



Exploring factors influencing competencies of scientific laboratory technicians and recommendations for improvement: A case study of a Scientific Laboratory based in a resource constraint setting.

By: *PhD Candidate:* Paidamoyo Kachambwa, KCHPAI001

Supervisor: A/Prof. Delva Shamley*

Co-Supervisor: Dr. Elmi Badenhorst*

Co-Supervisor: Dr. Amaal Abrahams*

Co-Supervisor: Dr. Danica Sims**

University of Cape Town* *University of Oxford*

For: Submitted to the Department of Human Biology in the Faculty of Health Sciences at the University of Cape Town.

In fulfilment of: The requirements for the degree, Doctor of Philosophy.

Date of Submission: 30 August 2024

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

Table of Contents

Table of Contents	2
Declaration	7
Acknowledgements	8
Abstract	9
Glossary	10
1. Chapter 1: Introduction	12
1.1. The importance of scientific laboratories in Africa (and the world)	12
1.2. Learning interventions are key for increasing capacity and quality outputs.	16
1.3. Organizational and Systems challenges.....	19
1.4. Rationale for undertaking study	21
1.5. Research Strategy: Transdisciplinary.....	23
1.6. Conceptual Framework: Linking competencies and quality outputs.	24
1.7. Outline of Dissertation	29
2. Chapter 2: Literature Review	31
2.1. Literature review strategy	31
2.2. Literature Review in relation to the research topic.....	34
2.3. Systems Theory - focusing on the Scientific Laboratory as a business.	42
2.3.1. <i>Systems theory in relation to business demands at the organization.</i>	42
2.3.2. <i>Systematic factors that inform understanding of phenomena</i>	45
2.3.2.1. PESTLE (macro level, external factors)	47
2.3.2.2. CATWOE (macro level, mainly internal factors)	52
2.3.2.3. GEMBA (micro level, internal and external factors, expanding on subset processes found in Rich picture and CIMO algorithms)	56

2.3.2.4.	Fishbone (micro level, internal and external factors, expanding on subset influences found in Rich picture and CIMO algorithms).....	61
2.3.2.5.	Rich picture (micro level, internal and external factors)	63
2.3.2.6.	CIMO (micro level, internal and external factors)	66
2.4.	Learning Theories - Influences on technicians' competencies at the Scientific Laboratory.....	69
2.4.1.	<i>Learning theories in relation to business demands at the organization.</i>	69
2.4.1.1.	Organogram.....	70
2.4.1.2.	Self-efficacy	74
2.4.1.3.	Community of Practice	76
2.4.1.4.	Organizational culture	78
2.4.2.	<i>Theoretical understanding of challenges in developing current competencies</i>	81
2.4.2.1.	Illustration: Background, initial understanding.....	82
2.4.2.2.	Illustration: Implemented resolution	85
2.4.2.3.	Illustration: Summary	88
2.5.	Theoretical understanding: Summary	88
2.6.	Aims, Objectives and Research Questions	90
2.7.	Problem statement.....	92
3.	Chapter 3: Methodology and Research Design.....	95
3.1.	Research Paradigm.....	95
3.2.	Case Study Approach.....	95
3.3.	Sequential mixed methods	97
3.4.	Participants – Sampling and rationale	100
3.5.	Establishing rigor	102
3.6.	Data gathering instruments.....	106
3.6.1.	<i>Focus Group</i>	106

3.6.2.	<i>Vignettes</i>	111
3.6.2.1.	Vignette development: Theoretical understanding.....	112
3.6.2.2.	Vignette: Used to facilitate technicians and managers separate focus groups.....	116
3.6.2.3.	Vignette: Questions used to prompt discussions around the phenomenon.....	117
3.6.3.	<i>Survey</i>	118
3.7.	Analysis strategies.....	119
3.8.	Ethical considerations.....	120
4.	Chapter 4: Data Collection and Capture, and Analysis and Results	123
4.1.	Phase 1: Focus Group – Managers and Technicians: Exploring factors related to phenomena. .	125
4.2.	Phase 2: Pilot Survey – Managers and Technicians: Evaluate the quality of the survey to help triangulate focus group findings.....	136
4.3.	Phase 3: Survey – Managers and Technicians: Triangulating focus group findings	138
4.4.	Phase 4: Safe to Fail Experiment – Senior Managers: Triangulating focus group findings.	140
4.5.	Phase 5: Survey – Senior Managers: Triangulating focus group findings.....	142
5.	Chapter 5: Discussion	144
5.1.	Summary of study: Rationale, Justification and Significance of Study.....	144
5.2.	Research Questions 1, 2 and 3.....	149
5.2.1.	<i>Theme 1: Education</i>	150
5.2.2.	<i>Theme 2: Interpersonal</i>	155
5.2.3.	<i>Theme 3: Organizational climate/culture</i>	159
5.2.4.	<i>Theme 4: Hierarchy</i>	162
5.2.5.	<i>Theme 5: Contextual factors</i>	167
5.2.6.	<i>Theme 6: Communication</i>	170
5.2.7.	<i>Theme 7: Operational systems</i>	174
5.2.8.	<i>Theme 8: Leadership</i>	175

5.2.9.	<i>Summary of themes: Technicians' and Managers' - Focus groups</i>	178
5.2.10.	<i>Summary of themes: Technicians' and Managers' - Survey</i>	189
5.3.	Research Question 4	211
5.3.1.	<i>Safe to fail experiment, Focus group facilitated by vignette – Understanding senior managers' perspective</i>	211
5.3.2.	<i>Theme Summary: contributions and proposed shift in thinking based on theoretical understanding</i>	212
5.3.3.	<i>Example: Leading questions and statements to aid in shifting thinking in senior managers' thinking</i>	224
5.3.4.	<i>Survey - Quantifying the senior managers' shift in thinking</i>	228
5.4.	Summary – Research questions.....	232
5.5.	Summary - Findings.....	234
5.6.	Limitations of this study	238
5.7.	Contribution of the study to existing literature and recommendations for further research	241
5.8.	Conclusion.....	244
6.	References	247
7.	Appendices	297
7.1.	Appendix 1: Literature Review Strategy	297
7.2.	Appendix 2: Reflective diary.....	298
7.3.	Appendix 3: Organization's Authorization letter	300
7.4.	Appendix 4: Informed Consent.....	301
7.5.	Appendix 5: HREC, FHS, UCT Approval.....	306
7.6.	Appendix 6: Master List.....	307
7.7.	Appendix 7: Sociodemographic questionnaire.....	308
7.8.	Appendix 8: Extract example of highlighted transcribed data.....	311
7.9.	Appendix 9: Survey Development	312

7.10.	Appendix 10: Survey Supervisor Pilot.....	313
7.11.	Appendix 11: Survey Scientific laboratory Pilot.....	317
7.12.	Appendix 12: Main study survey invitation.....	320
7.13.	Appendix 13: Pilot survey, participants' findings.....	321
7.14.	Appendix 14: Pilot survey, reviewers' findings	330
7.15.	Appendix 15: Main Study Survey	340
7.16.	Appendix 16: Safe to Fail Experiment Invitation.....	342
7.17.	Appendix 18: Safe to Fail Vignettes.....	344
7.18.	Appendix 18: Safe to Fail Analysis.....	345
7.19.	Appendix 19: Turnitin Report.....	355

Declaration

I, Paidamoyo Farai Kachambwa, hereby declare that the work on which this thesis is:

1. Based on my original work except where acknowledgments indicate otherwise.
2. Neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

Signature:

Signed by candidate

Date:

30 August 2024

Acknowledgements

To You, Almighty, Graceful, Loving, and Sovereign God, I am deeply grateful for it all. Oh Lord, I am eternally thankful for those you have put to walk beside me, to inspire me, to encourage me, to lift me up, to hold me up, to guide me, and to pray for me. May Your Spirit lead me to act and walk in the same way.

To my PhD supervisors, Delva, Elmi, Amaal, and Nici, your guidance, kindness, wisdom, and encouragement are unmatched; I am forever so deeply grateful. This was a long five-plus years of a part-time, full-time journey :) And there were many instances of physical and mental fatigue. There, the importance of a healthy relationship you had established with me became so important; thank you. And finally, all my current Mediclinic Precise and former CPGR and DIPLOMICS workmates who showed me such great empathy, encouragement, and support; your kindness is also unmatched! In particular, thank you to Lindsay and Lizahn!

To all my loved ones, family, friends, and church clique! From Christine bouncing 1-month-old Yanaya while I conducted my PhD focus groups and Caroline babysitting, to doing life with my family, my parents, who poured so much to lay the foundation, and siblings, Rufaro who once proof-read!, and my sibling's beautiful families, to my church people... All of you, every prayer, word of encouragement, the act of kindness, it was all greatly appreciated. From the absolute bottom of my heart, you mean a lot to me, and many blessings to you. Thank you!

Finally, to my absolutely sweet, kind, beautiful, and bright Yanaya, oh my word, you are now three years old, going on to four; you came right in the middle of this journey and injected me with the biggest dose of motivation! I have seen so much light, love, joy, future, and goodness through your eyes. I am even more motivated and disciplined to see us achieve much more. God has us in his hands, and His Spirit will lead us. I hope that through this and everyday life, I lead by example and let you know that you can achieve anything you put your mind to!

Abstract

Research in Africa and on African data is booming, seeing an increase in scientific projects conducted and products created. This has significant beneficial contributions to the bioeconomy, where establishing scientific laboratories is a key strategy. It is essential to ensure that there is competency, the necessary knowledge applied, when designing and implementing solutions. This produces quality outputs that attract funding and business. Technicians are key as they complete core functions that directly affect outputs. There are limited studies on scientific laboratory technicians in resource constraint settings, handling diverse projects, that focus on understanding underlying factors influencing their competencies.

Influences were investigated in a transdisciplinary manner. Learning theories focused on how the adults learn (Knowles), their self-efficacy (Bandura) and Community of Practice (Lave and Wenger). While Systems theory overlaid and focused on what a viable system should look like, Viable Systems Model (Beer). Focus groups were conducted with the technicians, managers, and senior managers. From thematic analysis, eight themes emerged: Communication, Contextual factors, Education, Hierarchy, Interpersonal, Leadership, Operational systems, and Organizational climate/culture. A main theme underlying all of the themes was Leadership, that is, how leadership influences and impacts the other themes. Surveys were conducted to triangulate findings and determine central tendencies.

Key overall findings were from the senior managers. They sit in a significant position that influences the emerged themes and can action change. Although the senior managers understood and valued the different influences, they were less aware of the underlying factors, interactions, and resulting adverse effects. Overall recommendations were related to training, and awareness at different hierarchy levels. For technicians and managers, frame how to differentiate between them viewing themselves as incompetent versus being in a hindering environment. For managers and senior managers, frame how different factors interact and influence technicians' competencies and resulting adverse effects. In Africa and abroad, this is replicable in scientific laboratories that conduct diverse scientific work, and this aids in developing the necessary contextual leadership training.

Glossary

<i>Bioinformatics</i>	Bioinformatics is a scientific subdiscipline that involves using computer technology to collect, store, analyse and interpret biological data. It is an ever evolving field as there are rapid advances in the technologies used to produce the biological data and even more advances in computational methods and technologies (Ramsden, 2023).
<i>Capacity</i>	An organisations ability/possession of skills to diligently carry out a specific task. In accordance with literature, this covers factors like the size of the organisation, it's location and the competence and quality of output produced by the employees (Abramo et al., 2011).
<i>Climate/ Culture</i>	An environment created by the social behaviour dictated by values, norms, and practices of an individual people. As Hofstede described, this would fall under the Individualism/Collectivism dimension (Hofstede, 1980). That is the way in which live together and the relationships that then exist between those individuals and the community (Latifi, 2006).
<i>Competency</i>	An umbrella term used to cover dimensions of behaviour associated with one's job performance (Woodruffe, 1993). In line with literature, competency has several meanings depending on the purpose for which it is used (Hoffmann, 1999). I have therefore adapted the definition for the purposes of this study to focus on the technician (Hasanovic et al., 2022). In this study competency describes one's ability/possession of skills, knowledge and attitude to diligently carry out a specific task (Hoffmann, 1999).
<i>Genotyping</i>	This is an experimental, next generation sequencing procedure which is used to identify how DNA sequences differ amongst people or defined groups of people. "Genetics is a cornerstone of molecular biology, and there have been significant developments in genotyping technologies during the last decades." (Kockum et al., 2023)
<i>HLA</i>	Human Leukocyte Antigens. "Technological advances have enabled pivotal progress in the determination of the molecular mechanisms that underpin the association between HLA genetics and functional outcome" (Dendrou et al., 2018).
<i>Immunogenetic</i>	This is a branch of Immunology and Genetics that explores the relationship between the immune system and genetics. An example of this stem cell donor registry work that looks at antigens (immunology) and alleles (genetics) (Schmidt et al., 2020).

<i>NGS</i>	Next generation sequencing. This is laboratory process that gives information on the structure of genomes, genetic variations, gene activity, and changes in gene behaviour. This field is ever evolving with great advancements that “hold promise for unlocking new insights into genomics and improving our understanding of diseases and personalized healthcare” (Satam et al., 2023).
<i>Resource constraint</i>	A resource constraint setting in this study refers to the limitation in means which include but is not limited to funding, infrastructure and resources challenges within and outside an organisation (Merry et al., 2023). These resources limitations have been shown to affect the overall quality of the products from a laboratory in various ways. These affects include an organisations ability to validate and refine methods over time or complete routine deliverables (Loh et al., 2023; Maduka et al., 2023; Tsehay et al., 2024). Resource constraints have been visualised through different lenses, one that best illustrates the nature of the organisations in the case study is the concept of global south and global north. Where organisations in the global south experience more resource constraints when compared to their northern counterparts and the aim is to unveil this disparity, that is, said economic differences (D. A. Sims, 2023). The focus of the study is to elucidate resource constraints of organisations in the global south to highlight their contextual challenges. It is important to distinguish the global south from north as best practices developed and successfully implemented in the global north may not be transferable to hold true in a global south setting (Rashid & Griffin, 2023; D. A. Sims, 2023).The wording “resource constraint” will be primarily used as it contextually best fits into the narrative of the study as it helps better illustrate the condition, of limited resources, in question. It is also a more familiar term used in related literature and by the target audience.
<i>Scientific Laboratory</i>	When mentioned as an entity in this study, it is the Case study organisation. Studies with similarly structured mandate, have shown similar activities such as “teaching, research, technological development, the provision of technological services, and technological extension” (Dias & Selan, 2023). The laboratory is run primarily as a Contract Research Organisation which occasionally collaborates on projects.
<i>scientific laboratory</i>	When written as scientific laboratory (or pl. laboratories), that is in small caps, this refers to general laboratories as referenced in the text in question.
<i>Systems</i>	This is in relations to the human system. “Systems theory is a conceptual framework based on the principle that the component parts of a system can best be understood in the context of the relationships with each other and with other systems, rather than in isolation” (Wilkinson, 2011).

1. Chapter 1: Introduction

1.1. The importance of scientific laboratories in Africa (and the world)

This thesis will explore factors influencing the competencies of scientific laboratory technicians and recommendations for improvement. The case study focuses on a Scientific Laboratory that is based in a resource constraint setting. It is especially important to note that when the study mentions *Scientific Laboratory* versus scientific laboratory in lowercase characters, it is the case study organisation. In this space, the laboratory technicians' expertise and diligence are instrumental in ensuring the efficiency and accuracy in how they complete services (Alsawidan et al., 2023). The technicians have a wide range of responsibilities and duties to be performed (Shirvan, 2021). To then become a successful technician, there are key skills to master, one of which is effective communication, sound competency, and interest in science and technology (Shirvan, 2021).

Before delving into the factors, we will discuss why it is important to investigate scientific laboratories, particularly those that are based in resource constraint settings. The laboratory is run primarily as a Contract Research Organisation that occasionally collaborates on projects. These scientific laboratories are a key part of research and implementing solutions for businesses in the field. They work to advance scientific research by creating an environment and expertise necessary to run experiments for academic studies. Examples of such experiments include Genome Wide Association Studies (GWAS) which is an exploratory, observational project that checks for a set of genetic variants in different individuals to see if any variant is associated with a disease or trait (Zhernakova et al., 2013). They also do the same in a supply chain manner, for example, in the routine screening for chromosomal conditions in an unborn baby via a Non-invasive prenatal test (NIPT). These businesses can span across the

fields of engineering and medicine. Literature has shown the great impact scientific laboratories have in pioneering discoveries, new businesses, and even industries (H. Beck et al., 2022). This has progressed research and industry endeavors to ultimately have a positive impact on society.

In a resource constraint setting, there are steep volume related costs associated with setting up a laboratory. A resource constraint environment can be described as a setting where there is limited access to human capital, funds, and, ultimately, supplies. Some of the prohibitive costs involve the upfront cost of buying and maintaining the equipment. The costs are volume related as the technology used in most laboratories results in cost per sample reducing as the volume of the sample increases. This is because there is one major cost related to a single use (run) of the machine. An analogy would be to imagine electricity is the biggest cost of using (running) a big hundred chicken roasting oven (machine). It is then more cost effective to roast one hundred chickens than to run the oven to roast just one chicken. The machines in the laboratory, like the oven, also have an expensive running cost, and therefore, it is important to run the maximum sample numbers allowed.

Another impeding factor in a resource constraint setting is that the scientific field has specialized skills shortages, for example Bioinformatics, therefore even if there was subsidized funding for machinery, the expertise needed in the workflow would be scarcely available and any employee turnover would be disruptive to the system (Hinkin & Tracey, 2000). Burnout and high employee turnover have been found to be costly to healthcare organizations as they have a direct impact on productivity and the quality of outputs (Al-Qathmi & Zedan, 2021). One of the last key critical impediments of a resource constraint setting is that industry and research, individually, cannot supply the volumes needed to financially sustain running a laboratory. Therefore, having one major laboratory that can provide services through outsourcing its services to other organizations from industry and academia is a more sustainable model.

It is essential to diligently conduct collaborative work across borders and organizations. This will sustainably build capacity to do work in Africa. Collaboration is how most projects are

conducted, as this harnesses the expertise and experience needed to produce a quality product and good outcomes, in particular, to tackle complex and/or big research or industry projects. Building capacity, trust, and scope requires that work is conducted in a diligent and reproducible manner (Chu et al., 2014; Whitworth et al., 2008). An example of an area where this work has been conducted is in the medical sciences field, where the field is constantly growing, advancing, and evolving. An example of collaborative projects in the medical sciences field is where clinicians partner with researchers to look at rare diseases that are hard to diagnose (Julkowska et al., 2017). Due to the low prevalence of each of the rare diseases, having any medical expertise on them is rare, resulting in limited knowledge and research on them. Patients with the rare disease are also scattered and have inadequate care offerings. The aim is to not only strengthen research efforts but also at the regulatory level, funding, and healthcare levels. Further collaboration efforts in rare diseases have been seen in the sharing of data to create opportunities for more rapid, efficient, and scalable drug discovery and testing (Lekstrom-Himes et al., 2023).

The main categories that impede the capacity growth of such scientific laboratories are infrastructural, institutional, financial, and educational fields (Kokwaro & Kariuki, 2001). Capacity here refers to the organisation's ability to conduct work diligently. Institutional here relates to the organisation, and educational learning relates to the employees' competencies. Furthermore, the educational category speaks to the occupational competency of the individuals who operate at different levels to ensure the deployment of the various technologies involved. This is particularly true for the technicians as they carry out a myriad of tasks essential for the smooth functioning of laboratories. Their responsibilities span from specimen collection and processing to conducting complex analyses using state-of-the-art equipment and methodologies (Alsawidan et al., 2023). When using the term "education," this study not only refers to gaining theoretical knowledge but also includes the training component for technicians to be familiar with the relevance and use of job-specific practical skills.

These main categories that impede the growth of capacity are mainly due to a monetary deficit and can be alleviated by receiving funding and/or for an organization to generate income. This is important as infrastructural resources such as machinery can be expensive. It may not be financially viable to change them frequently, and, at the same time, using outdated

methodologies in the laboratory may render your answer obsolete (Franzen et al., 2017; Maggio et al., 2018). Either of the two monetary solutions mentioned, that is, obtaining funding and generating income, dictates that organizations should produce quality outcomes as this attracts both funding and businesses needing to generate income.

This research study will focus on the barriers affecting an understanding of the relevance of and mastering of occupational job-specific skills as it builds on the competency needed to create quality outputs that attract funding and sustain business. Developing competencies will result in good outcomes. These good outcomes generate and/or attract the monetary funding that is needed to resolve the other three factors, namely, infrastructural, institutional, and financial. For an organization to produce quality outputs, it is important to ensure that there is competency, that is, the necessary knowledge is applied when designing and implementing solutions that are put in place to answer scientific questions for both research and industry (Baseke et al., 2022). The design stage is especially important and critical as it ensures that all factors that contribute towards a successful outcome are considered (Langdon et al., 2015). Once a project is designed and well planned, implementation will follow. The success of this critical process is dependent on the implementation by laboratory technicians.

WHO has also recognised that technicians have limited skills to address the scope of work presented to them (Aziz et al., 2006; World Health Organization, 2020). Further, WHO has emphasized and recognised the importance and impact of qualified technical employees (World Health Organization, 2011). With that, technician's development forms form part of various capacity and awareness projects, and sustainable development goals (Ages, 2017; Mphande, 2023; World Health Organization, 2020). For example, for technicians based in medical laboratories, there are overarching sustainable development goals set to promote universal healthcare in developing countries that have resource constraints. The sustainable development goal 3c sets a target to substantially increase health financing and the recruitment, development, training, and retention of the health workforce, especially in the least developed countries and states (Chiu & Fong, 2023; Mphande, 2023).

Therefore, in summary, we propose and hypothesize that developing competency will contribute to quality outputs, which in turn generate or attract funding. Expanding further, the delivery of quality outputs is essential to building customer confidence and satisfaction, which leads to enhancing reputation, which is key in enhancing organisational performance (Nair & Sankaranarayanan, 2014; Salman et al., 2020). This allows an organisation to also build a competitive advantage against its competitors (Barney, 1991; Wernerfelt, 1984), therefore gaining market share, which positively affects organisational performance. Studies from various fields have shown a positive correlation between competencies and organisational performance and have suggested competencies to be a positive predictor of organisational performance (Salman et al., 2020). Organisational performance has broad definitions and includes financial performance like profitability and non-financial performance like customer satisfaction. Therefore, this research study will explore current barriers to competency development for technicians in scientific laboratories. Identification of barriers to competency development could then enable targeted interventions. The next chapter will look at the learning interventions that have been suggested to result in an increase in capacity and quality of outputs.

1.2. Learning interventions are key for increasing capacity and quality outputs.

As scientific research in Africa and research on African data continues to boom in Africa, with respect to the growth in the number of projects taken up, it has been shown that there is not enough research capacity to meet this surge (Nordling, 2018b; Schemm Ylann, 2013). This naturally also results in a rise of scientifically related business endeavours. This growth seen in industry, specifically, scientific related businesses, is because the more that is understood about a field, the more one can translate research into a product. An example from the medical sciences field is the term “from bench to bedside”, which is a term that is used to describe “the process by which the results of research done in the laboratory are directly used to develop new ways to treat patients” (Drolet & Lorenzi, 2011). The more research is understood and

validated, the more it can be used in industry. In the case presented, human capacity is limited and has not matched these increases. This has led to a loss of projects to international laboratories with greater human and resource capacity. This will ultimately result in projects being completed overseas, which has a negative impact on the growth of related organisations in Africa. In cases where the organisations choose to take on the work, due to inadequate capacity, it results in poor outcomes. The poor outcomes at the Scientific Laboratory include but are not limited to:

1. Inability to timeously respond to clients.
2. Inability to meet turnaround times for delivering results.
3. A stressed team that constantly has to resolve issues. This also takes from their creativity and time they can spend improving on internal processes.
4. Retaining talent and the problems that come with it becomes difficult. Constantly having to find replacements creates instability.
5. In a cascade effect, unfilled vacancies then contribute to work overload and feeling overwhelmed.
6. Products or tests with inferior quality, for example, low laboratory quality control (QC) statistics achieved.
7. The reputational damage that comes with poor outcomes.
8. Lower client retention rate and client satisfaction.

These poor outcomes continue to reinforce the decision by clients and potential clients to conduct their work overseas as there is lowered confidence in Africa's capabilities. Studies have shown that there are many critical cost implications to poor outcomes, some of which have not been measured or accounted for (Malmi et al., 2004). An important example is the cost of producing low-quality data. All workflows, regardless of sample type or the end goal, produce data that is to be analysed. Studies show that this is further aggravated by senior management choosing not to act (English, 1999; Haug et al., 2011). One of the main reasons cited by this research is that senior management underestimates the costs of the errors or are constantly firefighting to dampen an immediate crisis rather than dealing with the long-term problem (Haug et al., 2011). These actions focus on short-term immediate problems at the cost of long-term sustainability. Such an environment results in a high turnover of employees. Some

of the financial effects of high employee turnover include hiring and orientation and the cost of maintaining continuity. Studies show that it also negatively affects the reliability of the product as the failure rates in services increase (Moon et al., 2022; Waldman et al., 2010).

With respect to the educational barriers, an end goal would be to better understand the factors that affect the competencies that are needed by individuals to have successful outcomes. Skills are known to influence the performance of laboratory personnel (Liebig et al., 2006). In Africa, particularly South Africa, there is a specialised skills shortage that has impacted an array of fields (Ekene & Kelly, 2023). Although the government has taken great strides to work towards filling positions for these skills by creating a critical skills list, these efforts have not fully fulfilled the mandate. One of the efforts created to attract and retain critical skills in the country is the development of regulatory legislation that created the critical skills visa, which is attractive as it is not lengthy to process and administratively easy to apply for (Asmal et al., 2023). One of the main reasons why the individual with the skillset cannot be retained is complex around there being better opportunities in more economically developed countries as there is limited placement, compensation, and career growth in South Africa. A practical example is a skillset employed at the Scientific Laboratory, Bioinformatics, a skillset that is on the South African government's gazetted critical skills list. The government's efforts include funding, creating awareness in educational programs, and creating immigration opportunities for those with these skills (Daniels, 2007; Department of Labour, 2006; N. Mulder et al., 2016). However, opportunities in more economically developed countries and lack of placement in employment have seen an exodus of Bioinformaticians along with other critically skilled individuals (Kaplan & Höppli, 2017; Mlambo & Adetiba, 2019, 2020).

However, when a critically skilled person is available, there may be limited funds to finance their employment. It is then more feasible to hire an employee with general skills and upskill, which, when viable, is often the path taken (Botha & Rasool, 2011). Adapting skills for use would then require robust systems in place to ensure that needed competencies are developed. Africa is persistently working to build a reputation for diligence and quality outputs, which will result in an increase in the diversity and number of projects taken up. In addition to funding, it would create business opportunities and as services are utilised. In doing so, they garner a reputation and eventually become trusted (Goldsmith, 1997; Höner, 2002). Customer

confidence and satisfaction lead to enhancing reputation, which is key in enhancing organisational performance (Nair & Sankaranarayanan, 2014; Salman et al., 2020).

Consequently, some projects are completed overseas, which may result in restricted access to the data. This is one of the effects of what has been deemed ‘helicopter’ research, where researchers from overseas are seen to only come and collect data from Africa (de Vries et al., 2015; N. Mulder et al., 2017; Nordling, 2018a). This phenomenon has been observed to occur in countries in the global south and is usually performed by those from the global north. This inequality is an effect of world economies, which are shaped by the history of colonisation (R. Connell, 2014). Where researchers in the wealthier, that is better resourced countries, located in the northern hemisphere (except for Australia and New Zealand) make roundtrips to the Global South research (Adame, 2021; Haelewaters et al., 2021). The poorer, developing researchers in countries located around the tropics and in the Southern Hemisphere collect materials, and then the wealthier counterparts process, analyse, and publish results with little to no involvement from local collaborators. Suggestions have been tabled on creating sustainable collaborations that can bring an end to helicopter research (Adame, 2021; Haelewaters et al., 2021).

1.3. Organizational and Systems challenges

There are various challenges that come with different scientific areas of study. These challenges may emanate from a lack of scientific comprehension of the subject in question. Some research areas may experience challenges if the employees are not knowledgeable in the subject matter. This may also be because some research areas and fields are complex and/or are not well understood. For example, there is a multifaceted approach to understanding prostate cancer prognosis in men of African descent (Johnson et al., 2024; Soh et al., 2023). Although prostate cancer is the second most commonly diagnosed non-skin malignancy and the second leading cause of cancer death among men, it is not well understood in men of

African descent. This is further made critical by the fact it is more aggressive, with a 2.5-fold mortality greater than the European counterparts. Despite there being advances in screening, diagnostic, and therapeutic efforts, disparities in prostate cancer incidence and outcomes remain prevalent. The reasons that lead to this disparity in outcomes are complex and multifactorial, including scientific and socio-economic reasons (Johnson et al., 2024; Soh et al., 2023). Other challenges may emanate from the regulations and legal governance in that field. Below, I will summarise some of these organisational challenges that scientific laboratories have experienced when it comes to conducting work. Literature has noted that “strengthening research in Africa allows for better investigation of disease factors specific to African populations. This leads to the development of evidence-based interventions that are more effective in addressing the continent’s health challenges. This will ultimately improve health-care outcomes for African patients and impact global scientific knowledge” (Olatunji et al., 2023).

Population genetics, the study of genetic variation within populations, plays a critical role when answering a number of scientific, especially medical sciences questions (Kimura, 2020; Majara et al., 2021; Ramos et al., 2015). In research, African populations are often underrepresented in studies across the world, yet they are the most genetically diverse. Hence, the data and methods that then emerge from those studies may not be applicable to the African population (M. C. Campbell & Tishkoff, 2008). In addition to being underrepresented, the African genome is quite diverse and not well characterized (Swart et al., 2020; Tishkoff et al., 2009). Genetic diversity is the variation in the amount of genetic information within and among individuals of a population. Genetic diversity is beneficial to research and industry as it details disease susceptibility and response to treatment (Gurdasani et al., 2015; Lu et al., 2009; Turkson-Ocran et al., 2020). Unfortunately, genetic diversity research is also an impeding factor as it has been difficult to capture data, and analyse and interpret all of the diversity as there is a lot of diversity to capture (Karikari et al., 2015).

In conclusion, this section describes the complexity of different subjects that scientific laboratories have to consider when executing services. In the example, it is important to understand this rich genetic diversity that describes a wider range of, for example, proteins produced in a person’s body (Möller et al., 2024). The proteins produced or not produced could

aid, protect and expose an individual when fighting disease. We all have a unique make up. This is the basis of precision medicine, also known as personalised care (Ashley, 2016). Precision medicine offers patients the best outcome as care is optimised by tailoring medical treatment to someone's genetic make-up or genotype (Kosorok & Laber, 2019). Currently, there is growth in the need for and emergence of genetic services related to precision medicine (El-Kamah et al., 2020; Kromberg et al., 2013; Mboowa & Sserwadda, 2019).

1.4. Rationale for undertaking study

As a Bioinformatics Team Leader at the Scientific Laboratory, I have realized that the diversity and complexity of the projects offered require specialized expertise. For example, a population geneticist may be needed to analyse and interpret the data. This expertise is not always workable and easily obtained in a resource constraint setting. This is an issue not only locally in South Africa but also at scientific laboratories across Africa. Further to the need for an expert workforce, establishing the physical laboratory in a complex is also necessary. Studies have shown that the establishment and upgrading of laboratories in Africa is often brought about by internal and external partners, sponsors and opportunities (Charani et al., 2022; Olatunji et al., 2023; Simpkin et al., 2019). This establishment of scientific laboratories often lacks coordination amongst partners, with duplicative actions without added benefit, but continued limitations in skilled personnel and often coordination is not aligned with government priorities, which affects sustainability (Mfuh et al., 2023).

I also observed this through working with different organisations across Africa, for example, on the MADCaP (Men of African Descent Cancer of the Prostate) project in Senegal, Nigeria, Ghana, and South Africa and by receiving samples from across Africa, for NIPT (Non-Invasive Prenatal testing), for example, from Botswana and Zimbabwe. Indeed, a lack of expertise in a country often leads to a reliance on current staff to be competent and able to adapt to the diversity of projects. It is of critical importance to have employees competent in utilising advanced laboratory equipment. However, brain drain and limited research capacity in Africa

can worsen the shortage of qualified employees, which further necessitates learning efforts (Olatunji et al., 2023).

In summary, in this example, the difficulty the system had to overcome was securing the expertise needed to diligently carry out a project. This becomes more apparent in, for example, HLA Typing, a type of genetic test used to identify certain individual variations in a person's immune system (Brodin & Davis, 2017). In this test, it was reflected in, firstly, during analysis, our inability to resolve some typing results, which were then sent off to experts. Lastly, the need for accreditation (Fleischhauer et al., 2018; Okezue et al., 2020); some clients had required that the Scientific Laboratory be EFI accredited (related to HLA typing) to give assurance of quality (Mathuba et al., 2021; Mertens et al., 2000). The process is very similar to an already implemented ISO 9001:2015 accreditation. The main difference between these processes is that EFI requires a specific set of skills and experience in certain laboratory positions. I have observed that, in a resource constraint setting where there are limited skills and projects to gain experience, it is difficult to fill such a requirement.

The following section, although related to a learning endeavour, is rather in relation to the systematic organisation and structuring of a program. To implement measures to ensure continuous professional development is effectively taking place at the Scientific Laboratory, I started a journal club for the new and routine HLA typing service. The motivation for starting this structured journal club was conceptualised to determine the best way to get different (disciplinary and levels of expertise) colleagues to be at an internally defined standard of understanding of the subject matter (Lao et al., 2014). This was particularly important as the Scientific Laboratory provides innovative solutions to a wide range of medical sciences challenges by using its state of the art 'omics' (Kandpal et al., 2009) services and technologies.

The aim was, therefore, to inject a theoretical understanding of the scope of scientific laboratory work. An HLA journal club seemed best suited to address the gaps in knowledge in the team members with respect to the immunogenetic field in which HLA typing is based. The design of the journal club drew from three learning theories, which will be described later. The structure here entailed planning content and related delivery. Such a structure is argued to

increase organisational effectiveness and lead to employee commitment (Prakash & Gupta, 2008). In summary, in this example, the difficulty the system had to overcome was keeping a proficient level of understanding when a new subject area was introduced.

The many organisational issues described above place the employees' competencies into question, and these form the gaps. Competencies in this case study are understood through the lens of learning, and they exist in a system. These issues are in line with those that WHO has also recognised, that is, technicians have limited skills to address the scope of work presented to them (Aziz et al., 2006; World Health Organization, 2020). Further, WHO has emphasized and recognised the importance and impact of qualified technical employees (World Health Organization, 2011). With that, technician's development forms form part of various capacity and awareness projects, and sustainable development goals (Ages, 2017; Mphande, 2023; World Health Organization, 2020). Based on these recommendations, my observations, and my experiences at the Scientific Laboratory and from the literature, this case study aims to explore factors contributing to developing competencies of technicians who are based in a resource constrained laboratory setting. Results from this study could shed light on what needs to be in place to ensure that these competencies are developed efficiently. This information is crucial in building capacity in scientific laboratories in Africa. This will not only allow us to attract funding but also generate funding for and in African research and business endeavours in Africa.

1.5. Research Strategy: Transdisciplinary

This research took a transdisciplinary approach, bringing together Learning theories and Business Systems Theory. The transdisciplinary approach looks to combine disciplinary contributions “to generate a more comprehensive level of understanding by applying an enlarged systemic framework of several disciplinary and interdisciplinary contributions” (R. J. Lawrence, 2010; Madni, 2007) often in the context of real-world cases. In this case, study involving the Scientific Laboratory, there is great complexity that one research discipline alone

may be unable to fully tackle (Gibbons, 1994). In this case study, learning theories would speak to the individual technicians and their ability to develop competencies. There is added complexity in that the technicians exist in an environment that has several factors that could affect their ability to develop competencies to produce good outcomes. To understand the environment, systems theory was employed. A transdisciplinary approach involving real-world cases can, therefore, result in innovative goals, enriched understanding, and a constructive interaction of new methods (R. J. Lawrence, 2010; Nicolescu, 2014). Enriched understanding results in comprehensive outcomes which better inform interventions.

1.6. Conceptual Framework: Linking competencies and quality outputs.

Overview

As mentioned in the section above, this research will take a transdisciplinary approach using two branches of knowledge, namely, learning theories and systems theory. I am part of the organization in which this phenomenon was observed, and my initial observations were that the work conducted resulted in poor outcomes. The Scientific Laboratory is accredited and governed by the International Organization for Standardization, which sets out the criteria for a quality management system (Wood, 2013). This means any deviation from expected positive outcomes is raised and investigated, and plans are made to mitigate the cause of the deviation. In order to investigate and better understand these poor outcomes, I had informal conversations. In the conversations, I observed that employees had an additional layer of complexity as they had to adapt to working on diverse projects. Further, the quality standards and mitigations for deviations that were implemented did not improve the outcomes. In these discussions, there were varied reasons why they could not adapt to the diversity of work conducted. They noted that they did not have or did not feel they had the competencies needed to complete the work. These were the factors the research wanted to explore.

The conversations noted above were water cooler talks, and literature has shown that they are reliable sources of information (Choudhury et al., 2023). Beyond them providing employees unfiltered perspective, it fostered collaboration and innovation as employees were able to informally socialize. Water coolers are useful in gathering necessary work information, building relationships, and venting. This was shown to lead to greater job performance and satisfaction (Blithe, 2014; Woo et al., 2023). They play a role in helping one foster social interactions, which can ultimately improve job productivity (Dufour et al., 2021). This happens in various ways. For example, they get a better understanding of the uncertainties being faced (DiFonzo, 2008). This interaction helps them better tackle their work. COVID-19 saw a move to remote working, which shed light on the importance of social interactions such as water cooler talks.

Water cooler talks

The following paragraphs will summarize the water cooler talks that prompted the study. Due to an increase in the decrease of the quality of outputs at the Scientific laboratory, it sparked water cooler discussions in relation to competencies. The technicians stated that they could not adapt to the diversity of work conducted in order to produce quality outputs. They discussed how they did not feel they had the competencies needed to complete the work. They also noted they did not feel comfortable and welcome to go and discuss this with their direct managers or any of the managers. The technicians spoke about how they felt they were expected to just understand the training or directive given as they met the criteria stated in the job advertisement. Literature has shown that the broadness of entry level positions sees the presence of many transferable skills in job advertisements. The transferable skills enable employees to participate and work in a flexible and adaptable workforce (Suartha et al., 2017). This is ideal in an organization like the Scientific Laboratory, which handles services for a diverse set of projects. Further, there is usually no shared understanding of the precise skill attributes that organizations are looking for (Bennett, 2002). Candidates will not know exactly what they are being asked to demonstrate, and educational institutions are still working to close this gap (Draissi et al., 2023; Suleman, 2018). In knowing what is expected of you, one can be effective. Higher levels of role clarity would be associated with higher role efficacy and

performance effectiveness (Bandura, 1997; Bray & Brawley, 2002). It is then left to the hiring organization, like the Scientific laboratory, to develop these skills.

The technicians also complained of preferential treatment of technicians who had certain accreditations, for example, being a Health Professions Council of South Africa (HPCSA) accredited laboratory technician. There are certain services that can be conducted in the Laboratory that make it mandatory to have a HPCSA accredited technician. A study relating to technicians in South African laboratories with differing accreditation, has shown that there is interpersonal tension was perceived between these groups in relation to level of qualification (Mullah et al., 2020). This tension, which also stems from other perceived factors like pay scale is known to affect retention of staff (Khadambi-Morokane et al., 2021; Mullah et al., 2020). Further, water cooler talks also revealed that the presence of a HPCSA accredited technician gave the Scientific Laboratory an air of trustworthiness as it employed accredited technicians to complete services. This sense of experiencing tension also came from the HPCSA accredited technicians. They felt they were becoming too stretched from being becoming the go to technicians so the main work horses and at the same time, show ponies for clients.

Lastly the technicians would discuss the organizational culture in terms of what it discouraged, what it allowed and, how the resulting dynamics affected their ability to develop competencies. The technicians mainly discussed decisions made at a managerial level that impacted their ability to develop competencies. For example, decisions on what needs training on, who needs the training and how technicians would then be considered competent to complete a task. Literature has shown the complexity and difficulty in defining and testing to see if one is competent in a laboratory, this is not only internally at an organization but also for conformity between laboratories, through government (Desjardins & Fleming, 2014). In this, the technicians were not concerned about being tested to see if their competent. Rather, they were not sure of their education and further, raising their hands to note that they do not feel they are competent enough to complete some services.

Summary

In looking at the phenomenon in question, it initially presented itself in the organization's ecosystem that was not functioning ideally. The unideal functioning was observed in poor outcomes. It was also observed that the quality management system in place did not improve the poor outcomes as expected. Systems theory would be the first layer used to locate the different areas in the ecosystem in which staff is not able to adapt to the constant diversity in the projects. The next and related layer is then looking at the different reasons which affect their ability to adapt their competencies to work on the diverse scope of projects and this is where learning theories was used. This has been summarized below in figure 1, where the overlaying of systems and learning theory to have a better view of the individual and the environment that they exist in.

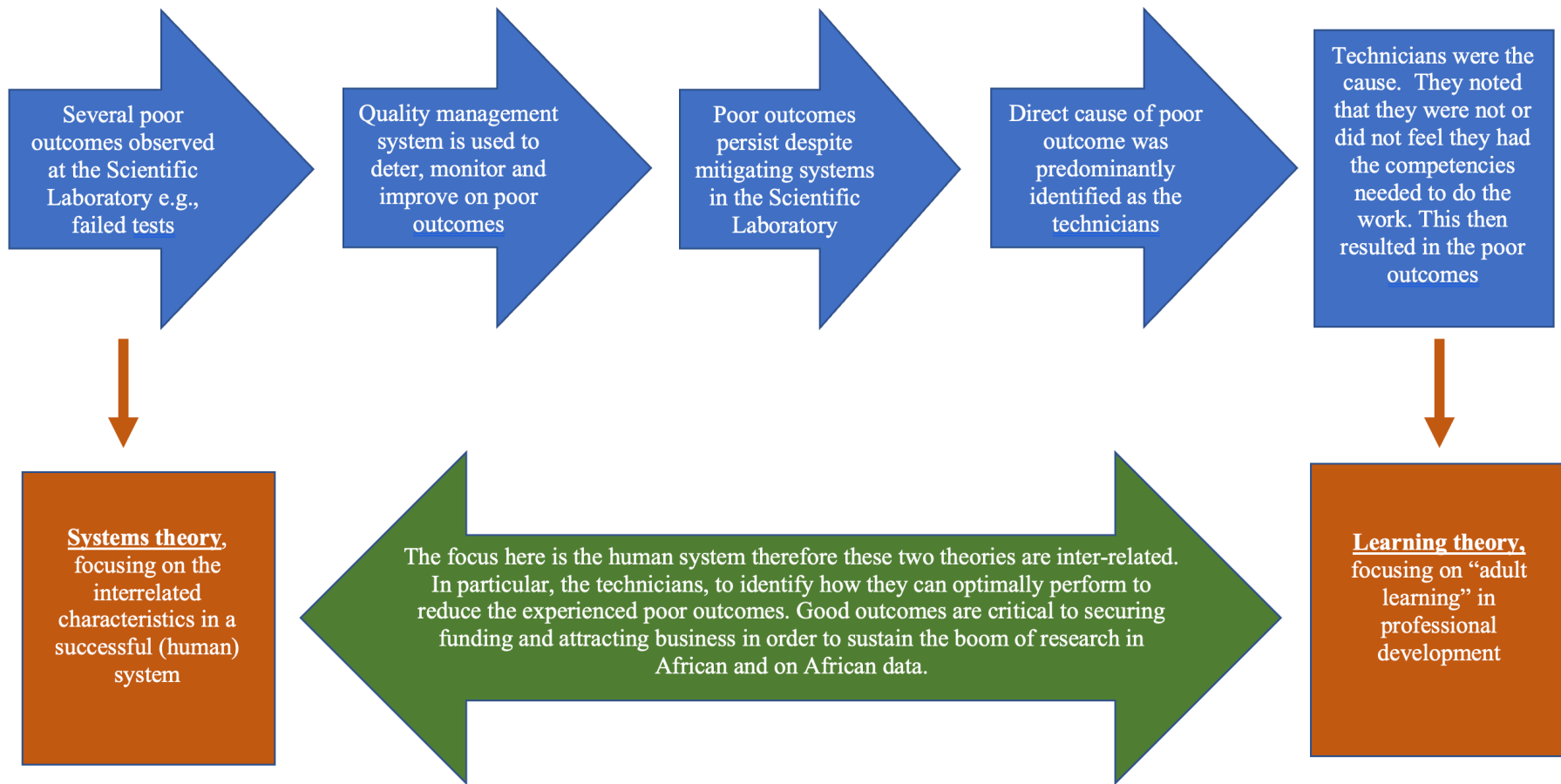


Figure 1. Conceptual framework workflow. This is a representation of the expected relationships between variables in the study.

1.7. Outline of Dissertation

Chapter 1 – Introduces the research question, exploring factors influencing competencies of scientific laboratory technicians as a case study of a Scientific Laboratory based in a resource constraint setting and research context. It looks at the importance of focusing on the research context, scientific laboratories. It then looks at the fields in which the research question exists. This spans across Learning and Business. A case is then made for a Transdisciplinary approach, and a conceptual framework is built.

Chapter 2 - Contains the literature review strategy, a scoping literature review. The review has two main focuses. The first, to understand the current landscape in which the Scientific Laboratory operates in. Second, to understand underlying causes that influence competencies in Africa.

Chapter 3 – Details the learning theories related to the development of competencies. First it looks at theories related to developing capacity at the organisation. Lastly, it looks at the theoretical understanding of current challenges related to the technicians' developing competencies.

Chapter 4 – Details system theory related to capacity at the organisation. First, it looks at the environment in which the Technicians are based. Lastly, it looks at the systematic factors that help to inform an understanding of the phenomenon better.

Chapter 5 – Covers the methods and research design. This entails looking at the aims, objectives, and research questions. Next, it looks at the interpretivist research paradigm used, how participants were sampled and how rigor was established in the case study approach. The section also covers the data gathering instruments used, the sequential mixed methods, and the analysis strategies that were employed.

Chapter 6 – Details the Analysis employed and the related results. This covers the Manager and Technician focus groups, the pilot survey, and the main study survey. It also details the Senior managers’ Safe to Fail experiment and the survey. It ends with the summary of the key findings.

Chapter 7 – Closes off the Thesis with a discussion and summary of the thesis. This details all the findings in Chapter 6. The chapter discusses contributions to existing literature, limitations to the study and recommendations for further research.

References and Appendices – The Reference list and the Appendices are located at the end of the Thesis. The reference list has the full citation to credit all the source material that was quoted in the Thesis. The appendices contain all supplementary documentation used to facilitate the readers understanding. These include tables, figures, consent documents, and extended results.

2. Chapter 2: Literature Review

2.1. Literature review strategy

This review was guided by the principles of a scoping review, which literature has shown essentially serves the purpose of identifying the existing literature on a specific research topic (Sargeant & O'Connor, 2020). The research question is: Exploring factors influencing competencies of scientific laboratory technicians and recommendations for improvement: A case study of a Scientific Laboratory based in a resource constraint setting. Subsequently, there was also a literature review done on the two main disciplines that the study integrates: Systems and Learning theories. This method has been popularly used in health-related topics, like those covered in the Scientific Laboratory (Pham et al., 2014). Taking from principles of the scoping review that are best suited for a study has become an increasingly common approach for mapping broad topics (Pham et al., 2014). The establishment of common definitions, strategies and purpose, is an important step toward enhancing the consistency in searching for literature (Levac et al., 2010).

The steps involved and that were followed are: Identifying the research question; Creating search terms and identifying relevant studies; Selected studies; Chart the data; and summarising the results (McGaghie, 2015). Further details on the strategy can be found in Appendix 1. Search terms and strings were generated from the research title: “Exploring factors influencing competencies of scientific laboratory technicians and recommendations for improvement: A case study of a Scientific Laboratory based in a resource constraint setting”. Developing the search terms followed suggested guidelines from the literature. These guidelines are listed below (B. A. Kitchenham et al., 2007; Pai et al., 2004):

1. Develop major terms from what is being broadly asked in the study, which is in the title. This is done by identifying the population, intervention, (if applicable) comparison intervention, and outcome in the study. The population is the technicians who are based

at the Scientific Laboratory, which is a resource constrained setting. Their competencies are the study factor and, therefore, the intervention. The comparisons would then be scientific laboratories with competent technicians. Lastly, outcomes are the predicted and desired results that one would like.

2. Identify any alternative spellings and synonyms for the major terms described in one.
3. Check for keywords in any relevant papers that have already been identified.
4. Use search methods that principally allow for the Boolean “OR” to be used in a search. This was used to search for the identified alternative spellings and synonyms.
5. Use search methods that principally allow for the Boolean “AND” to be used in a search. This was used in searching to link the major terms that were identified in one. That is, terms from population, intervention, and outcome.

The key term that would accompany all the search terms was “competencies”. This is because it is the central focus of the study, and all other aspects, e.g., scientific laboratory in a resource constrained setting, are contextual to the study. To allow for wider searches, the wildcard form of competencies was used, that is, “**competen***”. This would then cover variations of the word to include, competent, competency and competencies. Wild cards were also created from all accompanying search terms that will be used in conjunction, that is, would accompany, the key term “**competen***”. The title was divided by context, and the key search terms have been bolded in the following: “~~Exploring~~ (**factors**) ~~influencing~~ (**competencies**) ~~of~~ (**scientific**) (**laboratory**) (**technicians**) ~~and~~ (**recommendations**) ~~for~~ (**improvement**): A (**case study**) ~~of a Scientific Laboratory based in a~~ (**resource constraint**) ~~setting~~”. The crossed words are either prepositions or descriptive words that do not relate to understanding the phenomena in question.

I then used Google Scholar as my search portal/search engine and attached a wild card of an accompanying term to the wild card of a key term. For example: “**competen***” “**factor***” or “**competen***” “**lab***”. I used Mendeley reference manager to store and track saved literature. This also avoids storing duplicate literature. It also allows one to sort and search through saved literature to better understand findings. As expected, some searches produced a wide variety of literature. The search was narrowed down by filtering out literature that does not match the other terms. For example, if the search for “**competent***” “**factor***” yielded many findings,

only literature that covers the other unused terms will be kept, that is, in this case, **(competencies) of (scientific) (laboratory) (technicians) and (recommendations) for (improvement): A (case study) of a Scientific Laboratory based in a (resource constraint) setting**". This approach to interpreting the evidence lends itself to the qualitative evidence synthesis that the scoping approach entails (McGaghie, 2015).

As mentioned above, the main strategy of the literature review was to look for literature related to the research topic: "*Exploring factors influencing competencies of scientific laboratory technicians and recommendations for improvement: A case study of a Scientific Laboratory based in a resource constraint setting.*". When broken down, the aim was to find literature that had all of the six main interconnected aspects of the research topic. Each of the aspects above is contextually important, and if one of them is missing, then the findings of the work cannot be successfully applied to answer the study's research question. There was limited literature that had all six components; therefore, any missing component was not a criterion to exclude literature. The different sections in this chapter will show how different literature would cover some of the six aspects above and give reasoning why, if one is missing, the literature could not answer the research questions but be used to guide understanding. Table 1 below shows the six aspects of the research topic and gives a description of each of their importance, that is, significance, to the study.

Table 1: The five main aspects of the research question and their importance

	Aspect	Summarised importance to the study
<i>1</i>	<i>factors</i>	Understanding underlying reasons versus what the employees deem they need. Knowing underlying reasons allows for more precise solutions.
<i>2</i>	<i>competencies</i>	This is the central aspect in context of the business. The phenomenon in question shows influences on the technician's competencies as the central cause for poor outputs. This is the key aspect because the core of the study, in simplified terms, to look at how a business, Scientific Laboratory , is affected by competencies. There is a more pronounced

		connection to business outputs that is made as the outputs strongly affects the organisations viability. Naturally, the literature review, with respect to the research question, was centred around competencies.
3	<i>technicians</i>	The phenomenon in question shows technicians as the direct and therefore key contributor of poor outputs.
4	<i>recommendations</i>	The overall aim of the study is to give suggestions to improve outputs.
5	<i>Scientific Laboratory</i>	The case study, Scientific Laboratory, has characteristics that when altered influence the quality of the outputs. These include but are not limited to; the laboratory being run as a service business that experiences constant change of scope in work conducted. This change is because it is dependent on the clients', from research and industry, field of interest. These characteristics were taken into account when considering the type of organisation that the literature was reporting on.
6	<i>resource constraint</i>	Resource constraints, as often seen in the global south, create limitations and risks that affect processes needed to create quality outputs. These need to be strongly considered when developing strategies and solutions.

2.2. Literature Review in relation to the research topic

In the below paragraphs are the findings in relation to the scoping review. All searches were conducted in relation to the central aspect of the six. This central aspect is (*technicians'*) *competencies* in the context of the business, *Scientific Laboratory*. Given that there was limited literature that encompassed all six aspects of the study, practically, this meant broadly narrowing down on literature that had the central aspect, *competencies*. There were mostly between one to three aspects that were covered in each of the studies. Below are examples of different combinations of the six aspects that were found in literature, that is, in relation to the central aspect, *competencies*. In the illustration below, which is an example of a broad area, I

restated the research question and crossed out the aspects that are not covered. In this example, the findings were related to *competencies* based on what employees deemed needed in a *resource constraint* setting with *recommendations*. This example was chosen as most of the literature found related to this broad set of aspects. Any of the six aspects that are not covered in this broad set of literature are then crossed, see below:

*“~~Exploring factors influencing~~ *competencies* ~~of scientific laboratory technicians and~~ *recommendations for improvement: A case study of a Scientific Laboratory based in a resource constraint setting.*”*

The above represents literature looking at competencies that employees e.g., nurses have deemed needed, in a sciences or health sciences related organisations e.g., a hospital. The organisation is in a resource constraint setting, e.g., global south and recommendations for improvement are given, e.g., training strategies. This finding cannot be transferred successfully to answer the research topic because key aspects are missing, namely:

1. The research question seeks to find underlying factors as they would more precisely positively affect efforts to better the business’ outputs. This is even more important in an environment with limited resources.
2. (and 3) The employee and the organisation are different. In some of the literature, to be discussed further below, the organisation or employee’s characteristics that are considered by the research question are similar and therefore can contextually be applied to help answer the research question.

That said, it is important to note that the study, like other studies, had key aspects that can be used to greatly inform this study and, therefore, was used. The remainder of this section are paragraphs that give further examples of different combinations of the six aspects from literature. There were several other combinations of the six aspects that are covered by the literature. They could not all be covered but the core aim of the paragraphs below is to elucidate the importance of any missing aspect, of the six, in relation to the research question.

In context to the research topic: Importance of studies considering underlying factors.

From my literature search, most studies on competencies have looked at surveys of what employees deem is needed (dos Santos et al., 2019; Miedzinski et al., 2001). Acting on just what the employees deem needs is done at the cost of understanding underlying issue that needs to be addressed. Interestingly, studies have shown that, even when measuring competency, what employees measured themselves to be was much higher than what they scored when tested (Koc et al., 2023). It is like removing the leaves of a weed, the weed will continue to recur until the roots are addressed and taken out. However, few studies have focused on what factors are at play in the internal and external environment that results in what is then deemed as needed versus opinions of employees (Myers & Rodriguez, 2016). For example, a study looked at healthcare providers' digital competency where a cross-sectional survey in a low-income country setting was used to determine need (Shiferaw et al., 2020). This study draws on surveying employees' needs. The study looked to assess the competence of healthcare workers in using information communication technologies to perform their professional duties. The questionnaire used was adopted from the European Commission framework for assessing digital competency. Several studies in digital competency have noted the need to assess one's level of competency in order to give the appropriate level of training (Barakat et al., 2013; Brunner et al., 2018; Scott et al., 2018).

Frameworks and solutions are then developed based on deemed needs. This is one of the gaps the study sought to fill, to inform based on underlying factors. Understanding underlying causes would also allow for more precise and targeted solutions that will better address factors that negatively influence competencies that are affected by the diversity and often change of scope in work. Further, the majority of the studies that have been conducted to consider factors were based in developed countries, which are resource rich (Coccia & Cadario, 2014), and the results and solutions are not replicable to a resource constraint setting. That said there have been studies from outside Africa that were conducted on companies that are looking to adapt to diversity, and a constant change in the scope of work (Slocum et al., 1994).

In context to the research topic: Importance of competencies in a business and studies that look at scientific laboratory technicians in a system.

Furthermore, from the section above, once one has understood the need for underlying factors versus opinions, we then take a look at the different underlying factors that are known to influence competency. The influence on competency, that affects the quality of outputs, is not limited to the individual internally, within themselves, but also, external, for example, organisational and environmental factors that affect their competency (Feng et al., 2023). The most effective solution would not necessarily be to only determine the what they need to learn but to investigate issues external to the individuals that are barriers in the system (Li et al., 2020).

There is then a need to have a holistic view that best informs the solution; for example, it has been shown that healthier working conditions, that is, environments that support mental and physical health, for ICU nurses, lead to greater levels of satisfaction in their job and the quality of care for their patients (Stalpers et al., 2017; Wei et al., 2019). Here, the studies are based in environments where resources are less limited to aid in development and further financially related considerations do not need to be considered. Most of this research has been done overseas, which may hamper the understanding of the problem and lower the impact of the solution that is implemented.

Contextually, in a resource constraint setting, healthcare workers usually have varied limited resources, which creates a barrier to learning new skills. These limitations include funding, infrastructure and resource challenges within an organisation (Merry et al., 2023). Examples include a lack of human resources, time, skills, and/or capacity to develop, implement, and maintain the CPD system, including CPD activities and resources (Dunleavy et al., 2018; Msibi et al., 2014). This is further hampered by unsupportive employers and administrators who do not, for example, allocate time or resources to these endeavours, and on a macro level, it is exacerbated by limits from the government or healthcare professional bodies (Chekijian et al., 2021; Moetsana-Poka et al., 2014; Undilashvili et al., 2019). These aspects create a system with different interacting factors that influence outcomes.

In context to the research topic: Importance of studies in organisations that have the characteristics (in question for this research) of the Scientific Laboratory, that is, diverse and changing scope of service work.

For studies that have been conducted in the global south, the described organisations have one set and unchanging service and, therefore, do not have the added complexity of dealing with diversity in the work that they conduct, therefore having a constant change in scope of work (M. Mulder & Gulikers, 2011). A further description, is that these are organisations that have a focus in one field and, therefore, only have to build their core competency in that one field. For example, in a microbiology only laboratory, recommendations for development are then aligned to developing in that field, and any other fields of interest would naturally have a separate set of efforts (Gebregzabher et al., 2022). Even in this set and unchanging service, it is still complicated to reform and innovate by translating research to practice in the related industry in order to have good outputs (Suliman et al., 2020; Wei et al., 2019). That said, the former, rapidly changing knowledge and skill requirements, is also a research area where substantial effort has been made to better develop new skills and acquire more specific knowledge to better equip employees (Ceballos et al., 2021; Ferguson, 1998; Ifeoma et al., 2015). Change in scope, that is, having to process and understand projects from different fields, such as microbiology, genetics, and proteomics, becomes an important and challenging task for a single laboratory. This is important because as research and related business endeavours in Africa and on African data continue to grow, this has seen an increase in work and scope that is done in such scientific laboratories (Irikefe et al., 2011).

Other examples focused on studies conducted in resource constraint environments that have a set and unchanging service. Unfortunately, these are not replicable in settings that have a constant change of scope in work because of the diversity of the projects taken up. For example, there is a study that investigated the low performance of laboratory professionals in malaria microscopy (Challi et al., 2020). In this study, the importance of rigorous performance monitoring is more emphasized than repeated standard training (Hailu et al., 2017; A. Rowe et al., 2005). This will most likely not be feasible in a setting with continuous change of scope, because of the diversity of the projects taken up. This is because there are not enough resources to have rigorous performance monitoring and standard training for multiple scopes, because of the diversity of the projects taken up, of work.

In context to the research topic: Importance of studies in resource constraint settings.

In addition to the study constraints above, the majority of the studies based on scientific laboratories have been based on resource rich countries (Aronson & Rehm, 2015; Merry et al., 2023). While a few studies have been conducted in resource constraint settings, for example, the influence of limited economic resources and corruption, which in many countries are important contextual factors affecting organizations (Leufvén et al., 2015). In this case, they are contextual to Africa. Until recently, there have been limited studies that focus on the development of CPD systems, specifically in resource constraint countries (Merry et al., 2023). Evidence has also shown that the effectiveness of interventions to change health professionals' behaviour in developing countries is either scanty or flawed due to poorly designed solutions (S. Y. Rowe et al., 2019). Therefore, it is important to have a clear understanding of the problem, which in turn would allow one to design robust solutions. The solutions would positively influence the professionals to deliver good outputs. Given the drive to improve the quality of outputs, this has been seen as a priority area for researchers and industry who are looking to support the development of health systems and related scientific environments in developing countries (Baseke et al., 2022; Siddiqi et al., 2005).

This is made difficult in a resource constraint setting as it has a unique set of issues. These issues include, there being common tasks that laboratory technologists can be trained to do. On the other hand, each procedure has its specificities, meaning if one is not trained, then they can't participate in the routine running in circumstances when there is a shortage of staff (Challi et al., 2020). Other resource issues can even include not having the necessary laboratory setting to perform the task. This significantly hampers one's ability to do effective in-service training. As mentioned before, in situations where time is not an issue, there are other resources like laboratory equipment and reagents that are needed to maintain the needed or higher level of competency (Nega et al., 2020). Studies have shown that while the body of literature from the global north can offer insights and recommendations for development, implementation and sustainability, it may be of limited relevance for the global south, where the social, cultural, political and economic conditions are significantly different (Merry et al., 2023). It is only recently, in the last few years, that research in the global south has begun to emerge strongly

(Azad et al., 2020; Chan et al., 2021; Deprez et al., 2023; Guillaume et al., 2022; Hill et al., 2021; Miller et al., 2015; Vakani et al., 2024).

Conclusion

Drawing on the notion of reflexivity (Olmos-Vega et al., 2023), in order to examine my practices and judgements on the research, I made notes on the literature found. These notes were of any literature that stood out to me, and I researched further if needed. For example, there was a lot of literature on competencies in Nursing related journals. I researched further to better understand why this was a highly researched area and how this could relate to my study. Nurses work in a dynamic high, pressure and high stakes environment. Research has shown that in this challenging environment, the nurse-patient relationship has been shown is a direct impact on the quality of care and degree of satisfaction by both (Carol Ramos, 1992; Hartley et al., 2020; Molina-Mula & Gallo-Estrada, 2020). The pressure of the role and environment have become hindrances in developing competencies (Ma et al., 2023; Stalpers et al., 2017). Examples of pressures nurses experience in their environment include long shifts that are strenuous because of the physical and emotional burden related to illness, mortality, grief and trauma (Aregger Lundh et al., 2023; Clayton & Marczak, 2023).

The nurses can be transposed to the technicians in this researcher's case study. They play a direct and key role in delivering quality outputs. They also exist in a high-pressure environment that handles diverse work and, therefore, are exposed to a constant change in the scope of work conducted. There are obvious differences that emanate mostly from the difference in skillset and how it is applied; therefore, we can only borrow certain aspects of the findings from these studies. This matches my observations of technicians at the case study organisation, the Scientific Laboratory. The technicians exist in a high-pressure environment with projects from varying fields of study. The projects include clients from diagnostic and research organisations. This results in a similar outcome as those outlined in the literature. For example, these outcomes include burnout and poor outputs. Ultimately, the role and environment can become hinderances in developing competencies (Ma et al., 2023; Stalpers et al., 2017). This may be due to, for example, having limited time for continuous development. In the case of the

technicians at the Scientific Laboratory, this was seen when having a constant change of scope in work that made it impractical to have multiple focusses for continuous development.

To reiterate, there was limited literature that covered all six aspects of my research question; therefore, I amalgamated all the different findings to better understand current literature related to my research question. There being limited literature that provides contextual understanding of the phenomena, was one of the key motivators to undertake the study. The literature chosen resonated with different aspects that were experienced by technicians at the Scientific Laboratory. In most instances, the literature was not contextual to the environment the Scientific Laboratory is based in. For example, the Scientific Laboratory is based in a resource constraint setting. That said, the majority of literature on technician competencies was based on studies that were conducted in resource rich settings.

The two main gaps in the current research that I have identified are (gap 1) understanding underlying causes for: (the second gap) research in a Scientific laboratory, a resource constraint setting, that has a constant change of scope in work, because of the diversity in projects that it can and has taken up. After establishing the main gaps to fill, I broke down the research question into two main branches of understanding so as to integrate them to paint a clearer picture. The two branches are the Scientific Laboratory as a business and its influence on the technicians' competencies, which directly affect the quality of the outputs. The next two sections will then focus on systems theory in relation to the Scientific Laboratory as a business and learning theories in relation to the development of competencies.

To summarise, the niche of limited research that I would like to add to is described by the following four factors: Underlying causes; in a resource-constraint settings; in a scientific laboratory; experiencing a change of scope, because of the diversity of the projects taken up. The focus will be on a business level and on an employee level. The following theories, including learning and Systems theories, will help to elucidate the phenomenon in question.

2.3. Systems Theory - focusing on the Scientific Laboratory as a business.

2.3.1. Systems theory in relation to business demands at the organization.

Systems theory views organizations as open social systems, a human system, that must interact with their environments in order to survive (Lai & Lin, 2017). These interactions are critical to how organizations and their employees grow, adjust and adapt to changes in an organization's environment (Cutlip et al., 2006). This section will outline how systems theory can enable me to operationalise my research questions. This means I will use systems theory as a lens to look at the environment in which the technicians exist and how it influences their learning. Whilst the learning theories, in the following sections, outline how and why people learn, systems theory allows me to gain a deeper understanding of opportunities for exploring the workplace, that is, the organisation in which they learn. Systems theory gives a structured understanding of the organisation and its influence on the technicians learning.

Structure, for example, in the form of a diagram or a schema that shows related concepts, would give a guided approach which ensures different related scenarios are accounted for (Langdon et al., 2015). A practical example would be drawing out a diagram of how an employee may request to attend a course that the organisation will pay for. This is not always a linear process, as there are other factors that influence the request. Factors include, "where the course will be held", this will be further broken down to "has the organisation budgeted for travel costs?" or "can the employee travel? as they may have family responsibility, like childcare". A schema or diagram, like a rich picture, will map out these factors and influences, and it uncovers hidden or previously unrealized aspects of specific experiences, which adds depth to the understanding of a phenomenon (Gisby et al., 2023).

There are various systems related models to follow that will help elucidate this. Subsequently, solutions that are created by considering related concepts then answers the question more thoroughly (Hanson et al., 2011; Pearce et al., 2014; Turner et al., 2013). Schemas also assist in a better understanding of how different factors are related (Blessinger, 2015; Latham, 2016). Currently, evidence that is available is outlined for general research (Latham, 2016; Searcy & Mentzer, 2003) and falls short of considering important factors that are associated with diverse scientific work, such as the complication of dealing with ever changing, evolving and multifaceted projects. As mentioned, there are various models that will help elucidate the system in which the technicians exist. To understand a complex system, like the Scientific Laboratory, one can employ a Viable System Model (VSM). The model enables one to look at and map out all the components at any complexity and is also a scalable approach that can be used in small or large organizations (Schwaninger & Scheef, 2016). VSM aids in determining the viability and sustainability of an organization when it is mirrored against the ideal model (Beer, 1984). An ideal model, that is, a model capable of existing independently (Espinosa et al., 2023).

With respect to what influences the technicians' competencies, the system in which they exist will be measured against an ideal system to differentiate the environments. The differences will be analyzed to see how they influence the technicians' competencies. This gives an idea of how a system works and gives management principles that aid in greatly improving an organization's performance (Christopher, 2010). Analysis that follows to facilitate the solution is more efficient as the right questions are being interrogated (Schwaninger, 2006). In VSM, it does not only look at the organization in a traditional view but with all its parts, their purpose, how they work and how they relate to other parts (Christopher, 2010; Elezi et al., 2014; Espinosa et al., 2023). Here are the three main types of components in the system when looking at a VSM:

1. *Operational* units (in a value chain), which has smaller systems, which implement the work that defined by the system.
2. *Environment*, or niche, in which this work is carried out, there are feedback loops within the organization and between it and its environment, which enable control and adaption, thereby allowing for viability.

3. *Management and Technical* support that defines and carries out the work in the nodes in order to effectively implement their tasks.

The above describes three main types of components that exist in systems. This section describes the five interconnected systems (Beer, 1981, 1985) that are also recursively present in subsystems. This is to say, in system one, operations described below, the five systems should exist in that structure. For example, when you consider the *Operations* system, and take at the core products and services that technicians produce, the other systems recursively fall under it as operations are affected and directed by activities in the other systems, that is, by *Human Resources*, *Middle management*, *Senior management*, and the *Board*. The five systems have been listed and described (Elezi et al., 2014; Espinosa et al., 2023) below and, contextually related to the Scientific laboratory, case study organization in this research:

1. *Operations*, at the core, technicians; this system is concerned with producing and delivering the core products or services. It must continuously learn how to manage the variety of its niche, in order to be able to adapt to changes and emerging challenges.
2. *Human Resources* is one of the system's four systems that carries out the management function at the scientific organization. Its elements provide communication to allow for guidance and coordination, and this allows for cohesion to prevent any conflict that may arise when accessing resources. This aids in managing conflicts of interest like competition for resources.
3. *Middle management*, which controls operations (in system one, that is corresponds to point one) by managing its resources, translating strategic goals that were set at higher management levels, and does daily audits to inform strategic decisions for corrective action (authoritative instruction). This helps in facilitating and negotiating constructive collaboration.
4. *Senior management*, it is concerned with strategic near future and long-term plans, it works collaboratively with system three to monitor the current operations (in system one), capabilities against future strategic plans in order to adapt the organization. This helps in adapting to a rapidly changing and potentially hostile, mainly external, environment.
5. The *Board*, the highest level of management, gives the organization identity through vision, a set of values and goals that strongly guide and create boundaries for the rest of the organization, which creates a balanced decision-making context informed by multiple perspectives from the board members.

There are different mechanisms for viability, such as adaption and cohesion mechanisms, which refer to adapting and aligning individual and collective interests (Espejo, 1990). These are needed to adapt the organization as it increases its scope and, inevitably, its capacity. For the system to be viable, the organization would need to take a look at what influences the competencies of its employees who work to deliver successful outputs.

2.3.2. Systematic factors that inform understanding of phenomena

The Scientific Laboratory, the case study organization in this research, was built to increase South Africa's ability to ensure advanced and innovative "omics" technologies are available to Industry. It was to boost, to begin with, South Africa and, at a larger scale, Africa's biotech economy at a global level ("Affymetrix Announces Research Collaboration With Centre for Proteomic and Genomic Research CPGR in South Africa," 2012). This paragraph gives a high-level description of the Scientific Laboratory. This is to showcase the strategic involvement of scientific laboratories as part of South Africa's bioeconomy strategy (DST, 2013). The Bioeconomy Strategy is an initiative of the Department of Science and Innovation (DSI), South Africa. The strategy encompasses biotechnological activities that translate into economic outputs; this includes but is not limited to technological and non-technological exploitation of biological materials to improve human health, address food security and subsequently contribute to economic growth and improved quality of life (Beluhova-Uzunova et al., 2023; Chitaka & Schenck, 2023).

The success of this bioeconomy strategy not only hinges on technology advancements but the ability to translate the technology into long-term sustainable business value. The strategy was set up as it holds great promise of yielding value for broader economic growth in a country (Uctu & Essop, 2012). Studies have, therefore, intently researched the relationship between the technological catalysis of innovation and the economy from the perspective of a developing

country like South Africa (Bambo & Pouris, 2020; Hlangwani et al., 2023). These studies have shown that great investment into the sector and showcases the are different ways in which the bioeconomy aids in growing the broader South African economy. For example, the use of technology in the bioeconomic industries has resulted in job creation and economic growth through research and commercialization of biotechnologies (Hlangwani et al., 2023).

Studies have shown that the adoption of the concepts and technological aspects of this facet of the Fourth Industrial Revolution across government, academia, and industry has fostered innovation in the health, agricultural, and manufacturing sectors (Hlangwani et al., 2023). With respect to the viability of the bioeconomy strategy, this study has shown that a systems level approach is beneficial to unearthing how to ensure regulation and sustainability (Stark et al., 2022). For example, in ensuring regulation and sustainability, literature and expert opinions have shown that a sustainable bioeconomy will only come off the ground under appropriate governance arrangements (Biber-Freudenberger et al., 2020; Dietz et al., 2020). In this study, approaches and considerations similar to those mentioned above were taken. That is, to also look at the Scientific Laboratory, which was formed as part of bioeconomy strategy actions, as a business that holds great potential to contribute to the economy.

The following paragraphs show the external, internal, micro, and macro level factors that are at play in the system that inform an understanding of the phenomena that affects the Scientific Laboratory as a business. In order to map these factors out, various useful algorithms that speak to mapping out factors in the system were employed, and the understanding was combined to get multiple perspectives (Crowe et al., 2017). These factors to map out are in relation to the development of competencies and how this development influences the quality of the outputs that the organization produces:

1. **PESTLE** and **CATWOE**: *Macro level*, taking into account external (mainly PESTLE) and internal (mainly CATWOE) factors. These are broader, abstract, and high-level factors. This takes into consideration broader concepts, such as the legal policies that govern the environment in which the organization exists.

2. **Gemba** and **Fishbone** will show building block concepts of the detailed **Rich picture** and **CIMO: Micro level**, taking into account external and internal factors. This takes into consideration, juxtaposing the example given in one, how the legal policies that govern the environment in which the organization exists affects or influences day-to-day processes in the laboratory.

2.3.2.1. *PESTLE (macro level, external factors)*

The study used PESTLE analysis (see Figure 2) as a tool to gain a macro picture of the scientific industry's environment. This analysis is useful in giving a multidimensional perspective of an organization when contemplating a certain idea or plan (Casañ et al., 2021). This is done by providing contextual information. The information in this study ranged from how the Scientific organization positioned itself, where it seeks to grow and any potential risks to its productivity. Many companies use PESTLE to analyze the viability and impact of the company and its environment in which they plan to launch a product, service, or innovation (Casañ et al., 2021). This viability and impact can be achieved in the face of risks, barriers, and challenges that an organization may face (Dalirazar & Sabzi, 2023; Rastogi & Trivedi, 2016).

For this study, it would be in aid of understanding influences on developing competencies that directly affected launched and to be launched products, services, or innovations. This is looked at through the lens of systematic factors that are seen to play a role in influencing the technician's competencies. For example, the factors could be under one of the listed PESTLE categories, like technology. Technology in science is continually growing and evolving at a rapid pace, and we are said to be in an era characterized by rapid change and innovation, which has transformed industries and created sustainable businesses (Hallema, 2023). There is a need to have ongoing assessments post initial training that employees receive (Hallema, 2023) to meet the advancements in technology. This ongoing assessment post initial training are rarely done but even when done may still result in poor performance due to the non-optimal design of assessing competency needs (Haun & Leach, 2003). The PESTLE analysis is one of the most useful tools when looking at an external business environment, like the Scientific Laboratory, that is highly dynamic (A. Gupta, 2013). There are six categories to the PESTLE

analysis. PESTLE is an acronym that is elaborated as follows: Political, Economic, Social, Technological, Legal, and Environmental.

In the following, the PESTLE categories will be described in relation to the Scientific Laboratory; context has been given in Figure 2. The following categories' definitions were taken from (Perera, 2017) and interpreted to summarize the context in which the Scientific Laboratory exists in relation to the phenomenon :

1. *Political* – Political and government influences. For example, political instability, government support to industry, and national policies. This speaks to the role of government in enabling and establishing good governance and creating funding opportunities (Enaifoghe et al., 2023; Majokweni et al., 2024). Good governance can, for example, be seen in the establishment of policies that make competency assessment mandatory in needed fields (Chekijian et al., 2021; Desjardins & Fleming, 2014; Moetsana-Poka et al., 2014; Undilashvili et al., 2019) Funding opportunities are impacted by political and governance state can influence the already limited funding available for training deemed necessary and crucial to good outcomes (Ukoha & Mtshali, 2023).
2. *Economic* – Income levels in organization and country. For example, rates related to inflation, foreign exchange and employment, and customer attitudes and perceptions. This relates to funding availability for competency development. The following strongly influence the availability of funding for competency development. In relation to import and export, the volatile exchange rate is known to affect pricing (Eliakim, 2020). In relation to building a strong client base, customer attitudes and perceptions are key. They are known to attract funding from funding bodies due to a strong reputation. In addition, they generate income by converting potential customers. Overall, customers in this field would need to have competitive pricing and trust in the product to use it (S.-W. Chen et al., 2021; Liao et al., 2023).

3. *Social* – Values and beliefs. For example, values related to culture, religion, norms and ethics of the organization, environment, and customers. These factors influence cohesion between teams and individuals, as well as the environment in which they work. This environment and relationships overly affect the technician’s ability to operate and access development opportunities in the workplace. Their inability to perform optimally directly affects their ability to produce quality outputs (Dingel & Maffett, 2023; Parashakti et al., 2020).
4. *Technological* – The utilization of technology. Highly relevant in such a technology-based industry with a focus on essential technologies only. For example, in the infrastructure, upgrades, methods and development of related competencies. This speaks to the availability of funding to develop competencies to utilize the ever-evolving technologies and related methods (Hallema, 2023). Production of big data, a key characteristic of the technology, incurs costs of purchasing and maintaining technologies and storing big data (Phillips et al., 2014; Wordsworth et al., 2018). This diminishes funding that allows organizations to evaluate when development is needed, such as competency assessments. This also diminishes funding for employees to develop identified competencies to operate introduced technologies and methods that are needed for them to produce quality outputs.
5. *Legal* – Laws, guidelines, regulations, rules, and principles. For example, the presence or absence of regulatory bodies or policies affects the placement and/or development of competencies needed to perform specific tasks necessary in the Scientific Laboratory (Khadambi-Morokane et al., 2021). The presence of a regulatory body, for example, the South African National Accreditation System, that, requires a Health Professions Council of South Africa accredited technician to perform specific tasks in the laboratory (Khadambi-Morokane et al., 2022). This may limit finding an accredited employee to place in the role as they are scarce to place (Ellapen et al., 2021). The absence of a regulation can also restrict the governance needed to establish directive on continuous development of competencies (Biber-Freudenberger et al., 2020). A fine balance that is continually evaluated is often necessary to achieve effective stability. Further, the resulting lack of competencies based on governance, whether through a lack of personnel or development, is known to affect the quality of the outputs (Baseke et al., 2022; Khadambi-Morokane et al., 2022).

6. *Environmental* – Geographical concerns, location-based factors. For example, limited local availability of resources like reagents, electricity, and water. Again, this speaks to the competition for resources, that is, time and funding, that are required for developing competencies. The financial cost and the administrative, time consuming, burden associated with importing materials used in the Scientific Laboratory. This is because most of the technology and related materials are manufactured overseas, in the global north. This hindering reliance on imported materials was elucidated during the COVID-19 pandemic (Hendarwan et al., 2020; Umvilighozo et al., 2020). There are also water and power supply interruptions, and the major cost is in the disruption of services and the use of alternative supply (Akpeji et al., 2020; Mutambo et al., 2023).

The PESTLE analysis highlighted external macro level categories that influence the development of competencies. The major factors that it boiled down to was funding to develop competencies and the state of relations and processes that influence funding being assigned to develop competencies. The next system's algorithm, also a macro level view but the internal, CATWOE, will go a step further and look at the different stakeholders in the organization's environment, their viewpoints, and influences on developing competencies.

P <i>(Political)</i>	E <i>(Economic)</i>	S <i>(Social)</i>	T <i>(Technological)</i>	L <i>(Legal)</i>	E <i>(Environmental)</i>
<ul style="list-style-type: none"> - Funding mainly from a government department which experiences frequent budget cuts - Foreign currency rates may spike from political instability making imports expensive. This affects reagents and machinery that is sourced overseas - Policies in place to forward careers and work in the industry 	<ul style="list-style-type: none"> - Reduction in bioeconomy funding affects both research and industry and in turn CRO business - Most reagents and machinery are sourced overseas. High custom clearance costs. Fluctuating exchange rates - Potential customers perceptions of the organisations ability to do work 	<ul style="list-style-type: none"> - Management and subordinate cohesion - Team cohesion in and between departments - Global trends towards environments with work-life balance and engaging workplace environments - Customer culture of preferring global north for same services 	<ul style="list-style-type: none"> - Machinery is expensive, once outdated it is expensive to replace - Production of big data may require expensive computation and storage solutions - Possible limited willingness to use new, to the employee, machinery - Need to train employees on use 	<ul style="list-style-type: none"> - Regulatory bodies require accreditation on certain technical laboratory personnel. This puts a further strain on finding technicians - POPI act now fully in play. Important as CRO to ensure that in addition to self, clients are also compliant -Regulatory bodies on certain products, processes or services 	<ul style="list-style-type: none"> - External Services like the CHPC (The Centre for High Performance Computing) are affected by power cuts. This in turn disrupts analysis - High number of imported goods - Major delays in getting import certificates and clearing customs for international substances e.g., client samples

Figure 2. PESTLE analysis of the key external factors that were identified at the beginning of the study and are known to influence the Scientific Laboratory in relation to the Phenomena

2.3.2.2. *CATWOE (macro level, mainly internal factors)*

While PESTLE helps one understand the impact of various external factors on business, that is, the Scientific Laboratory, CATWOE helps one understand and map out (see Table 2) the environment that surrounds the business and the related influence. CATWOE is an acronym that stands for Customers, Actors, Transformation Process, World View, Owners, and Environmental Constraints. The CATWOE Analysis table helps to understand stakeholders' perspectives and the impact their views have on the direction of the business (Checkland, 1999). It also shows how the key actors in the rich picture of the organization and how they relate in the environment. The rich picture, at the micro level, will be further discussed later with the remaining systems methods.

This method focuses on creating a root definition of the services provided by the Scientific Laboratory from varying perspectives (Conlon et al., 2020). The aim is to elucidate perspectives on an issue, like competencies, by identifying the Customers, Actors, Transformation, and Worldview in the system (Crowe et al., 2017). The method also helps to highlight Stakeholders in the system. Stakeholders are individuals, groups of individuals or entities that have a vested interest in a business as they can affect or be affected by it. Without their existence, the Scientific Laboratory would cease to exist. As they are key to an organization's existence, it is important not only to identify them but also to understand their influences and impact in order to better stakeholder engagement as it shapes future, positive and negative, directions for the organisation (Kujala et al., 2022).

Each letter of the CATWOE acronym is described in the list below. It has been interpreted to summarize the context in which the Scientific Laboratory exists in relation to the phenomenon:

1. *Customer*: The recipient that will benefit directly makes use of the output. The monetary proceeds from the customers strongly influences the availability of funds for competency development. Customer attitudes and perceptions also play a critical role

in them buying into the Scientific Laboratory's services (S.-W. Chen et al., 2021; Liao et al., 2023). These customers who span from academia to industry, including in translational research (Andrews et al., 2018; Hiller & Ramesar, 2011). Additionally, this includes the main funding body, The DSI, which funds the organization as part of the bioeconomy strategy, and the output for the DSI would be economic growth in South Africa, with a secondary focus on Africa (DST, 2013; Hiller & Blackburn, 2008).

2. *Actor*: The staff that performs the activities needed to generate output. In this case, the focus of the study is the technicians who work directly on the outputs. Other employees in the system are also considered, but secondarily, as they play an influential role when it comes to the technician's development of competencies. For example, tension and lack of cohesion can strain relationships, therefore creating an unsupportive environment for developing competencies (Melesse et al., 2024; Semo et al., 2014).
3. *Transformation*: The core process that delivers the outputs to the customer. This involves essential qualities that lead to a project's success, which are reproducibility, predictability, and falsifiability (Piccione, 2020). These are employed in consultation and collaborative project design, project planning, practical laboratory work, data analysis, and reporting. Funding is needed to develop competencies that allow the technician to effectively contribute to each stage. Maintaining quality and productivity requires good project management approaches to help maximize the opportunities for the successful completion of projects (Baseke et al., 2022; Croxatto & Greub, 2017).
4. *Worldview (Weltanschauung)*: The underlying worldview of the transformation. Once more, as noted in point one, customer attitudes and perceptions also play a critical role in them buying into the Scientific Laboratory's services (S.-W. Chen et al., 2021; Liao et al., 2023). The resulting monetary gain creates the availability of funds that go towards competency development. In the case of transformation, their worldview of the organization will be directly linked to how the customers experienced the service provided to them by the laboratory.
5. *Owner*: The stakeholder with the overall authority in the processes. It is all customers mentioned in point one as they dictate the outputs (services) that they would like in line with the organization's offering and capability. They essentially can stop the service,

direct or transform how it is carried out (Conlon et al., 2020). For example, a significant uptake in research that requires a particular machine and service that is not at the Scientific laboratory can motivate, direct or transform the organization's service offering. The Scientific Laboratory only provides its expertise to help refine and guide the customers' decisions.

6. *Environment*: The rules and constraints surrounding the business system. The main constraints in the environment are navigating regulatory requirements, funding, and reputational trust. There is limited funding to overcome regulatory requirements, build up physical and competent human resources to conduct work. There is also the complexity of having low sample numbers but needing sample numbers to build resources, reputation, and trust to deter samples from being sent overseas to established, high throughput competitors. This complex of samples being sent overseas was again elucidated in the COVID-19 pandemic when there was a need to identify obstacles in the local environment as tests and research needed to be conducted locally (Kanteh et al., 2022).

Having understood, at a macro level, the external factors at play through PESTLE and the main internal factors, through understanding stakeholders via CATWOE, we took a look at the micro level. Therefore, having understood the broader underpinnings that influence technicians' competencies, we zoomed in to take a closer look at processes and their influences.

Table 2: Adapted CATWOE analysis – Stakeholders, Customers, Actors and Owners and their possible influence on the Scientific Laboratory’s business activities

Stakeholder	Customer	Actors	Transformation and Worldview	Owners	Environment
TIA (DSI)	(South) African Biotech	Scientific Laboratory, TIA, and Grant program	<ul style="list-style-type: none"> Services rendered help facilitate and stimulate Biotech activities. TIA Funding allows for “at cost” running of projects to facilitate research and industry activities 	TIA	<ul style="list-style-type: none"> Limited funding available to build up human and physical resources. Complex environment makes it difficult to measure success in a manner that funders can appreciate in order to motivate for increased funding. Grant program hosted at Scientific Laboratory (part of their Network) may create an image of bias.
Researchers and Students (Academia)	Project owners e.g., Principal investigators	Scientific Laboratory	Expert consultation in developing project plan. State of the art services. This translates into successful research outputs and improved patient outcomes.	Project owners	<ul style="list-style-type: none"> Limited funding available. Projects quoted at local “to cost” which in some cases is more costly than overseas competition. Overseas companies have large volumes which enables them to lower costs and the volumes run garners them a reputation.
Clinicians and Individuals (Industry)	Clinicians and Individuals	Scientific Laboratory subsidiary	Support and service on state-of-the-art services translate into improved patient outcomes and quality to consumer products for commercial services.	Clinicians and individuals.	<ul style="list-style-type: none"> Poor understanding and/or appreciation of advanced or more accurate services therefore difficult to motivate change from traditional solutions. Difficult to translate complex results into giving informative information to report to end user. Difficult to implement some regulatory requirements. Overseas companies have large volumes which enables them to lower costs and the volumes run garners them a reputation.

2.3.2.3. GEMBA (micro level, internal and external factors, expanding on subset processes found in Rich picture and CIMO algorithms)

The GEMBA and Fishbone were used to show and describe that there are detailed subset processes and influences on the broader ones that will be seen in the Rich picture and CIMO (Context, Intervention, Mechanism, and Outcome). The Rich picture and the CIMO will be described in the next systems algorithms. This was done to illuminate the complexity of the environment and show the importance of understanding the macro and micro levels. To recap, the context of all the systems algorithms will be in line with the phenomenon, and it will be to look at factors influencing the technician's competencies as there has been a decline in the quality of outputs. Competency of the technicians was cited as the key contributor when discussing reasons for the declined quality of outputs. I was preview to these conversations because I was once employed by the Scientific Laboratory. Literature has shown that these conversations, "water cooler" talk, are reliable sources of information (Choudhury et al., 2023). The recap was necessary to frame how the GEMBA and Fishbone were used. In summary, there were issues in the *workflow* that were attributed to the technicians' *competencies*. The GEMBA will be a walkthrough of the workflow, while the Fishbone will look at the influences on *competencies* in the organization. The GEMBA and Fishbone systems' algorithms will be described in the following paragraphs.

GEMBA is Japanese and translates to the real or actual place; this speaks to walking through the place where any value-adding or value-creating process is carried out (Mcclam Liebengood et al., 2013). The walk is a management practice for grasping the current situation through direct observation and inquiry before taking action for continuous improvement (Coughlin & Posencheg, 2019). In this study it would be the process in which the technicians create the output by carrying out a service in the laboratory. Literature has shown that in a laboratory, the quality of outputs will be dependent on the technician's competency in carrying out the service (Tsehay et al., 2024). When one walks through the workflow, one can observe the value adding process, cooperatively and respectful walk through the process with the technicians who do the

work, ask insightful questions to best understand why the process was set up in that way and lastly seek areas for continuous improvement.

Two GEMBA's have been created (see Figures 3 and 4) to show the walk through of a workflow. The workflows are from two broad categories of clients: academia and industry. This is one of the major differences in the workflows. Although the organization, the Scientific Laboratory, does not conduct its own academia or industry work, its service model has shifted from not only facilitating the use of the technology to playing more of a collaborative, role, which involves assisting in creating study plans and helping clients better understand the process and thus better understanding and generation of their results. Despite these workflows, from academia and industry, seeming very similar, when you observe each step, one will find that they have different nuances like influences and approaches.

For example, in the 3rd step, which is essentially designing the project. *Academia, an analytical study plan is generated:* Researchers want to conduct an exploratory, investigative experiment. The academics are actively involved in the research being conducted in the field that the experiment is based in. The plan is collaboratively generated by the researcher and Scientific Laboratory employees, and assumptions are made about the possible outcomes. The competency to complete the remainder of the steps up to interpretation and reporting lies collaboratively between the Scientific Laboratory employees and the Researcher. Whereas in *Industry, an agreement is completed:* Clients from the industry want to perform a standard and conclusive test. The industry clients are not as actively involved in research in the field in which the test is based. They have an entrepreneurial focus. Although there is a sense of collaboration in generating a plan, understanding the scientific underpinning of the test lies with the Scientific Laboratory employees. The competency to complete the remainder of the steps, up to interpretation and reporting, lies mostly with the Scientific Laboratory employees.

The slight change in client type in the GEMBA's also results in different pathways and interested stakeholders. One of the major differences is that Industry clients require more defined competencies versus their academic counterparts. This is especially important in a context where competencies are linked to the quality of outcomes. The organisation is set up

as an NPO, and it runs all services to Academia at cost and Industry ones at market value, which is a higher pricepoint that gives profit. The funds from industry, amongst many things, helps to sustain the organisation amidst budget cuts, creates funding for competency development and helps maintain important social impact research work (Sadeghi et al., 2021). Industry clients also run routine tests, so they are more likely to be repeat clients, and thus, their attitudes and perceptions play a critical role in them using the Scientific Laboratory's services (S.-W. Chen et al., 2021; Liao et al., 2023). The GEMBA helped to illuminate important processes and stress points in the system to give direction to continuous improvement with respect to competencies. In the next algorithm, Fishbone, we took a look at the system based on "water cooler" conversations to gain an understanding of the employees' perceptions on influences to developing competencies.

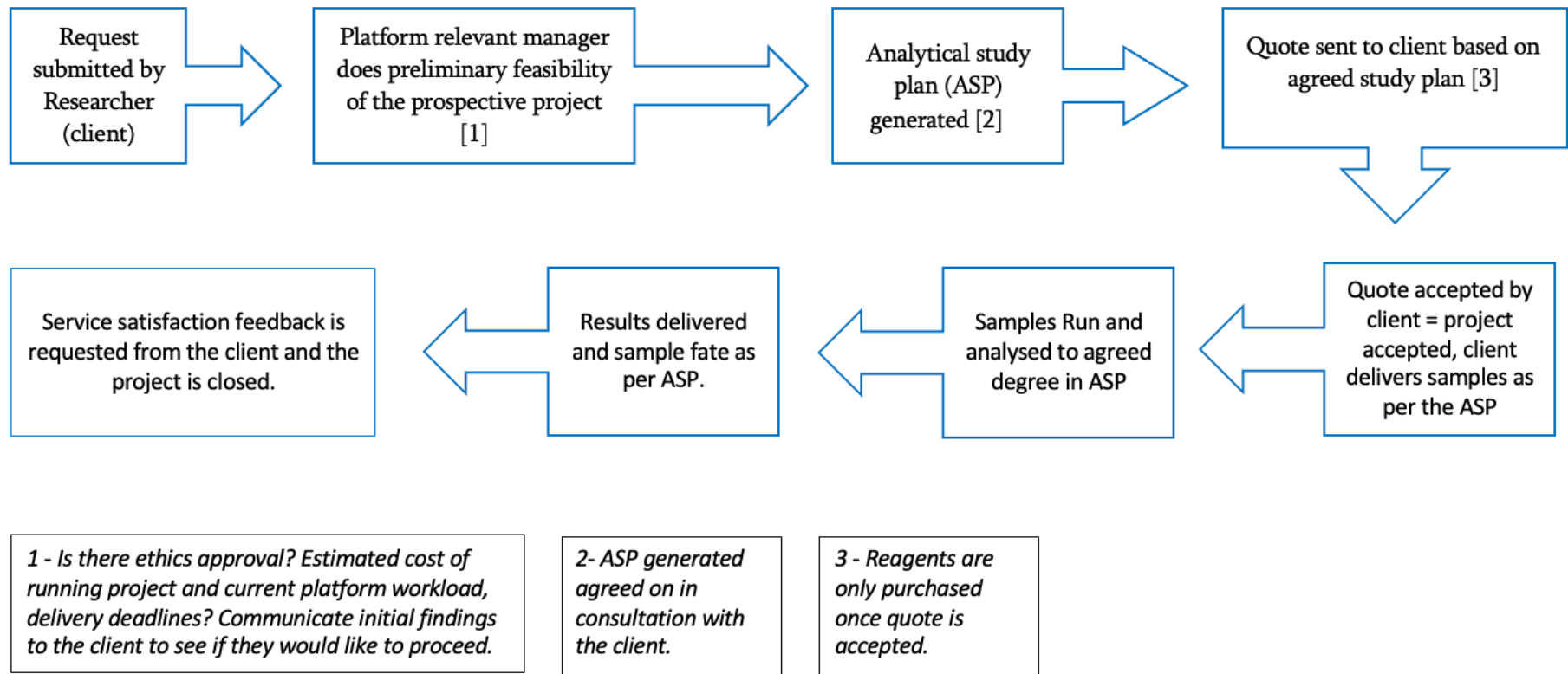


Figure 3. GEMBA depicts the value chain and walks through the workflow for Research Services.

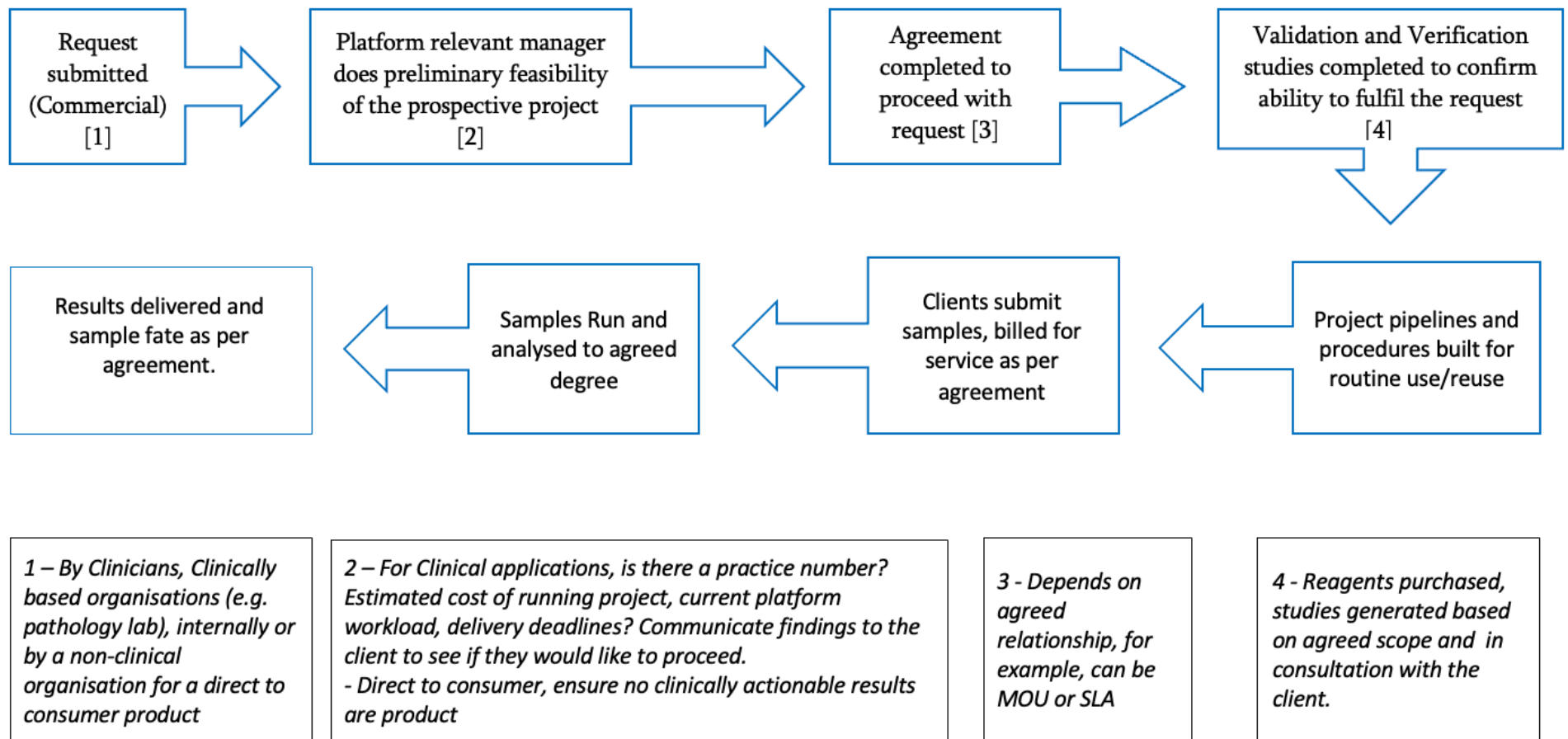


Figure 4. GEMBA depicting value chain, walkthrough the workflow, for Industry Services. This shows that even though there is a slight change in the client being serviced, this opens up the GEMBA to show different pathways and stakeholders.

2.3.2.4. Fishbone (micro level, internal and external factors, expanding on subset influences found in Rich picture and CIMO algorithms)

Having better understood points in the processes that could be improved upon, we looked at what influences those processes; for this, we employed the use of a Fishbone. A fishbone diagram is a graphical technique that shows the several causes or influences of a specific event (Aggarwal et al., 2024). To map possible contributors in the system to the current state of competencies, a Fishbone diagram (see Figure 5) was used to determine the underlying cause (Hall Barber et al., 2015). The diagram has possible causes and effects which include points that have frequently come out in discussions from “water cooler” talks. Literature has shown that. With respect to the “water cooler” talks and the Fishbone process, literature has shown that collecting group thoughts can systematically help management better understand, from different perspectives, and diagnose the organization's problems (Sakdiyah et al., 2022).

There are stages four stages in making a fishbone diagram (Hisprastin & Musfiroh, 2021). Firstly, the problem was determined, which was a decrease in the quality of output, which was attributed to inadequate competencies through “water cooler” talks. Secondly, determining the main categories which were people, processes, and environment. Lastly, analyzing the problem with a diagram, this was also identified in the other systems algorithms, like PESTLE, and it boiled down to the availability of funding to develop competencies and the state of relations and processes that influence funding being assigned to develop competencies.

Literature has shown that the use of Fishbone diagrams is beneficial in decision making because to each of the issues that are thoughtfully identified in the diagram, there will be targeted solutions and it is also expected to minimize obstacles to reaching the same solution in the future (Eviyanti, 2021; Sakdiyah et al., 2022). In the next algorithms, Rich Picture and CIMO, we will look at systems’ algorithms at a micro level that highlight a broader, bigger picture view of the processes to show the different mechanisms that are driving and influencing the processes.

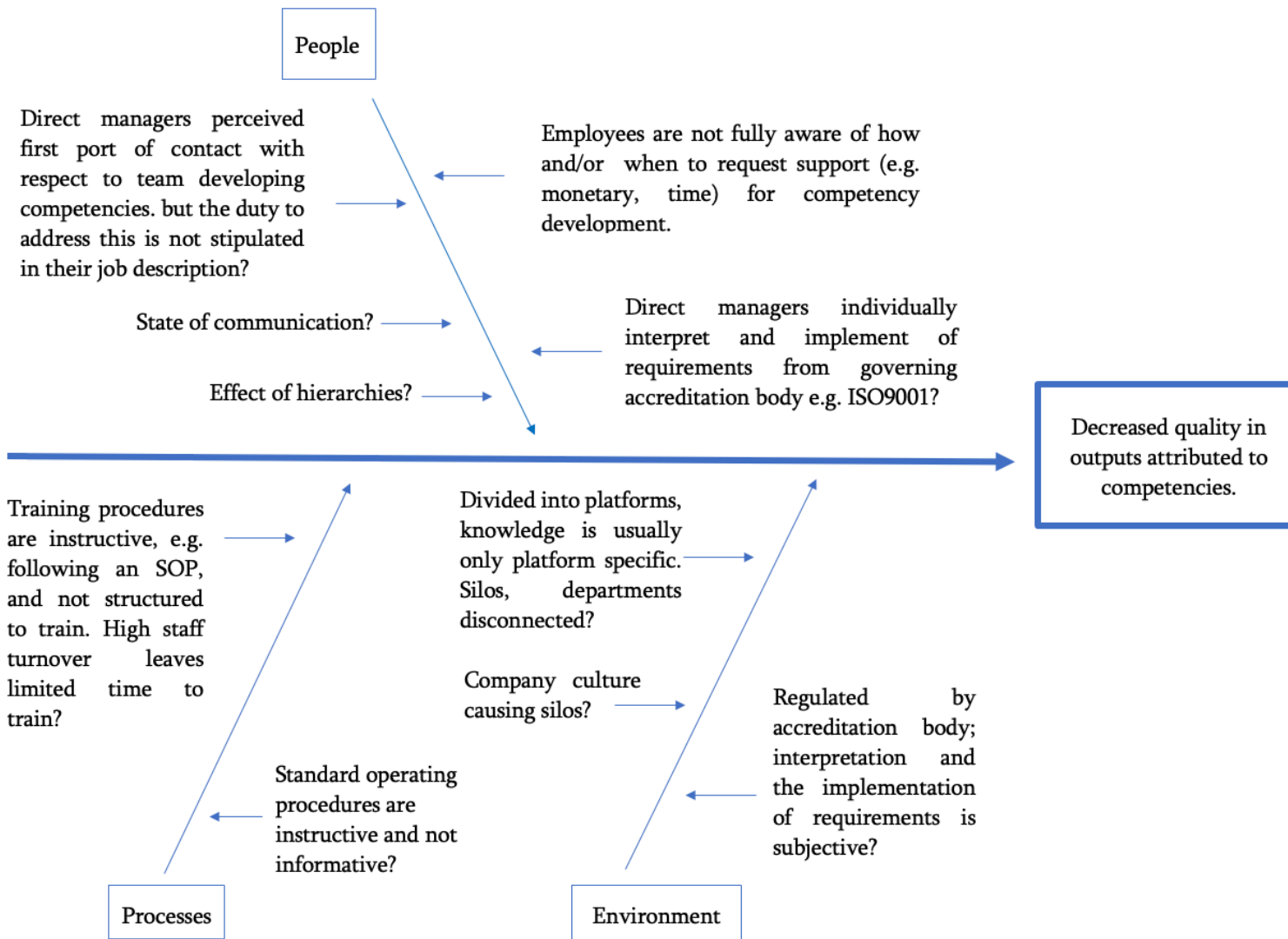


Figure 5. Underlying cause analysis in a fishbone diagram, which shows the possible observed contributors to current competencies.

2.3.2.5. Rich picture (micro level, internal and external factors)

Rich picture diagramming allows an organization to explore how their information flows, communications, subconscious, occult sentiments and conflicted understanding within their system (Conlon et al., 2020). The rich picture below (see Figure 6) shows how the complex environment and further data gathering and analysis will be needed to unearth other relationships or to contribute to a better understanding of the relationships. The relationships described in the rich picture are in relation to creating outputs and the competencies needed to create the quality outputs. The rich picture shows the different stakeholders and actors in the system and how they influence or direct decisions related to creating outputs or developing competencies.

Stakeholders are individuals, groups of individuals or entities that have a vested interest in a business as they can affect or be affected by it. Without their existence, the Scientific Laboratory would cease to exist. The actors are the staff that performs the activities needed to generate output. In this case, the focus of the study is the technicians who work directly on the outputs. Other employees in the system are also considered, but secondarily, as they play an influential role when it comes to the technician's development of competencies. For example, tension and lack of cohesion can strain relationships, therefore creating an unsupportive environment for developing competencies (Melesse et al., 2024; Semo et al., 2014).

The stakeholders have limited funding and are pulled by the appeal of overseas competitors who have lower pricing and established reputation. An alternative conundrum is that the Scientific Laboratory, needs sample numbers to build the reputation and price point to compete with overseas providers in the global north. There are therefore costs from lost leads that comes with not laboratory is to running at capacity, which is further hampered by the high cost, time constraints and administrative burden of importing the majority of materials used in the laboratory (Hendarwan et al., 2020; Umviligihozo et al., 2020). The overseas competitors and import costs are out of the Scientific Laboratory's control, at the least in the short term. There

is then a need to strengthen what is in their control, which is client interactions and outputs, to strengthen the clients' attitudes and perceptions of the Scientific Laboratory. Overall, customers would need to have competitive pricing and trust in the product to use it (S.-W. Chen et al., 2021; Liao et al., 2023).

Further and lastly, the rich picture shows the interactions between different actors in the systems. There is a hierarchy in the flow of information, with the majority of the information flowing from middle management. Although the majority of information flows from middle management, from the PESTLE analysis, we saw that the authority to initiate the flow of information lies with senior management. This means that middle management needs to be motivated for funding for various activities like competency development, the difficult task of recruiting the correct competencies from a shallow hiring pool and sticking to standards set by the accreditation body. This funding is used to facilitate the different information points that flow from them. The Teams that work hierarchically under them look to middle management for direction. Theories around the impact of these interactions will be expanded upon further when discussing learning theories in section 2.4. Being able to lay out these multifaceted interactions show that rich pictures constitute as an effective method to explore perspectives on complex phenomena (Kado et al., 2022).

The picture was revisited and reworked as aspects and views of the processes changed over time as new insights are encountered (Checkland & Scholes, 1991). Revisiting the diagram also prompted me to have interactions with different actors to gain a better understanding because a researcher's reflections alone are not reliable factual evidence (Midgley et al., 2013). Fundamentally, at the base of the operations is a human system, which is what we will focus on, as they drive the work. Studies have shown that in maintaining a trained and competent workforce, there is a strong need to strengthen an organizations HR capacity (Bavoria et al., 2019). The perspective from the rich picture provides an important view of the different stakeholders. Even in this view, it is important to note that this specific view can vary from actor to actor (Mele et al., 2010). It is, therefore, important to look at the perspectives of other key stakeholders that are in the rich picture. This was done and described above. Lastly, I looked at the CIMO in order to connect positive and negative interactions at play and see how they influence each other in developing competencies to produce quality outputs.

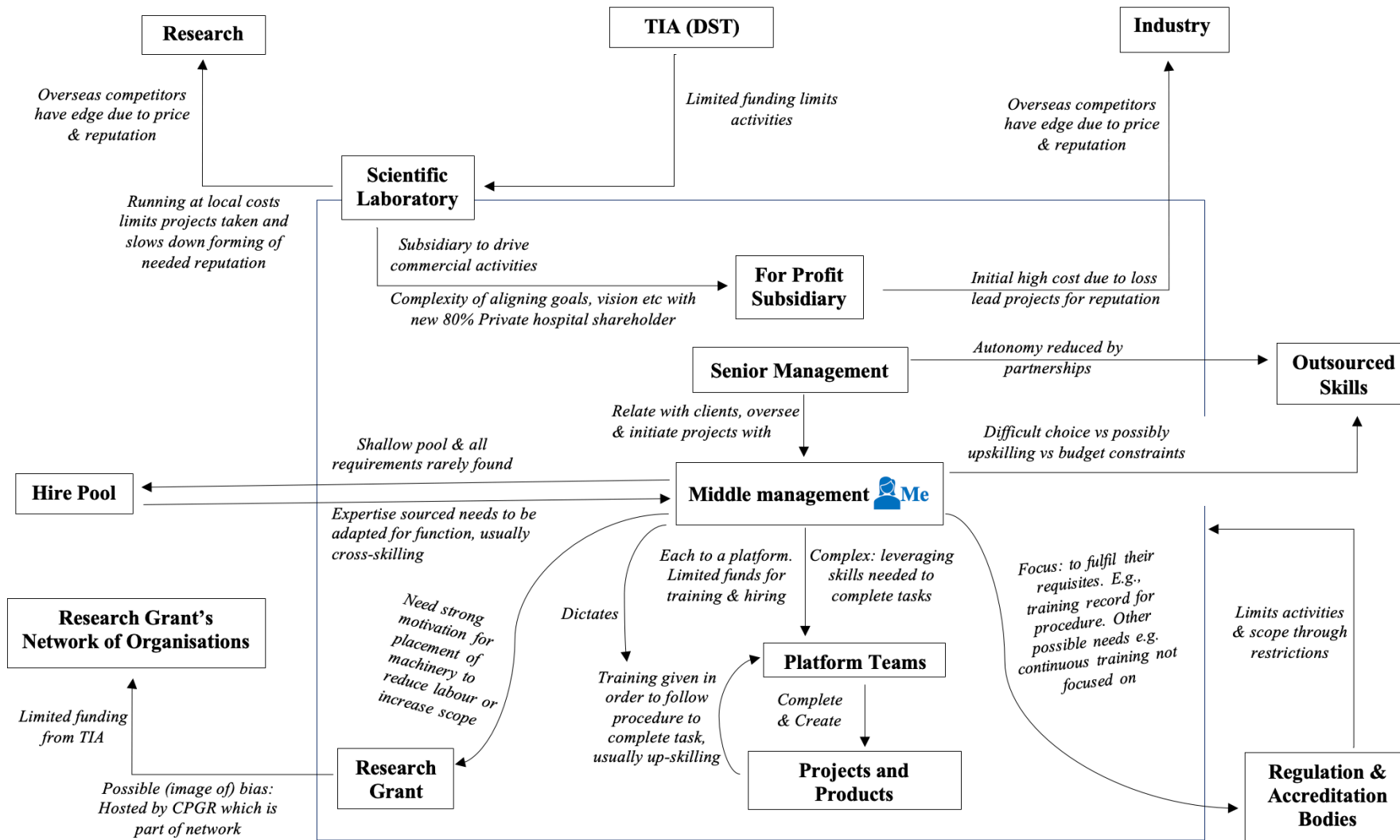


Figure 6. A rich picture of the complex environment at the Scientific Laboratory.

2.3.2.6. *CIMO (micro level, internal and external factors)*

The CIMO acronym stands for Context, Intervention, Mechanism, and Outcome Diagram (McClelland et al., 2022). It helps connect mechanisms at play in the system and form a causal map to show cause and effect, providing a greater appreciation and awareness of the interactions of variables (Mabin et al., 2006). To recap, all of the systems diagrams were generated using observations of the state of the organization at the beginning of the study. In the CIMO framework, researchers analyze these four elements in relation to one another, examining how they interact and influence one another to give a sense of when, why, how and the outcome (Crisan et al., 2021). The categories are described in relation to the study as:

1. *Context*: This is the social and organizational setting in which the phenomenon occurs. The surrounding factors that influence the actor, that is, the technician. This is the Scientific Laboratory that is based in a resource constraint setting.
2. *Intervention*: The actions are taken to address or influence the phenomenon. Purposeful actions and measures. These are illustrated in the CIMO (see figure 7) as the availability of funding for competency development, effective communication, a good state of competency and finally, good team and process dynamics.
3. *Mechanism*: The underlying processes or mechanisms that drive change within the phenomenon. Actioning the intervention, that is, triggered by the intervention. These are the availability of funding and positive interactions with respect to processes and individuals in the system.
4. *Outcome*: Mechanisms are put in place to produce the desired results, that is, the outcomes. The resulting changes occur due to the defining the intervention and carrying out the resulting mechanisms that have been put in place. This is seen when staff competencies are able to adapt to a change of scope in work by producing quality outputs, which effectively, in turn, boosts business.

The examinations of processes that are described in the different system's algorithms will help to answer the question of what influences competencies. The algorithms help to elucidate factors that are at play in the environment. It is important to realise that in understanding the

environment, this action will yield a substantial number of solutions when it comes to remedying individual shortfalls in performance. For example, in Figure 7, we see a number of positive and negative drivers. For example, limited funding is a negative driver and negatively influences developing competencies. That said, a positive driver would be communication, which results in competency development for the employee. In that state, of being competent, there are other drivers like stress, stress is driven by budget constraints, the instability of high employee turnover and perceived limited self-efficacy. A positive director to circumvent this would be a good state team and process dynamics in completing work. This is a positive driver back to the start, training for competency development.

These interactions and processes might be argued as obvious to see or easy to predict, but their interactions and effects are more nuanced but highly impactful. For example, in Figures 3 and 4 of the GEMBA walkthrough, there is a difference in the client type and the rest of the steps in the walk-through change. An understanding of the client type unearthed the need for more established competency, as the client would expect the employee to have grasped the scientific understanding of the test in order to deliver the agreed result. This is because clients from the industry are not running exploratory experiments but rather set routine tests compared to their counterparts in academia, who are rooted in the research area and are running experiments as part of their research projects. By making the influencing factors clear and showing their effect, for example, training an employee is not only for the individual, but there will be a clear responsibility for it to bring improvement to the system (Tate, 2010).

Systems theory aids in looking at the complexity of what influences competencies not in a vacuum but rather in its most realistic form, in a system where there are different players and internal and external interactions. These complex interactions include human resources (Salah et al., 2010) and how they can affect business performance. Having better understood the system in which the employees exist, the next section, Learning Theories, follows on to take a look at the central aspect of the (human) system, the employee. The section focuses on the learning aspect in developing competencies. It explores the factors that influence how the employees' competencies are developed, whereas the previous section looked at the environment in which they are developed. This would give a more refined picture of the internal and external factors that influence the technicians' competencies.

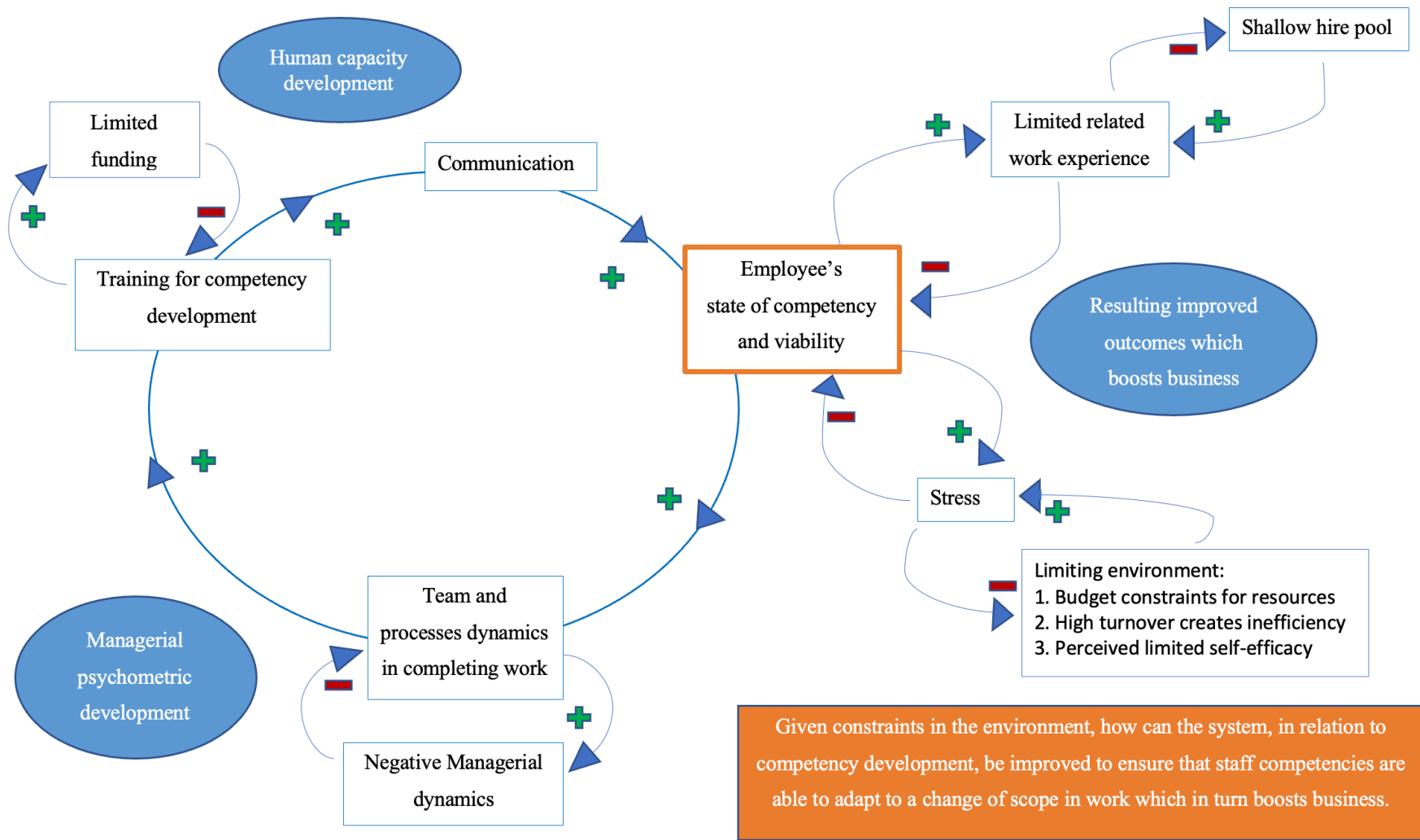


Figure 7. CIMO Diagram showing the current state of competencies. This was initially developed based on the researcher's observations in the system, and the diagram was refined over time based on data collected during the different phases of the study.2

2.4. Learning Theories - Influences on technicians' competencies at the Scientific Laboratory.

2.4.1. Learning theories in relation to business demands at the organization.

Systems theory excellently showed the cause and effect, interactions, and relations in the system at a macro and micro level of different important components in the Scientific Laboratory. These components are related to the viability of the organization, that is, influences on the development of the technicians' competencies to generate quality outputs. This learning theories section will now explain how these causes and effects, interactions, and relations are actually affecting the technicians, that is, influencing their aptitude to develop competency. I will give an analogy to help elucidate the integration of systems theory and learning theories, for example:

The phenomenon: A theoretical organization experiences a drop in productivity and spends significantly more on desk tissues in summer versus in spring when there are allergies or winter when there are flu and colds.

Systems theory: Shows cause and effect, interactions, and relations in the organization. Shows correlation between summer and some allergies but also shows that state, that none of employees has these allergies. By looking at the micro level, it shows that the employees cry when a specific flower is in bloom.

Learning theories: This then asks to understand the individual, what about the blooming flower makes them cry? It reminds remind them of a local natural disaster that occurred. The flower

was in bloom and native to the affected region. The flower is prominently featured in all images taken during the disaster. Therefore, the flower is a reminder of the devastating disaster.

Conclusion: Without using Systems theory, we would have a limited understanding of the different dynamics at play in the theoretical organization and learning theories helped to be more targeted in the understanding of what the cause and effect, interactions, and relations affect the employees.

In this study, learning theories describe how students receive, process, and retain knowledge during learning (D. Taylor & Hamdy, 2013). Multiple theories are used as no single theory explains how the principles of the theories will all come together under different, multidimensional circumstances (Austin et al., 2001). This approach is further supported by systems theory, showcasing the multidimensional complexity of the organization. This is further complicated by the fact that, in learning in order to develop competencies, each employee will bring their idiosyncratic challenges, personality, and abilities (Hargreaves, 2010). Learning theories consider the cognitive, emotional, and environmental influences, as well as prior experience. These listed factors all play a part in how understanding, or a worldview, is acquired or changed and knowledge and skills retained (Dierking, 1991). This section looks to expand on the environment the technicians work in to explore any factors influencing the technicians' competency development.

2.4.1.1. *Organogram*

As mentioned in the introductory paragraph in this section, learning theories consider environmental influences, like the individuals and the resulting relations, for example, company culture, that they create. We will, therefore, start by gaining an understanding of the different employees through the use of the organization's Scientific Laboratory organogram. An organogram is an organizational chart which is a graphic portrayal of an organizations formal structure. Literature has shown that in a laboratory setting, this can be standardized to provide a clear picture of the area of responsibility and reporting relationships within the organization (Obeta et al., 2019). The creation of this structure, in many processes, is employed

to make decisions including, but not limited to, recruitment, propelling technological innovation, and development activities such as training (DeCanio et al., 2000; Obeta et al., 2019). The listed processes have been shown and described in section 2.3, Systems theory algorithms, to have an impact on the development of competencies.

The Scientific Laboratory's organogram is arranged into different platforms that represent different functions (see Figure 8). Platforms, at the organization, essentially represent departments. The organogram has three levels of hierarchy, namely:

1. *Topmost, senior management*: Defining resources and direction. This consists of the managing director and overall organizational functions like Human resources and Finance.
2. *Middle management*: Design and, based on the given resources, allocate resources. These are divided into the different broad scientific fields like genomics, proteomics and bioinformatics.
3. *Base technicians* are the core teams, which are mostly technicians and support staff. They plan and execute based on directives from middle management.

Section 2.3., Systems theory algorithm PESTLE analysis expands on the different functions. It shows that decisions made at the in management level naturally affects the functioning of the technicians. It also goes a step further to show the cause and effect at a macro and micro level. The learning theories section will now go a step further to explain why that cause and why that effect is affecting the technicians.

The managers in the Scientific Laboratory are located in positions (See Figure 8) to action change as they are vital in planning structural adjustments that can guarantee the survival of the whole system (Mele et al., 2010). The manager's position influences the driving force at the organization, and that is the employees who routinely carry out the work, such as analysts and technicians. This shows the importance and influence that managers have in the organization when it comes to affecting the Technician's ability to complete work, for example, in the case of competencies. Further, it is important for those in leadership positions not to only consider the individual but their presence in a system, a systematic model of leadership (Tate,

2010). The role of leaders also transcends and is thought to have an influence on those they lead's self-efficacy.

It is proposed that leadership at different levels, senior and middle, at the organization, have different mechanisms of affecting employee's self-efficacy (G. Chen & Bliese, 2002). Direct leadership, that is, middle management, influences proximal factors to self-efficacy; these include reducing psychological strain. While indirect leadership, senior management influences a separate set of proximal factors to self-efficacy; these include clarity of what the employee's role entails.

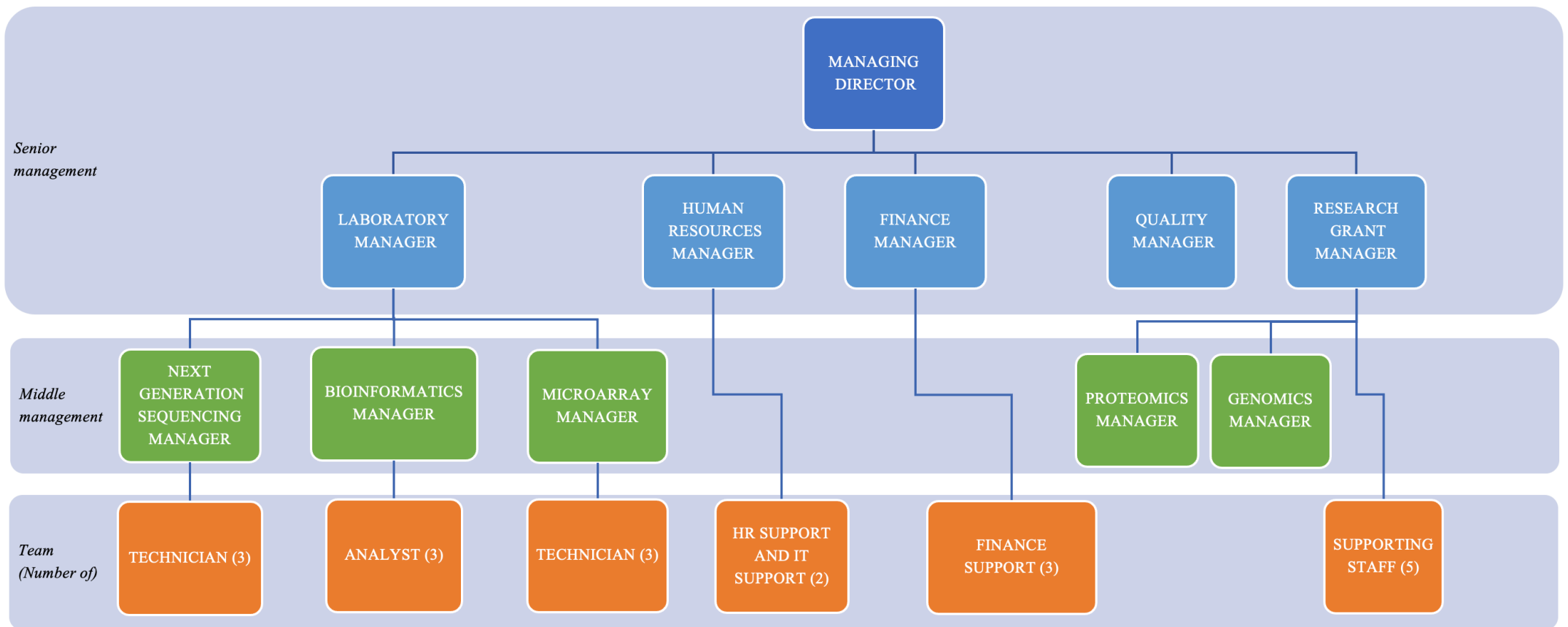


Figure 8. Organizational structure at the Scientific Laboratory in the study. The different colors represent the different hierarchical levels. Due to the high employee turnover, the numbers are constantly in flux, and the structure naturally evolves to adapt.

2.4.1.2. *Self-efficacy*

Bandura defines self-efficacy as “the belief in one’s capabilities to organize and execute the courses of action required to produce given attainments” (Bandura, 1997). Different levels and states of leadership, for example, a transformational leader (Gong et al., 2009), are known to predict self-efficacy and collective efficacy and the outputs of a boosted self or collective efficacy in subordinates, the technicians, are important. For example, to predict one’s likelihood to engage and persist in a task (G. Chen & Bliese, 2002), to have job satisfaction and less withdrawal behaviors (Mitterer & Mitterer, 2023; Ribeiro et al., 2023; Walumbwa et al., 2004). These examples enhance group cohesion (Pillai & Williams, 2004), and the latter are particularly associated with transformational leadership are critical to dealing with 21st century challenges (Pillai & Williams, 2004).

When it comes to the Technicians, the main sources of self-efficacy stems from four sources, (Bandura, 1997). These will be discussed in relation to the Scientific Laboratory using the example of learning how to do DNA extraction. These are ranked from strongest to weakest. Sources of self-efficacy will be:

1. *Enactive mastery* – Experience from previous performance. If the technician has successfully learnt and completed the DNA extraction process, and they believe it is based on their ability, they will also believe that they can complete the process again. This is ranked the strongest; successful performance is connected to job satisfaction, which in turn is connected to job performance (J. Taylor & Westover, 2011; H. Wang et al., 2015).
2. *Vicarious experiences* – Observing others perform. The “others” are models as they model and demonstrate the process for the technicians. For example, a senior technician or manager modelling and performing a DNA extraction process while the technician observes. If the technician feels they are able to relate, connect or associate with the model being observed, the experience is more likely to have an impact on them. This will lead them to believe that they can also learn and complete the process. Relating can be done in various ways, for example, by drawing attention to aspects of the

learning experience and engaging the employee in extracting new applications for future tasks that they may be interested in (Seabi et al., 2009).

3. *Verbal persuasion* – Positive verbal reinforcement and encouragement. Being told by others, like their manager, that they are able to learn and complete the process. This has short term effect and is less impactful than the first two listed. If the technician can relate, connect, or associate with the manager, giving verbal persuasion. The technician also needs to believe that the model can successfully complete the task, that is, interaction with a more knowledgeable individual (Loftus & Higgs, 2010). This experience, again, is more likely to have an impact on them. This will lead them to believing that they can also learn and complete the process.
4. *Physiological and affective states* – Internal and external reactions from the body. This source is the weakest of the four. There are physiological states that are often interpreted as signs of hesitancy or nervousness, such as shaking. These states can be interpreted by the technician as a sign that they are not able to learn and complete the DNA extraction process. Conversely, a technician may be aware of a state of calm. This state will lead them to believing that they can also learn and complete the process.

Strong self-efficacy beliefs can help technicians to face challenges, for example, the challenge of learning the DNA extraction process. Strong self-efficacy also helps the technician to stay committed to their goals. That said, low or high self-efficacy yields different results (Waddington, 2023). It is then important to maintain the balance between low and high, that is, strong self-efficacy. Too high self-efficacy can lead the technician to believe the process is easier than it actually is, having overconfidence. This often results in poor effort in the execution of processes (Bachrach et al., 2023; Wyatt, 2018). Continuing with the DNA extraction example, this would result in the technician not following the set guidelines and standard operating procedures for the DNA extraction process, leading to non-compliance and being open to mistakes. On the other hand, low self-efficacy can lead the technician to believe performing the DNA extraction process is harder than the process actually is. This will generate negative feelings about performing the task, generating avoidance of performing the process, which results in a decline in general performance and possibly detrimental to the technician's physical and mental well-being (Waddington, 2023).

All of the sources of self-efficacy, before they have learnt by themselves and are sourcing from *enactive mastery*, speaks to how the technicians relate to their others. Whether it is through observing others, *vicarious experiences*, or by verbal encouragement, *verbal persuasion*, it is in relation to others. This leaves *physiological and affective states*, which are influenced by self-belief. Literature has shown that *verbal persuasion* can influence *physiological and affective states* (Lamarche et al., 2014). Therefore, all of the initial sources of self-efficacy before the technician can source from *enactive mastery* are in relation, and they are influenced by their relation to other employees who have learnt and can successfully conduct a process, like DNA extraction. The technicians, in almost all cases, this is their direct manager whom they primarily learning from or through. This speaks to a community of practice, and literature has shown the key to long term success in self-efficacy. This is done by the support in learning that technicians receive from others and the organizational culture (Akmalia et al., 2023; Salanova et al., 2012). The following section then focuses on the Community of Practice (CoP), and the one after it looks at microculture as each department is separately responsible for its competency development.

2.4.1.3. *Community of Practice*

As mentioned in the previous paragraph on self-efficacy, it is important to unpack how an employee learns in the organization. Unpacking how employees learn involves the departments in the Scientific Laboratory as a Communities of Practice, CoP, this is possible in organizations that offering varied services, which are grouped by field, for example, genomics (Batz, 2024; Irving & Sayre, 2014). The term community of practice was first used in 1991 by theorists Jean Lave (cognitive anthropologist) and Etienne Wenger (educational theorist), who discussed the notion of legitimate peripheral participation in order to create a situated learning environment. In addition to drawing inspiration from Lave and Wenger, the CoP approach also references ideas from system theory (Etienne Wenger, 1999, 2012).

Lave explains that a legitimate peripheral participation describes how newcomers become experienced members and eventually experts within a community of practice or collaborative project (Lave, 1991). This is where scaffolding and guidance from the more knowledgeable

person takes place (Vygotsky, 1997). This extends to delving into the individuals in a group and the group's common and shared goals (to complete tasks in order to deliver services) and, lastly, to sharing and developing knowledge focused on the shared practice (E Wenger et al., 2004).

CoP will be discussed in more detail in section 2.4.2. In this section, I will be giving a practical example of when a CoP was utilised at the Scientific Laboratory. The CoP was established before this study commenced. Communities of practice have three key characteristics (Irving & Sayre, 2014; Etienne Wenger, 2012):

1. The individuals within the community form a group, either collocated or distributed (Coakes & Clark, 2006; Etienne Wenger, 1999). The groups, in relation to developing competencies, are collocated, and formed based on the departments that the organization is separated into. These departments are based on fields that the departments service, such as bioinformatics. The technicians form the core team that would conduct the hands-on, day-to-day work in the department.
2. The group has common goals or shared enterprise. CoPs emerge from people experiencing mutual engagement in a shared practice around which they share a common repertoire of knowledge (Baatz, 2024; Barab et al., 2002; Etienne Wenger, 1999). The mutual engagement in a shared practice would be the department carrying out services together. The common repertoire is the field of study that they are running the service in.
3. The group shares and develops knowledge focused on a common practice (Barab et al., 2002; Etienne Wenger, 1999). This final characteristic can be extended to include the sharing of mutually defined practices, beliefs, values, and history. This knowledge sharing can be done in various ways. One of which is a journal club, where the employees regularly gather to discuss scientific papers to refine their understanding of a specified subject area. This visually depicted in a circle with more knowledgeable individuals like the managers are at the center, drawing less knowledgeable individuals

like technicians to the center. In sharing information, they build relationships and learn from each other.

To recap, the organogram shows the different departments and levels in the Scientific Laboratory. Each department forms a CoP. Each department has a separate manager. The managers are situated in the middle level of the organogram and also at the centre of the CoP. The rich picture also shows the managers centrally located to the different linked concepts related to the development of competencies. That said, each department does not have its own specific, unique directive. The directive is driven and dictated by the Scientific Laboratory's senior management. This uniformity in culture and dynamics is because the departments are governed, funded, and directed under one umbrella. These leaders, senior managers, then shape the resulting set of values, beliefs, attitudes, systems, and rules to form an organizational culture in the Scientific Laboratory (Kargas & Varoutas, 2015; Schein, 2010).

This organizational culture influences the employees' behaviour in the Scientific Laboratory, and this extends to cover competency development. Further, the literature argues that the CoP concept requires mutual understanding and trust, as well as a commitment to a common objective (Atiti, 2012; Wals et al., 2009). These are elements that are related to organisational culture where literature has shown the link between communities of practice and organisational culture. This results in the positive development of competencies and overly improves service quality (M. Hamilton, 2011; Huq et al., 2006; Merabet & Agti, 2021). These elements include, studies showing individuals being positively impacted by the CoP as it reduced isolation and promoted belongingness, which positively impacts the organizational culture (Ulla & Perales, 2021). Therefore, in the last section, we will look at the organisational culture and its effect on competency development.

2.4.1.4. Organizational culture

Organizational culture describes, in relation to the study, a learning environment that includes a common set of shared values and practices in the Scientific Laboratory. Culture determines

how those in the organization see themselves and the world, and it shapes how they think, behave and interact with each other (H. Mulder et al., 2019; Schein, 2010). Literature has shown that culture is believed to shape individuals' confidence levels and their perceived sense of belonging in a learning environment (Sueb et al., 2023). Guay proposes that in a human system in which the technicians exist, a supportive environments, good organizational culture, fosters perceptions of competence and autonomy, which implies that an employee would feel effective when they perform a given task (Guay et al., 2006). This is because the employee feels that they can successfully determine the nature of the task or problem at hand and arrive at a course of action (G. Wang & Netemyer, 2002).

Layered within the organizational culture is a microculture. This has the same definition as the organizational culture but occurs in a restrictive group of participants in a formal or informal learning setting (Pöysä-Tarhonen, 2012). In the Scientific Laboratory, a restrictive group, a microculture, is represented by different departments, such as the bioinformatics department. The Scientific Laboratory, a case study organization, has been described as a high-pressure environment with respect to developing competencies to keep up with the constant change of scope in work. Researchers have proposed that, microculture can be formed as the result of a process of groups, within an organization, coping with different demands and their underlying values (Hafferty & Martimianakis, 2018; C. Lawrence et al., 2018; H. Mulder et al., 2019). Each department in the Scientific Laboratory has different needs, projects and areas of focus, which will ultimately define different demands.

A key example is communication internally and externally at the Scientific Laboratory. Communication is influenced by the organizational culture. Literature shows that attitudes to communication has its roots in organizational culture and this can be a strong influence to the demise of an organization (A. D. Brown & Starkey, 1994). This communication includes informal workplace discussions (water cooler talk) amongst employees. Information emerging from the water cooler is a source informatician that prompted this study. Discussions from the water cooler touched on complaints from dissatisfied clients who criticized the service quality. The reason for the low quality was attributed by the employees to be centered around the technicians' competencies. The complaints are detrimental as they may result in the loss of a customer or contract (Choudhury et al., 2023; Dufour et al., 2021). In addition, communication

rooted in a good state of organizational culture produces the ability to communicate vision and goals, implement regulations well and implement additional programs like training to develop competencies (Lubis & Hanum, 2020).

In this microculture, which is also formed from group dynamics, there is a hidden curriculum. Hidden curriculum describes what one teaches without even realizing it, through their interactions, modeling, the organization's culture; it consists of unspoken values and culture (Hafferty & Franks, 1994). Literature has emphasized the importance and power of the hidden curriculum, especially as it strongly influences professional identity development and is a reflection of the microculture, albeit not always a negative influence (H. Mulder et al., 2019). This learning is acquired unconsciously, and the function thereof can sometimes even succeed that of formal learning. The skills are also timeless and can bring about lifelong learning (Rossouw & Frick, 2023). An example of a hidden curriculum in the Scientific Laboratory could be unspoken rules that, when broken, have consequences. The unspoken rule may be, related to social interactions, not to interrupt when others are speaking, and the consequence or punishment could be isolation from the group conversations.

All of these layers in the organizational culture, that is, the microculture, hidden curriculum and more, forms the values that lie beneath what the organization rewards, supports and expects (Baumgartner, 2009). This shapes into the norms in the organization, which then underpin how procedures, policies, and practices are developed (Schneider, 1986). This, the norm formed, collectively is what is then experienced by the employees in the organization and ultimately becomes the values that they share which translates to behavior patterns. Any new employees are influenced by this norm, and ultimately, so is the sustainability of the organization (Assoratgoon & Kantabutra, 2023; Kotter, 81 C.E.). The formation of this norm is driven by leadership. Literature stresses the fact that leadership is seen as an important instrument in promoting and consolidating an adequate and strong organizational culture. That said, organizational culture itself plays a significant role in ensuring leadership effectiveness, which is an important factor in the continuous improvement of performance (Metz et al., 2020).

Further to the layers in organizational culture, there are three levels to how they are perceived or experienced (Baumgartner, 2009; Schein, 1990). The first and at the surface is *artifacts*, the

visible behavior, these are the visible and tangible structures and processes. It is hard to decipher the state of organizational culture at this level. In the Scientific Laboratory, this includes but is not limited to the day-to-day work and the accompanying standard operating procedures. The second is *values*, what is actively communicated, these are the strategies, goals, and philosophies. This also includes but is not limited to philosophies related to good service delivery and the resulting strategies and goals put in place to achieve any set goals. Third and last are *basic assumptions*, underlying core, and unconscious beliefs; this is the ultimate source of values and actions. The third level is the bottom and fundamental level that strongly influences the others. This means that something that is observed, in a behavior, in the *artifacts*, has a deeper level that it can be understood in the *basic assumptions*. The deeper level is not always easy to recognize and change.

Having understood the importance of the above learning theories to strategy for business viability and sustainable success, we take a look at the theoretical understanding of the specific challenges that were faced in the organization. This is to refine the theoretical understanding of the challenges faced. This is done by juxtaposing a theoretical understanding of what is needed (section 2.4.1) against challenges faced (section 2.4.2 that follows) in the organization.

2.4.2. Theoretical understanding of challenges in developing current competencies

This section looks at the *theoretical understanding of challenges in developing current competencies* through an illustration. *Current* in the title refers to the beginning of the study. The illustration here is an example of the set of scenarios that occurred at the Scientific Laboratory that prompted the genesis of this study. This illustration also depicts the general pathway and related outcomes that most learning efforts took. A study was prompted because, once more, the resolutions put in place did not address the problem. The problem was a decline in the quality of the outputs, which was attributed to the technicians' competencies. There was also a high employee turnover experienced during this time, which was also attributed to

competencies not being developed to meet service needs. This section, 2.4.2., looks at the theory related to the different steps taken in the example scenarios. This is to showcase the theory that was in play when navigating the challenge versus the section before, that is, 2.4.1., *Learning Theories - focusing on influences on technicians' competencies at the Scientific Laboratory* shows the preferred initial understanding that was researched once the study had started. The aim is to illuminate areas in the current state that may recursively need to be added to section 2.4.1.

2.4.2.1. *Illustration: Background, initial understanding*

As mentioned in the description of a community of practice, section 2.4.1, I formed an HLA journal club to keep abreast with the subject area and related activities in the Scientific Laboratory. With respect to the HLA journal club, gaps in understanding became apparent. For example, decisions that were made upstream in a workflow negatively affected subsequent person(s) that were downstream in the workflow.

Literature also shows that it is difficult for scientists to work in silos as additionally interdisciplinary fields are needed to provide a service (Albert et al., 2019). Examples of this in the Scientific Laboratory are the genomics and bioinformatics departments working together to fulfil a singular service that requires data production and analysis. The genomics department is in charge of running processes in the laboratory, data production and guiding data analysis. The bioinformatics department is in charge of carrying out the data analysis and interpretation. Therefore, in the case of the HLA service, it was futile for different points in the workflow to work separately in silos as each point feeds into another point. In some cases, this would subsequently affect various key business drivers like turnaround time. Turnaround time is an important factor but often over looked as reliability and accuracy take preference in laboratories (Chauhan et al., 2014). To be an effective collaborator, one must have an understanding of the other disciplines and/or departments and their contribution to the workflow (Burke et al., 2000).

The following section will outline how gaining insight into learning theories informed my research question by highlighting gaps in our understanding of learning in the workplace. This will draw on Jack Mezirow's Transformative learning theory (Mezirow, 1991) to describe my own journey, Community of Practice (Lave, 1991) to describe lessons learnt from the journal club I established and Knowles's Adult learning theory (Knowles, 1970) to understand participants' learning processes and what influences their competencies. It is important to note that Mezirow's theory was only used stand alone in this section to describe the journal club formation. As described at the beginning of this section, it acts as an example of learning that the technicians and managers go through. It will be used to juxtapose against theory related to learning in this case study, that is, 2.4.1., *Learning Theories - focusing on influences on technicians' competencies at the Scientific Laboratory* to refine and create a template to understand the phenomenon.

In the HLA workflow, communication alone with the technicians was not sufficient in resolving the gap in understanding the complexity of the problem when issues arose in the workflow. That is communicating where and why there was an issue. The communication was either done via email or in person; this was based on availability to discuss and details to share. More complex cases were shared via email and additionally discussed in person. Cases that deviated from the expected set procedures also required formal documentation. More had to be done in order for me to better understand and resolve the multifaceted factors that are at play. Drawing on Mezirow's ten steps of Transformative Learning (Mezirow, 1991). The steps will be described further in the following paragraphs. The steps are: (1) Disorienting Dilemma; (2) Self-Examination; (3) Critical Assessment; (4) Recognition of Shared Experiences; (5) Exploring Options for New Behaviour; (6) Planning a Course of Action; (7) Trying New Roles; (8) Acquisition of Knowledge; (9) Building Confidence and (10) Reintegration.

The first step, my disorientating dilemma, was experiencing that the solution put in place was not producing the expected resolution, that is a better understanding of workflows and the HLA subject area. A disorienting dilemma represents the initiation of a transformative learning experience, usually denoting a life crisis that triggers a questioning of assumptions and results in transformed beliefs (E. W. Taylor, 2000). The next step in Mezirow's theory, namely that of self-examination, came in the form of my better understanding of my role in this system (the

organisation's environment) and how I had also experienced the system, which led to a critical assessment of epistemic and sociocultural assumptions. In self-examination, which is the second step in Mezirow's sequence, I found this to be difficult as a lot of questions arose, such as how best will they learn, how do they learn and how can I be a good resource to them? There are sociocultural assumptions that I have made about how we relate and those could also be an impeding factor. In the third step in Mezirow's sequence, as a team leader, I had experienced the need to cross skill and upskill my team members. As proposed by Mezirow, the disorientating dilemma acted as a catalyst for transformative learning and revealed the complexity of the matter (Laros, 2017).

I had recognised my own discontent and observed, from the conversations, that is, what was shared by other staff members. This further motivated the need for an intervention, such as the journal club, and this was the fourth step in Mezirow's sequence. To begin, I explored new actions that could be implemented, and this was the fifth step in Mezirow's sequence. I structured the club by gathering topics related to HLA typing efforts at the organization. This plan of action was then the sixth step in Mezirow's sequence. I assigned colleagues to present as visual literacy would enhance understanding (Çelik, 2013) and lead to discussions in areas that they are most knowledgeable in, I had a better idea, from most, of the different components that we were using and thus also helped to guide conversations. This knowledge placed me at the centre of our community of practice. This step was the seventh in Mezirow's sequence.

There was provision for the new role of conducting the club, and there was participation, which I thought built competence and self-confidence. The former formed steps eight and nine in Mezirow's sequence. The tenth step, reintegration, was not attainable due to time constraints that caused the club to fall away. Mezirow used this theory to describe how people develop and use critical self-reflecting to consider their beliefs and experiences and, over time, analyse how it affects how they see the world (A. Kitchenham & Chasteauneuf, 2009). Mezirow was interested in peoples' worldviews and what led to a change in their particular view of the world (Christie et al., 2015). One criticism of Mezirow's theory is its emphasis upon a decontextualized form of rationality (E. W. Taylor, 1998), but recent considerations in the literature of these varying perspectives seem to indicate that one perspective does not need to exclude the other as differing perspectives may be required to deepen understanding and to

incorporate these ways of learning into transformative education (Dirkx et al., 2006; Paul, 2014). Essentially, this means it deepens understanding of the phenomenon to look at the learning decontextualized, just looking at the processes and also contextualised, not separating out the technicians' understandings which includes but is not limited to beliefs and views. This is what the section on theoretical understanding has also shown: the importance of the varying perspectives.

2.4.2.2. *Illustration: Implemented resolution*

The second learning theory that informed the design of the journal club was that of a Community of Practice. The club was to cultivate a community of practice (E Wenger et al., 2004) that fosters knowledge accumulation and peer-learning (Newswander & Borrego, 2009). A lens through a community of practice is applied to elucidate the process of learning in the journal club. A CoP consists of three main elements: first, the domain, which is the shared interest, in this case, HLA typing. Second, the practice, meaning the interactions that produce results which can effect change in how the work is conducted. Third and last is the community itself, which has different members, where the novices sit at the periphery and, as they gain knowledge through participation, move towards the centre where the experts are (Lave, 1991). In the case study, that is the Scientific Laboratory, the novices are the technicians and the experts are the senior technicians and managers. The term community of practice was first used in 1991 by theorists Jean Lave (cognitive anthropologist) and Etienne Wenger (educational theorist), who discussed the notion of legitimate peripheral participation in order to create a situated learning environment. (Lave, 1991; Etienne Wenger, 1999)

Studies on situated learning have shown that students learn better in an environment where they are able to put their learning into practice, this is in connection with having to experience real world or meaningful practices (Powell & Kalina, 2009). A few years after, Etienne Wenger extended the concept and applied it to other domains, such as organizations (Joram, 1993). In the case of an organisation, learning was embedded in an activity. Due to financial constraints, materials for learning in a laboratory are limited as reagents are expensive, but there are ample opportunities for observations and platform meetings that offer an opportunity to communicate

and discuss processes and also to engage on matters relating to the work culture. These opportunities speak to social interaction and collaboration, which are essential components of situated learning. One of these key social interactions, which was expanded on in the previous chapter, was “watercooler talk”. One of the criticisms of CoP was that it does not consider wider issues of social and economic inequalities, that is, the impact of any differentials that disallow beneficial social capital, for example, in colleagues relating well together, when pulling novices into the centre (Allen & Cherrey, 2000; Corso & Giacobbe, 2005; Rossignoli et al., 2023).

For this study, these issues, socio-economic inequalities and the impact of power differentials are discussed and addressed in a different section, systems theory (Hodkinson & Hodkinson, 2004). In a CoP, where the experts sit at the centre, they essentially have a strong influence on how the novice members participate. A novice in a work-based community refers to individuals new to the HLA typing service. Studies have shown that technicians can be affected by a lack of enthusiasm or participation at a higher level of management (Quinn et al., 2014). This journal club was limited and pushed for mainly by the Technicians who operated the workflow. This, the fact that the managers were unable to be more involved, in addition to the time constraint, Cognitive and social constructivism, and developing tools for an effective classroom, was the reason why the club fell away. That said, although the journal club was a good way to stay abreast with the field, it was not sufficient in addressing multifaceted factors. Furthermore, as the scope of work, because of the diversity of the projects taken up at the Scientific Laboratory changes, it is also not feasible to set up multiple journal clubs.

For the journal club sessions, I would reflect during (“reflection-in-action”) and after (“reflection-on-action”) and the journal club sessions (Schön, 1983) in order to ensure that my teaching practices are refined over time (Griffiths, 2000). With respect to reflecting after, I made notes throughout the session and read through them to determine if there were recurring points of interest to address in the next session. With respect to reflecting during, I observed engagement and questions asked. In terms of “they don’t understand”, I would use an example from our workflow to aid in answering the question, learning from real life experiences of the practical work conducted (Keeton, 1976). I would then re-explain and ask questions to better understand their train of thought as a way of scaffolding (Vygotsky, 1997). Such support

leverages what students already know to help them understand what they don't know so they can become more independent learners (Beed et al., 1991). In addition, I found that cross skilling, especially from a colleague in the same platform assisting another colleague to gain a skill or upskill seemed more effective. All of these points led me to realise the proposed importance of the relationship between the individual, their environment and others in their environment (Vygotsky, 1978). In other words, learning does not happen in isolation, knowledge is constructed against our socio-cultural influences.

To put it in one way, adults, unlike children, come with plenteous prior knowledge, experience, and beliefs. With respect to experience, it is stated that the needs and the experiences of the learner take precedence over the expertise of the instructor (Knowles, 1984). These factors, like prior knowledge that, affect adults learning, adults need to validate this information based on their past knowledge and experiences (Piaget, 1978). Adult learners also decide what is important to learn, and lastly, they expect the learning to be immediately useful to them. The usefulness of what they are learning is also a motivator to their learning; adults will ask themselves, "How will it be useful to me?" and are essentially self-directed learners (Knowles, 1970). With the technicians, it is then important to understand how their socio-cultural influences, which include their experiences and motivators, play a role in developing competencies.

Training forms a key component of developing competencies, and thus, it is important to investigate what affects training. Training here refers to a specific way of learning, where it differs from learning in a classroom situation. Bandura states that adults are more likely to show certain behaviour, that is, are motivated, in an environment where they are rewarded for that behaviour. This is an effective way to understand how to engage the learner and help them to adapt to the learning environment (Bandura, 1977). In addition, Bandura added the notion that new patterns of behaviour, for example, in the novice technicians, can be acquired through direct experience or by observing the behaviour of others, like their more experienced colleagues (Bandura, 1997). The training climate also plays a role as it influences on learning competencies (Schulz & Rosznagel, 2010). Training climate is the perceived support from management, work, and the organization for formal and informal training and development activities (Tracey & Tews, 2005). It is important as it is instrumental in how employees prepare

for formal and informal training activities and developmental activities (Tracey et al., 2001). There are different ways in which the different facets of the training climate might play out. Job support might, therefore, have an impact on the association of learning and control strategies with learning success (Schulz & Rosznagel, 2010).

2.4.2.3. *Illustration: Summary*

From these theories, I realised the need to have a better plan of action, more work needs to be done with respect to exploring factors that the technicians' competencies as they adapted to the change of scope of work, because of the diversity of the projects taken up. Such exploration will assist in revealing and, in turn, hopefully, address systematic factors that are affecting, directly or indirectly, the competencies of the employees at the organisation., Although individual competence is important, it alone is not sufficient to make an organisation successful (Tate, 2010), this was motivation to integrate the two theoretical understandings, Systems theory and Learning theories. This was to explore the development of competencies in the system in which they are utilised. The following chapter will explore the design of this exploratory study. These experiences informed the design of the study and how the theories discussed are useful in better understanding the illustrated experiences. In addition, this background information forms an in-depth base to provide insight into future explorations.

2.5. Theoretical understanding: Summary

To review, this summary is in relation to *understanding influences on the technicians' developing competencies*. In the absence of these needed competencies, a decline in the quality of outputs has been experienced. The points below are a summary of how the systems and

learning theories showed the need for a collective understanding of the following in order to address the phenomenon:

3. *The system* - How different components and processes interact and influence each other in order to permit the viability and continuity of the Scientific Laboratory. This viability is affected by the decline in quality outputs attributed to the technicians' limited competency. This leads to a focus on learning, influences on the technicians developing competencies given an understanding of the complex system that they are based in. The systems algorithms, namely PESTLE, CATWOE, GEMBA, Fishbone, Rich picture and CIMO showed the complexity of the system. This system, that is in relation to technicians developing competencies, has different stakeholders and actors, who influence or are influenced in varying strength but various internal and external factors. There are many parallels that are drawn between the two broad theories. These include but are not limited to, the notion that the technicians are individuals with different socio-economic backgrounds that play a role in them successfully completing tasks. The second is that they exist in an environment that has many facets of influence when it comes to their competency development.

4. *Technicians' ability to learn* - Self-efficacy, the technician's ability to believe that they can complete a task. The sources of self-efficacy are strongly influenced by the trainer, who in most cases is or is through their manager into the wider organisation. This leads to an understanding of the technicians and how they exist and thrive in the Scientific Laboratory. There are also parallels between the two broad theories as they discuss the technicians' learning in relation to the trainer, who, in the Scientific Laboratory, is mostly their manager or a senior technician. For example, the Systems theory algorithm, Rich Picture, visually shows the manager as a direct influence in either training or facilitating training for the technician. This is also seen when discussing Learning Theories, and we looked at the Organogram; they sit directly in a point of influence. How the state of influence looks is then further discussed when looking at Community of Practice and organizational culture.

5. *Technicians in the organisation* - This includes an understanding of the Technician as an individual with interpersonal, contextual factors and relationships that influence the development of their competencies. This is impacted and strongly influenced by the organisational culture, community of practice, communication, and relations with colleagues, including hierarchical relations. This again draws many parallels between the two broad theories when discussing, for example, what and how things are communicated in relating between employees. For example, in learning, self-efficacy shows the technician needed to relate to their trainer in order for them to learn effectively. This further spoke to the state of the organisational culture and if it facilitated these relations. In Systems, the CIMO showed the same need for good relations between the managers and technicians, which is a positive influence on the development of technicians' competencies.

2.6. Aims, Objectives and Research

Questions

Aim

The aim of this research is to explore the factors affecting the development of competencies of the Scientific Laboratory technicians. Technicians were selected as they directly affect the quality of the outputs produced in the business. The development of competencies is an iterative process of learning. Here, this refers to any competencies, whether technical, professional, or work based, that are needed to conduct work that produces quality outputs. In summary, they conduct the process from scheduling the service, sample reception, initial quality control checks, carrying out laboratory procedures, data quality control and writing up reports to clients. These are the most critical steps that determine the quality of the output. This is because they are directly involved in the data generation of client associated services. The aim of the laboratory procedures is to generate data that will be analyzed and interpreted downstream to give answers to the clients. If bad samples go in, bad information will come

out. This is why the Scientific Laboratory, as a standard routine, does quality control checks of the samples when they are initially received from the client as a way to maintain quality standards (Elbireer et al., 2013; Sığ et al., 2023).

Research questions

In order to effectively explore these factors, the research looked at the environment at a systems level and at an educational (learning) level. At the business level, the study focused on the characteristics of an ideally functioning business when compared against the case study, Scientific Laboratory, business. At an employee level, the study focused on how the employees learn and adapt to a change of scope because of the diversity of the projects taken up in the Scientific Laboratory. This is particularly important to explore in a resource constrained environment where there is a constant change in the scope of work. These technicians are not only the engines that power the work but are also building capacity in order to be the future senior members who will drive the work. The technicians are essential to carrying out services at the organization. Their managers play a crucial role in the system as they act as the previously described more knowledgeable other and are in a position of power to enact and influence key mediations to developing competencies for the technicians.

1. Does the system in which the technicians operate, as well as the internal and external environment, influence the technicians' competencies? If so, how?
2. Does the relationship between the technician and their direct manager influence the technicians' competencies? If so, how?
3. Does the technician's perception of themselves in the organization influence their competencies? If so, how?
4. Having understood the factors at play, what intervention could be implemented to change the outcome of low-quality outputs?

Objectives

To achieve the stated aim, the following six phases were set up:

1. Carry out two separate focus groups with the technicians and managers. This is to explore and determine the factors at play internally and externally in the Scientific Laboratory that are influencing the development of competencies in the technicians. One vignette was used to facilitate both of the separate focus groups. A vignette is a fictional scenario where technicians' competencies and their development (through learning in a system) are in question (Hughes & Huby, 2002; Murphy et al., 2023). The Vignette draws from theoretical understandings that underpin this chapter. The focus group allowed for broader discussions to help explore in-depth.
2. In addition to the focus groups exploring factors in the internal and external environment, they also look at how technicians perceive themselves in the Scientific Laboratory and how it affects the development of their competencies.
3. The inclusion of the managers' focus group allowed for the study to capture the managers' perception of their role in the development of competencies versus how the technicians perceive it. In addition, the managers were included to capture the perceived influence of the relationship between them, the managers, and the technicians in developing competencies.
4. Filter down factors influencing the technicians' developing competencies by categorizing the explored factors into themes. There are illustrated patterns in the data that are underpinned by a central concept and theme. This was done by evaluating and confirming findings from the focus groups in a survey with the initial participants.
5. Further, to narrowing down and understanding influences, using a focus group facilitated by a separate vignette, to explore the senior managers perception of the development of competencies in technicians' competencies. The senior managers are in a position of power to enact and influence key mediations to developing competencies, not only for technicians but also for their managers.
6. Lastly, use theoretical understanding to inform the development of potential interventions that will aid in the development of the technicians' competencies.

2.7. Problem statement

The problem to be addressed by this study is in relation to the decrease in the quality of outputs at the Scientific Laboratory and the parallel increase in employee turnover. The employees at the Scientific Laboratory have attributed these occurrences to be influenced by their state of competencies. Competency is key as the laboratory technicians' expertise and diligence are instrumental in ensuring the efficiency and accuracy (Alsawidan et al., 2023). The technicians have a wide range of responsibilities and duties to be performed (Shirvan, 2021). Burnout and high employee turnover have been found to be costly to healthcare organizations as they have a direct impact on productivity and the quality of outputs (Al-Qathmi & Zedan, 2021).

These incidents have occurred at a time when scientific research in Africa and research on African data continues to boom in Africa; with respect to the growth in the number of projects taken up, it has been shown that there is not enough research capacity to meet this surge (Nordling, 2018b; Schemm Ylann, 2013). This is also coupled with a lack of skilled individuals in South Africa who are needed to fulfil roles at the Scientific Laboratory (Ekene & Kelly, 2023; Hinkin & Tracey, 2000). It is then more feasible to hire an employee with general skills, like the entry level technicians and upskill, which when viable, is often the path taken (Botha & Rasool, 2011). Adapting skills for use would then require robust systems in place to ensure that needed competencies are developed. Literature has also shown the great impact scientific laboratories have in pioneering discoveries, new businesses and even industries (H. Beck et al., 2022). Building capacity, that is, trust and scope, requires that work is conducted in a diligent and reproducible manner (Chu et al., 2014; Whitworth et al., 2008).

The current body of literature does not adequately address the role of competencies for technicians, specifically in the scientific laboratory that is based in a resource constraint setting. These are the gaps that I would like to fill. The breakdown of these gaps in the literature can be found in section 2.2. In summary, frameworks and solutions are then developed based on deemed needs (dos Santos et al., 2019; Miedzinski et al., 2001) when compared to being informed based on underlying factors. Understanding underlying causes would also allow for more precise and targeted solutions that will better address factors that negatively influence competencies that are affected by the diversity and often change of scope in work. Further, the majority of the studies that have been conducted to consider factors were based in developed

countries that are resource rich. The results and solutions are not replicable in a resource constraint setting (Coccia & Cadario, 2014).

3. Chapter 3: Methodology and Research Design

3.1. Research Paradigm

This study adopted an interpretivist (constructivist) research paradigm. Through this lens, it focuses on understanding subjective experiences. In particular, the technicians' subjective experiences of developing competencies at the intricate Scientific Laboratory. The Scientific Laboratory has the complexity of changing the scope of work because of the diversity of the projects taken up and is based in a resource constraint setting. This is preferred when compared to using information that has been gathered in developed countries and who do not have limitations, such as resources. Where reality (ontology) is socially negotiated or constructed; that is, the technicians in question each will have a subjective view of reality, which is based on their experiences. In addition, knowledge (epistemology), the attainment of it as a product of the social and co-constructed interaction between individuals and society (Stalmeijer et al., 2014) is explored. In this described framework, qualitative research methodologies are generally used (Bunniss & Kelly, 2010).

3.2. Case Study Approach

This study is a case study and was broken down into six phases which have been described in the previous chapter. A case study is a research method that looks at an event, an individual, and, in this study, an entity, that is, the Scientific Laboratory, as a unit of analysis. In a case study, an enquiry into the phenomenon is conducted in its real-life context (Noor, 2008). Of

particular interest, with regards to case studies, in scientific research and related healthcare industry, there has been a push for enhancing the quality of services. The push has been driven by the recognition and development of complex systems in which health sciences organizations operate (Yin, 1999). Each phase was informed by the previous one and focused on better understanding the case study in question, see Figure 9:

1. *Phase 1*: 2 separate focus groups using the same vignette. One with four managers, The technicians' direct managers. The other group with four technicians where the technicians have been at the Scientific Laboratory for 3 years or less. The vignette recounted a fictional scenario where technicians' competencies and their development through learning in a system are in question. The focus group allowed for broader discussions to allow wider exploration. The group was estimated to take 60-90 minutes. The inclusion of the managers in this phase allowed me to capture their perception of their role in the development of competencies versus how the technicians perceive it.
2. *Phase 2*: The analyzed outcomes from the focus groups, and analysis of the human system as compared to a viable system (through Systems Theory) were used to inform the design of a closed ended survey on a Likert Scale, which was used for descriptive statistics. The survey was piloted to ten participants (three managers and seven technicians) who were not recruited in the main study for clarity and coherence.
3. *Phase 3*: An anonymous web-based survey. The reviews from the pilot were addressed, and the survey was finalized. The survey was then taken by the technicians and managers in the main study. This was estimated to take 10-15 minutes.
4. *Phase 4*: The outcomes from Phases 1 and 2 were used to inform a focus group with the senior managers that was guided by a vignette. This was structured as a safe to fail experiment. These experiments encourage participation as the results from the experiment are not disruptive, nor will they be detrimental to their current processes (Nicolaidis & Poell, 2020). This was estimated to take 60-90 minutes. This was used to gauge the senior managers' understanding of the phenomena and their understanding of the findings from the manager's and technicians' focus groups.
5. *Phase 5*: An anonymous web-based survey. This was estimated to take 10-15 minutes. The findings from the senior managers safe to fail experiment used to inform the design of a closed ended survey on a Likert Scale which was used for descriptive statistics.

The survey looked to gauge if there was a change in thinking by the senior managers before versus after the safe to fail experiment.

6. *Phase 6:* Once the above are better understood, intervention recommendations were given. In order to aid better development of the technicians' competencies.

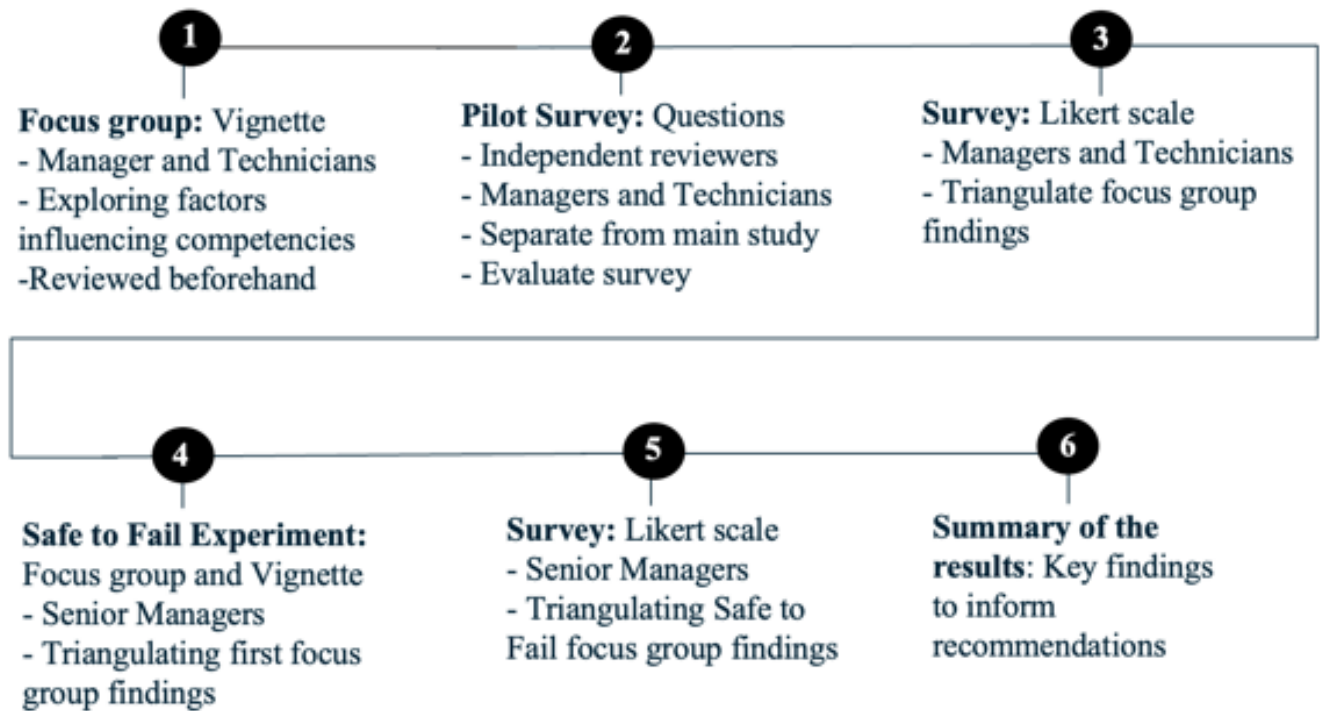


Figure 9: Summary of study procedure. Six key phases were undertaken.

3.3. Sequential mixed methods

This study draws on a sequential mixed methods approach. This can be seen summarised in Figure 10. This method applies both the quantitative and qualitative research approaches in a sequential manner (Mamorobela, 2022). It provides researchers with the opportunity to explore the phenomenon holistically by first conducting a quantitative study that provides a general understanding of the phenomenon. It then continues with a follow up qualitative study to provide a more in-depth explanation of the resultant findings of the quantitative part of the study (Creswell, 2018; Mamorobela, 2022). This method is mainly used in exploratory studies

to enhance the interpretation of significant findings (Antony et al., 2023; Garcia & Garcia, 2023; Onwuegbuzie & Leech, 2004). This research approach is in line with some of the key strengths of the mixed methods research design. These strengths are geared towards triangulation, complementarity, development, initiation, and expansion (Greene et al., 1989). The one the research design is most compatible with is triangulation, that is, in this study, the methods were employed in order to explore and triangulate findings.

The two approaches used were qualitative methods for exploration and quantitative for triangulation. Moreover, it uses different but complementary quantitative and qualitative research approaches, providing more nuanced, robust, holistic understandings of complex research phenomena. This order in the analysis is known as the sequential qualitative-quantitative analysis (Onwuegbuzie & Leech, 2004). To expand, the qualitative methods are being employed first in order to explore the phenomena. The quantitative method was used after, and this was to triangulate findings from the exploration. This sequence of qualitative and then quantitative was completed in cycles for the phases of data collection.

There are different types of sequential qualitative-quantitative analyses that have been identified (Onwuegbuzie & Teddlie, 2003). The one that best fits the agenda of the study is the quantitative negative case analysis versus the quantitative extreme case analysis. This is because we are not looking to discover an extreme case by doing the qualitative analysis but rather to explore and find if there is a “negative case”. A negative case, here in our study, is to see if the findings are negated (not holding true) when trying to triangulate the themes. We are checking to see if any of our findings are negated by the participant. This is done when the participants completed the survey to “confirm” the findings. We essentially did not want findings that did not hold true to what the participants described in the focus groups.

Quantitative extreme case analysis involves first undertaking a qualitative data analysis (e.g., thematic analysis). This qualitative analysis is then followed by a legitimation analysis in order to determine the extreme cases. In the second phase, new quantitative data are collected on all cases, followed by a quantitative analysis (e.g., t-test) of the newly collected quantitative data, wherein the extreme and non-extreme cases are compared, in an attempt to determine why the

former cases were so extreme in the first phase (Onwuegbuzie & Teddlie, 2003). In this study, thematic analysis was done for qualitative analysis. Due to low sample numbers, a t-test was not done, but the method is open to different statistical tests. The quantitative data was therefore analysed as interval data using the median value to determine central tendencies. Median value entailed taking the middle value when values were listed from lowest to highest.

Qualitative research seeks to understand individuals' perspectives and experiences, which are important as they shape their reality (Davies, 2007) , and this is in line with the interpretivist paradigm that the research follows. Meaning will be constructed in the researcher-participant interaction in the natural environment in order to gather diverse interpretations. The outcome of such research, that is, qualitative research, aids in better understanding different factors, which include attitudes and the environment, and how they shape the outcome in a system. This aids in better informing possible design, implementation and the evaluation of interventions (Ramani & Mann, 2016). Quantitative research in medical education commonly uses instruments with items that are rated on Likert-type scales, and this is best used when there is an understanding of the variable being measured (Cook et al., 2011; Ratelle et al., 2019). That said, using a mixed methods approach provides the best opportunity for addressing research questions and broader benefits in adult learning (Hammond, 2005). Each approach provides a different perspective on the topic and when analysed correctly and understood, the interpretations complement one another (Datta, 1994).

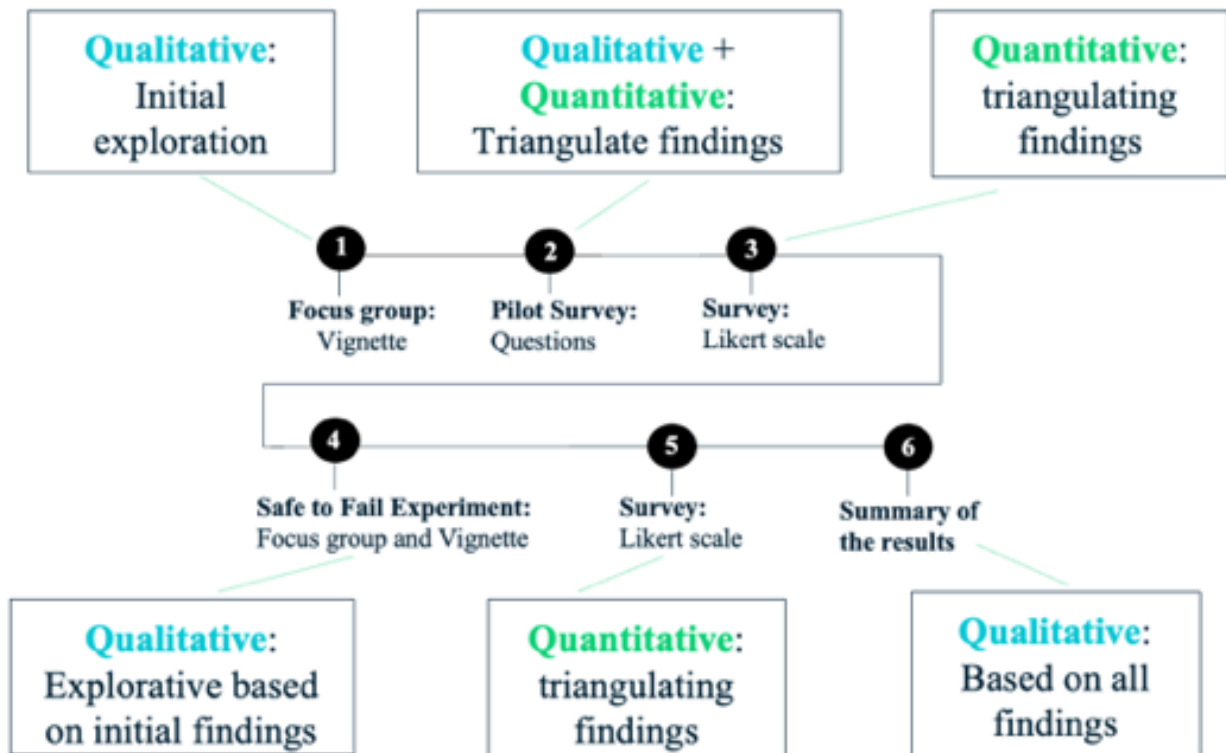


Figure 10: Study procedure summary showing points in the sequential mixed methods approach.

3.4. Participants – Sampling and rationale

As mentioned earlier, in Chapter 1, in section 1.2. and 1.3, in the introduction to give study context, there is great importance in hiring competent employees, and a great need to retain them as high employee turnover rates are disruptive to the system. Some of the financial effects of high employee turnover includes, hiring and orientation, cost of keeping continuity and studies show that it also negatively affects the reliability of the product as the failure rates in services increase (Moon et al., 2022; Waldman et al., 2010). This is especially true and more impactful when it comes to the staff carrying out the work. A real-world example to help paint the picture; in a cake bakery a high employee turnover in the CEO position may affect long term strategy but not in the core business is in making cakes. Therefore, if there is a high

employee turnover in skilled bakers, this directly affects the product, cakes, and the reputation of the business. This is the same in the Scientific Laboratory when working; the high employee turnover of skilled technicians who, for example, know how to operate the complex machinery and understand the field of study the service is being offered for, their high employee turnover directly affects the outputs and the Scientific Laboratory's reputation.

This shines a light on the need to improve the incentive management systems for those who work directly to produce outputs. Burnout and high employee turnover have been found to be costly to healthcare organizations as they have a direct impact on productivity and the quality of outputs (Al-Qathmi & Zedan, 2021). In addition to the technicians, the study interviewed their direct managers. There was additional information that was collected for transferability of the study but was not used in the study. Transferability here refers to how the study's findings can be transferred to other contexts, settings or respondents (Stalmeijer et al., 2024). This data can be found in Appendix 7. By going through this data, although not used in this study, the hope is to further research by presenting other potential research with familiarity to their own contexts (Lincoln & Guba, 1985; Patton, 2014). Therefore, providing readers with additional information to evaluate the applicability will aid in advancing the use of these findings in research.

The study interviewed four technicians and their respective four managers. In this case, technicians with less than 3 years at the organization and are in a non-senior role, e.g., senior technician. Saturation in this case study will be until new themes or categories no longer appear; that is, no new ideas or information emerge from the data (Bowen, 2008; Houghton et al., 2012). Individual interviews would also have been conducted to ensure saturation if anything had been unclear. A Likert scale survey was used to triangulate findings from the focus group. Focus group and possible interview data saturation can be tracked and reported using a graph, response versus (sub)themes, which is a clear and usable format (Hancock et al., 2016). Peer review of the data collected was completed by my supervisors, who functioned as independent raters.

3.5. Establishing rigor

Rigor was established throughout the study to assess and establish methodological robustness. This is traditionally achieved in studies by ensuring one has a statistically significant sample size. For this study, there was the need for refined rigor when considering that the case study had a low sample size. Low sample sizes do not lower the quality of the evidence. Rigor is used to enhance the quality of evidence. Qualitative researchers have thus developed rigorous criteria and frameworks to aid in enhancing the quality of evidence (Hamberg et al., 1994; Krefting, 1991; Tobin & Begley, 2004).

Although I may have designed the study based on my own observations, which is an inductive approach and existing theories, which is a deductive approach. The primary goal was to explore the technicians' perceptions, experiences, and understandings (Tavakol & Sandars, 2014). The aim of explorative studies is to create a model that best describes and explains the underlying characteristics and mechanisms of a phenomenon (Ringsted et al., 2011). With that in mind, it was then important to examine any biases that I may have had that may have influenced the study, diarize, and reflect on them. In particular, as I will be involved in the generation and analysis of the data.

Managers also act as mentors who enable and ensure that those they mentor, that is, the technicians, contribute productively to the organization (Clutterbuck, 2004; Quinlan, 1999). With the nature of these relationships in mind, I facilitated all the sessions and kept the conversations of each group separate and confidential. To reduce bias, in particular, with respect to my positionality, I conducted the study on peers whom I do not manage, that is, I do not have influence over. To ensure I was constantly examining my biases, a reflexive approach to interviewing was adopted, and I kept a reflective diary, see Appendix 2. Koch and Harrington suggest that reflexivity enables self-examination, which, in turn, means that the '... values, assumptions, prejudice and influence of the researcher must therefore be acknowledged'

(Koch & Harrington, 1998). The reflexive approach aids the auditability of qualitative research, which is necessary to demonstrate rigor (Hand, 2003; M Sandelowski, 1993; Whiting, 2008).

Forero notes that the triangulation and reflexivity strategies help one to minimize the investigators' bias and affirm that the findings were objective and accurately reflect the participants' perceptions and experiences (Forero et al., 2018). Abiding by a consistent method of data collection (e.g., interview protocol, the vignette and semi structured questions) and conducting the analysis with an experienced team of investigators, helps minimize the risk of interpretation bias (Forero et al., 2018). One of the key methods in establishing rigor is through Lincoln and Guba's evaluation criteria to establish trustworthiness (Lincoln & Guba, 1985, 1986). The strategies that correspond to each of the categories that were employed can be seen in Table 3 below; the table was adapted to research observed in a similar context (Forero et al., 2018). The definitions of each of the categories are listed below:

1. *Credibility*: Confidence in the 'truth' of the findings, that is, confidence in the results. Credibility was achieved through me as the researcher, who had prolonged and varied engagement within the environment. I was employed at the Scientific Laboratory for five years. In addition, at the beginning of the study, I attended post graduate courses in related to the research statement, this helped me to establish a refined understanding of the topic at hand. Once the study began, all notes and referential material were transcribed and stored for future reference. All of the conducted sessions, including focus groups, were debriefed and discussed in set scheduled meetings with this study's supervisory team. The data collection processes and techniques were developed from theoretical understanding. Before data collection, the process was reviewed for clarity and theoretical coherence mainly by this study's supervisory team.
2. *Transferability*: Showing that the findings have applicability in other contexts. Transferability was achieved by documenting the development of each process or method used. This included the reasoning and theoretical understanding was also attached to the process. The process involved discussions before proceeding with any method. In this discussion, recommendations were made, and the approach was refined.

The resulting information was also documented to create an audit trail that can be followed. In addition, once the approach was theoretically sound, some of the employed questions that could be asked inversely were created and analysed for coherence in answering. An example of a question being asked inversely is: “Are you a going out?” and the inverse, second question would then be: “Are you not going out?”. If they answer “yes” to the first question, for coherence, they will have to answer “no” to the second one.

3. *Dependability*: showing that the findings are consistent and could be repeated in this and the same study, that is, the same context and within the same cohort of participants. Dependability was achieved by Creating detailed documentation on how each instrument was developed and independently reviewed for clarity and theoretical coherence. This included a codebook that was generated when doing thematic analysis of the main exploratory focus groups for both the technicians and managers. There was versioning of documentation to create an audit trail for all documents that were used. There was a stepwise and cyclical methodology developed and applied in data collection. Lastly, a pilot survey was carried out for the technicians and managers. It was used to test the clarity and coherence of the survey. The survey was being used to aid in triangulating findings from the first two focus groups.

4. *Confirmability*: a degree of neutrality or the extent to which the findings of a study are shaped by the respondents and not researcher bias, motivation, or interest. This also encompassed the confidence that the results can be corroborated by other researchers. Confirmability was achieved through reflexivity. I kept and maintained a reflective journal. I also scheduled meetings to debrief, discuss and reflect. I particularly reflected on interactions during sessions with participants and the thoughts I had after the sessions were complete. There were also multiple areas where triangulation was employed. This included having surveys to triangulate findings from the focus groups. In addition, there was always a review of work conducted for clarity and theoretical coherence. Lastly, calculation on the Inter rater reliability. This was used in conjunction with the codebook to confirm findings in the main exploratory focus group transcripts.

Table 3: Rigor strategies adapted from Lincoln and Guba for this study.

Credibility	Transferability	Dependability	Confirmability
<ol style="list-style-type: none"> 1. There was prolonged and varied engagement with the environment as I, the researcher was employed at the organisation for five years. 2. I attended post graduate courses in the field at the beginning of the study to establish an understanding of the field. 3. All notes and referential material were transcribed and stored. 4. All sessions were debriefed in set scheduled meetings with my supervisory team. 5. Data collection processes and technique were developed from theoretical understanding. It was also reviewed for clarity and theoretical coherence. 	<ol style="list-style-type: none"> 1. The development of each process or method was documented. The reasoning and theoretical understanding was also attached to the process. 2. With the above point, discussions before proceeding with any method were had and recommendations given. This information was also documented to create an audit trail that can be followed. 3. In the study, questions that could be asked inversely were created and analysed for coherence in answering. 	<ol style="list-style-type: none"> 1. Detailed documentation on how each instrument was developed and independently reviewed for clarity and theoretical coherence. 2. A codebook was generated when doing thematic analysis of the main exploratory focus groups (managers and technicians). 3. There was an audit trail and version for all documents that were used. 4. There was a stepwise and cyclical methodology applied in data collection. 5. Pilot survey was done to test clarity and coherence. 	<ol style="list-style-type: none"> 1. Reflexivity: a reflective journal was maintained and scheduled meetings were taken to discuss and reflect. 2. There were multiple areas where triangulation was employed. This included having surveys to triangulate findings from the focus groups. Review of work conducted for clarity and theoretical coherence. 3. Inter rater reliability, was used in conjunction with the codebook. To confirm findings in the main exploratory focus group transcripts.

3.6. Data gathering instruments

Three main instruments were used to collect data for analysis.

1. Focus groups which were facilitated by a vignette.
2. Self-developed surveys on a Likert scale.
3. A safe to fail experiment was evaluated in the form of a focus group, which was facilitated through a vignette.

These were best suited to better understand the different factors influencing the technicians' competencies as they adapted to changing scope because of the diversity of the projects taken up of work. The next section expands on each of the instruments that are described above.

3.6.1. Focus Group

The group interview process was a focus group which was facilitated using a vignette. The focus group was used to collect data, build knowledge and understand experience through the process of the interviewer and interviewee interaction (L. Cohen et al., 2011; Creswell, 2018). Focus groups are a collection of people having discussions organized to explore a specific set of issues (Stalmeijer et al., 2014). The focus group allows for exploration, which helps to uncover underlying, subtle, or complex phenomena, unlike the survey, which only collects information without further context of one's experiences and individual perceptions (Kitzinger, 1994).

Focus groups were used because they are particularly appropriate for exploratory studies and research in study areas that are poorly understood (Kitzinger, 1995). In addition, by using a focus group, there is not only depth in the conversations but in also exploring exchanges between participants (Stalmeijer et al., 2014). These exchanges are important, in particular, because they are influential with respect to developing competencies; there are relations at play

between participants. These relations include learning in a Community of Practice and the organizational culture in the Scientific Laboratory.

On the other hand, focus groups are not ideal in certain research contexts. In those contexts, one-on-one interviews would then be recommended (Barbour, 2007) These unideal contexts include, but are not limited to, the potential of gathering data that participants would deem personal or sensitive and, therefore, would be unwilling to share in a group setting. The subject area and topic for this study is not of a sensitive nature therefore this would not apply. That said, there were measures put in place, and participants were made aware that there was support if anything personal or sensitive came up. The measure was that, if needed, the matter would be handled separately. Firstly, they could come and add the contribution separately to myself, the researcher or any of the supervisors. Lastly, depending on the severity of the matter, the matter would be handed over to the Scientific Laboratory's human resources department. Severity was determined as if the matter would have been handled by the human resources department if it had been uncovered at the Scientific Laboratory. With consent from the participant, we would then also refer the matter to the human resources department.

Another context that would make one-on-one interviews more ideal is if there were power differentials in the group. For example, the technicians and their direct managers. The technicians will most likely be unwilling to share freely because there may be consequences from their managers with respect to them sharing certain opinions. It was very likely that argumentative discussions or points of contention would arise as the study looked to explore the technician-manager relationship in relation to competency and, ultimately, the quality of outputs. For this reason, the focus groups were facilitated by the same vignette in the same manner but separated between technicians and managers. The focus sessions were also scheduled one after the other, the technicians going first and their direct managers after. This was so that the technicians would not have time to possibly carry out conversations with the managers, as these conversations could influence the managers' contributions.

The challenge that I would have faced with group interviews was creating a space where the interviewees felt comfortable and were able to go in depth in discussing a system that I am also a part of, particularly, if they have an area of deep contention that was linked to me or their colleagues. To counter this, an embargo (withholding findings linkable to them, e.g., by publishing the Thesis) on detailed results would have been put in place if requested by any of the participants to allow them to be free to share anything. Creating rapport became important to establishing a safe and comfortable environment as this has to be established so that the interviewee can share their personal experiences and attitudes as they actually occurred (Dicicco-Bloom & Crabtree, 2006; Spradley, 1979).

A semi-structured interview, unlike a structured one, which is highly controlled, allows the interviewee to respond, giving open answers in their own words, pursue their own thoughts and develop ideas; this will aid in researching complex social issues (Denscombe, 2010; Dicicco-Bloom & Crabtree, 2006). In particular, the open-ended question in the semi-structured interview helps in clearing up misconceptions. The questions used in the focus group were generated based on theoretical understandings. The questions were related to and came after the vignette. Conversely, studies have shown that an interviewer is not a spectator or passive player during interviews. Rather, the researcher can use their abilities, experiences and competencies in the interview situation (Lingard & Kennedy, 2010). For example, an interviewer who is based in the same environment may use their knowledge of processes to invite the interviewee to discuss issues more in-depth than if the interviewer was unfamiliar with the context. Therefore, interviewers are urged to make use of their background, albeit in a considerate way (C. McGrath et al., 2019).

Practically, there were two focus groups for the main exploration. Stage 1 consists of these two focus groups. As previously discussed, the technicians' direct managers were included in the study as they play a critical role in their technicians' development in the system. With that in mind, they underwent the same structured focus group as the technicians as a way of obtaining their views on the same matters. Due to the power associated with hierarchy, in order to allow for unrestricted and unfiltered conversations, the technician and manager focus groups were separated. Potential participants were recruited, and consent was also done in one email, see

Appendix 4. The participants were invited to a neutral venue offsite. They were provided with water and snacks for the duration of the focus group. They were also provided with paper to note any points that came to mind that they did not want to forget. The participants would then use the paper, for example, where they were unable to immediately speak as, e.g., someone else is speaking. Before the focus groups, to prepare, I was guided by literature on how best to conduct focus groups (C. McGrath et al., 2019).

The focus group was the foundational data source. Before the focus groups, to prepare, I was guided by literature on how best to conduct focus groups (C. McGrath et al., 2019). This allowed me to be aware of any bias and to create an environment that allows for open sharing. These are summarized below:

1. I ensured the research question and study purpose were clear for the participants. Literature has shown that this can be done by ensuring that the interview guide aligned to the methodological approach (Bolander Laksov et al., 2017). Defined planning allowed for:
 - 1.1. Clear conversations, e.g., from prepared open-ended questions.
 - 1.2. Easy identification and redirection of irrelevant discussions.
 - 1.3. Mindset tuned not to assume answers but to seek clarity and not to pass judgment.
2. Although having planned, it was also important to be able to adapt the guide. This required that I be attentive, reflect and gauge the participant's responses for understanding and relevance to the topic at hand. Literature has shown these to be effective methods (C. McGrath et al., 2019). Additional literature also includes proactively handling any unanticipated emotions sensitively as a way to adapt (Varpio & McCarthy, 2018). As discussed in previous chapters, not only has adapting been adopted, but there are also steps in place. There will be an intervention in case of any associated risk. Intervention by the researcher or the human resources department of the Scientific Laboratory.
3. I prepared and developed a checklist of tasks, topics, and questions to be covered before and during the session (Brinkmann, 2014).

4. I conducted the focus group using my institutional knowledge and, also understanding as a co-creator of the data to add contextual value and avoid bias (Lingard & Kennedy, 2010). I am an insider; I worked at the Scientific Laboratory for five years and started the study whilst still employed there.
5. This qualitative approach, as the literature has shown, allowed me to give more conservative individuals a voice to speak (Reeves et al., 2015) . This allowed for a more enriched dataset to be collected.
6. I separated the focus groups and conducted the sessions in consideration of the power dynamics that many studies have shown to exist between managers and subordinates (Nimmon & Stenfors-Hayes, 2016).
7. I facilitated comfortable conversations by establishing rapport. Developing rapport involves developing positive relations by trusting and respecting the information the participants share (Dicicco-Bloom & Crabtree, 2006). This established comfortability allowed for more detailed and open discussions (Briggs, 1986). This involved allowing for queries and initial conversations to begin prior to the focus groups (Tuttas, 2015). In addition, before the focus group began, I put the participants at ease by introducing myself and providing further clarity about the study, my role as the researcher and how the process would work. Literature has shown that this action establishes rapport and results in more meaningful discussions (Gill & Baillie, 2018).

Before each session, that is, with the managers and separately with the technicians, a standard introduction was done. This was guided by the preparation done in the section above. The introduction covered the following key subject areas:

1. Structure: A one-hour session, I, the researcher described to the participants that I would take them through a vignette. Thereafter, at the end, then ask the participants questions. The questions were a way to open discussions.
2. Research: A summary of why and how the study is being conducted.
3. Researcher: I acknowledged that I was part of the organization and would only participate as the researcher. A silent independent researcher was present to moderate the conversation

whenever needed. Although silent, when necessary, they will interject to guide the conversation as needed.

4. Expectations for participants: In discussion, they were free to draw examples from the vignette and/or their then current work. They were also welcome to discuss any related topics that came to mind.
5. Confidentiality:
 - 5.1. There should be no further discussion outside of the session by either the researchers or the participants. Except the participants sharing with each other or with the researcher.
 - 5.2. Their sessions would be recorded for research purposes only and would be stored safely. As it is a small organization, there was the possibility that they could easily be identified from the recordings, transcripts, or findings. They were then notified that they were welcome to request an embargo of 2 years on the findings. The transcripts and recordings are not going to be shared and are safely stored in a password protected drive.
6. Questions: They were welcome to ask any related questions at any point.

3.6.2. Vignettes

This method uses a short story that has made up characters which are placed in a specific hypothetical storyline that is related to the phenomena in question (Finch, 1987). Different questions are then asked of the participants about the hypothetical situation. This allows the researcher to explore issues that the participant may deem as sensitive personal information that they are unlikely to share directly (O'Dell et al., 2012). These questions are aimed at unveiling the different impressions that the participants had of the hypothetical situation presented (Hughes & Huby, 2002; Murphy et al., 2023). As only one participant can respond at a time, it is possible that already given answers or opinions can influence the answers of those who are yet to speak. Equally, already given answers can aid in enlightening other participants, for example, by bringing certain situations to remembrance. Literature has shown that there is no difference in the perception of a group versus an individual; that is, if the group

perceives themselves to be a unit, the group has consistent expectations and coherence (D. L. Hamilton & Sherman, 1996). In the case of the participants, they have a sense of unity within the organization, although they work on different projects and services. In essence, they carry out a fundamentally similar function with similar and have similar experiences.

Vignettes have been criticized that if not properly constructed, they will not be able to extract enough information to represent reality. Proper construction of the vignette is needed in order to elicit the appropriate responses (Sleed et al., 2002). To mitigate this, parallel analogies were drawn to better understand, retain and relate the descriptions detailed in the vignette. In addition, multiple sources were used to create a realistic link between the fictional situation and the real-world situation.

3.6.2.1. Vignette development: Theoretical understanding.

The vignette was developed to include the following contributions that emerged from theoretical understanding. The first concepts that arose from systems theory algorithms, namely, PESTLE, CATWOE, GEMBA, Fishbone, Rich picture and CIMO. The algorithms aided in describing the nature of a viable system. The second and last concepts and theories related to learning theories include an organogram to underpin an understanding of the relationships described in self-efficacy, Community of Practice, and organizational culture. There are parallels between the systems and learning theories. They were grouped under one concept, that is, one similar common idea that is described in the findings. Below is a summary of concepts taken from theoretical understanding in relation to what influences technicians' developing competencies.

Systems Theory

1. *Viable systems model* (Beer, 1984):

- 1.1. Internal and external influences that affect the viability of the Scientific Laboratory.
The viability is linked to the development of Technicians' competencies in order to produce quality outputs so that the organization is sustainable and can exist independently (Espinosa et al., 2023).
- 1.2. Environment (Beer, 1984; Guay et al., 2006) – The human system in which the subordinate exists, as well as its viability, autonomy, and supportive environments, foster perceptions of competence, which implies that an employee would feel effective when they perform a given task. Relatedness, which implies the degree to which an employee feels connected to significant others, for example, their teammates. Feeling connected to other employees is in line with theoretical understanding in the learning theories. This is found in points three, four and five. In particular, when successfully developing competencies, it is strongly influenced by the actors who are hierarchically placed above them, for example, the technician's managers.
- 1.3. PESTLE and CATWOE: Macro level, taking into account external (mainly PESTLE) and internal (mainly CATWOE) factors (Casañ et al., 2021; Checkland, 1999; A. Gupta, 2013). These are broader, abstract, and high-level factors. This takes into consideration broader concepts, for example, the legal policies that govern the environment in which the organization exists.
- 1.4. Gemba and Fishbone will show building block concepts of the detailed Rich picture and CIMO (Conlon et al., 2020; Mcclam Liebengood et al., 2013; McClelland et al., 2022; Sakdiyah et al., 2022). At a micro level, taking into account external and internal factors. This takes into consideration, juxtaposing from the macro level, how the broader governing factors in the environment in which the organization exists affects or influences day-to-day processes in the Scientific Laboratory.

The major factors that it boiled down to were what influenced having funds available for competency development. In addition, the state of relations (hierarchical ones, for example, with managers) and processes that influence funding being assigned to developing competencies. Systems theory showed the cause and effect, interactions, and relations in the system at a macro and micro level of different important components in the Scientific Laboratory. These components are related to the viability of the organization, that is, influences on the development of the technicians' competencies to generate quality outputs. The following learning theories section will edify in explaining how these causes and

effects, interactions and relations are actually affecting the technicians, that is, influencing their aptitude to developing competencies.

Learning theories

2. *Organogram* (Obeta et al., 2019)

2.1. This is not a theory but was used to underpin an understanding of the relationships described in self-efficacy, Community of Practice, and organizational culture. For example, it is proposed that leadership at different levels, senior and middle at the organization, have different mechanisms of affecting employees' self-efficacy (G. Chen & Bliese, 2002).

2.2. The creation of this structure, in many processes, is employed to make decisions including, but not limited to, recruitment, propelling technological innovation, and development activities such as training (DeCanio et al., 2000).

3. *Self-efficacy* (Bandura, 1997; G. Chen & Bliese, 2002):

3.1. What the participants think of themselves in the organization and what the organization should have in place in order for them to succeed. This will be a reflection of how they would see themselves based on their background and how best they can succeed (J. Taylor & Westover, 2011; H. Wang et al., 2015).

3.2. Hierarchy (Bandura, 1997; G. Chen & Bliese, 2002): Relationships between the manager and subordinates, where manager is an authority figure and subordinates' belief in their own capacity to execute necessary function to perform specific tasks.

3.3. The initial sources of self-efficacy before the technician can source from *enactive mastery* are influenced by their relation to other employees. The other employees would have learnt and can successfully carry out processes. In this case, these are usually the technicians' direct managers.

4. *Community of practice* (Lave, 1991; Etienne Wenger, 1999):

4.1. This delves into the individuals in a group and the group's common and shared goals to complete tasks in order to deliver services. In addition, the group sharing and developing knowledge focused on the shared practice (E Wenger et al., 2004).

- 4.2. The rich picture and organogram both shows the managers centrally located to the different linked concepts related to the development of competencies. Similarly, in a Community of Practice, similar power dynamics exist, literature argues that in a Community of Practice, the concept the requires elements like mutual understanding and trust, as well as commitment to a common objective (Atiti, 2012; Wals et al., 2009) to be sustainable and successful.
 - 4.3. These elements, like trust, are related to organisational culture concepts where literature has shown the link between communities of practice and organisational culture. This results in the positive development of competencies and overly improves service quality (M. Hamilton, 2011; Huq et al., 2006; Merabet & Agti, 2021).
5. *Organizational culture* (H. Mulder et al., 2019; Schein, 2010):
- 5.1. Organizational culture determines how those in the organization see themselves and the world, and it shapes how they think, behave and interact with each other (H. Mulder et al., 2019; Schein, 2010). Literature has shown that culture is believed to shape individuals' confidence levels and their perceived sense of belonging in a learning environment. (Sueb et al., 2023)
 - 5.2. This also speaks to layers within the organisational culture, the microculture and the hidden curriculum. Researchers have proposed that, microculture can be formed as the result of a process of group, within an organization, coping with different demands and their underlying values (Hafferty & Martimianakis, 2018; C. Lawrence et al., 2018; H. Mulder et al., 2019). Hidden curriculum describes what one teaches without even realizing it. This may be done through one's interactions, modeling, and the organization's culture. Hidden curriculum consists of unspoken values and culture (Hafferty & Franks, 1994) .
 - 5.3. A key example is communication. Communication, internally and externally, at the Scientific Laboratory, can be influenced by the organizational culture. Literature shows that attitudes to communication have their roots in organizational culture and this can be a strong influence on the demise of the company (A. D. Brown & Starkey, 1994). This is because organizational culture determines the type of communication that takes place. This includes informal workplace discussions (water cooler talk) with employees, which is where this study began. Discussions emerged from dissatisfied

clients who mentioned service quality. This is detrimental as it may result in the loss of a customer or contract (Choudhury et al., 2023; Dufour et al., 2021).

3.6.2.2. Vignette: Used to facilitate technicians and managers separate focus groups

The fictional story below was developed based off of theoretical understand of the above summarized literature. I went through the vignette below during the technician's and managers' sessions. The vignette was created using two components. The first was theoretical understanding associated with factors influencing competencies. The second and last component that was used to build the vignette using incidents that have occurred at the Scientific Laboratory. They were mimicked and made fictional in the vignette. These incidents are based on personal experiences, personal observations, and water cooler conversations with other colleagues. The vignette was reviewed by three independent reviewers for clarity and theoretical coherence. After going through the vignette, I used the questions in section 3.6.2.2 to facilitate a discussion underpinned by theoretical foundations. The questions were not necessarily meant to be asked sequentially. The priority was rapport and flow of conversation, which were, therefore, inserted into relevant conversations. The different elements described above, in section 3.6.2.1, were placed in the vignette below:

Jordan and Simphiwe are laboratory technicians in the Vitamins Production Department (VDP) at the Drug Production Laboratory (DPL). Both technicians have worked at the organization for 8 months as their first jobs after their honors studies. Athandwa is their department manager and manages three people in total, including Jordan and Simphiwe. The technician's job is to test the customer's sensitivity to a vitamin (including allergic reactions to various compounds that are used to create a custom vitamin) that the customer chose from a catalogue. The produced vitamin does not contain harmful compounds, and they are substituted. Athandwa oversees the creation of the standard operating protocols that they use for the sensitivity test and vitamin production in VDP.

There are eight other departments at DPL. The scope of work changes regularly as new insights on disease are refined and/or are discovered. In turn, the catalog, and procedures of creating the custom vitamins offered often changes. Athandwa received a complaint from a customer who had a severe allergic reaction to compound K in the vitamins. This compound K is covered in the sensitivity test. From records, it shows Jordan made a wrong call on the color of the sensitivity test for compound K. Simphiwe has not made an incorrect judgment when encountering the same call, Simphiwe got a second opinion from Athandwa. Simphiwe and Jordan have both encountered such a result once.

Athandwa, their manager, developed the current protocol based on procedures learnt at University XYZ, where Simphiwe also attended, 10 years after Athandwa. At the time Simphiwe attended, the protocol was dated to the current time. Athandwa and Simphiwe are in the same University XYZ Alumni departmental group. Jordan attended equally rated University ABC, where he learnt the same up to date protocol as Simphiwe. The vitamin production procedure also mirrors a concept Athandwa learnt from her tennis playmate, Ashley, who was a pioneer in the field. Simphiwe is also familiar with the concept, as he heard about it twice when he bumped into Athandwa and Ashley at the local tennis courts. Jordan is also quite familiar with the concept as he took a semester course on it at University ABC.

3.6.2.3. Vignette: Questions used to prompt discussions around the phenomenon

In a focus group, the facilitator can take on various roles to stimulate the discussion (Stalmeijer et al., 2014). In this study, I, as the researcher, played the role of facilitator. One of my supervisors played the role of a mostly observant facilitator, who gave prompts to progressively direct conversations. A questioning route is an important tool in getting rich information from the focus group (Stalmeijer et al., 2014). Questions were thus generated to help guide and start conversations.

1. Do you have any questions about the story before we proceed? At any point, you are welcome to ask any questions.
2. Based on the scenario above, in your view, what do you think is the underlying cause of the matter?
3. If you were the manager, in your opinion, how would you practically get to the underlying cause of the matter?
4. From your experience, what and why do you think are important attributes that the technician may not have contributed to the error happening?
5. If you were the manager or managing director, at this company, how would you improve the system. Both human and/or process system?
6. What else is interesting or stood out to you that you have observed from the story?
7. In your view, if you were Jordan, what other dynamics may be at play in the department that contribute towards how you, Jordan, is performing at your job.
8. In your view, if you were Jordan, what dynamics do you think may be happening internally with you that may have contributed to an incorrect call?
9. (For the researcher only) Open up room for non-predefined questions, this is an inductive approach as certain topics will invoke asking further questions whether to clarify or explore.

3.6.3. Survey

This was dependent on the outcome of the vignette. Essentially, the survey questions were developed based on the findings from the previous phases of data collection and analysis. They were set to confirm the findings of previous phases. In addition, member checking was conducted by the study participants. Member checking, also known as participant or respondent validation, is a technique for exploring the credibility of results. Data was returned to participants to check for accuracy and resonance with their experiences (Birt et al., 2016). In this study, the results were returned in a survey to check the accuracy of what was deduced from the focus group conversations. The survey was composed of close-ended questions which reflect the nature of this inquisition, (Dicicco-Bloom & Crabtree, 2006) where the respondent's attitudes and perceptions of their own competencies in the system were explored (Geer, 1988). The closed-ended questions would then allow them to confirm their contributions to the focus

groups. The first survey was piloted on non-participants to be refined on clarity and coherence. Independent reviewers also reviewed it for theoretical coherence.

The surveys also allowed for triangulation of data to increase the validity of this study's findings (Bowen, 2009). This meant that for every theme recorded by the researcher and independent researcher, questions were used to confirm its interpreted meaning. The participants were asked to complete a web-based survey. Web-based surveys are not only advantageous with respect to increased speed and ease of completion (Heiervang & Goodman, 2011), particularly for the participants, but are also easily accessible. In this case, Google Forms were used, and it allowed for anonymity and ease of completion. The survey was piloted for clarity and coherence with participants who were not part of the main study. The participants for the pilot study amounted to 3 managers and 7 Technicians. Their feedback, see Appendix 13, was used to refine the survey questions that the technicians and managers from the focus group were going to complete.

3.7. Analysis strategies

At each stage, thematic analysis was done using *a priori* procedure and, finally, abduction (Montgomery & Crittenden, 1977). This analysis followed the coding of responses, developing categories, and arriving at broader themes. The case study approach was used as it is valuable in that it informs the development of theory, evaluation of the current environment and the development of interventions because of its flexibility and rigor (Baxter & Jack, 2008). The close collaboration, mainly through the focus groups, is one of the advantages of the case study approach, as it enables the employees to tell their stories (Crabtree & Miller, 1992). These same stories are what forms their individual realities and in turn the perceptions that inform their actions (Ramesh et al., 2017).

From the responses of the focus groups, the transcriptions were coded into categories to arrive at themes, which is the task of classifying responses (Braun & Clarke, 2006; Lazarsfeld & Barton, 1955). An *a priori* procedure was used in which coding occurs after the data is collected. This is deemed the most suitable approach for use in, for example, pilot studies and pretest data. This method also eliminates a source of unreliability as the set of the categories are developed empirically from the responses and will reflect the point of view of the respondent unlike *posteriori* where categories are generated beforehand (Montgomery & Crittenden, 1977). Thereafter, the final stage is abduction. Abduction, deduction, and induction describe forms of reasoning. Reasoning is used to sort the categories that emerged from the coding into themes. Abduction is making a probable conclusion from what you know; that is, what is known is collected data. Abduction has been suggested to play a role in unearthing processes when analyzing qualitative data (Lipscomb, 2012).

3.8. Ethical considerations

The paragraphs below outline ethical considerations, such as participant recruitment, consent, and data management. The proposal was submitted and approved by the Human Research Ethics Committee (HREC) of the Faculty of Health Sciences at the University of Cape Town for approval (HREC 097/2021). The study only began once approval was received. Permission was also granted by the Case study organization, Scientific Laboratory (Appendix 3). This study adhered to the principles of the Declaration of Helsinki (Williams, 2008).

Participant recruitment and consenting

The potential participants for the main study and the survey pilot were asked to participate via email and sign an informed consent form to record the focus group, any possible interviews, survey data, and notes taken (Appendix 4). The mode of communication was English, and all the potential participants were fluent. None of the potential participants are physically or mentally incapable of giving consent; therefore, there is no need to seek consent from a legally

authorized representative (Millum & Bromwich, 2021). Ethical clearance was obtained from the Human Research Ethics Committee at the Faculty of Health Sciences of UCT, HREC 097/202 (Appendix 5). The Scientific Laboratory gave authorization for the study to take place at their organisation. The participants were informed in writing of the nature of the study, the purposes of the investigation and what their data will be used for (Appendix 4). Those who choose not to participate were not penalised and were made aware of this fact to allow true freedom to accept or decline, this in turn, aids in counteracting volunteer bias (Callahan et al., 2007).

Risks and benefits

The findings of this study could potentially have a positive impact on the development of competencies in scientific laboratories across Africa, especially for laboratories that experience a change in scope, because of the diversity of the projects taken up. I did not anticipate that the study would raise ethical issues with respect to its educational value. The study also avoids harm and the risk to the organization and the individual, which is deemed low (Stutchbury & Fox, 2009). The principles of Justice, Beneficence and non-maleficence were employed. This is where I, as the researcher, took on the duty to ensure that the welfare of the research participant was a goal of this research study. Expanding further, it speaks to a moral obligation that the researcher takes on to act for the participant's benefit. This is to help them to further their important and legitimate interests, often by preventing or removing possible harm (Beauchamp, 2008). With that, for example, the research was not conducted on a vulnerable population or community; therefore, justifiable responses to related needs will not need to be conducted. The participants will be informed of the final research outcome and results of the study; that is, they will be given a copy of the thesis and will be asked for participant feedback. I would like to declare that I do not have any conflict of interest related to this study.

Investigating risks

As it is a small organisation, the participants may also request that detailed research outcomes not be shared for two years if they have reasonable reasons to believe doing so may negatively affect them. Any further organizational related issues that may arise from the study would have been directed to be confidentially resolved by HR. The participants were also given contact details for the HREC, my supervisor, and co-supervisors if they have any questions or concerns that they cannot direct to me, as the researcher. The study will be halted if any unforeseen risks are encountered that outweigh the potential benefits and will only continue if they are resolved. Due to the Coronavirus disease (COVID-19) pandemic, measures to curb the spread, including social distancing, were taken into consideration when booking a room for the focus group. The organisation was within walking distance of this venue, and there were small refreshments at the venue. It was important to reflect during the interview and make the interview process less abrupt and more conversational (Jowett et al., 2011). My supervisor was also in the room to monitor any possible bias and to prompt and give any needed direction.

4. Chapter 4: Data Collection and Capture, and Analysis and Results

Data management plan

As the study had human participants, we therefore followed the declaration of Helsinki and the Good Clinical Governance Guidelines. Defined efforts were made to anonymise and secure the data by using a password protected cloud storage. Physical forms were kept in a locked filing cupboard. Electronic data (e.g., voice recordings, transcribed data, and survey/interview answers) were stored on cloud storage. Physical notes and forms were stored in a locked cabinet. When needed, it was planned that my supervisors would be given password protected access to any requested data. Confidentiality was ensured by keeping a master file (Appendix 6) of participants. Each was assigned an anonymous identifier in a separate access protected document stored in cloud storage. Only these assigned participant identifications will be used in the study. Any physical data was uploaded to make an electronic copy, e.g., by scanning or typing in notes. If requested by the participants, notes and recordings will be deleted. The data can be kept for two years in the custodian of my primary supervisor. If a request to withhold data is made, the data will be withheld for two years. Otherwise, the data will be made available within 12 months of the study being concluded.

Study Procedure - Summary

This section covers the study process, data collection and capture, and analysis and results over the different six phases of the study listed in 5.1., aims, objectives and research questions. The procedure consisted of the initial important exploration focused on the technicians. Figure 10 in Chapter 3 is a summary of the study procedure that was conducted to collect data. The focus group was designed based on theoretical understanding for the purpose of exploring factors influencing competencies. There were six defined stages, and each was built by iteratively considering previous phases. Figure 11 shows a summary of the analysis procedures that were conducted. Procedure, analysis, and results from each stage are expanded on in the following sections of this chapter.

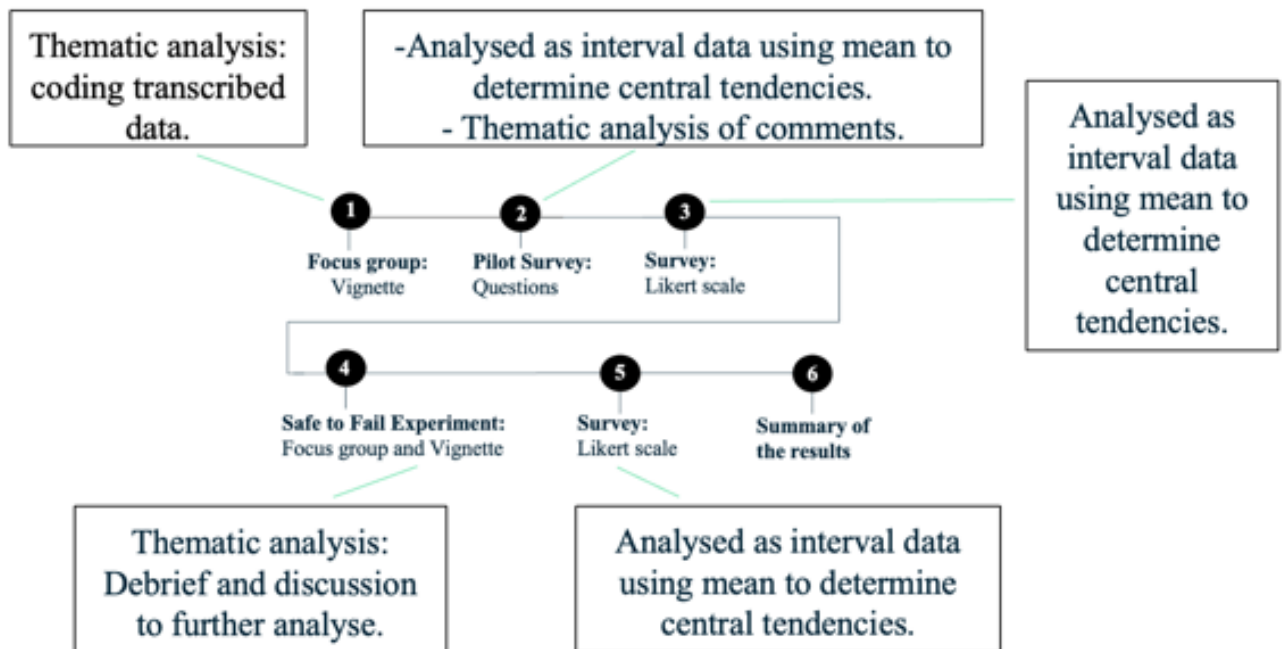


Figure 11: Study procedure showing a summary of study procedures over the six phases.

4.1. Phase 1: Focus Group – Managers and Technicians: Exploring factors related to phenomena.

Data Collection and Capture

The voice recordings from the manager and technician focus groups were transcribed. Voice recordings are the best tool as they allow the best replication of the discussion (Poland, 1995). An independent and experienced party did the transcription. That said, it is important to iteratively review the transcription. To iteratively review, I went through the transcript and listened to the recordings to check for any discrepancies. It is also important to consider pauses, giggles, and other cues offered by the interviewee as markers for important events in the interview (C. McGrath et al., 2019). Any of these incidents and the events that were marked were recorded in a reflective diary. The transcribed data was not altered except to anonymize the participants. Anonymization was done by changing the numbered participants and named participants to match their participant identities. It is recommended and was followed that any review of transcriptions be done soon after the session is conducted. This speediness is to ensure that the researcher reflects more clearly to build better analytical structures (C. McGrath et al., 2019).

It is also recommended to start analysis early as qualitative data has been described as an “attractive nuisance” that, although it is rich, is difficult to tackle (Miles, 1979). The solution, therefore, is similar to the one mentioned previously. It is not to procrastinate but to make use of all early thoughts and reflections to better the analysis process. To aid this, a post focus group reflection and debrief was also done with the researcher and the other three independent reviewers. Analysis of the transcribed data for the managers and technicians was conducted and tallied separately. As they were given the same vignette and questions, it was expected that

their answers would help explore the same concepts. This would give an enriched perspective as there would be different lenses (manager and subordinate) on the same factors. Thematic analysis was also done separately and resulted in the same themes emerging across the two groups. The data from the two focus groups was then combined.

Thematic analysis was then conducted on the transcripts for both focus groups. Thematic analysis, an independent qualitative descriptive approach, is mainly described as “a method for identifying, analysing and reporting patterns (themes) within data (Braun & Clarke, 2006). The main analytical approaches in qualitative studies that are used in breaking down narratives into smaller units of descriptive content that can be described are content and thematic analysis.

Thematic analysis was preferred as it is better suited for conducting exploratory work. It allows for a richer and more complex account of the data (Vaismoradi et al., 2013). In this research, a case study is a rich account. The thematic analysis looks to follow common and similar threads of information across the set of focus group transcripts (DeSantis & Ugarriza, 2000).

There are criticisms of thematic analysis. Of these criticisms, there are ones related to this study, which present potential pitfalls that will result in weak analysis. These criticisms are centered around unfounded and simplistic views of the data (Braun & Clarke, 2006; Javadi & Zarea, 2016). The counter to the criticisms of thematic analysis related to this study can be summarized into two main components. The two components are centered around providing high quality data. The first is establishing rigor by reviewing findings to avoid biased analysis. This builds conceptual coherence and consistency (Alhojailan, 2012). The second is a good theoretical understanding of the subject in question so as not to give a simplistic view. This helps in grouping or establishing categories of information that can go together by identifying interrelations among factors and variables (Alhojailan, 2012).

It has also been argued that thematic analysis is robust enough when used in studying a new phenomenon, in particular where the quality of data depends on the time and energy a researcher applies to the process of data gathering and subsequent analysis (Vaismoradi et al., 2013). In summary, informed by the above, the transcript was inductively coded into different themes. Thereafter, the data was also relayed deductively to different theories that were drawn.

The themes were key to helping an understanding of the system in which the technicians were based. It is important to note that although the thematic approach may have the concept about the target phenomena at the beginning when data was collected and analyzed, there was a commitment made to stay within the initial theories (Margarete Sandelowski, 2010).

Analysis and Results

As recommended in the literature, the following are the six phases, referred to here as stages, of theoretical analysis that were followed (Braun & Clarke, 2006; Vaismoradi et al., 2013). The detailed description of the methods used supports attempts to utilize the thematic analysis process, which includes the use of a codebook, and to determine rigor to support the establishment of credibility (Roberts et al., 2019):

Stage 1 – Review focus group recordings.

I familiarized myself with the data by listening to the recording and going over the transcribed data. Initially, I listened to a recap of the discussion and checked if the transcription was correct. Initial ideas were noted down on the second listen.

Stage 2 – Creating initial codes.

Initial codes were created from coding patterns from related data within and across the reviewed transcribed data. For some data points, more than one theme was assigned to them. The data was split into the main theme and a supporting theme(s). The data was bucketed into all of the identified themes. The interrogated patterns assessed the personal and social meaning around the topic (Clarke & Braun, 2017). This was done within and between the two focus groups. The relevant significant data, patterns related to the topic, which was to be coded was highlighted.

Stage 3 – Developing themes.

I examined all the significant data that was highlighted in stage two and created potential themes. These potential themes were each further placed into patterns related to the study research. See Table 4 for the initial themes and color codes that were created before inter rater coding occurred.

Table 4: List of initial highlight color codes.

Technicians	Managers
Education/Learning	Education/Learning
Processes	Processes/System
Interpersonal	Interpersonal
Hierarchical	Hierarchical
Intrapersonal	Intrapersonal
Unsure [What it entails to be a Manager and HR Manager]	Unsure [What it entails to be a Manager]
Unsure [Communication]	Unsure [Communication]

Literature describes themes as a coherent integration of the disparate pieces of data that constitute the findings (Margarete Sandelowski & Leeman, 2012), which captures something that is important in the way that it relates to the overall research question, unlike content analysis, which basically looks at the frequency in which text occurs. Please see an extracted example of highlighted transcribed data (see Appendix 8).

Stage 4 – Finalizing themes.

The themes were reviewed against how I was describing them. The themes were also reviewed to determine how they appeared within a group and between the groups of transcribed data. Once the review was finalized, the themes and highlighted transcript were also finalized. The next step was to create definitions for the themes to ensure that the process is replicable. This was done by creating a codebook. The eight finalized themes (see Table 5) that emerged were Communication, Contextual factors, Education, Hierarchy, Interpersonal, Leadership, Operational systems, and Organizational climate/culture.

Table 5: List of finalized highlight color codes.

Technicians and Managers	
1.	Communication
2.	Contextual factors
3.	Education
4.	Hierarchy
5.	Interpersonal
6.	Leadership
7.	Operational systems
8.	Organizational climate / culture

Stage 5 – Developing a codebook.

Two reviewers reviewed the process of creating a codebook. The reviewers were chosen as they had a strong theoretical understanding from knowledge and experience. The codebook was used by two separate independent raters in order to triangulate the data and check the robustness of the assigned themes. Studies have shown that a codebook, like in Table 6 below, aids in condensing data into identifiable topics that can be tracked (Mihas & Institute, 2019). Literature has shown that creating a codebook is an intensive process. In this intensive process, a team of reviewers are able to intertwine different theoretical underpinnings to apply them to understanding the study of the data (DeCuir-Gunby et al., 2011).

As is the unavoidable nature of all research, it needs to be upheld in the face of the independently available evidence (Krippendorff, 2019; Nowell et al., 2017), and this is done to ensure rigor. Specifically, this was done by having independent raters who also looked for any possible alternative interpretations, which were noted and discussed in the consensus meetings. The consensus meeting was attended by reviewers of the codebook and those who use the codebook to assign themes. Thereafter, we had a consensus meeting to discuss any themes on which we did not agree. This was an opportunity to give context to and refine the codebook. A second and final consensus meeting was held using the refined codebook and was mediated by my supervisor, who was a non-rater.

Table 6: Codebook with notes on inclusion and exclusion criteria

	Code		Code Notes
1	Education	<i>Included</i>	<ul style="list-style-type: none"> - Technicians’ education, learning or training, related to laboratory processes & systems and analysis. - Technicians and Managers learning or acquiring new skills related to their job profile.
		<i>Excluded</i>	<ul style="list-style-type: none"> - Any organizational administrative procedures related to learning or training.
2	Interpersonal	<i>Included</i>	<ul style="list-style-type: none"> - Interpersonal relationships which may be affected by personal context, personal culture, and environment. - Within the Community of Practice (COP).
		<i>Excluded</i>	<ul style="list-style-type: none"> - Any organizational administrative procedures related to interpersonal relationships.
3	Organizational climate / culture	<i>Included</i>	<ul style="list-style-type: none"> - How the organizational environment impacts on agenda & interpersonal interactions. - Impacts on learning/competency development.
		<i>Excluded</i>	<ul style="list-style-type: none"> - Individual (agency) related culture.
4	Hierarchy	<i>Included</i>	<ul style="list-style-type: none"> - Related to positionality associated with power which affect communication, relationships, and/or decision-making.
		<i>Excluded</i>	<ul style="list-style-type: none"> - Any hierarchical structures and systems.
5	Contextual factors	<i>Included</i>	<ul style="list-style-type: none"> - Anything related to the internal self and how it affects how they learn, develop competency, and carry out their job function. - State of the internal self can be influenced, for example, by home life. - Self-efficacy (ideas of agency) / Intrapersonal
		<i>Excluded</i>	<ul style="list-style-type: none"> - Any organizational administrative procedures related to individuals.
6	Communication	<i>Included</i>	<ul style="list-style-type: none"> - Anything related to communication and how it affects how they learn, develop competency, and carry out their job function.

			<ul style="list-style-type: none"> - Perceptions related to how communication is carried out. - Including perceptions of communication
		<i>Excluded</i>	<ul style="list-style-type: none"> - Interpersonal communication.
7	Operational systems	<i>Included</i>	<ul style="list-style-type: none"> - Operations Resources, processes, competencies influence work/performance and learning.
		<i>Excluded</i>	<ul style="list-style-type: none"> - Any communication about operational systems.
8	Leadership	<i>Included</i>	<ul style="list-style-type: none"> - What good leadership entails and/or should be or look like, for example management styles.
		<i>Excluded</i>	<ul style="list-style-type: none"> - Anything related to hierarchical power.

Stage 6 – Finalizing themes.

The last stage is to produce a report. This involved linking the extracted data, ideas, and threads to the research question. The data was split into the main theme and a supporting theme(s). The data was bucketed into all of the identified themes. A previous discussion noted that independence in interrater coding is not possible, nor are the results of this approach reliable. This is because two people can apply the same subjective perspective (Marks & Yardley, 2004; Vaismoradi et al., 2013). It was then of importance to have raters from diverse backgrounds as mine, whose field of work allowed them to look through a different lens. The consensus meeting was an opportunity to discuss the differing subjective views. To further improve on rigor, a reflective diary was utilized. This was done in an Excel spreadsheet where all phrases related to a theme were grouped together, and a column on reflection was placed. Literature has cautioned one to be careful about how information from the diary is incorporated as it is unclear how the information can be used in interpretation. The recommendation is to keep such notes alongside as a conscious reference when conducting the research and subsequent analysis thereof (Marks & Yardley, 2004; Rolfe, 2006). One of the best ways the quality of findings can be judged is by whether new insights or increased understanding of the phenomena are gained (Krippendorff, 2019).

Stage 6 (1 of 3): Interrater reliability

Stage 6 has been broken up into three sections. The independent reviewers, rater AA and rater NS, also followed the same steps in coding. They identified text that was associated with a single idea. Using the codebook, they bucketed the idea into an overarching theme. They were also encouraged to state secondary themes at play that support the primary theme. Once they independently coded the transcripts, I compared our coding and made a note to discuss where there was no consensus on either the theme assigned or whether it was a new theme suggested or from one of the deduced. I marked the incidences where there was no consensus and arranged a consensus meeting. In the meeting, the remaining two of my four supervisors acted as independent observers who would step in to assist in any deadlocks with respect to reaching a consensus. In the consensus meeting, I provided context for some singular idea statements that may have been unclear to the independent raters. For example, wording that may be specific to the organisation's departmental system. The organization uses the word "platform" to reference a department; when an idea statement says, "*I am unhappy with my platform,*" it can be misunderstood as a "*stage*" where they express their views versus a department. After the first consensus meeting, I refined the codebook, and we had a second consensus meeting to clarify and finalize any outstanding statements. The kappa statistic is frequently used to test interrater reliability. The importance of interrater reliability lies in the fact that it represents the extent to which the data collected in the study are correct representations of the variables measured (McHugh, 2012).

A reference diagram (see Figure 12) shows Interrater reliability score interpretation compared across key research publications on the y-axis (Cicchetti & Sparrow, 1981; Fleiss et al., 2013; Landis & Koch, 1977; Regier et al., 2013). In diagram 11, the x-axis represents Cohen's Kappa. It is a correlation statistic that can range from -1 to +1. On the x-axis, 0 represents the amount of agreement that can be expected from random chance, and 1 represents perfect agreement between the raters (McHugh, 2012). While kappa values below 0 are possible, Cohen notes they are unlikely in practice (J. Cohen, 1960). In this study, to get the score, I divided the total number of ratings in agreement, 1214, over the total number of ratings, 1239. This gave a ratio of 0.97982244, which was rounded up to 0.98.

For this study, Interrater reliability was done for the primary theme. Any supporting/secondary themes were not considered. This is because, further interpretation and meaning was being

derived from the data. The secondary theme was also not separate from the primary theme, so no information was lost or excluded. The interrater reliability for this study had a κ score of 0.98. Based on the key publications in Figure 12, this denotes a corresponding green (highest) corresponding to the description of the “Excellent” or “Almost Perfect” coefficient of agreement.

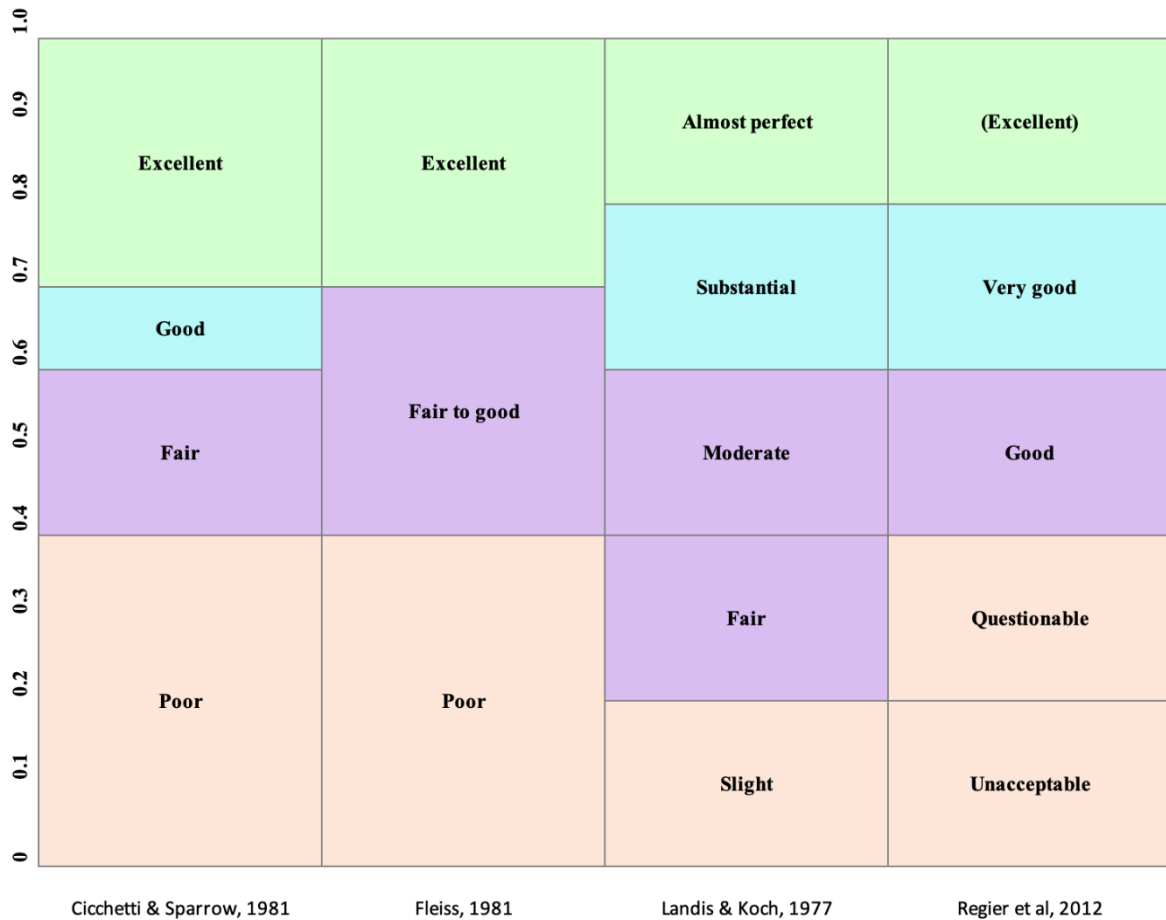


Figure 12: Interrater reliability score interpretation compared across key research publications.

Stage 6 (2 of 3): Quantitative comparison of themes

The research also took a quantitative look at the data to compare various aspects. I looked at the overall count of themes that were discussed in both focus groups (Figure 13), where the most discussed theme was operational systems. Figure 13 was developed from a detailed overall tally (Figure 13). This means that the coders noted that most of the idea statements from

the conversations were on "Operational systems". "No (To Main Theme)" means the coder/rater did not agree with the assignment, that is, there was no consensus in the theme assignment. The eight themes that emerged were Communication, Contextual factors, Education, Hierarchy, Interpersonal, Leadership, Operational systems, and Organizational climate/culture.

Theme	Count	Managers	Technicians
Communication	121	64	57
Contextual factors	187	134	53
Education	95	59	36
Hierarchy	72	42	30
Interpersonal	146	77	69
Leadership	193	133	60
Operational systems	239	162	70
Organizational climate / culture	169	107	62
No (To Main Theme)	17	14	13

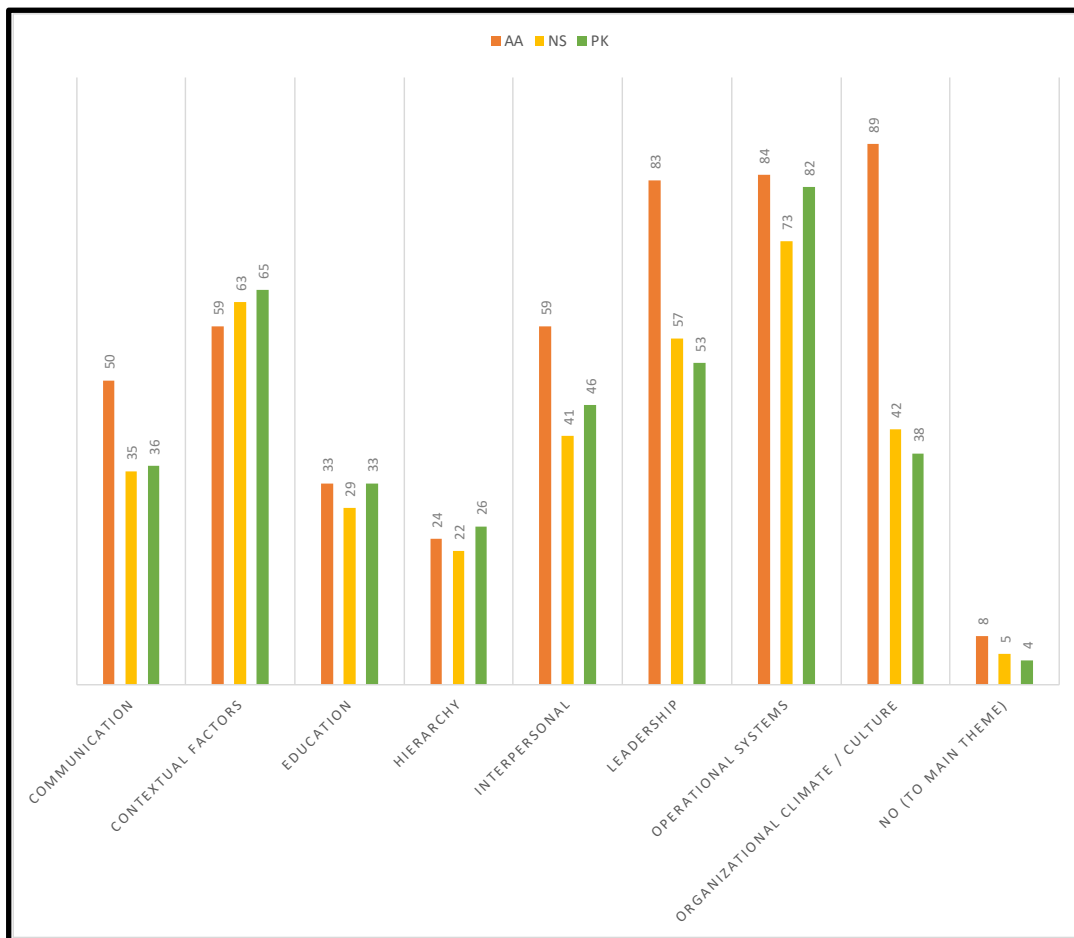
Figure 13: Shows tallies of how many times a theme appeared in the manager and technicians focus groups.

Stage 6 (3 of 3): Quantitative comparison of raters

In the breakdown of contributions per rater per theme, rater AA had overall the most contributions per sheet (See Figure 14). This is because rater AA assigned more secondary themes. These added supporting secondary themes will be useful in analysis as they will provide additional information to support how the primary theme is observed. rater AA mostly coded text as "Organizational climate/culture", rater NS's was "Leadership" and rater PK's was "Operational systems". Despite this, there was no statistical significance in difference, and there was still a high interrater reliability coefficient of 0.98 as the codebook was used to guide coding.

Theme	AA (%)	NS (%)	PK (%)	AA	NS	PK
Communication	40.00	27.69	32.31	50	35	36
Contextual factors	40.10	31.25	28.65	59	63	65
Education	39.85	30.08	30.08	33	29	33
Hierarchy	40.74	28.70	30.56	24	22	26
Interpersonal	40.65	30.97	28.39	59	41	46
Leadership	39.31	27.17	33.53	83	57	53
Operational systems	39.18	29.80	31.02	84	73	82
Organizational climate / culture	34.95	31.07	33.98	89	42	38
No (To Main Theme)	47.06	29.41	23.53	8	5	4

A: Tabulated representation



B: Graphical representation

Figure 14. Theme counts compared per rater. Each rater is represented by their initials, which are AA, NS, and PK.

To further check the data, a process guided by the member checking method was done. The process involves returning an interview transcript or debriefing the analytical results with participants for agreement (Creswell, 2018; Lincoln & Guba, 1985). The participants were all

employed full time, and although they were happy and willing to participate, they had noted limited availability and demanding schedules. The analyzed and summarized transcript findings were developed into a survey and sent to the participants to determine agreement. Creating a survey also minimized drawbacks related to member checking. Research has shown that member checking can introduce conflicting rules on interpretation (Angen, 2000; Morse et al., 2002; Varpio et al., 2017). This was especially true, given how rich transcriptions are. The participants were not geared technically to tackle the task. Therefore, the survey was best suited for the member checking process. Before the survey was conducted, a pilot survey was conducted to ensure that the survey questions were clear and theoretically coherent. This pilot survey will be discussed in the next section.

4.2. Phase 2: Pilot Survey – Managers and Technicians: Evaluate the quality of the survey to help triangulate focus group findings.

A separate set of managers and technicians, that is, from those who were in the focus groups, evaluated the pilot survey. The pilot study was set out to ensure that the questions were clear and theoretically coherent. This was very important as the main survey was set to aid in triangulating the findings from the focus groups. The questions were intentionally randomised to minimise response bias. The survey questions were set on a Likert scale, where response bias usually occurs. This bias occurs because the respondent wishes to provide a response that is socially desirable (Haberstroh et al., 2002; Hui & Triandis, 1989). This usually happens when they are able to predict what the question is asking. It is recommended to disrupt this cognisance, for example as done in this study, by reversing some questions and randomising responses (Haberstroh et al., 2002; Warner, 1965).

The questions were found to be clear and theoretically coherent. They were then ready to be used by the study participants who had participated in the focus groups.

Data Collection and Capture

Survey questions were based on the thematic analysis of the focus group data. The following describes the process of developing the survey. Once the data was coded and there was consensus, idea statements were grouped by theme. I then added any reflections that I had during the focus groups or while coding. Next, I added any follow up questions that I had. Finally, I added a survey question to qualify what the grouped idea statements in the theme were mirroring (Appendix 9). There were no questions that needed to be followed up on in an interview; this was determined after the thematic analysis. After thematic analysis, if there were any phrases or sentences that were not understandable, then they would have been listed for follow up interviews. This was done separately for the managers and technicians. Afterwards, the questions between the managers and technician groups were added together to create the survey. The survey was then independently reviewed by my supervisors (Appendix 10) for four main things:

1. Agreement with theme – the questions emerged from a theme; it was important to check if the question was consistent with the assigned theme.
2. Relevance to study – To check if the question would help answer the research questions.
3. Clarity of wording – This was to check if the question was clear.
4. Any additional questions that may be missing. That is, if there is a research question that is not represented in the survey.

The result was refined questions that were sent to the pilot study. There were no conflicting comments by the reviewers. Any questions or comments were used to refine how the question was framed (see Appendix 10 and Appendix 11).

Analysis and Results

The developed survey was piloted (Appendix 11) to ten consenting participants (Appendix 5) who were not part of the main study. The pilot was meant to refine clarity and coherence for the main study participants. For questions that the participants thought *were not*, or participants *were unsure* whether the questions were clear and coherent, the participants were asked to leave a comment to explain (See Appendix 11). The participant's responses were tabulated, and each question was compared against each of the participant's responses. There were no conflicting comments by the participants on how to refine the questions. Thereafter and in addition, my supervisors also looked at consistency and relevance to the themes in the study (See Appendix 10). In conclusion, there was general consensus on the clarity and theoretical coherence. That said, mainly grammatical and phrasing changes were made. The survey was then sent to the main study participants, and this shall be covered in the following section.

4.3. Phase 3: Survey – Managers and Technicians: Triangulating focus group findings

Data Collection and Capture

The main study participants were invited to take part in the survey (See Appendix 15). All of the eight participants were able to fill in the Google form to complete the study. The results were tabled in the following manner. All of the participants' responses were placed in one table. The different themes were highlighted in different colors in the Word document. The scores on a Likert scale were placed as numbers in the table to make it easier to see the average consensus per response. There was 100% concordance in scoring in the same questions that were asked in different ways. An overarching proposition was made for all the questions on each theme. These propositions are drawn from the paradigm of Pragmatism which questions the truth from the findings of the survey and how useful this truth is in enacting innovative

change in the organisation. In particular, to emphasize evaluating the data from the focus group and survey through an examination of how practical consequences could result (Morgan, 2014b).

Three concepts were used to generate the prepositions: emphasis on actionable knowledge, recognition of the interconnectedness of experience, knowing and acting and, lastly inquiry as an experiential process (L. M. Kelly & Cordeiro, 2020). The three will be expanded on in the following. The first, having actionable knowledge, looks to maintain a connection between the enquiry in the process to the evolving practices in the organisation and problems that may surface. This allows one to look into how different participants experience and are affected by the same phenomena (Morgan, 2014a). The second is the interlinkage between inquiry, experience, knowing, and acting, which addresses many of the weaknesses of existing organizational research, as this gives a richer and more realistic view of human behaviour in the organisation. This more precisely captures the complex and fluctuating context in which organizations operate (Farjoun et al., 2015). The third principle looks to surface complex themes and issues hidden in formal documentation or rhetoric in an organisation and this can be done through what the respondents have said in the focus groups and survey and triangulate it to what is observed in the system.

This is important in this context where there is a change of scope, because of the diversity of the projects taken up, in work at the organization that primarily functions as a Contract Research organisation (CRO). As a CRO, the Scientific laboratory looks to add value by collaborating on projects in various ways like research design. Fourth and last is looking at inquiry as an experiential process. According to the literature, all conscious human actions involve some amount of inquiry or assessment in response to a problem or obstacle (Dewey, 2018). This principle encourages researchers and organisations to probe what would be the consequences of acting in one way or the other. This can be done by outlining and tracking what different lines of action emerge. This allows researchers to gain a more detailed understanding of the phenomena under investigation. This aids in one of my challenges noted earlier, generalised solutions that merely focus on what they deem will work to mapping the consequences, experiences or meanings of social action for different individuals in an organization (L. M. Kelly & Cordeiro, 2020).

Analysis

Literature has shown the Likert scale as the best method to measure attitudes (Likert, 1932). For Likert-Type data versus Likert-scale data, it is recommended that median or mode are used. Likert-Type data comes from questions that, when combined, describe a personality trait or attitude (Boone Jr & Boone, 2012). For example, questions in the survey ask about feelings, which is an attitude towards a particular matter. A median score was used to measure central tendencies. This is a statistical measure that is used to identify a single, central, point in the data. This singular point acts as a representative of the entire distribution, that is a representative of all the responses given for a particular question (Manikandan, 2011; McCluskey & Lalkhen, 2007). Each of the survey questions had five possible responses. The responses were placed on the survey's Likert scale and were given a value from 1 to 5. From the median values, it showed that there was consensus in what I as the researcher deemed the participants to be saying, and how the participants responded. For every theme, there was an underlying leadership thread. This means that although the participants may have been talking about communication, the participants believed the breakdown in communication was because of poor leadership. This poor management was suggested to be at the senior management level. Once I had triangulated findings from the technicians and their managers, I set out to find out the senior managers' understanding of the technicians and managers' point of view. This will be covered in the next section.

4.4. Phase 4: Safe to Fail Experiment – Senior Managers: Triangulating focus group findings.

Data collection and capture

All five senior managers were recruited and consented via email (See Appendix 16). The Safe to Fail Experiment was conducted using a vignette. The vignette was created using the themes triangulated in the survey above. Each theme had a vignette. The vignette was reviewed by four reviewers for clarity and theoretical coherence. The vignette was created based on two components. The first, theoretical understanding that underpinned the data collection from the technician and managers groups. The second is common incidents that occur in the organization. The sessions were also planned and based on the same principles as the first focus groups. The vignettes, in this case, were different and shorter because they were exploring specific themes; therefore, questions were asked after each vignette (See Appendix 17). The vignettes were presented via PowerPoint in a meeting room at the Scientific Laboratory's office. The room was closed off, and the blinds were turned down to create a comfortable and confidential environment.

The session was recorded and transcribed. The transcription was checked for correctness. The names in the transcription were again anonymized to participant IDs. The Safe to Fail experiment was set out to see if the Senior managers understood what the technicians and managers were experiencing as key factors that influence their competencies. The aim was to see if there was a change in thinking if cause and effect were explained in a simpler form, that is, through the vignette. Section 5.3.1.1 shows the key concerns that the vignette sought to test. These concerns were derived from theoretical understanding and were also informed by the proposition in the theoretical pragmatism table. The key concerns stem from the eight themes that emerged from the technicians' and managers' focus groups. Namely, these themes are Communication, Contextual factors, Education, Hierarchy, Interpersonal, Leadership, Operational systems, and Organizational climate/culture. The questions were then constructed to query details contextually related to the theme. For example, regarding communication, the survey was enquiring whether, based on the vignette related to communication, the senior managers had shifted their thinking on how communication influences the technicians (competencies).

Analysis and results

The participant's initial thoughts, as probed by the questions in the vignette, were recorded. Most of the senior managers' responses (highlighted in yellow in Appendix 18) were in line with what technicians and managers had noted as adverse influences on their competencies in the focus group and the survey. I, as the researcher, then had to ask the senior managers questions to try to lead them to think alternatively. This was done by showing cause and effect. This was done by showing how a factor ultimately influences the end behavior or scenario that one sees.

After proposing an alternative way to think about the scenario, there were no further points made to support or to re-affirm their initial thoughts. From the audio, in some instances, there were agreeing hums to the new proposed way of thinking. There was no visual recording, so we could not do any visual analysis of, for example, their body language. That said, in the session, their facial expressions seemed to be agreeable. This was also highlighted in the summary notes of Appendix 18. To confirm that there was a change in thinking, it was important to have a survey to confirm. The same principles and strategies were employed in the Technicians' and managers' focus groups. The questions were again underpinned by theoretical understanding and were used to confirm findings from the eight vignettes.

4.5. Phase 5: Survey – Senior Managers: Triangulating focus group findings

Data collection and capture

A survey was created to determine whether the Senior managers had a shift in thinking. An email was sent out to each participant. They each filled out a separate survey on a Likert scale. Achieving a shift in thinking was the purpose of the Safe to Fail Experiment. There were eight

questions that represented the key themes (See Figure 15). This survey also follows the same theoretical underpinnings and principles as the technicians and managers focus groups.

Have you shifted your thinking about?	Please place an X on your chosen option					Please leave a comment on your selection
	Yes	Likely Yes	Neutral	Likely No	No	
1 Communication in the workplace.						
2 Contextual factors (e.g., personal, economic etc) in the workplace.						
3 Educational status wrt employees' productivity and career advancement.						
4 Hierarcy e.g., wrt impartiality in the workplace.						
5 Interpersonal relationships in the workplace.						
6 Leadership wrt sharing clear goals, expectations and, vision with employees.						
7 Operational systems and activities in the workplace.						
8 Creation and maintianance of organizational culture/climate in the workplace.						

Figure 15: Blank survey that was used to determine the shift in thinking in the Senior manager’s survey.

Analysis and results

The same analysis strategies and principles were used when analyzing the surveys for the technicians and managers. Central tendencies using the median were used to see if there was a change in thinking. A change in thinking would be denoted by a scale point of four and ideally five. The median value was four, which denoted that “likely yes” to the senior managers having a change in thinking. The comments given and contextual knowledge of the organization were considered in the discussion. The central tendencies were plotted on a scale to have a visual representation of the shift in thinking.

5. Chapter 5: Discussion

5.1. Summary of study: Rationale, Justification and Significance of Study

This thesis explored factors influencing competencies of Scientific Laboratory technicians and recommendations for improvement: A case study of a Scientific Laboratory based in a resource constraint setting. Science laboratories are a key component in scientific research and implementing solutions of scientific related businesses. They work to advance scientific research by creating an environment and expertise necessary to run experiments (H. Beck et al., 2022). They also do the same in facilitating running workflows for scientific related businesses. These businesses can span across the fields of engineering and medicine. The focus is set on the technician's competencies, as the work they do directly affects the outputs (Salman et al., 2020). I used a systems algorithm and design architecture model to elucidate the justification for the study. Once data collection was complete, with a refined understanding of the phenomenon, I used the design architecture model to look into the current situation and the challenges faced. In addition, I also looked at possible resolutions and what were the possible outcomes if the challenges were addressed. This has been summarized below (see Figure 16) to show the flow of thinking.

The design architecture model is based on design thinking. Design thinking looks to move away from what is known and understood from the past and looks forward to what is possible with the aim of solving problems and promoting innovation (T. Brown, 2008). It is a productive mix between analytical thinking, which looks to the past, and intuitive thinking, which looks to the future (Martin & Euchner, 2012; Rösch et al., 2023). Design thinking has a strong focus on user needs, in this case, the technicians. It allows for the researcher to immerse themselves in the user's and the technicians' situation. By being immersed, we are able to envision what

the future needs of the user could be. This results in innovative products and services (T. Brown, 2008). The following sections will expand on highlighting the phenomenon by presenting the current situation, challenges faced, possible solutions and predicted outcomes in relation to technicians developing competencies.

Current situation: The current setting is that the organization is a CRO which specializes in a wide scope of research and industry projects from the OMICS fields, in particular proteomics, genomics, and bioinformatics. The organization houses a wide range of high-end machinery. Each of these machines is able to facilitate work in a wide range of areas, including diagnostic solutions for various diseases like genetic disorders. The Scientific Laboratory has, over time, realized that strategically, they can best serve their clients by employing a collaborative approach. This would entail that, at the least, the employees would get involved in project design. Good design is a major component in ensuring that quality outputs are produced (Baseke et al., 2022).

With this, they have built a good reputation of having the value add on of a collaborative approach. This has tangible results in the improved definition of project aims, objectives, research questions, study design and expected outputs (Langdon et al., 2015). All of these need to be carried out and managed by competent staff who are competent in the field of study and in the use of different machinery in the laboratory. For an organization to produce quality outputs, it is important to ensure that there is competency, that is, the necessary knowledge is applied when designing and implementing solutions. These need to be put in place to answer scientific questions proposed by both research and industry (Baseke et al., 2022).

Challenges being faced: In order for the business to scale and be sustainable, they would need to make sure that they initially have quality outputs (Chu et al., 2014; Whitworth et al., 2008). For example, in order for the Scientific Laboratory to be scalable and sustainable, the organization would need to initially have income in place so that it is capable of existing independently (Espinosa et al., 2023). This income is linked to the quality of outputs, creating a reputation that attracts business and research (Nair & Sankaranarayanan, 2014; Salman et al., 2020) funding. This reputation also allows an organisation to also build a competitive advantage

against its competitors (Barney, 1991; Wernerfelt, 1984). More established, usually in the global north, organisations have garnered good reputations and thus have volumes that allow for competitive pricing (Umviligihozo et al., 2020). These challenges being described mainly emerge from the technician's competency in not keeping up with the change in scope, which lowers the quality of outputs. This inability to keep up is impacted and compounded by other various factors. What these factors are, is what is being explored in the thesis.

Such an environment results in a high turnover of employees. Some of the financial effects of high employee turnover includes, hiring and orientation, cost of keeping continuity and studies show that it also negatively affects the reliability of the product as the failure rates in services increase (Moon et al., 2022; Waldman et al., 2010). High turnover results in the load being shifted to the remaining staff, which also results in burnout. Burnout and high employee turnover have been found to be costly to healthcare organizations as they have a direct impact on productivity and the quality of outputs (Al-Qathmi & Zedan, 2021).

Possible outcomes: If the above challenges are understood and addressed, they will help establish efficiency, viability, and sustainability at the Scientific laboratory. These qualities would come out of various aspects. These aspects include having established competency, which is linked to high self-efficacy. This can predict one's likelihood to engage and persist in a task (G. Chen & Bliese, 2002), to have job satisfaction and less withdrawal behaviors (Mitterer & Mitterer, 2023; Ribeiro et al., 2023; Walumbwa et al., 2004). This would result in staff retention and negate the financial and reputational loss that comes with high staff turnover.

This is achieved by leaders creating an organizational culture that stimulates and encourages the development of competencies. Leaders do so in various ways, including establishing safety and trust among all employees (Mitterer & Mitterer, 2023). Further, the resulting organizational state would boost business activities. An increase in the diversity and number of projects taken up. In addition to funding, it would create business opportunities and as services are utilised, they garner a reputation and eventually become trusted (Goldsmith, 1997; Höner, 2002). Customer confidence and satisfaction which leads to enhancing reputation which

is key in enhancing organisational performance (Nair & Sankaranarayanan, 2014; Salman et al., 2020).

Outcomes: While the body of literature from the global north can offer insights and recommendations for development, implementation and sustainability, it may be of limited relevance for the global south, where the social, cultural, political and economic conditions are significantly different (Merry et al., 2023). Therefore, there is a need to understand the contextual cause of the current challenges as these have formed a specific norm in the Scientific Laboratory. This, the norm formed, collectively is what is then experienced by the employees in the organization and ultimately becomes the values that they share which translates to behavior patterns. Any new employees are influenced by this norm, and ultimately, so is the sustainability and viability of the organization (Assoratgoon & Kantabutra, 2023; Kotter, 81 C.E.).

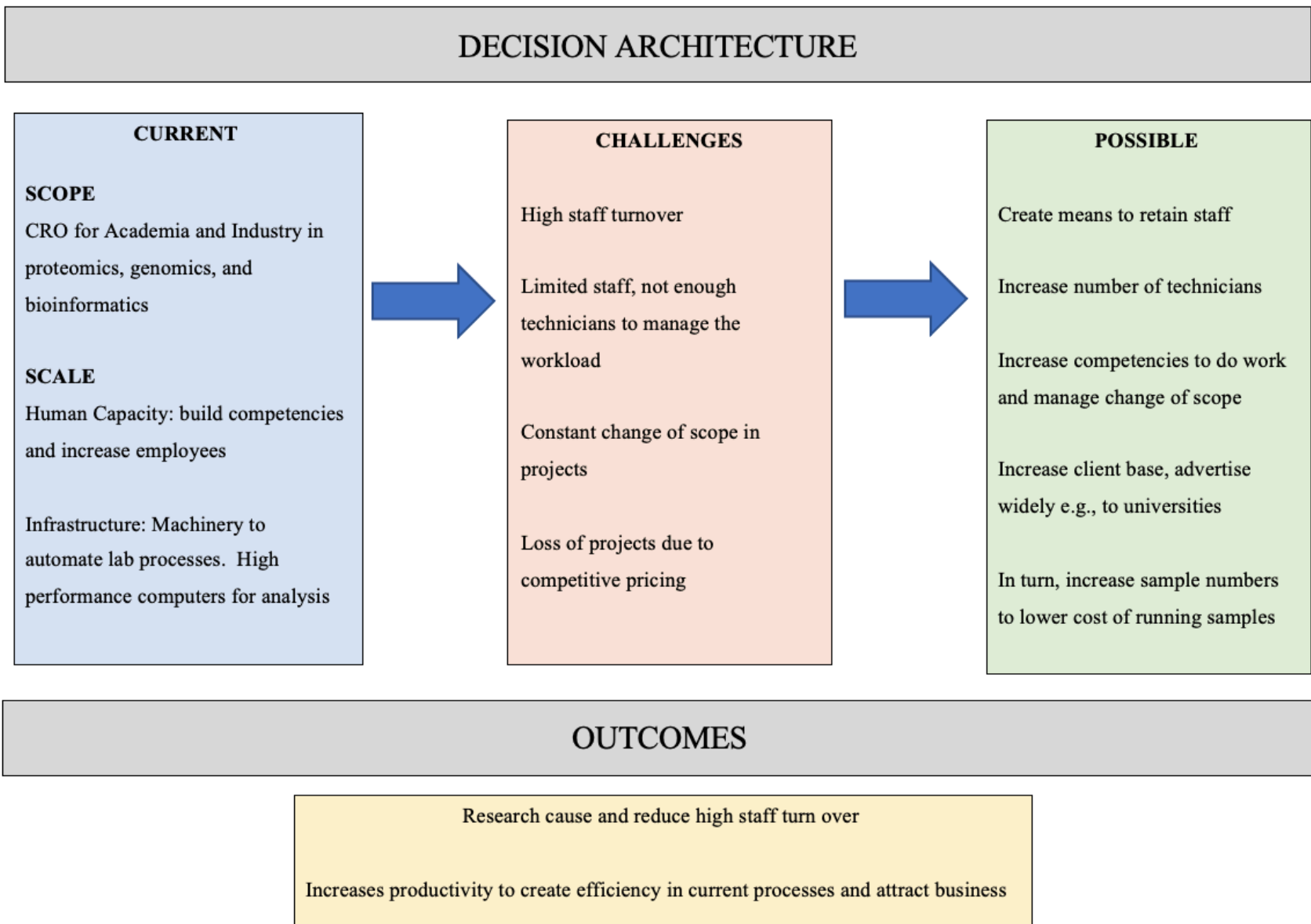


Figure 16 Decision architecture, which was used to determine the current environment, the challenges, possible results if the challenges are addressed and the overall outcome

5.2. Research Questions 1, 2 and 3

Research Question 1: Does the system in which the technicians operate, the internal and external environment, influence the technicians' competencies? If so, how? The overall key findings from the Managers' and Technicians' focus groups were the eight themes. The findings indicate that there are three internal and five external influences on the technicians' competency development. The three internal themes are Contextual factors, Education, and Interpersonal. The five external themes are Communication, Hierarchy, Leadership, Operational systems, and Organizational climate/culture. A breakdown of the numbers can be visualised in the sections to follow (See Figures 17 and 18). Each of the themes will be discussed individually in the rest of these sections, 5.2.1 to 5.2.8. In conclusion, in answering research question 1, the data suggests that there are internal and external influences on the technicians' competency development. These are the eight listed themes. How they influence the technicians is broken down in each theme, from section 5.2.1, Education, to section 5.2.8, Leadership.

Research Question 2: Does the relationship between the technician and their direct manager influence the technicians' competencies? If so, how? The findings from the study suggest that all of the themes had a strong relational component to them. The relational component mostly emerged from the findings between the technician and their direct manager. There were also fewer but significant discussions, relative to the technicians' competency development, that spoke about relationships with senior managers. These relations influenced the technicians' competency development. Some themes had a more pronounced relational component, and these themes are 5.2.2, Interpersonal; 5.2.4, Hierarchy; and 5.2.6, Communication. In conclusion, in answering research question 2, the findings suggest that the relationship between the technician and their direct manager influences on the technicians' competency development. How they influence the technicians is broken down in each theme, from section 5.2.1, Education, to section 5.2.8, Leadership.

Research Question 3: Does the technician’s perception of themselves in the organization influence their competencies? If so, how? The findings from the study suggest that all of the themes had a minor perception component to them. The component mostly emerged from the findings about how the technicians perceived themselves relative to how they believe they are seen in the system. This influenced the technicians’ competency development. Some themes had a more pronounced perception component, and these themes are 5.2.1, Education; 5.2.2, Interpersonal; and 5.2.5, Contextual factors. In conclusion, in answering research question 2, the findings suggest that the perception the technicians have of themselves influences on the technicians’ competency development. How they influence the technicians is broken down in each theme, from section 5.2.1, Education, to section 5.2.8, Leadership.

Summary The data suggests that when the technicians were unable to effectively deliver quality outputs, the technicians thought they were incompetent. Alternatively, they did not fully consider that the system they are in might be encumbering the necessary development of their competencies. The following sections, 5.2.1 to 5.2.8, will discuss the individual themes; this is in line with answering research question 1. Each theme will explore how relational dynamics affect the development of the technicians’ competency development; this is in line with answering research question 2. Lastly, in line with answering research question 3, the themes will also explore how the technician technicians perceived themselves relative to how they believe they are seen in the system.

5.2.1. Theme 1: Education

This included the technicians’ education, learning or training in relation to the Scientific Laboratory’s processes and systems. This also includes formal learning experiences. Further, it included the technicians and managers learning or acquiring new skills related to their job profile. This excluded any organizational or administrative procedures related to learning or training. A study relating to technicians in South African laboratories with differing accreditation has shown that there was interpersonal tension that was perceived between these groups in relation to the level of qualification (Mullah et al., 2020). This tension, which also

stems from other perceived factors like pay scale, is known to affect staff (Khadambi-Morokane et al., 2021; Mullah et al., 2020)retention.

This tension that emerges has many detrimental effects. These detrimental effects include having a preferred accreditation technician results in a preferred and subsequently favoured technician. The preferred technician may have more opportunities but equally more work assigned to them, which will most likely result in their burnout. Preferential treatment also diminishes team cohesiveness and their ability to relate to each other (Pillai & Williams, 2004). Further, this affects the unit's organisational culture. This could have emerged or birthed from a negative microculture within a department, with the hidden curriculum, which is the unspoken preferential treatment of accredited technicians (Hafferty & Martimianakis, 2018; C. Lawrence et al., 2018; H. Mulder et al., 2019). Either way, this results in strained relationships between managers and technicians.

These relationships between managers and technicians are important, as shown in various theoretical understandings. For instance, The CIMO showed the influence of a good relationship in the development of competencies, providing a greater appreciation and awareness of the interactions of variables (Mabin et al., 2006). This can be seen in a positive managerial dynamic resulting in the development of competencies. Self-efficacy goes further to show how technicians develop competencies to perform certain tasks (Bandura, 1997; G. Chen & Bliese, 2002). In particular, it is observed that the technicians' ability to relate with their managers in learning affects their belief in their ability to learn and complete a task. For example, the non-accredited technicians may feel they are not able to complete the same tasks as the accredited technicians. This is not only limited to the type of accreditation but also different educational factors that make the technicians believe they can not relate to technicians with different educational backgrounds (Waddington, 2023). The different educational backgrounds include the university the technician attended or the type of degree the technician was awarded.

In the vignette, the fictional technicians, Jordan and Simphiwe, have been described as having the same level of education that is needed to occupy the technician's role in the laboratory.

This is set to mimic processes in the Scientific Laboratory that are signed off to state that one is competent to perform a task. While completing a service in the fictional laboratory, Jordan (the fictional technician) makes the wrong interpretation of the result. Simphiwe (the other fictional technician) has faced the same situation and has made the correct interpretation. In the fictional story, I, as the researcher, describe a client who has a severe allergic reaction from the wrong compound being added and complains to the fictional laboratory. I then ask what the participants think may have gone wrong based on the vignette. I also let them know they are welcome to ask me questions about the vignette. All of the extracts, including other themes, are centred around the first question: What do the focus group participants think is the reason why Jordan got it wrong and Simphiwe got it right?

PID2: "I would say that they are trained by the manager. Because in your story when you're explaining that she updates all the protocols and stuff, is there ever a roster that shows that she explained it to Jordan and to Simphiwe both. Watched them actually perform the protocol and the test and everything to see if it's done the same way." ...

PID4: "I have one. So what degrees do the technicians have?"

PID5: "I have a question; how much experience do they have? How many years does Jordan and Simphiwe have?"

(Technicians' focus group)

The managers also asked the same question: what is their level of experience in completing certain tasks described? They were described as having the skills needed to complete the task. This was to mimic processes and training in the Scientific Laboratory. The process is that once the training prescribed by the manager is complete, the technician is signed off as being deemed competent to perform the task. In practice at the Scientific Laboratory, even after the technicians are signed off as competent, both the technicians and managers would still go on

to consider how much prior practical experience a technician has to measure if they can successfully complete the task, rather than just measuring their ability to complete the task via the formally set process of prescribed training. This consideration, of prior experience, is not formalised in deeming competency and is an unspoken ask which forms part of a hidden curriculum in the organizational culture.

In the extracts below, it is implied that being trained and signed off, informally, is not recognised as ensuring competency. This process is in place for compliance purposes, and does not completely test the signed off competencies. Literature has shown how difficult it is to set up and validate competency training (Desjardins & Fleming, 2014). Assessment and testing of competency were identified as a political weakness in the PESTLE analysis. PESTLE analysis is useful in giving a multidimensional perspective of an organization (Casañ et al., 2021). One of the reasons why it is a weakness is, it is very difficult to standardise tests and assessments. Further, the standards would require buy in and establishment of policies that must go through lengthy government processes (Chekijian et al., 2021; Moetsana-Poka et al., 2014; Undilashvili et al., 2019).

From the water cooler discussions, the technicians knew they were not feeling confident in their competency to complete the work assigned to them, and this concerned them. Despite the technicians knowing this, they did not voice this concern to their managers. They did not believe they had an interpersonal relationship with their managers, interlinking to the interpersonal theme, to voice this concern with their managers. The technicians also felt they should inherently pick up what they are trained for because they were hired based on set educational requirements. This means the technicians believe that they are expected to understand all that they are trained on as it is pitched at an academic and job experience level that they were hired on.

Further, from the water cooler discussions, they feared being deemed that they lacked the intellect to absorb the prescribed training if they noted they did not feel competent after the prescribed training. In addition to not having interpersonal relationships established, there is also no apparent formal process in place interlinking to the operational systems theme in place

to voice this concern of feeling inept. PID6 starts to make this connection in the extract below to say what other factors might be compounding this educational factor. Which is what the other seven themes are describing, they all flow out of the education theme. That is, the other themes explore other factors that facilitate or obstruct the learning described in the educational theme. It was then important to have the main characters in the vignette participating in the study. Their combined participation helps paint a fuller picture of how people might behave in real life. Their multi-voicedness demonstrates the move between various legitimate social and personal positions that become relevant at different points to make sense of the topic in question (O'Dell et al., 2012).

PID8: "I just also have a quick question now, so I know that Simphiwe and Jordan went to different universities, that they were on par, but do they have the same level of experience?" (Manager's focus group)

PID6: ... where the role is of Athandwa to be able to facilitate and train and guide people because ultimately the (back stops/) so that person, but the responsibility is being shifted to someone else to make that call so there should be a period of facilitation to make sure everyone is on the same page consistently, and I want to understand that process. The second thing is what is the psychology of the people here?"

PID8: "A competency test."

(Managers' focus group)

As the conversations in the focus group progressed, it began to show interlinking between the different themes. For example, there may be differences in the level of prior practical experience. That is, a technician may have learnt at an institution that did not cover certain skills in practical work but rather was covered in theory. It is a norm in the field that technicians may only have learnt certain skills in theory only, that is without practical lessons (Alsawidan et al., 2023; Shirvan, 2021). A technician who has practical prior experience may be preferred

when assigned tasks. The possibly resulting preferential treatment may create an environment that is not conducive to building the non-preferred technician's self-efficacy. Further, there may be interpersonal relationships at play that discouraged the technician with less prior practical experience from pursuing opportunities to gain some experiential learning. In addition, they may be discouraged to even persevere in gaining the initial competencies to start gaining experience from experiential learning. In addition, in summary, as they will be discussed in their own sections, there are other interlinked themes. Their themes are operational systems, communication, and hierarchy. They speak to the processes in place at the Scientific Laboratory that allow the technician to evaluate and communicate their need or barriers to gaining competency in a particular area.

For example, in the Scientific Laboratory, there may be two sets of technicians when it comes to having learnt DNA extraction. One set may have gone to a university that made practical applications, and the other set had just learnt the theory at the university they attended. The requirement for the role just requires just knowledge of DNA extraction. Their understanding of the process differs depending on their experience in completing that task. Both of them may have prescribed training when they started. The level of training was based on the hired technician only needing to have prior theoretical knowledge of DNA extraction. The one who did practical work may get preferential treatment as they are informally perceived to have a higher level of experience. This is despite the Scientific Laboratory stating the prescribed training has made them equally competent and equally viable options to be assigned to completing tasks.

In summary, the educational theme showed how different educational factors affected their ability to develop competencies. Although a general educational requirement was advertised in recruitment, once at the Scientific Laboratory, it was difficult to develop the competencies needed to complete tasks. The different barriers and opportunities to the technicians' improving on these competencies are what is explored in the rest of the themes.

5.2.2. Theme 2: Interpersonal

This included interpersonal relationships, which may be affected by personal context, personal culture, and environment. This also included anything within the Community of Practice. This was mainly in relation to an interpersonal relation between the technician and their manager. This excluded any organizational or administrative procedures related to interpersonal relationships. The organogram of the organisation, the rich picture and CIMO showed the structure, flow and influence of processes and information in the Scientific Laboratory (Conlon et al., 2020; Mabin et al., 2006; Obeta et al., 2019). In particular, with respect to the interpersonal theme, the development of competencies, even in the development of self-efficacy, happens in relation to the technicians' direct managers (Bandura, 1997; G. Chen & Bliese, 2002).

Literature shows how newcomers become experienced members and eventually experts within a community of practice (Lave, 1991). This is because there is scaffolding and guidance from the more knowledgeable person that takes place (Vygotsky, 1997). This extends to delving into the individuals in a group and the group's common and shared goals (to complete tasks in order to deliver services) and, lastly, to sharing and developing knowledge focused on the shared practice (E Wenger et al., 2004). Therefore, all of the initial sources of self-efficacy before the technician can source from enactive mastery are in relation to other employees who have learnt and can successfully carry out a task. The initial sources are through observing others, vicarious experiences, verbal encouragement, verbal persuasion, and physiological and affective states, which are influenced by self-belief. Literature has shown that verbal persuasion can influence physiological and affective states (Lamarche et al., 2014).

In the extract below the technicians are discussing how one of the fictional technicians could be doing better than the other. That is, Simphiwe was able to successfully run a service in the laboratory while Jordan was unable to. As in our theoretical understanding, in particular with developing self-efficacy, being able to relate to the more knowledgeable other who is training you plays a critical role in being able to efficiently learn and successfully complete tasks. If the relation only happens for a select few in the department, which is what is experienced by the technicians in the Scientific Laboratory in the water cooler talk, they then deem it as favouritism. This is also seen as PID6 describes having preferential interpersonal relationships as favouritism. Literature has shown the benefit of strong interpersonal relationships, in

particular in the establishment of a healthy organizational culture that facilitates learning (Huq et al., 2006).

From the water cooler talks, technicians also discussed not feeling welcome to discuss certain competency related matters with their managers at the Scientific Laboratory. They believe this inability to relate and communicate with the managers has affected the development of their competencies. This is in line with theoretical understanding. For example, A Community of Practice, a concept that facilitates the technicians developing competencies, is affected by interpersonal relationships. In addition, interlinking theories, the organizational culture that directs all of a Scientific Laboratory's beliefs, values, and attitudes, and how these influence the behaviour of its employees, influences and is influenced by interpersonal relationships. In the Community of Practice, this would include the importance of interpersonal relationships when the more knowledgeable other, the manager, pulls in the technician to the centre, which is then developing competencies (Lave, 1991; E Wenger et al., 2004). In organisational culture, it determines how those in the organization see themselves and the world, and it shapes how they think, behave, and, most importantly, in this theme, interact with each other (H. Mulder et al., 2019; Schein, 2010).

PID3: "favouritism. If there's more than one technician then maybe the manager has a better relationship with one than the other for various reasons. So, maybe Simphiwe had a bit more guidance when Jordan didn't. Also maybe the manager trusts Simphiwe more so Jordan would not take the initiative to go the further step to double check. Just in case."

PID4: "PID3 said also mentioned the relationship, so maybe Jordan is also too scared to approach Athandwa, and doesn't feel comfortable because they haven't had that relationship, as what Simphiwe and Athandwa has."

(Technicians' focus group)

In both the managers' and technicians' groups, they discussed the characteristics of Athandwa and Simphiwe's relationship when compared to Athandwa and Jordan. PID1 takes note of the similarity of contextual factors, interlinking to contextual theme, between them. The factors are their educational background and social interests. This relatability may also promote the manager's, Athandwa's, ability to empathise and relate more with Simphiwe, the technician. Empathy, along with trust, helps establish strong interpersonal relationships (P. Campbell & Evans, 2016; Wallo et al., 2021). Athandwa directly manages both of the technicians. Literature emphasizes the impact and importance of an employee's direct manager, especially when compared to other levels of management (Mbokasi et al., 2004). In the chosen extracts, the participants suggest reasons for Jordan's failure. The issues are related to how interpersonal relationships affect one's development of competencies. These issues include selective relationships based on external (outside of the company) shared interest between a manager and a technician. This results in, for instance, trust and guidance being selectively given.

Additionally, and generally, outside of any favouritism, the example issue also covers technicians then being too afraid to approach their manager to discuss competency development as they don't have an established interpersonal relationship with them. Literature has shown positive relationships between leaders who are trusted and an increase in three main factors. The factors are follower job satisfaction, job performance, and organizational commitment. (G. Chen & Bliese, 2002; Mitterer & Mitterer, 2023; Ribeiro et al., 2023; Walumbwa et al., 2004). These three factors and described leadership stance are known to predict self-efficacy and collective efficacy. The outputs of a boosted self or collective efficacy in the technicians results in competent employees producing quality outputs who also have an improved perception of unit-level productivity (Wong & Laschinger, 2013). This subsequently also results in a reduction in turnover (Mitterer & Mitterer, 2023; D.-S. Wang & Hsieh, 2013).

Lastly, PID6, a manager describes a manager having to back up what they say with action, in summary, establishing trust. The example given in the focus group is that if a manager says they will make time to interact with their technician, they should make the time. If the manager fails to make time for the technician, the manager has shot themselves in the foot. The term shot in the foot here means to inadvertently make a situation, the failed laboratory process by the technician, worse for the manager. This is because the manager would have lost a critical

opportunity to establish trust by honouring a promise and prioritising the technician. This indicates that the focus groups had an understanding of the importance of honouring interpersonal relationships in view of developing competencies. The managers and technicians emphasize the importance of forming and maintaining interpersonal relationships. In summary, the technicians need to be able to approach their direct managers in relation to developing competencies. There needs to be an interpersonal relationship in place that helps facilitate a meaningful link to their manager.

PID6: “.... Going back to making time for people, that’s only as good as your actions that follow that up so if you say to somebody ‘I’m going to make time for you’ and the first time they come to you and they say ‘do you have time for me’ and you say ‘not right now’, you’ve shot yourself in the foot. So you need to back that up with actions as well. And then you mentioned something...” ... Or is it a case of one feels they can’t approach that manager, or not?

PID1: “Or Athandwa and Simphiwe they might have closer relationship where Jordan feels left out. And because they’ve been same university, they go to same groups and all of that and Jordan always gets information from a different point. Theyre on the same par yes scientifically maybe but maybe Jordan didn’t feel comfortable going to Athandwa because they have the closer relationship, he made up his mind because he was confident that was the right decision.”

(Managers’ focus group)

5.2.3. Theme 3: Organizational climate/culture

This included how the organizational environment impacts on agenda and interpersonal interactions. Further, the organizational climate/culture's impact on competency development. This excluded an individual's self-efficacy and related culture. This included relation to positionality associated with power, which affects communication, relationships, and/or decision-making. This excluded any hierarchical structures and systems. This theme was in relation to all of a company's beliefs, values, and attitudes and how these influence the behavior of its employees in a particular behavior in developing competencies (Praveena A & Fonceca, 2023). Good organizational culture has a significant effect on the development of competencies and overall performance (Kim & Jung, 2022; Rantesalu et al., 2016).

The participants either discussed what could be done to improve the state of the organizational culture and how it influences employees' behavior in making decisions related to developing dependencies. The extracts below show the idea of belonging to a set of values and practices, and if employees cannot connect to these, they feel isolated. There then is an expectation of creating a culture that incorporates all employees, as suggested by PID 5, through an activity like team building. This is in line with literature which shows team building to have a significant positive effect on organisational culture and climate (M. L. Gupta & Pyngavil, 2012). This shapes into the norms in the organization, which then underpin how procedures, policies, and practices are developed (Schneider, 1986).

The underpinned are the practical, tangible outcomes that the employees interact with on a day-to-day basis, which are their norm. This, the norm formed, collectively is what is then experienced by the employees in the organization and ultimately becomes the values that they share which translates to behavior patterns. Any new employees are influenced by this norm, and ultimately, so is the sustainability of the organization (Assoratgoon & Kantabutra, 2023; Kotter, 81 C.E.). The formation of this norm is driven by leadership. Literature stresses the fact that leadership is seen as an important instrument in promoting and consolidating an adequate and strong organizational culture (Metz et al., 2020). That said, organizational culture itself plays a significant role in ensuring the effectiveness of leadership as an important factor in the continuous improvement of performance (Metz et al., 2020).

The participants also discussed the nature of the type of culture that is present in the fictional laboratory, and PID6 questions whether it is accepting or confrontational. Further to this, PID1 also raises an important point, they also discuss how employees perceive the existing organizational culture and how it might make them feel. This is because the organizational culture forms the values that lie beneath what the organization rewards, supports and expects (Baumgartner, 2009). If what the Scientific Laboratory rewards, supports and expects is not in line with effectively promoting different facets, like self-efficacy, that positively contribute to competency development, then there is a disconnect for the employees. This disconnect between what is said on paper and what is experienced in the organization results in lowered job satisfaction, job performance, and organizational commitment. (G. Chen & Bliese, 2002; Mitterer & Mitterer, 2023; Ribeiro et al., 2023; Walumbwa et al., 2004).

PID5: “Also I feel like as a manager you need a way to build that relationship. I think teambuilding is important. Make the team comfortable with one another. Open a platform of communication and those kind of things.”

PID2: “Instead of isolating someone. Which makes someone obviously cause more mistakes and things like that”

(Technicians’ focus group)

On paper, the Scientific Laboratory may have set organizational culture values, but this does not guarantee that they are translated into beliefs, values, and attitudes that influence the behavior of its employees (Praveena A & Fonceca, 2023). This is because there are three complicated levels to how organizational culture is perceived or experienced (Baumgartner, 2009; Schein, 1990). The first and at the surface is artifacts, the visible behavior, these are the visible and tangible structures and processes. It is hard to decipher the state of organizational culture at this level. In the Scientific Laboratory, this includes but is not limited to the day-to-day work and the accompanying standard operating procedures.

PID1: *“But the environment to the culture of the organization. What are they coming into, they might think ‘I’m stepping into this again, is this really what I want?’ or ‘I don’t enjoy my work environment’ or ‘the culture I don’t resonate with that.’ So, the environment.”*

PID6: *“So that culture, is that culture one of confrontation or not? Is it one of acceptance? Is it one of whatever. Over and above that we tend to mirror what we see in many many ways, what is the culture we have come from? That’s how I learnt behaviours in many many ways as well and can often have a major influence on how we end up behaving in new situations.”*

(Managers’ focus group)

The second is values, what is actively communicated, these are the strategies, goals, and philosophies. This also includes but is not limited to philosophies related to good service delivery and the resulting strategies and goals put in place to achieve any set goals. Third and last are basic assumptions, underlying core, and unconscious beliefs; this is the ultimate source of values and actions. The third level is the bottom and fundamental level that strongly influences the others. This means that something that is observed, in a behavior, in the artifacts, has a deeper level that it can be understood in the basic assumptions. The deeper level is not always easy to recognize and change and this is the level. This is the level that is formation of this norm is driven and influenced by leadership (Wallo et al., 2024). This will be discussed further in the leadership theme.

5.2.4. Theme 4: Hierarchy

This included relation to positionality associated with power, which affects communication, relationships, and/or decision-making. This excluded any hierarchical structures and systems. The focus is on the different decisions and directives that the employees make based on their respective hierarchical positions. Literature has showcased that there are some key competencies in effective management (Mbokasi et al., 2004). With respect to the line

managers, that is, the technicians' direct managers, there is leadership value attached to that specific hierarchical level. The key competencies in effective management at that hierarchical level are interpersonal competency and dynamic competency, to adapt in ever changing environments, like the Scientific laboratory that experiences every changing scope in projects. At this hierarchical level, it is indicated that there is value in being competent to lead others with enthusiasm and confidence (Mbokasi et al., 2004).

Hierarchy has power differentials that hold questions about how managers can be managed and held accountable. In particular, if the functions in their role may be barriers to technicians developing competencies. It is then important for subordinates to be able to review their direct managers. This would be a way to anonymously assess the managers' effectiveness without fear of repercussion. The outcomes allow the development of managerial behaviour; this has become one of the core practice areas applied in organizational sciences (Church, 2000). This can be done through the same process as the anonymous employee surveys that have already been conducted at the Scientific Laboratory. Literature has shown that direct reports of high performing managers are shown to experience a significantly more positive group climate in their day-to-day work environments when compared with those of lower performing managers (Church, 2000).

From the water cooler talks, technicians discussed not feeling welcome to discuss certain competency related matters with the managers that could affect the necessary change. The managers were their direct managers or other related managers in the Scientific Laboratory. Other related managers sit at senior management, which is the highest level. This is a level above the technicians' direct managers, and the levels can be seen in the organogram; please see Figure 8. This means, hierarchically, they have decision making power over the technicians' direct managers, so they can most likely facilitate the changes needed. Namely, these related managers are the human resources manager, who oversees general employee happiness, including competency development and the quality management systems manager, who oversees compliance, including training and competency development. Human resources management is an important function in an organisation. Literature shows that it is focused on and strongly influences the constructs of job commitment, job satisfaction, organizational effectiveness, and role fit between persons and organizations (Goswami, 2018). This is done

by effectively attracting, developing, motivating, and retaining talent in relation to the organization's strategy, operational goals and desired culture (Gold & Bratton, 2003).

That said, the technicians also understand that middle managers act at the interface between top managerial ranks and other hierarchical levels (Ou et al., 2017). Therefore, in directly interacting with senior management, the technicians would be circumventing the chain of command and, in the process, erode trust with their direct manager. From the rich picture, which showed the complex flow of processes, see Figure 6, it showed there was no direct connection between the technicians and senior managers. This is also in line with structures discussed in systems theory, five interconnected systems (Beer, 1981, 1985). These describe the middle managers, the technicians' direct managers as overseers of day-to-day decisions and senior management making strategic decisions.

In the extracts from the transcripts below, the technicians describe the hierarchical responsibilities and constraints that they perceive managers to have. With this pressure and constraints, they have rationalized that they do not want to be an inconvenience to their managers. Going back to the education theme, the competency development issues are also matters that they think they should not be experiencing. This issue further compounds and lowers the technicians' comfortability in approaching their manager. In the water cooler talks, the technicians described being afraid to discuss matters concerning developing competencies. The technicians noted they did not feel comfortable and welcome to go and discuss this with their direct managers or any of the managers. The technicians spoke about how they felt they were expected to just understand the training or directive given as they met the criteria stated in the job advertisement. Literature has shown that the broadness of entry level positions sees the presence of many transferable skills in job advertisements (Bennett, 2002).

These transferable skills enable people to participate in a flexible workforce (Suartha et al., 2017). This is ideal in an organization like the Scientific laboratory, that is, one that handles services for a diverse set of projects which need a flexible and adaptable workforce. In addition, recent graduates who are hired as technicians can give valuable input to current and new protocols and workflows. The recent graduates are new to the workplace and are looking to

prove themselves. They do so by applying and developing their skills. This makes them highly motivated to learn quickly, work hard and make an impact in the organisation in order to progress in their careers (Rodrigues et al., 2020). In the absence of this, that is, development opportunities, research reveals the consequence of high employee turnover, particularly among recent graduates (Sturges et al., 2002). Conversely, signalling that development opportunities will be delivered and reinforcing that signal with delivering opportunities creates employees with strong organizational commitment (Connelly et al., 2011).

Further, there is usually no shared understanding of the precise skill attributes that organizations are looking for (Bennett, 2002). Candidates will not know exactly what they are being asked to demonstrate by hiring organizations and educational institutions are still working to close this gap (Draissi et al., 2023; Suleman, 2018). In knowing what is expected of you, one can be effective. Higher levels of role clarity would be associated with higher role efficacy and performance effectiveness (Bandura, 1997; Bray & Brawley, 2002). It is then left to the hiring organization, like the Scientific laboratory, to develop the competencies that they would then require. This hierarchy falls in the sphere of the middle manager's responsibility, as they are the operational core (Rezvani, 2017). It is their duty to develop and implement strategies and processes for competency development (Wallo et al., 2021). In the absence of this, that is, development opportunities, research reveals the consequence of high employee turnover, particularly among recent graduates (Sturges et al., 2002). Conversely, signalling that development opportunities will be delivered and reinforcing that signal with delivering opportunities creates employees with strong organizational commitment (Connelly et al., 2011).

PID4: "I think sometimes with the higher you go up the more responsibility you get, so as a manager there's more responsibility, as a senior technician there's more responsibility, so as a tech you feel like you don't want to inconvenience because they're already overwhelmed with so much responsibility and so you just like..."

(Technicians' focus group)

On the other hand, in the managers' extract above, they discussed how, in a high-pressure environment, they use their hierarchical positioning to make strategic decisions. These day-to-day decisions are made at that level, and the instruction has to be carried out regardless of other considerations like resources or the state of the competencies needed to complete the service. This role's description is in line with the manner in which the role is also described in a viable system. That is middle management, the technicians' direct managers, and control operations. They do so by managing their resources and translating strategic goals that were set at higher management levels. Further, they do daily audits to inform strategic decisions for corrective action and give authoritative instructions. This helps in facilitating and negotiating synergy in the team, that is, the department (Elezi et al., 2014; Espinosa et al., 2023). The way in which these decisions are described and processes are made is what affects the development of competencies. The complexity of described processes, to developing competencies, can also be seen in the rich picture, see figure 6. The rich picture shows the technicians' direct manager, represented by me, at the centre of the image, with multiple processes and decisions flowing to and from them.

PID7: "I think it's also you cannot take and do something 'we can do this, but you don't actually have the resources for it. So, for example if you take on a job and you say, 'I can do this, we'll do this for you' but you don't actually have all the resources in place, but you expect the technicians to get on with it, it's a problem."

(Managers' focus group)

The way in which managers make decisions within their described role is what affects the development of competencies. The technicians are, at times, unhappy with the outcome of these decisions. In the technician's extract, when there is the possibility of an undesirable outcome, the technicians are uncomfortable approaching their managers to discuss how decisions made have or could possibly affect the development of their competencies. The technicians can also see the pressure their manager is under and do not want to burden them. Interlinking to another theme, interpersonal, can further be compounded by the poor state of interpersonal relationships. Having seen the load, the managers are carrying; the technicians also deter from initiating and trying to establish an interpersonal relationship. Another interlinking theme

becomes communication, in this case, the importance of the manager engaging technicians in making decisions. Literature has shown that leadership that obtains buy in from subordinate employees, like the technicians, at unit level, when making decisions is greatly important to developing competency for sustainable work outcomes (Wallin et al., 2006; Walumbwa et al., 2004).

5.2.5. Theme 5: Contextual factors

This included anything related to the internal self and personal factors, for example, gender. Also, additional factors surrounding the individuals, for example, public infrastructure. These were taken into account to see how they affect how the technician learns, develops competency, and carries out their job function. This also included the state of the internal self, which can be influenced, for example, by home life. The last inclusion was any ideas on intrapersonal. This excluded any organizational or administrative procedures related to individuals. Contextual factors are important to developing competencies. Literature shows that there is a relationship with contextual factors, like culture, in how it affects the development of competencies (Sueb et al., 2023) . In addition, the literature also shows how competencies and contextual issues can be predictors for individuals to successfully take on an endeavour (Teixeira & Davey, 2010).

In the extracts below, the technicians and managers were discussing contextual issues that may have caused the fictional technician to fail to complete the task in the laboratory. This failure is linked back to being unable to learn, develop competencies and ultimately carry out their tasks with efficiency (Engen, 2019). For example, PID3 noted receiving bad news that may preoccupy the technician's mind and distract them from what needs to be done during working hours. This is also true in literature, for example, studies have shown that gender, a contextual factor, is a significant predictor of digital competence. Gender is in favour of male teachers (Cai et al., 2017; Krumsvik et al., 2016). This also acts as a predictor for their future success when carrying out a task using the acquired competency. In the given example, males then demonstrated a higher proficiency in sourcing, creating, and sharing digital resources. Which means they will be more successful in completing their tasks. Further, studies have also shown

that contextual factors may help understand the technicians' competencies in relation to the different contexts in which they would need to be applied (Lucas et al., 2021).

This paragraph will be an example of how contextual factors can play a role in different contexts. For example, the Scientific Laboratory conducted a non-invasive prenatal screening service. The service screens a foetus for genetic abnormalities. It can also be used to determine foetal sex early in the pregnancy, as early as from 7 weeks gestation. The screening test is done by using the mother's blood, which has cell-free foetal DNA. Some patients who do the test may likely decide to abort if the screening outcome is that there is a high probability that the foetus has specific genetic abnormalities (Graf et al., 2023). Therefore, the screening can facilitate a decision to abort. Further, because foetal sex can be determined early, the screening can also be used to facilitate sex-selective abortion (Ravitsky et al., 2021). There are then conversations about the moral or cultural permissibility of the abortion that may not be universally shared (Graf et al., 2023; Ivry et al., 2023). Some of the technicians may have a moral standing against abortion, for example, emerging from cultural foundations. The technician may likely have a difficult time learning how to conduct the service that may facilitate abortion. Interlinking from other themes and theoretical underpinning, in summary, the technicians' ability to learn and develop competencies is also dependent on their interest and self-efficacy with the subject matter (Schweder & Raufelder, 2022). Understanding what contextual factors are at play would aid in creating a supportive, more effective and targeted competency development efforts (Lucas et al., 2021).

It is also important to empathise, build trustful relationships, and understand employees from different backgrounds (P. Campbell & Evans, 2016; Wallo et al., 2021). Literature has shown that positive relationships with leaders who are trusted see an increase in three main factors. The factors are follower job satisfaction, job performance, and organizational commitment. (G. Chen & Bliese, 2002; Mitterer & Mitterer, 2023; Ribeiro et al., 2023; Walumbwa et al., 2004). These three factors and described leadership stance are known to predict self-efficacy and collective efficacy. The outputs of a boosted self or collective efficacy in the technicians results in competent employees producing quality outputs, resulting in an improved perception of unit-level productivity (Wong & Laschinger, 2013). This subsequently also results in a reduction in

turnover (Mitterer & Mitterer, 2023; D.-S. Wang & Hsieh, 2013) as the employees' overall job satisfaction increases.

PID3: "Maybe Jordan received a call about bad finances or something relating to bad news and then he got distracted."

PID5: "Communications skills will save your uncertain or unsure someone. You have to be able to go to the manager or someone."

(Technicians' focus group)

PID7: "How do they get to work? Do they come on the N2?"

PID6: "It could also be politics, maybe the managing director sees Athandwa as a threat and is purposely not trying to set that person up for success, or maybe Athandwa sees Jordan as a threat, or whatever..."

(Managers' focus group)

Additionally, amongst other detrimental factors, work politics also affects job satisfaction and organizational commitment (Drory, 1993; Randall et al., 1999). Workplace politics, also known as organizational politics, is the process and behaviour that, in human interactions, involves power and authority (Cropanzano et al., 1997). It is a social-influenced process designed to achieve personal gain at the expense of others and the organization (Landells & Albrecht, 2017). Social influence involves intentional and unintentional efforts to change and adjust another person's beliefs, attitudes, or behaviour to meet the demands of the environment (Gass, 2015). Where the environment in question would be the Scientific Laboratory. Workplace politics is negative when the self-interest may be consistent with or at the expense of others (Vigoda, 2002). Both participant groups, managers and technicians, raised the idea of work politics and its relation to contextual factors.

Work politics is known to affect contextual issues. Findings from studies show possible reactions to work politics. For example, job distress or burnout may pose an additional load, resulting in somatic symptoms of strain and tension. These are suggested aggressors which can be carried from work into everyday life with family (Ferris et al., 2019; Vigoda, 2002). These are then brought back into the workplace, as described at the beginning of the section, as contextual issues that influence the development of competencies. That said, inversely, literature also shows that contextual factors play a role in workplace politics. For example, the contextual factor of culture. Different cultures affect how workplace politics manifests. Further to this, so much so that. New employees may likely need to adapt to potentially different political influence norms when they start working in a new cultural context (Ferris et al., 2019).

In summary, in line with theoretical understanding, the technicians and managers discussed how contextual factors are understood, perceived, and received in the organisation. The contextual factors are relative to each individual, for example a technician's cultural background or where the transport infrastructure where they stay and commute to work from. The participants discussed how the organisational culture would dictate how contextual issues are understood, perceived, and received. Further, they discussed that the shaping and forming of the organisational culture was done at a hierarchical, senior management level. Therefore, the participants noted that in order for contextual issues to be received in a manner that aids in the development of competencies, there would need to be specific leadership strategies in place to aid this.

5.2.6. Theme 6: Communication

This includes anything related to communication and how it affects how they learn, develop competency, and carry out their job function. In addition, perceptions related to how communication is carried out, including perceptions of communication. This excludes interpersonal communication. Communication, as discussed in self-efficacy and will be discussed in operational systems, is one of the key factors affecting self-efficacy (Conger &

Kanungo, 1988). To be effective in this requires people to make good decisions on what they are tasked to do. This means taking the appropriate actions to carry out the decisions that have been made. Poor communication is likely to hinder this (Siegall & Gardner, 2000). To then become a successful technician, there are key skills to master, one of which is effective communication, with a sound intellect and interest in science and technology (Shirvan, 2021). Communication at a macro level also involves effectively communicating and getting buy in on the organization's vision and strategy which strengthens group cohesion (Randolph, 1995; Wallo et al., 2024). This is in line with how these roles would work in a viable system. This would be both senior management, where they are concerned with strategic near future and long-term plans and the board, the highest level of management that gives the organization identity through vision, set of values and goals (Elezi et al., 2014; Espinosa et al., 2023).

In the extracts below, the technicians are giving real world examples of barriers to developing competencies. This example is important as it mimics communication in relation to developing competencies at the Scientific Laboratory. There are two main parties who are communicating in relation to developing competencies, these are the technicians and the managers, both middle and senior management. The first direction in which communication will be initiated, and flow is from the technicians to the managers. Findings in the other themes, for example, interpersonal and contextual themes, have shown why technicians may have been reluctant to communicate with their managers. For example, their reluctance might stem from not having leaders who can empathise, build trustful relationships and understand employees from different backgrounds (P. Campbell & Evans, 2016; Wallo et al., 2021).

The second direction is one in which communication is initiated and flows from the managers to the technicians. The technicians' discussion below was in line with an anonymous employee experience survey that the Scientific Laboratory's Human Resources department had sent out. At the management level, middle and senior, that I was a part of, we had discussed evaluating job satisfaction in response to the high employee turnover. The employee experience survey would then assist in understanding job satisfaction and be used in developing strategies to retain employees (Soni et al., 2017). The survey had some questions based on the employees' previous requests in relation to developing competencies. In addition, amongst other topics, they asked the employees about possible areas of improvement. The technicians here are

discussing that, months after the survey was completed, nothing about the survey was communicated and implemented by senior management.

In addition, part of building such strong interpersonal relationships includes communication of recognition and appreciation from management (Robbins, 2019). This is known to increase confidence, job satisfaction, employee retention levels, improved outcomes and organizational performance (Pfister et al., 2020; Sveinsdottir et al., 2016). In the extract below, in line with this, the technicians speak about wanting their managers to build their confidence. They believe this can be done by the managers simply recognizing the work that they are doing. Recognition is about giving positive feedback based on results or performance. In giving feedback, it is important to strategically execute the activity. This includes being specific and timely when communicating and providing recognition in public settings (Lind & Mishchenko, 2024). On the other hand, appreciation is not in light of their accomplishments but rather acknowledging a person's inherent value. Appreciation helps to facilitate the formation and maintenance of social bonds (Adler & Fagley, 2005). This affects the quality of professional life spaces, such as interpersonal relationships in the workplace (Garg & Mahipalan, 2023).

When the study was sent, there was no communication on what would explicitly happen after the survey was completed. Further, there was no feedback on the findings from the survey. Lastly, detailed findings are not always reported, but summary findings and strategies to tackle any areas of improvement are best communicated. Studies show that if surveys are conducted properly, they can actually increase employee mistrust (Huebner & Zacher, 2021). This mistrust could be in asking about the usefulness and true intention of the survey if it was not to enact the envisioned change (Thompson & Surface, 2009). In this instance, in the eyes of the employees, not conducting a survey properly included not getting any form of acknowledgement for their answers. The employees could end up feeling less valued by their employers, which is the opposite of what the survey intended. Further, from the extract below, the technicians felt like they kept on communicating, but no one was listening. This scenario can then become a source of mistrust. This also affects future participation in future surveys, particularly employee experience, which has a critical impact on the sustainable development of an organisation (Porkodi et al., 2024). Employees would then refuse to respond in future surveys. By then, they would also possess greater intentions to quit, less organizational

commitment, and less satisfaction toward supervisors and their own jobs (Rogelberg et al., 2000).

PID2: *“Build their confidence.”*

PID3: *“Just to recognize what they’re actually doing”*

PID4: *“nothing is been done to resolve why people feel that way. So it makes you feel like there’s no communication because nobody is listening. So you’re talking talking and nobody is listening to you.”*

(Technicians’ focus group)

PID1: *“If it’s an existing process and then the person doesn’t know what to do the to the next step, or they do it, but they need to be taken further but that process also doesn’t go further. I think it’s a communication.”*

(Managers’ focus group)

In the extract above, the managers are discussing what they would expect their technicians to communicate. They also acknowledge the importance of having an environment and relationships that helps facilitate communication. In line with this conversation, the managers also discussed the importance of then intentionally creating such an environment and relationships. For example, in building trust, the managers group discussed sticking to what you say. For example, if you say you will make time for the technician, then make time for them. Further, communication is also linked with the fact that contextual factors can affect how one communicates (Algren & Eichhorn, 2007). For example, some cultures have conversational styles that are sensitive to face to face interactions and, therefore, do not prefer them (Gut et al., 2017). This affects the quality of communication, making it important to have cultural awareness (Kienzle & Husar, 2007). Overly, it is important to foster open and considerate channels of communication that share relevant information. For example, one that

allows employees to open multiple channels to discuss development needs and co-design solutions. In such an environment, technicians can contribute to a multidisciplinary approach to service delivery, ultimately improving outcomes (Alsawidan et al., 2023).

5.2.7. Theme 7: Operational systems

These included operations related to resources, processes, and competencies that influence work/performance and learning. This excluded any communication about operational systems. Operational systems, with a focus on facilitating learning, are approved, directed and influenced at a managerial level (Beer, 1981; Wallo et al., 2021). Findings from the literature indicate that there is potential for organizational improvement by developing a learning and supportive professional environment. This is best achieved by involving employees in decision-making at the unit level on day-to-day matters (Wallin et al., 2006). This means that although the decision may be made at a managerial level, there is great benefit in co-developing the decision with the related subordinates. For example, these decisions can include allocating financial resources in the budget for competence development. Thereafter, in planning and scheduling, sufficient time and space should be provided for employees and managers to learn at work (Crans et al., 2021; Döös et al., 2015).

In the extracts below, both the technician and manager focus groups had several discussions about how certain operational processes in the vignette were set up. In section 5.2.9, in the summary, it shows that operational systems were the most discussed theme. The participant's conversations transcended to giving examples more from their own experiences, as per the design of the vignette, to draw from real life. The design was set to mimic the real world so that the participants can draw from their real world experiences (Hughes & Huby, 2002; Murphy et al., 2023). The participants may have discussed this theme more as the operational systems theme encompassed the technicians and managers everyday activities and considerations. The other themes may not have been as tangible and thus not as readily discussed. This does not take away from the significance or importance of the other themes.

PID2: “I was just thinking that they **just need to ensure that there’s standardized protocol** or something.”

(Technicians’ focus group)

PID8: “**Are people filling roles they are actually not meant to? Are they taking on extra work, should actually be completely different role?**”

(Managers’ focus group)

Middle managers play a key role in day-to-day decision-making, which can consist of recourse allocation and disturbance handling (Rezvani, 2017). These decisions are affected by a range of factors from interlinked themes in this section. For example, the educational theme, resource allocation and distribution handling can be skewed toward or away from technicians with a particular educational background. The same skew can occur when looking at the interpersonal theme toward or away from a technician with a particular socioeconomic background. The organisational culture, the organisations’ beliefs, values, and attitudes, plays a role in defining and directing how middle managers make decisions by influencing their behaviours (Wallo et al., 2024). Therefore, if the organisational culture has beliefs, values and attitudes that encourage impartiality and team cohesiveness, it improves trust and overly creates an environment that facilitates competency development. This includes creating an environment where learning is valued and prioritized. Further, it involves structuring and organising different elements in the organisation to promote learning in work practices (P. Campbell & Evans, 2016; Döös et al., 2015).

5.2.8. Theme 8: **Leadership**

This included what good leadership entails and/or should be or look like, for example, management strategies. This excluded anything related to hierarchical power. Progress in

societal and scientific spheres continues to highlight the importance of learning in organizations. Nurturing employee learning requires environments which prioritize learning-oriented leadership (Wallo et al., 2024; Yukl, 2009). With this, there has been substantial literature on how leaders facilitate learning in the workplace. The literature showcases and identifies ways in which leaders facilitate learning through their behaviours and actions.

Recent frameworks identify two elements of this learning-oriented leadership. The two elements are direct and indirect leadership. Direct leadership behaviour includes encouraging and motivating learning, for example, by showing empathy, creating trustful relationships, listening, and being available (Crans et al., 2021; Smeets et al., 2021; Wallo et al., 2021). These characteristics were also described in the other themes, for example, in the contextual theme. An example of the contextual theme is both in the technician and manager groups discussing the need to empathise, be in trustful relationships and understand employees from different socioeconomic backgrounds. They discussed that this needs to be done in order for the managers to effectively facilitate learning.

In the extract below, the technicians are discussing different ways in which learning is facilitated and accountability related to learning is governed. They describe leadership qualities that will help facilitate different learning related needs. In the same line of conversation in the manager's group, they discussed leadership qualities that would help facilitate learning. They contextualised it to the scientific field to discuss the notion that scientists do not necessarily make good leaders. To expand on the point, excelling in STEM, science, technology, engineering and, mathematics, related fields has traditionally been perceived as a sign of brilliance and intelligence (S. L. Kelly, 2023). Here, the purpose is not to discuss the validity of the notion but to point out that it is an existing perception. Therefore, it is believed that intelligence, as determined by success in the scientific field, can be transferred and applied to make one successful in leadership. Mastering a complex technical subject, like science, does not equate to then inherently gaining good leadership skills (Woteki, 2005). Leadership is a quality and skill that can be learned, and if continuously practiced, becomes a habit (Zenger & Folkman, 2014). The necessary leadership skills then need to be evaluated. Psychometric tests aid in understanding the potential of talent by giving insights into capabilities and aiding in developing effective talent management strategies (Wahdiniawati et al., 2024).

Literature has shown that positive relationships with leaders who are trusted sees an increase in three main factors. The factors are job satisfaction, job performance, and organizational commitment. (G. Chen & Bliese, 2002; Mitterer & Mitterer, 2023; Ribeiro et al., 2023; Walumbwa et al., 2004). These three factors and the described leadership stance are known to predict self-efficacy and collective efficacy in the employees. The outputs, from the boosted self or collective efficacy in the technicians, results in competent employees, who also have an improved perception of unit-level productivity, producing quality outputs (Wong & Laschinger, 2013). This subsequently also results in a reduction in turnover (Mitterer & Mitterer, 2023; D.-S. Wang & Hsieh, 2013).

PID4: "I can go to HR because they are trustworthy and I can disclose how I feel."

Facilitator: "And HR will actually be able to effectively handle the situation. So some of the words that you used were; unbiased, able to listen, and communicative. Any other words that you want to attribute to HR?"

PID2: "Approachable."

Facilitator: "Anything else that HR should have?"

PID3: "She needs to have confidentiality."

(Technicians' focus group)

PID8: "And most scientists don't make good managers because it's just two different ways of thinking."

(Managers' focus group)

On the other hand, indirect leadership behaviours include facilitating learning through building and influencing organisational culture, freeing up resources for learning, and encouraging knowledge dissemination (Wallo et al., 2024). This includes creating an environment where

learning is valued and prioritized. Further, it involves structuring and organising different elements in the organisation to promote learning in work practices (P. Campbell & Evans, 2016; Döös et al., 2015). For example, this can be seen when leaders budget financial resources towards competency development. Thereafter, in the leaders encouraging, planning and scheduling in the teams. This is to allow for sufficient time and space for employees and managers to learn at work (Crans et al., 2021; Döös et al., 2015).

5.2.9. Summary of themes: Technicians' and Managers' - Focus groups

Each of these themes was underpinned by the subject of Leadership. Leadership is a quality and skill that can be learned, and if continuously practiced, becomes a habit (Zenger & Folkman, 2014). It emerged that when the technicians did not produce the desired outputs, they believed it was because they were not competent to carry out the work. The technicians' direct managers also shared a similar sentiment. The technicians would have cited either their direct, middle managers' or senior managers' leadership as influences on each of the themes. The technicians' managers, in turn, also cited their direct managers, the senior managers, for having an influence on their leadership decisions. The technicians also had the understanding that the senior managers' directives can affect them directly and through their direct managers. Progress in societal and scientific spheres continues to highlight the importance of learning in organizations. Nurturing employee learning requires leaders who prioritize learning-oriented leadership (Wallo et al., 2024; Yukl, 2009).

For example, in the operational systems theme, technicians' work schedules influenced the resources, like time, available to assign to developing competencies. Leadership underpins how the schedule is created and managed. A learning-oriented environment is best achieved by involving employees in decision-making at the unit level on day-to-day matters (Wallin et al., 2006). Although decisions may be made at a managerial level, there is great benefit in co-developing the decision with the subordinates in a way that allows sufficient time and space

for employees and managers to learn at work (Crans et al., 2021; Döös et al., 2015). Interlinking to the hierarchy theme, the managers and technicians hierarchically fall in the sphere of middle management's responsibility, as they are the operational core (Rezvani, 2017). It is their duty to develop and implement strategies and processes for competency development (Wallo et al., 2021).

Keeping in line with the scheduling example, with respect to organisational culture, leadership also create and shapes it. The organisational culture is the company's beliefs, values, and attitudes, which influence the behavior of its employees in a particular behavior in developing competencies. This shapes into the norms in the organization, which then underpin how procedures, policies, and practices are developed (Schneider, 1986). Good organizational culture has a significant positive effect on the development of competencies and overall performance (Kim & Jung, 2022; Rantesalu et al., 2016). This, encouraging and facilitating learning, is enhanced by interpersonal relationships.

With respect to the interpersonal theme, the development of self-efficacy happens in relation to the technicians' direct managers (Bandura, 1997; G. Chen & Bliese, 2002). Literature shows how newcomers become experienced members and eventually experts within a community of practice (Lave, 1991). This is because there is scaffolding and guidance from the more knowledgeable person that takes place (Vygotsky, 1997). These interactions are strengthened by good interpersonal relationships. Literature has shown the benefit of strong interpersonal relationships, in particular in an established healthy organizational culture, which helps facilitate learning (Huq et al., 2006). Empathy, along with trust, helps establish strong interpersonal relationships (P. Campbell & Evans, 2016; Wallo et al., 2021).

The scheduling, in the operational systems' example, also needs to be co-created by the managers and technicians. This co-creation is facilitated through communication. To be effective in this it requires that employees make good decisions on what they are tasked to do. This means taking the appropriate actions to carry out the made decisions. Poor communication is likely to hinder this (Siegall & Gardner, 2000) , and miscommunication can foster mistrust (Thompson & Surface, 2009). Communication at a macro level also involves effectively

communicating and getting buy in on the organization's vision and strategy which strengthens group cohesion (Randolph, 1995; Wallo et al., 2024). This is in line with how these roles would work in a viable system that gives the organization an identity through vision, a set of values, and goals (Elezi et al., 2014; Espinosa et al., 2023).

Further, communication is also linked with the fact that contextual factors can affect how one communicates (Algren & Eichhorn, 2007). This affects the quality of communication, making it important to have cultural awareness (Kienzle & Husar, 2007). In addition to contextual factors, they also influence how technicians develop competencies (Sueb et al., 2023) . Literature also shows how competencies and contextual issues can be predictors for individuals to successfully take on an endeavour (Teixeira & Davey, 2010). It is also then important to empathise, build trustful relationships, and understand employees from different backgrounds (P. Campbell & Evans, 2016; Wallo et al., 2021).

Lastly, the educational theme, keeping in line with the scheduling example, the technician's educational background influenced how they were scheduled. The preferred technician may have more opportunities but equally more work assigned to them, which will most likely result in their burnout. Preferential treatment also diminishes team cohesiveness and their ability to relate to each other (Pillai & Williams, 2004). These decisions are again directed by the managers. The scheduling example helps to draw a line through all the themes to show the overall influence of leadership in creating and shaping an environment that encourages and facilitates the development of competencies. The boost in self in the technicians results in competent employees, who also have an improved perception of unit-level productivity and produce quality outputs (Wong & Laschinger, 2013).

The themes that emerged from the technicians' and managers' focus groups were combined (see Figure 17). Operational systems was the most discussed theme, most likely because it encompassed the technicians and managers everyday activities and considerations. The other themes may not have been as tangible and thus not as readily discussed. This does not take away from the significance of the other themes. In addition, the themes that emerged from the technicians' focus group were compared to the managers' focus group (see Figure 18). For

example, the contextual factors theme was more discussed with the managers than with the technicians. In reflection, I noticed that it was easier for the managers to critique and say what they thought were the shortfalls of the technician. Lastly and previously discussed, in chapter 4 (see Figure 14), each rater examined the themes. The different raters were used to triangulate the data by correlating how each rater grouped the themes.

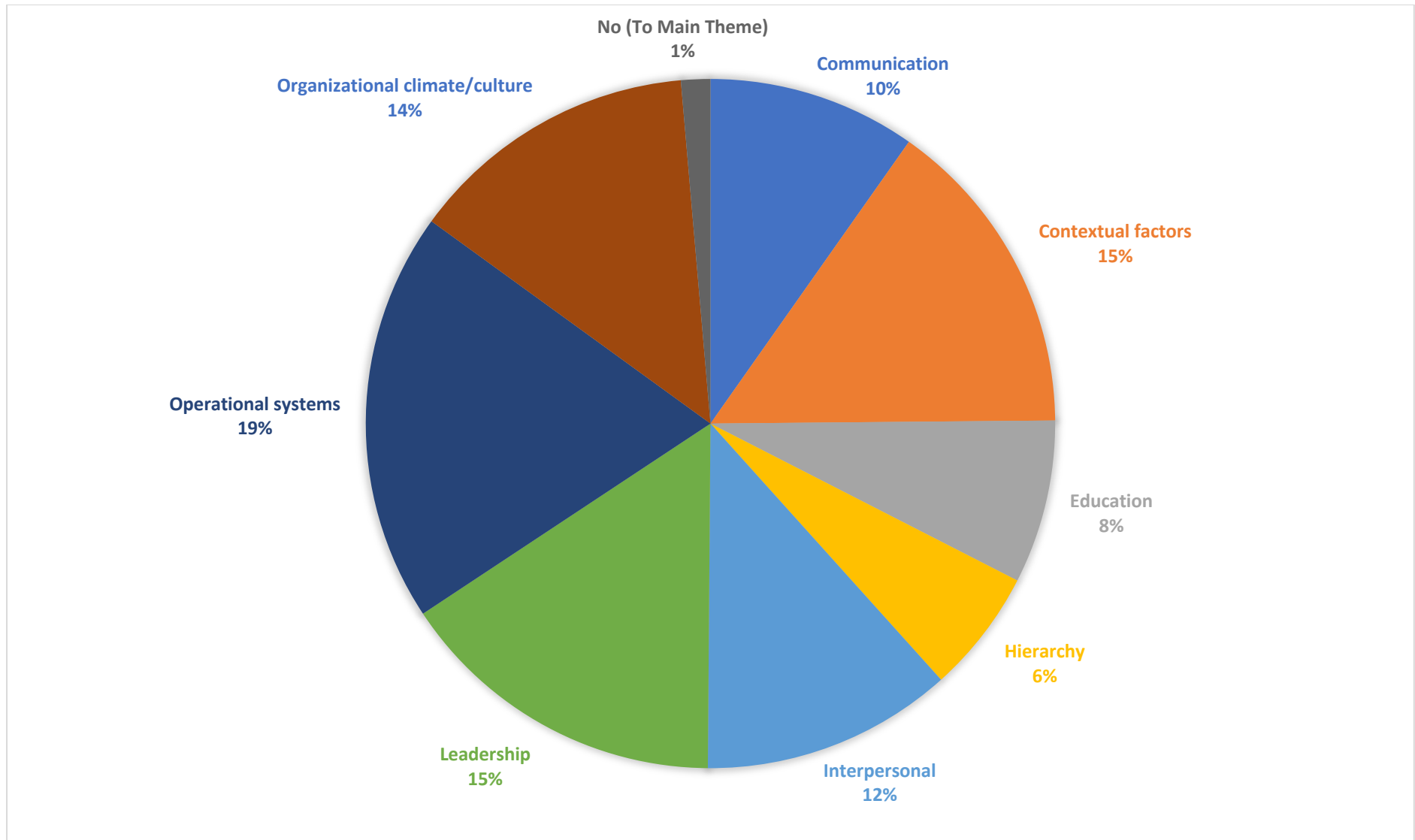


Figure 17. Theme counts turned into percentages combined from the technician's and manager's focus groups.

Supporting Themes	1		2		3		4		5		6		7		8		Coded as No (N)			(% Code Sheet Theme / All Codes on Sheet (Supporting themes))	Fraction Agreement for Primary Theme		
	Communication	Contextual factors	Education	Hierarchy	Interpersonal	Leadership	Operational systems	Organizational climate / culture	M	T	M	T	M	T	M	T						M	T
Theme on Excel Sheet	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M (%)	T (%)	MT/AT		
1 Communication	42	44	2	2	0	0	1	2	5	4	2	6	4	3	4	8	0	1	70.00	63.77	0.99		
2 Contextual factors	0	0	98	45	1	1	1	3	2	0	7	2	2	7	13	6	4	0	79.03	70.31	0.97		
3 Education	0	1	16	6	46	30	2	0	3	3	4	0	7	6	3	4	2	0	56.79	60.00	0.97		
4 Hierarchy	4	0	1	0	0	0	33	23	0	4	6	7	11	4	3	7	3	1	56.90	51.11	0.93		
5 Interpersonal	2	4	2	0	2	1	4	1	53	48	17	6	4	2	0	8	1	0	63.10	68.57	0.99		
6 Leadership	5	2	6	0	0	0	0	1	7	9	85	33	4	1	13	5	2	0	70.83	64.71	0.98		
7 Operational systems	11	2	4	0	10	4	1	0	6	1	7	4	125	54	12	4	1	0	71.02	78.26	0.99		
8 Organizational climate / culture	0	4	5	0	0	0	0	0	1	0	5	2	5	0	59	20	1	1	78.67	76.92	0.98		
Total	64	57	134	53	59	36	42	30	77	69	133	60	162	77	107	62	14	3					
Total (M Total + T Total)	121	187	95	72	146	193	239	169	17	Average											68.29	66.71	0.98
1239																							

Figure 18. This is a detailed tally of theme counts in the technician’s and managers’ focus groups. It also shows how each theme counts compared between the manager’s and technician’s focus groups. Lastly, this also shows the total number of main and supporting themes.

The concept Loop Diagram below (see Figure 19) was adapted from the CIMO in 2.3.2.6. The CIMO applied Systems theory to better understand the phenomena. CIMO is an acronym that stands for Context, Intervention, Mechanism, and Outcome diagram (McClelland et al., 2022). It helps us to connect the mechanisms at play in the system and form a causal map to show cause and effect, providing a greater appreciation and awareness of the interactions of variables (Mabin et al., 2006). The findings from the focus group, the eight themes, have assisted to place factors considering the positive and negative drivers. This has aided in connecting the mechanisms at play in the system and forming a causal map to show the effect. This provides a greater appreciation and awareness of the interactions of variables (Mabin et al., 2006). By making the influencing factors clear and showing their overall effect. For example, training an employee is not only for the individual, but there will be a clear responsibility for it to bring improvement to the system (Tate, 2010). The diagram shows that the system, the human system, which includes actors and stakeholders, in which the employees are based, can negatively influence the development of their competencies. A refined understanding of concepts describing the phenomenon is discussed in the paragraphs below. Each of the **boldened** sections represents a concept situated in the blue box in Figure 19. Each box shows the positive, green, and negative, red, influences and resulting effects.

System in which the technicians are based: The eight themes from the focus group were found to influence the environment and the human system, including actors and stakeholders. For example, actors are the managers and technicians, and stakeholders are funding agencies and clients. Each of these themes was underpinned by the subject of Leadership. The themes broadly span the environment, management, and relational interactions in the Scientific Laboratory. It emerged from the watercooler talk that when the technicians did not produce desired outputs, they believed it was because they were not competent to carry out the work. Their direct managers also shared a similar sentiment during watercooler conversations.

In addition, in the focus groups, the technicians cited either their direct, middle managers' or senior managers' leadership as influences on each of the themes. The managers, in turn, also cited their direct managers, the senior managers, and their direct managers for having an influence on their leadership decisions. The technicians also had the understanding that the senior managers' directives can affect them directly and through their direct managers.

Decisions and directives in each of these themes are made at a managerial level. There is great benefit in co-developing decisions with subordinates in a way that allows sufficient time and space for employees and managers to learn at work (Crans et al., 2021; Döös et al., 2015). The technicians' direct managers hierarchically fall in the sphere of the middle manager's responsibility; they are the operational core of an organization (Rezvani, 2017). It is their duty to develop and implement strategies and processes for competency development (Wallo et al., 2021).

Employee competency: If the system in which the technicians exist is not optimal, that is, as described in the themes analysis section in 5.2., then this negatively affects the technicians' ability to develop competencies. The hiring pool also adds a limitation. Essentially, there is a shortage of technicians and, in addition, a buffer between being qualified and being readily competent to work. This was illuminated by a great need for technicians during the COVID 19 pandemic (Nachega et al., 2021; Umviligihozo et al., 2020). There are not many technicians in the hiring pool for various reasons, such as the fact that there are more lucrative positions in developed countries (Mullah et al., 2020). Lucrative here describes the opportunity as beneficial in factors such as monetary compensation and career progression (S. Beck & Doig, 2005; J. Connell et al., 2007).

Further, there is still a gap between what is learnt in academic institutes and what is needed in practice. There is no shared understanding of the precise skill attributes that organizations are looking for (Bennett, 2002). Candidates will not know exactly what they are being asked to demonstrate by hiring organizations and educational institutions are still working to close this gap (Draissi et al., 2023; Suleman, 2018). In knowing what is expected of you, one can be effective. Higher levels of role clarity would be associated with higher role efficacy and performance effectiveness (Bandura, 1997; Bray & Brawley, 2002). It is then left to the hiring organization, like the Scientific laboratory, to develop the competencies that they would then require. In the absence of this, that is, development opportunities; research reveals the consequence of high employee turnover, particularly among recent graduates (Sturges et al., 2002). Conversely, signaling that development opportunities will be delivered and reinforcing that signal with delivering opportunities creates employees with strong organizational commitment (Connelly et al., 2011). This then requires a system that readily facilitates and

encourages the development of competencies. Additionally, limitations in the hiring pool and progress in societal and scientific spheres have seen the need for environments which prioritize learning-oriented leadership (Wallo et al., 2024; Yukl, 2009).

Positive outcome of work conducted: If the system in which the technicians exist is optimal, that is, as described in the themes analysis section in 5.2., then this positively affects the technicians' ability to develop competencies. The developed competencies, in turn, result in positive outputs for the work that is conducted. For example, the boost in self-efficacy in the technicians results in competent employees, who also have an improved perception of unit-level productivity, producing quality outputs (Wong & Laschinger, 2013). Quality outputs are core to building a favourable reputation and increasing the client base. In building a strong client base, customer attitudes and perceptions are key. These factors are known to attract funding from funding bodies due to a strong reputation. In addition, they generate income by then converting potential customers.

Overall, customers in this field would need to have competitive pricing and trust in the product to use it (S.-W. Chen et al., 2021; Liao et al., 2023). Trust is achieved by repeatedly having quality outputs, while competitive pricing is achieved by having quality outputs and increasing sample numbers. An increase in funding and business opportunities sees a natural increase in sample numbers. Larger sample numbers allow for price negotiations, this is common in laboratory settings. Further, competent employees who are able to create standard quality processes can help attract samples or collaboration from other laboratories. This further assists in building sample numbers to negotiate with vendors (Peter et al., 2009). An increase in sample numbers also lowers production costs. The price per laboratory machine run is decreased when the maximum possible samples are run (Gaio et al., 2022; Tvedte et al., 2021). These progressions sharpen the Scientific Laboratory's competitive edge by lowering price points for outputs.

High employee turnover, along with competency, were key features of the phenomenon. A high employee turnover in the Scientific Laboratory which saw exciting employees citing that they felt incompetent to complete their assigned roles' functions. An environment that fosters

learning will have employees with job satisfaction, job performance, and organizational commitment. (G. Chen & Bliese, 2002; Mitterer & Mitterer, 2023; Ribeiro et al., 2023; Walumbwa et al., 2004). In relation to the themes described in improving competency development, these factors are known to lower employee turnover (Moon et al., 2022; Waldman et al., 2010).

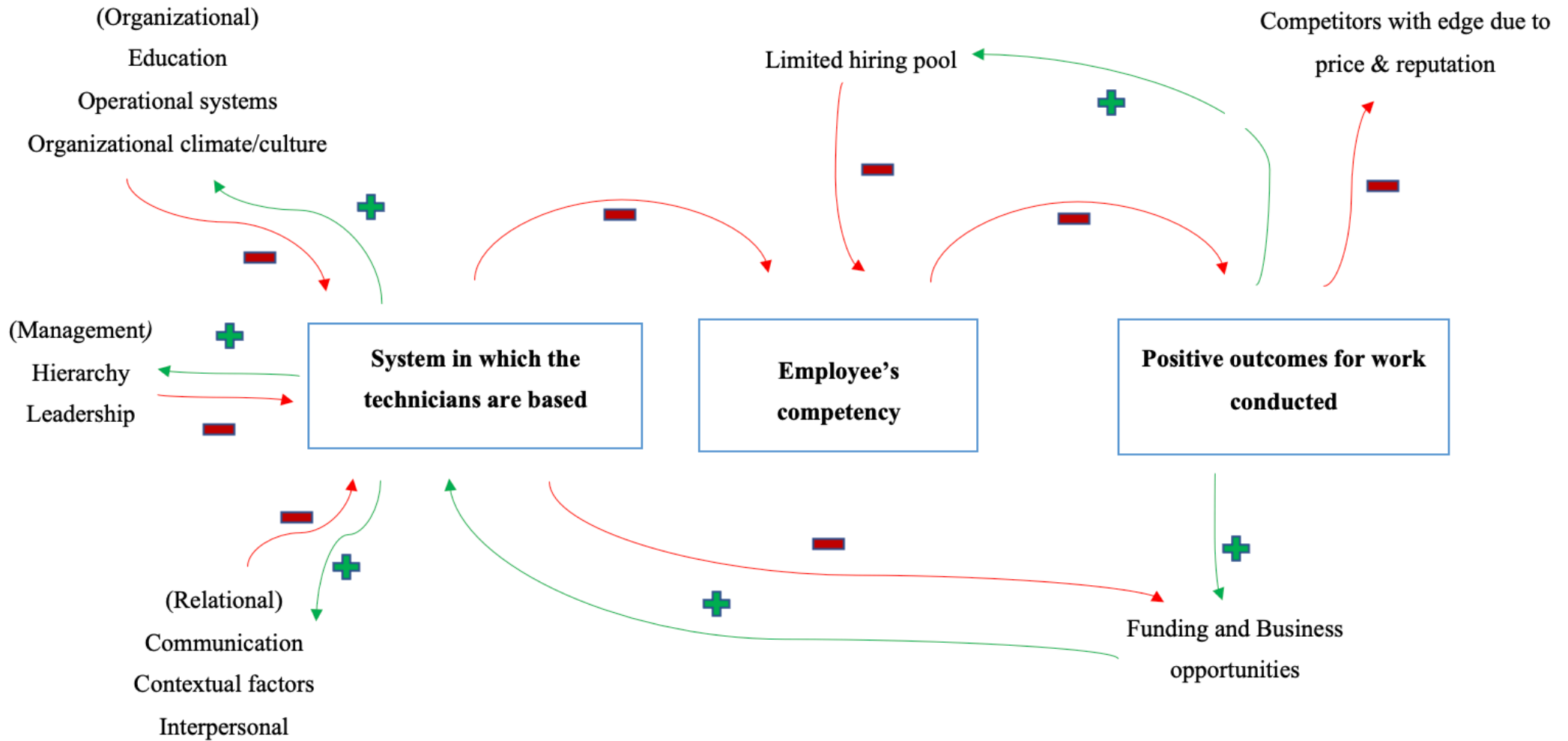


Figure 19. Concept Loop Diagram showing the connected nodes and feedback loops related to the observed phenomena, which was refined based on findings from the study.

5.2.10. Summary of themes: Technicians' and Managers' - Survey

The survey was done to triangulate findings from the thematic analysis of the technicians' and managers' focus groups. The focus group findings in a survey were returned to participants to check for accuracy and resonance with their experiences (Birt et al., 2016). The surveys were done in order to increase the validity, in particular, of the key base findings, that is from the focus groups (Bowen, 2009). The survey questions were based on the findings from focus groups, where the focus groups were based on a theoretical understanding of the phenomenon.

A median score was used to measure central tendencies. This is a statistical measure that is used to identify a single, central, point in the data. This singular point acts as a representative of the entire distribution, that is a representative of all the responses given for a particular question (Manikandan, 2011; McCluskey & Lalkhen, 2007). Each of the survey questions had five possible responses. The responses were placed on the survey's Likert scale and were given a value of either one (strongly disagree), two (disagree), three (neither agree nor disagree), four (agree) or five (strongly agree). What was expected to get consensus was median values on the far ends of the Likert scale. That is, either negating (one, "strongly disagree") or affirming (five, "strongly agree") what the question probed. The expected one or five median values would show that there was consensus in what I, the researcher, deemed the participants to be saying in the focus group findings and what the participants confirmed through the survey that they were saying. The median value for each question was weighted to say how much consensus it had. A value of five was given if the median value was equal to the expected value. This meant that if we expected the participants to strongly disagree, one on the Likert scale, on a question, and the median value for all participants was one, it would be weighted as five.

Practically, this meant there were two types of questions to gain consensus. The first, there is a finding which was used to create a question. I **expect** the participants to "strongly **disagree**" with the question. It then follows that to have a consensus, it should be scored as **one** (strongly

disagree) on the Likert scale. The second, there is a finding which was also used to create a question. I expect the participants to “strongly agree” with the question. It then follows that to have consensus, it should be scored as five (strongly agree) on the Likert scale. The calculated median score, based on participants responses, is compared to the expected (one or five) score, See table 7. If the calculated score is the same as the expected score, then there is consensus and is weighted a maximum of five. Any deviations are subtracted from the five. The weighted scores are as follows: one (strongly disagree, no consensus), two (disagree, no consensus), three (neither agree nor disagree), four (agree, consensus), and five (strongly agree, consensus).

The survey questions were intended to substantiate propositions for competency development. Propositions, in this study, are statements that express a judgement or gives an opinion as truth to base possible action (M. McGrath & Frank, 2005). Based on the grouped, by theme, survey questions, there were propositions, judgements, and opinions, made about competency related activities. The propositions are in line with establishing an environment that encourages and facilitates the development of competencies at the Scientific laboratory. The questions were based on the thematic findings from the focus groups. Table 7 below highlights the theme, details the survey questions asked, gives the median scores based on participants’ responses, and, lastly, details the propositions made. The next section will summarise the findings detailed in table 7. The section is divided up into themes, related questions, and propositions.

Education

The questions posed were in line with the technicians’ level of education and how it impacted the development of their competencies and, ultimately, the quality of outputs. The five questions sought to confirm the following findings from the focus groups. The first, the induction training given to technicians when they join the organization is sufficient for them to work effectively. There is a need for induction training as there is usually no shared understanding of the precise skill attributes that organizations are looking for (Bennett, 2002). Candidates will not know exactly what they are being asked to demonstrate, and educational institutions are still working to close this gap (Draissi et al., 2023; Suleman, 2018). In knowing what is expected of you, one can be effective. Higher levels of role clarity are associated with

higher role efficacy and performance effectiveness (Bandura, 1997; Bray & Brawley, 2002). It is then left to the hiring organization, like the Scientific Laboratory, to develop these skills.

Second, the training that technicians receive on new technologies or protocols is sufficient for them to work effectively. Training becomes even more critical in an era where there are ever evolving advancements in science. Technology in science is continually growing and evolving rapidly, and we are said to be in an era characterized by rapid change and innovation, which has transformed industries and created sustainable businesses (Hallema, 2023). Third, when you are experienced in carrying out a procedure, you are more likely to create shortcuts. Too high self-efficacy can lead the technician to believe the process is easier than it actually is, that is, a show of having overconfidence. This often results in poor effort in the execution of processes (Bachrach et al., 2023; Wyatt, 2018). Fourth, there is sufficient continuous development that helps me fulfil my roles and responsibilities. The availability of development opportunities is directed and influenced by managers. Nurturing employee learning requires environments which prioritize learning-oriented leadership (Wallo et al., 2024; Yukl, 2009). Fifth and last, technicians with certain qualifications, memberships or registrations, e.g. HPCSA, have inadvertent advantages in the company. A study relating to technicians in South African laboratories with differing accreditations has shown that interpersonal tension was perceived between these groups in relation to this level of qualification (Mullah et al., 2020).

The median score was 3.5 out of an expected 5. This score is between neither agree or disagree and agree, that there is consensus. That is, in how I, as the researcher, has interpreted the participants' contributions versus what the participants deem they shared, there is no firm consensus. This is the only theme with no firm consensus, the other themes have a 4, 4.5 and 5 which range between agree and strongly agree. In the theme summary for education, section 5.2.1, I discuss how the phenomenon was centred around the technicians feeling incompetent and how that affected the quality of their outputs. Alternatively, they did not fully consider that the system they are in might be encumbering the necessary development of their competencies. The output, from addressing alternative cumbrances in the system, is a boosted self or collective efficacy in the technicians. This results in competent employees producing quality outputs who also have an improved perception of unit-level productivity (Wong & Laschinger, 2013).

The participant's contributions suggest that they are in line with the premise of the study. That is, it was hypothesized that the technicians were not inherently incompetent, but rather, there were factors influencing the development of their now needed competencies. Further, I summarised that the other themes delve more into aspects of how the educational aspect and development of competencies may be influenced. As this is the phenomenon in question, it is plausible that the participants did not fully make this connection of how educational aspects affect their ability to develop competencies. In accordance with the proposition of the 3.5 consensus, the other themes are in line and support the findings in the education theme. This is seen in the connections and interlinking of themes that are discussed in each theme summary, sections 5.2.1 to 5.2.8.

The propositions put forward were that technicians do not feel trained enough to fulfil their role. It was then important that, when hired, training should include detailed initial induction training and training on subsequent technologies and protocols. Further, it may then be best to standardise the role expectations for the technicians. In standardising, the technicians would know what is expected of them and be more effective. In addition, after understanding what is needed and expected from them, it was noted there are limited continuous development efforts to meet competencies for the expected functions. Consequently, employees then feel more empowered as there are clear expectations, they are well trained, and they will subsequently be more competent to work more effectively.

Interpersonal

The questions posed were in line with the interpersonal relationship between the technicians and their direct manager. The development of competencies, including in the development of self-efficacy, happens in relation to the technicians' direct managers (Bandura, 1997; G. Chen & Bliese, 2002). The dynamics of the relationship impacts the development of their competencies and, ultimately, the quality of outputs. To a lesser extent, the study inevitably explored the interpersonal relationship between middle and senior management. The six questions sought to confirm the following findings from the focus groups. First, that

interpersonal and communication skills are essential and critical skills needed to be an effective manager. Literature has shown that there is a benefit to strong interpersonal relationships in particular, in an established healthy organizational culture, as they will aid in facilitating learning (Huq et al., 2006).

Second, I, that is the participant, am comfortable communicating how my personal circumstances may be affecting my work to my direct manager. Self-efficacy shows how technicians develop competencies in order to perform specific tasks (Bandura, 1997; G. Chen & Bliese, 2002). In particular, it is observed in how the technicians' ability to relate with their managers in learning affects their belief in their ability to learn and complete a task. Third, establishing a personal relationship with members of the platform should be part of a manager's function. The shaping and formation of a culture of relational interactions driven and influenced by leadership (Wallo et al., 2024). Fourth, personally knowing someone positively affects the work being conducted. Building on questions four and five, when your manager trusts you, it positively affects the work you are doing. Empathy, along with trust, helps establish strong interpersonal relationships (P. Campbell & Evans, 2016; Wallo et al., 2021). Sixth and last, my manager actively works to build my confidence. Building strong interpersonal relationships includes communication of recognition and appreciation from management (Robbins, 2019). This is known to increase confidence, job satisfaction, employee retention levels, improved outcomes and organizational performance (Pfister et al., 2020; Sveinsdottir et al., 2016). Improved outcomes include improvement in developing competencies.

The median score was 4 out of an expected 5. This score denotes agreement and consensus in what was interpreted by the researcher when compared to what the participants deem they shared. The propositions put forward were that, it is important to develop trust and interpersonal relations in the teams. Further, it is important to have work appropriate connections. That is, ones is which leaders are aware of how and why an employees' personal life may affect their work life. Lastly, the participants seemed to be neutral about whether it was difficult or not to communicate. That said, the participants also have non-neutral comments on the effects of ineffective communication. This scoring suggests that although the participants communicated their needs, there was no resolution put in place. With having no

resolution, in time, the participants felt that there was no use to, among many things, further, raise concerns or foster communicative relations.

Organizational climate/culture

The questions posed were in line with the state of the organisational culture in the Scientific Laboratory. The seven questions sought to confirm the following findings from the focus groups. First, that the organisational at the Scientific Laboratory, culture affects the management style. Organisational culture refers to the attitudes and behaviours of a company which drive and are driven by leadership. Good organizational culture has a significant effect on the development of competencies and overall performance (Kim & Jung, 2022; Rantesalu et al., 2016). Second, the participants feel that they are a part of and contribute towards the goals set by Senior management. Senior management's ability to effectively communicate and get buy in on the organization's vision and strategy from the employees strengthens the Scientific laboratory's group cohesion (Randolph, 1995; Wallo et al., 2024). This cohesion downstream affects a number of aspects, like the effective development of competencies.

Third, there is favouritism in the office. Establishing if this exists and, in turn, questioning the impact of it. This leads to question four: favouritism negatively affects the work being conducted. Preferentially, treatment and favouritism diminish team cohesiveness and their ability to relate to each other (Pillai & Williams, 2004). Further, this affects the unit's organisational culture. This could have emerged or birthed from a negative microculture within a department, with the hidden curriculum unspoken preferential treatment, for example, of HPCSA accredited technicians (Hafferty & Martimianakis, 2018; C. Lawrence et al., 2018; H. Mulder et al., 2019). This results in strained relationships between managers and technicians. Fifth, I, that is the participant, feel that I can freely give my opinion on how to improve any processes in my platform. This feeds into the inverse question. Six, I, that is the participant, do not feel free to give my opinion on how to improve any processes in my platform. Both questions are asking the same thing and are asked inversely to triangulate data (Forero et al., 2018). Seventh and last, when I communicate my needs, they are effectively and fairly resolved by management. Contextually, these needs referred to in questions five, six and seven were

communicated in the Scientific Laboratory's employee survey. Studies show that if surveys are conducted properly, they can actually increase employee mistrust (Huebner & Zacher, 2021). This mistrust could be in asking about the usefulness and true intention of the survey if it was not to enact change on what the employees raised (Thompson & Surface, 2009).

The median score was 4.5 out of a possible 5. This score denotes strong agreement and consensus in what was interpreted by the researcher when compared to what the participants deem they shared. The propositions put forward were that the company culture is important to how managers develop their management style. In addition, it is important to have a company culture where people feel heard and are free of impartiality and favouritism. Further, employees want to be part of the goals and vision set by management. Favouritism in the office negatively affects the work being done. Although employees may feel free to give their opinions, they feel their opinions are not effectively and fairly resolved by management.

Hierarchy

The questions posed were mainly in line with the hierarchy between the technicians and their direct managers. They explore how the dynamics of the ranking impacts the development of their competencies and, ultimately, the quality of outputs, to a lesser extent, between the technicians' direct managers and senior management. The three questions sought to confirm the following findings from the focus groups. First, technicians should do a performance assessment of their managers. Second, the HR Manager should act independently of the Managing Director and Managers when getting companywide feedback. Third and last, I, that is, the participant, being freely able to communicate my needs to management.

Hierarchy has power differentials that hold questions of how managers can be managed and held accountable. In particular, one of the functions of their role is to facilitate the technicians' developing competencies. It is then important for subordinates to be able to review their direct manager's efforts and effectiveness. This would be a way to anonymously assess the managers' effectiveness freely without fear of repercussion. The outcomes allow the development of

managerial behaviour, this has become one of the core practice areas applied in organizational sciences (Church, 2000). This can be done through the same process as the anonymous employee surveys that was already conducted at the Scientific Laboratory. Literature has shown that direct reports of high performing managers are shown to experience a significantly more positive group climate in their day-to-day work environments when compared with those of lower performing managers (Church, 2000). This positive environment is one in which learning to develop competencies is fostered.

The median score was 5 out of an expected 5. This score denotes strong agreement and consensus in what was interpreted by the researcher when compared to what the participants deem they shared. The propositions put forward were that there needs to be a change in the way that management is hierarchically perceived and reviewed. There are two main perceptions of how decisions made at their ranking level may be ineffective. Firstly, change how management is perceived and experienced for example, being viewed as not approachable. In addition, then be routinely able to obtain reviews from subordinates on their manager's effectiveness. Secondly, change that management is seen and experienced as being impartial or practising favouritism.

Contextual factors

The questions posed were in line with contextual factors related to the participants. They explore how the dynamics of outside effects impacts the development of their competencies and, ultimately, the quality of outputs. The eight questions sought to confirm the following findings from the focus groups. First, from a given short example, Alexis is a fictional technician. Alexis misunderstood a protocol and made a critical mistake while processing samples. In troubleshooting, Alexis should first check the protocol before checking where they went wrong. There may be multiple possibilities as to why the protocol was misunderstood and therefore not followed, for example, contextual factors. Second, personal circumstances can affect how I, that is, the participant, conduct my work. Literature shows that there is a relationship with contextual factors, like culture, in how it affects the development of competencies (Sueb et al., 2023) . In addition, the literature also shows how competencies and

contextual issues can be predictors for individuals to successfully take on an endeavour (Teixeira & Davey, 2010).

Third, I, that is the participant, know what I practically want the company to put in place in order for me to feel acknowledged and appreciated. Literature shows that employees could end up feeling less valued by their employers if they do not get acknowledgement for their requests (Huebner & Zacher, 2021; Thompson & Surface, 2009). That is, they make requests as they already know what they want. In addition, part of building such strong interpersonal relationships includes communication of recognition and appreciation from management (Robbins, 2019). This is known to increase confidence, job satisfaction, employee retention levels, improved outcomes and organizational performance (Pfister et al., 2020; Sveinsdottir et al., 2016). Fourth, my, that is the participant, personal background affects my interpersonal relationships in the workplace. Literature shows that there is a relationship with contextual factors, like culture, in how it affects the development of competencies (Sueb et al., 2023) . In addition, literature also shows how competencies and contextual issues can be a predictor for individuals to successfully take on an endeavour (Teixeira & Davey, 2010).

Fifth, work politics affects the work that I, that is the participant, do. Politics here refers to processes and behaviour in human interactions that involve power and authority. Work politics is known to affect contextual issues. Findings from studies show possible reactions to work politics. For example, these reactions could be job distress or burnout. These may pose as an additional load, resulting in somatic symptoms of strain and tension. The somatic symptoms are aggressors which can be carried from work into everyday life with family (Ferris et al., 2019; Vigoda, 2002). These are then brought back into the workplace, as described at the beginning of the section, as contextual issues that influence the development of competencies. That said, inversely, literature also shows that contextual factors also play a role in workplace politics. For example, the contextual factor of culture. Different cultures affect how workplace politics manifests. Further to this, so much so that new employees may likely need to adapt to potentially different political influence norms when they start working in a new cultural context (Ferris et al., 2019).

Sixth, when your manager regularly checks in on your personal well-being, it positively affects the work you are doing. Additionally, the seventh, others in my platform intuitively/instinctively know when to give help when it is needed. Eighth and last, one should take initiative when there is no one else to assist. The last three questions are associated with team cohesiveness, that is, the team working well together. Tension and lack of cohesion can strain relationships, therefore creating an unsupportive team environment that prevents the development of competencies (Melesse et al., 2024; Semo et al., 2014). The social values and beliefs here are, for example, values related to culture, religion, norms and ethics of the organization, environment, and customers. These factors influence cohesion between teams and individuals, as well as the environment in which they work. This environment and relationships overly affect the technician's ability to operate and access development opportunities in the workplace. Their inability to perform optimally directly affects their ability to produce quality outputs (Dingel & Maffett, 2023; Parashakti et al., 2020).

The median score was 4 out of an expected 5. This score denotes agreement and consensus in what was interpreted by the researcher when compared to what the participants deem they shared. The propositions put forward were that cohesiveness in a team is important for the team to work well. If cohesiveness is not there, there is uncertainty about working well together. Work politics, seemingly created due to a lack of transparency and openness, creates a strained environment. Such a strained environment results in a lack of open and honest communication. Employees are aware of and can communicate what they want/expect from their employer. How this communication is received and acted upon is the main issue. Regardless of personal background, employees can do their work effectively, but they also have personal issues or circumstances that can impact how they conduct work. Employees are more effective when management is aware of personal aspects that may affect their lives.

Communication

The questions posed were in line with subordinate and manager communication. This could have been the technician and their direct manager, line managers or senior management. To a lesser extent, the questions also covered the line managers and their direct managers in senior

management. The five questions sought to confirm the following findings from the focus groups. First, a manager should consult with their team when planning and executing projects. The managers in the Scientific Laboratory are located in positions to action change as they are directly vital in planning structural adjustments that can guarantee the survival of the whole system (Mele et al., 2010). Findings from literature indicate that there is potential for organizational improvement by developing a learning and supportive professional environment. This is best achieved by involving employees in decision-making at the unit level on day-to-day matters (Wallin et al., 2006). This means that although the decision may be made at a managerial level, there is great benefit in co-developing the decision with the related subordinates. For example, these decisions can include allocating financial resources in the budget for competence development. Thereafter, in planning and scheduling, to allow sufficient time and space for employees and managers to learn at work (Crans et al., 2021; Döös et al., 2015).

Second, **regarding** existing processes, understand if the participants feel free to have open and honest communication on a platform. Honest and open conversations are facilitated by an environment of trust. For example, in a Community of Practice, the concept requires elements like mutual understanding and trust, as well as a commitment to a common objective (Atiti, 2012; Wals et al., 2009) to be sustainable and successful. This is achieved by leaders creating an organizational culture that stimulates and encourages the development of competencies. Leaders do so in various ways, including establishing safety and trust among all employees (Mitterer & Mitterer, 2023). In addition to creating trustful relationships, inclusion into processes also involves leaders showing empathy, listening and being available (Crans et al., 2021; Smeets et al., 2021; Wallo et al., 2021).

The third, in relation to senior management, management should effectively communicate the vision and roadmap of the company. Fourth, which builds on the third question, the managing director should establish and have direct communication with all employees. Communication at a macro level also involves effectively communicating and getting buy in from all employees on the organization's vision and strategy, which strengthens group cohesion (Randolph, 1995; Wallo et al., 2024). Communication, which is rooted in a good state of organizational culture,

results in the ability to communicate vision and goals, implement regulations well and implement additional programs like training to develop competencies (Lubis & Hanum, 2020).

Fifth and last, I, that is the participants, feel that my contributions are effectively acknowledged by Senior Management. Part of building strong interpersonal relationships that aid in facilitating the development of competencies includes communication of recognition and appreciation from management (Robbins, 2019). This is known to increase confidence, job satisfaction, employee retention levels, improved outcomes and organizational performance (Pfister et al., 2020; Sveinsdottir et al., 2016). Recognition is about giving positive feedback based on results or performance. In giving feedback, it is important to strategically execute the activity. This includes, when communicating, being specific, timely, and providing recognition in public settings (Lind & Mishchenko, 2024). On the other hand, appreciation is not in light of their accomplishments but rather acknowledging a person's inherent value. Appreciation helps to facilitate the formation and maintenance of social bonds (Adler & Fagley, 2005). This affects the quality of professional life spaces, such as interpersonal relationships in the workplace (Garg & Mahipalan, 2023).

The median score was 5 out of an expected 5. This score denotes strong agreement and consensus in what was interpreted by the researcher when compared to what the participants deem they shared. The propositions put forward were that planning and executing day-to-day activities needs the whole team's input in order to create successful and inclusive processes. This helps build up trust and confidence in the technicians' abilities. This confidence and trust are also built into general day-to-day communication. The companywide vision needs to be communicated in order for people to feel included. Honesty and acknowledgment by management are important to the employees to feel seen and heard.

Operational systems

The questions posed were in line with how operational processes impact the development of their competencies and, ultimately, the quality of outputs. The eleven questions sought to confirm the following findings from the focus groups. First, a managerial course is essential

and critical for newly instated managers. Leadership is a quality and skill that can be learned, and if continuously practiced, becomes a habit (Zenger & Folkman, 2014). Such a skill can enable the managers to plan and schedule efficiently with their teams. This is to allow for sufficient time and space for employees and managers to develop competencies at work (Crans et al., 2021; Döös et al., 2015).

Second, I, that is the participant, am confident in the soundness of all the protocols and operating procedures put in place in my platform. Third, is the same question, inversely asked. I am unsure of the soundness of all the protocols and operating procedures put in place in my platform. This is in line with question five, which is that someone should review protocols and processes that the Platform Manager has put in place. These are in line with the soundness of the processes. For example, in self-efficacy, All of the sources of self-efficacy, before they have learnt by themselves and are sourcing from enactive mastery, speaks to how the technicians relate to their managers, whom they primarily learning from or through. Whether it is through observing them, vicarious experiences, or by verbal encouragement, verbal persuasion, it is in relation to them. This leaves physiological and affective states, which are influenced by self-belief. Literature has shown that verbal persuasion can influence physiological and affective states. Therefore, all of the initial sources of self-efficacy before the technician can source from enactive mastery are in relation to, are influenced, by their relation to other employees who have learnt and believe in the soundness of their ability to successfully carry out a process (Lamarche et al., 2014).

Fourth, recent graduates who are hired as technicians can give valuable input to current and new protocols and workflows. The recent graduates are new to the workplace and are looking to prove themselves. They do so by applying and developing their skills. This makes them highly motivated to learn quickly, work hard and make an impact in the organisation in order to progress in their careers (Rodrigues et al., 2020). In the absence of this, that is, development opportunities, research reveals the consequence of high employee turnover, particularly among recent graduates (Sturges et al., 2002). Conversely, signaling that development opportunities will be delivered and reinforcing that signal with delivering opportunities creates employees with strong organizational commitment (Connelly et al., 2011).

Sixth, there are enough people to do the work in the lab. Question six is related to the seventh, in terms of planning resources, my manager is aware and involved in the day-to-day running of the platform. Where the seventh question is a duplicate of the tenth question to triangulate results, my manager efficiently manages their day-to-day responsibilities. In line with structures discussed in systems theory, five interconnected systems (Beer, 1981, 1985). These describe the middle managers, the technicians' direct managers as overseers of day to day decisions and senior management making overall companywide strategic decisions. Findings from literature indicate that there is potential for organizational improvement by developing a learning and supportive professional environment. This is best achieved by involving employees in decision-making at the unit level on day-to-day matters (Wallin et al., 2006). Nurturing employee learning requires environments which prioritize learning-oriented leadership (Wallo et al., 2024; Yukl, 2009).

Eight, solutions created from findings in HR Surveys are sufficient and effective. Ninth, this goes to include, HR related surveys are an accurate representation of everyone's needs in the company. Studies show that if surveys are conducted properly, they can actually increase employee mistrust (Huebner & Zacher, 2021). This mistrust could be in asking about the usefulness and true intention of the survey if it was not to enact the envisioned change (Thompson & Surface, 2009). Eleventh and last, a skills appropriate/relevant technical mini course is essential and critical for newly instated technicians. There is a need for this training as there is usually no shared understanding of the precise skill attributes that organizations are looking for (Bennett, 2002). Candidates will not know exactly what they are being asked to demonstrate, and educational institutions are still working to close this gap (Draissi et al., 2023; Suleman, 2018). The hiring organisation, that is, the Scientific Laboratory, thus needs to train technicians accordingly.

The median score was 4.5 out of a possible 5. This score denotes strong agreement and consensus in what was interpreted by the researcher when compared to what the participants deem they shared. The propositions put forward were that there is a need to set up managerial training courses for new management employees, which is important to their effectiveness. Additionally, setting up training courses for new entry level employees is important to their effectiveness. As discussed, leadership is a skill, therefore there is need for different training

and assessments. Further, to the training instalments, would be to set up professional soft skills training for all employees. Management getting more involved in the planning of day-to-day activities will help to create efficient processes. In addition to training endeavours, getting input on processes from all team members gives them confidence in the processes. There is more of a need for transparency, achieved in co-planning, on work conducted versus the alternative additional efforts of monitoring and tracking work activities. Robust reviewing newly instated processes helps create confidence in the processes. There are areas where stakeholder engagement is important. For example, in determining the human resource feasibility of the work being conducted where additional human resources would help with managing the work load.

Leadership

The questions posed were in line with how leadership impacts the development of the technicians' competencies and, ultimately, the quality of outputs. The eight questions sought to confirm the following findings from the focus groups. First, good project management is an essential and critical skill needed to be an effective Manager. Design, planning and overall project management are critical aspects of the managerial role. This is also in line with structures discussed in systems theory, five interconnected systems (Beer, 1981, 1985). These describe the middle managers, the technicians' direct managers, as overseers of day-to-day decisions and activities. Maintaining quality and productivity requires good project management approaches to help maximize the opportunities for the successful completion of projects (Baseke et al., 2022; Croxatto & Greub, 2017). Good design is a major component in ensuring that quality outputs are produced (Baseke et al., 2022).

Second, a psychometric test is important to conduct before appointing a manager. Here, the psychometric test is an assessment designed to measure an applicant, suitability for the position/role based on knowledge, skills, personality traits, and attitudes. Progress in societal and scientific spheres continues to highlight the importance of learning in organizations. Nurturing employee learning requires leaders who prioritize learning-oriented leadership (Wallo et al., 2024; Yukl, 2009). Leadership is a quality and skill that can be learned, and if

continuously practiced, becomes a habit (Zenger & Folkman, 2014). In the context of the Scientific Laboratory, excelling in STEM fields has traditionally been perceived as a sign of brilliance and intelligence (S. L. Kelly, 2023). Here, it is not to discuss the validity of the notion but to point out that it is an existing perception. Therefore, it is believed that intelligence, as determined by success in the scientific field, can be transferred and applied to make one successful in leadership. Mastering a complex technical subject, like science, does not equate to then inherently gaining good leadership skills (Woteki, 2005). The necessary leadership skills then need to be evaluated. Psychometric tests aid in understanding the potential of talent by giving insights into capabilities and aiding in developing effective talent management strategies (Wahdiniawati et al., 2024).

Third, management style plays a big role in team cohesiveness. This question is related to the fourth and fifth questions. These are, fourth, management style is directly affected by company culture. Inversely, management style also affects company culture. Management drives the formation of organizational culture that influences how team dynamics develop, such as team cohesiveness (Wallo et al., 2024). For example, preferential treatment also diminishes team cohesiveness and their ability to relate to each other (Pillai & Williams, 2004). Inversely, studies show in a good community of practice, there is a reduction of isolation and belongingness and cohesiveness is promoted, and this positively impacts the organizational culture (Ulla & Perales, 2021). Additionally, a good state of organizational culture results in the ability to effectively communicate vision and goals, implement regulations well and implement additional programs like training to develop competencies (Lubis & Hanum, 2020).

Fifth, I, that is the participant, am fully aware of the expectations, that my manager has of me with respect to my roles and responsibilities. Further, sixth, senior management should directly and separately ask employees about the rewards and benefits that they would like. In addition, discussing along the lines of rewards, seventh, I, that is the participant, feel that issues pertaining to rewards, benefits, and being acknowledged are addressed appropriately. Overall, these questions are related to communication and engagement from leadership in relation to expectations and acknowledgement. Part of building such strong interpersonal relationships in the Scientific Laboratory includes communication of recognition and appreciation from management (Robbins, 2019). This is known to increase confidence, job satisfaction, employee

retention levels, improved outcomes and organizational performance (Pfister et al., 2020; Sveinsdottir et al., 2016). Appreciation helps to facilitate the formation and maintenance of social bonds (Adler & Fagley, 2005). This affects the quality of professional life spaces, such as interpersonal relationships in the workplace (Garg & Mahipalan, 2023).

Further, in knowing what is expected of you, one can be effective. Higher levels of role clarity would be associated with higher role efficacy and performance effectiveness (Bandura, 1997; Bray & Brawley, 2002). It is then left to the hiring organization, like the Scientific laboratory, to develop the competencies that they would then require. This hierarchy falls in the sphere of the middle manager's responsibility, as they are the operational core (Rezvani, 2017). It is in their duty to develop and implement strategies and processes for competency development (Wallo et al., 2021). Eighth and last, the HR manager is approachable and trustworthy. Human resources management is an important function in an organisation. Literature shows that it is focused on and strongly influences the constructs of job commitment, job satisfaction, organizational effectiveness, and role fit between persons and organizations (Goswami, 2018).

These positive features in an organisation are achieved by effectively attracting, developing, motivating, and retaining talent in relation to the organization's strategy, operational goals and desired culture (Gold & Bratton, 2003). Leaders, in particular, human resources management, create an organizational culture that stimulates and encourages the development of competencies. Leaders do so in various ways, including establishing safety and trust among all employees (Mitterer & Mitterer, 2023). Literature has shown positive relationships between leaders who are trusted and an increase in three main factors. The factors are follower job satisfaction, job performance, and organizational commitment. (G. Chen & Bliese, 2002; Mitterer & Mitterer, 2023; Ribeiro et al., 2023; Walumbwa et al., 2004). These are the features that were introduced at the end of the last paragraph as key focus areas for human resources management.

The median score was 5 out of an expected 5. This score denotes strong agreement and consensus in what was interpreted by the researcher when compared to what the participants shared. The propositions put forward were that there is a need for a change in leadership style

that is approachable and directly addresses needs. This includes implementing rewards and benefits and improving planning and organisation. Additionally, there is a need to set clear goals and expectations as part of sharing a vision. Employees feel this is how they can be fairly judged as expectations of them are clear. In hiring, there is a need to have a psychometric test before placing someone in a management role. Thereafter, after hiring, management training should be implemented as their management style is critical to how their subordinates perform. It is important for all employees to be aware of the chain of accountability and who managers report to and can be held accountable to. This chain must be impartial and approachable.

Table 7. Survey feedback median score by the technicians and managers, the related themes, and propositions.

Theme	Question asked (Evidence for proposition)	Calculated Median score	Expected median score	Weighted median score	Proposition
Communication (Bandura, 1997; G. Chen & Bliese, 2002) Overall median score = 5	1. A manager should consult with their team when planning and executing projects	5	5	5	- Planning and executing day-to-day activities needs the whole teams input in order to create successful processes - The companywide vision needs to be communicated in order for people to feel included - Honesty and acknowledgment by management is important to the employees to feel seen
	2. Management should effectively communicate the vision and roadmap of the company	5	5	5	
	3. The Managing Director should establish and have direct communication with all employees	4.5	5	4.5	
	4. I feel free to have open and honest communication in my platform	3	1	3	
	5. I feel that my contributions are effectively acknowledged by Senior Management	1	1	5	
Contextual factors (Beer, 1984; Guay et al., 2006; J. Taylor & Westover, 2011; H. Wang et al., 2015) Overall median score = 4	6. Alexis is a technician. Alexis misunderstood the protocol and makes a critical mistake while processing samples. In troubleshooting, Alexis should first check the protocol before checking where they went wrong	4	5	4	- Cohesiveness in a team is important for the team to work well. If cohesiveness is not there, there is uncertainty about working well together. - Work politics, seemingly created due of lack of transparency and openness, creates a strained environment. Such a strained environment results in lack of open and honest communication. - People are aware of and can communicate what they want/expect from their employer. How this communication is received and acted upon is the main issue - Regardless of personal background, employees can do their work effectively but they also have personal issues/circumstances that can impact how they conduct work. Employees are more effective when management is aware of personal aspects that may affect their lives
	7. Personal circumstances can affect how I conduct my work	3.5	5	3.5	
	8. I know what I practically want the company to put in place in order for me to feel acknowledged and appreciated	5	5	5	
	9. My personal background affects my interpersonal relationships in the workplace	2	5	2	
	10. Work politics* affects the work that I do. *Processes and behaviour in human interactions that involve power and authority	5	5	5	
	11. When your manager regularly checks in on your personal well-being, it positively affects the work you are doing	4.5	5	4.5	
	12. Others in my platform intuitively/instinctively know when to give help when it is needed	3	1	3	
	13. One should take initiative when there is no one else to assist	4	5	4	
14. The induction training given to technicians when they join the organization is sufficient for them to work effectively	2.5	1	3.5	- Technicians do not feel trained enough to fulfil their role. This training includes initial induction	

Education (E Wenger et al., 2004) Overall median score = 3.5	15. The training that technicians receive on new technologies or protocols is sufficient for them to work effectively	2.5	1	3.5	training and training on subsequent technologies and protocols - It may be best standardise the role expectations. Those whose roles were standardised were more effective as they know what is expected of them - There are limited continuous development efforts - Employees feel more comfortable when they are well trained and subsequently work more effectively
	16. When you are experienced in carrying out a procedure, you are more likely to create shortcuts	3	5	3	
	17. There is sufficient continuous development that helps me fulfil my roles and responsibilities	1.5	1	4.5	
	18. Technicians with certain qualifications / memberships / registrations e.g. HPCSA have inadvertent/unintentional advantage in the company	4	5	4	
Hierarchy (Bandura, 1997; G. Chen & Bliese, 2002) Overall median score = 5	19. Technicians should do a performance assessment of their managers	5	5	5	- Change that management is seen and experienced as not being approachable - In addition, then be routinely able to obtain reviews from subordinates on their managers effectiveness. - Change that management is seen and experienced as being impartial or practising favouritism
	20. The HR Manager should act independently of Managing Director and Managers when getting companywide feedback	5	5	5	
	21. I am freely able to communicate my needs to management	1	1	5	
Interpersonal (Choudhury et al., 2023; Dufour et al., 2021; E Wenger et al., 2004) Overall median score = 4	22. Interpersonal and communication skills are essential and critical skills needed to be an effective manager	5	5	5	- It is important to develop trust and interpersonal relations in the teams - Important to have work appropriate connections that is as a way to be aware of how and their personal lives may affect their work life - Employees seem to be neutral about whether it is difficult or not to communicate but have non-neutral comments on the effects of ineffective communication. Basically, although they communicate, there is no resolution and in time they will feel there is no use to felt that there is no
	23. I am comfortable communicating how my personal circumstances may be affecting my work to my direct manager	3	1	3	
	24. Establishing a personal relationship with members of the platform should be part of a manager's function	3	5	3	
	25. Personally knowing someone positively affects the work being conducted	5	5	5	
	26. When your manager trusts you, it positively affects the work you are doing	4.5	5	4.5	
	27. My manager actively works to build my confidence	2.5	1	3.5	

					use to foster relationships, along with other raised concerns.
Leadership (Bandura, 1997; G. Chen & Bliese, 2002) Overall median score = 5	28. Good project management is an essential and critical skill needed to be an effective Manager	5	5	5	- Need change in leadership style that is approachable and directly addresses needs (such as implementing rewards, benefits and better organisation) - There is a need to set clear goals and expectations as part of sharing a vision. Employees feel this is how they can be fairly judged - There is a need to have a psychometric test before placing someone in a management role. Thereafter implement management training as their management style is critical to how their subordinates perform - It is important for all employees to be aware of chain of accountability, who managers' report to and can be held accountable to. This chain must have impartial and approachable
	29. A psychometric test* is important to conduct before appointing a manager. *An assessment designed to measure an applicant, suitability for the position/role based on knowledge, skills, personality traits, attitudes	5	5	5	
	30. Management style plays a big role in team cohesiveness	5	5	5	
	31. Management style is directly affected by company culture	4	5	4	
	32. I am fully aware of the expectations, that my manager has of me with respect to my roles and responsibilities	3	1	3	
	33. Senior management should directly and separately ask employees about the rewards and benefits that they would like	5	5	5	
	34. I feel that issues pertaining to rewards, benefits, and being acknowledged are addressed appropriately	1	1	5	
	35. The HR manager is approachable and trustworthy	1	1	5	
Operational systems (G. Chen & Bliese, 2002; Mele et al., 2010) Overall median score = 4.5	36. A managerial course is essential and critical for newly instated managers	5	5	5	- Set up managerial training courses for new management employees is important to their effectiveness - Set up training courses for new entry level employees is important to their effectiveness - Set up professional soft skills training for all employees - Getting input on processes from all in Team members gives them confidence in the processes - There is a need for transparency rather than adding more tracking work to monitor activities - Robust reviewing of newly instated processes helps create confidence in the processes
	37. I am confident in the soundness of all the protocols and operating procedures put in place in my platform	4	5	4	
	38. I am unsure of the soundness of all the protocols and operating procedures put in place in my platform	2	1	4	
	39. Recent graduates who are hired as technicians can give valuable input to current and new protocols and workflows	4	5	4	
	40. Someone should review protocols and processes that the Platform Manager has put in place	5	5	5	
	41. There are enough people to do the work in the lab	2.5	1	3.5	
	42. My manager is aware and involved in the day-to-day running of the platform	1.5	1	4.5	

	43. Solutions created from findings in HR Surveys are sufficient and effective	1	1	5	- More human resources will help with the work load - Management getting more involved in the planning of day-to-day activities will help to create efficient processes
	44. HR related surveys are an accurate representation of everyone's needs in the company	1	1	5	
	45. My manager efficiently manages their day-to-day responsibilities	3	1	3	
	46. A skills appropriate/relevant technical mini course is essential and critical for newly instated technicians	5	5	5	
Organizational climate/culture (H. Mulder et al., 2019) Overall median score = 4.5	47. Company culture* directly affects management style. *Refers to the attitudes and behaviours of a company	4.5	5	4.5	- Company culture is important to how managers develop their management style. It is important to have company culture where people feel heard and is free of impartiality and favouritism - Employees want to be part of the goals and vision set by management - Favouritism in the office negatively affects the work being done - Although employees can somewhat freely give their opinion, they feel their opinions are not effectively and fairly resolved by management
	48. I feel that I am a part of and contribute towards the goals set by Senior management	2.5	1	3.5	
	49. There is favouritism in the office	5	5	5	
	50. Favouritism negatively affects work being conducted	5	5	5	
	51. I feel that I can freely give my opinion on how to improve any processes in my platform	2.5	1	3.5	
	52. I do not feel free to give my opinion on how to improve any processes in my platform	3	5	3	
	53. When I communicate my needs, they are effectively and fairly resolved by management	1	1	5	

5.3. Research Question 4

Research Question 4: Having understood the factors at play, what intervention could be implemented to change the outcome of low-quality outputs? (Elucidated from the culmination of the data gathering phases of the study)

5.3.1. Safe to fail experiment, Focus group facilitated by vignette – Understanding senior managers' perspective

The findings suggested factors influencing the technicians' competences, these findings have subsequently illuminated areas of intervention. Underlying all the themes was a thread from the leadership theme. Phase four and five of the study, that is, the Safe to Fail experiment and survey, showed a shift in thinking in the senior management group. This occurred when they were shown what an ideal, viable system should look like versus the current system, that is, the current state at the Scientific Laboratory. The shift in thinking, in summary, describes how the senior managers shifted a redirection of their understanding of the sources and repercussions of different identified themes. This study has identified and suggested that these themes which are factors that influence the development of competencies at the Scientific Laboratory.

Recommendations for training and awareness for Managers and Senior Managers were made and will be further discussed in the following section. The training and awareness are to aid in the understanding of what the themes and factors are and how they affect the development of competencies in the technicians. This would be done by framing how different aspects of the themes and factors emerge, interact and affect the development of competencies. This framing was covered in section 5.2, which detailed and discussed each theme. The aim would be to use

this understanding to aid in the development of information and education. This is in an effort to shift thinking for those with a different understanding of how the themes emerge and what they affect.

The Safe to Fail experiment was designed to identify a change in thinking in the senior managers. That is, their understanding is being changed to understand that the cause, which is what the technicians and managers experienced and raised as issues, has effects. The cause and effects in the scenarios raised by technicians and managers were elucidated by theoretical understanding. For example, from the findings of the focus groups, the senior managers had a clear appreciation of the importance of communication. This is seen in the extracts below, where the senior managers communicate aspects of the vignette. They have not been aware of instances where communication is poor and the detrimental downstream effects of poor communication. From the session, there seemed to be less of an appreciation or understanding of who mainly creates and influences the state of the environment or circumstances where employees thrive.

5.3.2. Theme Summary: contributions and proposed shift in thinking based on theoretical understanding.

Overall

Concerns the experiment set to test: The constant change of scope, because of the diversity of the projects taken up, of work and the complexity and ever evolving field made the employees feel incompetent when they couldn't work well and efficiently. Essentially, from water cooler discussions, it is suggested that science is a field where when the employees can't do the work, they believe it's because they are not competent enough to do the work. Excelling in STEM has traditionally been perceived as a sign of brilliance and intelligence (S. L. Kelly, 2023). Here, it is not to discuss the validity of the notion but to point out that it is an existing

perception. Therefore, it is believed that intelligence, as determined by success in the scientific field, can be transferred to work success in a work environment. This is not the case as there is as still gap between what is learnt in academic institutes and what is needed in practice, in a working environment. There is no shared understanding of the precise skill attributes that organizations are looking for (Bennett, 2002). Candidates will not know exactly what they are being asked to demonstrate by hiring organizations and educational institutions are still working to close this gap (Draissi et al., 2023; Suleman, 2018). In knowing what is expected of you, one can be effective. Higher levels of role clarity would be associated with higher role efficacy and performance effectiveness (Bandura, 1997; Bray & Brawley, 2002). It is then left to the hiring organization, like the Scientific laboratory, to develop the competencies that they would then require.

The senior managers identified with the duck in management that is, managing processes. Therefore, this suggests why they spoke from the perspective of the managing duck. In addition, from that perspective, this naturally suggests why the managers mostly justified the duck in management's actions and criticise the subordinate duck's actions. Having said that, even in identifying the duck in management that was not being shown in the best light, the senior managers continuously engaged and participated in the discussion. This proposes that the vignette was successful as the participants were able to directly share and give appropriate responses (O'Dell et al., 2012; Slead et al., 2002). The senior managers had a clear appreciation on the importance of a healthy environment where employees thrive. That is, thriving to work efficiently and effectively. There was less appreciation and understanding of who, in a hierarchical role, creates and influences the state of the environment or circumstances where employees thrive. Nurturing employee learning requires environments which prioritize learning-oriented leadership (Wallo et al., 2024; Yukl, 2009). This point is important as each of the themes is then underpinned by the element of leadership. That is, leadership would need to create, direct and influence the shift in thinking for each of the themes.

Summary understanding of the participant's responses and shift in thinking based on theoretical understanding: After proposing an alternative way to think about the scenario, there were no further points made to support or to re-affirm their initial thoughts. From the audio, in some instances, there were agreeing hums to the new proposed way of thinking. There was no

visual recording, so we could not analyze the body language, but their facial cues seemed to be in agreement. Therefore, this will not be used as an analysis point but as a general observation. From the focus group, they were an outspoken and dominant group, which suggests they would not have been reluctant to disagree with proposed alternate thoughts. This is also because they freely and openly shared their thoughts when something they were not in agreement with was presented. The survey that was conducted after the safe to fail experiment was used to evaluate if there was a shift in thinking.

Education

Concerns the experiment set to test: Understanding how to balance out workload and training endeavours. Limitations in the hiring pool and progress in societal and scientific spheres have seen the need for environments which prioritize learning-oriented leadership (Wallo et al., 2024; Yukl, 2009). Some of these limitations include. Understanding how different educational backgrounds can result in the perception of favouritism. Literature has shown that interpersonal tension can be perceived between these groups in relation to differing levels of qualification (Mullah et al., 2020). This tension, which also stems from other perceived factors like pay scale, is known to affect staff (Khadambi-Morokane et al., 2021; Mullah et al., 2020)retention. Additionally, preferential treatment also diminishes team cohesiveness and their ability to relate to each other (Pillai & Williams, 2004).

Summary understanding of the participant's responses and shift in thinking based on theoretical understanding: Most discussions centered around how the managers perceived the subordinate raising a concern or request as the subordinate complaining. Further, the managers translated the perceived complaint as though the manager was being told they were not doing a good job. In fewer instances, the managers empathized with the employee having a matter to raise. This was the recently promoted to senior manager who may still identify more with those in middle management. The contents of the matters raised were not discussed; therefore, I, the facilitator, steered the conversation in that direction. When the conversation was stirred towards discussing the contents, it was put forward that employees should proactively also go after opportunities, but at the same time, green duck was criticized for asking for opportunities. From the subordinate focus groups, the employees felt the opportunities were not fairly or

optimally advertised. Further, they noted balancing out operational requirements to allow for training was not done well. Whereas senior management perceives the barrier as a lack of “willingness to learn” by the subordinates. Thinking would then need to shift from perceiving requests to developing competencies as a flag for leadership that has failed to proactively present these opportunities to the technicians. The thinking should move to openly co-creating, between managers and technicians, the needed opportunities, planning and an environment that facilitates the development of competencies. Facilitating competency development operationally involves structuring and organising different elements in the organisation to promote learning in work practices (P. Campbell & Evans, 2016; Döös et al., 2015).

Interpersonal

Concerns the experiment set to test: This looks at the state and development of interpersonal relations in the teams, this goes to include key qualities like trust. Literature has shown positive relationships between leaders who are trusted and an increase in three main factors. The factors are follower job satisfaction, job performance, and organizational commitment. (G. Chen & Bliese, 2002; Mitterer & Mitterer, 2023; Ribeiro et al., 2023; Walumbwa et al., 2004). These three factors and described leadership stance are known to predict self-efficacy and collective efficacy. The outputs of a boosted self or collective efficacy in the technicians results in competent employees producing quality outputs who also have an improved perception of unit-level productivity (Wong & Laschinger, 2013). This subsequently also results in a reduction of key stability elements, such as turnover (Mitterer & Mitterer, 2023; D.-S. Wang & Hsieh, 2013).

Summary understanding of the participant’s responses and shift in thinking based on theoretical understanding. The managers discussed that it is important to know what is happening in their subordinates’ lives as it affects their efficiency at work. At the same time, they do not want to pry into the employee’s lives. They believed that interpersonal relationship lies with the employee being open to sharing their lives and initiating the relationship. Based on the conversations and the examples given in the session, it is possible that interpersonal relations in the workplace could have been misunderstood to have elements of the relationship of a personal friendship. Where personal relationships are voluntarily consented to, thinking

would then need to shift from the notion that interpersonal relationships in the workplace are impertinently enquiring or prying into an employee's life. Further, shift thinking away from the notion that any interpersonal relationship should be established only if the employee wants to have a relationship with their manager. The shift would be to understand that interpersonal relationships are an integral part of a professional environment. Literature has shown that the benefit of strong interpersonal relationships is more likely experienced in an organisation with an established healthy organizational culture that facilitates learning (Huq et al., 2006). Such a relationship is built by, for example, by developing empathy and trust with the employees. This helps establish strong interpersonal relationships (P. Campbell & Evans, 2016; Wallo et al., 2021).

Organizational Culture / Climate

Concerns the experiment set to test: Importance of management creating and maintaining good organizational culture. The organisational culture, the organisations' beliefs, values, and attitudes, plays a role in defining and directing how middle managers make decisions by influencing their behaviours (Wallo et al., 2024). Therefore, if the organisational culture has beliefs, values and attitudes that encourage impartiality and team cohesiveness, it improves trust and overly and an environment that facilitates competency development. This includes creating an environment where learning is valued and prioritized. Further, it involves structuring and organising different elements in the organisation to promote learning in work practices (P. Campbell & Evans, 2016; Döös et al., 2015). Any new employees are influenced by this norm, and ultimately, so is the sustainability of the organization (Assoratgoon & Kantabutra, 2023; Kotter, 81 C.E.). Literature stresses the fact that leadership is seen as an important instrument in promoting and consolidating an adequate and strong organizational culture (Metz et al., 2020). That said, organizational culture itself plays a significant role in ensuring the effectiveness of leadership as an important factor in the continuous improvement of performance in employees (Metz et al., 2020).

Summary understanding of the participant's responses and shift in thinking based on theoretical understanding: Those who do not participate in organization cultural events are seen as rebellious. Those who do not also participate are deemed to have particular negative

qualities. On the other hand, it was not considered in the discussion that the employees may have been in an unfavorable organizational culture that they found hard to integrate into. Additionally, it was discussed that, in reality, the employees who do not participate can be dismissed as being, number-wise, in the minority. In watercooler talks with the subordinates, the majority of the members do not believe the organizational culture is optimal and reluctantly participate in consideration of possible repercussions for not participating. These repercussions include the loss of rewards and support. This is because the organizational culture forms the values that lie beneath what the organization rewards, supports and expects (Baumgartner, 2009). If what the Scientific Laboratory rewards, supports and expects is not in line with effectively promoting different facets, like self-efficacy, that positively contribute to competency development, then there is a disconnect from what the employees expect. This disconnect between what is said on paper and what is experienced in the organization results in lowered job satisfaction, job performance, and organizational commitment. (G. Chen & Bliese, 2002; Mitterer & Mitterer, 2023; Ribeiro et al., 2023; Walumbwa et al., 2004).

In the safe to fail experiment, there were no conversations about how the health of the organizational culture may be or who is responsible for developing it. Players in the vignette who did not participate were expected to communicate their concerns versus excluding themselves. In addition, there are also discussion points applauding the coach for finding out what is wrong. This shift in thinking related to these two points is covered in the communication section. For this theme, thinking would then need to shift from labelling those who do not integrate into the organizational culture as bad apples to evaluating the characteristics and health of the organisational culture. Depending on the outcomes of the evaluation, then determine how best to integrate the employee or, if needed, better the state of the organizational culture.

Hierarchy

Concerns the experiment set to test: Impartial and unapproachable management structures affect an employee's effectiveness. Literature has showcased that there are some key competencies in effective management (Mbokasi et al., 2004). With respect to line managers, that is the technicians' direct managers, there is leadership value attached to that specific

hierarchical level. It is indicated that there is value in having the competence to lead others with enthusiasm and confidence (Mbokasi et al., 2004). The line managers' hierarchy falls in the sphere of the middle manager's responsibility; they are the operational core (Rezvani, 2017). It is in their duty to develop and implement strategies and processes for competency development (Wallo et al., 2021).

The focus is then on the different decisions and directives managers make and how subordinates are able to inform those decisions that affect them. Hierarchy has power differentials that hold questions about how managers can be managed and held accountable. Anonymous surveys are a way to assess a manager's effectiveness without fear of repercussion. The outcomes allow the development of managerial behaviour, this has become one of the core practice areas applied in organizational sciences (Church, 2000). Maintaining this balance and accountability of the key functions of human resources management. They do so by effectively attracting, developing, motivating, and retaining talent in relation to the organization's strategy, operational goals and desired culture (Gold & Bratton, 2003).

Summary understanding of the participant's responses and shift in thinking based on theoretical understanding: The conversations suggested that the senior managers were possibly unable to see how friendship in the workplace may affect impartiality. Further, they do not feel it is malicious to intentionally prefer working with certain people. Senior management also discussed that employees should make an effort to get someone seniors' attention or get them interested in them. One of the senior managers spoke on the need for impartiality. They discussed that a leader may need to develop the soft skills needed to live out and promote impartiality. Thinking would then need to shift from employees working to relate to their managers' interests so as to be preferred and to creating skillsets that promote impartiality and accountability in the workplace. This skillset would greatly benefit the responsibilities, hierarchically, at the line management level, for example, resource management. This would see line managers be transparent and impartial in conducting daily audits to inform strategic decisions and in giving authoritative instructions. This helps in facilitating and negotiating synergy in the team, that is the department (Elezi et al., 2014; Espinosa et al., 2023). Additionally, as the facilitator, based on the conversation points suggesting a defensive position, I made leading statements. The statements were to direct the

conversation to note that any need for improvement of soft skills does not take away from field specific, scientific, intelligence. Therefore, I suggested they choose to welcome the development when any apprehensive or defensive feelings arise.

Contextual factors

Concerns the experiment set to test: Understanding the impact of contextual factors on employee productivity and how this positively affects the business. Literature shows that there is a relationship with contextual factors, like culture, in how it affects the development of competencies (Sueb et al., 2023) . In addition, literature also shows how competencies and contextual issues can be a predictor for individuals to successfully take on an endeavour (Teixeira & Davey, 2010). Further, studies have also shown that contextual factors may help understand the technicians' competencies in relation to the different contexts in which they would need to be applied (Lucas et al., 2021).

It is also important to empathise, build trustful relationships, and understand employees from different backgrounds (P. Campbell & Evans, 2016; Wallo et al., 2021). Literature has shown that positive relationships with leaders who are trusted see an increase in three main factors. The factors are follower job satisfaction, job performance, and organizational commitment. (G. Chen & Bliese, 2002; Mitterer & Mitterer, 2023; Ribeiro et al., 2023; Walumbwa et al., 2004). These three factors and described leadership stance are known to predict self-efficacy and collective efficacy. The outputs of a boosted self or collective efficacy in the technicians results in competent employees producing quality outputs, resulting in an improved perception of unit-level productivity (Wong & Laschinger, 2013). This subsequently also results in a reduction in turnover (Mitterer & Mitterer, 2023; D.-S. Wang & Hsieh, 2013) as employees' overall job satisfaction increases.

Summary understanding of the participant's responses and shift in thinking based on theoretical understanding: they understood the importance of contextual factors. The issue was that they did not trust the employees. Additionally, it was implied that trust is given to the valuable or performing staff. This meant that they did not trust the employees' intentions when

the employees presented their different contextual aspects. For example, they may be using a socioeconomic issue like limited transportation options as an excuse to coming in late. The managers may have limited appreciation of understanding and acknowledging the employee's inherent value. Thinking would then need to shift from giving trust in the presentation of contextual issues as a condition of performance, as trust is needed for effective performance. The shift would be to give trust and appreciation upfront. Managing behaviour that may take advantage of the given trust is a key function of human resources management and line managers. This involves setting clear expectations that the employee can be measured against. Trust and appreciation would be important to be given upfront. The value of trust has been described in the paragraph above. On the other hand, appreciation is not in light of their accomplishments but rather acknowledging a person's inherent value. Appreciation helps to facilitate the formation and maintenance of social bonds (Adler & Fagley, 2005). This affects the quality of professional life spaces, such as interpersonal relationships in the workplace (Garg & Mahipalan, 2023).

Communication

Concerns the experiment set to test. Employees are communicating, but management is not acting on the communication. Employees feel unheard and consequently feel discouraged from communicating, which creates a particular culture. Employees seek an environment where they can be heard. To become a successful technician in the field the Scientific Laboratory is based, there are many skills to master, one of which is effective communication, with a sound intellect and interest in science and technology (Shirvan, 2021). Communication is also bidirectional. The state of the health of communication is created, directed and influenced at a macro level by management. Communication at a macro level also involves effectively communicating and getting buy in on the organization's vision and strategy, which strengthens group cohesion (Randolph, 1995; Wallo et al., 2024). This would be both senior management, where they are concerned with strategic near future and long-term plans and the board, the highest level of management that gives the organization identity through vision, set of values and goals (Elezi et al., 2014; Espinosa et al., 2023).

Summary understanding of the participant's responses and shift in thinking based on theoretical understanding. Reasons why there is such a situation are not attributed to general poor communication on both sides but to how green duck, the subordinate, was communicating with the blue duck, the manager. Findings in the other themes, for example, interpersonal and contextual themes, have shown why technicians may be reluctant to communicate with their managers. For example, their reluctance might stem from not having leaders who can empathise, build trustful relationships and understand employees from different backgrounds (P. Campbell & Evans, 2016; Wallo et al., 2021). This suggests the need for strong interpersonal relationships to strengthen communication, and there are various elements of how this can be achieved. For example, part of building such strong interpersonal relationships includes communication of recognition and appreciation from management (Robbins, 2019). This is known to increase confidence, job satisfaction, employee retention levels, improved outcomes and organizational performance (Pfister et al., 2020; Sveinsdottir et al., 2016). Building such strong interpersonal relationships includes communication of recognition and appreciation from management (Robbins, 2019). This is known to increase confidence, job satisfaction, employee retention levels, improved outcomes and organizational performance (Pfister et al., 2020; Sveinsdottir et al., 2016). Thinking would then need to shift from just a perception that the subordinate duck did not communicate properly to management creating, directing and influencing the development of an environment that allows for effective communication from all employees.

Operational systems

Concerns the experiment set to test: Managements engagement in day-to-day activities and needs. Findings from literature indicate that there is potential for organizational improvement by developing a learning and supportive professional environment. This is best achieved by involving employees in decision-making at the unit level on day-to-day matters (Wallin et al., 2006). This means that although the decision may be made at a managerial level, there is great benefit in co-developing the decision with the related subordinates. Middle managers, the line managers, play a key role in day-to-day decision-making, which can consist of resource allocation and disturbance handling (Rezvani, 2017). For example, these decisions can include allocating financial resources in the budget for competence development. Thereafter, in

planning and scheduling, to allow sufficient time and space for employees and managers to learn at work (Crans et al., 2021; Döös et al., 2015).

Summary understanding of the participant's responses and shift in thinking based on theoretical understanding: They identified with a green duck, who has the difficult task of having, at most times, turn down monetary requests. This operational system was the most discussed theme with the subordinate employees. The managers did not explicitly discuss the need, importance or action of engaging employees when making decisions about the requests that the employees would have placed. This was after I, the researcher, engaged them on the matter of engaging employees. I also discussed that not all decisions can be made together. It is then important to understand key decisions that critically affect employees and have them voice their opinions. In the managers' and technicians' focus groups, they proposed that managers had made insufficient conclusions when evaluating requests, which resulted in requests being denied. In summary, the subordinate employees noted they were not being engaged in decision making. Thinking would then need to shift from managers having to make difficult decisions in isolation to engaging and cocreating decisions with other employees. With respect to developing competencies, this includes creating an environment where learning is valued and prioritized. Further, it involves structuring and organising different elements in the organisation to promote learning in work practices (P. Campbell & Evans, 2016; Döös et al., 2015).

Leadership

Concerns the experiment set to test: The importance of setting and sharing clear goals and expectations and a vision with employees. This speaks to effective leadership that is able to create an environment where employees thrive. Progress in societal and scientific spheres continues to highlight the importance of learning in organizations. Nurturing employee learning requires environments which prioritize learning-oriented leadership (Wallo et al., 2024; Yukl, 2009). With this, there has been substantial literature on how leaders facilitate learning in the workplace. The literature showcases and identifies ways in which leaders facilitate learning through their behaviours and actions. Recent frameworks identify two elements of this learning-oriented leadership. The two elements are direct and indirect

leadership. Direct leadership behaviour includes encouraging and motivating learning, for example, by showing empathy, creating trustful relationships, listening, and being available (Crans et al., 2021; Smeets et al., 2021; Wallo et al., 2021). Further, effective leadership involves structuring and organising different elements in the organisation to promote learning in work practices (P. Campbell & Evans, 2016; Döös et al., 2015). For example, this can be seen when leaders budget financial resources towards competency development. Thereafter, in them encouraging, planning and scheduling in the teams. This is to allow for sufficient time and space for employees and managers to learn at work (Crans et al., 2021; Döös et al., 2015).

Summary understanding of the participant's responses and shift in thinking based on theoretical understanding: There was a need to differentiate between sharing company information and sharing, engaging and linking the vision and goals behind the information being shared. The senior managers discussed that employees not understanding the vision was deemed as sabotage, obstructive and negligent on the part of the employees. There was also an emphasis on the importance of briefing employees before major events. Although this briefing is important, there were no discussions of general continuous engagement to keep employees engaged and updated on the organization's vision and goals. Thinking would then need to shift from suggesting employees who do not align with the organisational vision and goals and obstructive and negligent. The shift would be to evaluating, creating an environment and leadership that effectively gets buy in from employees. Communication at a macro level also involves effectively communicating and getting buy in on the organization's vision and strategy, which strengthens group cohesion (Randolph, 1995; Wallo et al., 2024). Leadership is a quality and skill that can be learned, and if continuously practiced, becomes a habit (Zenger & Folkman, 2014). The necessary leadership skills then need to be evaluated. Psychometric tests aid in understanding the potential of talent by giving insights into capabilities and aiding in developing effective talent management strategies (Wahdiniawati et al., 2024).

5.3.3. Example: Leading questions and statements to aid in shifting thinking in senior managers' thinking

For context, The ducks in the vignette were used to represent different actors in the Scientific laboratory. The extract below contains contributions made by the participants and the senior managers. There were eight vignettes, and each represented one of the eight identified themes. That is, themes were identified in the analysis of the focus group managers and technicians, as well as the focus group and survey analysis. The extracts below will draw from the communication theme. In the vignette for the communication theme, the senior manager, blue duck, is asking the subordinate, green duck what they would like to eat. After the green duck responds, the blue duck proceeds to make a different meal. The vignette ends, and two questions are posed. The first asks if green duck and the subordinate will continue to answer. The second question asks if blue duck. Will ever make what green duck has requested.

An additional example, to further elucidate the safe to fail experiment, the senior managers noted that it is important to have a good company culture. In the same light, some participants also believed that when employees don't want to participate in the company's activities, it's because they are rebels. These participants did not comment on who in the organisation mainly influences the employees' enthusiasm to join activities. In addition, the senior managers also did not comment on what could possibly be the current state of the organisational culture that the "rebellious" employees don't want to be participating in. Therefore, in the session, I, as the facilitator, made leading statements and asked leading questions. For example, highlighted in the second extract below in blue.

In the extract below, the participants are answering the two posed questions and give their thoughts on the communication. In summary, they made two main observations, each related to the ducks. Firstly, that blue duck, the manager, does not intend to make the buns and that blue should have been answered based on what blue can make or communicate further the

insistence on buns. Secondly, green duck, the subordinate, is thought to have a preference, does not ask well and may just be answering to be polite.

SMID001: *"I suppose it goes on perspective. I mean the duck is asking for a bun, none of those options of croissant, bread and cupcakes are buns."*

SMID003: *"(Blue) Doesn't like buns – Blue is asking but already has a preference."*

SMID001: *"If I look at it, it seems like this poor little green duck only has one word. – Green, employee, should have alternative preferences"*

SMID004: *"The never intended on making the buns"*

SMID002: *"Blue just asked to be polite."*

SMID002: *"But I think they should be able to. I buns could also be more communicative to say, "I feel like buns I haven't really had in a long time. Can you please make you please make it?". Not just, "buns, thanks; buns, thanks". – Green, employee, doesn't ask well"*

SMID005: *"Communication issue from the organisation that they do not relay to the employees how important this launch was or they didn't know that there was launch or they just don't look like they're included. They idle there a little bit."*

(Senior manager's focus group - Participants)

Facilitator: So here the person who has, let's just say in quotes 'the power' is blue because they're making dinner, right. And green, because they're being asked, they're just going to be like, that's that. But maybe if blue said, "actually green of all the ingredients I have, I can't make buns". "I really do want to make something that you like, but I really can't make buns". So, this could be a communication breakdown That blue isn't just really communicating what's happening and because green is getting offered something, they're just like, can I now come and confront you when you've offered to me to dinner?

Facilitator: So, you are also like, oh at least they ask me, right? But at the end of the day, if this continues, it's going to create a particular culture where green will just say whatever is there and they can never look forward to having something for example. Okay, let me just check really quick. Okay. Yes. So, I think to just summarise this, sometimes maybe blue isn't aware how not communicating something may impact their relationship and as well for green that they're just sort of in the car just sitting in the passenger seat and they're not communicating or saying, "Hey, you know, when you said this, this is what happened. How do we fix this because now I'm going to look forward to having buns and then when I sit down, I'm having cupcakes again". Okay perfect. And that's basically how we're going to do it. Okay. It's very light. That's why I said by one we'll probably be done anyways. Okay, so this is two and then blue is

(Senior manager's focus group - Facilitator)

In the extract above, I, the **facilitator**, was engaging with the contributions made by the **participants**. Where the senior managers' responses did not align with a theoretical understanding of what influences competencies, I asked them leading questions. These leading questions were to lead them into thinking in line with theoretical understanding. That is, actions, positions and/or statuses that would positively influence the technician's competencies. These leading questions were placed naturally into conversations in order to try to shift in thinking without pausing to note that they needed to think alternatively. It was important not to have a non-confrontational conversation. Having light-hearted but theoretically sound vignettes and inserting leading cues into the conversation helped to keep

the conversation friendly and engaging. This helped establish and maintain rapport. A recap of the summary of the participant's discussion with respect to communication will be used to show what the leading question wanted to elucidate with respect to theoretical understanding. In summary, they made two main observations, each related to the ducks.

Firstly, that blue duck, the manager, does not intend to make to make the buns and that blue duck should have been answered based on what blue can make or communicate further the insistence on buns. The participants, senior managers, suggested that blue duck was not going to make buns. Here, intentions, what blue will and can do, need to be communicated to show how overall strategy and in daily planning influence decisions. Additionally, in such an engagement, the blue duck will also understand how and what is possible in the organisation.

Secondly, green, the subordinate, is thought to have a preference, does not ask well and may just be answering to be polite. The participants suggest that green does not know how to answer well, that is, continually asking for the same thing. This also suggests an inability to relate between the managers and subordinates. My leading conversations, in just this theme, pull from the themes of leadership, hierarchy, organisational culture, effective communication and interpersonal relationships.

The theoretical understanding that I drew from the leading questions can be found in the theme discussions. I will also contextually, to the discussion in this vignette, draw relevant concepts that the participants needed to shift their thinking to now understand. In summary, there are leadership qualities that are hierarchically set to create and direct an environment that fosters, amongst other key themes, effective communication and interpersonal relationships, which aid in the development of competencies. Studies show that if requests for information from employees, like surveys, are conducted properly, they can actually increase employee mistrust (Huebner & Zacher, 2021). This mistrust could be in asking about the usefulness and true intention of the survey if it was not to enact the envisioned change (Thompson & Surface, 2009). The mistrust can be mirrored to green duck being requested for what they would like and not receiving it. This also affects future participation in future surveys, in particular employee experience which has a critical impact on the sustainable development of an organisation (Porkodi et al., 2024).

The cooking request blue duck made can be equated to making decisions for processes in the organisation. Green duck is requesting what they would like, that is, requesting for a specific decision. Literature has shown that making effective decisions is best achieved by involving employees, like green duck, in decision-making at the unit level on day-to-day matters (Wallin et al., 2006). This means that although the decision may be made hierarchically at a managerial level, there is great benefit in co-developing the decision with the related subordinates. This co-creation is facilitated through communication. Poor communication is likely to hinder this (Siegall & Gardner, 2000) , and miscommunication can foster mistrust (Thompson & Surface, 2009). Communication at a macro level also involves effectively communicating and getting buy in on the organization’s vision and strategy, which strengthens group cohesion (Randolph, 1995; Wallo et al., 2024).

5.3.4. Survey - Quantifying the senior managers’ shift in thinking

After analyzing the focus group findings, a survey was conducted. The survey was used to triangulate findings, see Figure 20. It was used to determine whether there was a change in thinking in the Senior managers. There was a good central tendency, this was a median value of 4. The number denotes “Likely yes” and indicates that there was a shift in thinking among the senior managers. The highest and most ideal was the value of 5, which denoted a “Yes”. Contextually, SMID001 and SMID004 had the lowest individual median values with 1 and 3, respectively; they had both resigned by the time they completed the survey. Their scoring, that is, a limited shift in understanding, may echo that. They may be less open to introspecting on how the actions of management may have influence over the technicians developing their competencies.

Although SMID005 had also resigned from the organization, they stayed on in an advisory capacity in the Scientific Laboratory and, therefore, may be more open to shifting their understanding. From the water cooler talk, it was discussed that senior management attributed the current breakdown in the environment to the board. The board is also inaccessible to these

employees, that is, technicians and managers, but these employees still felt there were key issues that were not affected by things the board has influence over. In summary, in this water cooler talk, the senior managers believed they understood and were aware of what was needed to form a good environment but were limited by the board. This was also discussed by the managers, who had this same view as many of the factors at play did not need and or were not influenced by the board. In summary, with respect to the scores, those who scored lowly naturally may not necessarily be open to or have the motivation to introspect. This is because, in fairness, this suggests they are no longer participating to build the environment and have new endeavors that need their attention.

Have you shifted your thinking about?	Yes	Likely Yes	Neutral	Likely No	No	SMID001	SMID002	SMID003	SMID004	SMID005	Median question/theme	
1 Communication in the workplace.	X					2	5	5	5	5	5	
2 Contextual factors (e.g., personal, economic etc) in the workplace.		X				1	5	5	3	4	4	
3 Educational status wrt employees' productivity and career advancement.			X			1	5	3	3	3	3	
4 Hieracy e.g., wrt impartiality in the workplace.		X				1	5	4	1	5	4	
5 Interpersonal relationships in the workplace.			X			1	5	2	3	3	3	
6 Leadership wrt sharing clear goals, expectations and, vision with employees.		X				1	5	4	5	4	4	
7 Operational systems and activities in the workplace.	X					5	5	4	5	3	5	
8 Creation and maintianance of organizational culture/climate in the workplace.	X					1	5	5	1	5	5	4
						Median Individual	1	5	4	3	4	
										4		

Figure 20: Survey results for all the Senior managers. This shows if there was a shift in thinking for 8 of the questions related to the eight themes. The median score was calculated to determine central tendencies.

SMID002 and SMID003 are the senior managers who did not leave. Their scores and contributions during the discussions then suggest that they are interested in better understanding the factors that influence the development of competencies in the technicians. Along with having a new managing director, they would use this understanding to improve the quality of products. They were more likely going to reflect and thus have a shift in thinking. They are motivated to introspect to see where they can be changed. This is also mainly because they are primarily working with a new Managing director to rebuild, refine, and rethink. The

senior managers are doing this to help develop a strategy that ultimately counters the high employee turnover and poor quality of outputs.

After proposing an alternative way to think about each of the vignettes, there were no further points made to support or to re-affirm the senior managers' initial thinking. From the audio, in some instances, there were agreeing hums to the new proposed way of thinking. There was no visual recording, so we could not do any post session visual analysis of, for example, their body language. That said, in the session, their facial expressions seemed to be in agreement. To confirm that there was a change in thinking, it was important to have a survey to investigate this. The same principles and strategies were employed as in the technicians' and managers' focus groups. The questions were again underpinned by theoretical understanding and were used to confirm findings from the eight vignettes. The eight questions represented the eight key themes that emerged from the study.

Central tendencies using the median were used to see if there was a change in thinking. A change in thinking would be denoted by a scale point of four and ideally five. The median value was four, this denoted that "likely yes" to the senior managers having a shift in thinking about how different factors are influencing the technician's development of competencies. When visualized on a scale, see Figure 21, we can visually see the shift in thinking. There were eight themes, which were represented by one overarching question. The question asked if their understanding of each theme had changed. This was based on the understanding that the Safe to Fail experiment was designed to elucidate. A shift in thinking of how different aspects related to a theme influenced the development of competencies in the Scientific Laboratory and, overall, the quality of outputs.

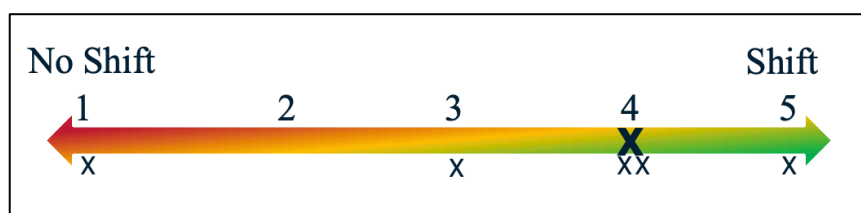


Figure 21: Scale to determine a shift in thinking in the Senior managers

The following two paragraphs cover the eight questions that were asked and the resulting scores; see Figure 21. This was done to quantify the shift in thinking. For each of the themes, a statement was posed, and the senior managers were to answer, on a scale, if they had shifted in their understanding. The scale was from no, likely no, neutral, likely yes and yes. The first statement was: Communication in the workplace. The median score was 5 out of an expected 5. This score denotes strong agreement, that is, yes, there was a shift in thinking. The second statement was: Contextual factors (e.g., personal and economic.) in the workplace. The median score was 4 out of an expected 5. This score denotes agreement, that is, likely yes, there was a shift in thinking.

The third statement was: Educational status with respect to employees' productivity and career advancement. The median score was 3 out of an expected 5. This score denotes that there was neutrality, neither there being nor there not being a shift in thinking. As it was not as expected, there was a need to better understand possible reasons for the neutrality in a shift in thinking. In the theme summary for education, section 5.2.1, I discuss how the phenomenon was centred around the technicians feeling incompetent and how it affected the quality of their outputs. Alternatively, they did not fully consider that the system they are in might be encumbering the necessary development of their competencies. The output, from addressing alternative cumbrances in the system, is a boosted self or collective efficacy in the technicians. This results in competent employees producing quality outputs who also have an improved perception of unit-level productivity (Wong & Laschinger, 2013).

The participant's contributions suggest that they are in line with the premise of the study. That is, it was hypothesizing that the technicians were not inherently incompetent, but rather, there were factors influencing the development of their now needed competencies. Further, I summarised that the other themes delve more into aspects of how the educational aspect and development of competencies may be influenced. As this is the phenomenon is question, it is plausible that the participants did not fully make this connection of how educational aspects affect their ability to develop competencies. The other themes are in line with and support the findings in the education theme. This is seen in the connections and interlinking of themes that are discussed in each theme summary, sections 5.2.1 to 5.2.8.

Continuing with the statements, the fourth statement was Hierarchy, e.g., with respect to impartiality in the workplace. The median score was 5 out of an expected 5. This score denotes agreement, that is, likely yes, there was a shift in thinking. The fifth statement was: Interpersonal relationships in the workplace. The median score was 3 out of an expected 5. This score denotes that there was neutrality, neither there being nor there not being a shift in thinking. As it was not as expected, there was need to better understand possible reasons around the neutrality in shift in thinking. The senior managers discussed that interpersonal relationship lies with the employee in being open to sharing and having the relationship. Based on the conversations and the examples given in the session, it is possible that interpersonal relations in the workplace could have been misunderstood to have elements of the relationship of a personal friendship. Where personal relationships are voluntarily consented to. Literature has shown there is a benefit to strong interpersonal relationships in particular, in an established healthy organizational culture, as they will aid in facilitating learning (Huq et al., 2006). In this environment, empathy, along with trust, helps further establish strong interpersonal relationships (P. Campbell & Evans, 2016; Wallo et al., 2021).

The sixth statement was: Leadership with respect to sharing clear goals, expectations and vision with employees. The median score was 4 out of an expected 5. This score denotes agreement, that is, likely yes, there was a shift in thinking. The seventh statement was: Operational systems and activities in the workplace. The median score was 5 out of an expected 5. This score denotes strong agreement, that is, yes, there was a shift in thinking. The eighth and last statement was: Creation and maintenance of organizational culture/climate in the workplace. The median score was 5 out of an expected 5. This score denotes strong agreement, that is, yes, there was a shift in thinking.

5.4. Summary – Research questions

Below, we look at the research questions and a summary of what the study elucidated.

Research question 1: Does the system in which the technicians operate, the internal and external environment, influence the technicians' competencies? If so, how? **Response:** The findings from the study suggest that there are internal and external influences on the technicians' competencies. The themes that emerged were related to internal and external factors. The internal themes were Contextual factors, Education and Interpersonal. The external themes were Communication, Hierarchy, Leadership, Operational systems, and Organizational climate/culture.

Research question 2: Does the relationship between the technician and their direct manager influence the technicians' competencies? If so, how? **Response:** The findings from the study suggest that there are relational influences between the technician and their direct general manager that influences the technicians' competencies. The themes that emerged were Interpersonal relationships, Hierarchy and Leadership. These three themes describe the interpersonal relationship between the managers and technicians, the power dynamics based on their hierarchical relationship, and lastly, the relationship with managers as leaders.

Research question 3: Does the technician's perception of themselves in the organization influence their competencies? If so, how? **Response:** The findings from the study suggest that there are factors related to how the technicians perceive themselves and how it influences the technicians' competencies. Within all the themes that emerged, there was a thread in each that showed how technicians perceive themselves. The data suggests that when the technicians were unable to effectively deliver outputs, the technicians think they are incompetent versus them exploring also that it might be a hindering environment.

Research question 4: Having understood the factors at play, what intervention could be implemented to change the outcome of low-quality outputs? **Response:** The findings suggested factors influencing the technicians' competences, these findings have illuminated areas of intervention. Underlying all the themes was a thread of leadership. Phases 4 and 5 of the study (Safe to Fail experiment and survey) showed a shift in thinking in the senior management group when they were shown what a viable, ideal system versus the current one, the Scientific

Laboratory. Recommendations for training and awareness for Managers and Senior Managers. Framing how different aspects interact and affect the Technicians, Managers and Senior managers.

5.5. Summary - Findings

The research process was summarized below in Figure 22. The diagram shows the path from the research question to the last phase of the study procedure, which is the recommendations. The workflow starts with stating the research statement and summary rationale for the study. It then outlines the research questions developed to address the research statement. Moving down one more, it shows the theoretical understanding that underpins answering the research questions. On the last level, it shows the data collection strategies used to answer the research questions, analysis, and recommendations.

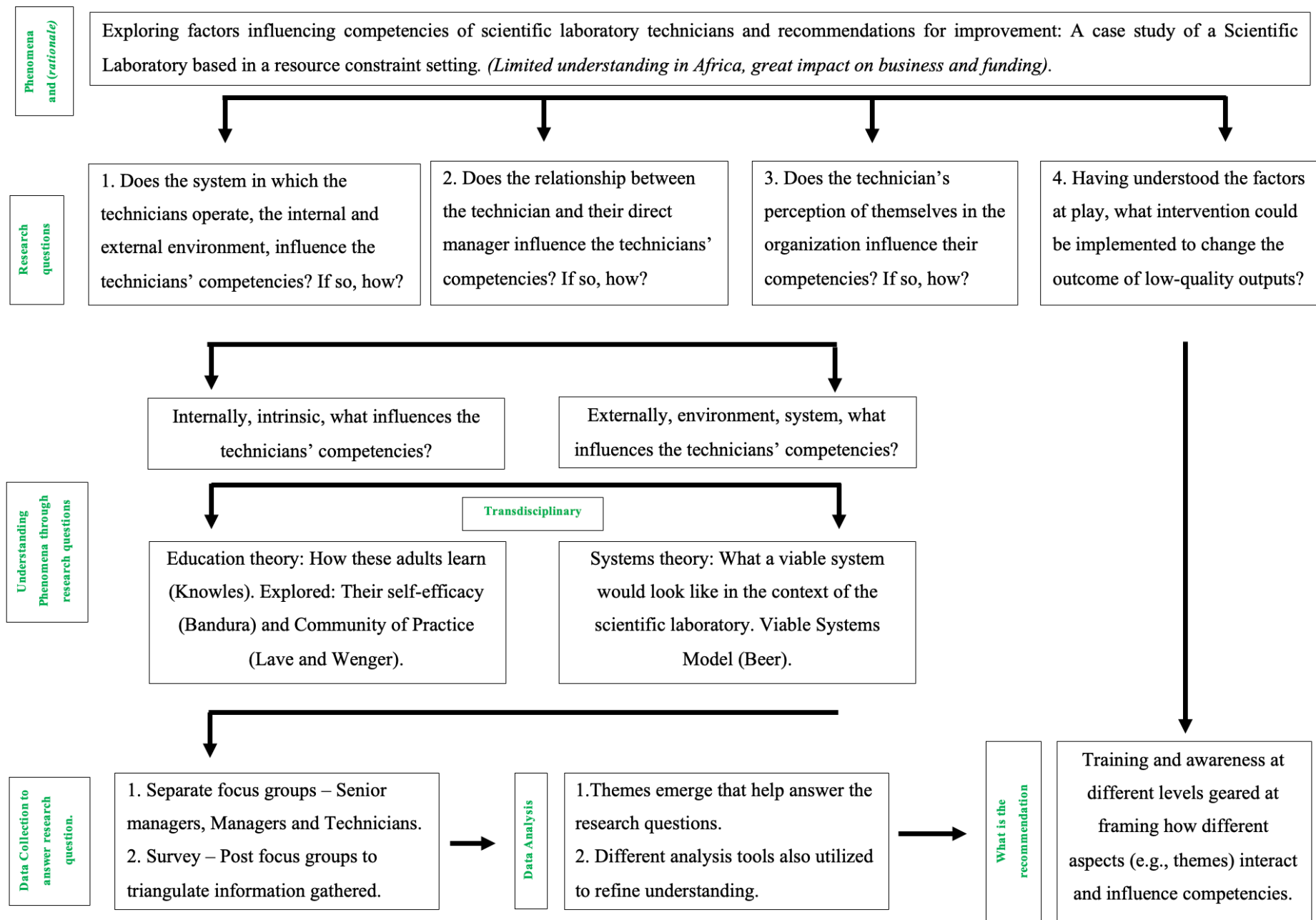


Figure 22: Summary of the research process, starting from the research statement and ending with recommendations

Below are the propositions logged based on the findings from this study. These observations from the focus groups and survey are summarized below. This gives a sequential understanding of the findings. The related observations are assigned to the themes that they primarily emerge.

The organization's strategic vision and goals are to be seen as engaging and inclusive of the employees: The companywide vision needs to be communicated in order for people to feel included (Communication). Employees want to be part of the goals and vision set by management (Organizational climate/culture). There is a need to have clear goals and expectations as part of sharing a vision. Employees feel this is how they can be fairly judged (Leadership). Honesty and acknowledgment by management is important to the employees to feel seen (Communication). There is a need for transparency rather than adding more tracking work to monitor activities (Operational systems). Change in the notion that management is seen and experienced as not being approachable (Hierarchy). It is important for all employees to be aware of the chain of accountability and who their managers report to and can be held accountable to.

This chain must be impartial and approachable (Leadership). Change that management is seen and experienced as being impartial or practicing favoritism (Hierarchy). Favoritism in the office negatively affects the work being done (Organizational climate/culture). Company culture is important to how managers develop their management style. It is important to have a company culture where people feel heard and free of impartiality and favouritism (Organizational climate/culture). This needs a change in leadership style to one that is approachable and directly addresses needs such as implementing rewards, benefits, and better organization (Leadership). Work politics, seemingly created due to a lack of transparency and openness, creates a strained environment. Such a strained environment results in a lack of open and honest communication (Contextual factors).

Employees will then feel that they are part of the organization. That is, there is a buy in to the vision, goals, and organizational culture. The employees are aware of what is expected of them and what they can expect from the organization: Employees are aware of and can communicate what they want/expect from their employer. How this communication

is received and acted upon is the main issue (Contextual factors). Employees seem to be neutral about whether it is difficult or not to communicate but have non-neutral comments on the effects of ineffective communication. Although they communicate, there is no resolution, and in time, they will feel there is no use in communicating (Interpersonal). Although employees can, to some extent, freely give their opinions, they feel their opinions are not effectively and fairly resolved by management (Organizational climate/culture). Regardless of personal background, employees can do their work effectively, but they also have personal issues /circumstances that can impact how they conduct work. Employees are more effective when management is aware of personal aspects that may affect their lives (Communication). More human resources will help with the workload (Operational systems).

These changes and shifts in understanding allow managers to effect change and create cohesive teams: Planning and executing day to day activities needs the whole team's input in order to create successful processes (Communication). Management getting more involved in the planning of day-to-day activities will help to create efficient processes (Operational systems). Reviewing newly instated processes helps create confidence in the processes (Operational systems). Getting input on processes from all Team members gives them confidence in the processes (Operational systems). It is important to develop trust and interpersonal relations in the teams (Interpersonal). Important to have work appropriate connections that are a way to be aware of how their personal lives may affect their work life (Interpersonal). Cohesiveness in a team is important for the team to work well. If cohesiveness is not there, there is uncertainty about working well together (Interpersonal).

These changes result in well-functioning teams that are trained and feel understood and understand their roles and responsibilities. It may be best to standardize the role expectations. Those whose roles were standardized were more effective (Education). Technicians do not feel trained enough to fulfil their role. This training includes initial induction training and training on subsequent technologies and protocols (Education). There is a need to have a psychometric test before placing someone in a management role. Thereafter implement management training as their management style is critical to how their subordinates perform (Leadership). Setting up managerial training courses for new employees is important to their effectiveness (Operational systems). Set up professional soft skills training for all

employees (Operational systems). There are limited continuous development efforts (Education). Employees feel more comfortable when they are well trained and subsequently work more effectively to produce quality outputs (Education).

5.6. Limitations of this study

Research inevitably involves a series of compromises among the principles of rigor, ethics and feasibility (Lingard & Watling, 2021). These principles may be found in the various stages of the research process, such as study design, data collection, data analysis and study results. This section outlines the limitations of this study. To be effective, this section looks to describe the potential study limitation, providing an explanation of why it is a limitation, the implication of the limitation and provide possible alternative approaches that could be used in future studies, and steps taken to mitigate the limitation in this study (Ross & Bibler Zaidi, 2019). There are other more detailed issues related to how the study was designed and carried out. These range from the research paradigm and the case study approach to analysis strategies and have been covered in detail in Chapter 4. The findings of this study have to be seen in light of some broader limitations, which are detailed in the sections below. They also link to some of the described limitations in chapter 4.

Given these limitations, a concentrated effort was made to establish rigor in the study. This was done by employing rigor strategies adapted from Lincoln and Guba (Lincoln & Guba, 1986). The efforts have been detailed in section 3.5., Establishing rigor. In summary, these efforts included ensuring that there was credibility, transferability, dependability and conformability in how the study was designed and conducted. The two limitations below are related to how the study was designed and how data was collected. Namely, sample size and continuity of the study during the COVID 19 pandemic. Neither low sample sizes nor disruptions in data collection necessarily lower the quality of the evidence. Rigor is used to enhance the quality of evidence. Qualitative researchers have thus developed rigorous criteria and frameworks to aid in enhancing the quality of evidence (Hamberg et al., 1994; Krefting,

1991; Tobin & Begley, 2004). This framework was employed to adapt strategies from Lincoln and Guba.

Sample size – Study design

The study had a moderately small sample size of a total of 13 participants. This consisted of 4 technicians and, their 4 direct managers and 5 senior managers. The participants were split into two major data collection points where they followed different vignettes; that is, different information was interrogated from them. The first phase with 4 technicians and their 4 direct managers. The second phase was the 5 senior managers. If it was solely a quantitative study, this could have led to inaccurate conclusions and results from the bias created by the low statistical power. Further, in the qualitative methodology of the study, an important determination of sample size was contextual and partially dependent upon the scientific paradigm under which the investigation is taking place (Boddy, 2016; Faber & Fonseca, 2014). In this study, under the interpretivist research paradigm, it was important to consider the depth and quality of the data collected. The quantitative methodology aided in refining quality and depth. A key aspect was that it was used to triangulate findings and create objective data that aided in communicating findings in the form of numbers (Adu et al., 2022).

That said, particularly when studies are conducted in a non-positivist paradigm, like ours, sample sizes involving one single case can be highly informative and meaningful, as demonstrated in examples from management and medical research (Boddy, 2016). The case study approach was then employed for the small study size. The mixed method approach was used to integrate the two methods for the purpose of strengthening interpretations (Leko et al., 2023). This ensured that a rich dataset was obtained. Rigor was also employed at every stage of the sequentially mixed methods approach to greatly minimise the possibility of fallacious conclusions and results. Overall, what is described in this study looks to support the notion of having sufficient depth and quality of the data that gathers enough evidence to develop a defensible finding versus how many samples the data was collected from (D. Sims & Cilliers, 2023). With this in mind, future studies can look to increase sample numbers to further enrich the dataset used to understand the phenomenon.

Continuity with the participants – Data collection

There was also disruption in the continuity of the study due to high employee turnover accompanied by the restrictions during the COVID-19 pandemic. Before phase 3, the survey, 90% of the technicians and managers had left the organisation. That was before the survey to triangulate findings from the focus group was sent out. This was inevitable as the phenomena in question had the element of high employee turnover. There was a risk that they would not continue with the study. To mitigate this, I contacted the now previous employees and thanked them for their participation, and reiterated that they could exit the study at any time with no consequence if, for any reason, they could no longer engage and participate effectively. I also noted that the study would continue if they were no longer available so they would not continue out of guilt.

Fortunately, they all stayed in the study to allow for the continuity. They agreed and noted they were happy to continue with the study. This may have also been to the benefit of the study as any restrictions in sharing that they may have had may have fallen away when they left the organisation. That said, in this stage of the study, they would not be able to introduce a new view or a biased view due to leaving; they were simply triangulating findings. Measured interventions were not in the scope of this study but may be greatly beneficial to future studies. The disruption in continuity caused by participants leaving the organisation would be something future studies would need to consider if they employed measured interventions. In addition, continuity and maintaining neutrality were greatly aided by adopting evidence-based practices. This allows one to critique and evaluate the rationale and evidence related to an adopted strategy (Rowles & McNaughton, 2017). The details of the adopted strategies and their criticisms are outlined in Chapter 4.

5.7. Contribution of the study to existing literature and recommendations for further research

This research sought to explore factors influencing the competencies of the Scientific Laboratory's technicians and give recommendations for improvement. The findings form a good foundation with respect to understanding influences for competencies and can be used to inform shifting mindsets for current employees and possible onboard training for future employees. These are processes that can easily be implemented in a resource constraint setting. There are many contextual factors that affect such a setting, in particular with respect to time and money (Leufvén et al., 2015).

In Africa and abroad, this again would be replicable in scientific laboratories experiencing low quality outputs and low competency. Optimising the environment that the technicians exist in, to promote competency development, increases the quality of the outputs. Good outputs attract funding and business. Better outputs in sciences usually move research and industry forward to ensure better outcomes for communities at large. Given the drive to improve the quality of outputs, this has been seen as a priority area for researchers and industry who are looking to support the development of health systems and related scientific environments in developing countries (Baseke et al., 2022; Siddiqi et al., 2005). This becomes important as competency studies that have been conducted in Africa have been conducted in organisations that have a set of unchanging services. Therefore, these organisations do not have the added complexity of dealing with diversity in the work that they conduct and, therefore, have a constant change of scope in work (M. Mulder & Gulikers, 2011).

In practice, this means the technicians in the Scientific Laboratory have the complexity of various expectations as they have diverse sets of work to complete. Literature has shown that

the broadness of entry level positions sees the presence of many transferable skills in job advertisements (Bennett, 2002). Candidates will not know exactly what they are being asked to demonstrate by hiring organizations and educational institutions are still working to close this gap (Draissi et al., 2023; Suleman, 2018). It is then left to the hiring organization, like the Scientific laboratory, to develop the competencies that they would then require. In knowing what is expected of you, one can be effective. Higher levels of role clarity would be associated with higher role efficacy and performance effectiveness (Bandura, 1997; Bray & Brawley, 2002).

Within similar organisations, especially those providing varying or specialist scientific services, this will be important to aid in building contextual training and awareness of the cause and effects of the themes identified in this study. In water cooler conversations before and during this study, different organisations have experienced the continued loss of employees. The reason informally cited is that they believed they did not feel they were competent enough to produce quality outputs. This contextual training can look to framing, for the technicians and managers, knowing to differentiate between incompetence and a hindering environment. In the same light, it is even more important to reframe for senior managers how different aspects interact and affect. For example, communication rooted in a good state of organizational culture produces the ability to communicate vision and goals, implement regulations well and implement additional programs like training to develop competencies (Lubis & Hanum, 2020). This would be created, directed, and influenced by senior managers. senior management is concerned with strategic near future and long-term plans, and the board, the highest level of management that, gives the organization identity through vision, set of values and goals (Elezi et al., 2014; Espinosa et al., 2023).

The majority of the literature exploring competency needs mainly looked at what employees deemed needed (dos Santos et al., 2019; Miedzinski et al., 2001). That is, what the employees believed they needed when compared to better understanding the underlying factors. There were also a few studies that focused on what factors are at play in the internal and external environment, that results in what is then deemed as needed versus opinions (Myers & Rodriguez, 2016). Understanding underlying causes would also allow for more precise and targeted solutions that will better address factors that negatively affect the development of

competencies that are affected by the diverse changes in the scope of work. The most effective solution would not necessarily be to only determine the what they need to learn but to investigate issues external to the individuals that are barriers in the system (Li et al., 2020).

This study shows the future promise of informing policy development. For example, policies that are informed by the Sustainable Development Goals. The goals broadly focus on global prosperity, human well-being and a healthy planet (Sachs et al., 2019). The study's contribution can speak to various goals, such as Sustainable Development Goals 3 and 8 (Chiu & Fong, 2023). Goal 3 broadly focuses on ensuring healthy lives and promoting human well-being. Goal 8 broadly focuses on decent work and economic growth (Okulich-Kazarin et al., 2024). The following is a broad extrapolation of the study's potential. Further, we caution when extrapolating to do so in similar contextual environments like resource constrained settings. This study can influence and begin to speak to or have a longer-term policy impact that aids in refining factors related to developing competencies. Developed competencies will ultimately speak to the following two broad aspects of improved outcomes. Improved outcomes result in improved business, improved health outcomes, and, lastly, improved broad economic development from the work conducted by a healthy population. A healthy population contributes to the economy. The second related aspect is improved scientific outcomes, which result in improved businesses and, ultimately, improved economic development from well-established businesses. A healthy business contributes to the economy. Literature shows these aspects as focusing specifically on science and innovation (Davies et al., 2017; Okulich-Kazarin et al., 2024).

Recommendations would be to have more studies on competencies in scientific laboratories in Africa. The majority of the studies that were conducted to consider factors were based in developed countries, which are resource-rich, and this includes studies in scientific laboratories (Aronson & Rehm, 2015; Coccia & Cadario, 2014). These results and solutions are not replicable in a resource constraint setting. Wherever possible, aim for organizations with larger employee sizes. This will open up the study to richer datasets. This will refine the understanding of the phenomena. That said, the qualitative approach, interpretivist paradigm and central tendencies used were more than ideal for the small study size.

The second recommendation would be to explore establishing contextual leadership training in similar scientific laboratories. This can be measured over time to see if the eight identified themes will show a change in positive influences. As mentioned in the limitations section in chapter 5.09, there would be a need to consider how the continuity of the study will be addressed as this high employee turnover is an element.

5.8. Conclusion

This thesis sought to explore factors influencing the competencies of Scientific Laboratory technicians and give recommendations for improvement. This was a case study of a Scientific Laboratory based in a resource constraint setting. Literature has shown the great impact scientific laboratories have in pioneering discoveries, new businesses, and even industries (H. Beck et al., 2022). This has progressed research and industry endeavors to ultimately have a positive impact on society, resulting in their inclusion into South Africa's bioeconomy strategy (DST, 2013). The strategy encompasses biotechnological activities that translate into economic outputs, this includes but is not limited to technological and non-technological exploitation of biological materials to improve human health, address food security and subsequently contribute to economic growth and improved quality of life (Beluhova-Uzunova et al., 2023; Chitaka & Schenck, 2023).

Developing competencies will contribute to the creation of quality outputs, which in turn generate or attract funding. Africa is persistently working to build a reputation for diligence and quality outputs, which would result in an increase in the diversity and number of projects taken up. This is as the continent looks to retain an understanding of data collected from local samples (de Vries et al., 2015; N. Mulder et al., 2017; Nordling, 2018a). This needs the development of knowledge and the adoption of sustainable collaborations (Adame, 2021; Haelewaters et al., 2021). That is, delivery of quality outputs is essential to building customer confidence and satisfaction, which leads to enhancing reputation, which is key in enhancing organisational performance (Nair & Sankaranarayanan, 2014; Salman et al., 2020). Literature has shown that there are many critical cost implications to poor outcomes, some of which have

not been measured or accounted for (Malmi et al., 2004). Further, studies from various fields have shown a positive correlation between competencies and organisational performance and have suggested competencies to be a positive predictor of organisational performance (Salman et al., 2020). This ensures the viability of the Scientific organisation.

The technicians are key to developing quality outputs as they complete core functions that directly affect outputs. Further, in a resource constraint setting with specialized skills shortages, any employee turnover would be disruptive to the system (Ekene & Kelly, 2023; Hinkin & Tracey, 2000). Burnout and high employee turnover have been found to be costly to healthcare organizations as they have a direct impact on productivity and the quality of outputs (Al-Qathmi & Zedan, 2021). Therefore, it is important to develop and retain technicians. The study focused on, internally and in the system, what influences the technicians' competencies. To then become a successful technician, there are key skills to master, one of which is effective communication, with a sound competency and interest in science and technology (Shirvan, 2021). The learning theories focused on learning. It explored how these adults learn (Knowles), their self-efficacy (Bandura) and Community of Practice (Lave and Wenger) in which the technicians exist with their direct managers. While Systems theory overlaid and focused on what a viable system would look like in the context of the Scientific Laboratory, Viable Systems Model (Beer, 1984).

The recommendations for improvement were drawn from the last phase of the study, phase 6, the safe to fail experiment and survey with the senior managers. The findings, based on theoretical understanding, forms a good foundation with respect to understanding influences on the technicians' competencies. They can be used to inform shifting mindsets for current employees and create a new framework for onboard training for future employees. The findings can be used to create training resources that give an understanding of the key themes and their effect on developing competencies and, overall, the quality of outputs. I suggest that this would not require initial substantial monetary input for materials and processes, making it likely implementable in a resource constraint setting. The findings from the study will allow for better influences over the technician's competencies. This, in turn, will positively affect several processes and rates. For example, the employee turnover rate is reduced, and there is an improvement in the quality of the outputs in the Scientific Laboratory. Quality outputs attract

funding and generate business as the perception of the organizations ability to conduct work would have improved.

There was an element of the leadership theme that ran a thread through all of the discussed themes. Progress in societal and scientific spheres continues to highlight the importance of learning in organizations. Technology in science is continually growing and evolving at a rapid pace, and we are said to be in an era characterized by rapid change and innovation, which has transformed industries and created sustainable businesses (Hallema, 2023). Nurturing employee learning requires environments which prioritize learning-oriented leadership (Wallo et al., 2024; Yukl, 2009). It was then imperative to determine a shift in thinking in the senior managers as they have the power to action the recommended changes. The hope is that the senior managers are able to incorporate the findings from this study into their current everyday environment. The study has outlined downstream benefits of improved products, which range from better enabling research projects in academia to innovation in research and design and, lastly, patient outcomes in medically related applications.

Word count [72694 words]

6. References

- Abramo, G., D'Angelo, C. A., & Di Costa, F. (2011). University-industry research collaboration: a model to assess university capability. *Higher Education*, *62*, 163–181.
- Adame, F. (2021). Meaningful collaborations can end 'helicopter research.' *Nature*, *10*.
- Adler, M. G., & Fagley, N. S. (2005). Appreciation: Individual differences in finding value and meaning as a unique predictor of subjective well-being. *Journal of Personality*, *73*(1), 79–114.
- Adu, J., Owusu, M. F., Martin-Yeboah, E., Pino Gavidia, L. A., & Gyamfi, S. (2022). A discussion of some controversies in mixed methods research for emerging researchers. *Methodological Innovations*, *15*(3), 321–330.
- Affymetrix Announces Research Collaboration With Centre for Proteomic and Genomic Research CPGR in South Africa. (2012). In *Proteomics Weekly* (p. 6). NewsRX LLC.
- Ages, A. (2017). Undp Support to the Implementation of Sustainable Development Goal 3. *United Nations Development Programme*.
- Aggarwal, A. K., Davè, D. S., & Sharma, V. M. (2024). Supply chain disruption at the US ports: an assessment of underpinnings using the fishbone approach. *International Journal of Productivity and Quality Management*, *41*(1), 128–139.
- Akmalia, R., Nst, W. N., & Siahaan, A. (2023). Influence of Self-Efficacy, Organizational Culture, and Job Satisfaction on The Performance of Madrasah Aliyah Teachers. *Nidhomul Haq: Jurnal Manajemen Pendidikan Islam*, *8*(3), 437–453.
- Akpeji, K. O., Olasoji, A. O., Gaunt, C. T., Oyedokun, D. T. O., Awodele, K. O., & Folly, K. A. (2020). Economic impact of electricity supply interruptions in South Africa. *SAIEE Africa Research Journal*, *111*(2), 73–87.
- Al-Qathmi, A., & Zedan, H. (2021). The Effect of Incentive Management System on Turnover Rate, Job Satisfaction and Motivation of Medical Laboratory Technologists. *Health Services Research and Managerial Epidemiology*, *8*, 2333392820988404–

2333392820988404. <https://doi.org/10.1177/2333392820988404>

- Albert, M., Friesen, F., Rowland, P., & Laberge, S. (2019). Problematizing assumptions about interdisciplinary research: implications for health professions education research. *Advances in Health Sciences Education*. <https://doi.org/10.1007/s10459-019-09911-7>
- Algren, M., & Eichhorn, K. C. (2007). Cognitive communication competence within public relations practitioners: Examining gender differences between technicians and managers. *Public Relations Review*, 33(1), 77–83.
- Alhojailan, M. I. (2012). Thematic analysis: a critical review of its process and evaluation. *WEI International European Academic Conference Proceedings, Zagreb, Croatia*.
- Allen, K. E., & Cherrey, C. (2000). Systemic leadership: Enriching the meaning of our work. (No Title).
- Alsawidan, A. H., Al-Suwaidan, H. M. M., Alsawidan, A. M. M., Alyami, H. M. A., Alswidan, A. M., Alswidan, A. M., Al Suliman, A. H. S., Alsawidan, S. M. M., Alhayek, S. Y. S., & Alyami, M. M. A. (2023). Enhancing Efficiency And Accuracy In Medical Laboratories: The Role Of Lab Technicians. *Journal of Namibian Studies: History Politics Culture*, 36, 1920–1930.
- Andrews, C., Fortier, B., Hayward, A., Lederman, R., Petersen, L., McBride, J., Petersen, D. C., Ajayi, O., Kachambwa, P., & Seutloali, M. (2018). Development, evaluation, and implementation of a pan-African cancer research network: men of African descent and carcinoma of the prostate. *Journal of Global Oncology*, 4, 1–14.
- Angen, M. J. (2000). Evaluating interpretive inquiry: Reviewing the validity debate and opening the dialogue. *Qualitative Health Research*, 10(3), 378–395.
- Antony, J., Sony, M., & McDermott, O. (2023). Conceptualizing Industry 4.0 readiness model dimensions: an exploratory sequential mixed-method study. *The TQM Journal*, 35(2), 577–596.
- Aregger Lundh, A., Tannlund, C., & Ekwall, A. (2023). More support, knowledge and awareness are needed to prepare emergency department nurses to approach potential intimate partner violence victims. *Scandinavian Journal of Caring Sciences*, 37(2), 397–405.
- Aronson, S. J., & Rehm, H. L. (2015). Building the foundation for genomics in precision

- medicine. *Nature*, 526(7573), 336. <https://doi.org/10.1038/nature15816>
- Ashley, E. A. (2016). Towards precision medicine. *Nature Reviews Genetics*, 17(9), 507–522.
- Asmal, Z., Borat, H., de Villiers, D., & Martin, L. (2023). *Skilled Immigration in South Africa*.
- Assoratgoon, W., & Kantabutra, S. (2023). Toward a sustainability organizational culture model. *Journal of Cleaner Production*, 400, 136666.
- Atiti, A. B. (2012). Exploring possibilities of organisational learning-based change and transition towards sustainability. In *Learning for sustainability in times of accelerating change* (pp. 439–456). Wageningen Academic.
- Austin, K., Orcutt, S., & Rosso, J. (2001). How people learn: Introduction to learning theories. *The Learning Classroom: Theory into Practice—a Telecourse for Teacher Education and Professional Development*.
- Azad, A., Min, J.-G., Syed, S., & Anderson, S. (2020). Continued nursing education in low-income and middle-income countries: a narrative synthesis. *BMJ Global Health*, 5(2), e001981.
- Aziz, M. A., Ryszewska, K., Laszlo, A., Blanc, L., Organization, W. H., & Group, D. E. W. (2006). *Strategic approach for the strengthening of laboratory services for tuberculosis control, 2006-2009*. World Health Organization.
- Baatz, A. (2024). Transforming practices through social learning: change and stability, collectivity and materiality. *Environmental Education Research*, 1–19.
- Bachrach, D. G., Rapp, T. L., Rapp, A. A., & Ogilvie, J. (2023). “Too Much” Self-Efficacy? Understanding the Curvilinear Consequences of Between-Person Self-Efficacy through a Moderated-Mediation Model of Perceived Proximity and Employee Effort. *Group & Organization Management*, 48(6), 1544–1581. <https://doi.org/10.1177/10596011211070098>
- Bambo, T. L., & Pouris, A. (2020). Bibliometric analysis of bioeconomy research in South Africa. *Scientometrics*, 125(1), 29–51.
- Bandura, A. (1977). *Social learning theory*. Prentice Hall.
- Bandura, A. (1997). *Self-efficacy: the exercise of control*. W.H. Freeman.
- Barab, S. A., Barnett, M., & Squire, K. (2002). Developing an empirical account of a

- community of practice: Characterizing the essential tensions. *The Journal of the Learning Sciences*, 11(4), 489–542.
- Barakat, A., Woolrych, R. D., Sixsmith, A., Kearns, W. D., & Kort, H. S. M. (2013). eHealth technology competencies for health professionals working in home care to support older adults to age in place: outcomes of a two-day collaborative workshop. *Journal of Medical Internet Research*, 15(9), e10–e10. <https://doi.org/10.2196/med20.2711>
- Barbour, R. S. (2007). *Doing focus groups*. SAGE.
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120.
- Baseke, J., Iramiot, J., Charles, O., Didas, A., Isabirye, L., Oboth, P., & Olupot-Olupot, P. (2022). *Opportunities and challenges in public health clinical diagnostic laboratories in Uganda: a cross sectional study*.
- Baumgartner, R. J. (2009). Organizational culture and leadership: Preconditions for the development of a sustainable corporation. *Sustainable Development*, 17(2), 102–113.
- Bavoria, S., Nongkynrih, B., & Krishnan, A. (2019). Health workforce availability and competency to manage noncommunicable diseases at secondary care level hospitals of Delhi. *International Journal of Noncommunicable Diseases*, 4(2), 38–42. https://doi.org/10.4103/jncd.jncd_10_19
- Baxter, P., & Jack, S. (2008). Qualitative case study methodology: study design and implementation for novice researchers.(Report). *The Qualitative Report*, 13(4), 544.
- Beauchamp, T. (2008). *The principle of beneficence in applied ethics*.
- Beck, H., Härter, M., Haß, B., Schmeck, C., & Baerfacker, L. (2022). Small molecules and their impact in drug discovery: A perspective on the occasion of the 125th anniversary of the Bayer Chemical Research Laboratory. *Drug Discovery Today*, 27(6), 1560–1574.
- Beck, S., & Doig, K. (2005). Laboratory managers' views on attrition and retention of laboratory personnel. *American Society for Clinical Laboratory Science*, 18(4), 238–247.
- Beed, P. L., Hawkins, E. M., & Roller, C. M. (1991). Moving Learners toward Independence: The Power of Scaffolded Instruction. In *Source: The Reading Teacher* (Vol. 44, Issue 9). <https://www-jstor->

org.ezproxy.uct.ac.za/stable/pdf/20200767.pdf?refreqid=excelsior%3A12d34618afadbb13a17e48774b22704c

- Beer, S. (1981). *Brain of the firm : the managerial cybernetics of organization* (2nd ed). J. Wiley.
- Beer, S. (1984). The Viable System Model: Its Provenance, Development, Methodology and Pathology. *Journal of the Operational Research Society*, 35(1), 7. <https://doi.org/10.1057/jors.1984.2>
- Beer, S. (1985). *Diagnosing the system for organizations : the managerial cybernetics of organization* . John Wiley.
- Beluhova-Uzunova, R., Shishkova, M., & Ivanova, B. (2023). BIOECONOMY STRATEGIES: VISIONS AND PROSPECTS. *Trakia Journal of Sciences*, 21(1), 110–117.
- Bennett, R. (2002). Employers' demands for personal transferable skills in graduates: A content analysis of 1000 job advertisements and an associated empirical study. *Journal of Vocational Education and Training*, 54(4), 457–476.
- Biber-Freudenberger, L., Ergeneman, C., Förster, J. J., Dietz, T., & Börner, J. (2020). Bioeconomy futures: Expectation patterns of scientists and practitioners on the sustainability of bio-based transformation. *Sustainable Development*, 28(5), 1220–1235.
- Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member checking: a tool to enhance trustworthiness or merely a nod to validation? *Qualitative Health Research*, 26(13), 1802–1811.
- Blessinger, P. (2015). Educational Research Methodology Framework. In *Higher Education Tomorrow academic blog* (Issue October). <http://www.patrickblessinger.com/ermf/>
- Blithe, S. J. (2014). Creating the water cooler: Virtual workers' discursive practices of gossip. *Qualitative Research Reports in Communication*, 15(1), 59–65.
- Boddy, C. R. (2016). Sample size for qualitative research. *Qualitative Market Research: An International Journal*, 19(4), 426–432.
- Bolander Laksov, K., Dornan, T., & Teunissen, P. W. (2017). Making theory explicit-An analysis of how medical education research (ers) describe how they connect to theory.

BMC Medical Education, 17, 1–9.

- Boone Jr, H. N., & Boone, D. A. (2012). Analyzing likert data. *The Journal of Extension*, 50(2), 48.
- Botha, C. J., & Rasool, F. (2011). *The nature, extent and effect of skills shortages on skills migration in South Africa : original research*. <https://www.ingentaconnect.com/content/sabinet/sajhrm/2011/00000009/00000001/art00011>
- Bowen, G. A. (2008). Naturalistic inquiry and the saturation concept: a research note. *Qualitative Research : QR*, 8(1), 137–152. <https://doi.org/10.1177/1468794107085301>
- Bowen, G. A. (2009). Document Analysis as a Qualitative Research Method. *Qualitative Research Journal*, 9(2), 27–40. <https://doi.org/10.3316/QRJ0902027>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Bray, S. R., & Brawley, L. R. (2002). Role efficacy, role clarity, and role performance effectiveness. *Small Group Research*, 33(2), 233–253.
- Briggs, C. L. (1986). *Learning how to ask: A sociolinguistic appraisal of the role of the interview in social science research* (Issue 1). Cambridge university press.
- Brinkmann, S. (2014). Unstructured and semi-structured interviewing. *The Oxford Handbook of Qualitative Research*, 2, 277–299.
- Brodin, P., & Davis, M. M. (2017). Human immune system variation. *Nature Reviews Immunology*, 17(1), 21–29.
- Brown, A. D., & Starkey, K. (1994). The effect of organizational culture on communication and information. *Journal of Management Studies*, 31(6), 807–828.
- Brown, T. (2008). Design thinking. *Harvard Business Review*, 86(6), 84.
- Brunner, M., McGregor, D., Keep, M., Janssen, A., Spallek, H., Quinn, D., Jones, A., Tseris, E., Yeung, W., Togher, L., Solman, A., & Shaw, T. (2018). An eHealth Capabilities Framework for Graduates and Health Professionals: Mixed-Methods Study. *Journal of Medical Internet Research*, 20(5), e10229–e10229. <https://doi.org/10.2196/10229>
- Bunniss, S., & Kelly, D. R. (2010). Research paradigms in medical education research. *Medical*

- Education*, 44(4), 358–366. <https://doi.org/10.1111/j.1365-2923.2009.03611.x>
- Burke, D., Herrman, H., Evans, M., Cockram, A., & Trauer, T. (2000). Educational aims and objectives for working in multidisciplinary teams. In *Australasian Psychiatry* • (Vol. 8, Issue 4). <https://journals-sagepub-com.ezproxy.uct.ac.za/doi/pdf/10.1046/j.1440-1665.2000.00277.x>
- Cai, Z., Fan, X., & Du, J. (2017). Gender and attitudes toward technology use: A meta-analysis. *Computers & Education*, 105, 1–13.
- Callahan, C. A., Hojat, M., & Gonnella, J. S. (2007). Volunteer bias in medical education research: an empirical study of over three decades of longitudinal data. *Medical Education*, 41(8), 746–753. <https://doi.org/10.1111/j.1365-2923.2007.02803.x>
- Campbell, M. C., & Tishkoff, S. A. (2008). African genetic diversity: Implications for human demographic history, modern human origins, and complex disease mapping. *Annual Review of Genomics and Human Genetics*, 9, 403–433. <https://doi.org/10.1146/annurev.genom.9.081307.164258>
- Campbell, P., & Evans, P. (2016). Reciprocal benefits, legacy and risk: applying Ellinger and Bostrom’s model of line manager role identity as facilitators of learning. *European Journal of Training and Development*, 40(2), 74–89.
- Carol Ramos, M. (1992). The nurse-patient relationship: theme and variations. *Journal of Advanced Nursing*, 17(4), 496–506.
- Casañ, M. J., Alier, M., & Llorens, A. (2021). A collaborative learning activity to analyze the sustainability of an innovation using PESTLE. *Sustainability*, 13(16), 8756.
- Ceballos, M., Madrigal-Cadavid, J., & Amariles, P. (2021). Educational programs and interventions offered to pharmacy staff to improve the delivery of pharmaceutical assistance services: A structured review. *Revista de La Universidad Industrial de Santander. Salud*, 53.
- Çelik, G. (2013). A magical way for education: visual literacy. *Science & Philosophy*, 1(2), 143–150.
- Challi, S., Miecha, H., Damtie, D., Shumie, G., Chali, W., Hailu, T., Tadesse, F. G., & Gadisa, E. (2020). The Unmet Need: Low Performance of Laboratory Professionals in Malaria Microscopy, Oromia Regional State, Ethiopia. *The American Journal of Tropical*

Medicine and Hygiene, 102(1), 117–120. <https://doi.org/10.4269/ajtmh.19-0106>

- Chan, A., Darwish, R., & Shamim, S. (2021). Pharmacy practice and continuing professional development in low and middle income countries (LMICs). In *Pharmacy practice research case studies* (pp. 187–205). Elsevier.
- Charani, E., Abimbola, S., Pai, M., Adeyi, O., Mendelson, M., Laxminarayan, R., & Rasheed, M. A. (2022). Funders: The missing link in equitable global health research? *PLOS Global Public Health*, 2(6), e0000583.
- Chauhan, K. P., Trivedi, A. P., Patel, D., Gami, B., & Haridas, N. (2014). Monitoring and root cause analysis of clinical biochemistry turn around time at an academic hospital. *Indian Journal of Clinical Biochemistry : IJCB*, 29(4), 505–509. <https://doi.org/10.1007/s12291-013-0397-x>
- Checkland, P. (1999). Soft systems methodology : a 30-year retrospective . In P. Checkland (Ed.), *Systems thinking, systems practice*. John Wiley & Sons.
- Checkland, P., & Scholes, J. (1991). Soft Systems Methodology in Action. In *The Journal of the Operational Research Society* (Vol. 42, Issue 9, p. 818). Pergamon Press. <https://doi.org/10.1057/jors.1991.157>
- Chekijian, S., Yedigaryan, K., Bazarchyan, A., Yaghjyan, G., & Sargsyan, S. (2021). Continuing medical education and continuing professional development in the republic of Armenia: the evolution of legislative and regulatory frameworks post transition. *Journal of European CME*, 10(1), 1853338.
- Chen, G., & Bliese, P. D. (2002). The Role of Different Levels of Leadership in Predicting Self- and Collective Efficacy: Evidence for Discontinuity. *Journal of Applied Psychology*, 87(3), 549–556. <https://doi.org/10.1037/0021-9010.87.3.549>
- Chen, S.-W., Lee, K.-Y., & Hsieh, C.-M. (2021). Determinants of Consumers' Trust in Biotech Brands and Purchase Intentions towards the Cord Blood Products. *International Journal of Environmental Research and Public Health*, 18(21), 11574.
- Chitaka, T. Y., & Schenck, C. (2023). Developing country imperatives in the circular bioeconomy: A review of the South African case. *Environmental Development*, 45, 100812.
- Chiu, W.-K., & Fong, B. Y. F. (2023). Sustainable Development Goal 3 in Healthcare. In

Environmental, social and governance and sustainable development in healthcare (pp. 33–45). Springer.

Choudhury, P., N Lane, J., & Bojinov, I. (2023). Virtual Water Coolers: A Field Experiment on the Role of Virtual Interactions on Organizational Newcomer Performance. *Harvard Business School Technology & Operations Mgt. Unit Working Paper*, 21–125.

Christie, M., Carey, M., Robertson, A., & Grainger, P. (2015). Putting transformative learning theory into practice. *Australian Journal of Adult Learning*, 55(1), 9–30.

Christopher, W. (2010). From System Science - A New Way to Structure and Manage the Company for Sustainable Success. *Service Science*, 2(1–2), 62–75. https://doi.org/10.1287/serv.2.1_2.62

Chu, K. M., Jayaraman, S., Kyamanywa, P., & Ntakiyiruta, G. (2014). Building research capacity in Africa: equity and global health collaborations. *PLoS Medicine*, 11(3), e1001612. <https://doi.org/10.1371/journal.pmed.1001612>

Church, A. H. (2000). Do Higher Performing Managers Actually Receive Better Ratings?: A Validation of Multirater Assessment Methodology. *Consulting Psychology Journal*, 52(2), 99–116. <https://doi.org/10.1037/1061-4087.52.2.99>

Cicchetti, D. V., & Sparrow, S. A. (1981). Developing criteria for establishing interrater reliability of specific items: applications to assessment of adaptive behavior. *American Journal of Mental Deficiency*, 86(2), 127–137.

Clarke, V., & Braun, V. (2017). Thematic analysis. *The Journal of Positive Psychology*, 12(3), 297–298.

Clayton, M., & Marczak, M. (2023). Palliative care nurses' experiences of stress, anxiety, and burnout: A thematic synthesis. *Palliative & Supportive Care*, 21(3), 498–514.

Clutterbuck, D. (2004). *Everyone needs a mentor : fostering talent in your organisation* (4th ed.). Chartered Institute of Personnel and Development.

Coakes, E., & Clark, S. (2006). *Communities of Practice: The Concept in Information and Knowledge Management*. IRM Press, Hershey, PA.

Coccia, M., & Cadario, E. (2014). Organisational (un)learning of public research labs in turbulent context. *Int. J. of Innovation and Learning*, 15, 115–129.

<https://doi.org/10.1504/IJIL.2014.059756>

- Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, 20(1), 37–46.
- Cohen, L., Manion, L., & Morrison, K. (Keith R. B. . (2011). *Research methods in education* (L. Manion & K. (Keith R. B. . Morrison (Eds.); 7th ed.). Routledge.
- Conger, J. A., & Kanungo, R. N. (1988). The empowerment process: Integrating theory and practice. *Academy of Management Review*, 13(3), 471–482.
- Conlon, M., Molloy, O., & ZolzerBryce, N. (2020). Driving the Bus: A Radiology Case Study Utilizing Rich Picture Diagramming and CATWOE to Capture Staff Perceptions and Inform Service Improvement Scenarios. *KMIS*, 88–99.
- Connell, J., Zurn, P., Stilwell, B., Awases, M., & Braichet, J.-M. (2007). Sub-Saharan Africa: beyond the health worker migration crisis? *Social Science & Medicine*, 64(9), 1876–1891.
- Connell, R. (2014). Using southern theory: Decolonizing social thought in theory, research and application. *Planning Theory*, 13(2), 210–223.
- Connelly, B. L., Certo, S. T., Ireland, R. D., & Reutzel, C. R. (2011). Signaling theory: A review and assessment. *Journal of Management*, 37(1), 39–67.
- Cook, D. A., Levinson, A. J., & Garside, S. (2011). Method and reporting quality in health professions education research: a systematic review. *Medical Education*, 45(3), 227–238. <https://doi.org/10.1111/j.1365-2923.2010.03890.x>
- Corso, M., & Giacobbe, A. (2005). Building Communities of Practice that Work: a case study based research. *The Sixth European Conference on Organizational Knowledge, Learning, and Capabilities*, 17–19.
- Coughlin, K., & Posencheg, M. A. (2019). Quality improvement methods–Part II. *Journal of Perinatology*, 39(7), 1000–1007.
- Crabtree, B. F., & Miller, W. L. (William L. (Eds.). (1992). *Doing qualitative research* . Sage Publications.
- Crans, S., Bude, V., Beusaert, S., & Segers, M. (2021). Social informal learning and the role of learning climate: Toward a better understanding of the social side of learning among consultants. *Human Resource Development Quarterly*, 32(4), 507–535.

- Creswell, J. W. (2018). Qualitative inquiry and research design : choosing among five approaches . In *Qualitative inquiry & research design* (4th ed. In). SAGE Publications.
- Crisan, E. L., Covaliu, B. F., & Chis, D. M. (2021). A systematic literature review of quality management initiatives in dental clinics. *International Journal of Environmental Research and Public Health*, *18*(21), 11084.
- Cropanzano, R., Howes, J. C., Grandey, A. A., & Toth, P. (1997). The relationship of organizational politics and support to work behaviors, attitudes, and stress. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *18*(2), 159–180.
- Crowe, S., Brown, K., Tregay, J., Wray, J., Knowles, R., Ridout, D. A., Bull, C., & Utley, M. (2017). Combining qualitative and quantitative operational research methods to inform quality improvement in pathways that span multiple settings. *BMJ Quality & Safety*, *26*(8), 641–652.
- Croxatto, A., & Greub, G. (2017). Project management: importance for diagnostic laboratories. *Clinical Microbiology and Infection*, *23*(7), 434–440.
- Cutlip, S. M., Center, A. H., & Broom, G. M. (2006). Effective public Relations, edisi kesembilan. *Jakarta: Kencana Prenada Media Group*.
- Dalirazar, S., & Sabzi, Z. (2023). Strategic analysis of barriers and solutions to development of sustainable buildings using PESTLE technique. *International Journal of Construction Management*, *23*(1), 167–181.
- Daniels, R. (2007). Skills Shortages in South Africa: A Literature Review. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.992111>
- Datta, L. (1994). Paradigm wars: A basis for peaceful coexistence and beyond. *New Directions for Program Evaluation*, *1994*(61), 53–70.
- Davies, P. (2007). The radical accuracy of the subjective viewpoint. *The British Journal of General Practice : The Journal of the Royal College of General Practitioners*, *57*(543), 848.
- de Vries, J., Tindana, P., Littler, K., Ramsay, M., Rotimi, C., Abayomi, A., Mulder, N., & Mayosi, B. (2015). The H3Africa policy framework: negotiating fairness in genomics. *Trends in Genetics*, *31*(3), 117–119.

<https://doi.org/https://doi.org/10.1016/j.tig.2014.11.004>

- DeCanio, S. J., Dibble, C., & Amir-Atefi, K. (2000). The importance of organizational structure for the adoption of innovations. *Management Science*, *46*(10), 1285–1299.
- DeCuir-Gunby, J. T., Marshall, P. L., & McCulloch, A. W. (2011). Developing and using a codebook for the analysis of interview data: An example from a professional development research project. *Field Methods*, *23*(2), 136–155.
- Dendrou, C. A., Petersen, J., Rossjohn, J., & Fugger, L. (2018). HLA variation and disease. *Nature Reviews Immunology*, *18*(5), 325–339.
- Denscombe, M. (2010). *The good research guide : for small-scale social research projects* (4th ed.). McGraw-Hill/Open University Press.
- Department of Labour. (2006). *State of Skills in South Africa*. Pretoria: Government Press.
- Deprez, D., Busch, A. J., Ramirez, P. A., Pedrozo Araque, E., & Bidonde, J. (2023). Capacity-building and continuing professional development in healthcare and rehabilitation in low- and middle-income countries—a scoping review protocol. *Systematic Reviews*, *12*(1), 1–8.
- DeSantis, L., & Ugarriza, D. N. (2000). The Concept of Theme as Used in Qualitative Nursing Research. *Western Journal of Nursing Research*, *22*(3), 351–372. <https://doi.org/10.1177/019394590002200308>
- Desjardins, M., & Fleming, C. A. (2014). Competency assessment of microbiology medical laboratory technologists in Ontario, Canada. *Journal of Clinical Microbiology*, *52*(8), 2940–2945.
- Dewey, J. (2018). The Influence of Darwinism on Philosophy. *Nóema (Milano)*, *9*. <https://doi.org/10.13130/2239-5474/9956>
- Dias, A., & Selan, B. (2023). How does university-industry collaboration relate to research resources and technical-scientific activities? An analysis at the laboratory level. *The Journal of Technology Transfer*, *48*(1), 392–415.
- Dicicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education*, *40*(4), 314–321. <https://doi.org/10.1111/j.1365-2929.2006.02418.x>
- Dierking, L. (1991). Learning theory and learning styles: An overview. *The Journal of Museum*

Education, 16(1), 4–6.

- Dietz, T., Rubio, K., & Börner, J. (2020). Designing Sustainability Governance for the Bioeconomy—A Global Expert Survey. *International Advisory Council on Global Bioeconomy: Berlin, Germany*.
- DiFonzo, N. (2008). *The watercooler effect: An indispensable guide to understanding and harnessing the power of rumors*. Penguin.
- Dingel, J., & Maffett, M. G. (2023). THE EFFECT OF WORK ENVIRONMENT AND INDIVIDUAL CHARACTERISTICS ON MEDICAL MEDICAL EMPLOYEE PERFORMANCE AT PT SARI TANI SUMATRA. *MEDALION JOURNAL: Medical Research, Nursing, Health and Midwife Participation*, 4(1), 6–14.
- Dirkx, J. M., Mezirow, J., & Cranton, P. (2006). Musings and Reflections on the Meaning, Context, and Process of Transformative Learning: A Dialogue Between John M. Dirkx and Jack Mezirow. *Journal of Transformative Education*, 4(2), 123–139. <https://doi.org/10.1177/1541344606287503>
- Döös, M., Johansson, P., & Wilhelmson, L. (2015). Beyond being present: Learning-oriented leadership in the daily work of middle managers. *Journal of Workplace Learning*, 27(6), 408–425.
- dos Santos, F. C., Riner, M. E., & Henriques, S. H. (2019). Brazilian questionnaire of competencies of oncology nurses: Construction and test of content validation. *International Journal of Nursing Sciences*, 6(3), 288–293. <https://doi.org/10.1016/j.ijnss.2019.06.005>
- Draissi, Z., Rong, Y., & Ebrahim Suliman, M. A. (2023). Employability and Education Mismatch in the Moroccan Urban Workplace. *SAGE Open*, 13(4), 21582440231217890.
- Drolet, B. C., & Lorenzi, N. M. (2011). Translational research: understanding the continuum from bench to bedside. *Translational Research*, 157(1), 1–5.
- Drory, A. (1993). Perceived political climate and job attitudes. *Organization Studies*, 14(1), 59–71.
- DST, D. of S. and T. (2013). *The Bio-economy Strategy is an initiative of the Department of Science and Technology, South Africa*. Department of Science and Technology (DST). http://www.gov.za/sites/default/files/gcis_document/201409/bioeconomy-strategya.pdf

- Dufour, L., Escribano, P. I., & Maoret, M. (2021). (How) Will I Socialize You? The Impact of Supervisor Initial Evaluations and Subsequent Support on the Socialization of Temporary Newcomers. *Organization Science (Providence, R.I.)*, 32(3), 881–908. <https://doi.org/10.1287/orsc.2021.1468>
- Dunleavy, K., Chevan, J., Sander, A. P., Gasherebuka, J. D., & Mann, M. (2018). Application of a contextual instructional framework in a continuing professional development training program for physiotherapists in Rwanda. *Disability and Rehabilitation*, 40(13), 1600–1608.
- Ekene, A. K., & Kelly, T.-D. (2023). Opportunities, Challenges and Risks: The South African Business Environment Profiling Opportunities and Challenges of Running Small and Medium-Sized Businesses in the Post-Apartheid Vhembe District of the Limpopo Province of South Africa. *Sustainable and Responsible Business in Africa: Studies in Ethical Leadership*, 41–61.
- El-Kamah, G. Y., Mohamed, A. M., Gad, Y. Z., Abdelhak, S., Hennig, B. J., Ramesar, R. S., Landouré, G., Gaye, A., Newport, M. J., & Williams, S. M. (2020). Developing a road map to spread genomic knowledge in Africa: 10th Conference of the African Society of Human Genetics, Cairo, Egypt. *The American Journal of Tropical Medicine and Hygiene*, 102(4), 719–723.
- Elbireer, A. M., Jackson, J. B., Sendagire, H., Opio, A., Bagenda, D., & Amukele, T. K. (2013). The good, the bad, and the unknown: quality of clinical laboratories in Kampala, Uganda. *PLoS One*, 8(5), e64661.
- Elezi, F., Schmidt, M. T., Tommelein, I. D., & Lindemann, U. (2014). *Analyzing implementation of lean production control with the Viable System Model* (Vols. 2015-, pp. 443–447). IEEE. <https://doi.org/10.1109/IEEM.2014.7058677>
- Eliakim, T. (2020). *Effect of exchange rates and inflation rates on Agricultural exports in Tanzania*. Institute of accountancy Arusha.
- Ellapen, M. T., Ellapen, T. J., & Paul, Y. (2021). The growth patterns of the medical technology profession in South Africa. *African Journal of Laboratory Medicine*, 10(1), 1–5.
- Enaifoghe, A., Dlamini, N. P., Jili, N. N., & Mthethwa, R. (2023). The role of e-government as enabler of good governance for socio-economic development in South Africa.

International Journal of Social Science Research and Review, 6(1), 493–508.

- Engen, B. K. (2019). Understanding social and cultural aspects of teachers' digital competencies. *Comunicar*, 27(61), 9–19.
- English, L. P. (1999). *Improving data warehouse and business information quality: methods for reducing costs and increasing profits*. John Wiley & Sons, Inc.
- Espejo, R. (1990). The Viable System Model. *Systems Practice*, 3(3), 219–221. <https://doi.org/10.1007/BF01062728>
- Espinosa, A. M., Walker, J., & Martinez-Lozada, A. C. (2023). The Viable System Model: An Introduction to Theory and Practice. *Journal of Systems Thinking*, 1–19.
- Eviyanti, N. (2021). Analisis Fishbone Diagram Untuk Mengevaluasi Pembuatan Peralatan Aluminium Studi Kasus Pada Sp Aluminium Yogyakarta. *JAAKFE UNTAN (Jurnal Audit Dan Akuntansi Fakultas Ekonomi Universitas Tanjungpura)*, 10(1), 10–18.
- Faber, J., & Fonseca, L. M. (2014). How sample size influences research outcomes. *Dental Press Journal of Orthodontics*, 19, 27–29.
- Farjoun, M., Ansell, C., & Boin, A. (2015). Pragmatism in Organization Studies: Meeting the Challenges of a Dynamic and Complex World. *Organization Science (Providence, R.I.)*, 26(6), 1787–1804. <https://doi.org/10.1287/orsc.2015.1016>
- Feng, P., Hao, J., Wang, Y., Zhang, Y., Yu, T., & Gu, L. (2023). A cross-sectional survey on nurses in burn departments: core competencies and influencing factors. *Burns*, 49(5), 1218–1224.
- Ferguson, C. (1998). The continuous professional development of engineers and flexible learning strategies. *International Journal of Lifelong Education*, 17(3), 173–183. <https://doi.org/10.1080/0260137980170303>
- Ferris, G. R., Ellen III, B. P., McAllister, C. P., & Maher, L. P. (2019). Reorganizing organizational politics research: A review of the literature and identification of future research directions. *Annual Review of Organizational Psychology and Organizational Behavior*, 6, 299–323.
- Finch, J. (1987). The Vignette Technique in Survey Research. *Sociology*, 21(1), 105–114. <http://www.jstor.org/stable/42854387>

- Fleischhauer, K., Horn, P. A., & Harmer, A. (2018). Immunogenetics Laboratory. In *Establishing a Hematopoietic Stem Cell Transplantation Unit* (pp. 111–128). Springer International Publishing. https://doi.org/10.1007/978-3-319-59358-6_8
- Fleiss, J. L., Levin, B., & Paik, M. C. (2013). *Statistical methods for rates and proportions*. John Wiley & Sons.
- Forero, R., Nahidi, S., De Costa, J., Mohsin, M., Fitzgerald, G., Gibson, N., McCarthy, S., & Aboagye-Sarfo, P. (2018). Application of four-dimension criteria to assess rigour of qualitative research in emergency medicine. *BMC Health Services Research*, *18*(1), 1–11.
- Franzen, S. R. P., Chandler, C., & Lang, T. (2017). Health research capacity development in low and middle income countries: reality or rhetoric? A systematic meta-narrative review of the qualitative literature. *BMJ Open*, *7*(1), e012332. <https://doi.org/10.1136/bmjopen-2016-012332>
- Gaio, D., Anantanawat, K., To, J., Liu, M., Monahan, L., & Darling, A. E. (2022). Hackflex: low-cost, high-throughput, Illumina Nextera Flex library construction. *Microbial Genomics*, *8*(1), 744.
- Garcia, M. B., & Garcia, P. S. (2023). Intelligent tutoring system as an instructional Technology in Learning Basic Nutrition Concepts: an exploratory sequential mixed methods study. In *Handbook of research on instructional Technologies in Health Education and Allied Disciplines* (pp. 265–284). IGI Global.
- Garg, N., & Mahipalan, M. (2023). Exploring intergenerational differences in the virtue of appreciation at the workplace. *Social Responsibility Journal*, *19*(5), 812–828.
- Gass, R. H. (2015). *Social Influence, Sociology of* (J. D. B. T.-I. E. of the S. & B. S. (Second E. Wright (Ed.); pp. 348–354). Elsevier. <https://doi.org/https://doi.org/10.1016/B978-0-08-097086-8.32074-8>
- Gebregzabher, E. H., Tesfaye, F., Cheneke, W., Edao, A., & Kedida, G. (2022). *Continuing Professional Development (CPD) Training Need Assessment for Medical Laboratory Professionals in Ethiopia*.
- Geer, J. (1988). What Do Open-Ended Questions Measure? *The Public Opinion Quarterly*, *52*(3), 365. <https://doi.org/10.1086/269113>
- Gibbons, M. (Ed.). (1994). *The New production of knowledge : the dynamics of science and*

research in contemporary societies . Sage.

- Gill, P., & Baillie, J. (2018). Interviews and focus groups in qualitative research: an update for the digital age. *British Dental Journal*, 225(7), 668–672.
- Gisby, A., Ross, C., Francis-Smythe, J., & Anderson, K. (2023). The ‘rich pictures’ method: Its use and value, and the implications for HRD research and practice. *Human Resource Development Review*, 22(2), 204–228.
- Gold, J., & Bratton, J. (2003). The Dynamics of Professionalization: Whither the HRM Profession. *Critical Management Studies Conference*, 2(3), 17–22.
- Goldsmith, R. (1997). Reputation: Realizing Value from the Corporate Image. In *The Service Industries Journal* (Vol. 17, Issue 2, pp. 354–355). Taylor & Francis Ltd.
- Gong, Y., Huang, J.-C., & Farh, J.-L. (2009). Employee Learning Orientation, Transformational Leadership, and Employee Creativity: The Mediating Role of Employee Creative Self-Efficacy. *The Academy of Management Journal*, 52(4), 765–778. <https://doi.org/10.5465/AMJ.2009.43670890>
- Goswami, A. (2018). Human resource management and its importance for today’s organizations. *Journal of Advances and Scholarly Researches in Allied Education*, 15(3), 128–135.
- Graf, W. D., Cohen, B. H., Kalsner, L., Pearl, P. L., Sarnat, H. B., Epstein, L. G., & Society, E. C. of the C. N. (2023). Fetal anomaly diagnosis and termination of pregnancy. *Developmental Medicine & Child Neurology*, 65(7), 900–907.
- Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis*, 11(3), 255–274.
- Griffiths, V. (2000). The reflective dimension in teacher education. *International Journal of Educational Research*, 33(5), 539–555. [https://doi.org/10.1016/S0883-0355\(00\)00033-1](https://doi.org/10.1016/S0883-0355(00)00033-1)
- Guay, F., Ratelle, C. F., Senécal, C., Larose, S., & Deschênes, A. (2006). Distinguishing Developmental From Chronic Career Indecision: Self-Efficacy, Autonomy, and Social Support. *Journal of Career Assessment*, 14(2), 235–251. <https://doi.org/10.1177/1069072705283975>

- Guillaume, D., Troncoso, E., Duroseau, B., Bluestone, J., & Fullerton, J. (2022). Mobile-Social Learning for Continuing Professional Development in Low-and Middle-Income Countries: Integrative Review. *JMIR Medical Education*, 8(2), e32614.
- Gupta, A. (2013). Environment & PEST analysis: an approach to external business environment. *International Journal of Modern Social Sciences*, 2(1), 34–43.
- Gupta, M. L., & Pyngavil, R. S. (2012). Effective team building in relation to organizational culture and organizational climate in banking sector: An inter-correlation analysis. *Prestige International Journal of Management & IT-Sanchayan*, 1(1), 52–66.
- Gurdasani, D., Carstensen, T., Tekola-Ayele, F., Pagani, L., Tachmazidou, I., Hatzikotoulas, K., Karthikeyan, S., Iles, L., Pollard, M. O., Choudhury, A., Ritchie, G. R. S., Xue, Y., Asimit, J., Nsubuga, R. N., Young, E. H., Pomilla, C., Kivinen, K., Rockett, K., Kamali, A., ... Sandhu, M. S. (2015). The African Genome Variation Project shapes medical genetics in Africa. *Nature*, 517(7534), 327–332. <https://doi.org/10.1038/nature13997>
- Gut, A., Wilczewski, M., & Gorbaniuk, O. (2017). Cultural differences, stereotypes and communication needs in intercultural communication in a global multicultural environment: The employees' perspective. *Journal of Intercultural Communication*, 2017(43), N_A-N_A.
- Haelewaters, D., Hofmann, T. A., & Romero-Olivares, A. L. (2021). Ten simple rules for Global North researchers to stop perpetuating helicopter research in the Global South. In *PLoS Computational Biology* (Vol. 17, Issue 8, p. e1009277). Public Library of Science.
- Hafferty, F. W., & Franks, R. (1994). The hidden curriculum, ethics teaching, and the structure of medical education. *Academic Medicine*, 69(11), 861–871.
- Hafferty, F. W., & Martimianakis, M. A. (2018). A rose by other names: some general musings on Lawrence and colleagues' hidden curriculum scoping review. *Academic Medicine*, 93(4), 526–531.
- Hailu, H. A., Shiferaw, M. B., Demeke, L., Derebe, M. M., Gelaw, Z. D., Emiru, M. A., & Lake, M. W. (2017). External quality assessment of malaria microscopy diagnosis among public health facilities in West Amhara Region, Ethiopia. *BMC Research Notes*, 10(1), 764. <https://doi.org/10.1186/s13104-017-3080-0>
- Hall Barber, K., Schultz, K., Scott, A., Pollock, E., Kotecha, J., & Martin, D. (2015). Teaching

- Quality Improvement in Graduate Medical Education: An Experiential and Team-Based Approach to the Acquisition of Quality Improvement Competencies. *Academic Medicine*, 90(10), 1363–1367. <https://doi.org/10.1097/ACM.0000000000000851>
- Hallema, D. W. (2023). Breaking Barriers: The Latest Advancements in Science, Technology, and Business. *International Multidisciplinary Journal Of Science, Technology & Business*, 2(3), 12–21.
- Hamberg, K., Johansson, E., Lindgren, G., & Westman, G. (1994). Scientific rigour in qualitative research—examples from a study of women’s health in family practice. *Family Practice*, 11(2), 176–181.
- Hamilton, D. L., & Sherman, S. J. (1996). Perceiving Persons and Groups. *Psychological Review*, 103(2), 336–355. <https://doi.org/10.1037/0033-295X.103.2.336>
- Hamilton, M. (2011). *The impact of organizational culture on communities of practice within a faith-based organization*. Southern Illinois University at Carbondale.
- Hammond, C. (2005). The Wider Benefits of Adult Learning: An Illustration of the Advantages of Multi-method Research. *International Journal of Social Research Methodology*, 8(3), 239–255. <https://doi.org/10.1080/13645570500155037>
- Hancock, M. E., Amankwaa, L., Revell, M. A., & Mueller, D. (2016). Focus group data saturation: A new approach to data analysis. *Qualitative Report*, 21(11), 2124–2130.
- Hand, H. (2003). The mentor’s tale: a reflexive account of semi-structured interviews. *Nurse Researcher*, 10(3), 15–27. <https://doi.org/10.7748/nr2003.04.10.3.15.c5893>
- Hanson, J. L., Balmer, D. F., & Giardino, A. P. (2011). Qualitative research methods for medical educators. *Academic Pediatrics*, 11(5), 375–386. <https://doi.org/10.1016/j.acap.2011.05.001>
- Hargreaves, A. (2010). Presentism, individualism, and conservatism: The legacy of Dan Lortie’s schoolteacher: A sociological study. *Curriculum Inquiry*, 40(1), 143–154.
- Hartley, S., Raphael, J., Lovell, K., & Berry, K. (2020). Effective nurse–patient relationships in mental health care: A systematic review of interventions to improve the therapeutic alliance. *International Journal of Nursing Studies*, 102, 103490.
- Hasanovic, M., Panayiotou, C., Silberman, D., Stimers, P., & Merzbacher, C. (2022). Quantum

- technician skills and competencies for the emerging Quantum 2.0 industry. *Optical Engineering*, 61(8), 81803.
- Haug, A., Zachariassen, F., & Van Liempd, D. (2011). The costs of poor data quality. *Journal of Industrial Engineering and Management (JIEM)*, 4(2), 168–193.
- Haun, D. E., & Leach, A. (2003). Performing poorly but testing perfectly. *Clinical Leadership & Management Review: The Journal of CLMA*, 17(2), 85–87.
- Heiervang, E., & Goodman, R. (2011). Advantages and limitations of web-based surveys: evidence from a child mental health survey. *Social Psychiatry And Psychiatric Epidemiology*, 46(1), 69–76. <https://doi.org/10.1007/s00127-009-0171-9>
- Hendarwan, H., Syachroni, S., Aryastami, N. K., Su'udi, A., Susilawati, M. D., Despitasi, M., Mulyani, U. A., Sumiarsih, M., Puspendari, N., & Indrati, A. R. (2020). Assessing the COVID-19 diagnostic laboratory capacity in Indonesia in the early phase of the pandemic. *WHO South-East Asia Journal of Public Health*, 9(2), 134–140.
- Hill, E., Gurbutt, D., Makuloluwa, T., Gordon, M., Georgiou, R., Roddam, H., Seneviratne, S., Byrom, A., Pollard, K., & Abhayasinghe, K. (2021). Collaborative healthcare education programmes for continuing professional education in low and middle-income countries: A Best Evidence Medical Education (BEME) systematic review. BEME Guide No. 65. *Medical Teacher*, 43(11), 1228–1241.
- Hiller, R., & Blackburn, J. M. (2008). *Integrating high throughput technologies to advance genomic and proteomic research in South Africa*.
- Hiller, R., & Ramesar, R. (2011). UCT and CPGR join forces with international Pharmacogenomics initiative focussing on African diseases. *EMBnet. Journal*, 17(2), 3–4.
- Hinkin, T. R., & Tracey, J. B. (2000). The cost of turnover: Putting a price on the learning curve. *Cornell Hotel and Restaurant Administration Quarterly*, 41(3), 14–21.
- Hisprastin, Y., & Musfiroh, I. (2021). Ishikawa diagram dan failure mode effect analysis (FMEA) sebagai metode yang sering digunakan dalam manajemen risiko mutu di industri. *Majalah Farmasetika*, 6(1), 1–9.
- Hlangwani, E., Mpye, K. L., Matsuro, L., & Dlamini, B. (2023). The use of technological innovation in bio-based industries to foster growth in the bioeconomy: a South African

- perspective. *Sustainability: Science, Practice and Policy*, 19(1), 2200300.
- Hodkinson, P., & Hodkinson, H. (2004). A constructive critique of communities of practice: moving beyond Lave and Wenger. *OVAL Research Seminar*, 04–02.
- Hoffmann, T. (1999). The meanings of competency. *Journal of European Industrial Training*, 23(6), 275–286.
- Hofstede, G. (1980). Culture and organizations. *International Studies of Management & Organization*, 10(4), 15–41.
- Höner, J. (2002). Reputation and Competition. *American Economic Review*, 92(3), 644–663. <https://doi.org/10.1257/00028280260136444>
- Houghton, C. E., Casey, D., & Murphy, K. (2012). Approaches to rigour in qualitative case study research. *Nurse Researcher*.
- Huebner, L.-A., & Zacher, H. (2021). Following up on employee surveys: A conceptual framework and systematic review. *Frontiers in Psychology*, 12, 801073.
- Hughes, R., & Huby, M. (2002). The application of vignettes in social and nursing research. *Journal of Advanced Nursing*, 37(4), 382–386.
- Huq, A., Raja, J. Z., & Rosenberg, D. (2006). Linking Organisational Culture and Communities of Practice. In *Encyclopedia of Communities of Practice in Information and Knowledge Management* (pp. 340–345). IGI Global.
- Ifeoma, E. A., Rebecca, E. F., Ezekiel, O. O., Mary-Jane, O., Uyime, E. C., Obiageri, E. N., Tola, A., & James, D. (2015). A cross-sectional study of the knowledge and attitude of medical laboratory personnel regarding continuing professional development. *Nigerian Medical Journal: Journal of the Nigeria Medical Association*, 56(6), 425.
- Irikefe, V., Vaidyanathan, G., Nordling, L., Twahirwa, A., Nakkazi, E., & Monastersky, R. (2011). Science in Africa: The view from the front line. *Nature*, 474(7353), 556–559. <https://doi.org/10.1038/474556a>
- Irving, P. W., & Sayre, E. C. (2014). Conditions for building a community of practice in an advanced physics laboratory. *Physical Review Special Topics-Physics Education Research*, 10(1), 10109. <https://doi.org/10.1103/PhysRevSTPER.10.010109>
- Ivry, T., Ogawa, M., & Murotsuki, J. (2023). Virtuous Indecisiveness: Structural Moral

- Ambivalence and the Tentative Implementation of Non-Invasive Prenatal Testing in Japan. *Cultural Anthropology*, 38(2), 171–197.
- Javadi, M., & Zarea, K. (2016). Understanding thematic analysis and its pitfall. *Journal of Client Care*, 1(1), 33–39.
- Johnson, J. R., Mavingire, N., Woods-Burnham, L., Walker, M., Lewis, D., Hooker, S. E., Galloway, D., Rivers, B., & Kittles, R. A. (2024). The complex interplay of modifiable risk factors affecting prostate cancer disparities in African American men. *Nature Reviews Urology*, 1–11.
- Joram, E. (1993). Between a rock and a hardplace? Situated learning: Legitimate peripheral participation. Jean Lave and Etienne Wenger. Cambridge University Press, Cambridge, 1991. No. of pages: 138. ISBN 41308 7 (hardback). Price \$29.95. *Applied Cognitive Psychology*, 7(1), 88–90. <https://doi.org/10.1002/acp.2350070111>
- Jowett, A., Peel, E., & Shaw, R. (2011). Online interviewing in psychology: Reflections on the process. *Qualitative Research in Psychology*, 8(4), 354–369.
- Julkowska, D., Austin, C. P., Cutillo, C. M., Gancberg, D., Hager, C., Halftermeyer, J., Jonker, A. H., Lau, L. P. L., Norstedt, I., & Rath, A. (2017). The importance of international collaboration for rare diseases research: a European perspective. *Gene Therapy*, 24(9), 562–571.
- Kado, S. K., Clarke, S., & Carr, S. (2022). Drawing on Experience: Using Rich Pictures to explore Health Professions Education Leadership. *ANZAHPE 2022-Partnerships*.
- Kandpal, R., Saviola, B., & Felton, J. (2009). The era of 'omics unlimited. *BioTechniques*, 46(5), 351. <https://doi.org/10.2144/000113137>
- Kanteh, A., Manneh, J., Sanyang, B., Kujabi, M. A., Jallow, H. S., Ndure, S. L., & Sesay, A. K. (2022). Simple and structured model to build sequencing capacity in west Africa. *The Lancet Global Health*, 10(9), e1240–e1241.
- Kaplan, D., & Höppli, T. (2017). The South African brain drain: An empirical assessment. *Development Southern Africa*, 34(5), 497–514.
- Kargas, A. D., & Varoutas, D. (2015). On the relation between organizational culture and leadership: An empirical analysis. *Cogent Business & Management*, 2(1), 1055953.

- Karikari, T. K., Quansah, E., & Mohamed, W. M. Y. (2015). Developing expertise in bioinformatics for biomedical research in Africa. *Applied & Translational Genomics*, 6, 31–34. <https://doi.org/10.1016/J.ATG.2015.10.002>
- Keeton, M. T. (1976). *Experiential learning* (1st ed). Jossey-Bass Publishers.
- Kelly, L. M., & Cordeiro, M. (2020). Three principles of pragmatism for research on organizational processes. *Methodological Innovations*, 13(2), 205979912093724. <https://doi.org/10.1177/2059799120937242>
- Kelly, S. L. (2023). Perceptions of brilliance, intelligence, ability, and interest: Understanding first-year students' inclinations towards STEM pathways. *Journal for STEM Education Research*, 6(1), 75–101.
- Khadambi-Morokane, H., Bhowan, K., & Ayuk, S. (2021). An overview of medical diagnostic laboratories in South Africa that meet the international standard of accreditation: ISO 15189. *The Journal of Medical Laboratory Science and Technology of South Africa*, 3(1), 27–34.
- Khadambi-Morokane, H., Bhowan, K., & Ayuk, S. (2022). The link between accreditation and quality laboratory services: public versus private laboratories in South Africa. *The Journal of Medical Laboratory Science and Technology of South Africa*, 4(2), 84–91.
- Kienzle, N., & Husar, S. (2007). How can cultural awareness improve communication in the global workplace. *Journal of the Communication, Speech & Theatre Association of North Dakota*, 20, 81–85.
- Kim, J., & Jung, H.-S. (2022). The effect of employee competency and organizational culture on employees' perceived stress for better workplace. *International Journal of Environmental Research and Public Health*, 19(8), 4428.
- Kimura, M. (2020). Introduction to population genetics. In *My Thoughts on Biological Evolution* (pp. 85–101). Springer.
- Kitchenham, A., & Chasteauneuf, C. (2009). An application of Mezirow's critical reflection theory to electronic portfolios. *Journal of Transformative Education*, 7(3), 230–244.
- Kitchenham, B. A., Mendes, E., & Travassos, G. H. (2007). Cross versus within-company cost estimation studies: A systematic review. *IEEE Transactions on Software Engineering*, 33(5), 316–329.

- Kitzinger, J. (1994). The methodology of focus groups: the importance of interaction between research participants. *Sociology of Health & Illness*, 16(1), 103–121.
- Kitzinger, J. (1995). Qualitative research: introducing focus groups. *Bmj*, 311(7000), 299–302.
- Knowles, M. S. (1970). *The modern practice of adult education : andragogy versus pedagogy* . Association Press.
- Knowles, M. S. (Ed.). (1984). *Andragogy in action* (1st ed). Jossey-Bass.
- Koc, E., Yurur, S., & Ozsahin, M. (2023). Problem-solving abilities of managers: inflated self-efficacy beliefs. *Journal of Hospitality and Tourism Insights*, 6(5), 2273–2297.
- Koch, T., & Harrington, A. (1998). Reconceptualizing rigour: the case for reflexivity. *Journal of Advanced Nursing*, 28(4), 882–890. <https://doi.org/10.1046/j.1365-2648.1998.00725.x>
- Kockum, I., Huang, J., & Stridh, P. (2023). Overview of Genotyping Technologies and Methods. *Current Protocols*, 3(4), e727.
- Kokwaro, G., & Kariuki, S. (2001). Medical research in Africa: problems and some solutions. *Malawi Medical Journal : The Journal of Medical Association of Malawi*, 13(3), 40. <http://www.ncbi.nlm.nih.gov/pubmed/27528905>
- Kosorok, M. R., & Laber, E. B. (2019). Precision medicine. *Annual Review of Statistics and Its Application*, 6(1), 263–286.
- Kotter, J. P. (81 C.E.). Heskett, JL (1992). Corporate culture and performance. *New York*.
- Krefting, L. (1991). Rigor in qualitative research: The assessment of trustworthiness. *The American Journal of Occupational Therapy*, 45(3), 214–222.
- Krippendorff, K. (2019). *Content analysis : an introduction to its methodology* (Fourth edi). SAGE.
- Kromberg, J., Sizer, E., & Christianson, A. (2013). Genetic services and testing in South Africa. *Journal of Community Genetics*, 4(3), 413–423. <https://doi.org/10.1007/s12687-012-0101-5>
- Krumsvik, R. J., Jones, L. Ø., Øfstegaard, M., & Eikeland, O. J. (2016). Upper secondary school teachers' digital competence: Analysed by demographic, personal and professional characteristics. *Nordic Journal of Digital Literacy*, 11(3), 143–164.

- Kujala, J., Sachs, S., Leinonen, H., Heikkinen, A., & Laude, D. (2022). Stakeholder engagement: Past, present, and future. *Business & Society, 61*(5), 1136–1196.
- Lai, C.-H., & Lin, S. H. (2017). Systems theory. *The International Encyclopedia of Organizational Communication, 41*, 1–18.
- Lamarche, L., Gionfriddo, A. M., Cline, L. E., Gammage, K. L., & Adkin, A. L. (2014). What would you do? The effect of verbal persuasion on task choice. *Gait & Posture, 39*(1), 583–587.
- Landells, E. M., & Albrecht, S. L. (2017). The positives and negatives of organizational politics: A qualitative study. *Journal of Business and Psychology, 32*, 41–58.
- Landis, J. R., & Koch, G. G. (1977). An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. *Biometrics, 33*, 363–374.
- Langdon, P., Johnson, D., Huppert, F., & Clarkson, P. J. (2015). A framework for collecting inclusive design data for the UK population. *Applied Ergonomics, 46*, 318–324. <https://doi.org/10.1016/J.APERGO.2013.03.011>
- Lao, W. S., Puligandla, P., & Baird, R. (2014). A pilot investigation of a pediatric surgery journal club. *Journal of Pediatric Surgery, 49*(5), 811–814. <https://doi.org/10.1016/j.jpedsurg.2014.02.068>
- Laros, A. (2017). *Disorienting Dilemmas as a Catalyst for Transformative Learning BT - Transformative Learning Meets Bildung: An International Exchange* (A. Laros, T. Fuhr, & E. W. Taylor (Eds.); pp. 85–95). SensePublishers. https://doi.org/10.1007/978-94-6300-797-9_7
- Latham, J. R. (2016). *The Research Canvas: A Framework for Designing and Aligning the DNA of Your Research Study* (2.0). Organization Design Studio, Ltd.
- Latifi, F. (2006). A dynamic model interpreting work-related values of multi-faceted cultures: the case of Iran. *The International Journal of Human Resource Management, 17*(12), 2055–2073.
- Lave, J. (1991). Situating learning in communities of practice. In *Perspectives on socially shared cognition*. (pp. 63–82). American Psychological Association. <https://doi.org/10.1037/10096-003>

- Lawrence, C., Mhlaba, T., Stewart, K. A., Moletsane, R., Gaede, B., & Moshabela, M. (2018). The hidden curricula of medical education: a scoping review. *Academic Medicine: Journal of the Association of American Medical Colleges*, 93(4), 648.
- Lawrence, R. J. (2010). Deciphering Interdisciplinary and Transdisciplinary Contributions. *Transdisciplinary Journal of Engineering & Science*, 1(1). <https://doi.org/10.22545/2010/0003>
- Lazarsfeld, P. F., & Barton, A. H. (1955). Some general principles of questionnaire classification. *The Language of Social Research: A Reader in the Methodology of Social Research*, 83–93.
- Leko, M. M., Hitchcock, J. H., Love, H. R., Houchins, D. E., & Conroy, M. A. (2023). Quality indicators for mixed-methods research in special education. *Exceptional Children*, 89(4), 432–448.
- Lekstrom-Himes, J., Augustine, E. F., Brower, A., Defay, T., Finkel, R. S., McGuire, A. L., Skinner, M. W., & Yu, T. W. (2023). Data sharing to advance gene-targeted therapies in rare diseases. *American Journal of Medical Genetics Part C: Seminars in Medical Genetics*, 193(1), 87–98.
- Leufvén, M., Vitrakoti, R., Bergström, A., KC, A., & Målqvist, M. (2015). Dimensions of Learning Organizations Questionnaire (DLOQ) in a low-resource health care setting in Nepal. *Health Research Policy and Systems*, 13(1), 6. <https://doi.org/10.1186/1478-4505-13-6>
- Levac, D., Colquhoun, H., & O'Brien, K. (2010). Scoping studies: Advancing the methodology. *Implementation Science*, 5. *Article*, 69.
- Li, X., Zhou, M., Wang, H., & Hao, W. (2020). Factors associated with core competencies of emergency-room nurses in tertiary hospitals in China. *Japan Journal of Nursing Science*, 17(3), e12337.
- Liao, C., Xiao, S., & Wang, X. (2023). Bench-to-bedside: Translational development landscape of biotechnology in healthcare. *Health Sciences Review*, 100097.
- Liebig, J. R., Vanderploeg, H. A., & Ruberg, S. A. (2006). *Factors affecting the performance of the optical plankton counter in large lakes: Insights from Lake Michigan and laboratory studies: Analysis of zooplankton distributions using the optical plankton*

counter. 111(C5).

- Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. sage.
- Lincoln, Y. S., & Guba, E. G. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New Directions for Program Evaluation*, 1986(30), 73–84.
- Lind, G., & Mishchenko, M. (2024). Positive Feedback. In *Radical Therapy for Software Development Teams: Lessons in Remote Team Management and Positive Motivation* (pp. 135–141). Springer.
- Lingard, L., & Kennedy, T. J. (2010). Qualitative research methods in medical education. *Understanding Medical Education: Evidence, Theory and Practice*, 323–335.
- Lingard, L., & Watling, C. (2021). The art of limitations. In *Story, Not Study: 30 Brief Lessons to Inspire Health Researchers as Writers* (pp. 53–59). Springer.
- Lipscomb, M. (2012). Abductive reasoning and qualitative research. *Nursing Philosophy*, 13(4), 244–256.
- Loftus, S., & Higgs, J. (2010). Researching the individual in workplace research. *Journal of Education and Work*, 23(4), 377–388. <https://doi.org/10.1080/13639080.2010.495712>
- Loh, T. P., Cooke, B. R., Markus, C., Zakaria, R., Tran, M. T. C., Ho, C. S., Greaves, R. F., & Protocols, I. W. G. on M. E. (2023). Method evaluation in the clinical laboratory. *Clinical Chemistry and Laboratory Medicine (CCLM)*, 61(5), 751–758.
- Lu, Y.-F., Goldstein, D. B., Angrist, M., & Cavalleri, G. (2009). *Personalized Medicine and Human Genetic Diversity*. <https://doi.org/10.1101/cshperspect.a008581>
- Lubis, F. R., & Hanum, F. (2020). Organizational culture. *2nd Yogyakarta International Conference on Educational Management/Administration and Pedagogy (YICEMAP 2019)*, 88–91.
- Lucas, M., Bem-Haja, P., Siddiq, F., Moreira, A., & Redecker, C. (2021). The relation between in-service teachers' digital competence and personal and contextual factors: What matters most? *Computers and Education*, 160, 104052. <https://doi.org/10.1016/j.compedu.2020.104052>
- Ma, F., Zhu, Y., Liu, L., & Liu, Y. (2023). Mediating effects of core competence between the

- transition shock and work readiness of newly graduated nurses in cancer hospitals: A cross-sectional study. *Nurse Education Today*, 125, 105793.
- Mabin, V. J., Davies, J., & Cox, J. F. (2006). Using the theory of constraints thinking processes to complement system dynamics' causal loop diagrams in developing fundamental solutions. *International Transactions in Operational Research*, 13(1), 33–57. <https://doi.org/10.1111/j.1475-3995.2006.00532.x>
- Madni, A. M. (2007). Transdisciplinarity: Reaching beyond disciplines to find connections. *Journal of Integrated Design and Process Science*, 11(1), 1–11.
- Maduka, C. P., Adegoke, A. A., Okongwu, C. C., Enahoro, A., Osunlaja, O., & Ajogwu, A. E. (2023). Review of laboratory diagnostics evolution in Nigeria's response to COVID-19. *International Medical Science Research Journal*, 3(1), 1–23.
- Maggio, L. A., Artino, A. R., Picho, K., & Driessen, E. W. (2018). Are You Sure You Want to Do That? Fostering the Responsible Conduct of Medical Education Research. *Academic Medicine*, 93(4), 544–549. <https://doi.org/10.1097/ACM.0000000000001805>
- Majara, L., Kalungi, A., Koen, N., Zar, H., Stein, D. J., Kinyanda, E., Atkinson, E. G., & Martin, A. R. (2021). Low generalizability of polygenic scores in African populations due to genetic and environmental diversity. *BioRxiv*.
- Majokweni, Z. P., Kahn, A., Kruss, G., Sithole, M. M., & Buchana, Y. (2024). *Promoting innovation collaboration in South Africa: unveiling patterns and barriers*.
- Malmi, T., Järvinen, P., & Lillrank, P. (2004). A collaborative approach for managing project cost of poor quality. *European Accounting Review*, 13(2), 293–317.
- Mamorobela, S. P. (2022). Understanding a Social Media-Enabled Knowledge Management Adoption Model for Small and Medium Enterprises in South Africa: An Explanatory Sequential Mixed Methods Research Design Study. In *Handbook of research on mixed methods research in information science* (pp. 324–339). IGI Global.
- Manikandan, S. (2011). Measures of central tendency: Median and mode. *J Pharmacol Pharmacother*, 2(3), 214–215.
- Marks, D., & Yardley, L. (2004). *Research methods for clinical and health psychology*. SAGE.
- Martin, R., & Euchner, J. (2012). Design thinking. *Research-Technology Management*, 55(3),

10–14.

- Mathuba, B., Koromina, M., Mitropoulou, C., & Patrinos, G. P. (2021). Catalyzing clinical implementation of pharmacogenomics and personalized medicine interventions in Africa. *Pharmacogenomics*, 22(2), 115–122.
- Mbokasi, B., Fourie, L., & Visser, D. (2004). Management perceptions of competencies essential for middle managers. *SA Journal of Industrial Psychology*, 30(1), 1–9. <https://doi.org/10.4102/sajip.v30i1.140>
- Mboowa, G., & Sserwadda, I. (2019). Role of genomics literacy in reducing the burden of common genetic diseases in Africa. *Molecular Genetics & Genomic Medicine*, 7(7), e00776.
- McClam Liebengood, S., Cooper, M., & Nagy, P. (2013). Going to the gemba: identifying opportunities for improvement in radiology. *Journal of the American College of Radiology : JACR*, 10(12), 977. <https://doi.org/10.1016/j.jacr.2013.08.016>
- McClelland, M., Grobbelaar, S. S., & Sacks, N. (2022). Towards an analytical framework to analyse the evolution of innovation systems. *ICE/ITMC - IAMOT*, 1–9. <https://doi.org/10.1109/ICE/ITMC-IAMOT55089.2022.10033208>
- McCluskey, A., & Lalkhen, A. G. (2007). Statistics II: Central tendency and spread of data. *Continuing Education in Anaesthesia, Critical Care & Pain*, 7(4), 127–130.
- McGaghie, W. C. (2015). Varieties of integrative scholarship: why rules of evidence, criteria, and standards matter. *Academic Medicine*, 90(3), 294–302.
- McGrath, C., Palmgren, P. J., & Liljedahl, M. (2019). Twelve tips for conducting qualitative research interviews. *Medical Teacher*, 41(9), 1002–1006.
- McGrath, M., & Frank, D. (2005). *Propositions*.
- McHugh, M. L. (2012). Interrater reliability: the kappa statistic. *Biochemia Medica*, 22(3), 276–282.
- Mele, C., Pels, J., & Polese, F. (2010). A Brief Review of Systems Theories and Their Managerial Applications. *Service Science*, 2(2), 126. https://doi.org/10.1287/serv.2.1_2.126
- Melesse, G. T., Amde, T., & Tezera, R. (2024). Competency in evidence-based medicine and

- associated factors among medical radiology technologists in Addis Ababa, Ethiopia. *Journal of Medical Radiation Sciences*.
- Merabet, K., & Agti, D. (2021). *Supportive Organizational Culture Of Communities Of Practice And Their Impact On Service Quality*.
- Merry, L., Castiglione, S. A., Rouleau, G., Létourneau, D., Larue, C., Deschênes, M.-F., Gonsalves, D. M., & Ahmed, L. (2023). Continuing professional development (CPD) system development, implementation, evaluation and sustainability for healthcare professionals in low-and lower-middle-income countries: a rapid scoping review. *BMC Medical Education*, 23(1), 498.
- Mertens, G., Gielis, M., De Smet, D., & Van Cleynenbreugel, G. (2000). Quality assurance in immunogenetics and histocompatibility: experience with EFI Accreditation. *Accreditation and Quality Assurance*, 5(9), 381–382. <https://doi.org/10.1007/s007690000191>
- Metz, D., Ilies, L., & Metz, M. (2020). The impact of organisational culture on leadership effectiveness and performance. *Proceedings of the International Management Conference*, 14(1), 776–788.
- Mezirow, J. (1991). *Transformative dimensions of adult learning* (1st ed). Jossey-Bass.
- Mfuh, K. O., Abanda, N. N., & Titanji, B. K. (2023). Strengthening diagnostic capacity in Africa as a key pillar of public health and pandemic preparedness. *PLOS Global Public Health*, 3(6), e0001998.
- Midgley, G., Cavana, R. Y., Brocklesby, J., Foote, J. L., Wood, D. R. R., & Ahuriri-Driscoll, A. (2013). Towards a new framework for evaluating systemic problem structuring methods. *European Journal of Operational Research*, 229(1), 143–154. <https://doi.org/10.1016/j.ejor.2013.01.047>
- Miedzinski, L. J., Davis, P., Al-Shurafa, H., & Morrison, J. C. (2001). A Canadian faculty of medicine and dentistry's survey of career development needs. *Medical Education*, 35(9), 890–900. <https://doi.org/10.1046/j.1365-2923.2001.01002.x>
- Mihás, P., & Institute, O. (2019). *Learn to build a codebook for a generic qualitative study*. SAGE Publications, Limited.
- Miles, M. B. (1979). Qualitative data as an attractive nuisance: The problem of analysis.

- Administrative Science Quarterly*, 24(4), 590–601.
- Miller, L. A., Chen, X., Srivastava, V., Sullivan, L., Yang, W., & Yui, C. (2015). CME credit systems in three developing countries: China, India and Indonesia. *Journal of European CME*, 4(1), 27411.
- Millum, J., & Bromwich, D. (2021). Informed consent: What must be disclosed and what must be understood? *The American Journal of Bioethics*, 21(5), 46–58.
- Mitterer, D. M., & Mitterer, H. E. (2023). The mediating effect of trust on psychological safety and job satisfaction. *Journal of Behavioral and Applied Management*, 23(1), 29–41.
- Mlambo, V. H., & Adetiba, T. C. (2019). Brain drain and South Africa's socioeconomic development: The waves and its effects. *Journal of Public Affairs*, 19(4), e1942.
- Mlambo, V. H., & Adetiba, T. C. (2020). The brain drain of teachers in South Africa: Identifying the dynamics of its push factors. *E-BANGI*, 17(1), 152–164.
- Moetsana-Poka, F., Lehana, T., Lebaka, M., & McCarthy, C. F. (2014). Developing a continuing professional development programme to improve nursing practice in Lesotho. *African Journal of Midwifery and Women's Health*, 8(2), 10–13.
- Molina-Mula, J., & Gallo-Estrada, J. (2020). Impact of nurse-patient relationship on quality of care and patient autonomy in decision-making. *International Journal of Environmental Research and Public Health*, 17(3), 835.
- Möller, M., Hoal, E., & Henn, B. M. (2024). The power of contemporary African DNA: Exploring models of human evolution and health in Africa. *South African Journal of Science*, 120(1–2), 1–4.
- Montgomery, A., & Crittenden, K. (1977). Improving coding reliability for open-ended questions. *Public Opinion Quarterly*, 41(2), 235–243. <https://doi.org/10.1086/268378>
- Moon, K., Loyalka, P., Bergemann, P., & Cohen, J. (2022). The hidden cost of worker turnover: Attributing product reliability to the turnover of factory workers. *Management Science*, 68(5), 3755–3767.
- Morgan, D. L. (2014a). *Integrating Qualitative and Quantitative Methods: A Pragmatic Approach*. SAGE Publications, Inc. <https://doi.org/10.4135/9781544304533>
- Morgan, D. L. (2014b). Pragmatism as a Paradigm for Social Research. *Qualitative Inquiry*,

20(8), 1045–1053. <https://doi.org/10.1177/1077800413513733>

- Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods*, 1(2), 13–22.
- Mphande, F. A. (2023). Sustainable Health in Low and Middle Income Countries; Focus on SDG Target 3.3, 3b, 3c and 3d. In *Sustainable Health in Low and Middle Income Countries: Achieving SDG3 in the (Post) Pandemic World* (pp. 1–12). Springer.
- Msibi, G. S., Mkhonta, N. R., Nkwanyana, N. R., Mamba, B., & Khumalo, G. T. (2014). Establishing a national programme for continuing professional development of nurses and midwives in Swaziland. *African Journal of Midwifery and Women's Health*, 8(2), 14–16.
- Mulder, H., Ter Braak, E., Chen, H. C., & Ten Cate, O. (2019). Addressing the hidden curriculum in the clinical workplace: A practical tool for trainees and faculty. *Medical Teacher*, 41(1), 36–43. <https://doi.org/10.1080/0142159X.2018.1436760>
- Mulder, M., & Gulikers, J. (2011). Workplace learning in East Africa: A case study. In *The SAGE Handbook of Workplace Learning* (pp. 307–318). <https://doi.org/10.4135/9781446200940.n22>
- Mulder, N., Adebamowo, C. A., Adebamowo, S. N., Adebayo, O., Adeleye, O., Alibi, M., Baichoo, S., Benkahla, A., Fadlemola, F. M., Ghazal, H., Ghedira, K., Matimba, A., Moussa, A., Mungloo-Dilmohamud, Z., Owolabi, M. O., Radouani, F., Rotimi, C. N., Stein, D. J., & Souiai, O. (2017). Genomic research data generation, analysis and sharing – challenges in the African setting. *Data Science Journal*, 16(49), 1–15. <https://doi.org/10.5334/dsj-2017-049>
- Mulder, N., Christoffels, A., De Oliveira, T., Gamielien, J., Hazelhurst, S., Joubert, F., Kumuthini, J., Pillay, C. S., Snoep, J. L., Bishop, Ö. T., & Tiffin, N. (2016). *The development of computational biology in South Africa: successes achieved and lessons learnt*. Public Library of Science.
- Mullah, M., Grant, K. A., & Hind, J. V. (2020). A survey of the working environment of medical technologists in South Africa. *The Journal of Medical Laboratory Science and Technology of South Africa*, 2(1), 22–28.
- Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018).

- Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, 18(1), 143. <https://doi.org/10.1186/s12874-018-0611-x>
- Murphy, J., Hughes, J., Read, S., & Ashby, S. (2023). Evidence and practice: a review of vignettes in qualitative research. *Nurse Researcher*, 31(2).
- Mutambo, H., Kawimbe, S., Meki-Kombe, C., & Mwange, A. (2023). *Impact of Electricity Load Shedding on Operations of Small-Scale Enterprises in Selected Developing Countries: A Review of Literature*.
- Myers, B., & Rodriguez, B. (2016). How do early career health sciences information professionals gain competencies? *Journal of the Medical Library Association*, 104(3), 215–220. <https://doi.org/10.3163/1536-5050.104.3.006>
- Nachega, J. B., Grimwood, A., Mahomed, H., Fatti, G., Preiser, W., Kallay, O., Mbala, P. K., Muyembe, J.-J. T., Rwagasore, E., & Nsanzimana, S. (2021). From easing lockdowns to scaling up community-based coronavirus disease 2019 screening, testing, and contact tracing in Africa—shared approaches, innovations, and challenges to minimize morbidity and mortality. *Clinical Infectious Diseases*, 72(2), 327–331.
- Nair, V. V., & Sankaranarayanan, K. C. (2014). *Behavioural competency management with special reference to commercial banks headquartered in Kerala*. Cochin University Of Science And Technology.
- Nega, D., Abebe, A., Abera, A., Gidey, B., Gtsadik, A., & Tasew, G. (2020). Comprehensive competency assessment of malaria microscopists and laboratory diagnostic service capacity in districts stratified for malaria elimination in Ethiopia. *PloS One*, 15(6), e0235151–e0235151. <https://doi.org/10.1371/journal.pone.0235151>
- Newswander, L. K., & Borrego, M. (2009). Using journal clubs to cultivate a community of practice at the graduate level. *European Journal of Engineering Education*, 34(6), 561–571. <https://doi.org/10.1080/03043790903202959>
- Nicolaidis, A., & Poell, R. F. (2020). ‘The only option is failure’: Growing safe to fail workplaces for critical reflection. *Advances in Developing Human Resources*, 22(3), 264–277. <https://doi.org/10.1177/1523422320927296>
- Nicolescu, B. (2014). Methodology of transdisciplinarity. *World Futures*, 70(3–4), 186–199.

- Nimmon, L., & Stenfors-Hayes, T. (2016). The “Handling” of power in the physician-patient encounter: perceptions from experienced physicians. *BMC Medical Education*, *16*, 1–9.
- Noor, K. B. M. (2008). Case study: A strategic research methodology. *American Journal of Applied Sciences*, *5*(11), 1602–1604.
- Nordling, L. (2018a). African scientists call for more control of their continent’s genomic data. *Nature*.
- Nordling, L. (2018b). World Bank pours hundreds of millions into African science. *Nature*, *561*(7721), 16–16. <https://doi.org/10.1038/d41586-018-06094-w>
- Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, *16*(1), 1609406917733847.
- O’Dell, L., Crafter, S., de Abreu, G., & Cline, T. (2012). The problem of interpretation in vignette methodology in research with young people. *Qualitative Research*, *12*(6), 702–714. <https://doi.org/10.1177/1468794112439003>
- Obeta, M. U., Eze, E. M., Ofojekwu, M. N., Jwanse, R. I., & Maduka, M. K. (2019). Organogram for medical laboratory services in Nigerian public health institutions. *NARR*, *2*, 69–75.
- Okezue, M. A., Adeyeye, M. C., Byrn, S. J., Abiola, V. O., & Clase, K. L. (2020). Impact of ISO/IEC 17025 laboratory accreditation in sub-Saharan Africa: a case study. *BMC Health Services Research*, *20*(1), 1–9.
- Olatunji, G., Emmanuel, K., Osaghae, O. W., Timilehin, I., Aderinto, N., & Abdulbasit, M. O. (2023). Enhancing clinical and translational research in Africa: a comprehensive exploration of challenges and opportunities for advancement. *Journal of Clinical and Translational Research*, *9*(5), 357–368.
- Olmos-Vega, F. M., Stalmeijer, R. E., Varpio, L., & Kahlke, R. (2023). A practical guide to reflexivity in qualitative research: AMEE Guide No. 149. *Medical Teacher*, *45*(3), 241–251.
- Onwuegbuzie, A. J., & Leech, N. L. (2004). Enhancing the interpretation of “significant” findings: The role of mixed methods research. *The Qualitative Report*, *9*(4), 770–792.

- Onwuegbuzie, A. J., & Teddlie, C. (2003). A framework for analyzing data in mixed methods research. *Handbook of Mixed Methods in Social and Behavioral Research*, 2(1), 397–430.
- Ou, A. Y., Seo, J., Choi, D., & Hom, P. W. (2017). When can humble top executives retain middle managers? The moderating role of top management team faultlines. *Academy of Management Journal*, 60(5), 1915–1931.
- Pai, M., McCulloch, M., Gorman, J. D., Pai, N., Enanoria, W., Kennedy, G., Tharyan, P., & Colford Jr, J. M. (2004). Systematic reviews and meta-analyses: an illustrated, step-by-step guide. *The National Medical Journal of India*, 17(2), 86–95.
- Parashakti, R. D., Fahlevi, M., Ekhsan, M., & Hadinata, A. (2020). The influence of work environment and competence on motivation and its impact on employee performance in health sector. *3rd Asia Pacific International Conference of Management and Business Science (AICMBS 2019)*, 259–267.
- Paul, P. V. (2014). Questions, Answers, and Decontextualized Rationality. *American Annals of the Deaf*, 158(5), 477–480. <https://doi.org/https://doi.org/10.1353/aad.2014.0005>
- Pearce, P. F., Christian, B. J., Smith, S. L., & Vance, D. E. (2014). Research methods for graduate students: A practical framework to guide teachers and learners. *Journal of the American Association of Nurse Practitioners*, 26(1), 19–31. <https://doi.org/10.1002/2327-6924.12080>
- Perera, R. (2017). *The PESTLE analysis*. Nerdynaut.
- Peter, T. F., Shimada, Y., Freeman, R. R., Ncube, B. N., Khine, A.-A., & Murtagh, M. M. (2009). The need for standardization in laboratory networks. *American Journal of Clinical Pathology*, 131(6), 867–874.
- Pfister, I. B., Jacobshagen, N., Kälin, W., & Semmer, N. K. (2020). How does appreciation lead to higher job satisfaction? *Journal of Managerial Psychology*, 35(6), 465–479.
- Pham, M. T., Rajić, A., Greig, J. D., Sargeant, J. M., Papadopoulos, A., & McEwen, S. A. (2014). A scoping review of scoping reviews: advancing the approach and enhancing the consistency. *Research Synthesis Methods*, 5(4), 371–385.
- Phillips, K. A., Trosman, J. R., Kelley, R. K., Pletcher, M. J., Douglas, M. P., & Weldon, C. B. (2014). Genomic sequencing: assessing the health care system, policy, and big-data implications. *Health Affairs*, 33(7), 1246–1253.

- Piaget, J. (1978). *Success and understanding*. Routledge & K. Paul.
- Piccione, P. M. (2020). Systematizing scientific laboratory work by a workflow and template for electronic laboratory notebooks. *Education for Chemical Engineers*, 31, 42–53. <https://doi.org/https://doi.org/10.1016/j.ece.2020.03.004>
- Pillai, R., & Williams, E. A. (2004). Transformational leadership, self-efficacy, group cohesiveness, commitment, and performance. *Journal of Organizational Change Management*, 17(2), 144–159. <https://doi.org/10.1108/09534810410530584>
- Poland, B. D. (1995). Transcription quality as an aspect of rigor in qualitative research. *Qualitative Inquiry*, 1(3), 290–310.
- Porkodi, S., Ahmad, A., & Tabash, B. K. H. (2024). Employee experience management and its critical impact on the sustainable development of an enterprise-a systematic literature survey with meta-analysis. *Journal of Sustainability Science and Management*, 19(4), 203–237.
- Powell, K. C., & Kalina, C. J. (2009). Cognitive and social constructivism: developing tools for an effective classroom. *Education*, 130(2), 241.
- Pöysä-Tarhonen, J. (2012). *Microculture of Learning Environments BT - Encyclopedia of the Sciences of Learning* (N. M. Seel (Ed.); pp. 2263–2265). Springer US. https://doi.org/10.1007/978-1-4419-1428-6_964
- Prakash, Y., & Gupta, M. (2008). Exploring the relationship between organisation structure and perceived innovation in the manufacturing sector of India. *Singapore Management Review*, 30(1), 55.
- Praveena A, A., & Fonceca, C. M. (2023). Organizational Culture and Its Influence on Employee Behavior. *International Journal of Recent Scientific Research*, 14.
- Quinlan, K. M. (1999). Enhancing Mentoring and Networking of Junior Academic Women: what, why and how? *Journal of Higher Education Policy & Management*, 21(1), 31. <http://10.0.4.56/1360080990210103>
- Quinn, E. M., Cantillon, P., Redmond, H. P., & Bennett, D. (2014). Surgical Journal Club as a Community of Practice: A Case Study. *Journal of Surgical Education*, 71(4), 606–612. <https://doi.org/10.1016/j.jsurg.2013.12.009>

- Ramani, S., & Mann, K. (2016). Introducing medical educators to qualitative study design: Twelve tips from inception to completion. *Medical Teacher*, *38*(5), 456–463. <https://doi.org/10.3109/0142159X.2015.1035244>
- Ramesh, S., Ireson, R., & Williams, A. (2017). International synthesis and case study examination of promising caregiver-friendly workplaces. *Social Science & Medicine*, *177*, 52–60. <https://doi.org/10.1016/j.socscimed.2017.01.052>
- Ramos, P. S., Shedlock, A. M., & Langefeld, C. D. (2015). Genetics of autoimmune diseases: insights from population genetics. *Journal of Human Genetics*, *60*, 657–664. <https://doi.org/10.1038/jhg.2015.94>
- Ramsden, J. (2023). *Bioinformatics: an introduction*. Springer Nature.
- Randall, M. L., Cropanzano, R., Bormann, C. A., & Birjulin, A. (1999). Organizational politics and organizational support as predictors of work attitudes, job performance, and organizational citizenship behavior. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *20*(2), 159–174.
- Randolph, W. A. (1995). Navigating the journey to empowerment. *Organizational Dynamics*, *23*(4), 19–32.
- Rantesalu, A., Mus, A. R., & Arifin, Z. (2016). *The effect of competence, motivation and organizational culture on employee performance: the mediating role of organizational commitment*.
- Rashid, M. A., & Griffin, A. (2023). Is west really best? The discourse of modernisation in global medical school regulation policy. *Teaching and Learning in Medicine*, 1–12.
- Rastogi, N., & Trivedi, M. K. (2016). PESTLE technique—a tool to identify external risks in construction projects. *International Research Journal of Engineering and Technology (IRJET)*, *3*(1), 384–388.
- Ratelle, J. T., Sawatsky, A. P., & Beckman, T. J. (2019). Quantitative Research Methods in Medical Education. *Anesthesiology*, *131*(1), 23–35. <https://doi.org/10.1097/ALN.0000000000002727>
- Ravitsky, V., Roy, M.-C., Haidar, H., Henneman, L., Marshall, J., Newson, A. J., Ngan, O. M. Y., & Nov-Klaiman, T. (2021). The emergence and global spread of noninvasive prenatal

- testing. *Annual Review of Genomics and Human Genetics*, 22, 309–338.
- Reeves, S., McMillan, S. E., Kachan, N., Paradis, E., Leslie, M., & Kitto, S. (2015). Interprofessional collaboration and family member involvement in intensive care units: emerging themes from a multi-sited ethnography. *Journal of Interprofessional Care*, 29(3), 230–237.
- Regier, D. A., Narrow, W. E., Clarke, D. E., Kraemer, H. C., Kuramoto, S. J., Kuhl, E. A., & Kupfer, D. J. (2013). DSM-5 field trials in the United States and Canada, Part II: test-retest reliability of selected categorical diagnoses. *American Journal of Psychiatry*, 170(1), 59–70.
- Rezvani, Z. (2017). Who is a middle manager: A literature review. *Extremes*, 1, 44.
- Ribeiro, D., Lima, R., França, C., Souza, A., Silva, I., & Pinto, G. (2023). Understanding self-efficacy in software engineering industry: an interview study. *Proceedings of the 27th International Conference on Evaluation and Assessment in Software Engineering*, 101–110.
- Ringsted, C., Hodges, B., & Scherpbier, A. (2011). “The research compass”: An introduction to research in medical education: AMEE Guide No. 56. *Medical Teacher*, 33(9), 695–709. <https://doi.org/10.3109/0142159X.2011.595436>
- Robbins, M. (2019). Why employees need both recognition and appreciation. *Harvard Business Review*.
- Roberts, K., Dowell, A., & Nie, J.-B. (2019). Attempting rigour and replicability in thematic analysis of qualitative research data; a case study of codebook development. *BMC Medical Research Methodology*, 19, 1–8.
- Rodrigues, R., Butler, C. L., & Guest, D. (2020). Evaluating the employability paradox: When does organizational investment in human capital pay off? *The International Journal of Human Resource Management*, 31(9), 1134–1156.
- Rogelberg, S. G., Luong, A., Sederburg, M. E., & Cristol, D. S. (2000). Employee attitude surveys: Examining the attitudes of noncompliant employees. *Journal of Applied Psychology*, 85(2), 284.
- Rolfe, G. (2006). Validity, trustworthiness and rigour: quality and the idea of qualitative research. *Journal of Advanced Nursing*, 53(3), 304–310. <https://doi.org/10.1111/j.1365->

2648.2006.03727.x

- Rösch, N., Tiberius, V., & Kraus, S. (2023). Design thinking for innovation: context factors, process, and outcomes. *European Journal of Innovation Management*, 26(7), 160–176.
- Ross, P. T., & Bibler Zaidi, N. L. (2019). Limited by our limitations. *Perspectives on Medical Education*, 8, 261–264.
- Rossignoli, F., Lionzo, A., Henschel, T., & Boers, B. (2023). Knowledge sharing in family SMEs: the role of communities of practice. *Journal of Family Business Management*.
- Rossouw, N., & Frick, L. (2023). A conceptual framework for uncovering the hidden curriculum in private higher education. *Cogent Education*, 10(1), 2191409.
- Rowe, A., de Savigny, D., Lanata, C. F., & Victora, C. G. (2005). How can we achieve and maintain high-quality performance of health workers in low-resource settings? *The Lancet (British Edition)*, 366(9490), 1026–1035. [https://doi.org/10.1016/S0140-6736\(05\)67028-6](https://doi.org/10.1016/S0140-6736(05)67028-6)
- Rowe, S. Y., Peters, D. H., Holloway, K. A., Chalker, J., Ross-Degnan, D., & Rowe, A. K. (2019). A systematic review of the effectiveness of strategies to improve health care provider performance in low-and middle-income countries: methods and descriptive results. *PloS One*, 14(5), e0217617.
- Rowles, E., & McNaughton, A. (2017). An overview of the evidence-based practice process for novice researchers. *Nursing Standard*, 31(43).
- Sadeghi, A. H., Koldeweij, C., Bogers, A. J. J. C., & Alvarez, M. M. (2021). Social non-profit bioentrepreneurship: current status and future impact on global health. *Frontiers in Public Health*, 9, 541191.
- Sakdiyah, S. H., Eltivia, N., & Afandi, A. (2022). Root cause analysis using fishbone diagram: company management decision making. *Journal of Applied Business, Taxation and Economics Research*, 1(6), 566–576.
- Salah, S., Rahim, A., & Carretero, J. A. (2010). The integration of Six Sigma and lean management. *International Journal of Lean Six Sigma*, 1(3), 249–274. <https://doi.org/10.1108/20401461011075035>
- Salanova, M., Lorente, L., & Martínez, I. M. (2012). The dark and bright sides of self-efficacy

- in predicting learning, innovative and risky performances. *The Spanish Journal of Psychology*, 15(3), 1123–1132.
- Salman, M., Ganie, S. A., & Saleem, I. (2020). Employee competencies as predictors of organizational performance: a study of public and private sector banks. *Management and Labour Studies*, 45(4), 416–432.
- Sandelowski, M. (1993). Rigor or rigor mortis: the problem of rigor in qualitative research revisited. *ANS. Advances in Nursing Science*, 16(2), 1–8. <https://doi.org/10.1097/00012272-199312000-00002>
- Sandelowski, Margarete. (2010). What's in a name? Qualitative description revisited. *Research in Nursing & Health*, 33(1), 77–84. <https://doi.org/10.1002/nur.20362>
- Sandelowski, Margarete, & Leeman, J. (2012). Writing Usable Qualitative Health Research Findings. *Qualitative Health Research*, 22(10), 1404–1413. <https://doi.org/10.1177/1049732312450368>
- Sargeant, J. M., & O'Connor, A. M. (2020). Scoping reviews, systematic reviews, and meta-analysis: applications in veterinary medicine. *Frontiers in Veterinary Science*, 7, 11.
- Satam, H., Joshi, K., Mangrolia, U., Waghoo, S., Zaidi, G., Rawool, S., Thakare, R. P., Banday, S., Mishra, A. K., & Das, G. (2023). Next-generation sequencing technology: Current trends and advancements. *Biology*, 12(7), 997.
- Schein, E. H. (1990). *Organizational culture*. (Vol. 45, Issue 2). American Psychological Association.
- Schein, E. H. (2010). *Organizational culture and leadership* (Vol. 2). John Wiley & Sons.
- Schemm Ylann. (2013). Africa doubles research output over past decade, moves towards a knowledge-based economy - Research Trends. *Research Trends*, 35. <https://www.researchtrends.com/issue-35-december-2013/africa-doubles-research-output/>
- Schmidt, A. H., Sauter, J., Baier, D. M., Daiss, J., Keller, A., Klussmeier, A., Mengling, T., Rall, G., Riethmüller, T., & Schöfl, G. (2020). Immunogenetics in stem cell donor registry work: The DKMS example (Part 2). *International Journal of Immunogenetics*, 47(2), 139–148.

- Schneider, B. (1986). Notes on climate and culture. In *Creativity in services marketing: What's new, what works, what's developing* (pp. 63–67). American Marketing Association Chicago.
- Schön, D. A. (1983). *The reflective practitioner : how professionals think in action* . Temple Smith.
- Schulz, M., & Rosznagel, C. S. (2010). Informal Workplace Learning: An Exploration of Age Differences in Learning Competence. *Learning and Instruction, 20*(5), 383. <https://doi.org/10.1016/j.learninstruc.2009.03.003>
- Schwaninger, M. (2006). Design for viable organizations: The diagnostic power of the viable system model. *Kybernetes, 35*(7–8), 955–966. <https://doi.org/10.1108/03684920610675012>
- Schwaninger, M., & Scheef, C. (2016). A test of the viable system model: theoretical claim vs. empirical evidence. *Cybernetics and Systems, 47*(7), 544–569.
- Schweder, S., & Raufelder, D. (2022). Students' interest and self-efficacy and the impact of changing learning environments. *Contemporary Educational Psychology, 70*, 102082.
- Scott, I. A., Sullivan, C., & Staib, A. (2018). Going digital: a checklist in preparing for hospital-wide electronic medical record implementation and digital transformation. *Australian Health Review, 43*(3), 302–313.
- Seabi, J., Cockcroft, K., & Fridjhon, P. (2009). Effects of Mediated Learning Experience, Tutor Support and Peer Collaborative Learning on Academic Achievement and Intellectual Functioning among College Students. *Journal of Psychology in Africa, 19*(2), 161–167. <https://doi.org/10.1080/14330237.2009.10820275>
- Searcy, D. L., & Mentzer, J. T. (2003). A framework for conducting and evaluating research. *Journal of Accounting Literature, 22*, 130–167.
- Semo, B.-W., Motswaledi, M. S., Nyangah, R., Phumaphi, O., Mpofu, M., Ledikwe, J. H., Martin, R., & Kasvosve, I. (2014). Continuing professional development training needs of medical laboratory personnel in Botswana. *Human Resources for Health, 12*(1). <https://doi.org/10.1186/1478-4491-12-46>
- Shiferaw, K. B., Tilahun, B. C., & Endehabtu, B. F. (2020). Healthcare providers' digital competency: a cross-sectional survey in a low-income country setting. *BMC Health*

- Services Research*, 20(1), 1021. <https://doi.org/10.1186/s12913-020-05848-5>
- Shirvan, S. J. (2021). The Importance of Laboratory Technicians in Health. *Academic Researches in Health Sciences*, 583.
- Siddiqi, K., Newell, J., & Robinson, M. (2005). Getting evidence into practice: what works in developing countries? *International Journal for Quality in Health Care*, 17(5), 447–454. <https://doi.org/10.1093/intqhc/mzi051>
- Siegal, M., & Gardner, S. (2000). Contextual factors of psychological empowerment. *Personnel Review*, 29(6), 703–722. <https://doi.org/10.1108/00483480010296474>
- Simpkin, V., Namubiru-Mwaura, E., Clarke, L., & Mossialos, E. (2019). Investing in health R&D: where we are, what limits us, and how to make progress in Africa. *BMJ Global Health*, 4(2), e001047.
- Sims, D. A. (2023). When I say... global South and global North. *Medical Education*.
- Sims, D., & Cilliers, F. (2023). Qualitatively speaking: Deciding how much data and analysis is enough. *African Journal of Health Professions Education*, 15(1), 2–3.
- Sığ, A. K., Özen, N., Duran, A. Ç., & Atik, T. K. (2023). Quality Data and Errors in a Tertiary Microbiology Laboratory (2017-2020): "The Good, the Bad and the Ugly". *Hamidiye Medical Journal*, 4(2).
- Sleed, M., Durrheim, K., Kriel, A., Solomon, V., & Baxter, V. (2002). The Effectiveness of the Vignette Methodology: A Comparison of Written and Video Vignettes in Eliciting Responses about Date Rape. *South African Journal of Psychology*, 32(3), 21–28. <https://doi.org/10.1177/008124630203200304>
- Slocum, J. W., McGill, M., & Lei, D. T. (1994). The new learning strategy: Anytime, anything, anywhere. *Organizational Dynamics*, 23(2), 33–47. [https://doi.org/10.1016/0090-2616\(94\)90067-1](https://doi.org/10.1016/0090-2616(94)90067-1)
- Smeets, L., Gijssels, W. H., Meuwissen, R. H. G., & Grohnert, T. (2021). Beyond psychological safety—the role of direct supervisor behavior in fostering learning from errors at the workplace. *Vocations and Learning*, 14(3), 533–558.
- Soh, P. X. Y., Mmekwa, N., Petersen, D. C., Gheybi, K., van Zyl, S., Jiang, J., Patrick, S. M., Campbell, R., Jaratlerdseri, W., & Mutambirwa, S. B. A. (2023). Prostate cancer genetic

- risk and associated aggressive disease in men of African ancestry. *Nature Communications*, 14(1), 8037.
- Soni, K., Chawla, R., & Sengar, R. (2017). Relationship between job satisfaction and employee experience. *Journal of General Management Research*, 4(2), 41–48.
- Spradley, J. (1979). Asking Descriptive Questions. In *The Ethnographic Interview* (pp. 78–91). <https://doi.org/10.1111/j.1365-2929.2006.02418.x>
- Stalmeijer, R. E., Mcnaughton, N., & Van Mook, W. N. K. A. (2014). Using focus groups in medical education research: AMEE Guide No. 91. *Medical Teacher*, 36(11), 923–939. <https://doi.org/10.3109/0142159X.2014.917165>
- Stalpers, D., van der Linden, D., Kaljouw, M. J., & Schuurmans, M. J. (2017). Nurse-perceived quality of care in intensive care units and associations with work environment characteristics: a multicentre survey study. *Journal of Advanced Nursing*, 73(6), 1482–1490. <https://doi.org/10.1111/jan.13242>
- Stark, S., Biber-Freudenberger, L., Dietz, T., Escobar, N., Förster, J. J., Henderson, J., Laibach, N., & Börner, J. (2022). Sustainability implications of transformation pathways for the bioeconomy. *Sustainable Production and Consumption*, 29, 215–227.
- Sturges, J., Guest, D., Conway, N., & Davey, K. M. (2002). A longitudinal study of the relationship between career management and organizational commitment among graduates in the first ten years at work. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, 23(6), 731–748.
- Stutchbury, K., & Fox, A. (2009). Ethics in educational research: introducing a methodological tool for effective ethical analysis. *Cambridge Journal of Education*, 39(4), 489–504. <http://10.0.4.56/03057640903354396>
- Suarta, I. M., Suwintana, I. K., Sudhana, I. G. P. F. P., & Hariyanti, N. K. D. (2017). Employability skills required by the 21st century workplace: A literature review of labor market demand. *International Conference on Technology and Vocational Teachers (ICTVT 2017)*, 337–342.
- Sueb, S., Hartanti, L. P., & Susanti, A. (2023). “I Better Not to Speak”: Micro-Culture and Identity Conflict of Female Muslim Students in Language Learning Classroom. *LETS*:

Journal of Linguistics and English Teaching Studies, 4(2), 155–168.

- Suleman, F. (2018). The employability skills of higher education graduates: insights into conceptual frameworks and methodological options. *Higher Education*, 76, 263–278.
- Suliman, Z., Kruger, W., & Pienaar, J. A. (2020). Continuing professional development (CPD): a necessary component in the workplace or not? *The Journal of Medical Laboratory Science and Technology of South Africa*, 2(1), 41–45.
- Sveinsdottir, H., Ragnarsdottir, E. D., & Blondal, K. (2016). Praise matters: the influence of nurse unit managers' praise on nurses' practice, work environment and job satisfaction: a questionnaire study. *Journal of Advanced Nursing*, 72(3), 558–568. <https://doi.org/10.1111/jan.12849>
- Swart, Y., van Eeden, G., Sparks, A., Uren, C., & Möller, M. (2020). Prospective avenues for human population genomics and disease mapping in southern Africa. *Molecular Genetics and Genomics*, 295, 1079–1089.
- Tate, W. (2010). Think, Manage and Lead Systemically. *Business Strategy Review*, 21(2), 48–53. <https://doi.org/10.1111/j.1467-8616.2010.00673.x>
- Tavakol, M., & Sandars, J. (2014). Quantitative and qualitative methods in medical education research: AMEE Guide No 90: Part I. *Medical Teacher*, 36(9), 746–756. <https://doi.org/10.3109/0142159X.2014.915298>
- Taylor, D., & Hamdy, H. (2013). Adult learning theories: implications for learning and teaching in medical education: AMEE Guide No. 83. *Medical Teacher*, 35(11), e1561–e1572.
- Taylor, E. W. (1998). The Theory and Practice of Transformative Learning: A Critical Review. Information Series No. 374. In E. W. Taylor (Ed.), *Undefined* (pp. 1–90).
- Taylor, E. W. (2000). Analyzing research on transformative learning theory. *Learning as Transformation: Critical Perspectives on a Theory in Progress*, 285–328.
- Taylor, J., & Westover, J. H. (2011). Job Satisfaction in The Public Service: The effects of public service motivation, workplace attributes and work relations. *Public Management Review*, 13(5), 731–751. <https://doi.org/10.1080/14719037.2010.532959>
- Teixeira, A. A. C., & Davey, T. (2010). Attitudes of Higher Education Students to New Venture

- Creation: The Relevance of Competencies and Contextual Factors. *Industry & Higher Education*, 24(5), 323–341. <https://doi.org/10.5367/ihe.2010.0005>
- Thompson, L. F., & Surface, E. A. (2009). Promoting favorable attitudes toward personnel surveys: The role of follow-up. *Military Psychology*, 21(2), 139–161.
- Tishkoff, S. A., Reed, F. A., Friedlaender, F. R., Ehret, C., Ranciaro, A., Froment, A., Hirbo, J. B., Awomoyi, A. A., Bodo, J.-M., Doumbo, O., Juma, A. T., Kotze, M. J., Lema, G., Moore, J. H., Mortensen, H., Nyambo, T. B., Omar, S. A., Powell, K., Pretorius, G. S., ... Williams, S. M. (2009). The Genetic Structure and History of Africans and African Americans. *Science*, 324(5930), 1035–1044. <https://doi.org/10.1126/science.1172257>
- Tobin, G. A., & Begley, C. M. (2004). Methodological rigour within a qualitative framework. *Journal of Advanced Nursing*, 48(4), 388–396.
- Tracey, J. B., Hinkin, T. R., Tannenbaum, S., & Mathieu, J. E. (2001). The influence of individual characteristics and the work environment on varying levels of training outcomes. *Human Resource Development Quarterly*, 12(1), 5–23. [https://doi.org/10.1002/1532-1096\(200101/02\)12:1<5::AID-HRDQ2>3.0.CO;2-J](https://doi.org/10.1002/1532-1096(200101/02)12:1<5::AID-HRDQ2>3.0.CO;2-J)
- Tracey, J. B., & Tews, M. J. (2005). Construct validity of a general training climate scale. *Organizational Research Methods*, 8(4), 353–374. <https://doi.org/10.1177/1094428105280055>
- Tsehay, A. K., Sineshaw, H. M., Eshetu, K., Gize, A., Abebe, S. A., Mihret, A., & Tullu, K. D. (2024). Competency Assessment on Gram Stain Examination and Interpretation Among Medical Laboratory Professionals Working in Selected Hospitals of Addis Ababa, Ethiopia. *Journal of Multidisciplinary Healthcare*, 1007–1021.
- Turkson-Ocran, R. N., Nmezi, N. A., Botchway, M. O., Szanton, S. L., Golden, S. H., Cooper, L. A., & Commodore-Mensah, Y. (2020). Comparison of cardiovascular disease risk factors among African immigrants and African Americans: an analysis of the 2010 to 2016 National Health Interview Surveys. *Journal of the American Heart Association*, 9(5), e013220.
- Turner, T. L., Balmer, D. F., & Coverdale, J. H. (2013). Methodologies and study designs relevant to medical education research. *International Review of Psychiatry*, 25(3), 301–310. <https://doi.org/10.3109/09540261.2013.790310>

- Tuttas, C. A. (2015). Lessons learned using web conference technology for online focus group interviews. *Qualitative Health Research*, 25(1), 122–133.
- Tvedte, E. S., Michalski, J., Cheng, S., Patkus, R. S., Tallon, L. J., Sadzewicz, L., Bruno, V. M., Silva, J. C., Rasko, D. A., & Dunning Hotopp, J. C. (2021). Evaluation of a high-throughput, cost-effective Illumina library preparation kit. *Scientific Reports*, 11(1), 15925.
- Uctu, R., & Essop, H. (2012). *The Role of the South African Government in Developing the Biotechnology Industry—from Biotechnology Regional Innovation Centres to the Technology Innovation Agency*.
- Ukoha, W. C., & Mtshali, N. G. (2023). Preconception Care Recommendations, Training, and Competency of Primary Healthcare Nurses in South Africa: A Quantitative Descriptive Study. *SAGE Open Nursing*, 9, 23779608231185924.
- Ulla, M. B., & Perales, W. F. (2021). Emergency Remote Teaching During COVID19: The Role of Teachers' Online Community of Practice (CoP) in Times of Crisis. *Journal of Interactive Media in Education*, 2021(1).
- Umviligihozo, G., Mupfumi, L., Sonela, N., Naicker, D., Obuku, E. A., Koofhethile, C., Mogashoa, T., Kapaata, A., Ombati, G., & Michelo, C. M. (2020). Sub-Saharan Africa preparedness and response to the COVID-19 pandemic: a perspective of early career African scientists. *Wellcome Open Research*, 5.
- Undilashvili, A., Ebralidze, K., & Beriashvili, R. (2019). Continuous professional development of healthcare workers-analysis of the current state. *Georgian Medical News*, 297, 158–163.
- Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences*, 15(3), 398–405. <https://doi.org/10.1111/nhs.12048>
- Vakani, F. S., Uebel, K., Balasooriya, C., & Demirkol, A. (2024). The status quo of continuing medical education in south-east asia and eastern mediterranean regions: a scoping review of 33 countries. *Journal of Continuing Education in the Health Professions*, 44(1), 44–52.
- Varpio, L., Ajjawi, R., Monrouxe, L. V, O'Brien, B. C., & Rees, C. E. (2017). Shedding the

- cobra effect: problematising thematic emergence, triangulation, saturation and member checking. *Medical Education*, 51(1), 40–50.
- Varpio, L., & McCarthy, A. (2018). How a needs assessment study taught us a lesson about the ethics of educational research. *Perspectives on Medical Education*, 7, 34–36.
- Vigoda, E. (2002). Stress-related aftermaths to workplace politics: the relationships among politics, job distress, and aggressive behavior in organizations. *Journal of Organizational Behavior*, 23(5), 571–591. <https://doi.org/10.1002/job.160>
- Vygotsky, L. S. (1978). *Mind in society : the development of higher psychological processes* (M. Cole (Ed.)). Harvard University Press.
- Vygotsky, L. S. (1997). *Educational psychology*. St. Lucie Press.
- Waddington, J. (2023). Self-efficacy. *ELT Journal*, 77(2), 237–240.
- Wahdiniawati, S. A., Sjarifudin, D., Santioso, L. L., Ariyani, F., & Febrian, W. D. (2024). Application of Talent Management: Assessment and Psychological Test Functions. *Dinasti International Journal of Digital Business Management*, 5(2), 408–417.
- Waldman, J. D., Kelly, F., Arora, S., & Smith, H. L. (2010). The shocking cost of turnover in health care. *Health Care Management Review*, 35(3), 206–211.
- Wallin, L., Ewald, U., Wikblad, K., Scott-Findlay, S., & Arnetz, B. B. (2006). Understanding work contextual factors: A short-cut to evidence-based practice? *Worldviews on Evidence-Based Nursing*, 3(4), 153–164.
- Wallo, A., Kock, H., Reineholm, C., & Ellström, P.-E. (2021). How do managers promote workplace learning? Learning-oriented leadership in daily work. *Journal of Workplace Learning*, 34(1), 58–73.
- Wallo, A., Lundqvist, D., & Coetzer, A. (2024). Learning-Oriented Leadership in Organizations: An Integrative Review of Qualitative Studies. *Human Resource Development Review*, 15344843241239724.
- Wals, A. E. J., van der Hoeven, E., & Blanken, H. (2009). *The Acoustics of Social Learning: Designing learning processes that contribute to a more sustainable world*. Wageningen Academic Publishers.
- Walumbwa, F., Wang, P., Lawler, J., & Shi, K. (2004). The role of collective efficacy in the

- relations between transformational leadership and work outcomes. *Journal Of Occupational And Organizational Psychology*, 77, 515–530.
- Wang, D.-S., & Hsieh, C.-C. (2013). The effect of authentic leadership on employee trust and employee engagement. *Social Behavior and Personality: An International Journal*, 41(4), 613–624.
- Wang, G., & Netemeyer, R. (2002). The effects of job autonomy, customer demandingness, and trait competitiveness on salesperson learning, self-efficacy, and performance. *Journal of the Academy of Marketing Science*, 30(3), 217–228. <https://doi.org/10.1177/0092070302303003>
- Wang, H., Hall, N. C., & Rahimi, S. (2015). Self-efficacy and causal attributions in teachers: Effects on burnout, job satisfaction, illness, and quitting intentions. *Teaching and Teacher Education*, 47, 120–130. <https://doi.org/10.1016/j.tate.2014.12.005>
- Wei, W., Niu, Y., & Ge, X. (2019). Core competencies for nurses in Chinese intensive care units: a cross-sectional study. *Nursing in Critical Care*, 24(5), 276–282. <https://doi.org/10.1111/nicc.12398>
- Wenger, E, McDermott, R., Snyder, W., & Lakomski, G. (2004). Cultivating communities of practice: a guide to managing knowledge. In E Wenger, R. McDermott, W. Snyder, & G. Lakomski (Eds.), *British journal of management* (Vol. 15, Issue Special, pp. 89–95).
- Wenger, Etienne. (1999). *Communities of practice: Learning, meaning, and identity*. Cambridge university press.
- Wenger, Etienne. (2012). *Communities of practice and social learning systems: The career of a concept*.
- Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5(2), 171–180.
- Whiting, L. S. (2008). Semi-structured interviews: guidance for novice researchers.(art & science: professional issues). *Nursing Standard*, 22(23), 35. <https://doi.org/10.7748/ns2008.02.22.23.35.c6420>
- Whitworth, J. A. G., Kokwaro, G., Kinyanjui, S., Snewin, V. A., Tanner, M., Walport, M., & Sewankambo, N. (2008). Strengthening capacity for health research in Africa. *Lancet (London, England)*, 372(9649), 1590–1593. <https://doi.org/10.1016/S0140->

- Wilkinson, L. A. (2011). *Systems Theory BT - Encyclopedia of Child Behavior and Development* (S. Goldstein & J. A. Naglieri (Eds.); pp. 1466–1468). Springer US. https://doi.org/10.1007/978-0-387-79061-9_941
- Williams, J. R. (2008). The Declaration of Helsinki and public health. *Bulletin of the World Health Organization*, 86, 650–652.
- Wong, C. A., & Laschinger, H. K. S. (2013). Authentic leadership, performance, and job satisfaction: the mediating role of empowerment. *Journal of Advanced Nursing*, 69(4), 947–959.
- Woo, D., Endacott, C. G., & Myers, K. K. (2023). Navigating water cooler talks without the water cooler: Uncertainty and information seeking during remote socialization. *Management Communication Quarterly*, 37(2), 251–280.
- Wood, S. (2013). The international organization for standardization. In *Business Regulation and Non-State Actors* (pp. 81–94). Routledge.
- Woodruffe, C. (1993). What is meant by a competency? *Leadership & Organization Development Journal*, 14(1), 29–36.
- Wordsworth, S., Doble, B., Payne, K., Buchanan, J., Marshall, D. A., McCabe, C., & Regier, D. A. (2018). Using “big data” in the cost-effectiveness analysis of next-generation sequencing technologies: challenges and potential solutions. *Value in Health*, 21(9), 1048–1053.
- World Health Organization, W. H. O. (2011). *Laboratory quality standards and their implementation*.
- World Health Organization, W. H. O. (2020). *Ending the neglect to attain the Sustainable Development Goals: a road map for neglected tropical diseases 2021–2030*. World Health Organization.
- Woteki, C. E. (2005). Developing scientist leaders for tumultuous times. *Journal of Veterinary Medical Education*, 32(3), 342–344.
- Wyatt, M. (2018). Language teachers’ self-efficacy beliefs: An introduction. *Language Teacher Psychology*, 122–140.

- Yin, R. K. (1999). Enhancing the quality of case studies in health services research. *Health Services Research, 34*(5 Pt 2), 1209–1224. <https://www.ncbi.nlm.nih.gov/pubmed/10591280>
- Yukl, G. (2009). Leading organizational learning: Reflections on theory and research. *The Leadership Quarterly, 20*(1), 49–53.
- Zenger, J., & Folkman, J. (2014). The skills leaders need at every level. *Harvard Business Review, 7*.
- Zhernakova, A., Withoff, S., & Wijmenga, C. (2013). Clinical implications of shared genetics and pathogenesis in autoimmune diseases. *Nature Reviews Endocrinology, 9*(11), 646–659.

7. Appendices

7.1. Appendix 1: Literature Review

Strategy


1. The principals of a Scoping Review were applied which serves the purpose of identifying the existing literature on a specific research question. They also, clarify concepts in the literature and define gaps in knowledge (Munn et al., 2018).
2. I defined and wrote down aims, objectives, and research questions.
3. From the research questions and conversations with supervisors and peers, I kept a record of key words, terms and phrases and grouped the related literature into folders.
4. In each folder I looked at the relevance (e.g., Journal and year) of where the themed literature is coming out of. If it was not aligning to answer the questions in my research questions, I relooked and if not found, noted the gap.
5. This search process also resulted in iteratively refining the search terms to find work that aligns best with answering the research question.
6. Each literature used was added to the reference manager (Mendeley). Literature here can be sorted by publisher and year to get an idea of where certain research lies. Recurring publications were also looked at for further literature e.g., Nursing related journals.
7. UCT's Primo Search engine was used to get access to papers and for searches. Google scholar was also used as it was at times better at searching for key terms.

7.2. Appendix 2: Reflective diary

Date	Notes
210709	<p><i>Focus Groups Discussions with Technicians then Managers:</i></p> <ol style="list-style-type: none"> 1. Technicians a bit more cautious and nervous when sharing views. 2. Managers, less cautious, somewhat bold, easily shared and the session went overtime. 3. Both groups know or feel they know what the issues are but cannot provide tangible solutions. 4. Conflicting views on approachability and creating sound guides for processes.
210721	<p><i>Sending agenda for meeting, Monthly meeting with AA, EB, and DS:</i></p> <p>For the technician-manager pairs, instances where they had conflicting views of what is happening e.g.:</p> <ol style="list-style-type: none"> 1. Manager notes is always busy but has made it clear to their team that they are approachable. Corresponding Technician notes, when a manager looks stressed, you don't bother them, so you do it on your own/take initiative. 2. Manager believes they have robust systems in place for processes, technicians believe instances of it the processes are disorganised or not well thought out. 3. Managers believe some allocated projects are "forced" on them from higher up without proper resource consideration. Technicians believe that allocated projects are forced on them from manager without proper resource consideration. Resource here is human and physical. 4. The feeling that they don't have a voice (that those with power will hear) to action change. 5. Technicians automatically making Athandwa (the manager in the vignette) the "villain". 6. Questions about robustness of training and characters involved in training/learning. 7. Important notes from Delva when she was observing me: <ol style="list-style-type: none"> a. To be mindful of when I added my own voice which may influence conversations. b. To be mindful of who I may have focused on and not, that is, would have then shared more.
270806	<p><i>Sending meeting notes, Monthly meeting with AA, EB, and DS:</i></p> <ol style="list-style-type: none"> 1. Reflecting on DS point that some processes that one would expect to robustly in place, reminded me that I also questioned it as earlier in the Focus groups during discussions that there was a lot of questioning about how sound the processes were. Another one from DS, Technicians, talking about things that they thought were already in place e.g. like talking to the managers.

	<ol style="list-style-type: none"> 2. Started thinking intentionally about how solutions are given that would best suite everyone because in a small company majority rule can be controversial e.g. if well paid are higher ups and for them a job well done is a pat on the back while younger staff may prefer the pay, always being outvoted.
210813	<p><i>Meeting with EB on Focus Group analysis:</i></p> <ol style="list-style-type: none"> 1. Read the data as is. 2. In analysis you can look at it through a personal lens as well then explain that you have insider information/experience.
2112	<ol style="list-style-type: none"> 1. The raters did individual analysis. 2. The was very low inter-reliability. 3. Met with DS to discuss algorithms. 4. We had to look through the same lens, so PK explained the context of the conversation and asked for a re-evaluation. 5. PK recreated stats and self-reflection on the data

7.3. Appendix 3: Organization's Authorization letter

 **CPGR** | CENTRE FOR PROTEOMIC & GENOMIC RESEARCH

Centre for Proteomic & Genomic Research (CPGR)
Upper level St Peter's Square Mall
Cnr Anzio & Main Road
Observatory, Cape Town 7925
South Africa
Tel: +27 21 447 5669
www.cogr.org.za

20 April 2020

Human Research Ethics Committee
Health Sciences Campus,
University of Cape Town
Cape Town
7700

Dear Sir/Madam

Re: Letter of Authorisation (Case Study) for Paidamoyo Farai Kachambwa (KCHPAI001)

I hereby confirm that Ms Paidamoyo Farai Kachambwa is employed full time at our organization, the Centre for Proteomic and Genomic Research (CPGR), as the Bioinformatics Team Leader.

I acknowledge that Ms Kachambwa is studying towards a doctoral degree in the Department of Health Sciences Education (DHSE) with her thesis title *"Exploring factors contributing towards competencies of medical laboratory technicians and recommendations for plausible improvement: A case study of a Scientific Innovation Laboratory based in a resource constraint setting."*

The CPGR supports Ms Kachambwa's research proposal and gives her permission to conduct her study at our organisation. Further, the CPGR will accept the decision made by the Ethics Committee with respect to her research proposal.

Yours sincerely,

Signed by candidate

.....
Dr Lindsay Petersen
Genomics Manager

Registered office: Upper Level, St Peter's Square Mall, Cnr Anzio & Main Road, Observatory, Cape Town 7925, South Africa
Incorporated in South Africa under section 21, registration number 2006/010411/08

7.4. Appendix 4: Informed Consent

Main study

Dear potential participant,

My name is Paidamoyo Kachambwa. I am a doctoral student at the University of Cape Town in the Health Sciences Faculty at the Department of Health Sciences Education. This study has obtained approval from the UCT Health Sciences Faculty Ethics in Research Committee (Reference: HREC 097/202): Exploring factors contributing towards competencies of medical sciences laboratory technicians and recommendations for plausible improvement: A case study of a Scientific Innovation Laboratory based in a resource constraint setting.

Why is this study being done?

Findings from this study will help towards building capacity in Africa and boost the image of Africa's diligence in conducting work. In summary, diligently conducted work (where the technicians conduct this work) attracts and generates funds.

Why am I being asked to take part?

You are either a technician or an individual who manages technicians. Part of exploring competencies involves gaining insights from direct managers on their role in development of competencies. Participation in this study is voluntary, and you may decide to withdraw from it at any time, without any consequences.

How many people will take part in the study?

All of the current technicians and their direct managers have been invited to take part. This will form 2 groups, managers, and technicians. I will facilitate all of the activities and will keep the conversations of each group confidential.

What am I being asked to do?

After signing the informed consent attached, you will be asked to participate in a confidential separate focus groups (20-30 mins) and thereafter fill in a short survey (10-15 mins). A further short interview may take place (10-15 mins) for clarification. A total of 1 hour separated into at most 3 phases. I will be the facilitator for all the above and will take notes and recordings which will be securely stored to a drive that only I have access to.

What will happen to the data?

Your personal identifying data will be anonymized from the start of the study, and you will be given a participant id. There will be one master list that has identifying data which will be password protected with only myself having access. The outcomes from the study will be shared with you, that is the thesis on the University of Cape Town for its Open Access platform. If at any point you feel any information you shared may identify you and may have a negative effect on you, identifying outcomes will be withheld from the organization for a period of 2 years. Please note that even the detailed outcomes will generally be anonymized. Recordings and notes will be deleted and not shared.

What are the risks?

There are no foreseen risks other than those related to data and are addressed in *What will happen to the data?* The UCT FHS Human Research Ethics Committee can be contacted on 021 406 6338 in case participants have any questions regarding their rights and welfare as research subjects on the study.

Who do I contact if I have any questions or concerns?

Person	Email	Phone
Paidamoyo Kachambwa	kchpai001@myuct.ac.za	079 305 8931
Dr. Elmi Badenhorst	Elmi.badenhorts@uct.ac.za	021 650 6336
A/Prof Delva Shamley	delva.shaley@uct.ac.za	021 650 1975

Informed Consent

By signing below, I acknowledge that:

1. I agree to participate in the study described above and understand that I have the right to withdraw from the study at any time, without any consequences.
2. I understand the purpose of the study and am giving informed consent.

Signature	
Full name	
ID number	
Place	
Date	

Survey Pilot Study



University of Cape Town: Division of Clinical Anatomy and Biological Anthropology

10 March 2022

Background

My name is Paidamoyo Kachambwa. I am a doctoral candidate at the University of Cape Town in the Health Sciences Faculty at the Department of Human Biology. This study has obtained approval from the UCT Health Sciences Faculty Ethics in Research Committee (HREC REF: 097/2021): Exploring factors contributing towards competencies of medical sciences laboratory technicians and recommendations for plausible improvement: A case study of a Scientific Innovation Laboratory based in a resource constraint setting.

Why is this study being done?

Findings from this study will help towards building research capacity in Africa and boost the image of Africa's diligence in conducting research. In summary, in fields with a constant change in scope of work, it is important to maintain diligent operational processes. This study examines an environment where the technicians are hands on and conduct this work and where the resulting direct outcomes attracts and generates funds which boosts work conducted.

Why am I being asked to take part in the pilot?

You are not part of the main study. We need independent reviewers of the survey questions. This will help improve the questions. Participation is voluntary, and you may decide to withdraw from this process in the study at any time, without any consequences.

What am I being asked to do?

Should you be willing to assist us, please complete, sign and send back this consent form. Thereafter, you can check to see if the survey questions are clear clarity and provide feedback if otherwise. This should take about 15 minutes of your time.

What will happen to the data?

Your personal identifying data will be anonymized from the start of the study and you will be assigned a participant study number. There will be one master list that has identifying data which will be password protected with only myself having access. Your responses will be confidential, and you will not be

identified in any reports or publications arising from this study. The data will form part of my thesis and may be published in a peer reviewed journal.

What are the risks?

There are no foreseen risks to you as a participant in this study. The UCT FHS Human Research Ethics Committee can be contacted on 021 406 6338 in case participants have any questions regarding their rights and welfare

Who can I contact if I have any questions or concerns?

Person	Email	Phone number
Ms. Paidamoyo Kachambwa	kchpai001@myuct.ac.za	079 305 8931
A/Prof. Delva Shamley	delva.shaley@uct.ac.za	021 650 1975
Dr. Elmi Badenhorst	elmi.badenhorts@uct.ac.za	021 650 6336
Dr. Amaal Abrahams	amaal.abrahams@uct.ac.za	021 406 6123

Informed Consent

By signing below, I acknowledge that:

1. I agree to participate in the pilot study described above and understand that I have the right to withdraw from the study at any time, without any consequences.
2. I understand the purpose of the study and am giving informed consent.

Pilot Participant ID	PS __ __ (Assigned by researcher)
CPGR Position title	
Full name	
Date	
Place	
Signature	

7.5. Appendix 5: HREC, FHS, UCT Approval

	<p>UNIVERSITY OF CAPE TOWN Faculty of Health Sciences Human Research Ethics Committee</p>	
<p>Room G50- Old Main Building Groote Schuur Hospital Observatory 7925 Telephone [021] 406 6492 Email: hrec-submissions@uct.ac.za Website: www.health.uct.ac.za/fhs/research/humanethics/forms</p>		
<p>10 March 2021</p>		
<p>HREC REF: 097/2021</p>		
<p>A/Prof D Shamley Division of Human Biology FHS Email: Delya.shamley@uct.ac.za Student: kchpai001@myuct.ac.za</p>		
<p>Dear A/Prof Shamley</p>		
<p>PROJECT TITLE: EXPLORING FACTORS CONTRIBUTING TOWARDS COMPETENCIES OF MEDICAL SCIENCES LABORATORY TECHNICIANS AND RECOMMENDATIONS FOR PLAUSIBLE IMPROVEMENT: A CASE STUDY OF A SCIENTIFIC INNOVATION LABORATORY BASED IN A RESOURCE CONSTRAINT SETTING-PHD CANDIDATE- MS, PAIDAMOYO, KACHAMBWA</p>		
<p>Thank you for your response letter, addressing the issues raised by the Faculty of Health Sciences Human Research Ethics Committee (HREC).</p>		
<p>It is a pleasure to inform you that the HREC has formally approved the above-mentioned study.</p>		
<p>This approval is subject to strict adherence to the HREC recommendations regarding research involving human participants during COVID -19, dated 17 March 2020 & 06 July 2020.</p>		
<p>Approval is granted for one year until the 30 March 2022.</p>		
<p>Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period. (Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)</p>		
<p>The HREC acknowledge that the student: - Ms Paidamoyo Kachambwa will also be involved in this study.</p>		
<p>Please quote the HREC REF 097/2021 in all your correspondence.</p>		
<p>Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.</p>		
<p>Please note that for all studies approved by the HREC, the principal investigator must obtain appropriate institutional approval, where necessary, before the research may occur.</p>		
<p>HREC/REF 097/2021sa</p>		

<p>Yours sincerely</p>	<p>Signed by candidate</p>
<p>PROFESSOR M BLOCKMAN CHAIRPERSON, FACULTY OF HEALTH SCIENCES HUMAN RESEARCH ETHICS COMMITTEE Federal Wide Assurance Number: FWA00001637. Institutional Review Board (IRB) number: IRB00001938 NHREC-registration number: REC-210208-007</p>	
<p>This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use: Good Clinical Practice (ICH GCP), South African Good Clinical Practice Guidelines (DoH 2006), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI), and Declaration of Helsinki (2013) guidelines. The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.</p>	

7.6. Appendix 6: Master List

FULL NAME	ID NUMBER	DOB YYMMDD	GENDER	PARTICIPANT ID
				PART01
				PART02

7.7. Appendix 7: Sociodemographic questionnaire

Sociodemographic questionnaire for: Exploring factors contributing towards competencies of medical sciences laboratory technicians and recommendations for plausible improvement: A case study of a Scientific Innovation Laboratory based in a resource constraint setting (HREC REF: 097/2021).

If there is anything that you do not understand, please feel free to clarify with the facilitator.

Participant ID	P I D <input type="checkbox"/>
Gender.	<input type="checkbox"/> Female <input type="checkbox"/> Male <input type="checkbox"/> Not listed - If not listed, please describe: _____
Ethnicity.	<input type="checkbox"/> Black / African <input type="checkbox"/> Coloured <input type="checkbox"/> White <input type="checkbox"/> Indian <input type="checkbox"/> Asian <input type="checkbox"/> Not listed - If not listed, please describe: _____
Date of Birth.	YYYY/MM/DD: _____
Marital Status.	<input type="checkbox"/> Single <input type="checkbox"/> Married <input type="checkbox"/> Divorced <input type="checkbox"/> Widowed <input type="checkbox"/> Separated <input type="checkbox"/> Not listed - If not listed, please state: _____
Number of dependants.	: _____
Highest Education level.	<input type="checkbox"/> Diploma <input type="checkbox"/> Degree <input type="checkbox"/> Honours <input type="checkbox"/> Masters <input type="checkbox"/> Doctorate Name of qualification e.g. BSc Microbiology : _____ University obtained : _____ Year obtained : _____

<p>Education most relevant to current role at the CPGR.</p> <p>(If more than 3, please list the 3 that are most relevant to your current role)</p>	<p>1. Name of qualification e.g. BSc Microbiology : _____</p> <p>University obtained : _____</p> <p>Year obtained : _____</p> <p>2. Name of qualification e.g. Hons Microbiology : _____</p> <p>University obtained : _____</p> <p>Year obtained : _____</p> <p>3. Name of qualification e.g. MSc Microbiology : _____</p> <p>University obtained : _____</p> <p>Year obtained : _____</p>
<p>Number of years at the CPGR.</p>	<p>: _____</p>
<p>Previous employer.</p>	<p><input type="checkbox"/> CPGR is my first employer</p> <p><input type="checkbox"/> I have a previous employer</p> <p>Number of years : _____</p> <p>Organisation : _____</p> <p>Position : _____</p>
<p>Number of years professional work experience in a field related to your current role at the CPGR.</p>	<p>: _____</p>
<p>Please list any memberships to any scientific organisations e.g. SACNASP, HPCSA.</p>	<p><input type="checkbox"/> I am not a member of any scientific organisations</p> <p><input type="checkbox"/> I am member, if more than 3, please list the 3 that are most relevant to your current role:</p> <p>1. _____</p> <p>2. _____</p> <p>3. _____</p>

END

Participant ID	Position	Gender	Ethnicity	Marital status	Highest degree	Number of dependants
PID1	Manager	F	White	M	MBA	0
PID2	Technician	M	Coloured	S	Honours	0
PID3	Technician	F	Indian	S	Honours	0
PID4	Technician	F	Coloured	S	Honours	0
PID5	Technician	F	Coloured	M	Honours	3
PID6	Manager	M	White	M	Doctorate	2
PID7	Manager	F	White	S	Masters	0
PID8	Manager	F	Coloured	M	Masters	0
SMID001	Senior manager	F	White	M	Masters	0
SMID002	Senior manager	F	Black	S	Masters	0
SMID003	Senior manager	F	Coloured	M	Bachelors	1
SMID004	Senior manager	F	White	S	Bachelors	0
SMID005	Senior manager	F	White	M	Doctorate	0

7.8. Appendix 8: Extract example of highlighted transcribed data

Facilitator:	"I understand, yeah."
PID6:	"Likewise both sets of people are going to be in their own different circles and where they overlap and so we can talk (one/) and say the manager has to pick up on these things but if the manager is completely under resourced and hes carrying on four, five, six peoples functions, two people functions, doesn't really matter, he may not have the capacity and time, it may be unfair to be asking this of him . So the fault may not necessarily lie just on the person who executed it, the fault may lie just with the person who executed it, it just depends on what the structure of that system is that theyre finding themselves at . So I think those are the questions you need to understand and get to and then..."
Facilitator:	"So what we're actually doing now is we're having [Inaudible 00:19:57] you know what could have contributed, you can actually say what those things are, so [inaudible 00:20:04] but you can just simply say I think it could be that theres no group communication. Or I think that home stresses play a key role in the environment so <u>its</u> just bringing those things out."
PID8:	"As you say with resources. If they are under resourced, people make mistakes as well "
PID1:	"I have a question actually, before they get employed, you said it's a colour test , do they undergo a colour test themselves to know what blue and-"
PID8:	" A competency test. "
PID1:	"Yes. To see that they not colour blind too."

7.10. Appendix 10: Survey Supervisor Pilot



University of Cape Town:
Division of Clinical Anatomy and Biological Anthropology

Study: Exploring factors contributing towards competencies of medical sciences laboratory technicians and recommendations for plausible improvement: A case study of a Scientific Innovation Laboratory based in a resource constraint setting.

Document: Checklist for Theme Consistency, Study Relevance and Wording Clarity .

Supervisor : AI/Prof. Delva Shamley

Co-Supervisor : Dr. Amaal Abrahams

Co-Supervisor : Dr. Elmi Badenhorst

PhD Candidate : Paidamoyo Kachambwa

1. Background

Thank you, the supervisory team, for agreeing to evaluate this questionnaire (ethics approval - HREC REF 097/2021). The purpose of this checklist is to ensure a structured evaluation of the survey questionnaire. There will be 4 main aspects that will be looked into: theme consistency, study relevance, word clarity and any additional questions that may need to be added.

2. Information

The themes have been summarized as below:

Abbr	Theme	~% in Focus Groups	~# expected in 50 Survey questions	# observed in 50 Survey questions
Com	Communication	10	5.00 (5)	5
Con	Contextual factors	15	7.50 (8)	8
Edu	Education	8	4.00 (4)	4
Hie	Hierarchy	6	3.02 (3)	3
Int	Interpersonal	12	6.00 (6)	6
Lea	Leadership	15	7.56 (8)	8
Ope	Operational systems	19	9.58 (10)	10
Org	Organizational climate / culture	14 = 99	7.06 (7) = 49.72 (51)	7 = 51

3 Survey Questions Review

The survey questions in the table below will be on a Likert Scale: (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree and (5) Strongly agree. That is when presented to the main study participants

Please score each column for each question between 1 and 3. The numbering has been explained below:

1	Did not meet criteria in [column]
2	Unsure whether it met the criteria in the column (NB: Please write in comment box why unsure)
3	Met the criteria in the column

Please complete the table below:

	Question	Theme	Consistency with Theme	Relevance to Study	Clarity of Wording	Comment
1	Good project management is an essential and critical skill needed to be an effective Manager	Lea	3	3	3	
2	Interpersonal and communication skills are an essential and critical skills needed to be an effective Manager	Int	3	3	3	
3	A manager should consult with their team when planning and executing projects	Com	3	3	3	
4	A managerial course is essential and critical for newly instated managers	Ope	2	3	3	Check that there is something similar for technicians. Is this not Education theme?
5	A psychometric test is important to conduct before appointing a manager	Lea	3	3	3	This could also be Education theme
6	Alexis is a technician. Alexis misunderstood the protocol and makes a critical mistake while processing samples. In troubleshooting, Alexis should first check the protocol before checking where they went wrong	Con	3	3	3	
7	Management style plays a big role in team cohesiveness	Lea	3	3	3	
8	Management <u>should</u> effectively communicate the vision and roadmap of the company	Com	3	3	3	
9	Company culture directly affects management style	Org	3	3	3	
10	Management style is directly affected by company culture	Lea	2	3	3	Is this not organizational culture?
11	I feel that I am a part of and contribute towards the goals set by Senior management	Org	3	3	3	
12	I am confident in the soundness of all the protocols and operating procedures put in place in my platform	Ope	3	3	3	
13	I am unsure of the soundness of all the protocols and	Ope	3	3	3	


	operating procedures put in place in my platform					
14	I am fully aware of the expectations, <u>that my manager has of me</u> with respect to <u>my</u> roles and responsibilities,	Lea	2	3	3	Communication?
15	Personal circumstances can affect how I conduct my work	Con	3	3	3	
16	I am comfortable communicating <u>how my personal circumstances may be affecting my work</u> to my direct manager	Int	3	3	3	
17	The induction training given to technicians when they join the organization is sufficient for them to work effectively	Edu	2	3	3	See question number 4 above. That is listed as Ope but induction training is education. Does not seem to be consistent.
18	The training that technicians receive on new technologies or protocols is sufficient for them <u>to</u> work effectively	Edu	2	3	3	Same comment as above.
19	When you are experienced in a carrying out a procedure, you are more likely to create shortcuts	Edu	3	3	3	
20	Recent graduates who are hired as <u>technicians</u> can give valuable input to current and new protocols and workflows	Ope	2	3	3	Education?
21	There is sufficient continuous development that helps me fulfil my roles and responsibilities	Edu	3	3	3	
22	Technicians should do a performance assessment of their managers	Hie	3	3	3	
23	The Managing <u>Director</u> should establish and have direct communication with all employees	Com	2	3	3	Hierarchy?
24	Senior management should directly and separately ask employees about the rewards and benefits that they would like	Lea	2	3	3	Communication?
25	I feel that issues pertaining to rewards, benefits, and being acknowledged are addressed appropriately	Lea	3	3	3	

26	Someone should review protocols and processes that the Platform Manager has puts in place	Ope	3	3	3	
27	I know what practically should be put in place in order for me to feel acknowledged and appreciated	Con	2	3	3	Org culture?
28	The HR Manager should act independently of Managing Director and Managers when getting companywide feedback	Hie	3	3	3	
29	I feel free to have open and honest communication <u>on</u> my platform	Com	3	3	3	
30	Establishing a personal relationship with members of the platform should be part of a manager's function	Int	3	3	3	
31	My personal background affects my interpersonal relationships in the workplace	Con	3	3	3	
32	Work politics affects the work that I do	Con	3	3	3	
33	There is favoritism in the office	Org	2	3	3	Interpersonal?
34	Favoritism negatively affects work being conducted	Org	2	3	3	Interpersonal?
35	Personally knowing someone positively affects the work being conducted	Int	3	3	3	
36	When your manager trusts you, it positively affects the work you are doing	Int	2	3	3	Org?
37	When your manager regularly checks in on your personal well-being, it positively affects the work you are doing	Con	2	3	3	Org?
38	I feel that I can freely give my opinion on how to improve any processes <u>on</u> my platform	Org	3	3	3	
39	I do not feel free to give my opinion on how to improve any processes <u>on</u> my platform	Org	3	3	3	
40	There are enough people to do the work in the lab	Ope	3	3	3	
41	Others <u>on</u> my platform intuitively know when to give help when it is needed	Con	3	3	3	

42	One should take initiative when there is no one else to assist	Con	2	3	3	Interpersonal?
43	I am freely able to communicate my needs to management	Hie	3	3	3	
44	When I communicate my needs, they are effectively and fairly resolved by management	Org	3	3	3	
45	My manager actively works to build my confidence	Int	2	3	3	Org and leadership?
46	My manager is aware and involved in the day-to-day running of the platform	Ope	3	3	3	
47	HR function is approachable and trustworthy	Lea	2	3	3	Operational?
48	Solutions created for findings in HR Surveys are sufficient and effective	Ope	3	3	3	
49	HR related surveys are an accurate representation of everyone's needs in the company	Ope	3	3	3	
50	I feel that my contributions are effectively acknowledged <u>by Senior Management</u>	Com	3	3	3	
51	My manager efficiently manages their day-to-day responsibilities	Ope	2	3	3	Org and leadership?
	<i>Additional Questions?</i>					
52						
53						
54						

4 Summary comments

Please feel free to make any additional comments that may be helpful to structuring the survey questions:

A large, empty rectangular box with a thin black border, intended for the user to provide additional comments. It occupies the majority of the page's vertical space below the instruction text.

7.11. Appendix 11: Survey Scientific laboratory Pilot



**University of Cape Town:
Division of Clinical Anatomy and Biological Anthropology**

10 March 2022

Study: Exploring factors contributing towards competencies of medical sciences laboratory technicians and recommendations for plausible improvement: A case study of a Scientific Innovation Laboratory based in a resource constraint setting.

Document: Checklist for Content clarity and coherence of Survey Questions

Supervisor: A/Prof. Delva Shamley

Co-Supervisor: Dr. Amaal Abrahams

Co-Supervisor: Dr. Elmi Badenhorst

PhD Candidate: Paidamoyo Kachambwa

Pilot participant ID: PS ____ (Assigned by researcher)

1. Background

You have been identified as Pilot Study Participant, that is, you are employed at the CPGR and are not participating in the Main Study (ethics approval - HREC REF 097/2021). Thank you for agreeing to evaluate if the questions on this questionnaire are clear. My supervisors have in addition looked at consistency and relevance to the themes in the study. The purpose of this checklist is to ensure that there is a structured evaluation of the survey questionnaire. Your responses will be confidential, and you will not be identified in any reports or publications arising from this study.

2. Survey Questions

To help you evaluate, please note that the survey questions will ultimately be placed on a Likert Scale with the following points: (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree and (5) Strongly agree. That is when they are presented to the main study participants.

3. Survey Questions to Review

Please score each question as 1, 2 and 3. The numbering has been explained below:

1	The question was unclear. Please write in the "Comment" column why you think the question was not clear.
2	Unsure whether the question was clear. Please write in the "Comment" column why you are unsure if the question was clear.
3	The question was clear. Please leave any comment you may have in the "Comment" column.

Please complete the table below:

	Question	Score	Comment
1	Good project management is an essential and critical skill needed to be an effective Manager		
2	Interpersonal and communication skills are an essential and critical skills needed to be an effective Manager		
3	A manager should consult with their team when planning and executing projects		
4	A managerial course is essential and critical for newly instated managers		
5	A psychometric test is important to conduct before appointing a manager		
6	Alexis is a technician. Alexis misunderstood the protocol and makes a critical mistake while processing samples. In troubleshooting, Alexis should first check the protocol before checking where they went wrong		
7	Management style plays a big role in team cohesiveness		
8	Management should effectively communicate the vision and roadmap of the company		
9	Company culture directly affects management style		
10	Management style is directly affected by company culture		
11	I feel that I am a part of and contribute towards the goals set by Senior management		
12	I am confident in the soundness of all the protocols and operating procedures put in place in my platform		
13	I am unsure of the soundness of all the protocols and operating procedures put in place in my platform		
14	I am fully aware of the expectations, that my manager has of me with respect to my roles and responsibilities,		
15	Personal circumstances can affect how I conduct my work		
16	I am comfortable communicating how my personal circumstances may be affecting my work to my direct manager		
17	The induction training given to technicians when they join the organization is sufficient for them to work effectively		

18	The training that technicians receive on new technologies or protocols is sufficient for them to work effectively		
19	When you are experienced in a carrying out a procedure, you are more likely to create shortcuts		
20	Recent graduates who are hired as technicians can give valuable input to current and new protocols and workflows		
21	There is sufficient continuous development that helps me fulfil my roles and responsibilities		
22	Technicians should do a performance assessment of their managers		
23	The Managing Director should establish and have direct communication with all employees		
24	Senior management should directly and separately ask employees about the rewards and benefits that they would like		
25	I feel that issues pertaining to rewards, benefits, and being acknowledged are addressed appropriately		
26	Someone should review protocols and processes that the Platform Manager has puts in place		
27	I know what practically should be put in place in order for me to feel acknowledged and appreciated		
28	The HR Manager should act independently of Managing Director and Managers when getting companywide feedback		
29	I feel free to have open and honest communication in my platform		
30	Establishing a personal relationship with members of the platform should be part of a manager's function		
31	My personal background affects my interpersonal relationships in the workplace		
32	Work politics affects the work that I do		
33	There is favoritism in the office		
34	Favoritism negatively affects work being conducted		
35	Personally knowing someone positively affects the work being conducted		

36	When your manager trusts you, it positively affects the work you are doing		
37	When your manager regularly checks in on your personal well-being, it positively affects the work you are doing		
38	I feel that I can freely give my opinion on how to improve any processes in my platform		
39	I do not feel free to give my opinion on how to improve any processes in my platform		
40	There are enough people to do the work in the lab		
41	Others in my platform intuitively know when to give help when it is needed		
42	One should take initiative when there is no one else to assist		
43	I am freely able to communicate my needs to management		
44	When I communicate my needs, they are effectively and fairly resolved by management		
45	My manager actively works to build my confidence		
46	My manager is aware and involved in the day-to-day running of the platform		
47	HR function is approachable and trustworthy		
48	Solutions created for findings in HR Surveys are sufficient and effective		
49	HR related surveys are an accurate representation of everyone's needs in the company		
50	I feel that my contributions are effectively acknowledged by Senior Management		
51	My manager efficiently manages their day-to-day responsibilities		
52	A technical mini course is essential and critical for newly instated technicians.		

4. Summary comments

Please feel free to make any additional comments that may be helpful to structuring the survey questions:

7.12. Appendix 12: Main study survey invitation

Dear XXXX,

Thank you for taking part in the focus group (HREC REF 097/2021) last year, I greatly appreciate your input. If you may recall, the next stage of the study is for you to kindly take this short 10 to 15-minute survey.

If you are no longer employed by the CPGR, please use experiences from when you were employed at the CPGR to complete the survey.

The survey can be completed on a smart phone, tablet, or laptop.

Link to survey: <https://forms.gle/XVSJKGDkN9sSzw1w9>
Your unique participant ID: XXXX

I am also happy to email this message to you, please reply with an email address if you would like me to.

Gentle reminder, participation in this study is voluntary, and you may decide to withdraw from it at any time, without any consequences.

Please get in touch if you have any questions or concerns.

Kind regards,

Paidamoyo.

6	Alexis is a technician. Alexis misunderstood the protocol and makes a critical mistake while processing samples. In troubleshooting, Alexis should first check the protocol before checking where they went wrong	3	2	the question being out of place throws off the balance and I am left asking myself what is the question but none of the others were questions. E.g. put everything relating to management together and everything relating to lab tasks together	3	3	3	3	3	3	3	3	I replace 'they' with 'she'	3	3	3	2.9
7	Management style plays a big role in team cohesiveness	3	3		3	3	3	3	3	3	3	3		3	3	3	3
8	Management should effectively communicate the vision and roadmap of the company	3	3		3	3	3	3	3	3	3	3		3	3	3	3
9	Company culture directly affects management style	3	3		3	How is company culture defined? What is company culture?	3	3	3	3	3	3		3	3	3	3
10	Management style is directly affected by company culture	3	1	This question is very similar to the previous one leaving me confused	3		3	3	3	3	3	3		3	3	3	2.8
11	I feel that I am a part of and contribute towards the goals set by Senior management	3	2	Only relevant if currently working in the environment	3		3	2	This is clear, but to me it represents two questions, whether you feel	3	3	3		3	3	3	2.8

								part of as well as whether you feel you contribute to the goals set – feelings towards these may be different.										
1 2	I am confident in the soundness of all the protocols and operating procedures put in place in my platform	3	2	As above and most labs do not refer to areas a s platforms but rather decisions or departments and it cause confusion	3	3	3	3	3		2	3	3	3	3	3	2.8	
1 3	I am unsure of the soundness of all the protocols and operating procedures put in place in my platform	3	1	This question is very similar to the previous one leaving me confused	3	3	3	3	3		2	3	3	3	3	2.7		
1 4	I am fully aware of the expectations, that my manager has of me with respect to my roles and responsibilities,	3	3		3	3	3	3	3	Remove the comma in the middle and the trailing comma at the end	3	3	Removed the comma before 'that.....'	3	3	3		
1 5	Personal circumstances can affect how I conduct my work	3	3		3	3	3	3	3		3	3	3	3	3	3		

1 6	I am comfortable communicating how my personal circumstances may be affecting my work to my direct manager	3	3		3		3	3	3		3		3		3		3		3
1 7	The induction training given to technicians when they join the organization is sufficient for them to work effectively	3	2	Not every organization calls it induction	3		3	3	3		3		3		3		3		2.9
1 8	The training that technicians receive on new technologies or protocols is sufficient for them to work effectively	3	3		3		3	3	3		3		3		3		3		3
1 9	When you are experienced in a carrying out a procedure, you are more likely to create shortcuts	3	3		3		3	3	3		3		3	1	When you are experienced in a carrying out a procedure, you are more likely to create shortcuts		3		2.8
2 0	Recent graduates who are hired as technicians can give valuable input to current and new protocols and workflows	3	3		3		3	3	3		3		3		3		3		3
2 1	There is sufficient continuous development that helps me fulfil my roles and responsibilities	3	3		3		3	3	3		3		3		3		3		3
2 2	Technicians should do a performance assessment of their managers	3	3		3		3	3	3		3		3		3		3		3

2 3	The Managing Director should establish and have direct communication with all employees	3	2	In some institutions it will be a CEO or a pathologist or even a HOD	3	3	3	3	3	3	3	3	3	3	3	3	3	2.9
2 4	Senior management should directly and separately ask employees about the rewards and benefits that they would like	3	3		3	3	3	3	3	3	3	3	3	3	3	3	3	3
2 5	I feel that issues pertaining to rewards, benefits, and being acknowledged are addressed appropriately	3	3		3	3	3	3	3	3	3	3	3	3	3	3	3	3
2 6	Someone should review protocols and processes that the Platform Manager has puts in place	3			3	3	3	'Puts' should be 'put'	3	3	3	3	Changed 'puts' to put	1	Someone should review protocols and processes that the Platform Manager has puts in place OR (Someone should review protocols and processes that the Platform Manager has implemented)	3		2.777778
2 7	I know what practically should be put in place in order for me to feel	3	3		2	3	3		3	3	3	3	3	3	3	3	3	2.9

	acknowledged and appreciated																			
28	The HR Manager should act independently of Managing Director and Managers when getting companywide feedback	3		3		3		3		3		3		3		3		3		3
29	I feel free to have open and honest communication in my platform	3		3		3		3		3		3		3		3		3		3
30	Establishing a personal relationship with members of the platform should be part of a manager's function	3		3		3		3		3		3		3		3		3		3
31	My personal background affects my interpersonal relationships in the workplace	3		3		3		3		3		3		3		3		3		3
32	Work politics affects the work that I do	3		3		3	What are work politics?	3		3		3		3		3		3		3
33	There is favouritism in the office	3		3		3		3		3		3		3		3		3		3
34	Favouritism negatively affects work being conducted	3		3		3		3		3		3		3		3		3		3
35	Personally knowing someone positively affects the work being conducted	3		2	Uncertain if it would cause confusion with the question of favouritism	3		3		3		3		3		3		3		2.9
36	When your manager trusts you, it positively affects the work you are doing	3		3		3		3		3		3		3		3		3		3
37	When your manager regularly checks in on your personal well-being, it positively affects the work you are doing	3		3		3		3		3		3		3		3		3		3

38	I feel that I can freely give my opinion on how to improve any processes in my platform	3		3		3		3		3		3		3		3		3		3
39	I do not feel free to give my opinion on how to improve any processes in my platform	3		3		3		3		3		3		3		3		3		3
40	There are enough people to do the work in the lab	3		3		3		3		3		3		3		3		3		3
41	Others in my platform intuitively know when to give help when it is needed	3		3		3		3		3		2		3		3		3		2.9
42	One should take initiative when there is no one else to assist	3		3		3		3		3		3		3		3		3		3
43	I am freely able to communicate my needs to management	3		3		3		3		3		3		3		3		3		3
44	When I communicate my needs, they are effectively and fairly resolved by management	3		3		3		3		3		3		3		3		3		3
45	My manager actively works to build my confidence	3		3		3		3		3		3		3		3		3		3
46	My manager is aware and involved in the day-to-day running of the platform	3		3		3		3		3		3		3		3		3		3
47	HR function is approachable and trustworthy	3		1		The term HR function is confusing in the sentence		3		3		3		3		3		3		2.8
48	Solutions created for findings in HR Surveys are sufficient and effective	3		2		Not everyone might be familiar with the concept of an HR survey		3		3		3		3		3		3		2.9
49	HR related surveys are an accurate representation of	3		3				3		3		3		3		3		3		3

targeting that is fine but if not the terms technologist and scientist will also need to be included.

-Things like induction and HR surveys might not be performed elsewhere or have different terms.

- I think in this type of survey it is also important to touch on registration as it can cause a lot of issues in the work environment. If an individual is registered it will often mean that they are either favoured in terms of work or stuck doing the same thing every day.

7.14. Appendix 14: Pilot survey, reviewers' findings

Table 14.1: Supervisors feedback on the pilot survey, this was done after the pilot survey.

#	QUESTION PRESENTED	PK COMMENTS	FINALISED QUESTION	AA COMMENTS	EB COMMENTS	DS COMMENTS	NS COMMENTS
1	Good project management is an essential and critical skill needed to be an effective Manager	None	Good project management is an essential and critical skill needed to be an effective Manager			Concurs with all comments given	Concurs with all comments given
2	Interpersonal and communication skills are an essential and critical skills needed to be an effective Manager	All comments noted the grammatical issue	Interpersonal and communication skills are essential and critical skills needed to be an effective manager	Happy with final question	Happy		
3	A manager should consult with their team when planning and executing projects	None	A manager should consult with their team when planning and executing projects				
4	A managerial course is essential and critical for newly instated managers	None	A managerial course is essential and critical for newly instated managers				

5	<p>A psychometric test is important to conduct before appointing a manager</p>	<p>Comment noted some technicians might not know what a psychometric test is. I added a definition.</p> <p><i>Q: Does the definition that I put work?</i></p>	<p>A psychometric test* is important to conduct before appointing a manager.</p> <p>*An assessment designed to measure an applicant's suitability for the position/role based on knowledge, skills, personality traits, attitudes.</p>	<p>Great idea to include definition. The definition could be written simpler. An assessment designed to measure an applicant's suitability for the position/role based on knowledge, skills, personality traits, attitudes.....</p>	<p>Agree with Amaal's more simple def</p>		
6	<p>Alexis is a technician. Alexis misunderstood the protocol and makes a critical mistake while processing samples. In troubleshooting, Alexis should first check the protocol before checking where they went wrong</p>	<p>Comment 1: Is asking for lab related etc questions be grouped together. This is a fair point and also recommended. I will do so.</p> <p><i>Q: Grouping questions by theme is also recommended in literature, any reasons against it?</i></p> <p>Comment 2: Was editing grammar that was not a grammatical issue</p>	<p>Alexis is a technician. Alexis misunderstood the protocol and makes a critical mistake while processing samples. In troubleshooting, Alexis should first check the protocol before checking where they went wrong</p>		<p>Ok with this</p>		
7	<p>Management style plays a big role in team cohesiveness</p>	<p>None</p>	<p>Management style plays a big role in team cohesiveness</p>				
8	<p>Management should effectively communicate the vision and roadmap of the company</p>	<p>None</p>	<p>Management should effectively communicate the vision and roadmap of the company</p>				

9	Company culture directly affects management style	<p>Comment 1: There was a question on what is company culture, I added a definition.</p> <p><i>Q: Does the definition that I put work?</i></p>	<p>Company culture* directly affects management style</p> <p>* Refers to the attitudes and behaviours of a company</p>	Happy with definition.	should one include values as well?		
10	Management style is directly affected by company culture	<p>Comment 1: Is saying the questions are similar, we want to ask the same question twice.</p>	Management style is directly affected by company culture				
11	I feel that I am a part of and contribute towards the goals set by Senior management	<p>Comment 1: Make note on phrasing.</p> <p><i>Q: When I send it out, there are those who have left the organisation. In the instructions, can I say? "If you are no longer employed by the Scientific laboratory, please use experiences from when you were employed"</i></p> <p>Comment 2: noting there might be 2 things and does that make it 2 questions. No</p>	I feel that I am a part of and contribute towards the goals set by Senior management	Agree with your comment 2. Good to add the preamble about no longer being employed.	Agree with comment 2 as well		

12	I am confident in the soundness of all the protocols and operating procedures put in place in my platform	Comment 1: Other organisations use the words division or department instead of Platform, since this is for Scientific laboratory staff, it is fine and what they are familiar with	I am confident in the soundness of all the protocols and operating procedures put in place in my platform				
13	I am unsure of the soundness of all the protocols and operating procedures put in place in my platform	Comment 1: Is saying the questions are similar, we want to ask the same question twice.	I am unsure of the soundness of all the protocols and operating procedures put in place in my platform				
14	I am fully aware of the expectations, that my manager has of me with respect to my roles and responsibilities,	All comments noted the punctuation issue	I am fully aware of the expectations, that my manager has of me with respect to my roles and responsibilities				
15	Personal circumstances can affect how I conduct my work	None	Personal circumstances can affect how I conduct my work				
16	I am comfortable communicating how my personal circumstances may be affecting my work to my direct manager	None	I am comfortable communicating how my personal circumstances may be affecting my work to my direct manager				
17	The induction training given to technicians when they join the organization is sufficient for them to work effectively	Comment 1: "Induction" not always used word in organisations, but sample set is Scientific laboratory based so it's fine	The induction training given to technicians when they join the organization is sufficient for them to work effectively				
18	The training that technicians receive on new technologies or protocols is sufficient for them to work effectively	None	The training that technicians receive on new technologies or protocols is sufficient for them to work effectively				

19	When you are experienced in a carrying out a procedure, you are more likely to create shortcuts	Comment corrected grammar	When you are experienced in carrying out a procedure, you are more likely to create shortcuts				
20	Recent graduates who are hired as technicians can give valuable input to current and new protocols and workflows	None	Recent graduates who are hired as technicians can give valuable input to current and new protocols and workflows				
21	There is sufficient continuous development that helps me fulfil my roles and responsibilities	None	There is sufficient continuous development that helps me fulfil my roles and responsibilities				
22	Technicians should do a performance assessment of their managers	None	Technicians should do a performance assessment of their managers				
23	The Managing Director should establish and have direct communication with all employees	Comment 1: "MD" not always used word in organisations, but sample set is Scientific laboratory based so it's fine	The Managing Director should establish and have direct communication with all employees				
24	Senior management should directly and separately ask employees about the rewards and benefits that they would like	None	Senior management should directly and separately ask employees about the rewards and benefits that they would like				
25	I feel that issues pertaining to rewards, benefits, and being acknowledged are addressed appropriately	None	I feel that issues pertaining to rewards, benefits, and being acknowledged are addressed appropriately				
26	Someone should review protocols and processes that the Platform Manager has puts in place	All comments noted the grammatical issue	Someone should review protocols and processes that the Platform Manager has put in place				

27	I know what practically should be put in place in order for me to feel acknowledged and appreciated	<p>There was no comment on the "unclear". I am assuming the question doesn't make sense.</p> <p><i>Q: Does changing the question to the below make it clearer?</i></p> <p><i>I know what I practically <u>want the company</u> to put in place in order for me to feel acknowledged and appreciated</i></p>	I know what I practically want the company to put in place in order for me to feel acknowledged and appreciated	Happy with your rephrasing of the question in red	Also happy with red rephrasing - also wonder must practically be in the sentence? No big deal - just wondering.		
28	The HR Manager should act independently of Managing Director and Managers when getting companywide feedback	None	The HR Manager should act independently of Managing Director and Managers when getting companywide feedback				
29	I feel free to have open and honest communication in my platform	None	I feel free to have open and honest communication in my platform				
30	Establishing a personal relationship with members of the platform should be part of a manager's function	None	Establishing a personal relationship with members of the platform should be part of a manager's function				
31	My personal background affects my interpersonal relationships in the workplace	None	My personal background affects my interpersonal relationships in the workplace				

32	Work politics affects the work that I do	<p>Comment 1: Asking what is work politics</p> <p><i>Q: Does the definition that I put work?</i></p>	Work politics* affects the work that I do	<p>For your definitions I see it is from the internet - please reference Paidamoyo or rephrase.</p>	Agree with Amaal		
33	There is favouritism in the office	None	There is favouritism in the office				
34	Favouritism negatively affects work being conducted	None	Favouritism negatively affects work being conducted				
35	Personally knowing someone positively affects the work being conducted	<p>Comment 1: Is saying that "personally knowing someone" may be confused as favouritism.</p> <p><i>Q: Does changing the question to the below make it clearer?</i></p> <p>Personally knowing someone, professionally, positively affects the work being conducted</p>	Personally, knowing someone positively affects the work being conducted	<p>Happy with the rephrase.</p>	happy		
36	When your manager trusts you, it positively affects the work you are doing	None	When your manager trusts you, it positively affects the work you are doing				
37	When your manager regularly checks in on your personal well-being, it positively affects the work you are doing	None	When your manager regularly checks in on your personal well-being, it positively affects the work you are doing				

38	I feel that I can freely give my opinion on how to improve any processes in my platform	None	I feel that I can freely give my opinion on how to improve any processes in my platform				
39	I do not feel free to give my opinion on how to improve any processes in my platform	None	I do not feel free to give my opinion on how to improve any processes in my platform				
40	There are enough people to do the work in the lab	None	There are enough people to do the work in the lab				
41	Others in my platform intuitively know when to give help when it is needed	<p>There was no comment on the "unclear". I am assuming the question doesn't make sense.</p> <p>Q: Does changing the question to the below make it clearer?</p> <p>Others in my platform intuitively/<u>instinctively</u> know when to give help when it is needed</p>	Others in my platform intuitively/ <u>instinctively</u> know when to give help when it is needed	Happy with including instinctively.	happy		
42	One should take initiative when there is no one else to assist	None	One should take initiative when there is no one else to assist				
43	I am freely able to communicate my needs to management	None	I am freely able to communicate my needs to management				
44	When I communicate my needs, they are effectively and fairly resolved by management	None	When I communicate my needs, they are effectively and fairly resolved by management				

45	My manager actively works to build my confidence	None	My manager actively works to build my confidence				
46	My manager is aware and involved in the day-to-day running of the platform	None	My manager is aware and involved in the day-to-day running of the platform				
47	HR function is approachable and trustworthy	<i>Q: Does changing the question to the below make it clearer?</i> <i>The HR Manager is approachable and trustworthy</i>	The HR manager is approachable and trustworthy	Yes, agree with the change	agree		
48	Solutions created for findings in HR Surveys are sufficient and effective	Comment 1 says people might. Not be familiar with HR surveys. I don't think so. <i>Q: Any thoughts on this, also look at Q50</i>	Solutions created for findings in HR Surveys are sufficient and effective	I think most employees would be familiar	think most will be familiar		
49	HR related surveys are an accurate representation of everyone's needs in the company	None	HR related surveys are an accurate representation of everyone's needs in the company				
50	I feel that my contributions are effectively acknowledged by Senior Management	This was not marked like Q48, yet it speaks of the same HR surveys	I feel that my contributions are effectively acknowledged by Senior Management				
51	My manager efficiently manages their day-to-day responsibilities	None	My manager efficiently manages their day-to-day responsibilities				

52	A technical mini course is essential and critical for newly instated technicians.	I instated comment 1's suggestion	A skills appropriate/relevant technical mini course is essential and critical for newly instated technicians.				
	GENERAL COMMENTS	<p>GENERAL COMMENTS</p> <p>PS02</p> <p>1. Scientists at the organisation are represented by the managers in this case study</p> <p>2. WRT favouritism for e.g. HPSCA registered staff. <i>Q: Under organizational culture theme, Add question? " Technicians with certain qualifications/memberships/registrations e.g. HPSCA cause favouritism in the company"</i></p> <p>PS06</p> <p>Here I am asking if it is enough, changing the words would be asking if it is needed. So, I would rather not change</p>	<p>Technicians with certain qualifications/memberships/registrations e.g., HPSCA have inadvertent/unintentional advantage in the company</p>	<p>Not sure about the word favouritism in the sentence. Is it not maybe an inadvertent advantage? Not sure if that is also the correct word but I don't think companies intentionally try and favour those individuals.</p> <p>Hope I have understood this correctly?</p>	ok		

7.15. Appendix 15: Main Study Survey

HREC REF 097/2021

-----> Instructions
Thank you for taking part in this short survey. Your responses are valuable and appreciated. This will take approximately 10-15 mins. If you are no longer employed by the CPGR, please use experiences from when you were employed at the CPGR to complete the survey.

-----> Study
UCT - Division of Clinical Anatomy and Biological Anthropology
Survey for: Exploring factors contributing towards competencies of medical sciences laboratory technicians and recommendations for plausible improvement: A case study of a Scientific Innovation Laboratory based in a resource constraint setting.

-----> Contacts
Supervisor : A/Prof. Delva Shamley (delva.shamley@uct.ac.za, 021 650 1975)
Co-Supervisor : Dr. Amaal Abrahams (amaal.abrahams@uct.ac.za, 021 650 6336)
Co-Supervisor : Dr. Elmi Badenhorst (amaal.abrahams@uct.ac.za, 021 406 6123)
PhD Candidate : Paidamoyo Kachambwa (khpal001@myuct.ac.za, 0793058931)

[Sign in to Google](#) to save your progress. [Learn more](#)

***Required**

Please select your unique Participant ID? *

Choose

Strongly disagree Disagree Neither agree nor disagree Agree Strongly agree

1. A manager should consult with their team when planning and executing projects

2. Management should effectively communicate the vision and roadmap of the company

3. The Managing Director should establish and have direct communication with all employees

4. I feel free to have open and honest communication in my platform

5. I feel that my contributions are effectively acknowledged by Senior Management

6. Alexis is a technician. Alexis misunderstood the protocol and makes a critical mistake while processing samples. In troubleshooting, Alexis should first check the protocol before checking where they went wrong

7. Personal circumstances can affect how I conduct my work

8. I know what I practically want the company to put in place in order for me to feel acknowledged and appreciated

9. My personal background affects my interpersonal relationships in the workplace

10. Work politics* affects the work that I do. *Processes and behaviour in human interactions that involve power and authority

11. When your manager regularly checks in on your personal well-being, it positively affects the work you are doing

12. Others in my platform intuitively/instinctively know when to give help when it is needed

13. One should take initiative when there is no one else to assist

14. The induction training given to technicians when they join the organization is sufficient for them to work effectively

15. The training that technicians receive on new technologies or protocols is sufficient for them to work effectively

16. When you are experienced in carrying out a procedure, you are more likely to create shortcuts

17. There is sufficient continuous development that helps me fulfil my roles and responsibilities

18. Technicians with certain qualifications / memberships / registrations e.g. HPCSA have inadvertent/unintentional advantage in the company

19. Technicians should do a performance assessment of their managers

20. The HR Manager should act independently of Managing Director and Managers when getting companywide feedback

21. I am freely able to communicate my needs to management

22. Interpersonal and communication skills are essential and critical skills needed to be an effective manager

23. I am comfortable communicating how my personal circumstances may be affecting my work to my direct manager

24. Establishing a personal relationship with members of the platform should be part of a manager's function

25. Personally knowing someone positively affects the work being conducted

26. When your manager trusts you, it positively affects the work you are doing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27. My manager actively works to build my confidence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28. Good project management is an essential and critical skill needed to be an effective Manager	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29. A psychometric test* is important to conduct before appointing a manager. *An assessment designed to measure an applicant's suitability for the position/role based on knowledge, skills, personality traits, attitudes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30. Management style plays a big role in team cohesiveness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
31. Management style is directly affected by company culture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
32. I am fully aware of the expectations, that my manager has of me with respect to my roles and responsibilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
33. Senior management should directly and separately ask employees about the rewards and benefits that they would like	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

34. I feel that issues pertaining to rewards, benefits, and being acknowledged are addressed appropriately	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
35. The HR manager is approachable and trustworthy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
36. A managerial course is essential and critical for newly instated managers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
37. I am confident in the soundness of all the protocols and operating procedures put in place in my platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
38. I am unsure of the soundness of all the protocols and operating procedures put in place in my platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
39. Recent graduates who are hired as technicians can give valuable input to current and new protocols and workflows	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
40. Someone should review protocols and processes that the Platform Manager has put in place	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
41. There are enough people to do the work in the lab	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
42. My manager is aware and involved in the day-to-day running of the platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

43. Solutions created for findings in HR Surveys are sufficient and effective	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
44. HR related surveys are an accurate representation of everyone's needs in the company	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
45. My manager efficiently manages their day-to-day responsibilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
46. A skills appropriate/relevant technical mini course is essential and critical for newly instated technicians.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
47. Company culture* directly affects management style. *Refers to the attitudes and behaviours of a company	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
48. I feel that I am a part of and contribute towards the goals set by Senior management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
49. There is favouritism in the office	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
50. Favouritism negatively affects work being conducted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
51. I feel that I can freely give my opinion on how to improve any processes in my platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

52. I do not feel free to give my opinion on how to improve any processes in my platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
53. When I communicate my needs, they are effectively and fairly resolved by management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Submit Clear form

This content is neither created nor endorsed by Google. [Report Abuse](#) - [Terms of Service](#) - [Privacy Policy](#)

Google Forms

7.16. Appendix 16: Safe to Fail Experiment Invitation

Email

Dear XXX,

As you may recall, the study* referenced above was initiated in 2019 and is approaching its final stages, hopefully it will come back to you as I describe further. A recap, I am enrolled part time to do a PhD. In a very basic summary, I am looking into the psychology and learning involved in business management, in particular, of medical sciences laboratories where the CPGR is my case study.

I enrolled 4 technicians and 4 of their respective managers from the CPGR to have separate focus groups and thereafter each complete a survey. Findings from these were used to design 8 small safe-to-fail experiments** for you, senior management, to go through. **I am kindly asking you for 1- 1.5 hours at the CPGR on Monday 13 March 2023, 1130-1300.** Prof Delva Shamley (cc'd), one of my supervisors, will also be in attendance in a supervisory capacity. I will send a separate meeting request to block off the preliminary time.

The experiments are conversations based on hypothetical scenarios and thus you do not need to do any prior preparation. Confidentiality is of utmost importance, in particular, as the CPGR is a small organisation. The data collected can be arranged to be shared with the CPGR after 2 years, or longer if any of the participants request. The data will always be anonymized. To kindly participate, please fill, sign and send back the attached consent form.

*(HREC REF: 097/2021): Exploring factors contributing towards competencies of medical sciences laboratory technicians and recommendations for plausible improvement: A case study of a Scientific Innovation Laboratory based in a resource constraint setting

**Small-scale experiments that approach issues from different angles in small and safe-to-fail ways.

Please do let me know if you have any questions/concerns/suggestions.

Kind regards,

Paidamoyo Kachambwa.

Consent Form

Good day potential participant,

Please find below information related to the study, may you please sign and send back the consent at the end of this document.

Background. My name is Paidamoyo Kachambwa. I am a doctoral candidate at the University of Cape Town in the Health Sciences Faculty at the Department of Human Biology. This study has obtained approval from the UCT Health Sciences Faculty Ethics in Research Committee (HREC REF: 0977/2021). Authorisation from the CPGR was required in order to receive this approval. The study title: Exploring factors contributing towards competencies of medical sciences laboratory technicians and recommendations for plausible improvement: A case study of a Scientific Innovation Laboratory based in a resource constraint setting.

Why is this study being done? Findings from this study will help towards building research capacity in Africa and boost the image of Africa's diligence in conducting research. In summary, in fields with a constant change of scope of work, it is important to then diligently conduct work. This is in an environment where the technicians are hands on and conduct this work and where the resulting direct outcomes attracts and generates funds.

Why am I being asked to take part? You are in senior management. In the organogram, you are at the topmost and therefore inform activity in structures under you. I will take you through 8 experiments; these are conversations based on hypothetical scenarios and thus you do not need to do any prior preparation. Beforehand technicians and the individual who directly manages them participated. Part of exploring competencies involved gaining insights from direct managers on their perceived role in development of competencies. Participation in this study is voluntary, and you may decide to withdraw from it at any time, without any consequences.

How many people will take part in the study? There are 3 main members of senior management that have been invited. The invitation can be extended to any other members of senior management. I will facilitate all of the activities and will keep the conversations strictly confidential. As this is a small organization strict confidentiality will continue to be practiced throughout the process and additional measures can be taken when publishing the research.

What am I being asked to do? To kindly participate, please fill, sign and send back this consent form. Thereafter, you will be asked to participate for 1 - 1.5 hours at the CPGR on Monday 13 March 2023, 1130-1300. I will be the facilitator for all the above and will take notes and recordings which will be securely stored on a drive that only I have access to.

What will happen to the data? Your personal identifying data will be anonymized from the start of the study and you will be given a participant id. There will be one master list that has identifying data which will be password protected with only myself having access. The outcomes from the study will be shared with you, that is the thesis, on the University of Cape Town's Open Access platform. If at any point you feel any information you shared may identify you and may have a negative effect on you, identifying outcomes will be withheld from the organization for a period of 2 years. The period can be extended if need be. Please note that even the detailed outcomes will always be anonymized. Recordings and notes will be deleted and not shared.

What are the risks? There are no foreseen risks other than those related to data and are addressed in *What will happen to the data?* The UCT FHS Human Research Ethics Committee can be contacted on 021 406 6338 in case participants have any questions regarding their rights and welfare as research subjects on the study.

Who can I contact if I have any questions or concerns?

Person	Email	Phone
Ms. Paidamoyo Kachambwa	kchpai001@myuct.ac.za	079 305 8931
Dr. Elmi Badenhorst	elmi.badenhorts@uct.ac.za	021 650 6336
Prof. Delva Shamley	delva.shaley@uct.ac.za	021 650 1975
Dr. Amaal Abrahams	amaal.abrahams@uct.ac.za	021 406 6123

Informed Consent

By signing below, I acknowledge that:

1. I agree to participate in the study described above and understand that I have the right to withdraw from the study at any time, without any consequences.
2. I understand the purpose of the study and am giving informed consent.

Full name	
Place	
Date	
Signature	
Participant ID	(Filled By Study Administrator)

7.17. Appendix 17: Safe to Fail Vignettes

Vignette 1 of 8: Questions

- On night 4, when Blue asks again, do you think **Green will respond** and say buns? Yes? No? Maybe? Please explain.
- When Blue asks, and Green says buns again, do you think **Blue will make buns**? Yes? No? Maybe? Please explain.

Vignette 2 of 8: Questions

- Do you think it is important for Purple to **understand** where employees stay and their mode of transport (and related personal factors)? Yes? No? Maybe? Please explain.
- Or **Blue just communicating** why and that they are running late is enough. Yes? No? Maybe? Please explain.

Vignette 3 of 8: Questions

- What do think are Orange's initial thoughts?
- From your experience, what do you think are the challenges with skills development?
- Given that Blue attended the London Art Institute, which is good exposure and reputation for the organisation, what are the first few thoughts that you get with respect to Green's points?

Vignette 4 of 8: Questions

- What are your initial thoughts on the scenario?
- What do you think makes Green **seem unapproachable**?

Vignette 5 of 8: Questions

- What are your initial thoughts on the scenario?
- Do you think Blue has a right to be shocked? Yes? No? Maybe? Please explain.

Vignette 6 of 8: Questions

- Why do you think are reasons employees do not know this?
- Do you think employees should be aware of this? Yes? No? Maybe? Please explain.

Vignette 7 of 8: Questions

- What are your initial thoughts on the scenario?
- How would you go about resolving Purple's request?
- Do you think Green has sufficient skills for making this and related decisions? Yes? No? Maybe? Please explain.

Vignette 8 of 8: Questions

- What are your initial thoughts on the scenario?
- What do you think may have contributed to this situation or how this situation may have developed?

7.18. Appendix 18: Safe to Fail Analysis

Concerns experiment set to test.	Initial thoughts by participant.	Leading questions to alternative thinking by researcher.
<p><i>Key points for all the vignettes:</i></p> <ol style="list-style-type: none"> 1. Constant change in scope, because of the diversity of the projects taken up, of work and the complexity and ever evolving field made the employees feel incompetent when they couldn't work well/efficiently. 2. Essentially it is probably an area/field where when the employees can't do the work, they believe it's because they are not competent enough to do the work. 	<p><i>Key points for all the vignettes:</i></p> <ol style="list-style-type: none"> 1. They identified with the duck with/in power/management. 2. Therefore, naturally, may justify the duck in management's actions and criticise the subordinate duck's actions. They are also less likely to criticise the duck in management's action. 3. Want and appreciate the importance of such an environment. 4. Less appreciation and/or understanding of who mainly creates/influences the state of environment or circumstances where employees thrive. 	<p><i>Key points for all the vignettes:</i></p> <ol style="list-style-type: none"> 1. After proposing an alternative way to think about the scenario, there were no further points made to support or to re-affirm their initial thoughts. 2. From the audio, in some instances, there were agreeing hums to the new proposed way of thinking. There was no visual recording, so we cannot do analysis of the body language etc, their facial ques seemed in agreement. 3. They are an outspoken dominant group who would not have been reluctant to disagree with proposed alternate thoughts.
<p>1 - Communication</p> <ol style="list-style-type: none"> 1. Employees are communicating but management is not acting on the communication. 2. Employees feel unheard and consequently feel discouraged to communicate and feel unheard which creates a particular culture. 3. Employees seek an environment where they can be heard. <p>Summary initial thoughts:</p>	<ol style="list-style-type: none"> 1. [Speaker 2] I suppose it goes on perspective. I mean the duck is asking for a bun, none of those options of croissant, bread and cupcakes are buns. 2. [Speaker 4] (Blue) Doesn't like buns – Blue is asking but already has a preference. 3. [Speaker 2] If I look at it, it seems like this poor little green duck only has one word. – Green, employee, should have alternative preferences 4. [Speaker 5] The never intended on making the buns. 5. [Speaker 3] Blue just asked to be polite. 6. [Speaker 3] But I think they should be able to. I buns could also be more communicative to say, “I feel like buns I haven't really had in a long time. Can you please make you please 	<ol style="list-style-type: none"> 1. [Speaker 1] So here the person who has, let's just say in quotes 'the power' is blue because they're making dinner, right. And green because they're being asked, they're just going to be like, that's that. But maybe if blue said, “actually green of all the ingredients I have, I can't make buns”. “I really do want to make something that you like, but I really can't make buns”. So, this could be a communication breakdown That blue isn't just really communicating what's happening and because green is getting offered something, they're just like, can I now come and confront you when you've offered to me to dinner? 2. [Speaker 1] So, you are also like, oh at least they ask me, right? But at the end of the day, if this continues, it's going to create a particular culture where green will just say whatever is there and they can never look forward to

<ol style="list-style-type: none"> 1. Reasons why there is such a situation are not attributed to poor communication by the asking duck (blue) with power. 2. This may be that they identify with blue who has the power to ask for requests/wishes and grant them. 	<p>make it?”. Not just, “buns, thanks; buns, thanks”. – Green, employee, doesn’t ask well</p>	<p>having something for example. Okay, let me just check really quick. Okay. Yes. So, I think to just summarise this, sometimes maybe blue isn't aware how not communicating something may impact their relationship and as well for green that they're just sort of in the car just sitting in the passenger seat and they're not communicating or saying, “Hey, you know, when you said this, this is what happened. How do we fix this because now I'm going to look forward to having buns and then when I sit down, I'm having cupcakes again”. Okay perfect. And that's basically how we're going to do it. Okay. It's very light. That's why I said by one we'll probably be done anyways. Okay, so this is two and then blue is</p>
<p>2 - Contextual factors</p> <p>Understanding the impact of contextual factors on employee productivity and how this positively affects the business.</p> <p>Summary initial thoughts:</p> <ol style="list-style-type: none"> 1. They understood the importance of contextual factors. 2. The issue was that they did not trust the employees. 3. They did not understand the importance and benefit of giving trust in a work relationship. Furthermore, that they are also covered contractually if the trust is broken. 4. Another is an insinuated notion of trust being given to the valuable or performing staff. 	<ol style="list-style-type: none"> 1. [Speaker 5] I think it's important to know because working well in a team whether it's the manager or you, you need to know what your staff go through. And for example, somebody using public transport, it's not a nice thing to do, especially winter or maybe when it's raining and yeah, that's why I think it's important. Showing empathy to your staff, you will get it back in return. Straight forward. 2. [Speaker 2] I mean, allow flexibility based on the performance of the employee. 3. [Speaker 6] Yes, absolutely. Yes. I think everybody's correct in a certain way, but I think what it comes down to is a trust relationship. So, if somebody's late all the time you end up having to say, “Are you being honest with me? Is this really a problem?”. And the only reason you can understand that is if you have circumstances around it. So, if you're late once and it's a taxi strike, in this country, you know can be late every day for the next three weeks. But you need to know the circumstances because it could be a very quick way to break trust in a working relationship and then you end up having a problem. So, I think being honest about the background is always important and understanding what somebody has to go through in order to have work. 4. [Speaker 6] Some people believe that trust has to be earned, and other people believe you have and get given a trust until the trust is broken. And one of the hardest things to deal 	<ol style="list-style-type: none"> 1. [Speaker 1] These interpersonal relationships and in relationships there needs to be trust. So, there are different thoughts on how trust comes about. So, some people say trust is earned and some people say trust is given until it is broken. So just talking about this relationship, obviously there's some sort of a relationship that's happening here. And as (name redacted) said now, which is interesting, which is where I was going, sometimes you are as (name redacted) said, okay with someone just saying thanks because you already know the context that they're in. And for some people, maybe because you don't have that interpersonal relationship, you might not know what's going on. So, then you might need them to tell you. So then other people may experience that differently. They may experience that as you don't trust me, or you do. So maybe just to open up that discussion now, how you feel in a work-related interpersonal relationship, how you think trust is best built. 2. [Speaker 1] So just to bring this together and I like what (name redacted) sort of touched on in terms of going back. So, there are lots of theories and things that come behind this. I know it's very light from me, having the ducks on the screen, but they say businesses you – (name redacted) and (name redacted) because you are doing, I think (name redacted) is doing an MBA and (name

	<p>with is once trust is broken to get that back again, it's almost impossible. But I'm of the opinion that I trust everybody upfront and living hopefully. So, to build trust for me. You don't need to build trust initially; I suppose I trust you. When the trust is broken, I don't if I'm one of those people who allow people to build trust again.</p> <p>5. [Speaker 3] Yeah, I think that trust will be earned through consistency and your track record. If somebody ask me to do something, even simple as keeping a secret, if you tell me a secret today, this month and two months later I haven't told anybody, then you know that now in December you can still tell me something. So, through my actions and my consistency, you then know that I can be trusted.</p> <p>6. [Speaker 2] Trust is earned. It's not necessarily given and once it is broken it's, it's a very hard thing to try and rebuild.</p>	<p>redacted) has done one. So, you would have done a component that talks a lot about human systems to say they're the biggest thing in business. So, I'm giving a summary of this. There's a whole theory behind it that says that people are a little bit more creative if they have a little bit of trust given to them. And because this is an interpersonal work relationship, you have KPIs that are given against them so you can always sort of track their trust. So, it's giving you a safe place to give them that trust because it'll help them be creative, it'll help them do their job well. It'll help them know I can make this decision. So, they're more willing to make decisions to take risks to think a little bit more because they know that you trust them to sort of go off and explore. But then obviously you have your KPIs wheelchair, like a little safe space for if they now started breaking all of the stress you can hold them to it. So, I think that's maybe a good thing about interpersonal relationships in a work environment because at least you have something you can sort of hold them to just say, actually I gave you room to not track what you're doing the whole day but you're deliverable as supposed to be minutes before the meeting every second day and I don't have to for example. So, giving people trust initially is sort of good. And then tracking their record because it's a controlled environment may also work well. But again, I agree with what you've all said, that sometimes people just show you that they're not that type of person and maybe you need to rethink how you work with certain people.</p>
<p>3 - Education</p> <ol style="list-style-type: none"> 1. Understanding balancing out work and training. 2. Understanding how different educational backgrounds can result in (perceived) favouritism. 	<ol style="list-style-type: none"> 1. [Speaker 4] I'm not that type of person. 2. [Speaker 5] You can't make Green feel despondent. 3. [Speaker 5] So, I would, and I'm thinking now there could be two reasons why Green didn't go firstly, Green might be more valuable at the local than at the London. Does that person know it or does Green know it? So, then you need to say that and if it is a matter of Green needs to learn more or hasn't grown as much as Blue has, you also just need to say 	<ol style="list-style-type: none"> 1. [Speaker 1] Okay, so then just the last part of this. So Blue actually did attend the London Art Institute and it is good exposure and reputation for the organisation to say we are someone here who the London Art Institute. So, what are your first few quotes given that when you're responding to Green? So yes, it is good exposure, yes, we will want to shine a light on it. Yes (name redacted), go ahead. 2. [Speaker 1] Or Green could think they needed to fill positions and here I am, I'm a position filler.

<p>Summary initial thoughts:</p> <ol style="list-style-type: none"> 1. At times the comments centred around the thought that a complaint is like saying one is not doing a good job or they are not doing a good job. 2. In the less case here, they empathised with the employee. This was the recently promoted to senior management who still identifies more with the employees. 3. What is most important is to deal with are the contents of the complaint. 4. When conversation is stirred toward the contents, it is believed employees should also go after opportunities but at the same time Green duck was criticised for asking for opportunities. 5. From the subordinate focus groups, the employees felt the opportunities were not fairly or optimally advertised and balancing out operational requirements to allow for training were not done well. Whereas senior management perceives the barrier as “willingness to learn” by the subordinates. 	<p>that in a way again that will motivate the person, not demotivate them.</p> <ol style="list-style-type: none"> 4. [Speaker 6] what have I done wrong to make Green feel that they're not as, I mean I choose the word value, not recognised as much as blue duck? Yeah. So that would be my initial thought because obviously he's perceiving something and I'm assuming as orange duck, that's perfect. I didn't do it on purpose. So, in some way or other there's a perception out there that he feels that he is being overlooked. So yeah, I would have to make sure that some way green duck is able to, yeah, I would have to discuss why because I'm just, perception is worse than a real cause, right? And you can't fix something that doesn't, that isn't there and the perception is why it's there. So, it could just be a personality discussion, something discussing with them. I don't think it would be something about skills development. Because you say their skills are the same. Yes, they started the same time. And then again, the skills are only the first step, right? It's always then how you grasp the opportunities you have. Imagine they've given the same opportunities. 5. [Speaker 2] I think it's a two-way street in skills development. One, the employee needs to want to build skills and then also it's about managing the time as well. I mean if some of the staff go on certain skills training, it's got to do with operational requirements as well and it's not. And then you also get others where you ask them, do you want to do something more? No, they don't. 6. [Speaker 4] Willingness to learn. 7. [Speaker 6] Perceptions kill an organisation. 	<ol style="list-style-type: none"> 3. [Speaker 1] Perceptions are killing an organisation. That's a good point. So it could be that Orange has set up all of these wonderful things and allowed equal opportunities that Green just hasn't taken. And then with Blue is now the lime limelight front and centre that's happening. Or it could also be that Blue is the front and centre because we are really catching in on the fact that they went. So, when people tell you like, “Oh have you seen this?” - Blue has seen it because they were in London during the time. So, it sort of also goes both ways. That is your shining duck that you want to parade everywhere to say we managed to get someone from the London Art Institute to come and work here and they have that little accreditation from the Queen or whatever it is and we're going to put them to shine. So, I think it sort of goes both ways and it's maybe up for Orange to manage this, and even when you try to manage expectations, someone has a perception it'll all extend, but at least Orange would've said equal opportunity to everyone. We will catch in on the fact that we can get good exposure, and our reputation can sort of get better because we have managed to employ some, we've attracted someone from the London who graduated from there. So yes, it does. It does I think go both ways. So, all of your points are really good.
<p>4 - Hierarchy</p> <p>Impartial and unapproachable management structures affect employee's effectiveness.</p>	<ol style="list-style-type: none"> 1. [Speaker 2] The typical work dynamic? 2. [Speaker 2] It is what it is. 3. [Speaker 4] Yeah. So Orange isn't saying that the person is unsatisfied in their work. They're just talking about the 	<ol style="list-style-type: none"> 1. [Speaker 1] So an interesting thing to think about this is that the creative director probably was a very great creative and then they moved him into this position. So maybe he

<p>Summary initial thoughts:</p> <ol style="list-style-type: none"> 1. Possibly unable to differentiate friendship in the workplace and how it affects impartiality. 2. They identify with the manager and do not feel it is malicious or intentional to prefer working with certain people. 3. Senior management also believed that employees should make an effort to get someone seniors' attention/interested. 4. The focus is about interests and not about impartiality in the workplace. 5. One was also able to pick up one of the factors that aids in impartiality where the leader may need to have these characteristics/soft skills. 6. Importantly noted to them that soft skills do not take away from field specific (scientific) brilliance so no need to be apprehensive or defensive about improving this. 	<p>dynamic of being excluded. I don't know. It's a weird thing. It's something that happens all the time, but I don't think it's intentional. From my observation, it definitely is not intentional from Green's side and would just mean that the person has a lot of, they seem to have the same style of thinking, which means that projects would be easier to manage between the two. Yeah, maybe Orange should be sending an email.</p> <ol style="list-style-type: none"> 4. [Speaker 5] So I agree with, each work environment's got different personalities, different cultures, different, we need to deal with it. And I think if Orange obviously knows Green well enough, they will know that they're reserved person and loner. So those people who have to find different ways to get their attention or to get them interested. 5. [Speaker 3] Question also, what has Orange done to be personable with Green? What interest has, have they tried to share, to bring to the table? Let's say I've also tried to do this, yeah. Get them interested in something that they do and then see how that pans out. 6. [Speaker 5] So that's what I was going to say is, sometimes we always think it's always from higher up that needs to show interest and want to make a better working environment, but it should also be Orange. Orange should also make an effort. 7. So Green is obviously unapproachable, a very unapproachable loner, and the boss. I think that makes when they say 'unapproachable' he probably walks around- 	<ol style="list-style-type: none"> 2. [Speaker 1] just quite doesn't have the soft skills to have that relationship. So, this is, what do you call them? Positions of power. So, you can never, if you're in a very hierarchical house, you can never go to your father and say, "oh I actually think we should water the garden on Thursdays cause water is better on", or whatever. Because that's a hierarchal relationship. So sometimes when someone is in a hierarchy, then they would need that soft skill. So, it also then goes to, if I am really great at pipetting, am I going to be really great with people? So are my people skills going to equate to, you could be a brilliant scientist and know what enzyme is doing what and figure out the pathway. And that's, that doesn't take away from your brilliance if maybe people skills aren't the best thing. So, if you are an advertisement creative director as (name redacted) has pointed out, you can still be a reserved loner, 3. [Speaker 1] but then your position has people underneath that need you to relate in a certain way. And equally I agree with the point that maybe orange duck hasn't been able to say certain things because the director is at a certain place. So also make yourself available to that. So, it's a dynamic that goes both ways. So, weighing them both out to say, yeah, okay, you feel excluded. Interestingly, orange feels they have no one to tell. So maybe the advertisement creative directors at the top of the top and maybe when they do speak about it with people to say, actually I can't get into that click, because I think it's very fair that there are people that you will more naturally click with maybe because they also do surfing so you will more naturally click with them. But in confines of a professional environment, you now need to think about impartiality and favouritism. So,
---	---	---

		<p>can this be deemed as favouritism because we have interests or is it,</p> <p>4. [Speaker 1] we are aligned in terms of vision? It is a creative place. We are aligned in vision, or you do work hard. So, we are aligned in that way. So just tossing those two up to say, yes, people can actually work well together because they share same similar interests versus impartiality and favouritism.</p>
<p>5 - Interpersonal</p> <p>Development of trust and interpersonal relations in the teams.</p> <p>Summary initial thoughts:</p> <ol style="list-style-type: none"> 1. Feeling it's important to know what is happening but also feeling that they do not want to pry into the employee's personal life. 2. The issue lies with the employee in being open to sharing and having an interpersonal relationship. 	<ol style="list-style-type: none"> 1. [Speaker 4] What's happening in this company? 2. [Speaker 3] Orange is very private. 3. [Speaker 6] Well I think because Blue personally manages Orange, they do have a very strong work relationship, but a work relationship doesn't always translate into a personal relationship. And Blue probably feels that the two should be more open perhaps in their personal life and orange maybe doesn't. 4. [Speaker 5] I think Blue is not interested. 5. [Speaker 6] I just don't think Orange wanted to tell him. 6. [Speaker 6] I just don't think Orange wanted to tell him. 7. [Speaker 3] That's how it comes across. 8. [Speaker 6] It's an orange issue. 9. [Speaker 6] But the next question I would ask is, does Blue know if Orange has dogs, do they know their father and their mother, what car do they drive? Marriage is a big thing. So, you think somebody would like to highlight it, but is Blue under this perception that they're closer than they are. 10. [Speaker 6] I think the difference between the travel issue is that who was getting to have some issues with travelling realised it probably wasn't going to be an issue. Yeah, well it wasn't going to be something, it was going to be something that might have happened again. And they obviously felt that they didn't put in time beforehand, put a mark against them and they had to explain it and in order to 	<ol style="list-style-type: none"> 1. [Speaker 1] Maybe it's an Orange issue, exactly. So, we initially spoke about interpersonal relationships and then there's also a line in prying in people's personal lives. So, it's also tossing those two up. Do you think then Blue has the right to be shocked by this news. Because now we're tossing up interpersonal relationships and- 2. [Speaker 1] And they are. Exactly. And if it's necessary in a work environment. So again, it will actually go back to the initial things we spoke about earlier to say it's been a toss-up between you getting married, was it during a critical time where it was important for you to tell me that 'I can't reach this particular work deliverable because I actually have to go and get married' and that's a valid reason. Or I saw you as selfishly taking time off, right? Do I need to know what's happening in your personal life? So where is that, where that boundary? So yes, so that's that particular scenario. So, anyone want to add anything else? 3. [Speaker 1] So for example then Blue may be shocked because they didn't feel that Orange cannot then come and approach them if ever, they need for example. So is it really a toss-up between, is this an interpersonal thing that impacts you delivering and work versus being

	<p>explain it they needed to give the surrounding information here. The Orange has the leave, has the time, it's not a pressing engagement. It's not anybody's business at work whether they're getting married or not. It's not going, they're not going to be perceived in a bad light because it's their right to take the leave and what they go and do with it. I think the two kind of business scenarios are requiring-</p>	<p>a personal issue that just really has to do with you that's not going to impact anything.</p>
<p>6 - Leadership</p> <p>Importance of setting and sharing clear goals and expectations and sharing a vision with employees.</p> <p>Summary initial thoughts:</p> <ol style="list-style-type: none"> 1. Sharing information and sharing a vision. There is a difference between sharing information on what the company is doing versus engaging the staff to understand and share this vision. 2. Not being part of the vision deemed as sabotage by subordinates or being obstructive or being negligent. 3. Emphasis on the importance of briefing before major events, this is important and true but there was no talk of an environment where they are initially brought into the fold to share the vision. 	<ol style="list-style-type: none"> 1. [Speaker 2] Well it's clearly not posted on their walls. 2. [Speaker 6] Communication issue from the organisation that they do not relay to the employees how important this launch was, or they didn't know that there was launch or they just don't look like they're included. They idle there a little bit. 3. [Speaker 6] Because they're the workforce that gets the drink out there on the shelves, they're integral parts of what's happening in the market. So, they really should be part of the story. They should know the story. 4. [Speaker 5] Yes, I think for the same reasons. And then why I think the employees do not know is, obviously, does Green's company even believe in their own vision? 5. [Speaker 5] do the people even buy into it, or was it just something they had to put on the company documents and say this is our vision and goals? 6. [Speaker 3] But also to the employee's benefit. The employers, even if it wasn't done, like with the point just made, that they came in for their induction every day before they were posted, just before this launch, they should have made sure that they reiterated and communicated the policies and just to make sure that everybody is on the same page. 7. [Speaker 6] One thing to know if they were invited to the party, they were included in for the interviews and stuff. So again, are the employees, are they happy with what's happening in the workplace and therefore they're now want to be obstructive? 	<ol style="list-style-type: none"> 1. [Speaker 1] So yes, I agree with all of your points and all of the little different angles are good because I also add those in mindset. It's great that you said them. So, an interesting thing, one of the theories that goes behind this is the power of buy-in from the employees. When you have a vision or a new direction you want to take to make it more practical or palatable to them, you'll be surprised at how much they actually want to pull or really, really buy into that idea. If you are presenting it in a way 2. [Speaker 1] that says in the bigger picture of what we are trying to do, this is where we are trying to go. But sometimes it's also like, are you even in that vision as (name redacted) said, is that really where you are pulling or does this actually need to change or at this point, you're not in a season. I'll give the example that (name redacted) gave - training. Are you in a season as a company where training is not a big component? Maybe R and D is a big component so you need to sort of shift people and say if we're focusing through this and we develop quite a lot, it will enable us to move more into training so that people understand what the vision and the direction is. So, theories will say when people have a lot of buy-in and absolutely understand that they will pull much harder and maybe will answer this interview in a much better way.

<p>7 - Operational systems</p> <p>Managements engagement in day-to-day activities and needs</p> <p>Summary initial thoughts:</p> <ol style="list-style-type: none"> 1. They identified with Green duck who has the difficult task of having to most times turn down monetary requests. 2. This was the most discussed topic with the subordinate employees. 3. In theory, they also believe in engaging the employees to discuss their requests, they do not say that they do this. 4. There are questions posed, in theory but not as an engagement with the employee who made the request, so subordinate employees believe insufficient conclusions are made and requests denied. 5. In practice the subordinate employees say there is no engagement to go through related requests. 	<ol style="list-style-type: none"> 1. [Speaker 4] I am the green duck. 2. [Speaker 3] I agree with the green duck. 3. [Speaker 3] I agree with the green duck. 4. [Speaker 3] I'll take it upon myself to volunteer and say maybe give me a few days, a few weeks to write something up to show you how this would work. How my scenario just using the current machine and all of that would work before buying the, yes. So, give something tangible, what do we call it. Yeah. Okay. That's it. 5. [Speaker 6] Yeah, they now just put in this place and depending on the risk averse, this little green duck is a little risk averse but it's not cancelling out the solution. He's just saying, okay we at that point now where we can start having the discussion, but let's see what we can do with what, 6. [Speaker 6] where we are currently. Yeah, I think it's a good request. I think there should be a timeline on it. I don't think things should be open-ended, because then you just make them all disappointed. So, if you've got to have a timeline or it's got to have a target revenue point. When they said 200%, they work but they don't say what the revenue. But there needs to be a point where you can say okay, we just got to reach this and then let's put your table. Otherwise, you just disheartening you don't how to do that either. 7. [Speaker 4] the person is newly promoted, so maybe they need to learn bit about how things work in the organisation first. So, it would be a good point for the response to be, let's set up a meeting to discuss what it is that you think you need. Let's investigate this 200% because that's impossible. That's- 8. [Speaker 4] Well, that's not 200% then. So, I think it should be more of a discussion so that Green can figure out whether this is a request that needs to be made or needs to materialise. And then it could eventually come to, like (name 	<ol style="list-style-type: none"> 1. [Speaker 1] I like that. Maybe just to piggyback off the words that you used – it's open-ended because purple could also be cheeky for coming in and saying we're all celebrating and then you're like, 'actually I need new', is this also the place to say this? So maybe Green's response is also okay or maybe Green should have given a little bit more insight. But let me let (name redacted). What are your thoughts? You could be Purple, you could be Green, you could represent both. 2. [Speaker 1] So the door open, just to maybe put a spanner into this, the door open may mean for Green that they're going to be getting requests left right hand centre. So, theories will say for example that you need to 3. [Speaker 1] partner. I wanted to use the correct word, partner with your employees to resolve operational issues. So, you need to, Green would need to sit with Purple and actually say, as you both said, how to be and untangle this and actually work out 200%, what's happening, whatever. But that takes time from Green, right? So, then it's now a toss-up between how much Green can entertain. How easily can Green make decisions but also give Purple that assurance that I've really looked into this issue, it doesn't make sense, I'm going to give you a flat-out no. Or is it, I'm going to open my door and anyone who's ever wanted anything can come in and I will sit, and I will talk through them and say okay you work from eight to nine and let's like, how much of it? So, I think it's also a toss-up. Does Green need additional skills and able in order to now say, this is how you draft a business plan and make sure that you're using resources efficiently, all of those things. Am I making a budget well? 4. [Speaker 1] that takes into account all of these things? As (name redacted) says, you'd need to show the
--	---	---


	<p>redacted) said, these are the steps that we have to take to get through that. Let's see what we can do first.</p> <p>9. [Speaker 2] Well the purple duck is an optimist. And the green duck is a realist. However, if you saying that your people are working 200%, you've got to ask yourself if the staff is at 200%, what is the percentage that the machine that you currently have is running it? Because if, it's likely that it's probably already running at a hundred percent capacity, then in order to keep up the pace and grow the business, you might want to consider investing in another printer machine.</p> <p>10. [Speaker 5] my first thought would be how hard was purple duck and the team working before this happened? Because 200% of 5% is still less than 100% capacity and just trying their luck. But I do think, for number three, I do think Green's making and does have the relevant skill to make the decision. It's just how you manage that with Purple. So not to shut them down and again, not just say flat out no, but keep the door open, communicating that effectively.</p>	<p>cut off to say once we reach this sizeable profit, then we're going to buy the machine. So, I think it's a toss-up of a lot of things. Maybe yes, Purple is being cheeky, but also how much does Green entertain? So, it's like a toss-up between all of those things. But theories will show that if you are able to engage and work through operational issues, it makes Purple feel okay. We've tried to work through it, this is what we're going to do in order to make it work, rather than to always say 'there's no money'.</p>
<p>8 - Organizational culture / Climate</p> <p>Importance of management creating and maintaining good organizational culture.</p> <p>Summary initial thoughts:</p> <ol style="list-style-type: none"> Those who do not participate in company culture events are seen as rebellious. Those who do not also participate are deemed to have particular negative qualities versus them being in an environment where those employees find it hard integrate. 	<ol style="list-style-type: none"> [Speaker 2] I think it's a purple duck problem and not a group problem. There are always people of a group that will not feel included. Even though you try your best to include everyone, it could be that maybe something was said or done, but I think if the general larger group are all prepared to huddle together and show team spirit and [Speaker 2] it's just a few that are excluded or feel excluded, it's probably a purple duck problem and not a general group thing. [Speaker 4] I think that it's nice that Orange is asking the question since he or she is new, so that they can gain more information. I agree with (name redacted) when she says it sounds like a purple duck problem because they actually say that 'we don't participate because we feel excluded'. But then 'the why' is missing this, there's not enough information 	<ol style="list-style-type: none"> [Speaker 1] how this situation may have developed where people don't feel included in the team culture. So, I think (name redacted) answered that by saying that some people will never feel included. So, then (name redacted) sort of concurred and said the same. So, (name redacted), what do you feel may have made this situation develop or contributed to you to be there? [Speaker 1] So, sorry, we can also answer question two, which says how this situation may have developed where people don't feel included in the team culture. So, I think (name redacted) answered that by saying that some people will never feel included. So, then (name redacted) sort of concurred and said the same. So, (name redacted), what do you feel may have made this situation develop or contributed to you to be there?

<p>3. Those who do not participate can be dismissed as minority.</p> <p>4. No conversation of how the environment may be or who is responsible for creating it.</p> <p>5. Players who do not participate were expected to communicate their concern versus excluding themselves, there are also points applauding the coach finding out what is wrong.</p>	<p>there. I mean the whole part or reason for being part of a team like that, a soccer club or any other extramural activity is really for that inclusion. So, you are part of the team, but you also get-</p> <p>4. [Speaker 4] Well then yes, assistant coach must find out what is the reason. Speak to the actual coach.</p> <p>5. [Speaker 4] Try and figure out where are we in this situation.</p> <p>6. [Speaker 6] I think the thing that I know most from what I've learned. Sometimes you do need to have new eyes on a situation to see if you can resolve it. Otherwise, it would've continued and neither the team, neither the purple ducks or the had any interest in finding a solution until somebody came in and perhaps highlighted it. But again, it's communication, right? It's what it is, that's what the issue is. And the purple ducks are just taking a stand.</p> <p>7. [Speaker 6] Personality, right? You get personality conflict that causes this issue. And then you always feel like the outsider and that the group will always think differently. And unfortunately, when the problem is bigger than the people, that's when you have this disconnect. If you need to kind of break and nobody bothered to just have the conversation to make sure that you are included. You don't all have to think the same in order to work effectively together. The whole idea is that if you don't all think the same, you get more done, you're more effective. But here,</p> <p>8. [Speaker 5] I also think it's a purple duck situation, just minority three versus-</p> <p>9. Speaker 3] Cause we might find, especially with that smaller team, seeing the scenario, we have a newer assistant. We might find that within the new purple ducks' team there's a new people. There are some new people, but there's also that one leader saying, don't do it. Don't, don't go in. Yeah.</p>	<p>3. [Speaker 1] So those are interesting points. I'm just going to click close and paint maybe a different picture about the purple ducks. So, the team culture if the general team culture, they don't feel included for it. The reason for me asking what contributed to that culture being formed is that they are not responsible for forming the culture, but they are responsible for whether I'm buying into it or not. That's something else. So, you can be rebellious, you can decide to go into the huddle but then address it later on.</p> <p>4. [Speaker 1] So, there is like that toss-up between the team, the people who would create the culture are the people at the top because they have the power to do it, right. I can't, if I'm at the bottom, I can't say 'today we're going to have high five'. They are going to be like 'who are you and what are you saying?', but if you're at the top, you have the power to create the high five culture. For example, if we make a sale, everyone says high five or whatever. If I'm at the bottom, I don't. But if I don't like that high five culture and everyone is sort of into it and I choose to rebel, instead of addressing that and saying, 'actually we're in Covid, why are we high fiving?'. But it's also sort of my responsibility to say, I'm going to stand back because of this. But the general culture itself, they are not responsible for forming it and they're coming into an already generated culture. Perfect. That's it. Any questions or comments? Closing questions or comments? (Name redacted)?</p>
--	--	---

7.19. Appendix 19: Turnitin Report

ev.turnitin.com/app/carta/en_us/?o=2439778283&s=1&student_user=1&ro=103&lang=en_us&u=1005544373

feedback studio Paidamoyo Kachambwa Thesis-Turnitin-2.docx



Exploring factors influencing competencies of scientific laboratory technicians and recommendations for improvement: A case study of a Scientific Laboratory based in a resource constraint setting.

By: *PhD Candidate:* Paidamoyo Kachambwa, KCHPAI001
Supervisor: A/Prof. Delva Shamley*
Co-Supervisor: Dr. Elmi Badenhorst*
Co-Supervisor: Dr. Amaal Abrahams*
Co-Supervisor: Dr. Danica Sims**
*University of Cape Town **University of Oxford

For: Submitted to the Department of Human Biology in the Faculty of Health Sciences at the University of Cape Town.

In fulfillment of: The requirements for the degree, Doctor of Philosophy.

Match Overview

6%

1	Submitted to University... <small>Student Paper</small>	1%
2	journals.sagepub.com <small>Internet Source</small>	<1%
3	core.ac.uk <small>Internet Source</small>	<1%
4	www.researchgate.net <small>Internet Source</small>	<1%
5	Roger Bennett. "Emplo... <small>Publication</small>	<1%
6	www.ncbi.nlm.nih.gov <small>Internet Source</small>	<1%
7	www.science.gov <small>Internet Source</small>	<1%
8	conferinta.managemen... <small>Internet Source</small>	<1%
9	www.tandfonline.com <small>Internet Source</small>	<1%

Page: 1 of 303 Word Count: 86459 Text-Only Report | High Resolution On

api.turnitin.com/newreport_classic.asp?lang=en_us&oid=2439778283&ft=1&bypass_cv=1

Document Viewer

Turnitin Originality Report

Processed on: 28-Aug-2024 16:50 SAST
 ID: 2439778283
 Word Count: 86459
 Submitted: 1

Thesis-Turnitin-2.docx By Paidamoyo Kachambwa

include quoted | include bibliography | exclude small matches | mode: quickview (classic) report | print | download

1% match (student papers from 13-May-2019)
 Class: e4f290dd-6195-476d-9342-3d320cf7e88a
 Assignment: Summative assignment PartTime Final
 Paper ID: [1129894397](#)

<1% match (student papers from 13-Oct-2009)
[Submitted to University of Cape Town on 2009-10-13](#)

<1% match (student papers from 17-Apr-2015)
[Submitted to University of Cape Town on 2015-04-17](#)

<1% match (student papers from 11-Jun-2019)
[Submitted to University of Cape Town on 2019-06-11](#)

<1% match (student papers from 28-Oct-2009)
[Submitted to University of Cape Town on 2009-10-28](#)

<1% match (student papers from 29-Aug-2016)
[Submitted to University of Cape Town on 2016-08-29](#)

<1% match (Internet from 17-Mar-2024)
<https://journals.sagepub.com/doi/10.1177/15344843241239723>

<1% match (Internet from 14-Dec-2022)
<https://core.ac.uk/download/pdf/51087771.pdf>

<1% match (Internet from 10-Jan-2023)
<https://core.ac.uk/download/pdf/211329949.pdf>

<1% match (Internet from 03-May-2024)
<https://core.ac.uk/download/386139060.pdf>

Similarity Index	Similarity by Source	
6%	Internet Sources:	4%
	Publications:	4%
	Student Papers:	3%