 2017).

Understanding emotions: This dimension involves the capacity to grasp the meaning and importance of one's emotions and the link between those emotions and one's thoughts and actions (Kewalramani et al., 2015). It also means being able to tell the difference between similar feelings and understanding the things that cause and change a person's emotions (Kelwalramani et al., 2015). Individuals with strong emotional intelligence are better able to control their own feelings, sympathise with

the feelings of others, and assist those going through difficult times (Di Fabio & Kenny, 2016).

Regulating emotions: This dimension involves the ability to manage and control one's own emotions to meet personal and professional goals and help others cope and control their emotions (Gross, 2015). It also includes being able to notice and control one's emotional responses and to use coping skills to control one's negative emotions (Tamir, 2016). Research has shown that those who are good at managing their emotions are better able to deal with stress (Grecucci et al., 2015) and maintain good relationships (Williams et al., 2018).

The Mayer and Salovey model of emotional intelligence has garnered significant attention and support from researchers, yet it has also faced criticism. Critics have contended that a substantial issue with the Mayer and Salovey model is the lack of a robust theoretical foundation for examining emotional intelligence (Razzaq et al., 2016). Some scholars contend that the Mayer and Salovey framework overemphasises the cognitive aspects of emotional intelligence and fails to consider the broader societal, cultural and environmental influences that impact emotional encounters (Drigas & Papoutsis, 2018). Van der Linden et al. (2017) contend that the four dimensions of the Mayer and Salovey model exhibit similarities with other cognitive abilities and personality traits, such as conscientiousness and agreeableness. The model has received criticism for representing a Western, individualistic viewpoint on emotions and emotional intelligence. This perspective may not hold relevance or significance in other cultural contexts, as emotional expression and regulation are subject to varying norms and expectations. (Gunkel et al., 2016).

Despite the criticisms directed towards the Mayer and Salovey model of emotional intelligence, it offers a comprehensive framework for comprehending emotional

intelligence. As researched by Castillo-Gualda et al. (2019), the Mayer and Salovey model holds a significant position among the various models of emotional intelligence owing to its extensive framework that facilitates the comprehension of cognitive processes that regulate emotions and interpersonal behaviour. The Mayer and Salovey model has been employed to investigate the role of emotional intelligence in diverse settings, such as leadership (Parrish, 2015; Doe et al., 2015), academic achievement (Thomas et al., 2017; MacCann et al., 2020) and psychological well-being (Li et al., 2015; Sharma et al., 2016).

3.5.2 Reuven Bar-On model

During the 1980s, Reuven Bar-On, a clinical psychologist and psychotherapist, developed a model of emotional intelligence through his research and developed the Emotional Quotient Inventory (EQ-i) (Bar-On & Dijk, 2022). The EQ-i model of emotional intelligence comprises 15 subscales categorised into five composite scales: self-perception, self-expression, interpersonal, decision-making, and stress management (Bar-On & Dijk, 2022).

Self-perception: This dimension refers to the ability to understand and accept oneself, including feelings, strengths, and limits (Ackley, 2016). It is also related to one's ability to understand and accept others. Emotional self-awareness, self-regard, and self-actualisation are all subscales that fall under this dimension (Ackley, 2016).

Self-expression: This aspect is about a person's ability to successfully and confidently express themselves verbally or nonverbally in any setting (Rastogi et al., 2015). Emotional expressiveness, assertiveness, and independent decision-making are all subscales that fall under this dimension (Rastogi et al., 2015).

Interpersonal: This dimension is about a person's ability to maintain good relationships with others (Aljazi & Alrekebat, 2019). It includes empathy, social responsibility, and skills related in making and keeping relationships (Aljazi & Alrekebat, 2019).

Decision-making: This dimension is about a person's ability to make good decisions based on intellectual and emotional factors (Tehranipour & Bagheri Masoudzade, 2023). Problem- solving, checking one's assumptions against reality, and exercising self-control are all subscales that fall under this dimension (Tehranipour & Bagheri Masoudzade, 2023).

Management of stress: This dimension pertains to a person's capacity to deal with stress and adapt to changing circumstances, including tolerance for stress and adaptability (Punia et al., 2015).

Bar-On's model of emotional intelligence has been criticised for not having strong construct validity, indicating that its subscales do not accurately capture the essence of emotional intelligence (Zhoc et al., 2017). Critics also argue that the Bar-On models subscales coincide with personality qualities like extraversion and neuroticism, suggesting that the model may evaluate personality rather than emotional intelligence (Di Fabio & Kenny, 2016). Another criticism of the Bar-On model is that it does not have a very good predictive ability for significant outcomes such as how well one does at work or school. The Bar-On model does not substantially predict work success above and beyond what can be explained by elements related to general intelligence and personality (Miao, Humphrey & Qian, 2017). Similarly, several studies have concluded that the Bar-On model offers only moderate insight into academic performance (Dawood, 2021).

Despite the criticisms, the Bar-On model of emotional intelligence has been significantly used in various sectors, including psychology, education, and business, among others, both in study and practice. It has been used to study the impact that emotional intelligence plays in areas including academic accomplishment, work performance and mental health (Sharma et al., 2017; Bar-On & Djik, 2022).

3.5.3 Goleman's model

Daniel Goleman introduced the concept of emotional intelligence in his book *Emotional Intelligence: Why It May Matter More Than IQ* published in 1995. The book significantly contributed to the widespread acceptance of emotional intelligence. The model formulated by Daniel Goleman initially categorised emotional intelligence into five distinct dimensions: self-awareness, self-regulation, motivation, empathy and social skills (Goleman, 2015). According to Goleman's model, achieving success in personal and professional domains necessitates excelling in these spheres. Following the publication of his book, Goleman's emotional intelligence model has been extensively researched and applied in various fields, including education, leadership development and organisational psychology. The five dimensions of emotional intelligence were later modified into four dimensions: self-awareness, self-management, social awareness and relationship management. These four dimensions of emotional intelligence proposed by Goleman (1998) are discussed in the following sub-sections.

3.5.3.1 Self-awareness

Self-awareness refers to awareness of one's emotions at work (Goleman, 2017) and is a critical leadership quality because it enables leaders to monitor their own emotions and their effects on the people around them. Self-aware leaders can see where to

improve and take the necessary steps (Goleman & Nevarez, 2018). According to Hassan et al. (2015), successful leaders have a high level of self-awareness, which helps them see opportunities for professional growth and progress. Studies have repeatedly shown a positive relationship between self-awareness and successful leadership. One such research is that of Caldwell and Hayes (2016), who showed that self-awareness positively correlates with leadership efficacy.

Several positive outcomes that have been linked to self-awareness include contentment in one's work environment, reduced stress levels, and the ability to strike a healthy work-life balance (Chung & Van Der Lippe, 2020). Furthermore, self-awareness has been regarded as an important part of effective leadership, highlighting the significance of self-awareness and ethical decision-making in the role of leaders (Koopman & Hakemulder, 2015). Self-awareness is a key component of emotional intelligence, and leaders must have a high degree of it to succeed in business and other institutional contexts (Koopman & Hakemulder, 2015). Leaders may benefit greatly from a deeper understanding of their own emotions and actions through the practice of self-awareness. As a result, they are better equipped to interact with one another, make sound decisions, and create a productive workplace (Chung & Van der Lippe, 2020).

3.5.3.2 Self-management

Self-management entails having the capacity to properly manage one's emotions and actions in the workplace (Goleman & Nevarez, 2018). Leaders with excellent self-management abilities can control their impulses, adapt to changing situations, and successfully handle stress, all of which are essential for effective leadership in organisations (Goleman, 2015). According to Goleman (2017), effective self-management requires several skills, including the capacity to exercise self-control

over one's emotions, to be transparent, adaptable, have an accomplishment orientation, take the initiative, and be optimistic. Leaders with these abilities can better control their emotions, keep calm when under pressure, keep their attention on the task at hand, and accomplish their objectives (Goleman, 2015).

Self-management has been shown to have a favourable relationship with successful business leadership. For instance, research conducted by Tse, Dasborough and Ashkanasy (2017) discovered that followers are more likely to believe that their leaders are successful if they demonstrate high levels of self-management. Similarly, a study conducted by Afsar, Badir and Kiani (2016) discovered that self-management is a positive predictor of transformational leadership. Self-management has also been shown to be associated with various good outcomes in businesses, such as performance, job satisfaction and organisational commitment (Afsar, Badir & Kiani, 2016; Tse et al., 2017). Strong self-management abilities enable leaders to successfully regulate their emotions and actions, resulting in a more pleasant work environment and greater employee well-being.

In conclusion, self-management is an essential aspect of emotional intelligence that is important to successful business leadership. This is because self-management is directly related to one's ability to control one's emotions. Leaders skilled in self-management can successfully regulate their feelings, thoughts and actions, resulting in improved outcomes for the leaders and the companies they serve.

3.5.3.3 Social awareness

Social awareness pertains to an individual's ability to identify and comprehend the emotions of others. According to Goleman (2015), leaders who exhibit social awareness can identify and demonstrate empathy towards their subordinates'

feelings. Social awareness entails competencies such as empathetic comprehension, understanding organisational dynamics and dedication to service (Goleman, 2017). A leader possessing these attributes demonstrates the capacity to comprehend the emotions of their subordinates effectively, understand their desires and apprehensions and leverage this insight to foster relationships and cultivate a positive work atmosphere (Goleman, 2017).

Previous studies have discovered a correlation between social awareness and successful leadership within firms. According to Wang, Chen and Lu (2018), leaders who exhibit elevated levels of social awareness are perceived as more successful by their subordinates. Alon and Higgins (2015) conducted a study that revealed social awareness as a positive predictor of transformational leadership.

Studies have demonstrated a positive association between social awareness and employee job satisfaction, organisational loyalty and productivity (Alon & Higgins, 2015; Wang et al., 2018). Leaders who demonstrate exceptional social awareness skills are better equipped to effectively interact with their subordinates, resulting in enhanced relationships and a more favourable work environment (Wang et al., 2018). In conclusion, social awareness is an essential component of emotional intelligence important to successful company leadership. Leaders equipped with excellent social awareness abilities can better sense and comprehend the feelings and requirements of their followers, which ultimately results in improved outcomes for both the leaders and the organisations they serve.

3.5.3.4 Relationship management

According to Goleman (2015), relationship management refers to the proficient management of relationships with others, which encompasses the skills of influencing,

collaborating and fostering strong bonds with followers. Experienced leaders in relationship management can foster a positive work environment, enhance the confidence of their followers, and effectively manage issues and conflicts within their organisation (Goleman, 2015). Goleman (2017) attests that effective relationship management necessitates acquiring several skills, including but not limited to communication, conflict resolution and teamwork. Leaders who exhibit these characteristics can communicate proficiently with their subordinates, adeptly manage conflicts and effectively cultivate collaboration, culminating in enhanced relationships and superior outcomes for their enterprises (Goleman, 2015).

Based on prior research, it has been determined that proficient leadership is positively correlated with successful relationship management within business contexts. Kong and Huang (2015) found that leaders who exhibit strong relationship management skills are more likely to be perceived as successful by their followers. According to Goleman (2017), relationship management is demonstrated as a reliable indicator of transformational leadership which prioritises inspiring and motivating followers. Furthermore, the management of relationships has been linked to a range of positive outcomes in the business environment, including employee job satisfaction, organisational commitment and performance (Kong & Huang, 2015; Goleman, 2017). In conclusion, the effective management of relationships is a crucial aspect of emotional intelligence that is imperative for achieving successful leadership in the corporate world. Professionally skilled leaders possess effective relationship management abilities that enable them to adeptly handle their interactions with others, resulting in enhanced outcomes for themselves and the organisations.

3.5.3.5 Criticisms of Goleman's model

Critics argue that Goleman's model is based on anecdotal evidence rather than rigorous scientific research (Lopes et al., 2012; Petrides & Furnham, 2014). The model is also criticised for lacking clarity and consistency, especially regarding how the many facets of emotional intelligence are defined and evaluated (Saklofske et al., 2012). Goleman's model is also criticised for relying mostly on self-report measures, which are subjective and prone to biases such as social desirability and response styles (Zeidner et al., 2012). Critics also argue that Goleman's approach gives an overly simplified perspective on emotions, concentrating exclusively on the positive aspects of such feelings while disregarding the possible adverse effects of emotional regulation (Zeidner et al., 2012).

3.5.3.6 Justification for adopting Goleman's model in this study

Several studies have used Goleman's emotional intelligence model to examine the relationship between emotional intelligence and various outcomes such as job performance, job satisfaction, leadership effectiveness and team productivity. Several studies have found a positive relationship between leader emotional intelligence and work-related outcomes such as job performance (Côté & Miners, 2015; Law, Wong & Song, 2021), job satisfaction (Garca-Sancho, Salguero & Fernández-Berrocal, 2019), and effective leadership (Garca-Sancho, Salguero & Fernández-Berrocal, 2019). Based on prior research, a positive correlation exists between emotional intelligence and team performance (Gao, Greenberg & Wong-On-Wing, 2015; Wang et al., 2021).

Research has demonstrated that emotional intelligence in leaders can potentially enhance the work performance of employees across various sectors, including the manufacturing industry (Gupta & Bamel, 2015). The positive behaviour of leaders can

potentially have a positive impact on the climate of an organisation, consequently influencing the job performance of employees (Cote & Miners, 2015). Developing a positive emotional work climate can result in increased productivity, improved job satisfaction and higher levels of employee motivation (Law et al., 2021). Understanding the interconnections among leaders' emotional intelligence and behaviour, organisational emotional climate, and employee job performance is crucial in devising effective leadership strategies within South Africa's 3D printing industry. Goleman's emotional intelligence model is relevant for examining the interrelationships among the emotional intelligence of leaders, leader emotional behaviour, the emotional climate within organisations and the employees' job performance in the South African 3D printing industry.

3.6 Emotional behaviour

According to Heath and Heath (2017), emotional behaviour pertains to observable and measurable displays of emotions that are evident to others. Forgas, Haslam and Laham (2016) argue that emotional behaviour refers to an individual's conduct and social interactions influenced by their present emotional state. Mayer, Salovey and Caruso (2016) state that emotional behaviour refers to the outward expression of emotional states through observable actions, such as facial expressions, body language and tone of voice. The definitions mentioned above are characterised by focus on the outward manifestation of emotions through an individual's behaviour, encompassing non-verbal cues such as facial expressions, gestures and vocal intonation. An individual's emotional state can significantly influence their behavioural patterns, which can be assessed and evaluated through various observable indicators.

Based on these definitions, this study defines emotional behaviour as the outward expression of an individual's emotional state through observable behaviours such as facial expressions, body language and tone of voice, which are influenced by their emotional state and can be quantified and measured through these observable indicators.

3.7 Defining leadership

Northouse (2015) defines leadership as the skill of persuading and guiding the thoughts and behaviours of others to achieve organisational goals. According to Chemers (2014), leadership can be defined as the ability to motivate and guide individuals towards achieving a common goal. Carter et al. (2020) define leadership as a social process in which an individual intentionally exerts influence over others to guide, coordinate and facilitate activities and relationships within a group or organisation. Avolio and Gardner (2018) describe leadership as the capacity to envision a better future, effectively communicate that vision and inspire and motivate others to actively participate in achieving that vision. According to Yull (2016), leadership is defined as a social influence process that aims to maximise the collective efforts of individuals towards attaining a common goal or vision.

The definitions of leadership are similar in that they emphasise persuading or motivating people to work toward a shared goal or vision. They also highlight the social dimension of leadership, focusing on the leader's interactions with their followers. Yet, there are some distinctions between these definitions. Some definitions, for example, highlight the leader's capacity to organise and structure activities and relationships (Carter et al. 2020), while others emphasise the significance of articulating and conveying a vision (Avolio & Gardner, 2018).

Based on the definitions, the study defines leadership as the ability to influence and inspire people towards achieving a shared objective or vision while simultaneously cultivating an atmosphere that encourages development, creativity and cooperation. Leadership in the 3D printing industry in South Africa would therefore entail guiding and motivating employees towards producing high-quality 3D-printed products and cultivating a culture of creativity and collaboration that enables the development of innovative new products and processes.

3.8 The role of leadership in organisations

Leaders play an essential role in developing and conveying an enticing vision for the business, inspiring and encouraging people to work together towards achieving a shared objective (Lucia & Achua, 2015). According to Foss and Lindenberg (2015), leaders with a strong vision are more likely to create a shared identity among employees and foster a sense of belonging in the organisation. This sense of belonging is a direct result of the leader's ability to inspire followers to buy into the organisation's mission and values (Foss & Lindenberg, 2015). The leaders of an organisation are responsible for formulating and carrying out a strategic plan that aligns with the business's vision and purpose (Lucia & Achua, 2015). According to Kellerman and Rhode (2017), successful leaders must anticipate and respond to changes in the business environment and develop strategies that enable the company to achieve its goals. Leaders must motivate and inspire their teams for employees to reach their maximum potential and contribute to the company's success (Kellerman & Rhode, 2017). Avolio and Yammarino (2015) state that leaders are more likely to achieve high levels of employee engagement and performance if they can foster a favourable work environment and a feeling of empowerment and autonomy among their workforce. Additionally, leaders who can encourage a culture of positivity at work and promote independence and empowerment among staff members are more likely to succeed (Avolio & Yammarino, 2015).

The ability to drive change across a company and establish a culture of innovation and ongoing improvement is an essential skill for leaders. According to Kotter (2015), successful change management involves strong leadership abilities. These qualities include the capacity to convey the necessity of change, create support among stakeholders and promote the adoption of new processes and procedures (Kotter, 2015). To ensure the organisation's continued success over the long term, effective leaders must cultivate and sustain strong relationships with their employees, customers, suppliers and other stakeholders (Nahavandi, Denhardt and Denhardt, 2015). The most effective way for leaders to influence others is to set a good example by acting ethically and taking responsibility. According to Trevio, Hartman and Brown (2015), ethical leadership is essential for establishing confidence and credibility among stakeholders and workers and maintaining the organisation's continued viability over the long term. Leaders have a responsibility to invest in their staff's professional progress and make opportunities for learning and advancement available. Research conducted by Avolio, Zhu, Koh and Bhatia (2015) found that leaders who prioritise employee development have a greater chance of fostering an environment that encourages innovative thinking, attracting and keeping top talent and achieving success over the long run.

The field of 3D printing in South Africa has been expanding quickly over the last several years and strong leadership has the potential to play a pivotal role in developing and promoting the industry. Leaders can articulate a specific plan for developing the 3D printing industry in South Africa and motivate stakeholders to work towards realising that plan. Leaders may help promote innovation, attract investment and develop collaborations by clearly defining the industry's long-term vision and communicating it to others. The formulation and execution of a strategy plan for the

3D printing industry in South Africa may be greatly aided by the contributions of industry leaders.

3.9 Emotional intelligence in leadership

This section discusses leader emotional intelligence and relates it to the 3D printing context. Leaders' positive emotional behaviour (e.g. vigour and friendliness) and negative behaviour (e.g. anger, depression, confusion/bewilderment, fatigue/strain and anxiety/tension) are discussed. Finally, the section provides literature on determinants of leaders' emotional intelligence, which comprises interpersonal and intrapersonal abilities, stress management and effective communication.

3.9.1 Leader emotional intelligence

According to Kashani (2019), a leader's ability to effectively regulate emotions while interacting with subordinates shows their emotional intelligence. A key component of effective leadership is emotional intelligence and a leader must monitor their followers' emotions to try to manage them (Kashani, 2019). Emotional intelligence includes the fundamental ability to control these emotions effectively (Kelly & Kaminskeine, 2016). The four key facets of a leader's emotional intelligence are self-awareness, self-management, social awareness, and relationship management.

Self-awareness is the ability to comprehend one's feelings and needs, wants and motivations (Goleman, 2015). Self-aware leaders can confess their errors to themselves and others since they are candid (Goleman, 2014). Self-aware leaders behave in a particular manner to realise their principles, objectives and aspirations (Goleman, 2017). Generally, a leader's self-awareness also requires intuition and

vision to analyse one's strengths and weaknesses regarding values, objectives and emotions (Goleman & Nevarez, 2018). Self-awareness is crucial for leaders to navigate the complex and fast-changing environment in the South African 3D printing industry effectively.

Having self-control over one's emotions at work is referred to as self-management (Goleman, 2015). Since it liberates individuals from being held captive by their own emotions, the capacity for self-management is a crucial aspect of emotional intelligence (Drzewiechka & Roczniowska, 2018). Given how readily negative emotions may spread across an organisation, particularly among a leader's subordinates, the capacity to manage one's sentiments and feelings is a crucial element of emotional intelligence (Goleman, 2014). Only leaders who have mastered self-management can learn emotional management (Ferguson & Rivera, 2021). By using one's self-knowledge to regulate and impact one's emotions, self-control, trustworthiness, conscientiousness, motivation, adaptability and invention may all be enhanced (Goleman, 2014). Leaders in the South African 3D printing sector must have strong self-management skills to effectively manage their teams and make strategic decisions.

Leaders with a high degree of social awareness (empathy) are more likely to be open about the differences between cultures, which is critical to the success of a leadership team (Goleman, 2017). Employee-employer relationships benefit from a higher level of social awareness (or empathy), according to Miao, Humphrey and Qian (2016). Additionally, a successful leader must be able to see the world from the perspective of others (Makkar & Basu, 2019). Therefore, effective leadership requires leaders to develop empathy (Goleman, 2017). According to the social awareness dimension of emotional intelligence, it is essential for a leader to be aware of both the situation and the level of comprehension of their followers (Makker & Basu, 2019). Empathy is the

most readily apparent aspect of emotional intelligence (Goleman, 2014). When it comes to the 3D printing industry in South Africa, having strong social awareness is essential for leaders who seek to develop good connections with their workers, customers and suppliers. Leaders in this industry need to comprehend their stakeholders' needs and expectations and cultivate solid relationships with them. Leaders with a high degree of social awareness are in a better position to understand the needs and expectations of their clients.

Managing relationships effectively comes down to knowing how to deal with the feelings of others (Goleman & Nevarez, 2018). Emotional intelligence includes social skills, which are not as easy to develop as they seem. For leaders to be effective, they need to understand their own emotions and can empathise with the people they lead, whether it is a new project or an agreement on a marketing strategy. Authenticity, then, is the first step in mastering the art of relationship management (Goleman, 2014). Emotional intelligence can positively impact relationship management in the 3D printing industry in South Africa by fostering better collaboration and communication among team members and stakeholders. Leaders' emotional intelligence is crucial in developing team cooperation and effective communication, ultimately improving project results. Emotional intelligence is significant in managing relationships with customers, vendors and other stakeholders. Furthermore, the study found that leaders with a high level of emotional intelligence were better able to manage complex relationships and foster positive outcomes in the 3D printing sector.

3.9.2 Leader emotional behaviour

Leader emotional behaviour refers to how leaders express and manage their emotions in the workplace. It is widely recognised that the leader's emotional behaviour can significantly impact employee well-being, job satisfaction and organisational

performance (Goleman, 2017). Gooty, Gavin, Johnson, Frazier and Snow (2015) argue that leaders' emotional behaviour may have a considerable impact on the levels of work satisfaction, organisational commitment and job performance of employees. As such, when leaders displayed positive emotions in the workplace, such as enthusiasm, excitement and optimism, workers reported greater job satisfaction and loyalty to the firm. However, employees reported lower work satisfaction and organisational commitment when leaders demonstrated negative emotions such as anger, impatience and anxiety.

Kiazad, Seibert and Kraimer (2018) also investigated the connection between leaders' emotional behaviour and their employees' well-being. The results indicated that workers working for managers who demonstrated good emotional behaviours, such as empathy, compassion and thankfulness, reported better levels of psychological well-being and greater job satisfaction. On the other hand, employees who worked under leaders who displayed negative emotional behaviours, such as wrath, hostility and anxiety, reported having poorer levels of psychological well-being and lower levels of satisfaction with their jobs.

Tummers, Landweerd and Van Merode (2016) also researched the link between the emotional behaviour of leaders and the effectiveness of organisations. According to the research findings, organisations led by individuals who displayed good emotional behaviours, such as friendliness, warmth and approachability, had greater customer satisfaction, innovation and financial success. On the other hand, leaders who displayed negative emotional behaviours in their firms, such as hostility, detachment, and insensitivity, had lower levels of customer satisfaction, innovation and financial performance.

In this section, the study discusses negative emotional behaviours (anger, confusion or bewilderment, depression, fatigue or strain, and anxiety) and positive emotional behaviours such as vigour and friendliness, and their implications in the 3D printing environment in South Africa.

3.9.2.1 Anger

Anger is a negative emotion that can significantly impact a manager's performance in the workplace (Stollberger et al., 2020). According to Yang (2022), workplace anger may lead to lower creativity and innovation. The result also showed that managers who are angry are less likely to create new ideas and innovative solutions, which may have a detrimental influence on organisational performance (Yang, 2022). Stollberger et al. (2020) attest that anger may lead to biased decision-making, with managers more likely to judge based on their emotions rather than objectivity. This may lead to poor decision-making and unfavourable organisational effects (Stollberger et al., 2020). Employees are more likely to feel job discontent and lower organisational engagement when supervisors display anger in the workplace (Renstrom & Back, 2021). Furthermore, managers who experience workplace anger are more likely to develop burnout, which may lead to poor job performance and greater attrition (Renstrom & Back, 2021). Finally, anger as a negative leader emotional behaviour may have a substantial influence on a manager's workplace performance, leading to decreased creativity and innovation, biased decision-making, decreased employee job satisfaction and organisational commitment, and increased burnout (Renstrom & Back, 2021).

In the South African 3D printing industry, leaders with high levels of emotional intelligence may be more adept at handling workplace anger and minimising its adverse effects on employee job performance. Through proficient regulation of their

emotions, these leaders can establish a favourable work atmosphere that cultivates inventiveness, originality and professional judgment. Organisations can create a work environment that fosters transparent communication and motivates staff members to express their apprehensions and suggestions without the risk of retaliation. This phenomenon can result in increased levels of employee engagement, job satisfaction and reduced instances of burnout.

3.9.2.2 Confusion/bewilderment

Confusion or bewilderment as negative leader emotional behaviour can significantly affect a manager's workplace performance (Krumm et al., 2018). According to Diefendorff, Erickson and Grandey (2016), manager confusion or ambiguity might lead to lower work satisfaction and higher job stress. Therefore, managers who are unsure about their duties or tasks are less likely to be content with their positions and are more susceptible to stress (Diefendorff et al., 2016).

Krumm et al. (2018) investigated the influence of confusion on workplace communication. According to the research, when managers are confused or bewildered, they are less likely to communicate effectively with their staff, resulting in misunderstandings and decreased productivity. Furthermore, Van Kleef, De Dreu and Manstead (2015) evaluated the effect of confusion on managers' decision-making abilities. According to the research, when managers are confused, they are more likely to make inconsistent or biased judgments, which may have a detrimental impact on the firm. Fröhlich, Martinez and Richter (2018) also investigated the influence of confusion on managers' emotional exhaustion. According to the research, managers who are confused or bewildered are more likely to feel emotional tiredness, which may lead to poor work performance and greater attrition.

In turn, when leaders with high emotional intelligence effectively manage their confusion or bewilderment and maintain their job performance, it can positively impact employee job performance in the 3D printing sector in South Africa. Employees are more likely to receive clear communication, consistent decision-making and a supportive work environment, which can contribute to their job satisfaction, motivation and productivity. Thus, leaders' emotional intelligence can be crucial in promoting optimal job performance and well-being in the workplace, even in the face of confusion or bewilderment.

3.9.2.3 Depression

Leaders who experience depression often exhibit a range of symptoms that can significantly impact their job performance. Poor concentration is a common symptom of depression, making it challenging for leaders to stay focused on tasks and make informed decisions (Eby et al., 2016; Kessler et al., 2015). Decreased motivation may reduce enthusiasm for work-related projects, resulting in a lack of drive and initiative (Bakker et al., 2015; Eby et al., 2016). Restlessness and irritability, often associated with depression, can affect a leader's ability to interact with customers, coworkers and team members in a positive and professional manner, leading to strained interpersonal relationships (Bakker et al., 2015; Kessler et al., 2015). Additionally, the reduced ability to make decisions, a cognitive symptom of depression, can impair a leader's ability to make timely and effective decisions. (Bakker et al., 2015; Eby et al., 2016).

Emotional intelligence can play a crucial role in addressing the impact of depression on a leaders' job performance in the 3D printing sector in South Africa. Leaders with high levels of emotional intelligence can recognise and regulate their emotions to help them manage their symptoms of depression and maintain their job performance. For

example, leaders with high emotional intelligence can use positive coping mechanisms to manage their stress levels and prevent depression from affecting their work performance.

3.9.2.4 Fatigue/strain

Leadership positions often come with high demands and responsibilities that can lead to tiredness, fatigue and exhaustion. These symptoms of strain are prevalent among workplace leaders and can significantly affect their job performance and overall well-being (Steege et al., 2017). The continuous experience of fatigue and strain can have severe physical consequences, including high blood pressure and cardiovascular disease (Dorhrmann et al., 2019). As a result, it is crucial for leaders to manage their levels of strain to maintain optimal health and productivity.

Additionally, when leaders display indications of stress, it can impact the way their subordinates perceive the objectives and undertakings of the organisation. According to Steege et al. (2017) leaders who exhibit elevated levels of strain communicate to their staff that the organisation's pursuits necessitate substantial personal exertions. This perception can lead employees to believe that organisational goals are challenging and require a high level of effort to achieve. However, employees may only be motivated to invest the required effort if they have a high drive and a propensity to take risks (Steege et al., 2017; Dorhrmann et al., 2019).

In the 3D printing sector in South Africa, leaders with high emotional intelligence can play a crucial role in managing their strain and exhaustion levels while also fostering employee well-being and job performance. They can create a supportive work environment that promotes open communication and collaboration while implementing strategies to reduce employee strain and exhaustion. By doing so, they

can improve employee motivation, engagement and job satisfaction, leading to higher levels of organisational performance.

3.9.2.5 Anxiety/tension

Anxiety is a psychological condition characterised by an uncontrollable and negatively affective chain of thoughts and images (McCarthy et al., 2016). It often causes distress, insecurity and an aversion to uncertainty (McCarthy et al., 2016). In the context of leadership, anxiety can be understood as the result of attempting to solve problems with uncertain but potentially negative outcomes. Leaders who display signs of anxiety may communicate to their employees that the progress of the organisation's goals is uncertain and possibly negative (Cheng & McCarthy, 2018). When employees perceive their leaders as anxious, it can have a negative impact on their motivation and engagement levels. Leaders who frequently express their anxiety can lead employees to attribute more uncertainty and risk to the organisation's goals. This perception can cause employees to become less motivated and more averse to taking risks, leading to decreased organisational performance (Wang et al., 2021).

Therefore, leaders must manage their anxiety levels and communicate their concerns effectively to their employees. Leaders can do this by providing their employees with a clear understanding of the challenges they face and developing effective strategies to address them (Schwarzmueller et al., 2018). Additionally, leaders can create a supportive work environment that encourages employees to express their concerns and ideas, thereby fostering a culture of open communication and collaboration (Schwarzmueller et al., 2018). Individuals who possess strong emotional intelligence are more adept at regulating their anxiety levels and exhibiting effective communication with their subordinates within the 3D printing industry in South Africa. Individuals with emotional intelligence exhibit proficiency in recognising and managing

their own emotions and demonstrate enhanced aptitude in comprehending the feelings of their subordinates. This enables them to establish a conducive work milieu that fosters open communication and support, resulting in improved job performance and heightened employee engagement.

3.9.2.6 Vigour/activity

Vigour is a constructive emotional experience that encompasses a feeling of robust physicality and emotional vitality experienced in one's work environment (Scotto di Luzio et al., 2019). There is a positive connection between emotional intelligence and vigour (Lan, Zhang, & Wang, 2015). Emotional intelligence can influence vigour in that being able to recognise and regulate one's own and other people's emotions effectively results in higher levels of experienced vigour (Kumar & Srivastava, 2015). In other words, emotionally intelligent leaders who can manage their feelings effectively are more likely to experience high levels of vigour (Kumar & Srivastava, 2015).

Furthermore, it can be argued that high levels of vigour promote emotional intelligence (Lan et al., 2015). When individuals experience high levels of vigour, they are more likely to be motivated, engaged and proactive in their work, leading to greater success in managing emotions and relationships with others. In the 3D printing sector, where creativity and innovation are key, emotionally intelligent leaders who exhibit high vigour may be particularly effective. These leaders may be better able to inspire and motivate their team members to think creatively and take risks, leading to increased innovation and success in the sector. Additionally, leaders emotionally intelligent leaders who exhibit high vigour may be better equipped to manage the high-pressure environment of the 3D printing sector, leading to improved job performance and overall success.

3.9.2.7 Friendliness

Workplace friendships can yield substantial positive effects on both individuals and organisations. According to Methot et al. (2016) workplace friendships can enhance job satisfaction, foster organisational commitment and promote overall well-being. In addition, it has been noted that friendliness in the workplace can improve communication, collaboration and trust among team members, resulting in improved problem-solving and decision-making abilities (Sias & Shin, 2019). Additionally, studies have shown that workplace friendships are associated with reduced employee turnover rates (Al Mamun & Hasan, 2017). Research suggests that employees who maintain strong interpersonal connections with their colleagues are more inclined to remain with their current employer due to a heightened loyalty and commitment to the organisation and its workforce. Interpersonal relationships can aid employees in assimilating new organisational values and standards, particularly in periods of transition or ambiguity (Al Mamun & Hasan, 2017).

In addition, friendships at work can provide instrumental and emotional support. Colleagues can offer help and advice with work-related tasks, share information and resources and serve as mentors or role models (Colbert et al., 2016). Emotional support can include providing a listening ear, offering encouragement and reassurance and being a source of empathy and understanding. This emotional support is particularly important during times of stress or when facing difficult situations at work (Craig & Kuykendall, 2019). Lastly, workplace friendships can also protect individuals from workplace bullying. Employees who have strong relationships with their colleagues are less likely to be the targets of workplace bullying, and if they are targeted, they are more likely to receive support and protection from their friends (Hsu et al., 2019).

In the 3D printing sector in South Africa, leaders with high emotional intelligence can foster workplace friendships by creating a positive and supportive work environment. They can encourage teamwork, communication and collaboration and model respectful and empathetic behaviour. Leaders can also facilitate social interactions outside work, such as team-building activities or social events, to encourage colleagues to build meaningful relationships. By promoting workplace friendships, leaders can help improve organisational outcomes and create a more positive and productive work environment.

3.9.3 Determinants of leaders' emotional intelligence

This section provides literature on the determinants of leaders' emotional intelligence including intrapersonal ability, interpersonal ability, stress management and effective communication. The selection of these variables as key factors influencing leaders' emotional intelligence is grounded in existing literature, which underscores the significance of intrapersonal skills (Bese & Dali, 2021; Ingram et al., 2019) and interpersonal abilities (Moradi et al., 2018; Bae et al., 2019) among emotionally intelligent leaders. Additionally, the literature highlights the importance of effective stress management and communication with subordinates as integral components of emotional intelligence in leadership (Desa et al., 2018; Stokes, 2019).

In the context of the 3D printing sector in South Africa, the identified determinants of leaders' emotional intelligence hold significant implications. Intrapersonal skills are crucial for leaders to navigate the dynamic 3D printing landscape, requiring self-awareness for informed decision-making. Interpersonal abilities gain added importance for fostering innovation through collaboration and relationship-building. Effective stress management becomes a critical asset due to the rapid evolution of 3D printing technologies and associated challenges. Adept communication with

subordinates is vital for ensuring a cohesive and efficient work environment, contributing to the overall growth and success of the 3D printing industry in South Africa.

3.9.3.1 Intrapersonal ability

Intrapersonal ability refers to an individual's capacity to understand oneself and effectively manage emotions, thoughts and behaviour to achieve personal goals. Okwuduba, Nwoso, Okigbo, Samuel and Achugbu (2021) have posited that intrapersonal ability encompasses self-awareness, reflection and efficient planning. In the context of leadership, intrapersonal abilities hold significant relevance. Leaders must possess a keen sense of self-awareness, managing their emotions and thoughts to effectively guide their team while being cognisant of their strengths and weaknesses.

In the 3D printing sector, managers with emotional intelligence are better equipped to navigate the industry's challenges. For example, they may handle the stress and pressure of meeting tight deadlines or managing complex projects more effectively than those lacking emotional intelligence. They may also be more adept at building positive relationships with employees, clients and stakeholders, leading to greater collaboration and productivity.

One key aspect of intrapersonal ability is emotional awareness, which refers to an individual's ability to accurately recognise and label their emotions. Bese and Dali (2021) note that emotional awareness is crucial for leaders to understand their own emotional states and respond effectively to the feelings of others. For example, leaders aware of their emotions can recognise when they are feeling stressed or overwhelmed and take steps to manage their stress levels to prevent burnout. In addition to emotional awareness, intrapersonal ability also involves effectively

expressing and communicating one's feelings and needs. Ingram et al. (2019) suggest that leaders who can share their emotions and needs effectively can build stronger interpersonal relationships with others. Effective communication allows leaders to manage conflicts and negotiate effectively in group settings.

Finally, managers with high emotional intelligence are more likely to be self-aware, which can help them identify their strengths and weaknesses as leaders. By recognising their emotional triggers and areas for improvement, they can take steps to manage their emotions and develop more effective communication and leadership skills.

3.9.3.2 Interpersonal ability

The capacity to effectively interact with others is a vital element of emotional intelligence, especially for individuals leadership positions within the 3D printing sector. The concept of interpersonal ability pertains to an individual's capacity to engage with others, encompassing colleagues, subordinates and superiors (Moradi et al., 2018). The skill set entails the capacity to identify and regulate the emotions of individuals, coupled with the ability to empathise with their emotional states (Bae et al., 2019). Individuals with strong interpersonal skills are more likely to succeed in their positions within the 3D printing sector. They possess enhanced abilities to construct efficient teams, cooperate with peers and communicate proficiently. Interpersonal ability can be attributed to individuals' ability to comprehend the sentiments of others and leverage this understanding to cultivate favourable associations and establish a constructive professional environment (Vyatkin et al., 2019).

Interpersonal ability is a crucial aspect of effective leadership. Leaders with strong interpersonal skills are better equipped to communicate effectively with their team members, thereby enhancing their overall communication skills. According to Moradi et al. (2018), individuals who can actively listen, remain receptive to feedback and offer constructive criticism when appropriate are considered proficient in these areas. In addition, possessing strong interpersonal skills is crucial for effectively attaining the objectives of an organisation by using its personnel. According to Hamid et al. (2019), leaders who exhibit strong interpersonal skills are more capable of motivating and inspiring their teams, leading to increased productivity and overall success for the organisation.

In conclusion, interpersonal ability is critical to a leader's emotional intelligence in the 3D printing industry. Leaders with high levels of interpersonal ability are better equipped to build effective teams, communicate effectively and achieve organisational goals through their workforce. As such, developing interpersonal abilities should be a key focus for leaders in the 3D printing industry.

3.9.3.3 Stress management

Stress management is an essential aspect of a leader's emotional intelligence, as it affects their ability to manage their emotions and those of their employees (Holman et al., 2018). In the current workplace environment, leaders are exposed to various stressors that can significantly affect their performance and that of their employees (Stokes, 2019). These stressors include work overload, pressure to deliver on time, writing reports, supervising subordinates and managing negative employee behaviour (Stokes, 2019). Effective stress management on the part of leaders involves their ability to withstand stressors in the working environment and still remain efficient in discharging their duties (Desa et al., 2018). Leaders who can manage stress in the

workplace can remain calm and work effectively under pressure to achieve the firm's goals through their employees (Desa et al., 2018). Therefore, effective stress management is critical to a leader's emotional intelligence.

As the 3D printing industry continues to emerge through the commercialisation of 3D products, leaders of 3D printing firms must exhibit emotional intelligence through effective stress management (Desa et al., 2018). These leaders should be able to manage the stressors associated with the 3D printing industry and remain calm and focused on achieving organisational goals (Holman et al., 2018). By doing this, leaders can implement the commercialisation agenda of their firms through their employees by producing 3D printing products that meet and exceed the consumers' expectations. Leaders must also possess effective stress management skills to remain calm and focused amidst various stressors associated with the industry, thereby achieving the firm's goals through their employees.

3.9.3.4 Effective communication

Effective communication is a crucial element of a leader's emotional intelligence and is essential for successful leadership in the 3D printing sector in South Africa. According to Turaga's (2019) research, proficient communication is a vital component of emotional intelligence that promotes successful leadership. Touhidul and Sorooshian (2019) argue that individuals in leadership positions who exhibit high levels of emotional intelligence typically show greater transparency in their communication, fostering a workplace culture that encourages employees to freely express their opinions. Leaders can foster a positive workplace culture that promotes teamwork and collaboration by facilitating open communication, which creates a sense of inclusivity.

In addition, a leader who exhibits emotional intelligence is attentive to non-verbal signals such as facial expressions, vocal intonation and physical gestures during their interactions with their team members (Rajhans, 2018). Efficient leaders possess the ability to perceive the emotional condition of their personnel and respond appropriately, thereby augmenting communication and fostering positive relationships within the organisation. Leaders who engage in effective communication and proactively seek employee feedback can cultivate a sense of commitment and accountability among employees, thereby achieving organisational goals (Zorlu & Korkmaz, 2021; Khanna, 2020).

Effective communication is crucial for leaders in the 3D printing industry in South Africa, as it is essential in fostering a positive work environment that encourages creativity and innovation. Leaders who demonstrate high levels of emotional intelligence possess the capacity to inspire and motivate their team members, leading to increased productivity and improved organisational success. Leaders with emotional intelligence can cultivate transparent communication and build strong connections with their staff members by establishing a constructive and all-encompassing workplace atmosphere. This has the potential to substantially contribute to the organisations' success in the 3D printing environment.

3.10 Organisational emotional culture/climate

The concept of the emotional climate of the organisation has been used to examine the impact of collective emotions on organisational outcomes. According to Maamari and Majdalani (2017), the emotional climate of the organisation refers to how members of an organisation perceive the emotional atmosphere of their workplace, including the emotions of their colleagues, their job tasks, the organisation itself and its management. Emotional climate of the organisation has been identified as a sub-

category of organisational climate, defined as the shared perceptions of employees about their work environment (Ashkanasy & Dorris, 2017).

Research has suggested that the emotional climate of the organisation can be used to better understand employee behaviour and its impact on organisational outcomes. For instance, Park and Seo (2017) found that the emotional climate of the organisation was a reliable variable in predicting organisational effectiveness and that higher levels of positive emotions within the organisation were associated with better employee outcomes such as job satisfaction, commitment and performance. In this section, four types of emotional climate of the organisation are discussed: joy, love, fear and sadness.

3.10.1 Organisational emotional climate of love

Companionate love is a unique emotion that goes beyond self-focused positive emotions and centres on interdependence and sensitivity towards others (Yang & Hung, 2015). It is characterised by affection, compassion, caring and tenderness for others and is considered a fundamental emotion that plays a crucial role in the human experience (O'Neill & Rothbard, 2017).

According to Barsade and O'Neill (2014), organisational emotional climate of love is frequently characterised as enhancing social connections and preserving interpersonal associations. The development of an emotional climate of love serves as a means to promote social unity and collaboration among individuals, thereby augmenting their capacity to function collectively in the organisation (Yang & Hung, 2015). Like other emotions, companionate love can be expressed through multiple channels such as facial expressions, vocal tone, body language, touch, physiological sensations, subjective experience, cognitive appraisal and behavioural action

tendencies (Yang & Hung). Companionate love in organisations encompasses not solely the individual's perception of fondness and concern towards others, but also the manifestation of these emotions through verbal and nonverbal cues. Studies have indicated that companionate love within a workplace environment can benefit employees and organisations. According to O'Neill and Rothbard (2017), when leaders and subordinates demonstrate care, support and appreciation towards employees, it results in higher levels of engagement, commitment and job satisfaction. According to Yang and Hung (2015) companionate love in organisational climates can improve team dynamics, resulting in improved collaboration, communication and teamwork. Additionally, research suggests that employees who experience companionate love within the workplace are more inclined to exhibit prosocial behaviours such as offering assistance, providing support and collaborating with colleagues (Barsade & O'Neill, 2014).

In the 3D printing sector in South Africa, leaders who exhibit emotional intelligence and foster an emotional climate of companionate love may contribute to improved employee job performance. Leaders who express and model emotions such as compassion, caring and tenderness towards their employees may facilitate a sense of connection and commitment among team members. This emotional climate may increase positive emotions such as happiness, satisfaction and contentment, which can translate into better job performance (Yang & Hung, 2015). Research has shown that employees who feel cared for by their leaders have higher job satisfaction, organisational commitment and engagement (O'Neill & Rothbard, 2017). In addition, companionate love in the workplace may lead to lower employee turnover rates, higher job performance and greater customer satisfaction (Barsade & O'Neill, 2014). Leaders who are emotionally intelligent and promote companionate love in the workplace may create a work environment that fosters positive emotions and

interpersonal connections, which can lead to better job performance and business outcomes in the 3D printing industry in South Africa.

3.10.2 Organisational emotional climate of joy

An emotional climate of joy is characterised by the predominance of positive emotions, especially joy, supported by joy-related moods like feeling happy, pleased, content and pride (Barsade & Knight, 2015). This emotional climate is associated with a strong urge to play, push limits and be creative, which promotes the development of innovative solutions to problems faced by the team (Hartman et al., 2021).

Research has shown that an emotional climate of joy emerges during good times for the team, such as when they successfully launch a new product after obtaining internal funding and gaining approval from different layers of their hierarchy (Morselli, 2017). Team members are positively reinforced, eliciting joy and emotions like elation and satisfaction. Typical behaviours associated with an emotional climate of joy include collectively celebrating successes and achievements, strengthening team bonds and promoting positive relationships among team members (Morselli, 2017). A positive emotional climate also improves employee motivation, productivity and job satisfaction, leading to better organisational outcomes (Barsade & Knight, 2015).

In the 3D printing industry in South Africa, leaders who exhibit high levels of emotional intelligence can create an emotional climate of joy through effective communication and leadership practices. As mentioned earlier, emotionally intelligent leaders are more open to communication and allow employees to express their opinions, which can increase employee engagement and motivation (Touhidul and Sorooshian, 2019). Leaders can build trust and establish positive relationships with their subordinates by

paying attention to non-verbal cues such as posture, facial expression and tone of voice (Rajhans, 2018).

As previously described, an emotional climate of joy can also increase employee job performance in the 3D printing industry. Research has shown that when employees experience positive emotions, such as joy, they are more likely to engage in creative thinking and problem-solving (Hartmann et al., 2021). This can lead to increased innovation and productivity in the workplace. An emotional climate of joy can also strengthen employee relationships and increase team cohesion, resulting in better collaboration and teamwork (Morselli, 2017).

3.10.3 Organisational emotional climate of fear

The presence of an emotional atmosphere characterised by fear can have an adverse impact on the welfare, drive and work output of employees within the South African 3D printing industry. According to Kiewitz et al. (2016) leaders who demonstrate low emotional intelligence and foster a culture of fear can have adverse effects on the emotional atmosphere of their organisation. In a given environment, the workforce may encounter heightened stress and anxiety levels, resulting in reduced job contentment and productivity levels (Kiewitz et al., 2016). According to Lebel (2017), fear can impede creativity and innovation in the workplace as employees may exhibit reluctance to take risks or present novel ideas due to potentially negative outcomes.

In addition, it has been observed that fear can negatively affect employees' decision-making skills as they may tend to make unfavourable assessments regarding future occurrences (Lebel, 2017). This may lead to reduced self-assurance regarding decision-making capacity and a decline in the drive to undertake fresh challenges or obligations. Leaders who possess high emotional intelligence have the ability to

establish a favourable emotional atmosphere, characterised by positive emotions such as joy or love (Lebel, 2017). This type of environment can effectively enhance employees' well-being and job satisfaction. According to Barsade and Knight (2015) and O'Neill and Rothbard (2017), this phenomenon can improve motivation and productivity while fostering a proclivity for risk-taking and innovation.

In this regard, leaders within the 3D printing industry in South Africa need to recognise the impact of emotional environments on the efficiency and well-being of their employees. It is relevant for individuals to strive towards creating a positive emotional environment by enhancing their emotional intelligence. This pertains to the ability to recognise and manage one's own emotions, as well as the feelings of others. Leaders who demonstrate the capacity to cultivate a positive emotional climate possess the potential to promote employee engagement, job satisfaction and the overall performance of the organisation.

3.10.4 Organisational emotional climate of sadness

An emotional climate of sadness can negatively impact an organisation and its employees. A study by Kong and Drew (2016) found that employees in workplaces with a sad emotional climate tend to disengage from their work and use emotion management strategies such as daydreaming or hiding their feelings from others. Such behaviours can lead to poor performance and relatively high turnover rates (Barsade & O'Neill, 2016).

Furthermore, Scherer and Ekman (2014) suggest that an emotional climate of sadness is commonly associated with feelings of unfairness in the organisation, leading to decreased motivation and job satisfaction. This may be due to employees feeling they are not treated fairly, which can result in negative attitudes towards their

work and organisation. Given the negative consequences of an emotional climate of sadness, organisations should aim to address the underlying causes of sadness and work towards creating a more positive emotional atmosphere. For example, leaders can encourage open communication and provide support to employees who are experiencing difficult times. Additionally, promoting a positive emotional climate, such as joy or love, can help counteract feelings of sadness and encourage well-being and job satisfaction (Barsade & O'Neill, 2014).

The impact of emotional intelligence exhibited by leaders in the South African 3D printing industry can be significant in employee job performance, particularly in the emotional climate of the workplace. Goleman (2017) attests that leaders with high emotional intelligence demonstrate exceptional skills in understanding, regulating and managing the emotions of their subordinates. Studies indicate that leaders who exhibit emotional intelligence are better equipped to cultivate a favourable emotional climate within their company (Barsade & O'Neill, 2014; O'Neill & Rothbard, 2017).

On the other hand, leaders with low emotional intelligence may struggle to effectively manage negative emotions in the workplace, such as sadness, which can result in a negative organisational emotional climate. For example, leaders who lack emotional intelligence may be unable to address employees' fears about job insecurity or organisational changes, leading to increased anxiety and disengagement among employees (Goleman, 2021). Similarly, leaders who are not attuned to the emotions of their employees may fail to recognise and address feelings of sadness or grief, resulting in decreased motivation and performance (Kong & Drew, 2016).

Leaders with higher emotional intelligence are more likely to create a positive emotional climate, which can contribute to improved job performance and well-being among employees in the 3D printing sector in South Africa. By understanding and

managing their own emotions as well as effectively responding to their employees' emotions, leaders can create a supportive and engaging work environment that fosters higher levels of job satisfaction, commitment and performance.

3.11 Measuring emotional intelligence, emotional behaviour, and organisational emotional culture

This section provides literature on the instruments used for measuring emotional intelligence, emotional behaviour and organisational emotional culture.

3.11.1 Measuring emotional intelligence

The Mayer and Salovey model of emotional intelligence is a widely recognised framework that can be used for evaluating an individual's emotional intelligence. The Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) questionnaire is a standardised assessment instrument for evaluating emotional intelligence grounded on the Mayer and Salovey model (Caruso et al., 2015). The MSCEIT assessment comprises 141 questions that aim to evaluate an individual's emotional intelligence concerning the four sub-domains of the MSCEIT. The assessment items are presented in diverse formats, encompassing rating scales, multiple-choice questions, and items that require a precise response. The duration of completing the questionnaire may vary from 15 to 30 minutes, depending on the method of administration employed (Lanciano & Curci, 2015)

The MSCEIT questionnaire has been used in numerous studies since its inception, confirming its reliability and validity. According to Sanchez-Garcia et al. (2016), the MSCEIT questionnaire demonstrated high levels of internal consistency and test-

retest reliability. According to MacCann et al. (2016), the MSCEIT questionnaire showed favourable convergent validity with alternative emotional intelligence assessments.

In a recent study, Shalchi et al. (2021) employed the MSCEIT questionnaire to evaluate the emotional intelligence of medical professionals working amidst the COVID-19 pandemic. The study's findings indicate a positive correlation between emotional intelligence and resilience and a negative correlation between emotional intelligence and burnout. These findings underscore the significance of emotional intelligence within the healthcare setting. The MSCEIT questionnaire is a widely recognised and rigorously validated instrument used for evaluating emotional intelligence. The assessment has demonstrated strong psychometric properties across diverse contexts and populations.

The Reuven Bar-On model of emotional intelligence is measured using the Emotional Quotient Inventory (EQ-i). The questionnaire is a standardised assessment tool that evaluates emotional intelligence following the Reuven Bar-On model. The model is founded on five factors comprising intrapersonal and interpersonal variables, adaptability, stress management and overall mood (Davis & Wigelsworth, 2018). The EQ-i questionnaire contains 133 questions specifically designed to evaluate an individual's emotional intelligence concerning the five components that constitute the EQ-i framework. The presented items adhere to the standard Likert scale format, encompassing a spectrum ranging from strongly disagree to strongly agree (Sanchez-Teruel et al., 2020). The survey typically requires a commitment of approximately 20 to 30 minutes for completion. The questionnaire has undergone numerous studies since its inception, contributing to its established reliability and validity (Sanchez-Teruel et al., 2020).

According to Ciarrochi et al. (2010), the EQ-i questionnaire demonstrated high levels of internal consistency and test-retest reliability. In an alternative investigation, Ferrando et al. (2020) showed that the EQ-i questionnaire exhibited a significant level of criterion validity when measuring anxiety and depression. Zamora-Ramrez et al. (2021) used the questionnaire to evaluate the level of emotional intelligence demonstrated by nursing students. The study's findings indicate that emotional intelligence positively correlates with academic achievement and clinical proficiency. These findings underscore the significance of emotional intelligence within the nursing field. The EQ-i questionnaire is a tool that has been extensively used and validated to evaluate emotional intelligence. Furthermore, it has been demonstrated to have strong psychometric properties across diverse settings and populations.

3.11.1.1 Emotional competence inventory

Boyatzis et al. (2010) developed the Emotional Competence Inventory (ECI) as a self-report questionnaire to assess emotional and social competencies, using Goleman's emotional intelligence model. The ECI assesses 12 competencies classified into four groups: self-awareness, self-management, social awareness and relationship management. Various studies have verified the credibility of the ECI, exhibiting strong psychometric characteristics such as reliability and validity. Boyatzis et al. (2010) discovered that the ECI revealed strong internal consistency and test-retest reliability in their research. According to Ng et al.'s (2010) research, the ECI demonstrated strong internal consistency, test-retest reliability and construct validity compared to assessments of emotional intelligence, personality traits and job performance. From the findings of O'Sullivan et al. (2013), the ECI showed strong criterion validity by accurately predicting leadership effectiveness. Slaski and Cartwright's (2014) study revealed that the ECI exhibited strong reliability and validity. The cluster pertaining to relationship management within the ECI has been identified as the most efficient

predictor of job satisfaction. According to Barchard et al. (2017), the ECI demonstrated strong construct validity in a study of healthcare workers, as evidenced by its correlation with measures of well-being and stress.

The ECI has been proven to be an effective instrument for predicting outcomes such as work performance and leadership potential, in addition to its reliability and validity. In a study of Chinese workers, for example, Shao et al. (2020) discovered that the ECI was a good predictor of job success and creativity. Miao et al. (2019) found that the ECI showed strong criteria validity with leadership effectiveness metrics. The ECI has been proven to be an effective instrument for predicting work performance and other outcomes, in addition to its reliability and validity. In a study of Korean workers, Hur et al. (2020) discovered that the ECI was a good predictor of job success and leadership potential. In another study by Schaubroeck et al. (2015), the leaders' ECI predicted their workers' job satisfaction and organisational commitment. Schlaerth et al. (2018) discovered that leaders' emotional intelligence, as evaluated by the ECI, predicted their transformative leadership behaviour. According to Liu et al. (2019), the ECI moderated the association between their narcissism and their followers' work happiness. The ECI is a popular instrument for assessing emotional intelligence and a valid and reliable assessment of emotional and social abilities. As a result, using the ECI to evaluate leaders' emotional intelligence in the South African 3D printing business may assist in identifying leaders with the requisite emotional and social competencies to manage their teams and organisations successfully.

3.11.2 Measuring emotional behaviour

The Differential Emotion Scale (DES), developed by Izard (1997), is a self-report questionnaire that assesses the strength of various emotions an individual experiences. The DES comprises 30 questions that measure the strength of ten

distinct emotions: joy, interest, surprise, sadness, anger, disgust, contempt, fear, humiliation and guilt (Izard, 1997). The DES has been used to assess emotional behaviour in various contexts; for example, it has been used in parenting studies to examine the emotional climate of the home and the extent to which parents communicate positive and negative emotions with their children (Cole et al., 2003). The DES has been used in clinical settings to measure the emotional experiences of people suffering from diseases such as depression (Rottenberg et al., 2002) and anxiety (Chapman et al., 2006).

The DES has been proven to have strong psychometric qualities, including internal consistency, test-retest reliability and convergent validity with other emotional measures (MacDonald & Leary, 2005). The DES's capacity to rate the intensity of multiple emotions, which gives a more complex knowledge of emotional experiences, is one of its strengths as a questionnaire for evaluating emotional activity (Izard, 1997). Nevertheless, it does not examine the frequency or duration of emotions, which may restrict its use in certain situations (MacDonald & Leary, 2005).

The DES has been used in several studies to assess emotional behaviour in various demographics and circumstances. Diener et al. (2018) used DES to evaluate people's emotional reactions to positive and negative experiences. The findings demonstrated that the DES was a reliable and meaningful measure of emotional experiences. In another study, Van Liew et al. (2018) used the DES to assess emotional reactions to a virtual reality environment in children with and without autism. According to the findings, it was a good instrument for evaluating emotional behaviour in this cohort. Ashford et al. (2021) employed the DES to investigate emotional responses to music in people suffering from depression. The findings suggested that it was a sensitive indicator of emotional experiences that might be used to evaluate treatment success. Cox et al. (2018) investigated emotional reactions to pain in older adults using the

DES. According to the findings, it was a reliable and accurate measure of emotional experiences.

The DES has been validated in multiple studies as a reliable and valid measure of emotional experiences across diverse demographics and circumstances, making it an excellent instrument for measuring leaders' emotional behaviour in the 3D printing industry. The DES assesses distinct emotions; thus, it may give a complete evaluation of leaders' emotional experiences in reaction to various circumstances or occurrences.

3.11.3 Measuring organisational emotional climate

The Emotional Climate Scale (ECS) was developed by Ashkanasy, Hartel and Daus (2000) and is based on their definition of emotional climate as the generally enduring quality of organisational members' emotional experiences in reaction to the organisation's policies, practices and procedures. The ECS questionnaire was developed to assess organisational emotional climate. It is a 15-item scale that examines perceptions of emotional experiences in the workplace, covering both positive and negative emotions.

The measure has undergone comprehensive psychometric testing, including reliability, validity and construct validity tests. The ECS's dependability has been studied. In a sample of U.K. healthcare professionals, for example, Legood (2010) observed good internal consistency (Cronbach's $\alpha = 0.91$) and test-retest reliability (ICC = 0.84). Similarly, Lee, Thomas and Martin (2011) found strong internal consistency (Cronbach's $\alpha = 0.92$) and good test-retest reliability (CA = 0.85) in a sample of Australian public sector personnel. The ECS has been shown to have strong construct validity, meaning it measures what it claims to measure. Legood

(2010), for example, discovered that the ECS was linked to measures of job satisfaction and burnout, suggesting that it captures relevant features of the work environment. Similarly, Lee et al. (2011) discovered that the ECS was substantially linked to corporate culture and climate parameters.

In recent years, the ECS has been extensively used to assess the emotional climate in several organisational situations. Ovayolu and Ovayolu (2012) investigated the emotional environment among nurses working in a Nigerian hospital using the ECS. They discovered that emotional climate was substantially related to work satisfaction and the desire to leave. The ECS was used by Manzano-Garca and Ayala-Calvo (2013) to analyse the emotional climate in Spanish care homes. They discovered that staff burnout, job satisfaction and perceived quality of treatment were all strongly associated with emotional climate. The ECS was used by López-González et al. (2017) to assess the emotional climate of a sample of Spanish healthcare workers. They discovered that an emotional environment was strongly associated with work satisfaction and organisational commitment. Cho et al. (2018) measured emotional climate in a sample of Korean industrial organisations. They discovered that employee creativity and work satisfaction were highly connected to the emotional climate. Anagnostopoulos et al. (2019) assessed the emotional climate in Greek government agencies. They discovered that emotional climate was strongly associated with employee well-being and organisational commitment. Shanafelt et al. (2020) employed the ECS to assess the emotional climate among US doctors. They discovered that the emotional environment was strongly connected to burnout and professional contentment.

In the 3D printing sector, where employees are likely to face high levels of technical complexity and uncertainty, an emotional climate can be crucial in promoting employee resilience and engagement. Measuring emotional climate using the ECS

can provide valuable insights into the emotional experiences of employees in the 3D printing sector, which can help organisations identify areas for improvement and enhance employee well-being and productivity.

3.12 Chapter summary

This chapter reviewed the literature on leaders' emotional intelligence in the work context. Based on the literature, the researcher concludes that in the role of leadership, the leaders' emotional intelligence and behaviour have implications on the kind of organisational emotional climate that will exist in the 3D printing industry. Leaders with high levels of emotional intelligence tend to exhibit positive emotional behaviour, such as vigour and friendliness, thereby contributing to a positive organisational emotional climate of joy and love. On the other hand, leaders with low levels of emotional intelligence are most likely to exhibit negative emotional behaviour such as depression, anger and bewilderment/confusion, which could contribute to a negative organisational emotional climate of sadness and fear within the 3D printing industry in South Africa.



CHAPTER FOUR

CONCEPTUAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

4.1 Introduction

This chapter presents empirical literature on the relationships among the variables of the study (leaders' emotional intelligence, emotional behaviour, organisational emotional climate and employee job performance) and sets out the conceptual framework of the study. Empirical literature is presented on the direct relationships between leaders' emotional intelligence and employee job performance, leaders' emotional intelligence and leaders' behaviour, and leaders' emotional intelligence and organisational emotional climate. The leaders' emotional behaviour and organisational emotional climate, organisational emotional climate and employee job performance and also the moderating effect of organisational emotional climate on the relationship between leaders' emotional intelligence and employee job performance are analysed.

4.2 Leaders' emotional intelligence and employee job performance among 3D printing firms

The study conducted by Lakshmi and Rao (2018) examined the correlation between the emotional intelligence of leaders and the work performance of teachers in public schools in India. The study used a quantitative cross-sectional survey methodology, with a sample of 113 teachers randomly selected. The task of collecting the required data was achieved through questionnaires. The research findings suggest a significant positive correlation between teachers' emotional intelligence and job

performance. Jordan et al. (2016) conducted a study investigating the impact of a leader's emotional intelligence on job performance, with job satisfaction as a moderating variable. It was found that there is a significant positive relationship between leader's emotional intelligence and employee job performance. Pant and Yadav (2016) investigated the connection between a leader's emotional intelligence and their employees' job performance in five software businesses in Moradabad, India. A representative sample of 100 workers was selected from five software development organisations to conduct research and a questionnaire was administered to them. The study's findings suggest that a leader's emotional intelligence significantly enhances employees' job performance by enabling effective stress management. Javed (2018) investigated the impact of emotional intelligence on the job performance of project managers in India. Questionnaires were distributed to 222 project managers in the construction industry. The research findings showed a significant positive relationship between the emotional intelligence of construction workers and their job performance.

Another study by Ahmed, Sabir, Rehman, Khosa and Khan (2015) investigated the potential relationship between the emotional intelligence of leaders and the job performance of their employees in Pakistani higher education institutions. The data collection questionnaires were completed by a sample of 235 individuals and the research findings suggest a significant positive correlation between the emotional intelligence of leaders and the job performance of employees in higher education institutions in Pakistan. Mohammed and Jais (2016) conducted a study in Malaysia to investigate the impact of emotional intelligence among school administrators on teachers' work performance. The study involved a sample of 212 participants from six distinct categories of secondary schools in Malaysia. The research findings indicate a positive correlation between the emotional intelligence of leaders and the job performance of teachers. Miao, Humphrey, and Qian (2021) conducted a meta-

analysis within the hospitality industry to examine the correlation between a leader's emotional intelligence and their staff's work performance. A positive correlation between the leaders' emotional intelligence and the hospitality staff's work performance was seen. Loh and Yee (2017) employed a quantitative research approach to investigate the correlation between leaders' emotional intelligence and employees' job performance in a manufacturing organisation based in Malaysia. The results indicate that the emotional intelligence of their leader significantly influenced the degree of work performance exhibited by employees. A cross-sectional research methodology was used by Huang et al. (2015) to examine the correlation between the emotional intelligence of company leaders and the job performance of employees in Taiwanese high-tech companies. The findings revealed that a leader's emotional intelligence substantially impacted their employees' work performance. Based on the literature, therefore, it is hypothesised in this study as follows: *H1: There is a significant positive relationship between leaders' emotional intelligence and employee job performance in 3D printing firms.*

4.3 Leaders' emotional intelligence and emotional behaviour among 3D printing firms

According to recent studies, leaders' level of emotional intelligence is shown to have a direct correlation with their emotional behaviours (Walter, Humphrey & Cole, 2012; Walter & Bruch, 2009). Dabke (2016) researched how subordinates perceived the emotional behaviours of leaders with emotional intelligence who also employed the transformational leadership style. In this study, Dabke focused on leaders who used transformational leadership styles. The total number of participants in the research was 200. As leaders with emotional intelligence were more successful in their roles, their subordinates had a positive impression of these leaders' emotional behaviours. In addition, the data showed that emotional behaviours demonstrated by leaders were

connected to their exhibition of transformational leadership, which subordinates rated as successful leadership. It has also been stated that emotional intelligence in leaders gives them the ability to exhibit good emotional behaviours while maintaining control over negative emotional behaviours such as rage, confusion, despair and worry, amongst others, while showing positive emotional behaviours such as empathy, positive reinforcement, gratitude, active listening and optimism (Siegling, Nielsen & Petrides, 2014b).

Individuals in leadership positions with high levels of emotional intelligence exhibit adeptness in regulating their emotions, thereby enhancing their efficacy in fulfilling their job performance (Ashkanasy & Humphrey, 2011; Boyatzis et al., 2011). The result clearly demonstrated that an individual's level of emotional intelligence significantly impacts their emotional behaviour. Prezerakos (2018) investigated the effects of emotional intelligence on positive leadership behaviours, specifically effective leadership. The study examined the impact of emotional intelligence on nursing supervisors. A bibliometric analysis was conducted to examine the qualitative and quantitative research on the emotional intelligence of nurse managers in the field of literature. This review used various electronic databases and articles published from 2000 to 2017. Eleven articles, comprising ten quantitative and one qualitative, met the inclusion criteria for the study. The research findings suggest a positive correlation between emotional intelligence and managerial performance, as evidenced by positive emotional behaviour. Based on the literature, therefore, it is hypothesised in this study as follows: *H2: There is a significant positive relationship between leaders' emotional intelligence and leaders' emotional behaviour in 3D printing firms.*

4.4 Leaders' emotional intelligence and organisational emotional climate among 3D printing firms

The presence of a high level of emotional intelligence impacts the emotional climate of an organisation, including the prevalence of emotions such as fear, sadness, joy and love. The impact of leaders' emotional intelligence, employee creativity and the emotional climate of an organisation was examined by Jafri, Dem and Choden (2016). Based on the research findings, it could be inferred that leaders with emotional intelligence positively impact their subordinates' creativity. The correlation between a leader's emotional intelligence and the creativity of their subordinates was moderated by the emotional climate of the organisation. Maddocks (2017) used a quantitative survey approach to examine the impact of leaders' emotional intelligence on the emotional climate of the organisation. The study involved the participation of 108 high-level managers and directors from the public and private sectors. The research indicates a significant positive connection between a leader's emotional intelligence and the emotional climate within the organisation. The research findings further suggest that the interpersonal aspects of emotional intelligence in leaders, such as social awareness and relationship management, are more strongly associated with the emotional atmosphere of the workplace than the intrapersonal aspects of emotional intelligence, such as self-awareness and self-management.

Sembiring, Nimran, Astuti and Utami (2020) conducted a quantitative research study to examine further the influence of leaders' emotional intelligence on organisational justice, job satisfaction, organisational caring climate, and the performance of criminal investigators in Indonesia. The data obtained were analysed using path analysis and partial least squares (PLS) structural equation modelling. The study found significant correlations between organisational justice and job satisfaction, emotional intelligence and employee performance, and job satisfaction and both emotional intelligence and

organisational justice. Research findings indicated a significant and positive correlation between the emotional intelligence of corporate executives and the caring work climate fostered within their organisations. Ahmed and Zaheer's study (2015) on 300 employees in the banking sector revealed a significant positive association between the emotional intelligence of leaders and the organisational emotional climate. This climate encompasses job contentment, corporate loyalty, and organisational citizenship behaviour. According to a study conducted by Yatim et al. (2016) involving 325 workers in the banking industry, a positive correlation exists between emotional intelligence and the emotional climate within an organisation. A study on 235 public sector workers by Zakeri et al. (2017) revealed that there is a positive correlation between the emotional intelligence of leaders and the organisational emotional climate and employee job satisfaction. Furthermore, the researchers discovered that organisational climate partially mediated the relationship between leaders' emotional intelligence and employee job satisfaction. Based on this empirical evidence, a hypothesis was proposed as follows: *H3: A significant positive relationship exists between leaders' emotional intelligence and organisational emotional climate.*

4.5 Leader's emotional behaviour and organisational emotional climate among 3D printing firms

Gooty, Gavin, Johnson, Frazier and Snow (2016) examined the effect of leaders' emotional behaviour on the emotional climate of organisations. According to the study's findings, there is a correlation between the emotional behaviour exhibited by leaders and the resulting positive emotional environment among employees and their level of job satisfaction. The current finding is consistent with previous research conducted by Kelloway, Francis and Gatien (2015), which suggests that leaders' emotional behaviours significantly impact the emotional climate within organisations.

A study by Chen et al. (2015) to assess the impact of leader emotional behaviour on organisational emotional behaviour within Chinese banks revealed a positive correlation between a leader's emotional behaviour and the emotional outcomes of employees and the overall emotional climate within Chinese banks. The study additionally demonstrated that the positive outcomes of staff members serve as a moderating factor in the correlation between the positive behaviour of leaders and the positive climate of the organisation. Kafetsios and Zampetakis (2019) examined the effect of leaders' emotional behaviour on organisations' emotional environment and its employees job performance. From the findings of the study, a positive correlation was found between the emotional behaviour of leaders and the job performance of employees and the emotional climate of the organisation. Based on the empirical studies, a hypothesis was proposed as follows: *H4: A significant positive relationship exists between leaders' emotional behaviour and organisational emotional climate.*

4.6 Organisational emotional climate and employee job performance among 3D printing firms

Organisations that nurture positive emotional climates, such as emotional climates of love and of joy, can improve company and staff performance (Seppala & Cameron, 2015). It has also been argued that a positive emotional environment in the workplace positively impacts employees' moods and emotions, resulting in a suitable working environment for people to reach their full potential. (Barsade & Knight, 2015). Businesses are focusing their efforts on creating healthy emotional cultures in the workplace. Positive employee emotions like joy, satisfaction and companionate love are highlighted in these cultures, which increases employee attention to clients and worker creativity (Barsade & O'Neill, 2016).

In the context of Chinese insurance firms, Fu, Weihui, Deshpande and Satish (2014) investigated the link between job performance and factors such as organisational caring environment, work satisfaction and organisational commitment. The findings revealed that a caring climate within a firm had a significant positive association with job satisfaction, staff commitment and job performance. Work satisfaction was also discovered to be a mediator in the link between the firm's caring climate and the performance of its workers. Zhou et al. (2015) assessed 33 software development teams and found that a good emotional environment was associated with higher team performance, whereas a negative organisational climate was related to poor team performance. Aziri (2017) surveyed 253 employees working for organisations in Macedonia and found that positive emotions in the workplace were positively associated with employee performance and that this relationship was strengthened by perceived organisational support. Lee and Seo (2019) carried out a study of 526 employees in Korean firms. They discovered that a positive emotional climate was connected to employee work performance. There was a negative association between a poor emotional environment and employee work performance. According to a study conducted on 400 people working in the public sector in Sri Lanka by Alwis and Amarasinghe (2022), the emotional environment significantly and positively affected job performance. Adekoya and Adekoya (2021) performed research in Nigeria with a sample size of 300 employees from various businesses. They found that the emotional environment of the workplace has a significant and positive impact on individuals' job performance levels. Mamun and Islam (2021) revealed that emotional climate significantly and positively impacted work performance after studying 250 healthcare professionals in Bangladesh. Based on the literature, the study proposes a hypothesis as follows: *H5: There will be a significant positive relationship between organisational emotional climate and employee job performance among 3D printing firms.*

4.7 Leaders' emotional behaviour and employee job performance among 3D printing firms

Employees' positive opinions regarding their leaders' emotional behaviours contribute to favourable work outcomes such as employee job performance, and vice versa (Dulebohn et al., 2012). Positive leaders treat their subordinates with respect, approbation and love, inspiring them to do well in the assigned tasks (Moss Ritossa & Ngu, 2006). Positive emotional actions on the part of leaders, according to Moss et al. (2006) and Dulebohn et al. (2012), improve subordinate job performance. Choudhary, Naqshbandi, Philip and Kumar (2017) studied faculty members at Indian universities to examine the role of leaders' emotional management skills and their impact on employee work performance, with job characteristics functioning as a moderating variable. According to the study, leaders' emotional management abilities at universities had a strong positive association with workers' job performance. Employee work characteristics were also observed to mitigate the relationship between leaders' emotional management skills and employee job performance.

In another study, Bambale, Kassim and Musa (2016) investigated the influence of emotional leadership style on employee performance among tertiary institution workers in Gombe, Northern India. Among the emotional leadership characteristics investigated were assertiveness, empathy, relationship management and flexibility. According to the results, the emotional behaviours of leaders, such as assertiveness and relationship management, have a significant favourable impact on employee job performance. Based on the empirical results, therefore, the researcher hypothesises as follows: *H6: There will be a significant positive relationship between leaders' emotional behaviour and employee job performance among 3D printing firms.*

4.8 Organisational emotional climate, leaders' emotional intelligence and employee job performance among 3D printing firms

Cherniss, Grimm and Liautaud (2014) conducted a study to investigate the effects of emotional intelligence training on a healthcare organisation's emotional climate and its employees' job performance. According to the research findings, implementing emotional intelligence training for leaders led to improvements in their subordinates' emotional climate and job performance. Merkin, Shmotkin and Hazan (2019) conducted a longitudinal study to investigate the correlation between leaders' emotional intelligence, employee commitment, and employee work performance over a period of time. According to the research findings, a significant correlation exists between the emotional intelligence of a company's leaders and the work performance of their employees. Nonetheless, the study has indicated that this correlation was moderated by the emotional climate prevalent within the organisation.

Karimi, Malekzadeh and Khaksar (2019) employed a quantitative survey methodology to examine the influence of leader emotional intelligence on employee work performance while considering the moderating effect of organisational emotional climate. The results suggest a significant association between a leader's emotional intelligence and subordinates' job performance. The study showed that the emotional atmosphere in an organisation plays a moderating role in the relationship between a leader's emotional intelligence and the subordinates' job performance. Côté and Miners (2016) conducted a study using a multi-source survey methodology to collect data from 117 managers and their subordinates employed in diverse Canadian firms. According to research findings, the emotional intelligence of leaders has a significant positive connection with their employees' job performance. Furthermore, a positive organisational climate moderates the relationship between a leader's emotional intelligence and the employees' job performance. Based on the empirical results, the

researcher hypothesised as follows: *H7: Organisational emotional climate will moderate the relationship between leaders' emotional intelligence and organisational emotional climate.*

4.9 Conceptual framework

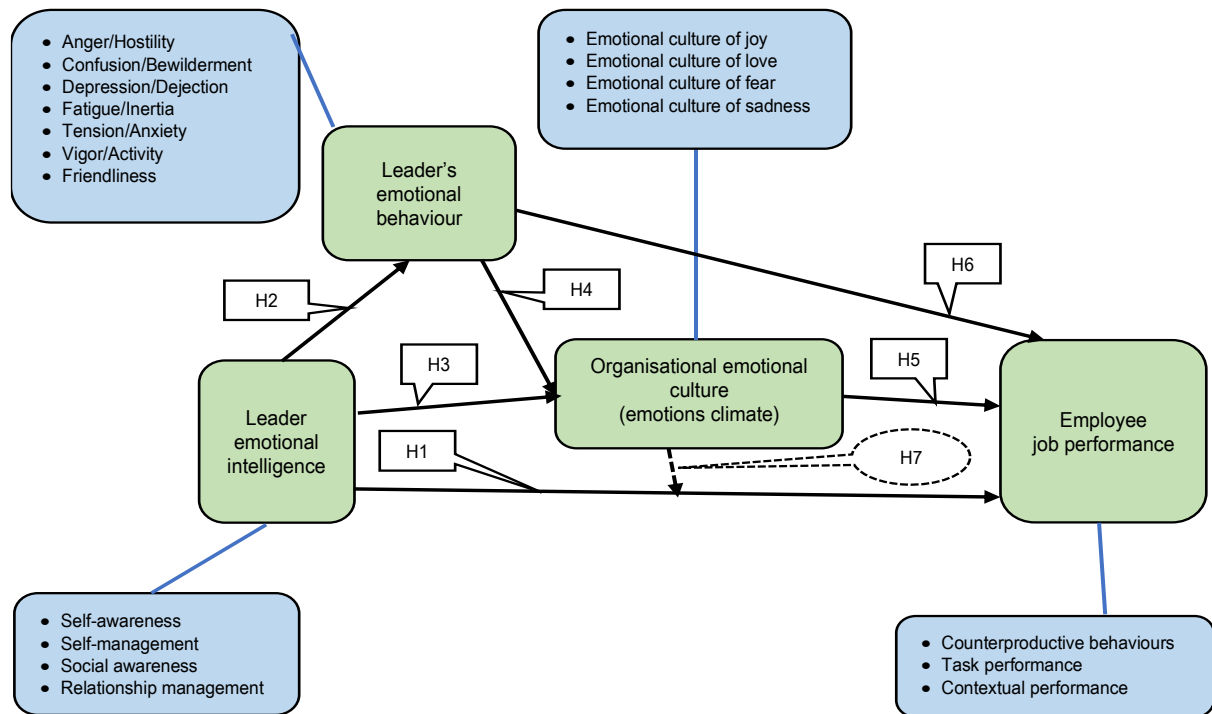


Figure 4.1: Conceptual framework of the study

The conceptual framework is influenced by the social exchange theory, which stresses the importance of costs and rewards in forming relationships between leaders and their subordinates. Leaders need emotional intelligence to have good relationships with their subordinates in the 3D printing industry.

Through emotional intelligence and the exhibition of positive emotional behaviours such as friendliness and vigour, positive emotional climates such as those of joy and

love will be created in 3D printing firms, and thus, both leaders and their subordinates will find their interrelationships rewarding and not costly. Dwelling on the social exchange theory, the conceptual framework of this study proposes that the level of leaders' emotional intelligence in terms of self-awareness, self-management, social awareness, and relationship management could, directly and indirectly, affect the display of positive (e.g. friendliness, vigour) or negative (e.g. anger, hostility, depression, etc.) emotional behaviour in 3D printing firms in South Africa. Therefore, employees will react to leaders' emotional intelligence exhibited through their emotional behaviours by showing task performance, contextual performance, or counterproductive behaviours. Again, a leader's level of emotional intelligence and emotional behaviour could play an important role in the overall organisational emotional climate (joy, love, sadness and fear), and it must be emphasised that a positive emotional climate (joy and love) could be reciprocated by positive employee performance behaviours (task and contextual). On the other hand, a negative emotional climate (sadness and fear) could be reciprocated by negative job performance in terms of counterproductive behaviours. Again, from the conceptual framework, it was predicted that organisational emotional climate moderates the relationship between leaders' emotional intelligence and employee job performance in the 3D printing industry in South Africa.

4.10 Chapter summary

In this chapter, the researcher presented empirical literature based on the objectives of the study, which led to the formulation of research hypotheses related to the 3D printing industry. The empirical literature provides the right foundation to test the hypotheses within the context of the 3D printing sector in South Africa and thereby contribute significantly to the literature.



CHAPTER FIVE

METHODOLOGY

5.1 Introduction

The preceding chapter examined the relationships between leader emotional intelligence, leader emotional behaviour, organisational emotional climate and employee job performance, leading to the formulation of hypotheses and conceptual framework that guided the study. This chapter presents the methodological approaches used in the study, commencing with a discussion of the positivist research paradigm and justifies its applicability in relation to assumptions such as epistemology, ontology and axiology. The justification for choosing a deductive research approach quantitative research method, the target population, sample size and data collection processes are discussed. The ethical issues addressed during the data collection process and the data analysis techniques are also presented.

5.2 Research paradigms

A research paradigm refers to a broad framework or worldview that shapes the researcher's assumptions, beliefs, and methodologies in conducting research (Rehman & Alharthi, 2016). It encompasses the fundamental principles and philosophies that guide how knowledge is understood, generated, and validated within a particular discipline or field of study (Kivunja & Kuyini, 2017). Positivist, interpretivist and pragmatic research paradigms are the three main research paradigms used in social research (Khaldi, 2017). Positivist research paradigm operates under the assumption that there is an objective reality that exists independently of human perception (Park, Konge & Artino, 2020). Positivist research typically employs

quantitative methods to gather empirical data, test hypotheses, establish causal relationships between variables (Park et al., 2020). The interpretivist research paradigm recognizes the subjective nature of reality and emphasizes understanding the social and cultural contexts in which individuals interpret their experiences (Alharahsheh & Pius, 2020). It focuses on exploring meanings, perspectives, and social processes (Antwi & Hamza, 2015). Moreover, the pragmatic research paradigm emphasises practical problem-solving and the integration of multiple perspectives and methods (Kaushik & Walsh, 2019). Pragmatism values flexibility, contextuality, and the relevance of research findings for addressing real-world issues (Maarouf, 2019). Pragmatic research adopts a mixed methods approach, combining quantitative and qualitative methods, to capture both the numerical and contextual aspects of phenomena (Biddle & Schafft, 2015; Rahi, 2017).

Research paradigms are based on specific ontological, epistemological, and axiological assumptions. Ontological assumptions pertain to the nature of reality and the existence of phenomena under study (Creswell & Poth, 2018). These assumptions reflect the researcher's beliefs regarding what exists, how it exists, and the nature of its existence (Bryman, 2016). Different research paradigms adopt distinct ontological assumptions. Positivism, for instance, embraces an ontological assumption of objectivism, positing an external and objective reality that exists independently of human perception (Rehman & Alharthi, 2016). Conversely, interpretivism adheres to an ontological assumption of subjectivity, contending that reality is subjective and resides within an individual's consciousness (Khaldi, 2017). Subjective ontology implies that individuals interpret reality based on their personal experiences, beliefs, and perspectives (Khaldi, 2017).

Epistemological assumptions relate to the nature of knowledge and how it can be acquired or generated (Alharahsheh & Pius, 2020). Epistemological assumptions

therefore reflect the researcher's beliefs about the sources of knowledge, the processes involved in gaining knowledge, and the criteria used to evaluate its validity (Alharahsheh & Pius, 2020). The epistemology of positivism assumes that knowledge can be obtained through systematic observation, measurement, and the application of scientific methods (Davies & Fisher, 2018). Interpretivist epistemology recognises the subjective and context-dependent nature of knowledge. It emphasises understanding individuals' lived experiences, meanings, and social constructions through qualitative methods and also values subjective interpretations and the role of the researcher in shaping knowledge (Davies & Fisher, 2018).

Axiological assumptions pertain to the researcher's stance on values, ethics, and the role of personal values in the research process (Rahi, 2017). In the positivist paradigm, the axiology aims for value-free and objective research, seeking to minimize the impact of the researcher's values, biases, or personal experiences (Biddle & Schafft, 2015). Moreover, interpretivist axiology recognizes the influence of values and emphasizes the researcher's subjectivity (Biddle & Schafft, 2015). It advocates for value engagement in the research process, acknowledging that personal values and perspectives shape the research and contribute to a deeper understanding of the phenomena under investigation (Rahi, 2017).

5.2.1 Justification for positivist research paradigm

The positivist research paradigm was chosen for this study based on justifications stemming from its ontology, epistemology, and axiology. Ontologically, positivism asserts that reality exists objectively and independently of human perception (Creswell & Poth, 2018). The ontological assumption of positivist paradigm aligns with the study's aim to objectively examine the relationships between variables, such as leaders' emotional intelligence, behavior, organisational emotional climate, and

employee job performance. The use of online questionnaires for data collection enhanced objectivity in the data collection process, since the researcher did not have any direct interaction with the respondents.

Epistemologically, positivism relies on rigorous scientific methods, such as experiments, surveys, and statistical analysis, to acquire knowledge (Alharahsheh & Pius, 2020). In this study, a survey approach was employed to collect data from participants in the 3D printing industry, while statistical techniques like PLS Structural Equation Modeling were used to analyze the data. By adhering to the positivist epistemology, the study gathered empirical evidence, tested hypotheses, and established relationships between the variables under investigation. Axiologically, positivism seeks to eliminate personal biases and achieve value-free research (Rahi, 2017). To achieve the axiological assumption, the researcher ensured that his personal beliefs and values were not incorporated in the data collection, analysis and reporting processes.

5.3 Research design and its justification

Research design constitutes the plan or strategy used by a researcher to investigate a particular phenomenon (Creswell, 2014). In this study, the explanatory correlational research design was deemed most appropriate, although there are other types of research designs, such as descriptive and exploratory designs. The choice of the explanatory correlational research design is justified on the premise that it is used to examine the causal relationships between two or more variables and is also most appropriate for testing hypotheses (Creswell, 2014). This design choice enabled the researcher to establish the direct relationships between leader emotional intelligence and employee job performance, leader emotional behaviour, and organisational emotional behaviour, among others. The explanatory correlational

research design is also justified as the study tested a hypothesis on the moderating effect of organisational emotional climate on the relationship between leader emotional intelligence and employee job performance in 3D printing firms in South Africa.

5.4 Research approach and its justification

The inductive and deductive research approaches are two different approaches used in research. Inductive research involves moving from specific observations and data to broader generalizations and theories (Woiceshyn & Daellenbach, 2018). Inductive research approach follows a bottom-up approach, where researchers start with collecting and analysing empirical data and then develop theories or patterns based on their observations (Armat et al., 2018). Deductive research involves moving from general theories or hypotheses to specific observations or data (Young et al., 2020). Deductive research approach follows a top-down approach, where researchers start with a theory or hypothesis and then collect data to test or confirm it (Cerezo et al., 2016).

In this study, the deductive research approach was chosen. The choice of a deductive research approach was justified by formulating hypotheses based on existing theories, such as the job demands resources theory and social exchange theory to establish direct and indirect (moderation) relationships between leader emotional intelligence, leader emotional behavior, organisational emotional climate, and employee job performance within the context of 3D printing firms in South Africa.

5.5 Research method and its justification

Quantitative and qualitative research methods are distinct approaches used in research to gather, analyze, and interpret data (Creswell, 2014). Quantitative research method focuses on numerical data and aims to measure variables, establish patterns, and provide objective and generalizable findings (Creswell, 2014). Quantitative research method employs structured data collection methods, such as surveys and relies on statistical analysis to draw conclusions (Bryman, 2016). Qualitative research, on the other hand, aims to understand the complexity of human experiences and social phenomena (Denzin & Lincoln, 2018). Qualitative research method relies on non-numerical data, such as interviews, observations, or textual analysis, to uncover subjective meanings and contextual insights, to gain an in-depth understanding of a phenomenon (Yin, 2018).

In this study, a quantitative research method was utilised to examine the relationships between leader emotional intelligence, leader emotional behavior, organisational emotional climate, and employee job performance in 3D printing firms in South Africa. The use of quantitative research method was justified as it, allowed for the collection of numerical data, enabling the researcher to test hypotheses and analyse the data collected using statistical techniques.

5.6 Target population and sampling

This section presents the study's target population, sample size and sampling techniques used for selecting study participants.

5.6.1 Target population

The target population comprises all the units with characteristics of interest to the researcher (Saunders et al., 2019). The target population of this study comprised employees of 3D printing firms that participated in the 23rd Annual RAPDASA Conference held from 9–11 November, 2022. The total number of employees of 3D printing firms and institutions that participated in the conference was 275.

5.6.2 Sample size

The Rao Soft Sample Size calculator was used to deduce the appropriate sample size based on a population of 275. Using the Rao Soft Sample Size calculator, at the 95% confidence level, the appropriate sample size for a population of 275 is 161.

5.6.3 Sampling technique and procedure

A simple random sampling technique was used to select the respondents. Since Google Forms was used for the online data collection procedure, simple random gave each participant an equal opportunity to be selected to participate in the study. First, to implement the simple random sampling technique, numbers were assigned to the emails of the 275 employees of 3D printing firms and institutions that participated in the conference. The Statistical Package for Social Sciences (SPSS) version 26 random number generator function was used to generate random numbers for 161 participant emails out of the population of 275.

5.7 Data collection

This section presents the data collection instruments used for the data collection as well as procedure for data collection.

5.7.1 Data collection instruments

Standardised Likert-scale questionnaires served as data collection instruments. The questionnaire was based on validated questionnaires already available. Leader emotional intelligence and leader emotional behaviour served as the independent variables, while employee job performance served as the dependent variable. Organisational emotional climate served as the moderating variable. The questionnaire was divided into five sections. Section A captured the demographic data of the respondents, such as gender, age, highest educational qualification, work title or specification and also the number of years spent working in a 3D printing firm in South Africa. Section B measured leaders' emotional intelligence based on four dimensions from Goleman's model: self-awareness (3 items), self-management (3 items), social awareness (3 items), and relationship management (3 items). The items for measuring a leader's emotional intelligence were adopted from the Emotional Competence Inventory (ECI) developed by Boyatis and Goleman (1998).

Section C sought the opinions of participants on employee job performance, measured in the following dimensions: task performance (5 items), contextual performance (7 items), and counterproductive behaviour (6 items). Items used for measuring employee job performance were adopted from the Individual Work Performance Questionnaire (IWPQ) developed by Koopmans (2015).

Section D sought the opinions of participants on leader emotional behaviour and consisted of the following dimensions: anger (3 items), confusion/bewilderment (3 items), depression (3 items), fatigue/strain (3 items), anxiety/tension (3 items), vigour (3 items) and friendliness (3 items). Items used for measuring leaders' emotional behaviour were adopted from the Differential Emotional Scale (DES) developed by Izard (1997).

Section E of the questionnaire sought the opinions of participants on organisational emotional climate, which comprised the following dimensions: organisational emotional climate of joy (3 items), organisational emotional climate of love (3 items), organisational emotional climate of sadness (3 items) and organisational emotional climate of fear (3 items). Items used for measuring organisational emotional climate were adopted from the Emotional Climate Scale (ECS) developed by Ashkanasy, Hartel and Daus (2000).

5.7.2 Data collection procedure

Data collection was done online using Google Forms. An approved questionnaire was converted to an online version using Google Forms. The questionnaire was emailed to participants randomly selected by the researcher using the SPSS random generator. Three months were taken to gather data online from respondents. This is because most of the respondents delayed filling out the online questionnaires, and as a result, email reminders were sent from time to time until an acceptable response rate was reached for data analysis.

5.8 Validity and reliability assurance

Validity and reliability have vital roles to play in research. Validity is defined as the ability of a research instrument to measure what it intends to measure (Tabachnick & Fidell, 2014). Reliability assurance deals with the sources of unreliable observations in social science measurements and the strategies taken to minimise these threats (Haradhan, 2017).

5.8.1 Validity assurance

For this study, validity assurance was attained by adopting the theoretical assessment of the validity approach (Saunders et al., 2018). The theoretical assessment of validity approach focuses on how well an operational measure conveys or represents the idea of a theoretical construct (Creswell, 2014). Two sub-types of the theoretical evaluation of validity were used in this study: face and content validity. To achieve face validity, the researcher ensured that the investigated constructs were operationally defined (Taherdoost, 2016). Furthermore, items for measuring the constructs were deduced from the constructs' operational definitions to ensure they were correctly contextualised for the 3D printing environment. Content validity concerns how the items on a scale represent the concept being measured (Denzin & Lincoln, 2018). Content validity was achieved by seeking expert opinions from academia and industry on the items used to measure the constructs. This was achieved as ratings from the expert views fit into the operational definition of the investigated constructs.

5.8.2 Reliability assurance

In conducting this study, one of the threats that could affect instrument reliability was subjectivity (Mohajan, 2017). Since the topic was about leaders' emotions, the

emotional climate in 3D printing firms and employee job performance, it would be unreliable to use observations of employees to explain their emotions, which could be subjective. In this regard, subjectivity was overcome as the researcher used questionnaires (Krosnick, 2018), allowing employees to express their opinions on their leaders' emotional intelligence and organisational emotion climate based on their experiences with their leaders. Ambiguous and imprecise questions can also bring about inappropriate responses, negatively affecting reliability assurance (Cohen et al., 2017). To minimise this threat, the researcher ensured that measuring the constructs being investigated was clearly defined and understandable. Any unclear questions were avoided. Opinions from experts in academia and industry also helped to deal with ambiguous and imprecise questions.

5.9 Ethical approaches

Three ethical issues were addressed during the data collection: informed consent, confidentiality and anonymity.

Informed consent was achieved as the researcher introduced the questionnaire when it was sent to the participants' emails. In the introduction, the researcher specified the purpose of the study and informed participants that their decision to participate was based on their own voluntary decision. In this regard, every employee of a 3D printing firm who participated in the study did so out of their own free will.

Confidentiality was also achieved as the researcher ensured that every response received from the survey was used for research purposes only. Raw data from Google Forms was converted into Statistical Package for Social Sciences (SPSS) version 26, stored on the One Drive Cloud Database and encrypted to ensure that the data gathered was not exposed to any third party.

Anonymity was achieved as the researcher ensured that any information that could reveal the identity of participants, such as participant names, phone numbers and staff IDs, was not made part of the questionnaire. Emails from respondents were also deleted after they responded to the online survey.

5.10 Data analysis

First, the data gathered from Google Forms was extracted into Microsoft Excel format and then imported into the Statistical Package for Social Sciences (SPSS) version 26 software. The data was coded by assigning appropriate numerical values and entered into the SPSS software. The SPSS software was also used to analyse the demographic data of the participants as well as descriptive statistics of the variables, such as minimum, maximum, mean and standard deviations. After importing the data from SPSS, the researcher utilised Smart PLS 4 software to conduct direct and indirect (moderation) analysis for testing the proposed hypotheses. This analysis was performed using Partial Least Squares (PLS) Structural Equation Modeling (SEM). PLS-SEM is a statistical technique commonly employed in social sciences research to examine direct and indirect relationships between variables (Hair et al., 2021). It allows researchers to assess both the direct and indirect effects of variables on the outcome of interest (Cepeda-Carrion et al., 2018). In this study therefore, the researcher utilised PLS-SEM to examine the direct and indirect (moderating) relationships between emotional intelligence, emotional behavior, organisational emotional climate, and employee job performance among 3D printing firms in South Africa.

5.11 Chapter summary

This chapter described the methodology used for the study that helped to achieve the objectives. The positivist research paradigm was justified based on its epistemological, axiological and ontological assumptions. The explanatory research design and quantitative research approach were also appropriately justified. Simple random sampling was used in selecting 161 participants from a population of 275. Questionnaires were used for data collection. Data was collected online using Google Forms and analysed using SPSS and Smart PLS.

CHAPTER SIX

RESULTS AND DISCUSSIONS

6.1 Introduction

This chapter presents the results of the study and discusses them in line with relevant literature. The first section sets out the demographic analysis, which comprises variables such as participant's gender, age, highest educational qualification, work title/specification and also the number of years spent working in a 3D printing firm in South Africa. The second section presents and discusses results on the descriptive statistics of the variables used for the study: leader emotional intelligence dimensions (self-awareness, self-management, social awareness, relationship management), employee job performance (task performance, contextual performance, counterproductive behaviours), leader emotional behaviour (anger, confusion/bewilderment, depression, anxiety/tension, fatigue/strain, vigour, friendliness) and organisational emotional climate (love, joy, fear, sadness). The third section presents the PLS Structural Equation Modelling result for testing the proposed hypotheses.

6.2 Response rate

A total of 161 questionnaires were administered online using Google Forms. Out of the 161, a total of 148 were returned, giving a response rate of 91.9%. According to Saunders, Lewis and Thornhill (2019), when conducting a quantitative survey, a response rate greater than 70% makes the data appropriate for data analysis. Since this study had a response rate of 91.9%, the researcher deemed it appropriate to commence with data analysis.

6.3 Demographic information of respondents

The demographic data reveals several key implications for the 3D printing sector in South Africa. Firstly, the age distribution indicates a significant presence of mid-career professionals (36–40 years) who form the majority of respondents. This suggests a mature and experienced workforce, likely bringing stability and a wealth of industry knowledge. However, the industry's workforce is predominantly male (79.7%), highlighting a gender imbalance that may warrant attention for fostering diversity and inclusion.

Educationally, a substantial portion holds master's degrees (39.9%), reflecting a highly educated workforce, crucial for addressing the complexities of the 3D printing sector. The distribution of participants across various job titles, including CAD designers, researchers, and business developers, signifies a diverse skill set within the industry.

In terms of firm categories, the prevalence of participants in 3D printing consulting (35.8%) and software/technologies (31.8%) underscores the importance of these areas within the sector. The ethnic composition, with a majority being black South Africans (51.4%), highlights the need for inclusivity and representation initiatives to ensure a diverse industry.

The duration of employment in 3D printing firms indicates a considerable number with 4–6 years of experience, suggesting a relatively stable workforce. However, the presence of individuals with more than 10 years of experience (14.2%) indicates long-term industry expertise that can contribute to innovation and knowledge transfer.

The relevance of this demographic data to the study's objectives lies in understanding the composition of the workforce and its potential impact on the 3D printing sector. Insights into age, gender, education, job titles, and firm categories provide a

foundation for tailoring strategies to enhance diversity, skill development, and overall workforce effectiveness in the context of South Africa's 3D printing industry.

Table 6.1: Demographic information of participants

Age	Frequency	Percentage (%)
26–30 years	29	19.6
31–35 years	31	20.9
36–40 years	49	33.1
41–45 years	22	14.9
46–50 years	12	8.1
Over 50 years	5	3.4
Total	148	100

Gender	Frequency	Percentage (%)
Male	118	79.7
Female	30	20.3
Total	148	100

Highest Educational Qualification	Frequency	Percentage (%)
Advanced Certificate	5	3.4
Diploma	14	9.5
Bachelor's/Advanced Diploma	20	13.5

Honours/Postgraduate Diploma	37	25
Master's	59	39.9
Doctorate	13	8.8
Total	148	100

Work title	Frequency	Percentage (%)
Business developer	17	11.5
IT personnel	20	13.5
CAD designer	29	19.6
Operations officers	24	16.2
Sales personnel	20	13.5
Researcher	26	17.6
Marketing officer	12	8.1
Total	148	100

3D Printing Firm Category	Frequency	Percentage (%)
3D Machine reseller	11	7.4
3D Material supplier	21	14.2
Consulting	53	35.8
3D Software and related technologies	47	31.8
Design and tool making	16	10.8
Total	148	100

Ethnic Origin	Frequency	Percentage (%)
Black South Africa	76	51.4
	25	

Other Black African	26	16.9
White South Africa	21	17.6
Coloured	148	14.2
Total		100

Number of Years Spent Working in Your 3D Printing Firm	Frequency	Percentage (%)
1–3 years	22	14.9
4–6 years	71	48
7–10 years	34	23
More than 10 years	21	14.2
Total	148	100

6.4 Descriptive statistics of variables

This section presents the descriptive statistics of the variables used in the study. The descriptive statistics comprise the minimum and maximum values attained for each item used for measuring the constructs. The mean and standard deviations of the items used for measuring each construct are presented.

6.4.1 Leader emotional intelligence

Leader emotional intelligence was measured using the Emotional Competence Inventory (ECI) and comprised of 12 items under four sub-components, namely self-awareness (3), self-management (3), social awareness (3) and relationship management (3).

For the leader's self-awareness, the minimum value attained was 1.00, while 6 was the maximum. The mean values on leaders' self-awareness ranged from 4.3649–4.7770, which were greater than the median score of 3.5. This indicates that most of the respondents gave high ratings ranging from 4 (slightly agree) to 6 (strongly agree) on the variable leader's self-awareness. The standard deviation values were low compared to the mean, which implies that the values are clustered around the mean.

The minimum and maximum values attained on the leader's self-management were 1.00 and 6.00, respectively. The item "My manager easily adapts to changing situations or circumstances," had a mean score of 3.3243, which was less than the median value of 3.50. This indicates that most respondents gave low ratings of 1–3 on that specific item. However, the item "My manager learns from setbacks," had a mean value of 4.0135, while the item "My manager shows enough patience when dealing with people," had a mean value of 4.7297. This implies that high ratings of 4–6 were given on these two items. Standard deviation values were low, indicating that data points were clustered around the mean.

On the leader's social awareness, each of the three items used for measuring had a minimum value of 1.00 and a maximum value of 6.00. The mean scores on the leader's social awareness ranged from 4.5068–4.6622, which were greater than the median value of 3.50. This implies that, on social awareness, most respondents gave high ratings ranging from 4 (slightly agree) to 6 (strongly agree). The data points were clustered around their respective mean values, with low standard deviation values.

Regarding leader relationship management, 1.00 was attained as the minimum value, while 6.00 was the maximum value. The mean scores ranged from 4.5338–4.5608, which were greater than the median score of 3.50. This means that most respondents

gave high ratings of 4 (slightly agree) and 6 (strongly agree) on the construct of leader relationship management. The low standard deviation scores also showed that the data points are clustered around the mean.

Based on the descriptive statistics, it appears that the leaders of 3D printing firms in South Africa tend to demonstrate more of the interpersonal dimension of emotional intelligence than the intrapersonal dimension. The interpersonal dimension includes skills such as social awareness and relationship management, which are important for effective communication and collaboration. In contrast, the intrapersonal dimension includes skills such as self-awareness and self-management, which are important for personal growth and development.

This finding is consistent with previous research on emotional intelligence in the workplace. It has shown that leaders who demonstrate high levels of emotional intelligence tend to be more effective in their roles and that interpersonal skills are particularly important for success in leadership positions. For example, a study by Goleman et al. (2015) found that emotional intelligence is a key predictor of leadership performance and that leaders who demonstrate high emotional intelligence tend to be more effective in their roles. Another study by Higgs and Aitken (2017) found that emotional intelligence is an important factor in leadership effectiveness and that interpersonal skills such as empathy, social awareness and relationship management are particularly important for success in leadership positions.

In the context of the 3D printing industry in South Africa, there is a growing recognition of the importance of emotional intelligence for leadership effectiveness. As the industry grows and evolves, leaders must demonstrate strong interpersonal skills to succeed. For example, leaders must communicate effectively with employees, customers, and other stakeholders and build strong relationships with these groups.

They will also need to collaborate effectively with other leaders in the industry and work together to address common challenges and opportunities.

Table 6.2: Descriptive statistics on leader emotional intelligence

Self-awareness	N	Minimum	Maximum	Mean	Std. Deviation
My manager understands the implications of his/her emotions on subordinates	148	1.00	6.00	4.7770	1.29268
My manager is open to feedback from his/her subordinates	148	1.00	6.00	4.7162	1.39015
My manager is confident in the execution of his/her duties	148	1.00	6.00	4.3649	1.66251
Self-management	N	Minimum	Maximum	Mean	Std. Deviation
My manager shows enough patience when dealing with people	148	1.00	6.00	4.7297	1.55880
My manager easily adapts to changing situations/circumstances	148	1.00	6.00	3.3243	1.75823
My manager learns from setbacks	148	1.00	6.00	4.0135	1.78804

Social Awareness	N	Minimum	Maximum	Mean	Std. Deviation
My manager is open to diversity	148	1.00	6.00	4.6622	1.65597
My manager gives constructive feedback to subordinates	148	1.00	6.00	4.5068	1.57141
My manager leads by example	148	1.00	6.00	4.6014	1.55069
Relationship Management	N	Minimum	Maximum	Mean	Std. Deviation
My manager anticipates the impact of his/her actions and words on people	148	1.00	6.00	4.5608	1.43440
My manager addresses conflict issues appropriately	148	1.00	6.00	4.5541	1.49049
My manager ensures effective cooperation among employees	148	1.00	6.00	4.5338	1.45413

6.4.2 Employee job performance

Employee job performance was measured using three sub-constructs: task performance (5 items), contextual performance (7 items) and counterproductive behaviour (6 items). This section presents descriptive statistics on the three dimensions of employee job performance.

The construct task's performance was measured using five items. All five items had 1.00 as their minimum value and 6.00 as their maximum value. In terms of mean scores, the range was between 4.3514–4.6622, which were greater than 3.50 (median score). The mean scores indicate that most of the respondents gave ratings of 4 (slightly agree) and 6 (strongly agree). The standard deviation scores were also low, indicating that data points are clustered around the mean.

Contextual performance was measured using seven items. All seven items had a minimum value of 1.00 and a maximum value of 6.00. The mean scores for each of the seven items were greater than 3.50, ranging between 4.3851 and 4.905. This indicates that most respondents rated 4 (slightly agree) to 6 (strongly agree) on contextual performance. The standard deviation values for the seven items were low, which indicates that the data points are clustered around their respective mean values.

Counterproductive behaviour was measured using six items. Out of the six items, two of them, namely "I sometimes do less than is expected of me," and "I sometimes do nothing while I should have been working," had minimum values of 1.00 and maximum values of 4.00 and also had mean scores of 2.8986 and 3.3986, respectively, which were less than the median value of 3.50. This means these two items had low ratings of 1 (strongly disagree) to 3 (slightly disagree). However, the remaining four items had minimum values of 1.00 and maximum values of 5.00, with mean scores ranging from 3.6284–4.2297, which were greater than the median value of 3.50. This implies that sometimes employees of 3D printing firms exhibit counterproductive behaviours such as complaining about unimportant matters at work, making problems greater than they were and also focusing on the negative aspects of the work situation.

However, it can be inferred that the average values for counterproductive behaviours are lower than those for task and contextual performance. The results indicate that task and contextual performance are more prevalent than counterproductive behaviours in the 3D printing industry of South Africa, as evidenced by the lower mean values observed for the latter. Previous research has demonstrated that task and contextual performance are important predictors of job performance. According to a study conducted by Borman and Motowidlo (2016), task and contextual performance are crucial determinants of job performance, and their combined effect is vital for achieving success in a job. Salgado et al. (2019) attest that contextual performance plays a crucial role in professions that require effective teamwork and collaboration. Within the South African 3D printing industry, task and contextual performance appear to have a greater influence than counterproductive behaviours. This suggests that organisations prioritise achieving favourable outcomes and that employees are incentivised to actively contribute to the organisation's success.

Table 6.3 Descriptive statistics on employee job performance

Task Performance	N	Minimum	Maximum	Mean	Std. Deviation
I plan my work so that it was done on time.	148	1.00	6.00	4.4730	1.62232
I kept in mind the results that I had to achieve in my work.	148	1.00	6.00	4.3514	1.62826
I can set the priorities when performing tasks	148	1.00	6.00	4.6622	1.45945
I can separate main issues from side issues at work.	148	1.00	6.00	4.5743	1.47584

I always perform my work well within time with minimal effort.	148	1.00	6.00	4.5338	1.49564
Contextual Performance	N	Minimum	Maximum	Mean	Std. Deviation
I take on extra responsibilities at my workplace	148	1.00	6.00	4.3851	1.53208
I start new tasks by myself, when my old ones were finished.	148	1.00	6.00	4.3919	1.55023
I take on challenging work tasks, when available.	148	1.00	6.00	4.5270	1.42593
I work at keeping my job knowledge up-to-date	148	1.00	6.00	4.6149	1.34783
I come up with creative solutions to new problems.	148	1.00	6.00	4.6959	1.40291
I keep looking for new challenges in my job.	148	1.00	6.00	4.7905	1.33632
I take on challenging work tasks, when available.	148	1.00	6.00	4.7838	1.34286
Counterproductive Behaviours	N	Minimum	Maximum	Mean	Std. Deviation
I sometimes complain about unimportant matters at work.	148	1.00	5.00	4.2297	1.01750

I sometimes make problems greater than they were at work.	148	1.00	5.00	3.9527	.85979
I focus on the negative aspects of a work situation, instead of on the positive aspects.	148	1.00	5.00	3.6284	1.12655
I speak with people from outside the organisation about the negative aspects of my work.	148	1.00	5.00	3.8446	1.24383
I sometimes do less than is expected of me.	148	1.00	4.00	2.8986	.76256
I sometimes do nothing, while I should have been working.	148	1.00	4.00	3.3986	.86299

6.4.3 Leaders' emotional behaviour

Leader emotional behaviour was measured using 21 items comprising both negative emotional behaviours such as anger (3), confusion or bewilderment (3), depression (3), fatigue or strain (3), and anxiety (3) and positive emotional behaviours such as vigour (3) and friendliness (3).

The leader's anger was measured using three items. The minimum and maximum values attained were 1.00 and 5.00, respectively. For mean scores, one of the items, "My manager gets angry at subordinates who make errors in performing tasks," had a mean score of 3.4257, which was less than 3.50. This implies that there were relatively low ratings, from 1 (strongly disagree) to 3 (slightly disagree) on that item.

However, the remaining two items, namely "My manager gets angry when subordinates perform poorly in tasks assigned to them," and "My manager gets angry when subordinates are unable to meet deadlines," had mean scores of 3.5878 and 3.8243, respectively, which were both greater than the median value of 3.50. This implies that for those two items, there were relatively high ratings ranging from 4 (slightly agree) to 5 (agree). In this regard, it could be rightly inferred that the expression of anger by leaders as an emotional behaviour is prominent in the 3D printing environment in South Africa.

The construct leader's confusion or bewilderment was measured using three items. Each of the three items had a minimum value of 1.00 and a maximum value of 6.00. The mean values ranged from 4.4122–4.0473, which were greater than the median value of 3.50. This implies that the expression of the emotional behaviour of confusion exists to some extent in the 3D printing environment, which is triggered by poor communication with subordinates and poor decision-making.

The construct leader's depression was measured using three items. The minimum and maximum values attained for the construct were 1.00 and 6.00, respectively. Mean scores ranged from 3.5068–4.3919. Since the mean values were greater than the median value of 3.50, it could be rightly inferred that leader emotional behaviour of depression exists to some extent in the 3D printing environment in South Africa, which is characterised by poor concentration during working hours, restlessness, and also decreased motivation to work.

The leader's fatigue and strain were measured using three items. The minimum and maximum values attained were 1.00 and 6.00, respectively. The mean score values ranged from 3.7500–4.1824, respectively, which were greater than the midpoint value of 3.50. Therefore, the implication is that, to some extent, leaders exhibit emotional

behaviour of fatigue or strain in the 3D printing working environment, which is characterised by difficulty in managing job demands, complaints of tiredness and not having time to rest.

Leaders' anxiety and tension were measured using three items. The minimum values attained were 1.00, and the maximum values were 6.00. The mean scores ranged from 4.1014–4.2432, respectively. The mean scores were greater than the midpoint value of 3.50. This implies that, to some extent, emotional behaviour of anxiety or tension is exhibited by leaders in the 3D printing environment, characterised by feelings of job insecurity when deadlines are not met, feeling anxious when unable to solve problems and getting distressed when things go wrong at the workplace.

Despite the negative emotional behaviour exhibited to some extent by leaders in the 3D printing environment, it could be inferred that positive emotional behaviours such as vigour and friendliness are the most prominent. This is because the mean scores of the items on vigour and friendliness are higher than those of the negative emotional behaviours. For instance, regarding vigour, mean scores ranged from 4.5000–4.6419, while mean scores for friendliness ranged from 4.4527–4.5676. Comparatively, for all the negative leader emotional behaviour, the item with the highest mean score (4.4122) was item three, under confusion. In this regard, it could be rightly argued that, in as much as negative emotional behaviours are exhibited by leaders in a 3D printing environment, positive emotions such as vigour and friendliness outweigh the negative emotions.

The finding that positive emotional behaviours such as vigour and friendliness are more prominent than negative emotional behaviours among leaders in the 3D printing industry in South Africa is consistent with previous research on emotional intelligence and leadership. Leaders who exhibit positive emotional behaviours such as vigour

and friendliness are more likely to create a positive organisational climate and engage in effective communication and collaboration with their employees (Luthans & Youssef, 2017). This is particularly important in the 3D printing industry, where creativity, innovation and teamwork are critical for success.

However, it is also important to recognise that negative emotional behaviours can have a significant impact on employee well-being and job satisfaction (Liu et al., 2020). Leaders who exhibit negative emotional behaviours such as confusion, frustration or anger can create a toxic work environment that undermines employee motivation and engagement. Therefore, leaders in the 3D printing industry need to develop their emotional intelligence and be mindful of the impact their emotions have on their employees. This includes recognising and managing negative emotions as well as promoting positive emotional behaviours such as enthusiasm, empathy and optimism (George, 2015).

Table 6.4: Descriptive statistics on leader emotional behaviour

	N	Minimum	Maximum	Mean	Std. Deviation
Anger					
My manager gets angry when subordinates are unable to meet deadlines	148	1.00	5.00	3.8243	.95273
My manager gets angry when subordinates perform poorly in tasks assigned to them	148	1.00	5.00	3.5878	1.00967

My manager gets angry at subordinates who make errors in performing tasks	148	1.00	5.00	3.4257	1.01747
Confusion/Bewilderment	N	Minimum	Maximum	Mean	Std. Deviation
My manager openly expresses confusion	148	1.00	6.00	4.0473	1.35694
My manager expresses confusion when communication with subordinates is poor	148	1.00	6.00	4.1216	1.45174
My manager makes poor decisions when confused	148	1.00	6.00	4.4122	1.48887
Depression	N	Minimum	Maximum	Mean	Std. Deviation
My manager often experiences poor concentration during working hours	148	1.00	6.00	4.3108	1.32917
My manager experiences decreased motivation to work	148	1.00	6.00	4.3919	1.34839
In most instances, my manager experiences restlessness	148	1.00	6.00	3.5068	1.71626
Fatigue/strain	N	Minimum	Maximum	Mean	Std. Deviation
My manager complains of fatigue in most times	148	1.00	6.00	3.7500	1.58597

My manager finds it difficult to manage job demands at the workplace	148	1.00	6.00	4.0946	1.44438
My manager barely has time to rest at the workplace	148	1.00	6.00	4.1824	1.49392
Anxiety/tension	N	Minimum	Maximum	Mean	Std. Deviation
In most instances, my manager gets distressed when things go wrong at the workplace	148	1.00	6.00	4.1014	1.38868
My manager sometimes expresses feelings of job insecurity when deadlines are not met	148	1.00	6.00	4.2432	1.41720
My managers feels anxious when unable to solve problems that come his/her way.	148	1.00	6.00	4.1757	1.47411
Vigour/Activity	N	Minimum	Maximum	Mean	Std. Deviation
My manager exhibits positive attitude towards works	148	1.00	6.00	4.6419	1.42385
My manager shows strong physical capabilities at work	148	1.00	6.00	4.5608	1.47185
My manager has a strong mental strength that helps him/her to overcome challenges at the workplace	148	1.00	6.00	4.5000	1.51411
Friendliness	N	Minimum	Maximum	Mean	Std. Deviation

My manager is friendly towards subordinates at the workplace	148	1.00	6.00	4.5068	1.42617
My manager provides good emotional support for subordinates	148	1.00	6.00	4.5676	1.42934
There is good communication between managers and subordinates	148	1.00	6.00	4.4527	1.50886

6.4.4 Organisational emotional climate

Organisational emotional climate was measured using 12 items under the following sub-constructs: emotional climate of joy (3), emotional climate of love (3), emotional climate of sadness (3), and emotional climate of fear (3).

The emotional climate of joy was measured using three items. All three items had a minimum value of 1.00 and a maximum value of 6.00. The mean scores ranged from 4.5473 to 4.6689, which were greater than 3.50. This implies that, to a greater extent, an emotional climate of joy exists in 3D printing firms in South Africa, which is characterised by a feeling a sense of happiness at work, feeling the urge to become more creative and innovative, and also encouraging collaborations among employees to achieve goals. The finding that an emotional climate of joy is prevalent is consistent with previous studies that have highlighted the importance of positive emotions in promoting creativity, innovation, and collaboration in the workplace (Fredrickson, 2003; George, 2015). Positive emotions such as joy have been shown to broaden people's attention, increase their cognitive flexibility and enhance their ability to generate new ideas and solve problems (Fredrickson, 2001). Moreover, positive emotions have been found to promote social bonding, trust and cooperation among

team members, which are essential for effective collaboration and teamwork (George, 2015). The prevalence of an emotional climate of joy in the 3D printing firms can be attributed to several factors. First, the 3D printing industry is still in its early stages of development in South Africa, which means that many firms are still small and entrepreneurial and employees are passionate about their work and motivated to succeed (Kuklane et al., 2018). Second, 3D printing technology is inherently creative and innovative, which means that employees are encouraged to experiment and try new things, leading to a sense of excitement and joy (Scully et al., 2018). Finally, many 3D printing firms have a strong culture of collaboration, with employees working together to solve complex problems and achieve common goals (Kuklane et al., 2018).

The emotional climate of love was measured using three items with a minimum value of 1.00 and a maximum value of 6.00. The mean scores ranged from 4.3986 to 4.6486, which were greater than the midpoint value of 3.50. This indicates that the emotional climate of love is prominent in 3D printing firms to a good extent. The emotional climate of love is characterised by a sense of compassion among employees, a sense of good connection and commitment among employees, and managers showing a lot of care for the needs of employees. The presence of an emotional climate of love is consistent with the literature on the importance of positive workplace relationships and employee engagement for organisational success (Spreitzer et al., 2017; Bakker et al., 2018). Love is considered a positive emotion that can enhance employee well-being and job satisfaction and improve team dynamics and creativity (Grant, 2018). In the 3D printing industry, where collaboration and innovation are crucial, a climate of love can foster a sense of trust and commitment among employees, leading to higher levels of engagement and performance. Furthermore, research has shown that leaders who display empathy, care and compassion towards their employees are more likely to create a positive emotional climate and foster employee well-being

(Dutton et al., 2014; Liao et al., 2019). This finding is consistent with the result that the emotional climate of love in 3D printing firms in South Africa is characterised by managers showing a lot of care for the needs of employees.

The emotional climate of sadness was measured with three items. A minimum value of 1.00 and a maximum value of 5.00 were attained. Mean scores ranged from 3.6486 to 4.0946. In as much as the mean scores were greater than 3.50 (the midpoint value), they were less than the mean scores attained for the emotional climates of joy and love, respectively. This implies that an emotional climate of sadness characterised by the unhappiness of employees with working conditions and feelings of frustration when not treated well by superiors may exist in some circumstances or situations at 3D printing firms but is not as dominant as an emotional climate of joy and love.

The finding that an emotional climate of sadness exists to a lesser extent is consistent with research that suggests negative emotions can have a significant impact on employee well-being and job satisfaction (Liu et al., 2020). When employees experience negative emotions such as sadness, it can lead to decreased motivation, job dissatisfaction, and even absenteeism or turnover (Salovey & Mayer, 2017). Therefore, it is important for leaders in the 3D printing industry to be aware of the potential for negative emotions to impact their employees and take steps to mitigate them. One way to address the emotional climate of sadness is by promoting positive emotions such as joy and love. Research has shown that positive emotions can have a range of benefits for individuals and organisations, including improved performance, greater job satisfaction, and increased resilience (Fredrickson, 2001). By creating an emotional climate that prioritises positive emotions, leaders in the 3D printing industry can help buffer against negative emotions such as sadness. Furthermore, leaders can also address the emotional climate of sadness by fostering a positive work environment that values employee well-being and promotes work-life balance. This

can include offering flexible work arrangements, providing opportunities for employee development and growth and creating a supportive and inclusive workplace culture (McMullen & Shepherd, 2016).

The emotional climate of fear was also measured with three items and had minimum values of 1.00 and maximum values of 5.00. Mean scores ranged from 3.6149 to 3.9189, which were greater than 3.50 (the midpoint value) but less than the mean scores attained for the emotional climate of joy and love. The implication is that, although an emotional climate of fear may exist, it is not a dominant emotional climate in the 3D printing environment in South Africa.

This is consistent with research indicating that positive emotions such as joy and love are more likely to be experienced in the workplace than negative emotions like fear (Fredrickson, 2013). Positive emotional climates have been linked to increased productivity and job satisfaction (Carmeli et al., 2013), which is important for the growth and development of the 3D printing sector. In South Africa, the 3D printing sector is still relatively new and faces several challenges, such as a lack of funding and infrastructure (Grimm, 2021). This may contribute to a climate of uncertainty and anxiety, which could manifest as fear in the workplace. Therefore, organisations need to address these challenges and create a positive work environment that promotes collaboration and innovation. Furthermore, research has shown that emotional climate is influenced by organisational culture (Huang et al., 2015). Therefore, it is important for organisations to foster a culture that values creativity, experimentation and risk-taking while also promoting safety and quality. This can help create a positive emotional climate that promotes innovation and growth in the sector.

Table 6.5: Descriptive statistics on organisational emotional climate

Emotional Climate of Joy	N	Minimum	Maximum	Mean	Std. Deviation
In my organisation employee always feel a sense of happiness at work	148	1.00	6.00	4.5473	1.38178
At my firm, employees feel the urge to become more creative and innovative	148	1.00	6.00	4.6689	1.37217
In my firm, management encourages collaborations among employees to achieve goals	148	1.00	6.00	4.6486	1.34955
Emotional climate of love	N	Minimum	Maximum	Mean	Std. Deviation
There is a sense of compassion among employees in my firm	148	1.00	6.00	4.5811	1.53425
There is a sense of good connection and commitment among employees in my firm	148	1.00	6.00	4.6486	1.47018
In my firm, managers show a lot of care to the needs of employees	148	1.00	6.00	4.3986	1.59395
Emotional climate of sadness	N	Minimum	Maximum	Mean	Std. Deviation
In my firm, employees experience humiliation from managers when they are unable to meet targets	148	1.00	5.00	3.7703	.90422
In my firm, employees show feelings of grief when not well treated by their superiors	148	1.00	5.00	4.0946	1.16839
In my firm, employees are unhappy with their working conditions	148	1.00	5.00	3.6486	1.06180
Emotional climate of fear	N	Minimum	Maximum	Mean	Std. Deviation
In most instances, employees feel nervous about their work	148	1.00	5.00	3.6149	1.10363

In most instances, employees feel a threat to their work when they are unable to achieve targets	148	1.00	5.00	3.6216	1.07795
In most instances, employees are unable to take initiatives because they fear to make mistakes	148	1.00	5.00	3.9189	1.20381

6.5 Structural equation modelling results

This section presents results on structural equation modelling using the Smart PLS 4 software. First, results were presented to check for validity and model fit indices such as construct validity using factor loadings, convergent validity using Average Variance Extracted (AVE), reliability statistics, discriminant validity using Fornell-Larcker criterion, multicollinearity statistics using Variance Inflation Factor (VIF) and R-Square statistics. The direct and indirect (moderation) effects among the variables were also checked and decisions were taken on the acceptance or rejection of the proposed hypotheses. Results from the direct and indirect (moderation) analysis were discussed with the relevant literature and theories such as the social exchange theory and job-demands resources theory.

6.5.1 Construct validity

In structural equation modelling (SEM), construct validity refers to the degree to which the measurement model accurately reflects the measured construct (Tabachnick & Fidell, 2012). Specifically, construct validity is the extent to which the observed indicators (i.e. manifest variables) are appropriate and valid indicators of the underlying construct (i.e. latent variable). In SEM, construct validity is typically assessed by examining the factor loadings of the observed indicators on the latent variable. Factor loadings represent the strength of the relationship between the latent

variable and the observed indicator. According to Hiar, Black, Babin and Anderson (2010), factor loadings of 0.5 or above are considered a good indicator of construct validity.

From Table 6.6.1, all 12 items for measuring leader emotional intelligence had factor loadings that were greater than 0.5 and therefore met the criteria for construct validity. However, for employee job performance, the five items for measuring task performance and the seven items for measuring contextual performance had factor loadings greater than 0.5, achieving construct validity. That notwithstanding, the six items used for measuring counterproductive behaviours had factor loadings that were less than 0.5 and, therefore, could not meet the criteria for construct validity; hence, those six items were omitted from the structural equation modelling.

Out of 21 items used for measuring leader emotional behaviour, 12 had factor loadings that were greater than 0.5 and therefore met the criteria for construct validity. Such items as ANX1, ANX2, ANX3, VIG1, VIG2, VIG3, FRI1 and FRI2 were maintained in the model. However, nine variable items, such as ANG1, ANG2, ANG3, CONF1, CONF2, DEP1, DEP2 and DEP3, could not meet the criteria for construct validity since their factor loadings were less than 0.5. These nine variable items on leader emotional behaviour were omitted from the structural equation modelling. All 12 items used for organisation emotion climate had factor loadings greater than 0.5 and therefore met the criteria for construct validity. Hence, all 12 items were maintained in the structural equation modelling.

Table 6.6.1 Construct validity on leader emotional intelligence

Leader emotional intelligence valid Items	Factor loadings
SA1: My manager understands the implications of his/her emotions on subordinates	0.634
SA2: My manager is open to feedback from his/her subordinates	0.670
SA3: My manager is confident in the execution of his/her duties	0.631
SM1: My manager shows enough patience when dealing with people	0.589
SM2: My manager easily adapts to changing situations/circumstances	0.531
SM3: My manager learns from setbacks	0.693
SOA1: My manager is open to diversity	0.781
SOA2: My manager gives constructive feedback to subordinates	0.874
SOA3: My manager leads by example	0.867
RM1: My manager anticipates the impact of his/her actions and words on people	0.846
RM2: My manager addresses conflict issues appropriately	0.798
RM3: My manager ensures effective cooperation among employees	0.762

Table 6.6.2: Construct validity for employee job performance

Employee job performance valid items	Factor loadings
TP1: I plan my work so that it was done on time.	0.686
TP2: I kept in mind the results that I had to achieve in my work.	0.688
TP3: I can set the priorities when performing tasks	0.702
TP4: I can separate main issues from side issues at work.	0.765
TP5: I always perform my work well within time with minimal effort.	0.782
CP1: I take on extra responsibilities at my workplace	0.737
CP2: I started new tasks by myself, when my old ones were finished.	0.788
CP3: I take on challenging work tasks, when available.	0.800
CP4: I work at keeping my job knowledge up-to-date	0.800
CP5: I come up with creative solutions to new problems.	0.782
CP6: I keep looking for new challenges in my job.	0.757
CP7: I take on challenging work tasks, when available.	0.681

Table 6.6.3: Construct validity for leader emotional behaviour

Leader emotional behaviour valid items	Factor loadings
CONF3: My manager makes poor decisions when confused	0.557
FAT1: My manager complains of fatigue in most times	0.593
FAT2: My manager finds it difficult to manage job demands at the workplace	0.527
FAT3: My manager barely has time to rest at the workplace	0.647
ANX1: In most instances, my manager gets distressed when things go wrong at the workplace	0.715
ANX2: My manager sometimes expresses feelings of job insecurity when deadlines are not met	0.733
ANX3: My managers feels anxious when unable to solve problems that come his/her way.	0.743
VIG1: My manager exhibits positive attitude towards works	0.835
VIG2: My manager shows strong physical capabilities at work	0.849
VIG3: My manager has a strong mental strength that helps him/her to overcome challenges at the workplace	0.818
FRI1: My manager is friendly towards subordinates at the workplace	0.814
FRI2: My manager provides good emotional support for subordinates	0.795

Table 6.6.4: Construct validity for organisational emotional climate

Organisational emotional climate valid items	Factor loadings
OECLJ1: In my organisation, employees always feel a sense of happiness at work	0.775
OECLJ2: At my firm, employees feel the urge to become more creative and innovative	0.777
OECLJ3: In my firm, management encourages collaborations among employees to achieve goals	0.862
OECL1: There is a sense of compassion among employees in my firm	0.833
OECL2: There is a sense of good connection and commitment among employees in my firm	0.803
OECL3: In my firm, managers show a lot of care to the needs of employees	0.788
OECS1: In my firm, employees experience humiliation from managers when they are unable to meet targets	0.730
OECS2: In my firm, employees show feelings of grief when not well treated by their superiors	0.800
OECS3: In my firm, employees are unhappy with their working conditions	0.614
OECLF1: In most instances, employees feel nervous about their work	0.615
OECLF2: In most instances, employees feel a threat to their work when they are unable to achieve targets	0.624

OECF3: In most instances, employees are unable to take initiatives because they fear to make mistakes	0.599
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6.5.2 Convergent validity

Convergent validity is a type of validity that examines the extent to which multiple measures of the same construct are positively related to each other. Convergent validity is typically assessed by examining each construct's average variance extracted (AVE). The AVE is a measure of the amount of variance in the observed indicators that is explained by the construct. A rule of thumb for AVE suggests that the AVE value should be 0.5 to indicate good convergent validity (Fornell & Larcker, 1981; Hair, Black, Babin & Anderson, 2010). According to Table 6.6.5, the AVE values attained for the constructs comprised: leader emotional intelligence = 0.535, employee job performance = 0.560, leader emotional behaviour = 0.528 and organisational emotional climate = 0.560. From the AVE values for the constructs, it could be concluded that convergent validity was achieved since AVE values for each construct were greater than 0.5.

6.5.3 Measures of internal consistency or reliability

Cronbach's alpha, composite reliability (ρ_A), and composite reliability (ρ_C) are all measures of the internal consistency of a scale or set of items. These measures are commonly used to assess the reliability of a measure.

Cronbach's alpha measures the internal consistency of a scale or set of items. It is calculated by examining the correlation between each item and the total score and is generally considered to measure the extent to which a set of items measures a single

construct. According to Tabachnick and Fidell (2012), Cronbach alpha values greater than 0.7 indicate a good measure of internal consistency or reliability of items used for measuring the constructs. From Table 6.6.5, Cronbach alpha values attained were greater than 0.9 showing strong internal consistency of the items used for measuring the variables/constructs.

Composite reliability (ρ_A) is a measure of the internal consistency of a set of items which is based on the factor loadings of the items on the underlying construct. Values that are greater than 0.7 indicate a good measure of internal consistency (Diamantopoulos & Siguaw, 2006). For this study, composite reliability (ρ_A) values were greater than 0.9, which shows a strong measure of internal consistency of items used for measuring each of the constructs.

Table 6.6.5: Convergent validity and measures of internal consistency

	Cronbach's alpha	Composite (ρ_a)	reliability	Average (AVE)	variance	extracted
Organisational emotional climate	0.925	0.938		0.549		
Employee job performance	0.928	0.929		0.560		
Leader emotional behaviour	0.917	0.930		0.528		
Leader emotional intelligence	0.918	0.930		0.535		

6.5.4 Discriminant validity using Fornell-Larcker criterion

Discriminant validity is a type of construct validity that assesses the degree to which a measure is distinct from other unrelated measures. In other words, it is the extent to which measures of different constructs are not highly correlated. Fornell-Larcker criterion is a method for assessing discriminant validity in structural equation modelling. The Fornell-Larcker criterion assesses discriminant validity by comparing the square root of the AVE for each construct to the correlation among the constructs. Discriminant validity is achieved if the square root of the AVE for each construct is greater than the correlation between that construct and any other construct (Fornell & Larcker, 1981). From Table 6.6.6, discriminant validity was achieved because the square root of the AVE for each variable (leader emotional intelligence, employee job performance, leader emotional behaviour, organisational emotional climate) was greater than the correlation between each construct and any other construct.

Table 6.6.6: Discriminant validity using Fornell-Larcker criterion

	Organisational emotional climate	Employee job performance	Leader emotional behaviour	Leader emotional intelligence
Organisational emotional climate	0.741			
Employee job performance	0.734	0.749		
Leader emotional behaviour	0.781	0.666	0.727	
Leader emotional intelligence	0.667	0.854	0.721	0.731

6.5.5 Multicollinearity statistics using variance inflation factor (VIF)

Multicollinearity is a statistical phenomenon that occurs when two or more predictor variables are highly correlated, making it difficult to distinguish the unique effects of each predictor on the outcome variable. One commonly used measure of multicollinearity is the Variance Inflation Factor (VIF). The rule of thumb for interpreting VIF values is that a VIF value greater than 10 indicates the presence of significant multicollinearity. From Table 6.6.7, there was no incidence of multicollinearity since the VIF values of valid items used in the structural equation modelling was less than 10.

Table 6.6.7: Multicollinearity statistics using variance inflation factor (VIF)

Variable Items	VIF
ANX1	3.874
ANX2	3.892
ANX3	3.153
CONF3	1.398
CP1	2.623
CP2	4.287
CP3	3.976
CP4	3.678

CP5	4.183
CP6	5.443
CP7	3.155
FAT1	2.050
FAT2	2.054
FAT3	2.733
FRI1	5.330
FRI2	3.718
OCF1	2.708
OCF2	2.700
OCF3	2.614
OCJ1	2.863
OCJ2	3.507
OCJ3	3.850
OCL1	4.252
OCL2	4.027
OCL3	3.014

OCS1	2.230
OCS2	3.278
OCS3	2.632
RM1	4.213
RM2	3.653
RM3	2.981
SA1	2.451
SA2	2.960
SA3	2.052
SM1	1.840
SM2	1.354
SM3	1.954
SOA1	3.091
SOA2	5.768
SOA3	5.479
TP1	3.020
TP2	3.057

TP3	2.475
TP4	4.638
TP5	4.547
VIG1	3.415
VIG2	4.838
VIG3	5.244

6.5.6 R-square and adjusted R-square

In Structural Equation Modelling (SEM), the R-square measures the proportion of variance in the dependent variable that can be explained by the independent variables in the model. The adjusted R-square is a modified version of the R-square that considers the number of independent variables in the model. According to the R-square value of 0.801, it could be rightly inferred that 80.1% of the variation in employee job performance could be explained by leader emotional intelligence in the 3D printing sector in South Africa.

However, the r-square value of 0.520 indicates that 52% of the variation in leader emotional behaviour is explained by leader emotional intelligence in the 3D printing sector in South Africa. The r-square value of 0.632 implies that 63.2% of the variation in organisational emotional climate is explained by leader emotional intelligence in the sector.

Table 6.6.8: R-square

	R-square	R-square adjusted
Organisational emotional climate	0.632	0.627
Employee job performance	0.801	0.795
Leader emotional behaviour	0.520	0.517

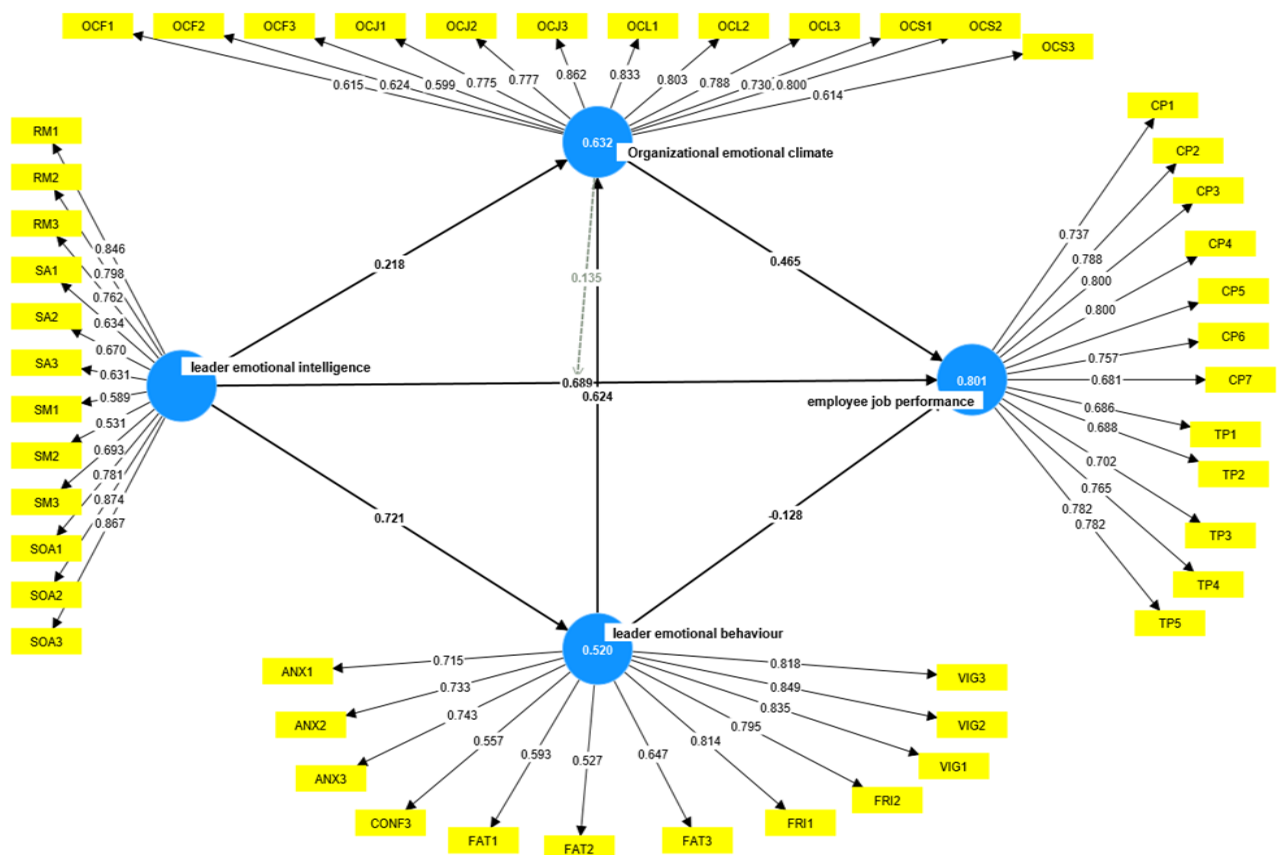


Figure 6.1: Structural equation model

6.5.7 Hypotheses testing and discussion of results

This section tests the hypotheses proposed for direct and indirect (moderating) effects. Decisions were taken as to whether the hypotheses tested were supported or not. Furthermore, the results based on the research hypotheses were discussed in line with the relevant literature.

Table 6.6.9: Hypotheses testing

Hypotheses	B-value	t-statistic	p-value	Decision
H1: Leader emotional intelligence -> employee job performance	0.689	8.695	0.000	Supported
H2: Leader emotional intelligence -> leader emotional behaviour	0.721	12.358	0.000	Supported
H3: Leader emotional intelligence -> organisational emotional climate	0.218	2.755	0.006	Supported
H4: Leader emotional behaviour -> organisational emotional climate	0.624	8.727	0.000	Supported

H5: Organisational emotional climate -> employee job performance	0.465	6.347	0.000	Supported
H6: Leader emotional behaviour -> employee job performance	-0.128	1.579	0.114	Not Supported
H7: Organisational emotional climate x leader emotional intelligence -> employee job performance	0.135	3.755	0.000	Supported

6.5.7.1 Effect of leader emotional intelligence and employee job performance

Based on the findings, it can be inferred that a significant favourable correlation exists between leaders' emotional intelligence and employees' job performance in 3D printing companies in South Africa ($B = 0.689$, $p = 0.000$). This suggests a positive correlation between leaders' emotional intelligence and employees' job performance, with a significant increase of 68.9%. This means that Hypothesis 1 has been validated. This discovery aligns with prior research. According to Vratskikh et al. (2016), a positive correlation exists between the emotional intelligence exhibited by leaders and job performance and job satisfaction in Jordan.

Pant and Yadav (2016) have reported that effective stress management by leaders with high emotional intelligence positively impacts on employee job performance in Indian software companies. According to Ahmed et al. (2015), a noteworthy positive correlation exists between the emotional intelligence exhibited by leaders and the job performance of employees in higher education institutions located in Pakistan. Loh and Yee (2017) demonstrated that leaders' emotional intelligence predicted employee

job performance in Malaysian manufacturing firms. This result is also in congruence with job demand and resource theory. This is because, in the context of the 3D printing sector in South Africa, a leader's emotional intelligence could be considered a job resource. Emotionally intelligent leaders can better control their own emotions and the emotions of their subordinates, communicate effectively and also gain social support. These activities may help create a positive work atmosphere while improving employee job performance.

6.5.7.2 Leader emotional intelligence and leader emotional behaviour

The findings indicate a significant positive connection between the emotional intelligence of leaders and their emotional behaviour in 3D printing firms in South Africa ($B = 0.721$, $p = 0.000$). Consequently, it can be inferred that enhancements in a leader's emotional intelligence result in a 72.1% increase in emotional behaviour by the leader. Thus, Hypothesis 2 has been supported. The finding is consistent with previous research. Dabke's (2016) study found that leaders with high emotional intelligence are more likely to exhibit positive emotional behaviours. Siegling, Nielsen and Petrides (2014b) also suggested that emotional intelligence helps leaders control negative emotions such as anger, confusion, despair and worry while exhibiting positive emotions such as empathy, positive reinforcement, gratitude, active listening and optimism.

The finding is also discussed in congruence with the social exchange theory, which posits that relationships between leaders and subordinates are built on a series of transactions in which each participant expects to obtain benefits equal to the costs (Blau, 1964). In this regard, employees are more likely to be devoted and engaged in the context of leadership if they believe their leader is supportive and responsive to their emotional needs (Cropanzano & Mitchell, 2005). Due to their emotional

intelligence, leaders who demonstrate good emotional behaviours may be more likely to engage in positive relationships with their subordinates, resulting in increased work satisfaction and employee job performance. It is also emphasised that positive connections between leaders and subordinates may be especially important in South Africa's 3D printing business, where competition for talent is intense. Leaders who display positive emotional behaviours may attract and retain top talent as a consequence of their emotional intelligence, resulting in a more engaged and productive staff.

6.5.7.3 Effect of leader emotional intelligence on organisational emotional climate

According to the results, a significant and positive association exists between a leader's emotional intelligence and the organisational emotional climate ($B = 0.218$, $p = 0.006$). According to the findings, a leader's emotional intelligence has a 21.8% positive influence on the organisational emotional climate. Hypothesis 3 was therefore supported. The findings are consistent with previous research. Maddocks's (2017) study supports this result by revealing that the interpersonal dimensions of emotional intelligence (social awareness and relationship management) have a stronger link with the emotional climate of the workplace than the intrapersonal dimensions (self-awareness and self-management).

The study by Sembiring et al. (2020) confirms a positive relationship between leader emotional intelligence and organisational caring climate. This is relevant because a caring atmosphere is associated with higher levels of job satisfaction, organisational fairness and productivity. Leaders with high emotional intelligence may be more adept at creating a caring climate within their organisations, resulting in improved employee job performance outcomes. Several studies have also found significant positive

correlations between a leader's emotional intelligence and the emotional climate within organisations (Ahmed & Zaheer, 2015; Yatim et al., 2016; Zakeri et al., 2017).

The result is also discussed in light of the job demands and resources theory, which holds that the interaction between job demands and resources affects employee well-being, job satisfaction and performance. According to Bakker and Demerouti (2014), the theory of job demand resources predicts that improving emotional intelligence in leaders could result in a substantial improvement in the emotional climate of the organisation. The rationale for this is because a positive climate is a valuable resource that may significantly influence employee well-being and work performance. Leaders who exhibit emotional intelligence are more likely to create a positive emotional environment, which may be considered useful for their subordinates. A positive emotional climate can reduce job-related stress and improve the overall well-being and work performance of workers in the South African 3D printing industry.

6.5.7.4 Effect of leader emotional behaviour on organisational emotional climate

The results indicated a significant positive association between leader emotional behaviour and organisational emotional climate ($B = 0.624$, $p = 0.000$). Thus, leader emotional behaviour positively contributes to the organisational emotional climate by 62.4%. Hypothesis 4 was therefore supported. The result was supported by previous research. According to Gooty et al. (2016), a positive correlation exists between the emotional behaviour of leaders and the positive emotional climate of organisations and the job satisfaction of employees. The result is also consistent with the study by Kelloway et al. (2015), which established that the emotional behaviour of leaders has a significant positive association with organisational emotional climate. According to

Chen et al. (2015), a significant positive correlation exists between leader emotional behaviour and organisational emotional behaviour in Chinese banks.

Apart from the result supported by the empirical literature from previous studies, the job demand resources theory also provides insights into the result. This is because a positive organisational emotional climate could serve as an organisational resource that promotes employee well-being and work performance in the 3D printing sector in South Africa. On the other hand, positive leader emotional behaviour is also considered a managerial resource that has positive implications on employee work satisfaction and performance. In this regard, despite the job demands and stressors that employees of 3D printing firms could be exposed to, positive leader emotional behaviour such as empathy, vigour and friendliness could promote positive organisational emotional climates of joy and love. This would contribute to effective coping with job demands and stressors and improve employee work performance.

6.5.7.5 Effect of organisational emotional climate on employee job performance

The research indicates a striking correlation between an organisation's emotional climate and its employees' job performance ($B = 0.465$, $p = 0.000$). This suggests that enhancements in the emotional climate of an organisation result in a 46.5% increase in employee job performance. Therefore, it can be concluded that Hypothesis 5 has been validated. The finding that a favourable emotional atmosphere within organisations has a notable beneficial influence on employee job performance aligns with prior research on the subject, as outlined in the literature presented. Specifically, Seppala and Cameron (2015) and Barsade and Knight (2015) suggest that organisations can benefit from promoting positive emotional climates, such as those characterised by love, pleasure and companionate love, which can enhance employee job performance.

Moreover, other studies cited in the literature also support the notion that a positive emotional climate can have beneficial effects on job performance by fostering employee resilience (Lee & Seo, 2019), enhancing job satisfaction (Ram & Prabhakar, 2019) and increasing work engagement (Jaiswal & Dhar, 2020). Additionally, Alwis and Amarasinghe (2022) and Adekoya and Adekoya (2021) found that emotional climate had a significant positive impact on job performance among public sector employees in Sri Lanka and various organisations in Nigeria, respectively. Mamun and Islam (2021) found a similar positive effect on job performance among healthcare workers in Bangladesh.

This finding is also discussed in congruence with the social exchange theory. This is because when employees perceive that their organisation values their emotional well-being, they may reciprocate by investing more effort into their work and performing better. This reciprocal relationship between employees and their organisation can lead to a virtuous cycle of positive outcomes, including improved job performance among 3D printing firms in South Africa.

6.5.7.6 Effect of leader emotional behaviour on employee job performance

The results of the study showed that a non-significant negative relationship exists between leader emotional behaviour and employee job performance (-0.128 , $p = 0.114$). This was because the p-value associated with the relationship between leader emotional behaviour and employee job performance was greater than 0.05. Hence Hypothesis 6 was not confirmed. The finding that there is a non-significant negative relationship between leader emotional behaviour and employee job performance is interesting but not entirely unexpected. While previous research has shown that leaders who display positive emotional behaviours can positively impact employee job

performance (Dulebohn et al., 2012; Bambale et al., 2016; Ongori & Agolla, 2018), the current study suggests that the effect may not be as straightforward as previously thought. It is possible that the effect of leader emotional behaviour on job performance is moderated by other factors, such as the specific job demands and resources that employees face.

6.5.7.7 Moderating role of organisational emotional climate

According to the results, it was found that organisational emotional climate positively moderated the relationship between leader emotional intelligence and employee job performance (0.135, $p = 0.00$). Thus, the interaction between organisational emotional climate and leader emotional intelligence positively contributed to employee job performance by 13.5%. Hence, Hypothesis 7 was confirmed. The finding that organisational emotional climate positively moderates the relationship between leader emotional intelligence and employee job performance is consistent with previous research, which has shown that organisational emotional climate moderates the relationship between leader emotional intelligence and employee job performance (Côté & Miners, 2016; Karimi et al., 2019).

The finding of the study is also explained using the job-demand resources theory. This is because a leader's emotional intelligence is considered a managerial resource, while organisational emotional climate is also considered as an organisational resource. In the 3D printing sector in South Africa, which is a fast-growing industry, employees may face various job demands, such as tight project deadlines and complex technical tasks. However, providing a positive emotional climate through effective leadership and organisational climate can help employees cope with these demands and enhance their performance. For example, leaders with high emotional intelligence can create a positive emotional climate by promoting positive emotions,

such as enthusiasm and support and managing negative emotions such as stress and frustration. Additionally, organisational interventions, such as team-building activities, can help foster positive emotional climates and create a sense of social support among employees, contributing to their overall well-being and work performance.

6.6 Chapter summary

This chapter presented the results of the study and also discussed them with relevant empirical literature as well as the job demand resources theory and social exchange theory. All seven hypotheses were tested for direct and moderating effects using the PLS structural equation modelling. Six out of the seven hypotheses were supported, while one hypothesis was not supported. In the next chapter, the study provides the conclusions based on the results of the study and also provides practical recommendations and recommendations for future studies.



CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

The focus of this study was to examine the moderating effect of organisational emotional climate on the relationship between leader emotional intelligence, leader emotional behaviour and employee job performance among 3D printing firms in South Africa. The study was guided by seven research objectives, questions and hypotheses and supported by a conceptual framework. Out of the seven hypotheses tested using Partial Least Squares (PLS) Structural Equation modelling, six hypotheses were accepted, while one was rejected. In this chapter, the study provides the conclusions derived from the results of the study and its related practical recommendations. The chapter also provides suggestions that future researchers can explore on the subject matter among 3D printing firms in South Africa.

7.2 Conclusions based on empirical findings

In this section, the study provides conclusions based on each of the hypotheses that were tested using PLS Structural Equation Modelling. Table 7.1 provides a summary of conclusions based on the findings discussed in Chapter 6 followed by a detailed narrative.

Table 7.1: Conclusions on the hypotheses/ objectives

Objectives	Hypotheses	Sig (0.05)	@	Result (Accept/Reject)	Conclusion
To assess the relationship between leaders' emotional intelligence and employee job performance among 3D printing firms.	H1: There will be a significant positive relationship between leaders' emotional intelligence and employee job performance among 3D printing firms.	0.000		Supported	Leader emotional intelligence positively contributes to employee job performance among 3d printing firms in south Africa.
To examine the relationship between leaders' emotional intelligence and leaders' emotional behaviour among 3D printing firms.	H2: There will be a significant positive relationship between leaders' emotional intelligence and leaders' emotional behaviour among 3D printing firms.	0.000		Supported	Leader emotional intelligence positively contributes to leader's emotional behaviour among 3D printing firms in South Africa
To examine the relationship between leaders' emotional intelligence and organisational emotional climate among 3D printing firms.	H3: There will be a significant positive relationship between leaders' emotional intelligence and organisational emotional climate among 3D printing firms.	0.006		Supported	Leader emotional intelligence positively contributes to organisational emotional climate among 3D printing firms in South Africa.
To assess the relationship between leaders' emotional behaviour and organisational emotional climate among 3D printing firms.	H4: There will be a significant positive relationship between leaders' emotional behaviour and organisational emotional climate among 3D printing firms.	0.000		Supported	Leader emotional behaviour positively contributes to leaders' emotional behaviour among 3D printing firms in South Africa.

To assess the relationship between organisational emotional climate and employee job performance among 3D printing firms.	H5: There will be a significant positive relationship between organisational emotional climate and employee job performance among 3D printing firms.	0.000	Supported	Organisational emotional climate positively contributes to employee job performance among 3D printing firms in South Africa.
To examine the relationship between leaders' emotional behaviour and employee job performance among 3D printing firms.	H6: There will be a significant positive relationship between leaders' emotional behaviour and employee job performance among 3D printing firms.	0.114	Not Supported	Leaders' emotional behaviour does not positively contribute to employee job performance among 3D printing firms in South Africa.
To develop and test a structural model for employee job performance based on emotional intelligence.	H7: Organisational climate will moderate the relationship between leaders' emotional intelligence and job performance among 3D printing firms.	0.000	Supported	Organisational emotional climate strengthens (moderates) the relationship between leaders' emotional intelligence and employee job performance among 3D printing firms in South Africa.

7.2.1 Conclusions on hypothesis one

The first hypothesis was accepted since a significant positive relationship existed between leader emotional intelligence and employee job performance among 3D printing firms in South Africa. The study, therefore, concludes that as the industry continues to evolve, attention must not only be given to the technical and engineering aspects of 3D printing but also managerial skills, such as leader emotional intelligence, must be given the utmost attention because of its positive implications on employee job performance.

7.2.2 Conclusions on hypothesis two

The second hypothesis was also accepted since a significant positive relationship existed between leader emotional intelligence and leader emotional behaviour. The study, therefore, concludes that due to emotional intelligence, leaders in 3D printing firms are better positioned to exhibit positive emotions such as vigour and friendliness and also control negative emotions such as anger, depression, anxiety and confusion, among others. In this regard, the study concludes that leader emotional intelligence must be a strategic managerial skill that can help leaders to exhibit positive emotional behaviours in the 3D printing working environment in South Africa.

7.2.3 Conclusions on hypothesis three

Hypothesis three was accepted since a significant positive association existed between leader emotional intelligence and organisational emotional climate. Based on this finding, the study concluded that leaders with high levels of emotional intelligence in the 3D printing sector in South Africa can create a positive organisational emotional climate, such as an organisational emotional climate of joy and love. The study further concludes that the significant positive association between leader emotional intelligence and positive organisational emotional climate has implications for positive organisational outcomes such as employee job satisfaction, productivity and performance. Hence, the argument that leader emotional intelligence can be a strategic managerial asset for the 3D printing sector in South Africa is most appropriate.

7.2.4 Conclusions on hypothesis four

Hypothesis four was also accepted, as a significant positive relationship existed between leader emotional behaviour and organisational emotional climate. From the finding, the study concludes that positive leader emotional behaviour, such as vigour and friendliness, can create positive organisational behaviour such as an organisational emotional climates of love and joy. The study further concludes that positive organisational emotional behaviour promotes positive work outcomes such as healthy relationships among coworkers, employee satisfaction and commitment and improved job performance, which are relevant for the growth and productivity of the 3D printing sector in South Africa.

7.2.5 Conclusions on hypothesis five

The fifth hypothesis was supported since a significant positive connection was found between organisational emotional climate and employee job performance among 3D printing firms in South Africa. The study concludes that a positive organisational emotional climate, such as emotional climates of love and joy, has positive implications for employee job performance in the sector. In this regard, promoting healthy relationships, effective communication and teamwork among employees contribute to positive organisational emotional climates of joy and love, essential for improving employee job performance.

7.2.6 Conclusions on hypothesis six

Hypothesis six was not accepted since a non-significant negative relationship existed between leader emotional behaviour and employee job performance. From this finding, the study concludes that, in as much as it was expected that positive leader

emotional behaviour such as vigour and friendliness could lead to improve job performance, it could not always be the case in the 3D printing sector in South Africa. This is because there could be other factors, such as employee working conditions in terms of remuneration and work benefits, level of motivation in the firm and job satisfaction which could influence their job performance.

7.2.7 Conclusions on hypothesis seven

Hypothesis seven was accepted since the study results showed that organisational climate positively moderated the relationship between leader emotional intelligence and employee job performance. Based on the result, the study concludes that leaders with high levels of emotional intelligence can create positive organisational emotional climates of love and joy, which lead to improved job performance. The study also concludes that creating positive organisational emotional climates of love and joy among 3D printing firms in South Africa is instrumental in enhancing the impact of leader emotional intelligence on employee job performance.

7.3 Recommendations

This section provides recommendations for policy, practice and further studies.

7.3.1 Recommendations for policy

Based on the results and conclusions, the study provides the following recommendations for policy:

Firstly, policy stakeholders in 3D printing sector in South Africa such as RAPDASA, CRPM, 3D printing researchers and managers of 3D printing firms in South Africa, should recognise the importance of emotional intelligence as a critical competency for effective leadership. Policy stakeholders should also encourage 3D printing firms to integrate emotional intelligence training into their managerial development programs. This can be achieved through collaborations with educational institutions, professional associations, and industry experts to ensure that leaders of 3D printing firms in South Africa receive comprehensive training in emotional intelligence.

Secondly, policy stakeholders should play a role in establishing guidelines or standards for assessing emotional intelligence in the recruitment and selection processes of employees within the 3D printing industry. This can involve working with human resource experts and industry stakeholders to develop assessment tools and criteria that accurately measure emotional intelligence competencies of prospective employees of 3D printing firms during recruitment and selection processes.

Lastly, policy stakeholders should influence the development of leadership competency frameworks to include emotional intelligence as a core component. By aligning these leadership frameworks with industry standards, policy stakeholders can ensure that emotional intelligence is recognised as an essential skill for effective leadership within the 3D printing industry.

7.3.2 Recommendations for practice

Dwelling on the results and conclusions, the researcher provides the following recommendations for practice:

The study recommends that training programmes on leader emotional intelligence for 3D printing firms must adopt a practical approach where leaders can understand how to identify and regulate their emotions and identify and manage the emotions of their subordinates. Furthermore, practical training programmes on emotional intelligence for leaders will enhance their ability to understand both positive and negative emotional behaviours and how they can improve on positive emotional behaviours while controlling negative emotional behaviours in the working environment.

Secondly, the study recommends the need for training and capacity building for leaders on developing and maintaining positive organisational emotional climates such as an organisational emotional climates of love and joy. The acquisition of managerial skills in creating and maintaining positive organisational emotional climates will be relevant for achieving positive employee outcomes such as employee job satisfaction, productivity and job performance, which has ramifications on the growth and development of 3D printing firms in South Africa.

Thirdly, the study recommends the need for 3D printing firms to adopt emotional intelligence as a prerequisite in their recruitment of employees and appointment of leaders instead of focusing only on technical skills. This will enable the firms to continually develop human resource capacities that are focused on not only technical skills but also critical soft skills, such as emotional intelligence, which has positive implications for employee outcomes such as job performance and organisational outcomes such as organisational emotional climates of love and joy.

Furthermore, the study recommends the need for 3D printing firms to create an open employee feedback system and working environment where employees can feel comfortable communicating with management easily on issues pertaining to their working conditions, motivation and satisfaction with their jobs. This will create good

coherence between management and employees and also instil employee confidence to improve their work performance.

Finally, the study recommends the need for government support for training and capacity building in the 3D printing industry in South Africa to also allocate funding for training and workshops for leaders to be trained in key managerial skills such as leader emotional intelligence, developing positive emotional behaviour, controlling negative emotional behaviour and also developing and managing positive organisational emotional behaviour. Funding for training on emotional intelligence for 3D printing firms will enable them to organise appropriate training programmes and workshops and reap the benefits in terms of improved job performance.

7.3.3 Recommendations for future studies

Based on the results and conclusions, the study provides the following recommendations for future studies.

Firstly, in as much as the study assessed the moderating role of organisational emotional climate on the relationship between leader emotional intelligence, leader emotional behaviour and employee job performance, future researchers can focus on the mediating effects of organisational emotional climate on the relationships between leader emotional intelligence, leader emotional behaviour and employee job performance.

Secondly, future researchers can use leader emotional behaviour as a moderating or mediating variable. In this regard, the moderating or mediating effect of leader emotional behaviour on the relationships between leader emotional intelligence and employee job performance can be conducted by future researchers.

Thirdly, future researchers can expand the scope of this study by not limiting it to the 3D printing sector in South Africa alone. Rather, other manufacturing firms in South Africa that have adopted the traditional manufacturing approach can be included in studies conducted by future researchers. Again, manufacturing firms using the hybrid manufacturing model, which combines both 3D printing and traditional manufacturing, can be included to expand the scope for future researchers.

Lastly, since this study used the quantitative research approach, future researchers can adopt the mixed research approach, combining both quantitative and qualitative research methods to gain an in-depth understanding of why certain relationships were found in the study's results.

7.4 Chapter summary

In this chapter, the conclusions of the study were provided based on the results of the study. Practical recommendations were also presented which portray the need for a paradigm shift from the technical and engineering aspect of 3D printing training programmes to the managerial dimension by giving emotional intelligence the utmost priority.

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APPENDIX

QUESTIONNAIRE FOR DATA COLLECTION

Dear respondent. I am Afrifa S.J. I am a PhD student from the Central University of Technology (CUT) Free State in South Africa. My supervisor is Professor Dennis Yao Dzansi from the same university.

I am researching on the topic: An explanatory structural model of employee job performance in the 3D printing environment in South Africa. The study's main objective is to assess the interactive effects of leaders' emotional intelligence, leaders' emotional behaviour and organisational emotional climate on employee job performance among 3D printing firms in South Africa.

I would be very grateful for your assistance in completing the questions below. Please read the statements carefully and mark **x** the number that corresponds to your choice. The study is entirely for academic purpose, hence any information provided would be considered valuable and confidential. It is hoped that you would be as candid as possible. Thank you.

Please mark appropriate answer with X in the applicable box								
1.	Your age (in years)							
2.	Your gender	1 Male				2 Female		
3.	Your highest qualification	1 Advanced Certificate	2 Diploma	3 Bachelors/ AdvDiploma	4 Honours/ PGDiploma	4 Masters	5 Doctorate	6 Other (specify)
4.	State the work you do in the firm							

5.	Which category best describes your current 3D printing firm	1 3D Machine Reseller	2 3D Material Supplier	3 Consulting	4 3D Software & related Technologies	5 Design and Tool Making	6 Other (specify)
6.	Please indicate your ethnic origin	1 Black South African	2 Other Black African	3 White South African	4 Indian/Asian	5 Coloured	6 Other (specify)
7.	Please indicate the number of years you have been in 3D printing						

Please express your candid opinions on the following statements by choosing from the options 1-6							
8.	My manager understands the implications of his/her emotions on subordinates	1 Strongly Disagree	2 Disagree	3 Slightly Disagree	4 Slightly Agree	5 Agree	6 Strongly Agree
9.	My manager is open to feedback from his/her subordinates	[1]	[2]	[3]	[4]	[5]	[6]
10.	My manager is confident in the execution of his/her duties	[1]	[2]	[3]	[4]	[5]	[6]
11.	My manager shows enough patience when dealing with people	[1]	[2]	[3]	[4]	[5]	[6]
12.	My manager easily adapts to changing situations/circumstances	[1]	[2]	[3]	[4]	[5]	[6]
13.	My manager learns from setbacks	[1]	[2]	[3]	[4]	[5]	[6]
14.	My manager is open to diversity	[1]	[2]	[3]	[4]	[5]	[6]
15.	My manager gives constructive feedback to subordinates	[1]	[2]	[3]	[4]	[5]	[6]
16.	My manager leads by example	[1]	[2]	[3]	[4]	[5]	[6]
17.	My manager anticipates the impact of his/her actions and words on people	[1]	[2]	[3]	[4]	[5]	[6]
18.	My manager addresses conflict issues appropriately	[1]	[2]	[3]	[4]	[5]	[6]

19.	My manager ensures effective co-operation among employees	[1]	[2]	[3]	[4]	[5]	[6]
20.	I plan my work so that it was done on time.	[1]	[2]	[3]	[4]	[5]	[6]
21.	I kept in mind the results that I had to achieve in my work.	[1]	[2]	[3]	[4]	[5]	[6]
22.	I can set the priorities when performing tasks	[1]	[2]	[3]	[4]	[5]	[6]
23.	I can separate main issues from side issues at work.	[1]	[2]	[3]	[4]	[5]	[6]
24.	I always perform my work well within time with minimal effort.	[1]	[2]	[3]	[4]	[5]	[6]
25.	I take on extra responsibilities at my workplace	[1]	[2]	[3]	[4]	[5]	[6]
26.	I start new tasks by myself, when my old ones were finished.	[1]	[2]	[3]	[4]	[5]	[6]
27.	I take on challenging work tasks, when available.	[1]	[2]	[3]	[4]	[5]	[6]
28.	I work at keeping my job knowledge up-to-date	[1]	[2]	[3]	[4]	[5]	[6]
29.	I come up with creative solutions to new problems.	[1]	[2]	[3]	[4]	[5]	[6]
30.	I keep looking for new challenges in my job.	[1]	[2]	[3]	[4]	[5]	[6]
31.	I take on challenging work tasks, when available.	[1]	[2]	[3]	[4]	[5]	[6]

32.	I sometimes complain about unimportant matters at work.	1 Strongly Disagree	2 Disagree	3 Slightly Disagree	4 Slightly Agree	5 Agree	6 Strongly Agree
33.	I sometimes make problems greater than they were at work.	[1]	[2]	[3]	[4]	[5]	[6]

34.	I focus on the negative aspects of a work situation, instead of on the positive aspects.	[1]	[2]	[3]	[4]	[5]	[6]
35.	I speak with people from outside the organisation about the negative aspects of my work.	[1]	[2]	[3]	[4]	[5]	[6]
36.	I sometimes do less than is expected of me.	[1]	[2]	[3]	[4]	[5]	[6]
37.	I sometimes do nothing, while I should have been working.	[1]	[2]	[3]	[4]	[5]	[6]
38.	My manager gets angry when subordinates are unable to meet deadlines	[1]	[2]	[3]	[4]	[5]	[6]
39.	My manager gets angry when subordinates perform poorly in tasks assigned to them	[1]	[2]	[3]	[4]	[5]	[6]
40.	My manager gets angry at subordinates who make errors in performing tasks	[1]	[2]	[3]	[4]	[5]	[6]
41.	My manager openly expresses confusion	[1]	[2]	[3]	[4]	[5]	[6]
42.	My manager expresses confusion when communication with subordinates is poor	[1]	[2]	[3]	[4]	[5]	[6]
43.	My manager makes poor decisions when confused	[1]	[2]	[3]	[4]	[5]	[6]
44.	My manager often experiences poor concentration during working hours	[1]	[2]	[3]	[4]	[5]	[6]
45.	My manager experiences decreased motivation to work	[1]	[2]	[3]	[4]	[5]	[6]
46.	In most instances, my manager experiences restlessness	[1]	[2]	[3]	[4]	[5]	[6]
47.	My manager complains of fatigue in most times	[1]	[2]	[3]	[4]	[5]	[6]
48.	My manager finds it difficult to manage job demands at the workplace	[1]	[2]	[3]	[4]	[5]	[6]
49.	My manager barely has time to rest at the workplace	[1]	[2]	[3]	[4]	[5]	[6]

50.	In most instances, my manager gets distressed when things go wrong at the work place	[1]	[2]	[3]	[4]	[5]	[6]
51.	My manager sometimes expresses feelings of job insecurity when deadlines are not met	[1]	[2]	[3]	[4]	[5]	[6]
52.	My managers feels anxious when unable to solve problems that come his/her way.	[1]	[2]	[3]	[4]	[5]	[6]

53.	My manager exhibits positive attitude towards works	1 Strongly Disagree	2 Disagree	3 Slightly Disagree	4 Slightly Agree	5 Agree	6 Strongly Agree
54.	My manager shows strong physical capabilities at work	[1]	[2]	[3]	[4]	[5]	[6]
55.	My manager has a strong mental strength that helps him/her to overcome challenges at the workplace	[1]	[2]	[3]	[4]	[5]	[6]
56.	My manager is friendly towards subordinates at the workplace	[1]	[2]	[3]	[4]	[5]	[6]
57.	My manager provides good emotional support for subordinates	[1]	[2]	[3]	[4]	[5]	[6]
58.	There is good communication between managers and subordinates	[1]	[2]	[3]	[4]	[5]	[6]
59.	In my organisation employee always feel a sense of happiness at work	[1]	[2]	[3]	[4]	[5]	[6]
60.	At my firm, employees feel the urge to become more creative and innovative	[1]	[2]	[3]	[4]	[5]	[6]
61.	In my firm, management encourages collaborations among employees to achieve goals	[1]	[2]	[3]	[4]	[5]	[6]

62.	There is a sense of compassion among employees in my firm	[1]	[2]	[3]	[4]	[5]	[6]
63.	There is a sense of good connection and commitment among employees in my firm	[1]	[2]	[3]	[4]	[5]	[6]
64.	In my firm managers show a lot of care to the needs of employees	[1]	[2]	[3]	[4]	[5]	[6]
65.	In my firm employees experience humiliation from managers when they are unable to meet targets	[1]	[2]	[3]	[4]	[5]	[6]
66.	In my firm, employees show feelings of grief when not well treated by their superiors	[1]	[2]	[3]	[4]	[5]	[6]
67.	In my firm, employees are unhappy with their working conditions	[1]	[2]	[3]	[4]	[5]	[6]
68.	In most instances, employees feel nervous about their work	[1]	[2]	[3]	[4]	[5]	[6]
69.	In most instances, employees feel a threat to their work when they are unable to achieve targets	[1]	[2]	[3]	[4]	[5]	[6]
70.	In most instances, employees are unable to take initiatives because they fear to make mistakes	[1]	[2]	[3]	[4]	[5]	[6]

Thank you for participating in this study