FACTORS THAT INFLUENCE THE UTILISATION OF HIGH-PERFORMANCE COMPUTING SYSTEMS AT A SELECTED HIGHER EDUCATION INSTITUTION

BY

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DECLARATION

I, Ndwamai Reginald Mulalo, student number 15006092, thus affirm that this research project is entirely my own work and that all sources used were properly cited in this document. It is presented as a partial fulfilment of the criteria for the University of Venda's Master's degree in Human Resource Management. It has not already been submitted for a degree at another university.

18 JULY 2023

Signature Date

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ABSTRACT

High levels of organisational performance may be achieved through the effective use of technology. By supplying High-Performance Computing (HPC) systems to previously underserved universities, the South African government sought to promote science and innovation while addressing Sustainable Development Goal No. 4 (SDG 4), which aims to improve the quality of education. This was done to improve research capacity and correct resource disparities in institutions. However, not all universities offer access to and ensure the effective use of these systems. As a result, the study aimed to investigate the factors that affect how the University of Venda's (UNIVEN) HPC system is accessed and used.

The study used a mixed research approach. Descriptive research design was used to explore and understand the phenomenon., A non-probability sampling method based on a purposive sampling method was used to select 10 participants who provided qualitative data. On the other hand, a random stratified sampling was utilised to identify the 218 participants who provided quantitative data. The research study comprised three groups, namely masters students, PhD students and academics. Simple random sampling was then used within each group to select the participants. The total sample size was 228.

Data were gathered by the researcher using self-administered questionnaires and in-person structured interviews. The ATLAS.ti program, which manages thematic content, was used to analyse the qualitative data that had been collected. To handle the themes, the researcher followed four steps: reading the material for the first time, recognising potential topics, classifying codes into themes, and producing a table of themes that summarizes all the themes. The Statistical Program for Social Sciences (SPSS) version 28.0 was used to analyse quantitative data. The study highlights the importance of organisational support, perceived ease of use and perceived usefulness in the actual use of High-Performance Computing system at the University of Venda. Therefore, the study's outcomes indicate that the support provided by an organisation and the users' perception are crucial elements for the successful implementation and use of technological systems.

Keywords: Academics; higher education**;** High-Performance Computing system; organisational support; perceived ease of use; perceived usefulness, technology; utilisation.

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4IR	- Fourth Industrial Revolution
ASTD	- American Society for Training and Development
CPU	- Control Processing Unit
CSIR	- Council for Scientific and Industrial Research
HPC	- High-Performance Computing
HR	- Human Resources
HRIS	- Human Resource Information System
HRM	- Human Resource Management
ICT	- Information Communication Technology
IT	- Information Technology
PC	- Personal Computers
SDG	- Sustainable Development Goal
SPSS	- Statistical Package for Social Science.
TAM	- Technology Acceptance Model
UL	- University of Limpopo
UNIVEN	- University of Venda
UTAUT	- Unified Theory of Acceptance and Use of Technology
UWC	- University of Western Cape

CHAPTER ONE: INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 INTRODUCTION

This chapter discusses background information regarding awareness of High-Performance Computing (HPC) systems among academics, masters and doctoral students and the factors that affect their usage of these systems. The problem statement, research objectives and questions are presented. Furthermore, study's significance is also discussed. The study's conceptual framework, based on the study's variables, is presented, and lastly, key terms crucial to understanding the research are given.

1.2 BACKGROUND

The application of technology in organisations is associated with high levels of productivity (Fay, 2017). As Selwyn (2011) pointed out, technology and automation make work easier and more accurate. However, the literature cautions that although technology and automation present organisations with numerous benefits, their access and utilisation are always straightforward (Jalaliyoon & Taherdoost, 2011).

This research focused on the factors influencing the use of HPC systems donated to higher education institutions. The Council for Scientific and Industrial Research (CSIR), which donated HPC systems, intended to contribute to quality education and research in South African institutions of higher learning (Mamushiane, Mwangama & Lysko, 2021). In line with the CSIR's mandate to lead in directed research and scientific development for socio-economic growth, this donation of the HPC systems was based on the belief that technology can help address Sustainable Development Goal (SDG) Number four (4), which seeks to promote quality education and innovation.

The study by Butcher, Wilson-Strydom and Baijnath (2021) shows that integrating HPC simulations into Science, Technology, Engineering and Mathematics education enhances the quality of education by providing students with experiential learning opportunities, improving their problem-solving skills and fostering innovation. It also emphasizes the importance of making HPC resources accessible to a diverse range of educational institutions to ensure inclusivity (Butcher, Wilson-Strydom & Baijnath, 2021).

Access to and full utilisation of HPC systems will enhance the achievement of these goals (Lee et al., 2011). Therefore, advanced technology such as HPC systems must be accessible to the users and be utilised fully in universities to realise their benefits, including big data processing in research. Access to HPC systems will also benefit other stakeholders within and outside the university, such as surrounding communities and municipalities, who might need to utilise the systems. This would make the institution relevant to the community and promote engaged scholarship.

According to National Research Council (2011), an organisation's readiness for technology is ensured by training employees to acquire skills that will apply to technological innovations, and the organisation's culture must change or be aligned with the technology. Only then will the technology be more accessible and used. Therefore, an organisation's top management must vigorously advocate access to and use of technology (National Research Council, 2011). Top management should oversee carrying out the tasks outlined above in terms of training and acquiring sophisticated technology features, as well as organisational and personal elements (National Research Council, 2011).

1.3 PROBLEM STATEMENT

The University of Venda received an HPC system from the CSIR in 2016. It was donated to improve research and learning by providing capabilities for processing big research data, and helping the institution be more innovative, efficient and productive. However, to date, the HPC system is only used by masters and PhD students and four academics from the departments of Chemistry and Mathematics. Some of the departments at the University of Venda are not using it. This raises the question of whether the HPC system is being utilised to serve its intended purpose within UNIVEN. Therefore, the study sought to investigate the factors that influence the utilisation of the HPC system by researchers (supervisors and postgraduate students; masters and PhD) at the University of Venda.

1.4 AIM AND OBJECTIVES OF THE STUDY

This study aimed to explore factors that influence the utilisation of HPC systems at the University of Venda.

The study attempted to accomplish the following research objectives:

- To investigate factors that influence the utilisation of the HPC systems at University of Venda.
- To develop a framework that promotes the utilisation of HPC systems at University of Venda.

1.5 RESEARCH QUESTIONS

The major research question was:

1. How do perceptions of researchers towards HPC systems influence their utilisation at the University of Venda?

1.6 RESEARCH HYPOTHESES

The study was guided by the following research hypotheses:

H1: Organisational support has positively influenced actual use of the HPC system at the University of Venda.

H2: Perceived ease of use has positively influenced actual use of the HPC system at the University of Venda.

H3: Perceived usefulness has positively influenced actual use of the HPC system at the University of Venda.

H4: The actual use of the HPC system at the University of Venda is positively influenced by organisational support, perceived ease of use and perceived usefulness.

1.7 JUSTIFICATION OF THE S\TUDY

University of Venda community (students and academics) will learn about the HPC system's existence. They could then use the HPC system to analyse big data in their research projects. Council for Scientific and Industrial Research would benefit from this study though sustainability by the means of development in its council. Growth in terms of awareness, technology and innovations. Therefore, the CSIR will be able to motivate values such as beliefs, principles and impact, as it will help improve scientific research quality. Involves how people embark on the field of science locally and globally. The more the HPC system is used, the more individuals become more productive and tend to be more innovative. The CSIR can rely on these individuals if it needs additional researchers to join it.

Significantly, this will assist in understanding the role of science and innovation in the 4th Industrial Revolution (4IR), given its important role in the South African economy. Conclusively, academics and postgraduate students will develop technical and analytical competencies once they have used the HPC system at UNIVEN.

1.8 OUTLINE OF THE STUDY

The research is divided into five chapters.

Chapter 1: Background to the study

Chapter 1 includes introduction and background, problem statement, study objectives, and the study's history. The study’s conceptual framework and research aims and questions are also presented. The Chapter also discusses the study’s importance.

Chapter 2: Literature Review

The chapter reviews the literature concerning factors that influence the utilisation of HPC systems in higher education institutions. It contextualises theoretical issues and empirical aspects in relation to perceptions, access and utilisation. The review concentrated on the arguments offered by various scholars and on the practical features of academics' perspectives on the utilisation of HPC systems.

Chapter 3: Research Methodology

The chapter described the methodology and design employed in the study. The sampling approach, sampling technique and sampling size are all covered in this chapter. Additionally, methods for data collection, analysis and ethical considerations are explained.

Chapter 4: Data Analysis and Interpretation of Results

The study would present data that would be analysed through SPSS and ATLAS.ti. It will end with interpreting results.

Chapter 5: Discussion of Results, Conclusions, and Recommendations for Future Research

The chapter includes a discussion of the findings of the study and goes on to draw conclusions and make recommendations.

1.9 DEFINITION OF THE OPERATIONAL TERMS

Academics- Is used to refer to the scholars, researchers or teachers in higher education institutions. Therefore, it is in relation to or associated with an academy (Becher & Trowler, 2001).

Technology- According to Brill and Galloway (2007), it is a tool or application for scientific knowledge. For the intended aim of an organisation, it is inherent in the operation of all machinery whether one is fully aware of how they work (Brill & Galloway, 2007).

Organisational support- This is when top management support all structures of an organisation with training and development and through the provision of strategic development (Capece & Campisi, 2013).

Access- Access is said to occur when someone is given permission to access something (Adas, 1981). Therefore, when staff members are allowed to utilise the HPC system, it is regarded as access. Chapter 2 of this project provided a thorough explanation of this phrase.

High-Performance Computing System - Compared to general-purpose computers, HPC systems are described as having high-performance levels (Jones, 2011). The entire subject of the HPC system as it relates to the attitudes of university staff regarding the system was covered in chapters two and four.

Perception- Perception is the collection of methods people employ to interpret the many circumstances they encounter (Mulholland, 2012). When various employee viewpoints are offered in chapter four, it will be taken into consideration how employees at UNIVEN feel about the HPC system.

1.10 CHAPTER SUMMARY

The introduction and background of this study were outlined. The background and context for the study's topic, "Factors that influence the utilisation of HPC system at the University of Venda," were presented. The problem statement was also discussed and supported. The research hypotheses were described and presented in line with the study's objectives. The study outlined a summary of the conceptual framework employed for the investigation. Additionally, the study's significance and structure were explained.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter discusses literature on the research topic. This discussion occurs against the background of the donations by the CSIR of HPC systems to the University of Venda (UNIVEN), University of Limpopo (UL), University of the Western Cape (UWC), University of Fort Hare (UFH) and Walter Sisulu University (WSU). The problem statement regarding the utilisation of the system at the University of Venda is outlined in the previous chapter, together with the aim and objectives. The preceding chapter also described the research questions and hypotheses.

The present chapter aims to present a discussion of previous studies undertaken by scholars in relation to this study's concepts which are attitudes toward HPC system and utilisation of the HPC system. The discussion includes reflections on how the University of Venda uses it, the definition of access to the HPC system, various elements of access to technology and the dimensions of perceptions. The concepts of the utilisation of the HPC system are also discussed together with the concept of Technology Acceptance Model. The chapter ends with relationships among study variables and a chapter summary.

2.2 THEORETICAL MODEL

The researcher has discussed models and theories that grounded the argument of the study. Models and theories were linked with factors that influence the utilisation of HPC system at the University of Venda by the academics, masters and PhD students. The Technology Acceptance Model (TAM) was adopted to make sure that participants understand the importance of accepting technology in the modern world. This model has considered elements including organisational support, perceived usability, perceived utility, and intent to employ the HPC system.

2.2.1 Technology Acceptance Model

Technology Acceptance Model is a theory that explains how individuals adopt and use technology (Masrom & Taherdoost, 2009). Its goal is for users to utilise technology. This model is significant because it enhances the ability to forecast the utilisation of resources (Masrom & Taherdoost, 2009). Therefore, it will encourage the utilisation of the HPC system available at the University of Venda and other institutions with similar resources. Thus, the

TAM by Marangunic and Granic (2015) was used in this study so that employees could perceive the ease of using the HPC system. An understanding of the impact of using the HPC system was articulated through TAM. Therefore, this model brought a green light to accessing and using the HPC system within the University of Venda.

According to White (2015), Technology Acceptance Model is recognised as one of the models for technology adoption, access and use that is the most frequently cited. It has aided in explaining the opinions and attitudes of staff members regarding using the system. Hence, as the most cited model, it also helped in identifying the perceptions of university employees toward the access and utilisation of the HPC system at the University of Venda. This model was adopted in this study because it has assisted in enhancing understanding of technology access and utilisation, specifically at the University of Venda, where they have already adopted the resource. On the other hand, other institutions and organisations may adopt this model so that they can be able to have access and utilisation in an HPC system. In addition, this model clarifies how users are incentivised by the perceived availability and use of the system within an organisation (Agarwal, Angst & Karahanna, 2006).

2.2.1.1 Utilising High-Performance Computing system in relation to Technology Acceptance Model

Usability, according to Park (2009), is the efficiency and simplicity with which people may utilise a system. According to him, a good system is one that satisfies the users' demands for affordability, usability and simplicity. Usability is frequently seen as a collection of objectives, including utility, learnability, efficiency, and effectiveness (Preece & Rodgers, 2002). The perceived ease of use in the original TAM refers to users' estimation of the amount of effort needed to use the technology, which considers their estimations of comprehension, mental effort, ease of use, and technology adaptability (Davis, 1989).

In 2000, Venkatesh proposed an augmentation of the TAM that emphasizes usability and identifies the key elements that affect perceived ease of use. He proposed that anchor and adjustment factors have an impact on how consumers perceive ease of use. Contrary to popular belief, Venkatesh found that these elements could explain up to 60% of the difference in how technology is considered easy to use.

Venkatesh's evaluation only considered objective usability, disregarding users' subjective usability judgements (Venkatesh, 2000). According to Wade and Lyng (2000), usability is essential in the educational sector since systems can fail if there is no pedagogical support present. Nevertheless, software development companies lack methods for designing educational materials for teachers and students and pre-distribution evaluation procedures (Albion, 2001). Staff members are unsure whether educational software meets the demands of flexible instruction and individualised care (Shiratuddin & Landoni, 2002). Despite this, Williams, Boone and Kingsley (2004) found a paucity of research on the usability of educational software.

Moreover, this concept is perceived in adoption as when new technology is accepted by relevant stakeholders within the institution for better access and utilisation (Mohamad, 2014). Regarding the University of Venda case, the TAM is being adopted. The institution adopted it to utilise it in teaching and learning process facilitated by academic staff. Then, adoption will become a new reality for teaching and learning processes in higher education since institutions will have access to the technology that has been adopted for greater usage (Mohamad, 2014).

After adoption, the technology is anticipated to be used by the institution. Technology utilisation describes the process where stakeholders use HPC systems to process data and involve students in teaching and learning using the same technology (Mohamad, Salam & Bakar, 2014). Therefore, every lecture and associated lesson in higher education will be presented using technology. In terms of technological aptitude, stakeholders and students are anticipated to be more sophisticated (Fortenberry & Thackston, 2015).

Therefore, the role of top management in resource access and usage is very important in leading staff to use the HPC system. Top management must take full responsibility for HPC system access and usage. Top management is responsible for providing training on resource utilisation (Eton et al., 2019). University stakeholders remain under the responsibility of top management as they seek to have skills and attributes to access and utilise the technology. Moreover, top management must ensure that university stakeholders participate in the training provided to equip them with relevant technical skills that will be useful when initiating access and utilising the HPC system (Eton et al., 2019).

Top management, again, should commit to technological innovations so that they remain in a good state to understand the process of acquiring skills and competencies of technology access and utilisation (Ashurst, Cragg & Herring, 2011). Ashurst et al. (2011) stated that once top management is vigilant about technology through embracing responsibility, it will be simple to anticipate negative perceptions towards the HPC system's perceived access and usability.

According to the TAM, an individual's intention to use technology is influenced by organisational perceived usefulness and perceived ease of use (Davis, 1989). Perceived usefulness refers to the extent which an individual believes that the technology provides benefits or enhance job performance, while perceived ease of use refers to the degree to which an individual believes that technology is simple to learn and operate (Davis, 1989).

Technology Acceptance Model also considers organisational support, an independent variable, which refers to the extent to which an organisation promotes and supports the use of new technology by offering training and resources, promoting it to employees and allocating resources for its implementation (Davis, 1989). Actual use of HPC system is the dependent variable in the TAM and is influenced by the independent variables such as organisational support, perceived ease of use and perceived usefulness (Venkatesh & Bala, 2008). Therefore, when an individual perceives technology as useful, easy to use, and supported by their organisation, they are more likely to have the intention to use it. Technology Acceptance Model provides a helpful framework for comprehending the factors that impact the utilisation of the HPC system at the University of Venda based on this research study.

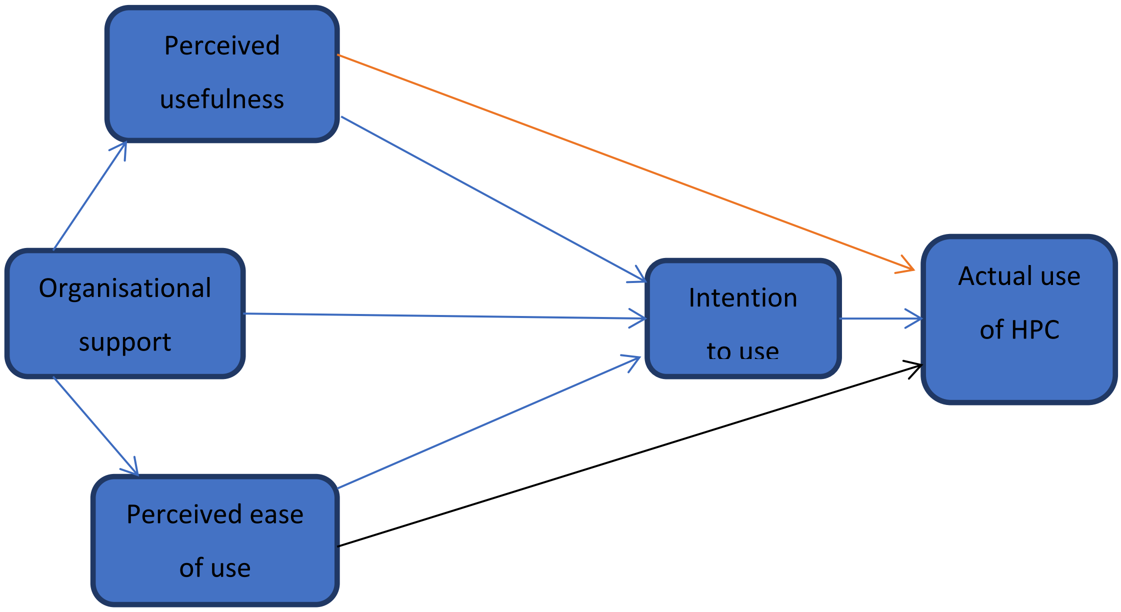

Figure 2.1

Technology Acceptance Model by White (2015)

2.2.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

Effort expectancy is a level of simplicity linked with the usage of a particular organism. It is grounded by TAM, Theory of Planned Behaviour, Motivational Model and the Innovation

Diffusion Theory (IDT), which all have similar definitions and measuring scales (Venkatesh et al., 2003). For users of the HPC system, the ease of use of this system is crucial for them to adopt it. They must perceive the effort needed to use it and understand how it can be generated (Gupta et al., 2008; Chauhan & Jaiswal, 2016).

Performance expectancy is a degree where a person believes that utilising an HPC system would assist them in reaching increases in job performance. This study has anticipated that the University of Venda community should be educated on performance expectancy when using the HPC system. The term "performance expectancy" refers to a concept that integrates ideas from a number of theoretical paradigms, including the HPC system, the Theory of Planned Behavior, the Motivational Model, the Model of Personal Computer Use, the Innovation Diffusion Theory, and the Social Cognitive Theory. It is the most reliable indicator of usage intention and applies in voluntary and required scenarios (Venkatesh et al., 2016; Zhou et al, 2010).

Four main approaches were used to adapt the model, which involved modifying it for different contexts, changing the internal variables, adding attitudinal antecedents and investigating different variables. The model was expanded to apply to new technologies, focus on different user segments and test it in different geographical and cultural settings. The study conducted by Casey & Wilson-Evered (2012) extended the model with web-specific constructs, such as trust and personal web innovativeness, to examine how accurately it predicted the use of web tools.

Although the original UTAUT framework (Venkatesh et al., 2003) was initially designed to explain and predict technology acceptance within organisational settings, subsequent studies have extended its applicability to non-organisational contexts (Thong et al., 2016). Over time, the generalisability of this theory has expanded as it has been repeatedly employed (Venkatesh et al., 2012; Neufeld, Dong & Higgins, 2007). In recognition of the evolving landscape of information communication technologies and advancements in the field, numerous scholars have made modifications to the Unified Theory of Acceptance and Use of Technology, either adapting it to specific contexts or enhancing its predictive capabilities (Venkatesh et al.,2012).

Researchers in the Chemistry and Mathematics department at UNIVEN employ an HPC system to evaluate their experiments in the laboratory. The importance of utilising this system lies in understanding the significance of accepting and using technology. According to the UTAUT, behavioural intention determines how technology is applied. Therefore, academics and postgraduate students can utilize the HPC system by developing pure intentions for using it. The likelihood that this technology will be adopted depends on the effects of these features: performance expectancy, effort expectancy, social influence, and facilitating variables. The impact of the forecasters is diminished by experience, age, gender and voluntariness of use (Venkatesh et al., 2003).

According to Venkatesh et al. (2003), "social influence" refers to how much people value the belief that others think they should use a new system. In the context of the HPC system, academics, master's and PhD students can influence each other to use the system, even if they initially had no interest in it. The effect of social influence is particularly strong when technology use is mandatory for everyone, as individuals may comply with the requirement but not necessarily because they want to use it for their reasons (Venkatesh & Davis, 2000).

A person's conviction in the existence of organisational and technological infrastructure to support the usage of a system, with assistance predominantly assumed to come from university management, is referred to as a facilitative condition, according to Venkatesh et al. (2003). Compatibility perceived behavioural control and facilitating conditions make up this concept. The intention to use a system is directly and positively influenced by facilitating conditions, but this effect is negligible after the first use. Considering this, the model contends that conducive circumstances have a direct and substantial influence on user behaviour. The UTAUT is depicted in Figure 2.

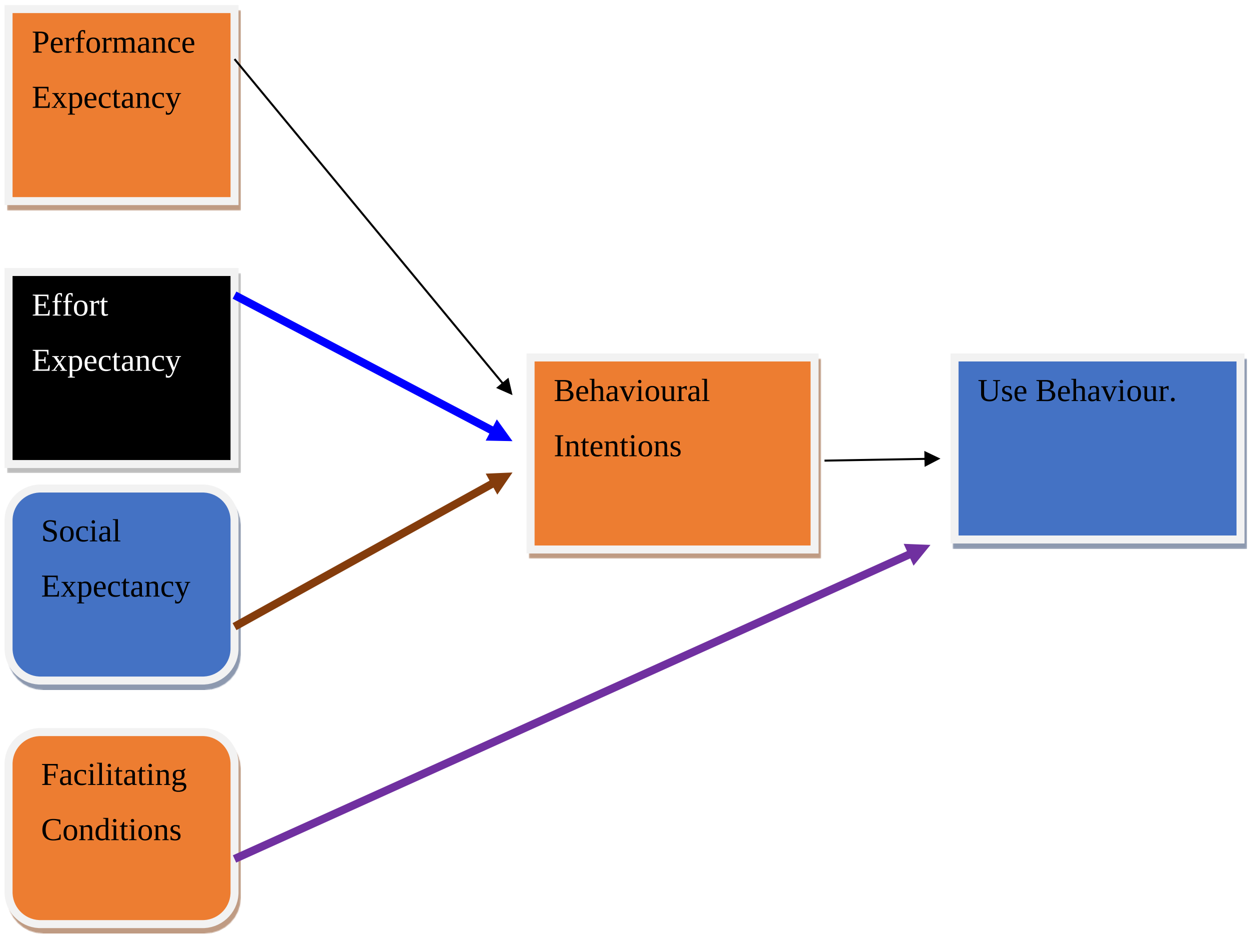

Figure 2.2

Unified Theory of Acceptance and Use of Technology by Venkatesh (2003)

2.3 THE CONCEPT OF A HIGH-PERFORMANCE COMPUTING SYSTEM

The term "High-Performance Computing" refers to mixing computing resources to provide significantly greater output than what can be achieved through a regular desktop computer or workstation. This is done to tackle complex challenges in fields such as science, engineering, or business, as described by Dongarra and Meuer in 2019. It is important to use HPC systems since it gives an organisation a chance to tackle all the problems that may be extremely difficult for small computers (Strong et al., 1995). For this reason, some specific departments at the University of Venda utilise this system. This system only takes seconds to process big data that could take hours using small computers. Many organisations did not use HPC systems for better progressive production since they were not ready for this technological innovation. The University of Venda is one of those institutions.

High-Performance Computing systems are frequently used in fields like creating automobiles and aviation products, oil and gas exploration, genomics and drug discovery, weather forecasting and climate modelling, 3D picture rendering, and sophisticated financial modelling. Access to their infrastructure has typically been limited to large established organizations, government research centres or agencies and universities because of the high cost involved with these systems (Espadanal, Oliveira & Thomas, 2004). Espadanal et al. (2004) further indicated that large institutions struggle to use HPC systems due to limited infrastructure. Not all the departments at the University of Venda fully utilise this system. This can be in terms of a lack of knowledge regarding the system which is available for utilisation. Furthermore, they can be failing to use it due to the limited infrastructure that supports the utilisation of the HPC system.

In addition to complex financial modelling, oil and gas exploration, genomics and drug discovery, weather forecasting and climate modelling and the development of automotive and aerospace goods, HPC systems are frequently employed in these industries (Espadanal et al., 2004). Due to the high cost of these systems, access to their infrastructure has traditionally been restricted to well-established major corporations, government research centres or agencies, and well-funded universities (Espadanal et al., 2004).

Top management of institutions should support the proper use of this technology by maintaining it since it will bring a much-needed impact. So, it is very important to maintain the HPC system to ensure it operates well (Fortenberry & Thackston, 2015). Organisational support should be perceived in this manner to evaluate the system's components and whether they are in good condition.

According to Hall et al. (2013), the success of developing an HPC system for specialised and specific higher educational programs depends on user education. Asatiani (2015) states that such systems can positively impact higher education by simplifying program facilitation and making it easy for all academics to access and engage with the system in the 4th Industrial Revolution (Asatiani, 2015).

The HPC system can also prevent issues such as misplaced scripts and certificates while ensuring secure storage and easy information retrieval. With adequate knowledge and training, stakeholders can streamline tasks and improve the processing of large academic datasets (Joseph et al, 2018). Therefore, HPC systems are crucial in higher education settings, and user education is critical for their success.

Microcomputers, mainframes and HPC systems are the three types of technology that Joseph et al. (2018) identified. Microcomputers are placed on, next to, or beneath a desk. They are made for a single user and process data quickly. A mainframe computer can take up an entire room and cost a lot of money (Joseph et al., 2018). In this regard, HPC systems, thought to be the fastest computers for data processing, are the final technology type.

So out of these types of technology, the HPC system is perceived as one that is currently not being accessed and used in most organisations (Jones, 2011). One needs an HPC system rather than a standard desktop computer or workstation to handle complex problems in science, engineering, or business (Dongarra & Meuer, 2019).

It is important to use the HPC system since it gives an organisation a chance to tackle all the problems that are extremely difficult for small computers. This system only takes seconds to process big data, which could take hours using small computers (Hall et al., 2013). Many organisations did not use HPC systems for better progressive production since they were not ready for this technological innovation. The University of Venda is one of those institutions.

In the study of Gangwar, Date and Raoot (2014), technological innovation comes through the means of HPC system. This is through the application of technology in terms of HPC system access and utilisation at the institutions. Employees are equipped to have more knowledge about innovation to be able to use the system (Joseph et al., 2018).

2.3.1 Factors that Influence the utilisation of High-Performance Computing systems

Based on this study, there are several factors that influence the utilisation of the HPC system at the University of Venda. The use of the system is influenced by these factors for academics and postgraduate students. The researcher has articulated the following factors: organisational support, perceived ease of use, perceived usefulness, intention to use, poor infrastructure and inadequate technology.

2.3.1.1 Organisational support

According to Smith (2012), organisational assistance is perceived as offering training and growth within the organisation. The management of the University of Venda, where this study is based, remained committed to giving all researchers who used HPC systems complete support when starting their training. As shown in figure 1.1, researchers have the propensity to comprehend the significance, features, and ease of use of the HPC system. Therefore, the training offered by the University of Venda administration will aid in understanding its utility and simplicity.

According to a study by Bakić et al. (2019), people are more inclined to use an HPC system if they believe it to be user-friendly and helpful for reaching research objectives. Additionally, Bakić et al. (2019) noted that factors that include the HPC system's suitability to the researchers' needs, the quality of the HPC system, and the support offered by the organisation all impact how valuable people view the HPC system to be.

Therefore, organisations must provide adequate support and resources for the effective utilisation of HPC systems and to ensure that HPC systems are perceived to be easy to use and useful for researchers' needs. By addressing these factors, organisations can promote the adoption and use of HPC systems, leading to increased research productivity and scientific advances (Bakić et al., 2019).

Furthermore, a significant aspect affecting the use of the HPC system in higher education is the level of institutional support. Higher utilisation rates are typically found in universities that offer sufficient assistance for the HPC system. Better support is given by the Universities of Johannesburg, Cape Town, Pretoria, and Wits to enable their respective researchers to use the system to calculate big data for their research projects (Al- Ailan, 2020). As a result, there may not be enough support available at the University of Venda.

The assistance may take the form of staff assistance, technical assistance, and cash for software and hardware updates. Universities can also implement rules that encourage the use of HPC systems, such as offering rewards to researchers who use these systems successfully. Such regulations may promote the use of HPC systems by researchers, hence increasing their use. Institutional support was one of the key success factors for adopting the HPC system in higher education, according to a study by Mamushiane et al. (2021). This may support the claim that researchers at the University of Venda are likewise using the system efficiently.

High-Performance Computing system is a critical resource that enables institutions to solve complex problems in fields such as science, engineering, and finance. It needs support from the institution. Organisational support is essential for maximising the utilisation of the system. According to Cox et al. (2017), organisational support for systems refers to the tools, guidelines, and rules organisations implement to facilitate the efficient use of the HPC system. This list of resources includes hardware, software, and human resources including application developers, system administrators, and technical support personnel. According to Altmann and Wichmann (2017), efficient organisational support maximizes usage rates by allowing users to access and operate the HPC system effectively.

The University of Venda may overcome several obstacles when implementing and using an HPC system. The expense of purchasing and maintaining a machine is one of the biggest obstacles. This system needs specialised equipment, software, and support personnel, which can be costly to buy and keep up-to-date (Altmann & Wichmann, 2017). Additionally, organisations like the University of Venda might not have the technical knowledge necessary to successfully implement and run an HPC system, resulting in lower utilisation rates.

Another challenge is the need for collaboration and sharing of resources across departments and organisations (Cox et al., 2017). HPC system is often shared among users, departments and organisations. Therefore, effective collaboration and resource-sharing policies are essential for maximising utilisation rates. However, implementing and enforcing these policies can be challenging, especially in organisations with decentralised decision-making structures (Cox et al., 2017).

However, the availability of funding is also a crucial factor that influences the utilisation of the system in higher education. It requires significant investments in hardware, software, and maintenance. University of Johannesburg, University of Cape, University of Pretoria and Wits University, which provide adequate funding for HPC systems, tend to have higher utilisation rates.

The University of Venda may implement the strategy of generating funding for HPC system utilisation. However, many universities face budgetary constraints, limiting their investments in the HPC system. In such cases, universities can explore alternative funding sources, such as government grants and partnerships with industry. This is a more suitable funding source that the University of Venda may adopt. The availability of external funding sources can increase adoption of the HPC system in higher education (Al- Ailan, 2020).

In addition, adequate funding is crucial for advancing and utilising the HPC system. The acquisition and upkeep of these systems can be costly, and funding is necessary for procuring and updating hardware and software and offering technical assistance and user education (Makowski, 2021). Therefore, funding is a critical factor in the effective utilisation of HPC systems. It requires significant financial resources to acquire and maintain, including purchasing specialised hardware and software, hiring technical staff, and providing user training and support (Makowski, 2021). Adequate funding enables organisations to acquire and maintain HPC systems, ensuring that they remain up-to-date and fully operational (Berman et al., 2013).

Institutions face several challenges in obtaining and managing funding for HPC systems. One of the most significant challenges is the prohibitive cost of acquiring and maintaining HPC resources. Institutions may lack the financial resources to purchase and maintain HPC systems, particularly in developing countries and underfunded research areas (Makowski, 2021). According to Foster (2015), another challenge is the competition for funding. Many institutions require funding for various purposes, and the HPC system may not always be a top priority. Additionally, obtaining funding for this system may require extensive grant writing and proposal submission. However, the University of Venda is in association with the University of Northwest and the University of Limpopo to start its own HPC system.

It can be difficult to manage the money allocated for the HPC system. Institutions must effectively manage their budgets to meet their other financial commitments and dedicate enough resources to the HPC system (Foster, 2015). Institutions must also successfully manage their HPC system to ensure they are used effectively and meet user needs. The University of Venda may be able to manage this difficulty because it has the resources to fund its utilisation. To overcome these obstacles, the University of Venda may look for funding from various sources, including governmental organizations, private foundations, and business alliances. To cut expenses, it can cooperate with other institutions and pool resources for the HPC system (Makowski, 2021).

According to Berman et al. (2013), institutions can implement effective monetary management practices, such as budget planning and cost tracking, to ensure that they allocate sufficient resources to the HPC system while meeting other financial obligations. Additionally, institutions can develop strategies to maximise the utilisation of the HPC system, such as user training programs and technical support services (Berman et al., 2013).

2.3.1.2 Perceived ease to use High-Performance Computing system

After receiving instruction on how to use an HPC system, researchers typically report that it is perceived to be simple to use (Ali et al, 2015). High-Performance Computing Systems are more likely to be used by researchers when they believe they are user-friendly. They design their study projects using it after realising its significance. Therefore, a mindset toward using the HPC system encourages all these manifestations in research. This only indicates that the researchers' attitude toward using it is influenced by its perceived simplicity (Ali et al., 2015).

Additionally, Users' level of expertise is another crucial factor that influences the utilisation of the HPC system in higher education (Hennessy, 2018). Researchers who are proficient in programming and data analysis are more likely to use HPC systems effectively. However, many researchers lack the necessary skills to use HPC systems, limiting their utilisation. According to Freedman (2019), one of the major hindrances to implementing the HPC system in higher education is the insufficient availability of skilled personnel.

The University of Venda can provide training programs to improve the skills of researchers, increasing their utilisation of the HPC system. The training programs can include workshops, online courses, and tutorials. The University of Cape Town has also established HPC system centres that provide support and training to researchers to enhance their skills in using HPC systems (Freedman, 2019).

Since the HPC system is a complex system that requires an elevated level of expertise to operate and utilise effectively, the expertise of users as an important factor can significantly influence the utilisation of the HPC system (Sterling & Weicker, 2019). According to Dongarra et al., (2019), expertise in HPC systems refers to the competencies necessary to use HPC systems effectively. Users with the competency are more likely to use the full potential of the HPC system, leading to higher utilisation rates. These users are typically experienced in programming languages and have a good understanding of algorithms and parallel processing techniques, which enables them to optimise their applications for HPC systems (Stevens et al., 2019). Therefore, they are better equipped to manage the complexities associated with the HPC system and can maximise their utilisation.

Depending on their skill levels, users of HPC systems face different challenges. The system architecture may be difficult for novice users to comprehend, and they might not be familiar with the programming languages needed for HPC system applications. To utilise an HPC system successfully, they could need more assistance, leading to lower utilisation rates. Expert users, on the other hand, could encounter difficulties when using unfamiliar systems. Utilisation rates may decline because of the additional training they might need to learn the new system (Stevens et al., 2019).

2.3.1.3 Perceived usefulness of High-Performance Computing system

Alford and Page (2015) describe perceived usefulness as the degree to which researchers trained to use HPC systems have recognised the value of such systems and have subsequently shown an interest in using them because of their improved knowledge. According to Alford and Page (2015), this level of expertise helps people have favourable opinions about using the HPC system. Therefore, using it is straightforward once the researchers adopt a positive attitude. Figure 1.1 shows that attitudes toward using HPC systems are developed because of perceived utility, which is a favourable influence.

2.3.1.4 Actual use of High-Performance Computing system

Porter and Donthu (2006) examined how researchers perceived and approached the use of HPC systems. They found that researchers' perceptions of how to utilise these systems were found to have an impact on the actual use of HPC systems. Thus, the mentality or mindset that motivates researchers to employ HPC systems is crucial. It influences how individuals interact with and behave around such systems. Therefore, if researchers have a positive attitude on HPC system utilisation, it is likely that they will actually use it (Porter & Donthu, 2006).

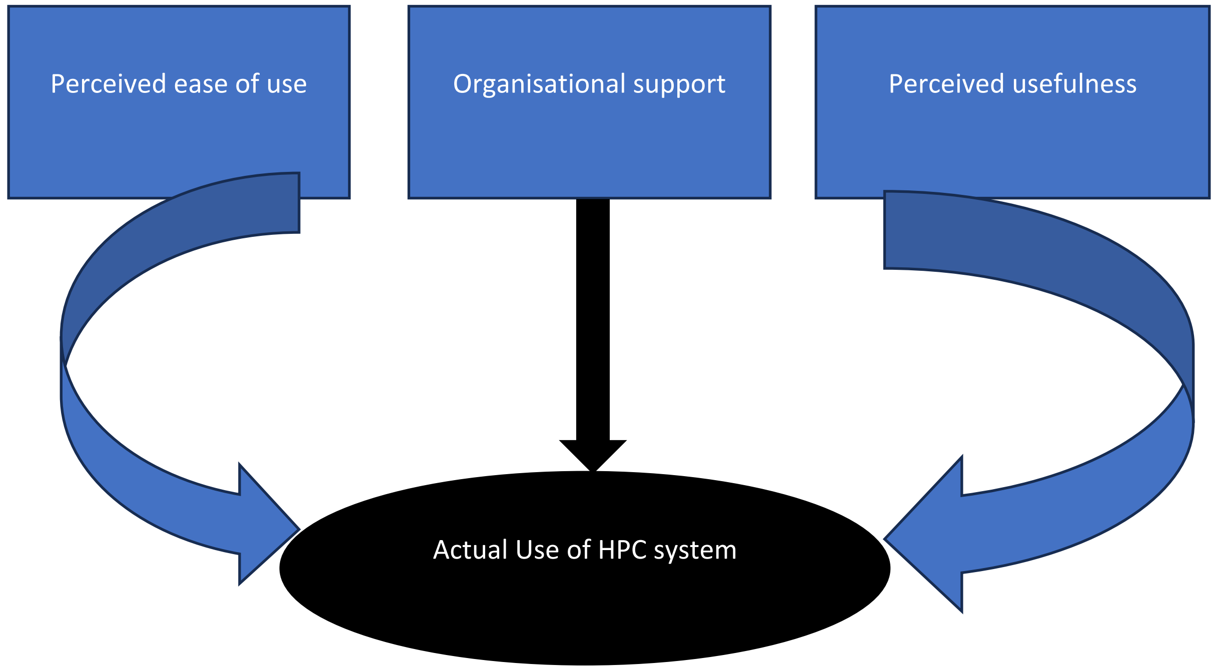

Figure 2.3

Framework for the Effective Use of High-Performance Computing by Buis, Piacentini and Déclat (2006)

2.3.3 The components of a High-Performance Computing system

The study has outlined and discussed some of the components of an HPC system. The components below were articulated to ensure that the academics, masters and PhD students understand how these components function. The following sections discuss how an HPC system's hardware and software component's function.

2.3.3.1 Hardware

Computer hardware is defined by Krawczyk, Zajdel and Szczepaski (2021) as the physical components of a computer system that can be felt or seen. For example, the computer screen users utilize to see the display is a hardware device (Krawczyk et al., 2021). According to Hayward, Choksi, Lanvin and Ramstein's explanation from 2007, computer systems use a variety of hardware components, such as printers for producing outputs and computer memory for storing data and programs, for improving their performance. Information technology specialists develop specialised daily software, providing important advantages and minimizing human labour. This illustrates that researchers and the entire Human Resource Management and Labour Relations department may enable High-Performance Computing platforms. Computer software cannot function properly without the appropriate hardware.

For instance, a hard drive is a piece of hardware that may hold a ton of information, programs, or data, but it is useless without software. For an HPC system to function properly, its hardware and software components must cooperate. Another illustration is installing a sound card on a computer, which enables users to watch films, play games, and listen to music. However, the hardware cannot work properly, and users cannot hear any sound without the right driver software (Choksi et al., 2007). Drivers are computer programs supplied with hardware devices (Choksi et al., 2007).

2.3.3.2 Software

As Campion, Wang and Hayward (2005) describe system software controls hardware to enable the execution of any application software to do various tasks that programmers have specified. They monitor various computer system components, such as the Central Processing Unit (CPU), primary and secondary storage and other Personal Computer peripherals and running and executing applications. They coordinate computer gear, such as printers, scanners, webcams, sound cards, and other peripherals, so that the systems can carry out the specific duty allocated to them efficiently and appropriately. As part of the application software development, they also offer a platform for the performance and execution of applications (Campion et al., 2005).

They also transmit data to hard drives, preparing text, photos, or graphics for display on screens. People need to be aware of these features to ensure they can use the HPC system effectively. Device drivers and other system software designed for other specific purposes are installed in the system. For example, appropriate device drivers are necessary for display cards and sound cards to enable sound playback from sound cards and achieve higher resolutions on computer screens (Krawczyk et al., 2021). System software also includes compilers, interpreters, utility programs, and programming tools. Operating systems and language processors are examples of system software; operating systems serve as the user's interface to computers, while language processors translate between different programming languages (Krawczyk et al., 2021).

2.3.4 The Impact of HPC systems on higher education

According to the usage patterns of the University of Venda, two academic departments, specifically the Mathematics and Chemistry departments, utilise the HPC system. These two groups are fit to use the HPC system since they work with big data every day. Their experimental studies require them to do much practical analysis and implementations in terms of developing products, weather forecasting, mixing chemicals and determining components that distinguish various products.

The pilot study for this research in Human Resource Management and Labour Relations (HRM & LR) suggests that Performance Management can be implemented by integrating the HPC system. System since this system loads a huge amount of data of all stakeholders at the University of Venda. Chemistry and Mathematics departments may benefit from this system since all the information is secured on cloud computing. This is through the connectivity with the HPC system Centres at the CSIR. The University of Venda indicated that, through this connectivity, students and supervisors using the system find it easy to get their data calculated and processed.

Moreover, the HPC system has significantly impacted various sectors, including education (Kaviraj, 2017). The HPC system in higher education has enabled researchers and students to process vast amounts of data and run complex simulations, leading to ground-breaking discoveries in various fields. According to Kaviraj (2017), the HPC system has enabled researchers in higher education to process massive amounts of data and run complex simulations, leading to discoveries and advancements in various fields. An example of the application of the HPC system is in astrophysics, where it has been utilized to model the creation and progression of clusters.

Researchers at the University of Zurich used the HPC system to simulate clusters' formation and evolution, which helped them better understand the processes involved in cluster formation (Kaviraj, 2017). Compared to South Africa, the University of Pretoria and Wits University are among the universities significantly impacted by the system. The HPC system has also been used in molecular biology to analyse large-scale genomic data and identify potential drug targets for diseases (Abdullai & Micheni, 2020). This impact may significantly influence the utilisation of the system in the departments of Chemistry and Mathematics.

The impact of the HPC system in research is not limited to science and engineering disciplines (Kaviraj, 2017). Researchers in humanities and social science have used HPC systems to process massive amounts of data from digital archives and analyse them using advanced analytics techniques. For example, the HathiTrust Research Centre provides researchers access to a massive collection of digitised books, enabling them to analyse the text in new ways and uncover hidden patterns and connections (HathiTrust Research Centre, 2021).

The HPC system has also had an impact on education, enabling the development of new educational tools and resources. For example, the University of Illinois at Urbana-Champaign developed an HPC system-based platform for teaching parallel programming, allowing researchers to learn how to write code that can be executed on HPC systems (Lusk, 2019). This platform allows researchers to gain practical experience developing high-performance parallel applications, a valuable skill in the job market. HPC system has also been used to create virtual laboratories and simulations for various scientific disciplines, which can enhance students' understanding of complex concepts. For example, virtual simulations of complex biological processes can help students better understand how these processes work and how they can be manipulated for various applications (Liu, 2018).

Therefore, the HPC system has significantly impacted higher education, enabling researchers and post-graduate students to process massive amounts of data and run complex simulations, leading to new discoveries and advancements in various fields. HPC system has also enabled the development of new educational tools and resources, allowing post-graduate students to gain practical experience in developing high-performance parallel applications and enhancing their understanding of complex scientific concepts (Liu, 2018).

Additionally, in terms of research culture. The research culture at the University of Venda influences the underutilisation/utilisation of the HPC system. Due to this culture, the University of Venda may have an advantage in using the system. Moreover, a strong research culture tends to have higher utilisation rates of the HPC system at the University of Venda. A strong research culture encourages researchers to pursue innovative research projects that require advanced computing resources. A strong research culture also promotes collaboration among researchers, increasing the HPC system's utilisation (Khan, Atta & Al-Mazros, 2016).

HPC systems have become an indispensable tool for scientific research because they enable researchers (academics, masters and PhD students) to perform complex simulations and analyses that would not be possible with traditional computing resources (Brown, 2021). However, the effective utilisation of HPC systems depends on the availability of hardware and software and the research culture within an organisation. The utilisation of the HPC system in research is influenced by the research culture, which encompasses the principles, outlooks, and behaviours that regulate scientific inquiry in each institution (Freedman, 2019).

A strong research culture is essential for the effective utilisation of the HPC system (Kneale, Reid & Murray, 2018). Individuals need to comprehend the capabilities and limitations of the

HPC system and be willing to incorporate it into their research workflow. Additionally, researchers may be willing to collaborate and share resources to maximize the utilisation of the HPC system at the University of Venda. Organisations face challenges in fostering a research culture that supports HPC system utilisation. The University of Venda may be facing challenges in terms of a lack of awareness and understanding of the HPC system among academics, masters and PhD students. Many researchers seem unfamiliar with HPC systems and do not understand how they can assist them in their research. Additionally, researchers may lack the competency and training to effectively utilise this system (Kneale et al., 2018).

Therefore, several factors must be considered to develop a framework that promotes the utilisation of HPC systems. One of the critical factors is funding, which determines the level of investment in HPC system infrastructure and resources. Institutional support is also essential, as it provides the necessary resources and support for the effective utilisation of the HPC system (He & Shen, 2017). Software availability is another critical factor, as it determines the availability of software tools required for HPC system usage. The expertise of users, including knowledge, skills, and attitudes, is another crucial factor in HPC systems utilisation, as researchers who possess skills and knowledge are more likely to utilise them effectively (Zhang, Zhang & Li, 2018). Finally, research culture plays an important role, as it determines the level of adoption and utilisation of HPC systems within research communities.

2.4 The relationship between staffs' perceptions and technology acceptance

Researchers at the University of Venda are more likely to use HPC systems in their education if they have positive attitudes and beliefs about their use and show high levels of confidence. Acceptance of HPC systems may also lessen secondary hurdles like staff members' attitudes toward technology's applicability in higher education and their readiness to adapt their teaching strategies to use it. The attitudes and views of staff employees about the use of HPC systems are greatly influenced by personal factors such as topic matter, gender, and job experience. Additionally, the intention of staff to use technology is significantly influenced by their positive sentiments toward its utility.

Therefore, staff attitudes are a crucial factor in the successful integration of the HPC system in institutional settings. Strong, Dishaw and Brady's (2006) study evaluated the use of various computer programs in the workplace, and the findings revealed that, given the right training and support, staff attitudes toward the HPC system and educational software significantly affect their students' attitudes toward technology. As a result, the workplace integration of the HPC system is greatly influenced by employee attitudes. Employees' planning, instructional choices, and corporate practices are significantly influenced by their educational and professional values.

Holden (2009) found that attitudes are the most significant predictors of staff's intent to use inquiry-based teaching methods, which is critical to educational reforms. In another study, Lai (2008) surveyed 363 employees on their perceptions of HPC system integration and found that employees who embrace creative working methods tend to have a more positive attitude towards technology use. Contextual factors also contribute to staff resistance to HPC system integration. Liu (2018) found that contextual factors such as staff's beliefs about working with students and their practices significantly influenced their attitudes towards HPC system usage. Finally, Burton, Tones and Hubona (2005) investigated staff members' perceived needs for the HPC system as part of professional development experiences.

2.5 The relationship between organisational support and utilisation of High-Performance Computing system through its accessibility

The accessibility of HPC systems within an organisation, facilitated by organisational support, has significant implications for both university personnel and students. When universities provide access to and support for HPC systems, it creates favourable impressions of higher education institutions that embrace new technology (Agarwal, 2015). As the Fourth Industrial Revolution (4IR) progresses, technology becomes increasingly available, leading to transformative changes in higher education (Agarwal, 2015).

With the rapid advancements in HPC systems and information technologies, technology has become an integral part of work, education and communication (Rogers & Fisk, 2000). In the higher education setting, the level of access to HPC systems directly influences the quality of output from employees and students (Agarwal, 2015). Therefore, the presence of organisational support, including the allocation of resources, establishment of policies and implementation of initiatives, is crucial for promoting the effective utilisation of HPC systems.

Institutions that priorities and invest in HPC technology demonstrate their commitment to enhancing research capabilities and driving technological advancements. This organisational support not only enables users within the organisation, including university personnel and students, to access and use HPC systems but also creates an environment that fosters high-quality output (Agarwal, 2015).

Researchers should have better access to the HPC system and be provided with enough training on how to utilise the system. Management of the institutions will ensure that proper training is provided and that all stakeholders that are taking the initiative to acquire enough knowledge regarding the HPC system. Lack of access to and inability to use HPC systems may increasingly disadvantage organizations like the University of Venda in their capacity to deliver high-quality outcomes and operate successfully and autonomously.

Furthermore, Lee (2001) explained that the full benefits of the HPC system may not be realised by the university only but by the population. HPC systems can potentially improve the freedom and quality of life of junior and senior employees by boosting their capacity to carry out various tasks and access information. However, system designers will continue to view senior personnel as active users of technology until there is an understanding of why organisations like the University of Venda find it difficult to adopt new technologies (Proctor & Vu, 2003).

If the project does not start today, it will continue to be difficult for future generations to successfully access and utilise HPC systems (Agarwal, 2015). According to Czaja and Sharit (2007), the variety of technology is expanding at an unheard-of rate. So, to access the HPC system, institutions should embark on strategic planning that will assist in accessing the system easily. This strategic planning should always be implemented for new employees (Czaja & Sharit, 2007). The inability to access and use technology will thus put workers at a disadvantage in terms of their capacity to live independently, do basic tasks and successfully navigate constructed environments (Proctor & Vu, 2003).

Additionally, elderly workers could not fully benefit from technology (Czaja & Lee, 2002). Technology can enhance workers' independence and quality of life by increasing their ability to perform various activities and gain access to information and services (Rogers & Fisk, 2000). Rathi, (2018) observed that unless there is an understanding of why senior employees struggle to adapt to new technologies and new employees are perceived as active users of technology by system designers, successful use of technology will continue to be challenging for future generations of employees. Because technology constantly evolves, people will regularly need to learn new processes or skills throughout their lifetimes (Rathi, 2018).

High-Performance Computing system is increasingly becoming essential for organisations requiring considerable computing power to handle complex computations (Mehta, 2021). The utilisation of the HPC system in organisations is determined by the availability of the infrastructure (Mehta, 2021). Therefore, organisational support plays a significant role in utilising the HPC system. An organisation that supports HPC system utilisation provides its employees with the necessary resources, infrastructure, and training. With this, the University of Venda might not have such support, resulting in the underutilisation of the system.

The organisation also ensures that its stakeholders have access to the system when they require it. This level of support is essential in ensuring stakeholders have the necessary knowledge and resources to utilise the HPC system effectively (Mehta, 2021). Several studies have shown that organisational support is positively correlated with HPC system utilisation. For instance, a study by Guo (2019) found that organisations that provided more resources and support to their employees had a higher HPC system utilisation rate. This support may also positively influence the utilisation of the HPC system at the University of Venda. The study by Guo (2019) further indicated that stakeholders who received training on how to use the HPC system were more likely to utilise the system effectively. Another study by Mehta (2021) found that accessibility to HPC systems is critical in determining their utilisation. Organisations that provided easy access to HPC systems had a higher utilisation rate compared to those that did not provide easy access.

The researcher also checked the accessibility of HPC systems. According to (Rathi, 2018), accessibility is an essential factor in determining the utilisation of HPC systems. Organisations that provide easy access to HPC systems have a higher utilisation rate than those that do not. In this sense, if the University of Venda can provide easy access to the system, researchers may be able to utilise the system, and that would be a good thing. Moreover, Rathi (2018) stated that the ease of accessibility includes factors such as the availability of HPC system, the speed of access, and the system's user-friendliness. Organisations that provide their researchers with fast and reliable access to HPC system is more likely to have higher utilisation rates. Additionally, organisations that provide user-friendly HPC system is more likely to have a higher utilisation rate.

2.5.1 Organisational support dimensions

2.5.1.1 Empowering researchers on the utilisation of high-performance computing system

The crucial element regarding empowering researchers to utilise the HPC system is that the university will internally look for the experts who can facilitate the technological innovation through the available system. The HRIS is essential in the field of HRM and its facilitation is of great importance. This means that it is not a priority for the Human Resource personnel to understand the components and internal things. Rather having an understanding of how to utilise the system is one of the important things to consider.

2.5.1.2 Training and development of academics on the usability of high-performance computing system

The effective utilisation of HPC system greatly benefits from training and development in light of technological advancements. At the University of Venda, it is crucial to provide researchers and staff members with training and technical expertise to maximize the potential of HPC systems.

Austin (2002) defined training and development as systematic actions by an organization or its leaders that result in long-lasting changes in the members' attitudes, knowledge, or abilities. Training exercises help people learn things they may use right away or soon, like getting ready for a promotion. On the other hand, development activities seek to build skills or qualities that might not be immediately useful (Austin, 2002).

According to (Van der Heijden, 2004), organisations are increasing their employee training and development investments. A company like the University of Venda can attain its goals by investing in personnel development. Master's and PhD students using the HPC system will be making a prudent investment if HR implements programs for staff development.

Traditional forms of training, such as hands-on or instructor-led methods, are being replaced by computer-based delivery modes. As a result, there is growing interested in offering essential information to all employees at a fair price and partnerships between established training organisations and new economy software startups are becoming more common. The concept of protecting and maximising employees' competencies has also been included in more recent organisational change models (Pfeffer & Sutton, 2000; Tannenbaum & Alliger, 2000).

2.5.1.3 Virtual teams and performance management through high-performance computing system

The concept of protecting and maximizing employees' competencies has also been included in more recent organisational change models (Pfeffer & Sutton, 2000; Tannenbaum & Alliger, 2000). Members of the University of Venda's HR department evaluate these platforms during back-to-back sessions. Most of them utilise personal phones while participating in such meetings at home. The little devices tend to cause issues with incoming phone calls and network issues, which makes it difficult to assist effectively. The HPC system's deployment might make every member's life easier because the system will operate more quickly and efficiently. It can be used to host every member while far away. The researcher sees the system's importance in facilitating virtual teams and performance management.

In response to an increasingly decentralised and global work environment, several companies have established virtual teams, where members of the group who are physically or chronologically apart work together (Hunt, 2011). Based on the prevalent online actions, the researcher supports this. The problem of virtual teams has spread to social media, academic communities, and the business sector. Additionally, because of the convergence of technological innovation and the requirement to adapt to the modern workplace, most large firms now use virtual teams to varied degrees (Farr, Fairchild & Cassidy, 2013). The introduction of virtual teams has made it possible to address and successfully implement the issue of performance management.

Despite increasing growth of virtual teams and related technology, little is known about how to manage the HR components, such as performance feedback effectively, inside these teams (Farr et al., 2013). Electronic Performance Monitoring (EPM), which uses computer-based systems to record various performance metrics, is one topic that has attracted some empirical attention. According to Hertel (2015), most studies show some proof that Electronic Performance Monitoring is linked to higher employee stress levels. However, Hertel (2015) observes that these Electronic Performance Monitoring impacts are also very variable and significantly muted when considering employee involvement, system input, team cohesion and individual variations like locus of control. Hertel (2015) concludes that Electronic Performance Monitoring is not well suited for managing virtual teams and instead favours a more hierarchical structure in which some administrative responsibilities are delegated to team members.

Since HPC system is adapted to all the processing as one of the fastest systems, this is when a variety of activities from the HR department take place to ensure that HRIS is deployed through various virtual teams.

2.5.1.4 Compensation and rewards activities using High-Performance Computing system

Traditionally, employees were paid their salaries in cash in envelopes (Kavanagh, 2012). This was the system adopted by HR at that time due to a lack of more advanced methods of paying salaries, such as direct bank transfers. Due to technological advances, however, most organisations can now remunerate their employees electronically and remotely. Thus, HR departments have adopted Human Resource Information Systems to facilitate compensation (Kavanagh, 2012). Therefore, based on this view, HR practitioners at the University of Venda may have the advantage of using the HPC system to perform compensation functions. The system is very user-friendly, fast and smart in processing data. For this reason, the researcher sees that this can be helpful.

2.6 CHAPTER SUMMARY

The literature review was grounded by the theoretical model, concepts of all variables and the factors that affect the utilisation of the HPC system at the University of Venda. The arguments were based on the TAM and the UTAUT. The researcher discussed the HPC system concept and the relationship between organisational support and utilisation. Then, after discussing the HPC system, all the factors were incorporated. The research technique and design were thus the main topics of the next chapter.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 INTRODUCTION

The study outlined a literature review in the preceding section. This chapter discusses the research methodologies that were chosen for the study. The chapter's opening part covered the intellectual foundations and research methodology. The study's population, sample, research instruments and data collection methods are also included. The study discussed the data analysis process. The researcher also did a preliminary investigation. At the end of the chapter is a summary.

3.2 RESEARCH PHILOSOPHY

According to Scotland (2012), research philosophy is a collection of assumptions about the nature of the reality under study. The field of knowledge being investigated affects the decision of certain research philosophies. However, when conducting research, researchers tend to presuppose certain things about human knowledge that are connected to the discipline of epistemology.

Lewis and Saunders (2018) identify positivism, realism, pragmatism, and interpretivism as the four primary research philosophies employed in academic studies. Lewis and Saunders (2018) claim that positivism is a research theory that focuses on measuring observable and measurable variables in a controlled setting without considering human interpretation or bias. But when a social reality has value-charged traits, realist philosophy, which is objective and unaffected by human beliefs or experiences, is understood by social actors (Brierley, 2017).

However, the pragmatism philosophy is a way where researchers incorporate both subjective and objective evaluations into their research, making it more suitable for mixed-methods studies (Brierley, 2017). The scholars and social phenomena are connected through interpretivism, to sum up. To comprehend a social phenomenon, one can use the researchers' justification and evaluation (Kivunja & Kuyini, 2017).

Therefore, a pragmatic philosophical approach was employed, guided by the underlying suppositions that investigate the elements encouraging academic, master's, and doctoral students to engage with the HPC system at the University of Venda. This philosophy was key in exploring if academics, masters and PHD students had the authority to use the system. The concept of pragmatism made it possible to test hypotheses. The qualitative method produced fresh, richer views of social settings and environments. This study philosophy covers the qualitative technique by examining the variables that affect how academics and postgraduate students at the University of Venda use the HPC system. However, the quantity technique was covered by testing the hypotheses described in this research study.

3.3 RESEARCH DESIGN

Research design is a method that gathers, analyses and interprets data to address research objectives (Babbie, 2017). As a result, explanatory research attempts to test and develop social theory or focuses on why things happen (Babbie & Roberts, 2018; Neuman & Robson, 2018). Exploratory research design focuses on developing fresh insights into research by formulating research questions and speculating on novel and unexplored research (Leavy, 2017). Studies that characterise and describe a data collection so that it may be easily understood are part of the descriptive research design (Patten & Newhart, 2018). It gives a methodical image with detailed information on a circumstance, endeavour, social setting, or connection (Neuman & Robson, 2018).

Therefore, the descriptive research design is appropriate as the study seeks to gain new insights, discover the latest ideas and understand the existing factors that influence the utilisation of HPC system at the University of Venda. By adopting a descriptive research design, the researcher finds it easy to determine research approaches. Overall, the researcher understands the types of interviews to collect qualitative data and helps develop self-administered questionnaires for quantitative data.

3.4 RESEARCH APPROACH

There are three approaches: quantitative, qualitative and mixed. As defined by Bryman (2017), quantitative research involves using mathematical and statistical analysis of gathered data. As a result, quantitative research generates functional statistics from numerical data. It is used to quantify several factors, including behaviours, perceptions, and feelings. However, Denzin and Lincoln (2018) contend that qualitative research adopts a naturalistic, explanatory perspective on reality. Qualitative research observes occurrences in natural settings while interpreting phenomena considering the context individuals bring.

Like this, Creswell and Creswell (2017) claimed that qualitative research emphasizes the individual's individuality while focusing on people's experiences. However, this qualitative research approach aims to construct a theory from qualitative evidence that is methodically gathered and examined. The qualitative research methodology enables qualitative procedures for proposing perceptions and occurrences in the natural world realistically and comprehensively (Ordu, 2015). Once more, the qualitative research approach is utilised to examine people's current states and gather and evaluate broad impressions not supported by numerical data (Orbay & Develi, 2017).

Mixed methods focus on quantitative and qualitative (Biddle & Schafft 2015). The researcher usually bases knowledge claims in a mixed-method approach on pragmatic ideas like consequence-oriented, issue-centred, and pluralistic reasoning. To better comprehend study issues, this uses inquiry approaches that call for data collecting either continuously or sequentially (Creswell & Creswell, 2017).

The researcher looked into several mixed research types to determine the most pertinent. In order to address research problems, a sequential explanatory design is a hybrid research approach incorporating qualitative and quantitative data-gathering techniques (Rupani & Vyas, 2023). This approach involves collecting non-numerical information to get a deeper understanding of the study and then using quantitative methods to test the hypotheses derived from the qualitative phase (Rapani & Vyas, 2023). This approach was utilised to explore factors that influence the utilisation of the HPC system. The researcher collected data through structured interviews about perceptions that academics, masters and PHD students had in relation to the utilisation of the system. However, a self-administered questionnaire was used to explore organisational support, perceived ease of use, perceived usefulness and intention to use the HPC system at the University of Venda.

In a sequential explanatory approach, the qualitative phase often comes after the quantitative phase. The goal of the qualitative phase is to develop hypotheses or theories and a greater understanding of the study problem (Decuir-Gunby, McCoy & Gibson). In this stage, data is often gathered using techniques including focus groups, interviews, and observations. On the other hand, the quantitative phase involves testing the hypotheses generated from the qualitative phase using statistical analysis of numerical data. This phase typically involves collecting data through surveys or experiments (Othman, Steen & Fleet, 2020).

A sequential exploratory design is the second variety of mixed research. The sequential exploratory design combines the advantages of exploratory and confirmatory research (Hirose & Creswell, 2023). According to Schiepe-Tiska, Dzhaparkulova and Ziervald (2021), a smaller study is carried out initially to test a theory. A larger investigation is carried out to confirm the results. Researchers can use this method to quickly test new hypotheses and gather data before committing to a more in-depth examination. The sequential explanatory research addressed most of this method's elements. Thus, the researcher decided against using it.

In addition, the study employed sequential transformative, a mixed-methodology approach that combines the advantages of exploratory and confirmatory research, according to Hammersley (2014). Small-scale research is first carried out to test a theory, and then a larger investigation is carried out to confirm the findings of the earlier inquiry (Creswell & Plano, 2018). This approach allows researchers to quickly test new theories and gather data before committing to a more thorough examination. In this research study, a researcher did not. Concurrent triangulation is another mixed research approach that employs two or more case studies to investigate a phenomenon.

Concurrent embedding, on the other hand, integrates qualitative and quantitative research techniques to examine connections between challenging-to-measure events (Hauken, Larsen, & Holsen, 2019). Thus, to obtain a thorough knowledge of a phenomenon, concurrent transformative integrates the gathering and analysis of data (Hirose & Creswell, 2023).

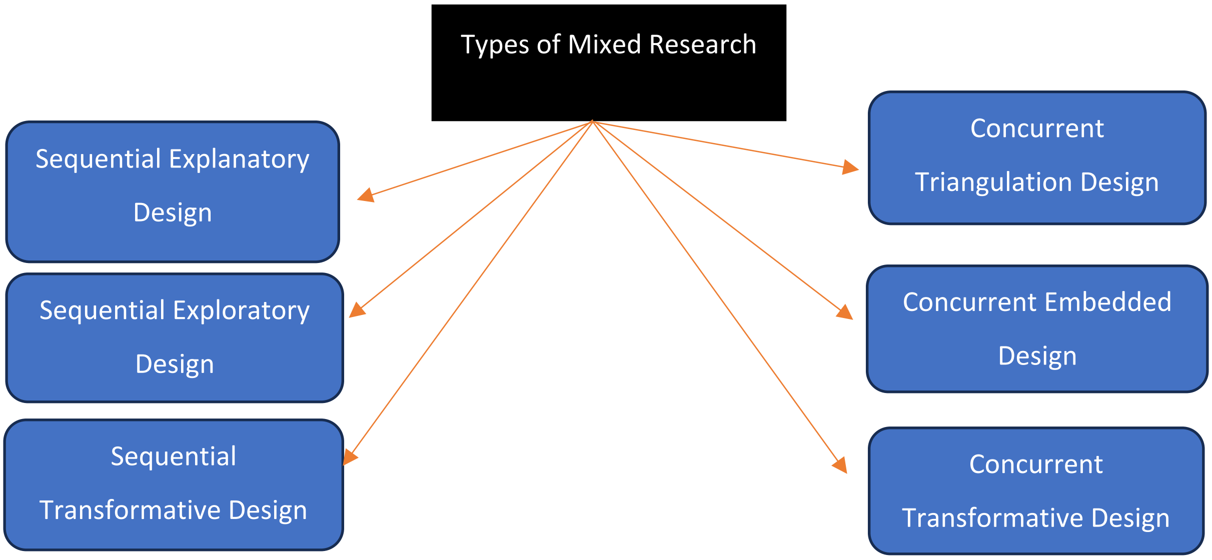

Figure 3.1

Types of mixed research approach by Hirose and Creswell (2023).

The research study's main aim was to investigate the factors that influence the utilisation of the HPC system at the University of Venda. Therefore, a mixed research approach – sequential explanatory design is used in this study since it explores the factors that influence the utilisation of the HPC system at the University of Venda. This research approach enabled the academics, master's students and PhD students to express their views on the utilisations of the HPC system. The researcher used physical interviews to collect data concerning how academics, masters and PHD students perceive the HPC system. The perception of the participants was obtained through the interview. It is also used because it can efficiently test the relationship between variables and hypotheses (Saunders & Lewis, 2018). Hypotheses are tested by performing statistical testing through SPSS 28.0. The researcher analysed quantitative data through SPSS. Hence qualitative data was analysed through ATLAS.ti.

3.5 POPULATION

According to Katz, Lazarsfeld and Roper (2017), a population is any collection of elements a study targets. Therefore, all researchers from the University of Venda's four faculties—the Faculty of Health Sciences, Management, Commerce and Law, Science, Engineering and Agriculture and Humanities, Social Sciences and Education—comprised the research study's population. This study's researchers comprised academics (supervisors) and postgraduate students at Masters and PhD levels. The population size is 554. Masters students numbered 250, PhD students 54 and supervisors 250. According to the faculty manager of Management, Commerce and Law, this is the latest statistics for the whole university. From this population, ten participated in the qualitative study, while 218 participated in the quantitative study.

3.6 SAMPLE AND SAMPLING PROCEDURE

Babbie and Roberts (2018) indicated that the sample is selected from the population and can be viewed as a team of individuals who support the study's goals. Gentles, Charles, Ploeg and McKibbon (2015) define sampling as selecting a subset representing the population to determine its parameters. Probability sampling and non-probability sampling are types of sampling procedures (Shikuku, 2015). Probability sampling provides equal opportunity in selecting participants (Punch & Oancea, 2014).

Non-probability sampling, in contrast, is a type of sampling that draws participants from the total population based on non-random features (Lochmiller & Lester, 2015). Simple random probability sampling, stratified, systematic and cluster are the four different types of probability sampling. However, Okeke and Van Wyk (2016) provided four descriptions of probability sampling techniques. The researcher can conduct simple random probability sampling using a simple random sample and a number. Then, a set of random numbers is produced.

It is also a probability sampling technique, meaning that each potential sample of a given size and every component of the population have an equal (Scheaffer, Mendenhall & Ott, 2006). The following describes its process: The target population is first defined, determining an existing sample frame for the population or creating a new one. The researcher outlines the benefits and drawbacks of non-probability and basic random sampling techniques. Its benefits include employing inferential statistics for data analysis and the tendency to produce representative samples. Simple random sampling has several advantages over other probability sampling techniques, which should be considered when deciding what kind of probability sample design to use.

The second kind of probability sampling is stratified sampling, which divides the target population into different strata and then selects the final participants proportionately from different subgroups (Thompson, 2002). There are lists of the subpopulations the population participants are already separated into (Binson, Canchola & Catania, 2000). Following specific steps is required when choosing participants for a cluster. Before choosing the ideal sample size, the study specifies the target population. These two steps are to create a new one using clusters of the target population, review the sampling frame, and adjust as needed.

The ideal clusters would be mutually exclusive, collectively in-depth, and as diversified as the population. If items from the population belonged to more than one cluster, duplicate elements might appear in the sample. Bias will result from omissions. Therefore, the researcher decides how many clusters to choose from. Divide the sample size by the anticipated average number of population elements in each cluster to achieve this. As the number of clusters rises, precision rises to the extent that the identical and non-identical of clusters diverge from those of the population. On the other hand, precision falls as disparities between clusters rise. The targeted number of clusters is chosen randomly as part of the conclusion method.

Compared to non-probability sampling methods, a cluster comprises of advantages and disadvantages of probability sampling. However, it differs from other probability sampling techniques (Binson, Canchola & Catania, 2000). The ultimate probability sampling strategy used in the quantitative methodology of this study is systematic sampling, which aligns with the researcher's alignment. According to Binson, Canchola and Catania (2000), systematic sampling involves randomly selecting the first sample element and then regularly selecting subsequent elements until the desired sample size is reached.

The use of a sample frame is not always necessary. Assume that certain sites have a physical presence, such as a constant flow of population elements. In that instance, neither the target population nor a sampling frame is required.

One could, for instance, systematically pick every patient entering a hospital's emergency room after a random start, or one could store consumers in line or documents in file drawers (Scheaffer et al, 2006). The following processes are involved: the desired sample size is determined after defining the target demographic (n). Before assessing the sampling, frame and periodicity and making any necessary adjustments, the researcher locates an existing sampling frame or creates one for the intended population.

Systematic sampling is a decent approximation of random sampling if the sample frame is randomized. By dividing the total number of elements in the sampling frame (N) by the required sample size, the researcher can calculate the sampling interval and the number of elements in the sampling frame (n). The study's target population was 228 of both groups (supervisors and postgraduate students). The sample size might be more significant than ideal if the numbers are rounded down and compressed. If so, it is possible to remove the excess choices arbitrarily. One may fix the sampling fraction if the precise population size is unknown or impracticable. Finally, a researcher selects a sample by randomly choosing several subjects.

Compared to non-probability sampling techniques, systematic sampling has the advantages and disadvantages of probability sampling methods (Scheaffer et al., 2006). Table 3.6d below provides a summary of these effects. The discussion of probability sampling has been concluded. Therefore, given that this study used a mixed methodology, a researcher must present the non-probability as it relates to the qualitative technique. According to Etikan, Musa and Alkassim (2016), there are four non-probability sampling methods: convenience, purposive, snowball and quota. Using the convenience sampling method, cases are selected based on their availability for the study. As a result, a researcher favours volunteers in this kind of non-probability selection based on their convenience or availability.

According to Chaudhuri and Stenger (2005), the study chooses the nearest surviving participants. It involves choosing elements that are accessible. As an illustration, a researcher at the University of Venda chooses their friends and classmates for the study based on practicality. In this non-probability sampling technique, everyone who fits the requirements is eligible to be included in the sample. Let's take the example of people on the streets. To collect completed questionnaires, a researcher can stand on the corner of a street with copies of the form. Individuals walk by the location where the researcher is handing out copies of the questionnaire (Chaudhuri & Stenger, 2005).

The second non-probability sampling is a purposeful sample. To maintain the study's aims, the researcher chooses the participants for this sampling depending on their discretion (Andale, 2015). It chooses cases based on its expertise or with a goal in mind. Both exploratory and field research utilise this kind of sampling. The researcher rarely makes sure that the chosen examples accurately represent the population when using purposive sampling (Andale, 2015). Most sampling procedures may be intentional because sample problems are typically approached.

Participants who are accessible are chosen using purposeful sampling, which is less expensive, available and more practical. The study cannot guarantee that the sample represents the population. Therefore, the researcher's capacity to evaluate the population's component parts is given more weight (Chaudhuri & Stenger, 2005). A sample of MPs, educators, and journalists might be chosen for the survey to examine attitudes regarding any significant topic. Because they are more likely than other groups to reflect the right mindset, they are competent to participate in purposive sampling (Chaudhuri & Stenger, 2005).

Additionally, snowball is used when it is challenging to locate people of the target demographic (Fiek, 2003). A non-probability sampling technique with a sociometric bent is called snowball sampling. Even while some individuals view snowball sampling as an accidental strategy, it is useful when it is difficult to locate members of a specific demographic, such as the homeless or migrant workers. The data collector first collects information from a contact or contacts that they are typically familiar with (Fiek, 2003). The researcher acquires the respondent's contact information following the data collection procedure (such as a questionnaire, survey, or interview). These responses are contacted, engaged with, and given requests for additional contact information. Until the researcher's goal is attained, this process is repeated. Quota sampling, in some ways, combines availability sampling with purposive sampling by focusing on precise amounts of products with qualities (Daniel, 2012). Snowball sampling is useful when there are limited choices.

Finally, quota sampling can be used to select a sample of easily discernible variables that provides proportions identical to the population (Etikan, 2016). To understand this type of sampling, a researcher must be familiar with the concept of a quota. In this sampling strategy, the participants are split into predetermined groups (for instance, 100 literate people and 100 illiterate people). Based on a defined quota, the researcher selects a sample. The study examines several groups, such as 100 men and 100 women. These sampling techniques also fall under the categories of uncontrolled and regulated quota sampling. The sample in uncontrolled quota sampling is selected at the researcher's convenience.

A number of restrictions are placed to limit the alternatives available to researchers utilizing controlled quota sampling. Stratified sampling and this sample strategy share similarities (Etikan, 2016). The researcher ensures that the sample adequately represents each demographic group or stratum. The researcher chooses the participants who immediately meet the requirements using the quota sampling strategy instead of a stratified sample (Daniel, 2012).

The purposive sampling method selects the cases-based judgement of a researcher about a situation (Alkassim et al., 2016). A simple stratified sampling method randomly selects participants of the population within the groups created as a procedure of stratified sampling. Considering the nature of the study and the period during which it was carried out when most researchers were working remotely due to the COVID-19 pandemic and the availability of flexible technology, a sample size of ten participants was used to collect qualitative data. Bryman (2017) stated that a sample size of five to twenty-five people is sufficient when doing a qualitative study employing interviews. Ten (10) participants were selected for this study to gather qualitative data using purposive sampling. 104 Masters students comprise, 20 PhD students and supervisors comprise to give a total of 228 participants for the study. Raosoft calculator was used to get these figures of participants per class.

3.7 DATA COLLECTION METHOD

The study employed mixed research methods. Controlled observations, in-person interviews, experiments, telephonic interviews and surveys are just a few of the appropriate approaches in research (Torrentira, 2020). Physical interviews and an online self-administered survey were both used in this investigation. To gather information from the participants, these two strategies used a set of questions and statements (Du-Plooy-Cilliers, 2014).

Data collection is the process of gathering and measuring information on certain variables in an established system (Kabir, 2016). The emphasis on ensuring accurate and truthful data collecting is continuous, even though methods vary depending on the discipline (Kabir, 2016). Any data collection should aim to collect accurate data to produce responses to questions that are believable and reliable (Gravetter & Forzano, 2018).

Horton, Macve and Struyven (2004) defined structured interviews as interviews in which the interviewer does not strictly stick to a predetermined set of questions. The interviewer used a more open-ended approach than a traditional question-and-answer format to encourage the academics, master's students, and PhD candidates to provide in-depth responses. Since these participants are familiar with the High-Performance Computing system, the departments of Mathematics and Chemistry were chosen to give the qualitative data.

Since physically structured interviews were an efficient strategy for data collection when the researcher needed to obtain qualitative data, the researcher personally met these participants and performed physically structured interviews with them. Additionally, the study used an online questionnaire to gather quantitative.

These two techniques were effectively used to obtain exact information from 218 participants regarding variables that affect the use of the HPC system. Purposive sampling was used to identify the ten (10) participants who would provide the qualitative data. However, 218 researchers who supplied quantitative data for this project were also chosen via a rigorous probability sampling method. There are 76 participants in each category—masters students, PhD students, and academics—because all three are represented. Seventy-six participants, multiple by three groups, give a researcher 228 study participants.

3.7.1 Data collection instruments

(i) Demographic characteristics

At the University of Venda, a self-developed demographic questionnaire was used to gather data on the gender, age, department, and employment history of academics, master's students, and PhD candidates.

(ii) The utilisation of High-Performance Computing System

The study was conducted using a self-administered questionnaire and a structured interview. Academics, master's students, and PhD candidates are surveyed quantitatively about the factors that influence the utilisation of the HPC system at the University of Venda.

The researcher employs structured interviews as a qualitative method to gather data on how academics, graduate students, and PhD candidates perceive the aspects that affect how they use the University of Venda's HPC system. These resources are provided as the researcher's questionnaire and interview guide. For structured interviews, essential questions are provided so the researcher may guide the conversation toward achieving research objectives.

<u>Questions that are included in the structured questionnaire are the following:</u>

1. How do researchers' perceptions of the High-Performance Computing system influence its utilisation at the University of Venda?
2. How do these factors (organisational support, perceived usefulness, perceived ease of use and intention to use) influence your attitude towards using the High-Performance Computing system?

To assess how effectively HPC systems were being used, a 35-item scale was devised (Dillman, 2000). Responses are tallied on a 5-point Likert scale, where 1 denotes "strongly agree" and 5 denotes "strongly disagree." The ways in which highly processing large data machines are used are all correct. Using a big data machine with high processing power has a 0.77 Cronbach alpha value. (Morris, Venkatesh, Davis & Davis, 2003). The measure has an alpha coefficient of 0.79 when used in a study by Dalbouh (2013). For instance, “I believe that deploying a high-performance computing system in an organisation is a fantastic idea.”

3.7.2 Pilot study

A pilot study is a smaller-scale variant of a larger study done before the final investigation. The pilot study aimed to evaluate the feasibility, suitability and appropriateness of the methodology (Babbie & Mouton 2010). As part of a pilot study, the interview guide was given to five participants from the target audience. The remaining four are composed of one from the Department of public management, two from the department of auditing and accounting, two from the Department of business information technology, and one from each. The respondents from this section were not included in the analysis to avoid response bias.

3.8 DATA ANALYSIS

According to Calitz (2009), a pilot study is a scaled-down version of a larger study or a test run before the full investigation. The goal of the pilot study was to determine whether the study could be conducted, whether the questionnaire was appropriate and whether the research approach was adequate (Babbie & Mouton 2010). Five respondents from the target population were given the interview guide as part of a pilot study. Two from the Department of Auditing and Accounting, two from the Department of Business Information Technology, and one from the Department of Public Management comprise the remaining five. The pilot study's respondents were excluded from the analysis to prevent response bias.

The study used ATLAS.ti to analyse qualitative data. ATLAS.ti as an effective tool for this analysis of sizable volumes of textual, graphical, audio, and video data, according to Dubois and Gadde (2002). When analysing data, a researcher should become familiar with or adhere to the following stages, which Biggerstaff and Thompson (2008) recommend:

- *Stage 1: Initial contact with the text*

Researchers recorded their thoughts, observations, or reflections as they looked through transcripts or other written materials. These notes contained recurrent words, inquiries from the researcher, participant emotions, and descriptions or remarks regarding the language employed. The researcher then uses these notes to record any significant observations or insights they may have had while reading the text.

- *Stage 2: Identifying preliminary themes/codes.*

This study re-read material after the initial reading and then selected codes that precisely reflected key aspects of the interview. The study identifies links among the codes and the topics that each segment of the transcript included.

- *Stage 3: Organising codes into clusters/themes.*

The study's next task was to group the codes into clusters or subjects to create a framework investigation. The goal was to create a group of codes and develop subordinate categories to show how they related to one another hierarchically.

- *Stage 4: Creating a summary table of themes.*

Based on the categories discovered at this point, the researchers created a list of themes. The themes were organised into a framework that draws attention to the crucial aspects and problems raised by the participants.

Moreover, quantitative data underwent a comprehensive analysis, including an examination of demographic characteristics, descriptive statistics, item analysis to assess the quality of survey items, exploratory statistics to uncover initial data patterns, correlation analysis to understand relationships among organisational support, perceived ease of use, perceived usefulness and actual use and multiple regression analysis to identify significant factors impacting HPC utilization. All these analyses were executed using SPSS version 28.0, a well-established statistical software.

3.9 RELIABILITY AND VALIDITY

Reliability and validity are crucial elements in quantitative research, ensuring the trustworthiness and meaningfulness of collected data and findings (Babbie, 2016; DeVellis, 2017; Hair et al., 2019; Nunnally & Bernstein, 1994). Reliability refers to the consistency and stability of measurements, while validity pertains to the accuracy and representation of intended constructs or variables. In quantitative research, reliability is often evaluated through measures such as internal consistency or test-retest reliability, which assess the consistency of results over time or across different samples, indicating the dependability and reproducibility of measurements.

Validity, on the other hand, can be examined through approaches like content validity, criterion validity and construct validity (Babbie, 2016). Content validity examines the adequacy of items in representing the intended construct, while criterion validity assesses the correlation with external criteria. Construct validity explores the underlying theoretical structure of measurements. Regarding the utilisation of HPC system, variables include organisational support, perceived ease of use, perceived usefulness and actual use of HPC systems.

To comprehensively explore these variables, this study ensured the reliability and validity of measurements. This enabled the examination of relationships among organisational support, perceived ease of use, perceived usefulness and actual use of HPC system at the University of Venda.

3.10 TRUSTWORTHINESS

Pilot and Beck (2014) stated that the degree of assurance in methodologies used to ensure the quality of the study is known as the study's trustworthiness. This study has established protocols and procedures, followed ethical standards, and used legitimate research methodologies in this work. The following factors contribute to a study's credibility.

3.10.1 Components of trustworthiness

Guba and Lincoln (1994) have outlined the following components:

i. ***Credibility***

According to Guba and Lincoln (1994), credibility refers to how accurate and believable the research findings are. It is improved by employing proper research techniques, gathering information from numerous sources, and ensuring that the tools used to acquire the data are valid and dependable. The study used the proper protocol in collecting data from participants. These participants' groups offered information based on how they view, use, and do not use high-performance computing systems.

ii. ***Transferability***

Transferability refers to the degree to which the findings of a study can be applied to other contexts. This is enhanced by describing methods, using purposive sampling, and collecting rich data (Pilot & Beck, 2014). The project leader of this research study has found it easy to follow all methodologies so that this research study can meet credibility.

iii. ***Dependability***

Dependability describes how consistent and reproducible a study's findings are. Lynne and Pitman (2016) articulated that it is enhanced by using clear and detailed procedures for data collection and analysis and by keeping an audit trail of all decisions and changes made throughout the research process (Pilot & Beck, 2014). Other scholars interested in this research study may find it easy to depend on while working on similar research projects.

iv. ***Confirmability***

According to Guba and Lincoln (1994), confirmability describes the extent to which conclusions are unbiased. According to Lynne and Pitman (2016), it is improved by utilizing numerous data sources, triangulating results, and involving multiple researchers in the data analysis process. The University of Venda, the University of Limpopo, Fort-Hare University, Walter Sisulu University, and the University of Western Cape all used these components of trustworthiness to ensure that research studies were rigorously conducted and reliable and that other researchers could trust the findings. Furthermore, CSIR officials and other stakeholders worldwide can trust this research study.

3.11 ETHICAL CONSIDERATIONS

Ethical guidelines were:

(i) Informed consent

According to Burns and Grove (2001), informed consent is when participants are told about their rights of participation. This demonstrates that the research project was disclosed to academics, master's students, and PhD candidates so they could select whether to participate. Additionally, it is customary for researchers to get the master's students and PhD candidates' informed consent before starting a study and to be mindful of the possibility that participants (researchers) may wish to withdraw their consent at any time for any reason (Burns & Grove, 2001).

Before starting the research, the academics, master's and PhD students must understand and freely consent to their involvement in the study and its terms and practical considerations. The researcher informs participants that they are free to stop participating without giving a reason. The researcher should make every effort to ensure that all prospective academics, master's students, and PhD students have the best understanding of what is involved in a project (Burns & Grove, 2001). The importance of their participation, their responsibilities, what will happen to the data they provide, how that data is used, and how and to whom the results are presented are all explained to participants (researchers) (Burns & Grove, 2001).

(ii) Anonymity

When study participants stay anonymous, this is what is meant by anonymity (Jackson, 2015). Therefore, in this study, all participants' personal information was kept secret so no one could access details like names. The PhD students, master's students, and academics are informed that their similar profiles should remain secret.

(iii) Confidentiality

Confidentiality is the study's handling of the participant's shared confidential information, which cannot be revealed to outside parties without the participant's permission (Burns & Grove, 2001). Only a researcher, supervisor and project officials will have access to any information submitted by academics, master's students, and PhD students. All study participants are aware of this ethical norm since the researcher informed them about it.

(iv) No harm to participants

No harm must occur to participants because they participate in the research, which is a fundamental requirement (Vitae, 2013). Putting participants at ease and avoiding placing too many expectations on them are the goals of ethical study design and execution (Vitae, 2013). Before data collection, researchers have a duty of care to recognize any dangers, be ready for, and be prepared to minimize and manage any potential distress or discomfort (British Educational Research Association, 2013). Any activities taken by the researcher that cause emotional distress or other types of harm are promptly re-examined to minimise such distress (British Educational Research Association, 2013).

The researcher's responsibility to protect academics, master's students, and PhD candidates increases as their risk increases. The participants (academics, master's students, and PhD students) shall be informed of any foreseeable harm or disadvantage that could arise from the conduct or reporting of the research. Participants are immediately informed of any unanticipated injuries sustained while participating in this study (British Educational Research Association, 2013).

3.12 CHAPTER SUMMARY

Research philosophy was discussed with a focus on the use of positivism as the guiding philosophy for the present study. The study employed a qualitative approach and the characteristics of the study population were also discussed. Additionally, the research design was described and the reasoning for its appropriateness was provided. The study's population, as well as the sampling and sampling procedures, were also addressed. This study also delved into ways data were collected and analysed. This study also detailed the ethical considerations that were observed throughout.

CHAPTER FOUR: DATA ANALYSIS AND PRESENTATION

4.1 INTRODUCTION

The preceding chapter centred on the research methods utilised in this research study. In this section, qualitative results are presented. The results focus on the following sub-topics: perceived understanding of HPC systems, awareness levels regarding HPC systems, perceptions towards utilisation of HPC systems and factors influencing the use of HPC systems at the University of Venda. The results were drawn from the ATLAS.ti version 9 software, and thus, network diagrams are utilised to visualise thematic areas and selected quotations. Ten (10) participants were interviewed to obtain data.

Furthermore, this section presents the quantitative data collected from Two Hundred and Eighteen (218) participants in relation to factors that influence the utilisation of the HPC system. The data collected was subjected to demographic properties, descriptive statistics, item analysis, exploratory statistics, correlation analysis, and multiple regression analysis, executed on the Statistical Package for Social Science (SPSS) version 28.0. The measurement instruments' reliability was assessed using Cronbach's alpha coefficients.

4.2 QUALITATIVE RESULTS

Ten (10) participants provided adequate and enough information that a researcher has used for this section. Qualitative results are presented as follows:

4.2.1 Perceived understanding of High-Performance Computing system

This section was meant to explore how participants (academics, masters and PhD students) understand the HPC system at the University of Venda. As shown in Figure 4.1, the main view was that the HPC system is a high-performance and complex computing system. In this regard, the HPC system is an upgrade to normal computers in terms of performance speed, complex calculations and efficiency. Selected verbatim words regarding this view are furnished in Figure 4.1. Some perceived HPC as a big data analysis system capable of quickly processing and synthesizing large volumes of data. Others regarded the HPC as an artificial intelligence handling computation system. Therefore, based on the diverse views, HPC systems are understood as high-performance computing systems utilised to calculate complex and big data.

Therefore, the results on the HPC system highlight the importance of providing further education and training on their capabilities and potential applications. The researcher can utilise these results to create a framework that addresses the knowledge gaps and encourages using the HPC system among academics, masters, and PhD students. This framework can align with the objectives of the research study, which are to investigate the factors that influence the use of HPC systems and develop a plan to promote their utilisation.

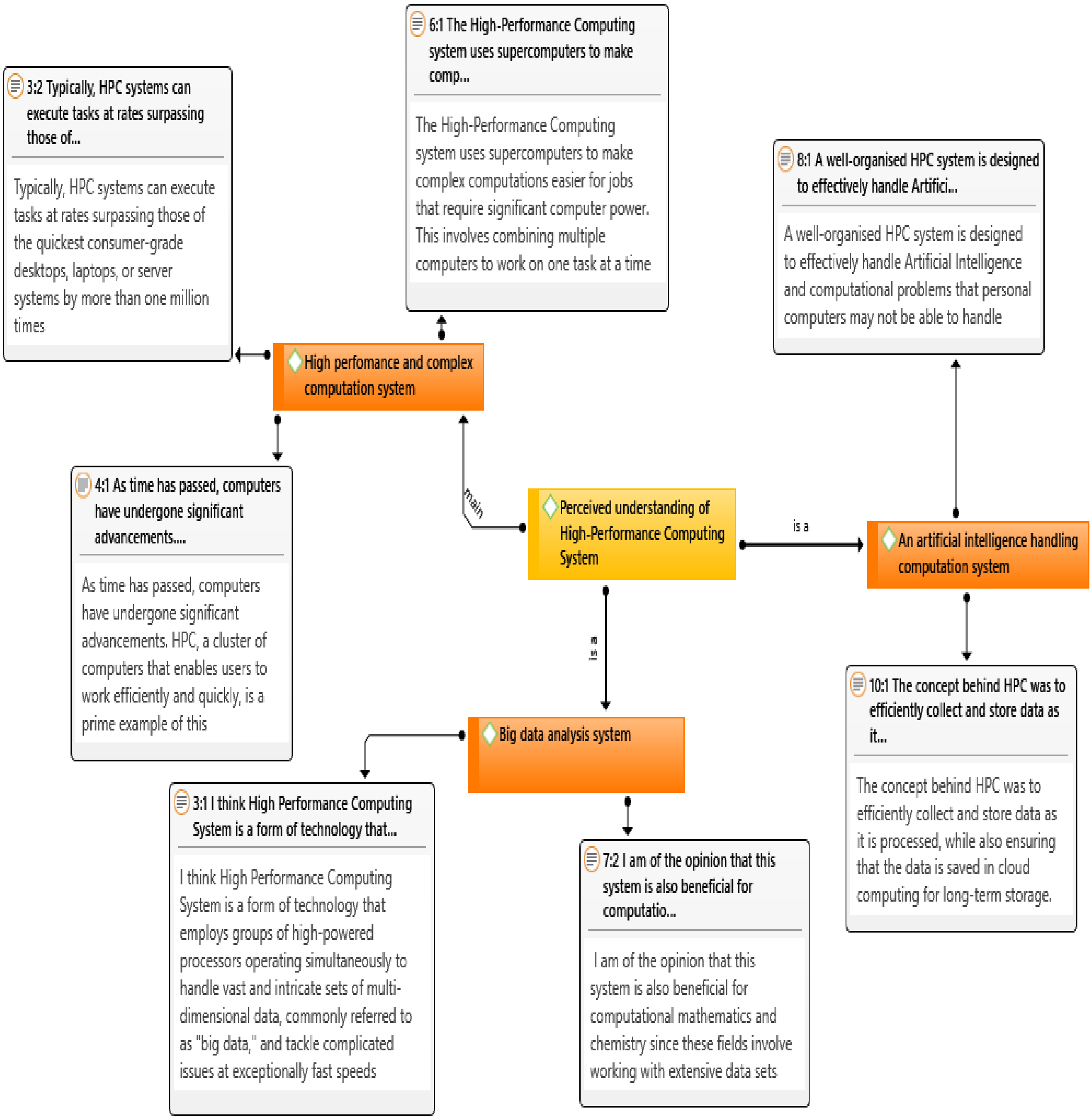

Figure 4.1

Perceived understanding of the HPC system

4.2.2 Awareness levels regarding HPC system

Results on the level of awareness about the HPC system indicated four distinct views. As shown in Figure 4.2, most participants were highly aware of the HPC system. They knew about the system's existence at the university and in different departments. Those who were aware were also knowledgeable about the system as they received training through various platforms. However, only a few participants had experience using the system as they had never utilised it in their research projects. Only a few were unaware of the system due to either lack of exposure, interest or support from the departments and university.

The results indicate that although there is a high level of awareness about the HPC system among participants at the University of Venda, only a few have utilised it in their research. This suggests that obstacles or difficulties may hinder researchers from fully utilising the HPC system. To overcome these challenges, the researcher has developed a framework to promote the use of HPC systems among researchers. Figure 3 in Chapter Two illustrates the development of this framework, which aligns to promote the utilisation of HPC systems.

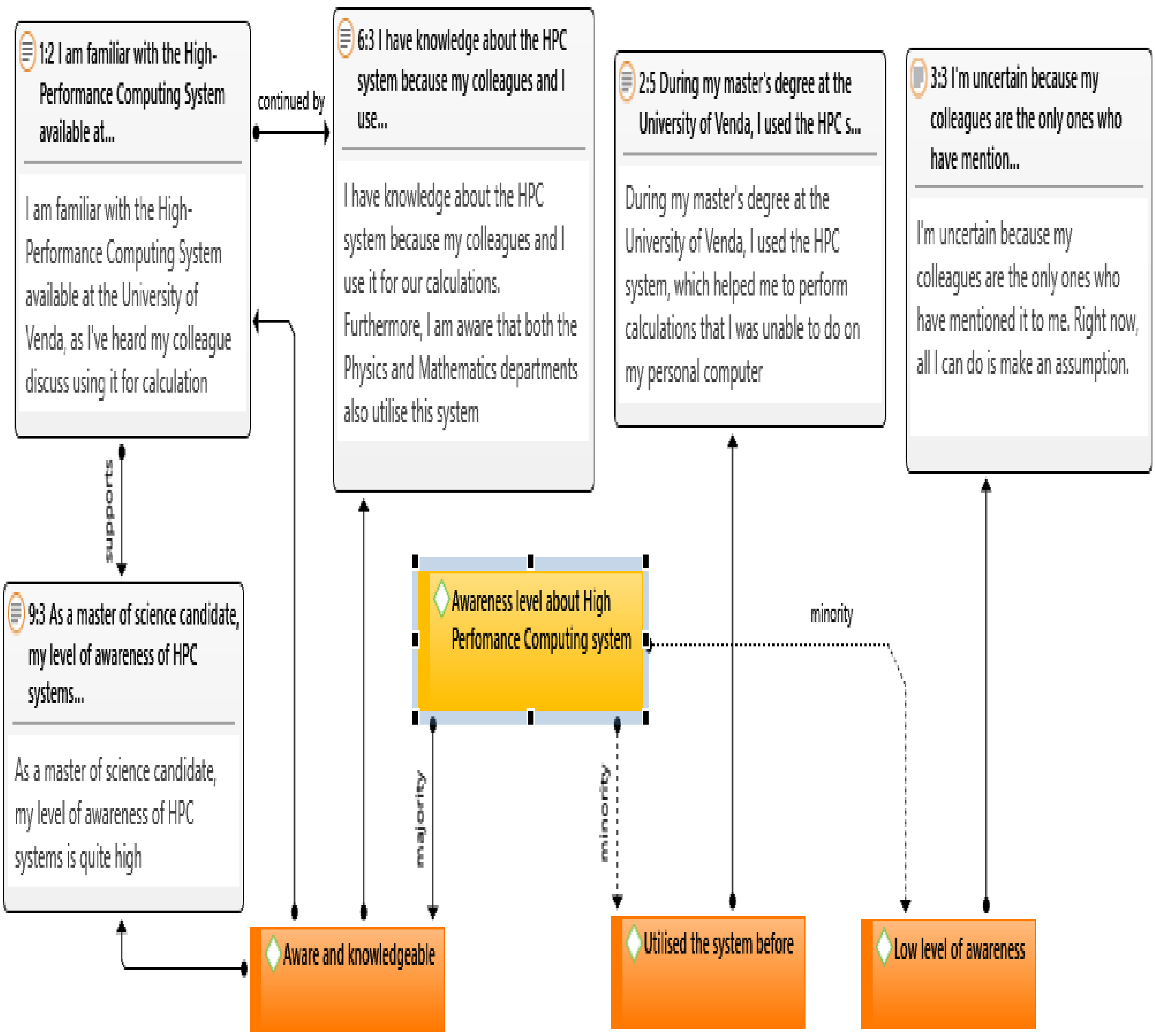

Figure 4.2

Awareness levels about the HPC system

4.2.3 Perceptions towards utilisation of HPC system

Perceptions towards the utilisation of the HPC system were sought. This was meant to understand the interest of academics, masters and PhD students in using the system. Results showed that most participants were interested in using the HPC system (Figure 4.3). This is because they had prior knowledge of the use and impact of the system in modern-day research. More so, referrals from colleagues and fellow students intrigued desire to utilise the system. A few participants also indicated that the system was convenient in analysing complex data and, thus, useful in departments such as mathematics, engineering, chemistry, and physics, where researchers often deal with multi-dimensional and large data sets. Others further indicated that the HPC system is desirable as it has transformed research and allows for simulations and modelling of complex systems such as weather patterns and protein folding. Despite a positive interest in the system by most participants, a few were concerned about the limited accessibility of the system across the university. Selected verbatim words regarding these views are provided in Figure 4.3

The researcher found that the participants, including academics, masters and PhD students, were positively interested in using the HPC system, particularly in departments (Mathematics and Computational, Chemistry, Physics and Statistics) where multi-dimensional and large data sets are used for research. The system's convenience and usefulness in analysing complex data and its ability to allow for simulations and modeling of complex systems were noted. However, the limited accessibility of the system across the university was a concern for a few participants. The researcher may use these findings to develop a framework that addresses accessibility issues and promotes the use of HPC systems among academics, masters, and PhD students, as per the objectives of this study.

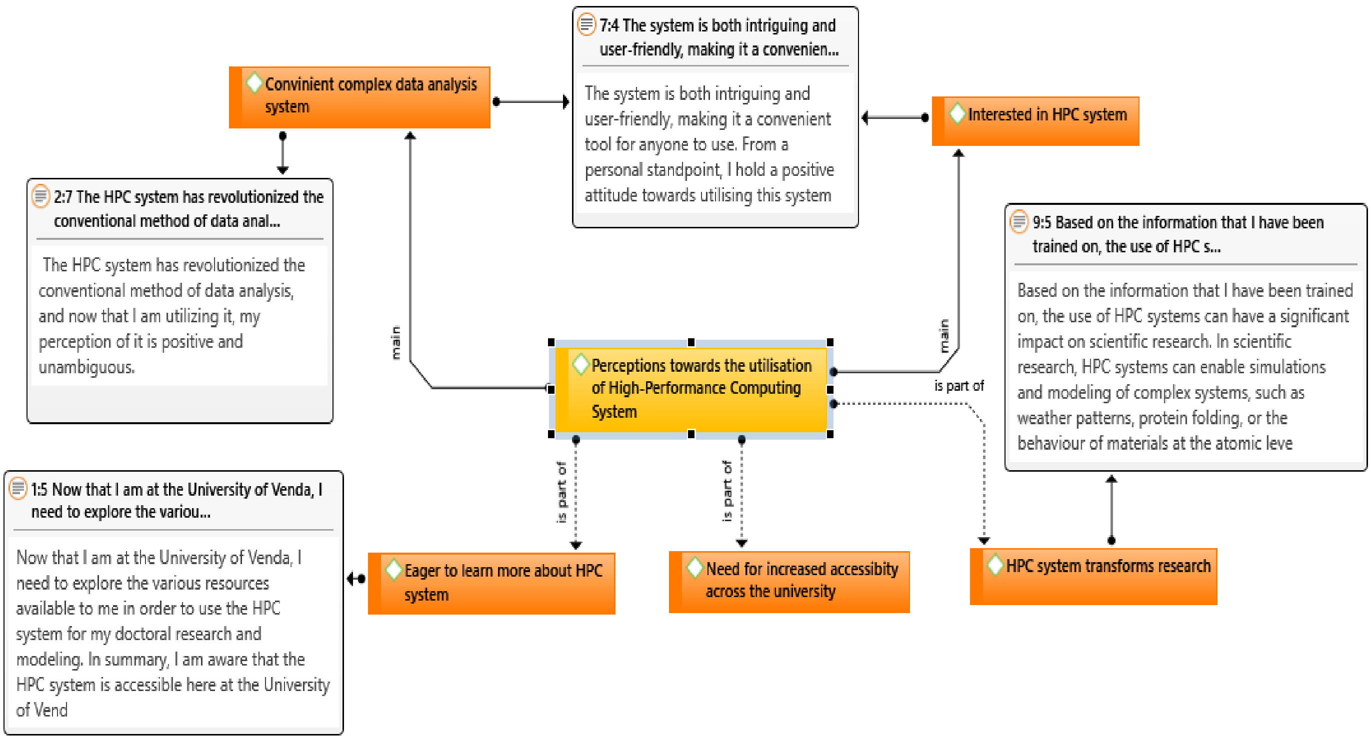

Figure 4.3

Perceptions towards the utilisation of the HPC system.

4.2.4 Factors influencing attitude towards the use of HPC system

The utilisation of HPC is influenced by factors such as organisational support, perceived ease of use, perceived usefulness. This subsection sought to understand how these factors influence participants' desire to use the HPC system. As indicated in Figure 4.4, there were divided opinions in terms of organisational support. Some believed that there was adequate support across the university, while others believed inadequate support was provided to departments in terms of training and accessibility of the system. Regarding perceived ease of use, all participants believed that the system was user-friendly and easy to operate, motivating them to use it. All participants also confirmed that the system's usefulness influenced them to use it in their projects. Lastly, most had the intention to use the system in their projects because they were aware of its usefulness and convenience. Selected quotations to substantiate this information are provided in Figure 4.4

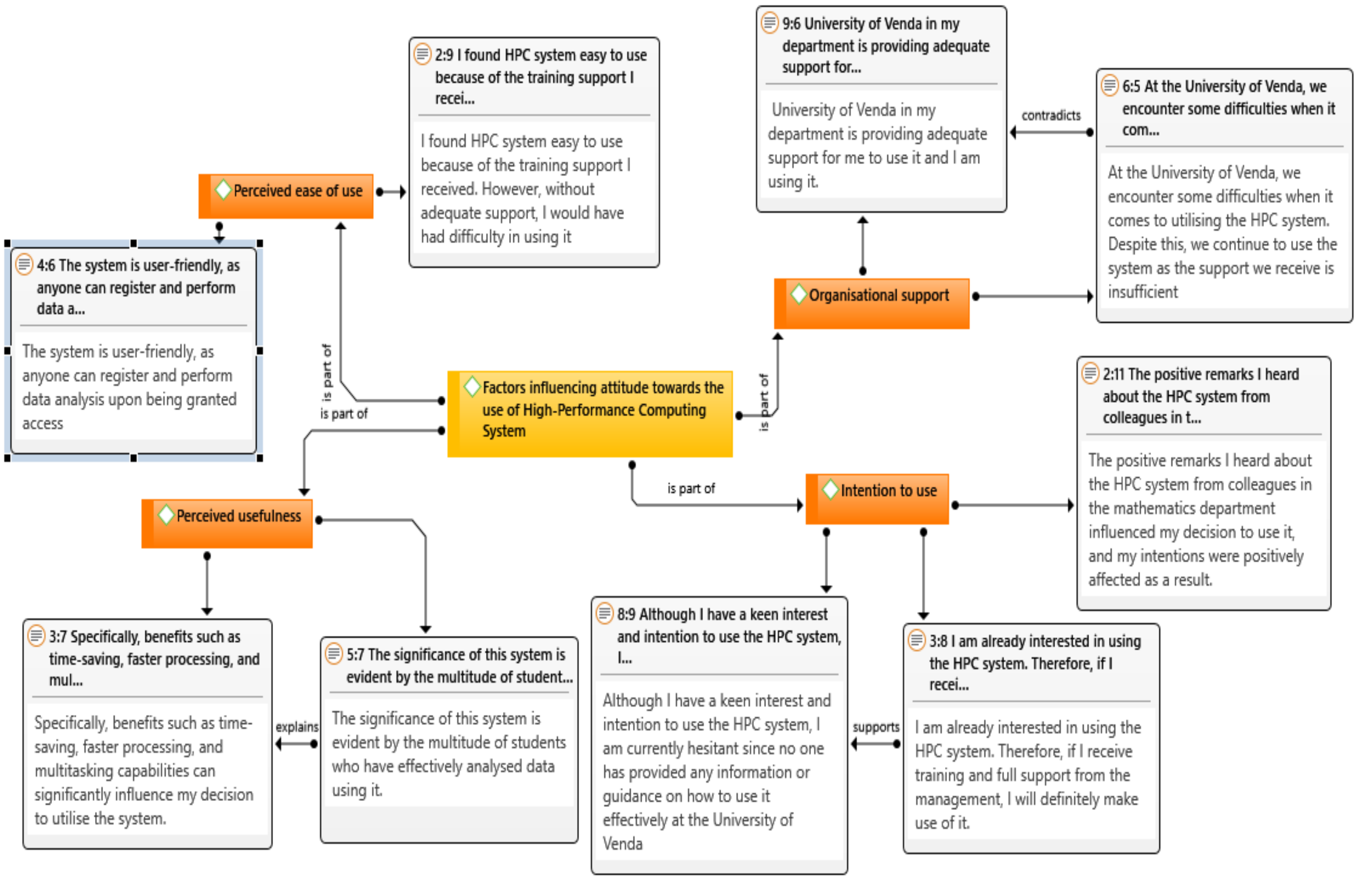

Figure 4.4

Factors influencing attitude towards the use of HPC system

To sum up, the study's findings suggest that participants, comprising academics, masters, and PhD students, view the HPC system at the University of Venda as a sophisticated and powerful computing system. They perceive it as an upgraded version of regular computers, capable of handling intricate calculations, analysing big data, and conducting artificial intelligence computations. While most participants know the HPC system's existence at the university, only a few have used it in their research projects. Nevertheless, there is a positive inclination towards utilising the HPC system, particularly in departments where there is a need for processing multi-dimensional and large data sets. The participants recognised the system's convenience and utility, including its ability to facilitate simulations and complex system modelling.

However, some participants expressed concerns about the limited accessibility of the system across the university. The participants' attitude towards using the HPC system is influenced by organisational support, perceived ease of use and perceived usefulness. While opinions varied regarding organizational support, all participants agreed that the system is user-friendly and easy to operate. The perceived usefulness of the system and the participants' awareness of its benefits motivated them to incorporate it into their projects. These findings underscore the significance of providing additional education and training on the capabilities and potential applications of HPC systems. Based on these results, a framework can be developed to address knowledge gaps, promote the utilisation of HPC systems, and overcome accessibility challenges.

4.3 QUANTITATIVE RESULTS

In this section, several statistical analyses are conducted to examine the relationships among organisational support, perceived ease of use, perceived usefulness and actual use of HPC system at the University of Venda. These analyses include an examination of the demographic properties of the sample, item analysis, exploratory factor analysis, descriptive statistics, Pearson's correlation analysis, and multiple regression analysis.

4.3.1 Demographic properties

The characteristics of the sample population, such as their age, gender, academic class and department affiliation, provide crucial information about the participants involved in the study, including academics, master's and PhD students. The total number of participants was 2018 for this study.

4.3.1.1 Gender

Table 4.1 shows that most respondents were male, comprising 130 participants (59.6%), whereas females accounted for 88 participants (40.4%). The findings suggest that males at the University of Venda showed a higher level of interest in understanding and utilising the HPC system than females. This was unexpected since there is a general assumption that females have been empowered to take the lead in technological advances, as males have traditionally dominated the scientific industry.

Table 4.1

Gender

Category	Frequency	Percentage (%)
Male	130	59.6%
Female	88	40.4%
Total	**218**	**100.0%**

4.3.1.2 Age group

Table 4.2 reveals that the largest group of participants (52.8%) in the study belonged to the age range of 20-39 years, while the second largest group (22.9%) was in the 40-49 age range. The age range of 50-59 years had 37 participants (17.0%), while the smallest group was 60 years and above, with only 16 participants (7.3%). The results indicate that individuals aged between 20 and 39, who were academics, masters and PhD students, had a significant impact on the use of HPC systems. This suggests that young people are more likely to adopt and understand technology through HPC systems compared to older individuals.

Table 4.2

Age group

Category	Frequency	Percentage (%)
20-39	115	52,8%
40-49	50	22.9%
50-59	37	17.0%
60 and above	16	7.3%
Total	**218**	**100.0%**

4.3.1.3 Class

The table in section 4.3 displays the number of participants based on their academic classification. As per the table, out of 218 participants, more than half (51.4%) were classified as Masters students, followed by supervisors (30.7%) and PhD students (17.9%). The higher percentage of Masters students might indicate that the study results may reflect the opinions and experiences of this category more than the other academic groups. Therefore, while developing the framework to promote HPC system usage, the researcher must consider the input and insights from all academic categories, ensuring that the framework is inclusive and effective for all groups.

Table 4.3: *Class*

Category	Frequency	Percentage (%)
Masters	112	51.4%
PhD	39	17.9%
Supervisors	67	30.7%
Total	**218**	**100.0%**

4.3.1.4 Department/Faculty

The researcher in Table 4.4 displays the distribution of participants based on the faculties they belong to. The table shows that out of the total 218 participants, 62.8% or 137 individuals, the largest group of participants belonged to the Faculty of Science, Engineering, and Agriculture (FSEA). The second-largest group was the Faculty of Management, Commerce, and Law (FMCL), with 26.1% or 57 participants. The Faculty of Humanities, Social Sciences, and Education (FHSSE) had 7.8% or 17 participants, while the Faculty of Health Sciences (FHS) had the smallest number of participants, with only 3.2% or seven individuals. This indicates that the FSEA has a significantly higher representation in the study, while FHS has the least representation. The over-representation of participants from FSEA may have implications for the generalizability of the findings and recommendations of the study, as the perspectives and experiences of participants from FSEA may be overrepresented.

Table 4.4

Department/Faculty

Category	Frequency	Percentage (%)
FMCL	57	26.1%
FSEA	137	62.8%
FHSSE	17	7.8%
FHS	7	3.2%
Total	**218**	**100.0%**

Key: FMCL = Faculty of Management, Commerce and Law; FSEA = Faculty of Science, Engineering and Agriculture; FHSSE = Faculty of Humanities; Social Sciences and Education; FHS = Faculty of Health Sciences

4.3.2 Item analysis

A reliability test is conducted to determine a measure's consistency and accuracy, which is a procedure for evaluating the goodness of the measure (Ferdus & Kabir, 2018; Shanmugam, Abidin & Tulus, 2018). In this research study, an item analysis was used to identify survey items that may negatively affect the internal consistency of the measured variables (Veloen, 2016). The items that showed negative values were reversed, and those with a score of less than 0.30 were removed to maintain the items' internal consistency, as suggested by Musarurwa (2017) and Pallant (2016). According to Pallant (2016), a Cronbach alpha coefficient above 0.89 represents very good internal consistency, while a score above 0.80 is preferred, and a score above 0.79 is considered acceptable. On the other hand, a Cronbach alpha coefficient below 0.30 indicates low internal consistency, as shown in Table 4.5. These guidelines were used to determine the Cronbach alpha coefficients of organisational support, perceived ease of use, perceived usefulness and actual use the HPC system.

Table 4.5

Rule of thumb for labelling Cronbach Alpha coefficient

The scale of Cronbach's Alpha co-efficient	Internal consistency
Above .89	Very good
Above .80	Preferable
Above.70	Acceptable
Less than .30	Low

Source: Pallant (2016)

4.3.2.1 The items related to the four subscales of HPC system utilisation, which are organisational support, perceived ease of use, perceived usefulness and actual use, were subjected to item analysis.

4.3.2.1.1 Organisational support

Table 4.6 presents the item analysis results for the subscale of organisational support (OS) in the HPC system utilisation study. According to Pallant (2016), the scale mean if an item is deleted represents the average score of the subscale if a particular item is removed from the scale. If an item is deleted, the scale variance represents the degree of variability in the responses after a particular item is removed from the scale (Pallant, 2016). After excluding that item, the corrected item-total correlation represents the correlation between each item and the total score of the subscale (Pallant, 2016). The Cronbach's alpha, if an item is deleted, represents the internal consistency of the subscale after removing a particular item (Pallant, 2016).

The results show that all items have a scale mean, and scale variance close to the overall subscale mean and variance, indicating that no item significantly affects the average score or variability of the subscale. The corrected item-total correlation for all items is above the recommended threshold of 0.3, indicating that all items contribute to the subscale's internal consistency, according to Pallant (2016). The Cronbach's alpha if an item is deleted for all items is also close to the overall subscale Cronbach's alpha, indicating that no item significantly affects the subscale's internal consistency. Therefore, all items in the organisational support subscale are reliable and contribute to the measurement of organisational support in HPC system utilisation.

Table 4.6

Item-total analysis for Organisational support

		Cronbach's Alpha		N of Items
		.846		11
Item	**Scale Mean Item Deleted**	**Scale if Variance Item Deleted**	**Corrected if Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
OS1	31.74	43.245	.377	.845
OS2	31.93	37.475	.627	.825
OS3	31.89	38.012	.562	.830
OS4	31.95	36.523	.667	.821
OS5	31.89	36.987	.585	.828
OS6	32.05	39.044	.462	.838
OS7	31.86	36.639	.652	.822
OS8	31.86	36.041	.484	.836
OS9	32.01	40.221	.369	.846
OS10	31.98	38.253	.4.88	.837
OS11	31.89	38.537	.542	.832

4.3.2.1.2 Perceived ease of use

Looking at Table 4.7, a researcher can see that all items have a corrected item-total correlation above 0.3, indicating a good relationship with the overall scale score, according to Pallant (2016). Additionally, deleting any of the items would decrease Cronbach's alpha, which suggests that all items contribute to the internal consistency of the scale (Pallant, 2016). However, some items have a larger impact on the scale than others. For example, deleting PEU3 would result in the largest decrease in scale mean and Cronbach's alpha, indicating that this item is particularly important for the scale's reliability. Conversely, deleting PEU6 would have the smallest impact on the scale. According to Pallant (2016), item-total statistics can be used to identify problematic items and improve the reliability of a scale.

Table 4.7

Item-total analysis for perceived ease of use

		Cronbach's Alpha		N of Items
		.846		8
Item	Scale Mean Item Deleted	Scale if Variance Item Deleted	Corrected if Item-Total Correlation	Cronbach's Alpha if Item Deleted
PEU1	22.81	24.347	.517	.835
PEU2	22.87	23.163	.587	.827
PEU3	22.76	22.182	.695	.813
PEU4	22.71	22.577	.650	.819
PEU5	22.71	22.999	.644	.820
PEU6	22.77	24.171	.485	.840
PEU7	22.72	23.578	.583	.828
PEU8	22.82	23.468	.501	.839

4.3.2.1.3 Perceived usefulness

Table 4.8 shows the scale mean and variance if each item is deleted, as well as the corrected item-total correlation and Cronbach's alpha if the item is deleted. Looking at Table 4.8 for the perceived usefulness (PU) scale, a researcher can see that all items have a corrected item-total correlation above 0.3, indicating a moderate to strong relationship between each item and the overall perceived usefulness construct, according to Pallant (2016). Removing any of the items would slightly increase the scale mean and variance, and decrease Cronbach's alpha, indicating that each item contributes positively to the scale's internal consistency (Pallant, 2016). Overall, Pallant indicated that the item-total statistics suggest that the PU scale is a reliable measure of the construct of perceived usefulness.

Table 4.8

Item-total analysis for perceived usefulness

	Cronbach's Alpha			N of Items
	.792			9
Item	**Scale Mean Item Deleted**	**Scale if Variance Item Deleted**	**Corrected if Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
PU1	25.62	26.228	.499	.770
PU2	25.65	25.465	.530	.765
PU3	25.66	25.534	.493	.770
PU4	25.73	24.897	.574	.759
PU5	25.61	26.083	.499	.769
PU6	25.70	26.525	.430	.778
PU7	25.75	25.738	.424	.780
PU8	25.71	25.102	.478	.772
PU9	25.78	26.083	.407	.782

4.3.2.1.4 Actual use

All items in Table 4.9 have a corrected item-total correlation above 0.45, indicating a good correlation with the overall scale score, according to Pallant (2016). However, deleting any item from the Actual Use (AU) scale would decrease Cronbach's alpha, with the largest decrease seen for AU4 and AU5. This suggests that all AU scale items contribute to the scale's internal consistency (Pallant, 2016).

Table 4.9

Item-total analysis for actual use

	Cronbach's Alpha			N of Items
	.809			7
Item	**Scale Mean Item Deleted**	**Scale if Variance Item Deleted**	**Corrected if Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
AU1	18.05	26.398	.452	.799
AU2	18.06	26.287	.472	.796
AU3	18.04	24.925	.589	.776
AU4	18.17	24.071	.606	.773
AU5	18.22	23.995	.600	.773
AU6	18.19	24.107	.596	.774
AU7	18.10	25.553	.491	.793

4.3.3 Reliability testing summary

Table 4.10 summarises Cronbach's Alpha coefficient for four dimensions of a High-Performance Computing (HPC) system. According to Pallant (2016), Cronbach's Alpha measures the internal consistency of a scale or questionnaire. It indicates how closely related a set of items in a scale are as measures of a single construct (Pallant, 2016). Generally, a Cronbach's Alpha of 0.7 or higher is considered acceptable for research purposes, while a value of 0.8 or higher is preferable (Pallant, 2016). The table shows that Cronbach's Alpha coefficient for the dimensions of Organisational Support and Perceived Ease of Use are both 0.846, which is preferable. This indicates that the items in these dimensions are highly related and consistently measure the same construct. Therefore, these dimensions are reliable and can be used to make valid conclusions.

The Cronbach's Alpha coefficient for the dimension of Perceived Usefulness is 0.792, which is acceptable. While it is not as high as the other two dimensions, it is still within an acceptable range. It suggests that the items in this dimension are somewhat related and are measuring the same construct, although there may be some room for improvement in the reliability of this dimension. Finally, Cronbach's Alpha coefficient for the dimension of Actual Use is 0.809, which is also preferable. This suggests that the items in this dimension are highly related and consistently measure the same construct. This dimension is also reliable and can be used to make valid conclusions.

Table 4.10

Summary of the Cronbach's Alpha coefficient of four HPC system dimensions

Instrument	Dimensions	Cronbach's Alpha (r)	Items	Interpretation
High-Performance Computing system	Organisational Support	.846	11	Preferable
	Perceived ease of use	.846	8	Preferable
	Perceived usefulness	.792	9	Acceptable
	Actual use	.809	7	Preferable

4.3.4 Exploratory factor analysis

According to Johnson and Wichern (2007), exploratory factor analysis is a statistical method employed to determine the underlying dimensions or factors that elucidate the connections among a group of observed variables. In this research study, exploratory factor analysis was utilised to recognise the fundamental factors that impact the utilisation of the HPC system.

4.3.4.1 Factor analysis of the organisational support

In the principal component analysis, the component matrix presents the relationship between the observed variables (OS1-OS11) and the extracted component. Except for OS1 and OS9, all observed variables have loadings above 0.5 on the extracted component, implying a strong association with the component. This finding indicates that the observed variables are appropriate indicators of the underlying construct measured by the component. The variables with the highest loading values are OS4 (0.770), followed by OS2 (0.742) and OS7 (0.736), indicating that these variables are highly associated with the extracted component. In contrast, OS6 (0.563) and OS10 (0.564) have the lowest loading values but still surpass the suggested threshold of 0.5, as presented in Table 4.11.

Moreover, the finding states that factor analysis was performed on two datasets for the organizational support subscale. The Kaiser-Meyer-Olkin (KMO) measures for both datasets were 0.855 and 0.844, respectively. These KMO measures indicate the suitability of the datasets for factor analysis. Typically, KMO values above 0.7 are considered good, suggesting that the variables in the datasets are suitable for factor analysis.

Furthermore, the finding mentions that Bartlett's test of sphericity was significant for both datasets. This significance indicates that the correlations between variables within each dataset were appropriate for factor analysis. Bartlett's test of sphericity assesses whether the correlation matrix is significantly different from an identity matrix, which is a prerequisite for conducting factor analysis. A significant result suggests intercorrelations among the variables, supporting factor analysis.

The factor matrix of the organisational support subscale for the first dataset is displayed in Table 4.11a in Chapter Four. This matrix provides information about the factor loadings, representing the relationships between each variable and the underlying factors identified through factor analysis. By examining the factor matrix, researchers can understand how the variables load onto the factors and interpret the factor structure of the organizational support subscale.

In summary, the findings indicate that both datasets used for factor analysis of the organizational support subscale have suitable KMO measures, suggesting their appropriateness for factor analysis. Additionally, Bartlett's test of sphericity was significant for both datasets, supporting the presence of intercorrelations among variables and justifying the use of factor analysis. The factor matrix in Table 4.11a provides further insights into the factor structure of the organizational support subscale in the first dataset.

Table 4.11

Factor matrix of the organisational subscale

	Factor
OS2	.742
OS3	.686
OS4	.770
OS5	.698
OS6	.563
OS7	.736
OS8	.574
OS10	.564
OS11	.619

4.3.4.2 Factor analysis of the perceived ease of use sub-scale

The component matrix, table 4.12, displays the relationship of the eight observed variables to the extracted component. All variables had loadings above 0.5, suggesting they are highly associated with the extracted component (Noorbakhsh & Asadollahi, 2020).

Table 4.12

Factor matrix of the perceived ease of use

	Factor
PEU1	.635
PEU2	.707
PEU3	.794
PEU4	.757
PEU5	.753
PEU6	.597
PEU7	.695
PEU8	.614

4.3.4.3 Factor analysis of the perceived usefulness sub-scale

The component matrix in a principal component analysis shows (table 4.13) the link between the observed variables (PU1-PU9) and the extracted component. According to the table, all observed variables have loadings on the extracted component greater than 0.5, showing a close relationship with the component. This implies that the observed variables are accurate predictors of the fundamental construct that the component is measuring. The factors with the strongest correlation to the extracted component are PU4 (0.719), PU2 (0.674), and PU3 (0.648), according to the highest loading values. The PU9 loading number is the lowest (0.514), although it is still more than the suggested level of 0.5. These findings imply that the observed variables are suitable measures for the construct the component is evaluating.

Table 4.13

Factor matrix of the perceived usefulness subscale

	Factor
PU1	.629
PU2	.674
PU3	.648
PU4	.719
PU5	.647
PU6	.572
PU7	.542
PU8	.580
PU9	.514

4.3.4.4 Factor analysis of the actual use

In a principal component analysis, the component matrix shows how the extracted component and the observed variables (AU1–AU7) are related. All observed variables had loadings over 0.5 on the extracted. component, showing a strong connection with the component and pointing to the possibility that the observed variables are accurate predictors of the underlying construct the extracted component is measuring. The variables with the strongest associations with the extracted component have the highest loading values for AU4 (0.743), followed by AU5 (0.739) and AU6 (0.730). AU1 has the lowest loading value, although its loading value of 0.587 is still more than the suggested level of 0.5. These findings show that, overall, the observed variables are suitable indicators of the construct that the component is measuring. One component alone was retrieved from this analysis.

Table 4.14

Factor matrix of the actual use sub-scale

	Factor
AU1	.587
AU2	.611
AU3	.725
AU4	.743
AU5	.739
AU6	.730
AU7	.633

4.3.5 Pearson correlation: Relationship between variables

Kerlinger and Lee (2000) defined Pearson correlation as a statistical method that measures the degree of linear correlation between two continuous variables, with the correlation coefficient ranging from -1 to 1. They explained that the purpose of conducting Pearson correlation is to determine whether a significant relationship exists between actual use and perceived usefulness, actual use and perceived ease, and actual use and organisational support. This technique is widely used in various fields, including psychology, education, and social sciences, to examine the relationship between variables.

4.3.5.1 The rule of thumb correlation values

Table 4.15 shows the Pearson-product correlation used to assess the association among organisational support, perceived ease of use, perceived usefulness and intention to use. The table includes a reference guide that can be used to interpret the strength of the correlation coefficients. Correlation coefficients that are 0.7 or higher suggest a very strong relationship, while coefficients that range from 0.5 to 0.69 indicate a strong relationship. Coefficients in the range of 0.3 to 0.49 suggest a moderate relationship, while those in the range of 0.1 to 0.29 indicate a low relationship. Correlation coefficients below 0.1 indicate a very weak relationship.

Table 4.15

The rule of thumb of correlation values

R-value	Interpretation
0.7 and above	Very strong relationship
0.5 to 0.69	Strong relationship
0.3 to 0.49	Moderate relationship
0.1 to 0.29	Very low relationship

Source: Ferdas and Kabir (2018)

4.3.5.2 Relationship among organisational support, perceived ease of use, perceived usefulness and intention to use

In this section, a researcher presents the study results that showed significant positive correlations among all the variables analysed. Specifically, the findings suggested that organizational support had a moderate and positive correlation with perceived ease of use (.001, r = .578) and perceived usefulness (.488, r = .488), but a weaker correlation with actual use (.001, r = .355). The findings suggest that organisational support is positively associated with the users' perception of the system's ease of use and usefulness. However, the correlation between organisational support and actual use is relatively weaker. This implies that while organisational support may influence users' perceived ease of use and usefulness, it may not substantially impact their actual use of the system.

The correlation analysis revealed that perceived ease of use had moderate and positive correlations with both perceived usefulness (.001, r = .680) and actual use (.001, r = .409). This suggests that users who perceive the system as easy to use are more likely to consider it useful and intend to use it. The correlation between perceived usefulness and actual use was moderate and positive (.001, r = .591), indicating that users who consider the system useful are more likely to have the actual use of the system. These findings imply that organisational support and perceived ease of use are significant factors that can impact how users perceive the system's usefulness and the actual use of it.

Hypothesis one: Organisational support has positively influenced the actual use of the High-Performance Computing system at the University of Venda. Table 4.16 of correlations reveals that there is a significant and positive correlation between actual use (AU) and organisational support (OS) ($r = 0.355$, $p < 0.001$). This suggests that there is a relationship between the two variables, and academics, masters, and PhD students who perceive a higher level of support from the organisation for using the HPC system are more likely to use it. This finding provides evidence for hypothesis one.

Hypothesis two: Perceived ease of use has positively influenced the actual use of the High-Performance Computing system at the University of Venda. Based on the results, it is evident that there exists a statistically significant positive correlation between Perceived Ease of Use (PEU) and Actual Use (AU) ($r = 0.591$, $p < 0.001$). This suggests that there is a direct relationship between these two variables, indicating that academics, masters, and PhD students who perceive the HPC system as easy to use are more likely to use it. This result supports hypothesis two.

Hypothesis three: Perceived usefulness has positively influenced the actual use of the High-Performance Computing system at the University of Venda. A significant positive correlation was found between Perceived Usefulness (PU) and the Actual Use (AU) of the HPC system ($r = 0.591$, $p < 0.001$). This means that the two variables are related, and academics, masters, and PhD students who perceive the HPC system as useful are more likely to use it. This supports hypothesis three.

Hypothesis four: The actual use of the High-Performance Computing System has influenced its actual use at the University of Venda. The results indicate that there is a significant positive correlation between the actual use (AU) and actual use (AU) of the HPC system ($r = 0.305$, $p < 0.001$). This implies that there is a connection between these two variables, and researchers who have a favourable actual use of the system are more likely to use it. This result confirms the validity of hypothesis four.

Overall, the results show that correlation coefficients and their significances suggest that perceived ease of use (PEU), perceived usefulness (PU), and organisational support (OS) have significant positive effects on the actual use (AU) of the High-Performance Computing System (HPC) at the University of Venda. However, the correlation coefficient shows that perceived ease of use (PEU) has the strongest impact on AU, with a coefficient of 0.591, followed by perceived usefulness (PU), with a coefficient of 0.488. The correlation coefficient for organisational support (OS) and AU is 0.355. Therefore, all three hypotheses are supported, but perceived ease of use is the strongest predictor of the actual use of the HPC system.

Table 4.16

Relationship among organisational support, perceived ease of use, perceived usefulness and actual use

		OS	PEU	PU	AU
OS	Pearson Correlation	1			
	Sig. (2-tailed)				
PEU	Pearson Correlation	.578**	1		
	Sig. (2-tailed)	.001			
PU	Pearson Correlation	.488**	.680**	1	
	Sig. (2-tailed)	.001	.001		
AU	Pearson Correlation	.355**	.409**	.591**	1
	Sig. (2-tailed)	.001	.001	.001	

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

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

Key: OS = Organisational Support; PEU = Perceived Ease of Use; PU = Perceived Usefulness; AU = Actual Use

4.4 CHAPTER SUMMARY

This chapter presented both qualitative and quantitative analyses. The qualitative themes focused on participants' understanding, awareness, perceptions, and factors that affect the utilisation of the HPC system. On the other hand, the quantitative analysis involved descriptive statistics of biographical information obtained, exploration of factor subscales, item analysis, and reliability testing. The chapter also presented the results of the relationships among organisational support, perceived ease of use, perceived usefulness and actual use.

CHAPTER FIVE: DISCUSSION, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

The preceding chapter focused on data analysis and presentation of both qualitative and quantitative results. In this chapter, a researcher discusses the results in relation to literature about the factors that influence the utilisation of High-Performance Computing (HPC) system at the University of Venda. Both qualitative and quantitative results set for discussion in line with objectives of the research study. The study sought to achieve the following objectives:

- To investigate factors that influences the utilisation of High-Performance Computing System at the University of Venda.
- To develop a framework that promotes the utilisation of High-Performance Computing System utilisation at the University of Venda.

Therefore, this chapter is divided into two (2) independent subsections, with reference to literature, namely qualitative and quantitative discussion.

5.2 DISCUSSION OF THE RESULTS

5.2.1 Discussion of qualitative results

Discussion of qualitative results will include comparisons with the literature on factors that influence the utilisation of the HPC system at the University of Venda. In line with this literature, four (4) sub-sections are outlined below to ground the qualitative results discussion. The sub-sections are as follows:

5.2.1.1 Perceived understanding of HPC system

The findings on the perceived understanding of the HPC system suggest that academics, masters, and PhD students at the University of Venda perceive the HPC system as a complex and high-performance computing system. This perception aligns with the definition of HPC systems as tools for solving computationally intensive problems that traditional computing systems cannot handle. Participants in the study recognized the HPC system as an upgraded version of normal computers, capable of performing complex calculations, processing large volumes of data quickly, and supporting artificial intelligence computations.

Cao, Song and Jiang (2019) highlight the multifaceted understanding of the HPC system among participants, with some viewing it as a big data analysis system and others considering it as an artificial intelligence computation system. These varying perspectives contribute to an overall understanding that the HPC system is utilized for complex and big data calculations. Fialho, Rodrigues and Fraga (2020) emphasise the significance of better understanding and awareness of the capabilities of HPC systems among academic staff and students. This suggests that promoting education and training on the potential applications and benefits of HPC systems is essential for fostering the adoption and utilization of such systems in academic institutions.

The definition provided by Dongarra and Meuer (2019) further supports the understanding of HPC systems as tools designed to handle computationally intensive tasks requiring large-scale data processing, complex algorithms, and high-speed networking. This aligns with the findings of Kim and Chung (2016), who found that the researchers perceive HPC systems as supercomputing machines with high-speed data processing capabilities.

The study's findings highlight the importance of enhancing understanding and awareness of HPC systems among academic staff and students. By recognising the capabilities of HPC systems and their potential applications in solving complex problems, academic institutions like the University of Venda can promote the adoption and utilization of these systems effectively.

5.2.1.2 Awareness levels regarding HPC system

The research study found that most participants had a high level of awareness about the HPC system, as they knew about the existence of the system at the university and in different departments and were knowledgeable about it through training. However, only a few had experiences using the system for research projects, while some had low awareness due to a lack of exposure, interest, or support from the university or departments. Moreover, the findings regarding awareness levels of the HPC system at the University of Venda suggest that most participants had a high level of awareness about the system, including its existence and availability in different departments. However, only a few participants had experience using the system in their research projects, suggesting there may be a need for greater utilisation and adoption among academic staff and students.

Furthermore, the limited awareness among a few participants may suggest a need for increased exposure, interest, and support from departments and the university. The literature supports the importance of awareness and education about the HPC system. The current study suggests that a lack of understanding and awareness about the HPC system can be a barrier to adoption and utilisation (Apon, Rajachandrasekar & Zheng, 2018; Haleem, - Ahmad, Farooq & Waqas, 2019). Training and education programs have been identified to increase awareness and promote the adoption of the HPC system among academic communities (López-Peréz, Parra-González & Suárez-Figueroa, 2018; Miron, Lintermann & Grigoras, 2019). Additionally, studies have highlighted the importance of collaboration and communication between HPC centres and academic departments to promote awareness and utilisation of HPC systems (Nathan, Stockwell, Hachey, Kistler, 2017; Potluri, Bach, Beckwith, Cope, Gioiosa, Guillen & Zoss, 2019).

5.2.1.3 Perceptions towards the utilisation of the HPC system

This study's findings suggest that most academics, masters and PhD students were interested in using the HPC system due to their prior knowledge and referrals from colleagues and fellow students. The system was perceived as convenient, useful in analysing complex data, and desirable for complex systems simulations and modelling. However, a few participants expressed concerns about the limited accessibility of the system across the university (Mashwama, Rikhotso & Malekian, 2021).

The literature highlights the benefits and potential of HPC systems in advancing research and solving complex problems that traditional computing systems cannot handle. HPC system is used for a wide range of applications, including weather forecasting, drug discovery, and aerospace engineering (Dongarra & Meuer, 2019). In academic settings, the HPC system can facilitate research in physics, chemistry and biology by enabling simulations and data analysis that were impossible before (Alam, Pramanik, Alam & Jahan, 2020). However, the adoption and utilization of the HPC system in academic institutions can be hindered by factors such as limited resources, lack of expertise, and inadequate training (Aguilar, Batista-Navarro & Rosales-Mendoza, 2020).

Moreover, the research study conducted by Mashwama et al. (2021) highlights the perceptions of academics, master's, and PhD students towards the utilisation of the HPC system. Most of the participants had a positive attitude towards the utilisation of the HPC system. They perceived the system as convenient and useful in departments such as mathematics, engineering, chemistry, and physics, where researchers deal with multi-dimensional and large data sets. Participants also believed that the system has transformed research as it allows for simulations and modelling of complex systems such as weather patterns and protein folding.

These findings are consistent with previous studies on the utilisation of HPC systems. For example, Mashwama et al. (2021) reported that the HPC system is essential in scientific research and has significantly improved research outcomes by providing faster processing speeds, more efficient data analysis, and simulation of complex systems. Similarly, Alam et al. (2020) found that the HPC system is useful in bioinformatics, where large data sets are analysed to understand complex biological systems.

Moreover, the HPC system has been used in various research fields, such as climate modelling, financial analysis, and drug discovery (Aguilar et al., 2020). These studies indicate that the HPC system is a powerful tool for scientific research that allows for the analysis of complex data sets and the simulation of complex systems.

5.2.1.4 Factors that influence the utilisation of the HPC system

The utilisation of HPC systems is becoming increasingly important in scientific research, engineering, and many other fields that require processing large amounts of data. This subsection discusses the factors that influence attitudes towards the use of HPC systems. The current research study found that four factors are particularly important: organisational support, perceived ease of use, intention to use, and perceived usefulness (Liu, Huang & Yang, 2018).

Organisational support was found to be a divisive issue among participants, with some believing that there was adequate support across the university and others feeling that there was inadequate support provided to departments in terms of training and accessibility of the system. This indicates that providing adequate support and resources is crucial for the successful adoption of the HPC system (Liu et al., 2018).

Regarding perceived ease of use, all participants believed that the HPC system was user-friendly and easy to operate, which motivated them to use it. This finding highlights the importance of designing an intuitive and easy-to-use HPC system for non-expert users (Molina, Lonsdale, Tsai, Anderson, Feng, Leidelmeijer & Walsh, 2020).

All participants confirmed that the usefulness of the HPC system influenced them to use it in their projects. This suggests that the perceived benefits of using HPC systems are an important factor in motivating users to adopt them. Lastly, most participants intended to use the system in their projects because they were aware of its usefulness and convenience. This highlights the importance of promoting the benefits of HPC systems to potential users (Raza, Alshahrani & Alomari, 2018).

5.2.2 Discussion of quantitative results

The following section discusses the quantitative results of the study.

5.2.2.1 Demographic profile results

The demographic properties of participants in a research study provide essential information about the sample population. In this study, the sample population consisted of 218 participants, including academics, master's, and PhD students. This section presents the results of the demographic properties of the participants, including gender, age group, class, and department/faculty affiliation.

The gender distribution of participants in the study was predominantly male, accounting for 59.6% of the sample population, while females accounted for 40.4%. These findings are consistent with previous studies that have reported a male-biased gender distribution in higher education institutions (Korabik, Lero & Carr, 2017; Prabhakar, 2019). However, it is essential to note that the gender distribution of participants in a study should reflect the actual distribution in the target population.

Age group distribution of participants in this study showed that the majority fell in the age bracket of 20-39 years old, comprising 52.8% of the sample population. This finding is unsurprising since this age group typically represents most of the student population in higher education institutions (National Centre for Education Statistics, 2019). The second-highest age group was 40-49, comprising 22.9% of the sample population. These findings suggest that the study had a relatively diverse age distribution among the participants.

Class distribution of participants in this study showed that more than half of the sample population were Masters students (51.4%), followed by supervisors (30.7%), while PhD students were the least represented (17.9%). These findings suggest that Masters students are more likely to participate in research studies than PhD students, which is consistent with previous studies that have reported a lower participation rate among PhD students in research (Kumar & Manrai, 2018; Mohajan, 2017).

Department/Faculty distribution of participants in this study showed that the Faculty of Science, Engineering, and Agriculture (FSEA) had the highest number of participants (62.8%), followed by the Faculty of Management, Commerce, and Law (FMCL) with 26.1% of the sample population. The Faculty of Humanities, Social Sciences, and Education (FHSSE) had 7.8% of the participants, while the Faculty of Health Sciences (FHS) had the least representation (3.2%). These findings suggest that the study had a significant representation from the science, engineering, and agriculture faculties, while the health sciences faculty had the least representation. It is important to note that the faculty distribution of participants in a study should reflect the actual distribution in the target population.

In conclusion, the findings suggest that the study had a diverse representation of participants in terms of age, gender, class, and department/faculty affiliation, enhancing the generalisability of the findings.

5.2.2.2 Reliability results

A reliability test was conducted to ensure the internal consistency of the four dimensions used to assess HPC system utilisation. These four dimensions were organisational support, perceived ease of use, perceived usefulness and actual use.

This study conducted an item analysis to identify and address such issues. Items with negative values were reversed, and items with a score of less than 0.30 were removed to maintain internal consistency. This study used the item analysis technique to analyse the results showed that all items in each subscale had corrected item-total correlation above the recommended threshold of 0.3, indicating that all items contribute to the subscale's internal consistency.

a. Organisational Support

The item analysis for the subscale of organisational support (OS) indicates that all items are reliable and contribute to the measurement of organisational support in HPC system utilisation. If items are deleted, the scale means, and variance are close to the overall subscale mean and variance, suggesting that no item significantly affects the average score or variability of the subscale. The corrected item-total correlation for all items is above the recommended threshold of 0.3, indicating that all items contribute to the internal consistency of the subscale. The Cronbach's alpha if items are deleted is also close to the overall subscale Cronbach's alpha, suggesting that no item significantly affects the subscale's internal consistency. Therefore, all items in the organisational support subscale can be considered reliable and valid for measuring organisational support in HPC system utilization.

b. Perceived Ease of Use

For the perceived ease of use (PEU) subscale, the item analysis reveals that all items have a good relationship with the overall scale score, as indicated by the corrected item-total correlation exceeding the threshold of 0.3. Deleting any of the items would decrease Cronbach's alpha, indicating that all items contribute to the internal consistency of the scale. However, some items have a larger impact on the scale than others, with PEU3 being particularly important for the scale's reliability. These findings suggest that the perceived ease of use subscale is reliable and valid for measuring the perceived ease of use of the HPC system.

c. **Perceived Usefulness**

The item analysis for the perceived usefulness (PU) subscale indicates that all items have a moderate to strong relationship with the overall perceived usefulness construct, as indicated by the corrected item-total correlation exceeding 0.3. Removing any of the items would slightly increase the scale mean and variance while decreasing Cronbach's alpha, suggesting that each item contributes positively to the scale's internal consistency. Overall, the item-total statistics suggest that the PU scale is a reliable measure of the perceived usefulness construct in the context of HPC system utilisation.

d. Actual Use

The item analysis for the actual use (AU) subscale reveals that all items correlate well with the overall scale score, with corrected item-total correlations above 0.45. Deleting any item from the AU scale would lead to a decrease in Cronbach's alpha, indicating that all items contribute to the scale's internal consistency. Among the items, AU4 and AU5 have the largest impact on the scale's reliability. These findings suggest that the AU subscale is reliable and valid for measuring the actual use of the HPC system.

Based on the item analysis, all subscales (organisational support, perceived ease of use, perceived usefulness, and actual use) demonstrate good internal consistency and reliability. The items in each subscale contribute meaningfully to their respective constructs and can be considered reliable measures within the context of HPC system utilisation.

5.2.2.3 Exploratory factor analysis results

In this study, a researcher used exploratory factor analysis, a statistical technique that helps identify the underlying factors or dimensions that explain the relationships among observed variables (Johnson & Wichern, 2007). This analysis aimed to identify the key factors that impact the utilisation of the HPC system at the University of Venda.

Factor analysis of the organisational support sub-Scale was performed on two datasets with KMO measures of 0.855 and 0.844, respectively, indicating their suitability for factor analysis. Bartlett's test of sphericity was significant for both datasets, indicating that the correlations between variables were appropriate for factor analysis. Table 4.11a in chapter four displays the factor matrix of the organisational support sub-scale (set one). The results indicated that the sub-scale had a single underlying factor, with all variables having factor loadings greater than 0.5. This finding is consistent with previous research that suggests organisational support is a unidimensional construct, such as the study conducted by Venkatesh et al. (2003).

The component matrix in chapter four, Table 4.12, indicates that all variables in the perceived ease of use sub-scale had a factor loading of more than 0.5, implying a robust connection with the extracted factor. This finding implies that the perceived ease of use sub-scale was unidimensional, which aligns with earlier research, such as Davis (1989).

The suitability of the perceived usefulness sub-scale for factor analysis was confirmed by a KMO measure of 0.792 and a statistically significant Bartlett's test of sphericity ($p < 0.001$), according to chapter four's Table 4.13. The results of the factor analysis indicate that the sub-scale was unidimensional, with all variables having factor loadings greater than 0.5. This finding aligns with earlier research suggesting that perceived usefulness is a unidimensional construct (Venkatesh et al., 2003).

In analysing the actual use sub-scale, the KMO measure was 0.823, and Bartlett's test of sphericity was significant at $p < 0.001$. These results indicate that the sub-scale is suitable for factor analysis. Table 4.14 in Chapter Four presents the results of the analysis, showing that all variables had factor loadings greater than 0.5, indicating that the sub-scale was unidimensional. This is consistent with previous research that has suggested that the actual use is a single construct (Venkatesh et al., 2003).

5.2.2.4 correlation results: Testing of hypothesis

Pearson correlation analysis was conducted to understand the links among organisational support, perceived ease of use, perceived usefulness and actual use of the High-Performance Computing System at the University of Venda. The findings revealed a significant positive association between organisational support, perceived ease of use, perceived usefulness and actual use of the HPC system. These results align with prior research that has reported similar links among these factors concerning technology adoption (Davis, 1989; Venkatesh et al., 2003). The use of the HPC system is supported by perceived usefulness, perceived ease of use and organisational support since these factors have a positive correlation.

According to the study, there was a moderate positive correlation between organisational support and perceived ease of use (r = .578) and perceived usefulness (r = .488) but a weaker correlation with actual use (r = .355). These findings indicate that when users perceive that their organisation supports technology adoption, they are more likely to view the system as easy to use and useful. This result aligns with the Social Cognitive Theory (Bandura, 1986), which asserts that organisational support can influence an individual's beliefs and attitudes towards technology adoption. This theory is associated with TAM only on the factor of organisational support, which was hypothesised together with perceived ease of use, perceived usefulness and actual use of the HPC system.

The study found a moderate positive correlation between perceived ease of use and perceived usefulness (r = .680) and a moderate correlation between perceived ease of use and actual use (r = .409). These results imply that users are more likely to view the HPC system as useful and intend to use it when they perceive it as easy to use. This finding aligns with the Technology Acceptance Model (Davis, 1989), which states that users' attitudes towards technology adoption are influenced by their perceived ease of use.

The study found a moderately positive correlation between perceived usefulness and actual use (r = .591), indicating that users are more likely to use a system when they perceive it as useful. This result is consistent with previous research that identified perceived usefulness as a critical factor in technology adoption. Additionally, there was a significant positive correlation found between actual use and other factors, including organisational support (r = .591), perceived ease of use (r = .680), and perceived usefulness (r = .409). This suggests that users' intention to use a system has a considerable impact on their actual use. This finding aligns with previous studies that have reported a positive relationship between intention to use and actual use of technology.

In conclusion, the study's outcomes indicate that the support provided by an organisation and the users' perception are crucial elements for the successful implementation and use of technological systems. These findings can provide valuable insights for organisations to comprehend the significance of supporting technology adoption and ensuring that users perceive systems as both convenient and beneficial. Additionally, the study results could assist organisations in creating and executing effective plans to stimulate users' intention to use the system, ultimately leading to a rise in its actual use.

5.3 CONCLUSION

The study's quantitative results focused on the participants' demographic profile, reliability of the measurement scales, factor analysis, and correlations between variables. The findings indicated a diverse representation of participants in terms of age, gender, class, and department/faculty affiliation, enhancing the study's generalisability. The reliability analysis showed that all subscales (organisational support, perceived ease of use, perceived usefulness and actual use) demonstrated good internal consistency and reliability. The factor analysis revealed unidimensional constructs for each subscale. The correlation analysis showed significant positive associations among organisational support, perceived ease of use, perceived usefulness and actual use of the HPC system.

The qualitative results discussed the perceived understanding and awareness levels of the HPC system among participants. The findings showed that participants perceived the HPC system as a complex and HPC system, capable of solving computationally intensive problems and supporting artificial intelligence computations. Most participants had a high level of awareness about the HPC system, but only a few had hands-on experience with it.

The quantitative and qualitative discussions support each other by providing complementary insights into the utilisation of the HPC system. The quantitative results provide statistical evidence regarding the demographic profile, reliability of measurement scales, factor analysis, and correlations between variables. On the other hand, the qualitative results offer a deeper understanding of participants' perceptions, awareness levels, and experiences with the HPC system. Together, these findings contribute to a comprehensive understanding of the factors influencing the utilisation of the HPC system at the University of Venda.

5.4 LIMITATIONS OF THE RESEARCH STUDY

A few constraints in this study should be considered for future research. Firstly, the study's scope was confined to academics and postgraduate students, and it may not reflect the views of the entire population of researchers. Secondly, the study did not delve into the technicalities of the HPC system, such as the detailed functioning of its components. Lastly, the study did not examine the influence of cultural and organisational factors on adopting the HPC system.

Therefore, to overcome these limitations, future research should adopt several strategies. Firstly, broadening the participant pool by including researchers from different disciplines, industry professionals, and undergraduate students would provide a more comprehensive understanding of attitudes towards HPC systems. Secondly, conducting in-depth technical analyses to examine the components, architecture, and functioning of HPC systems would enhance researchers' understanding of the technical factors influencing adoption decisions and potential improvements in HPC technology.

Thirdly, investigating the impact of cultural and organizational factors, such as cultural norms, values, and structures, would offer insights into the acceptance and implementation of HPC systems. Finally, utilizing a mixed-methods approach, combining qualitative and quantitative methods through surveys, interviews, and observational studies, would enable a more comprehensive analysis of the adoption of HPC systems. Additionally, conducting longitudinal studies would track the evolution of attitudes and adoption patterns over time, shedding light on the changing perceptions and identifying factors influencing the sustained adoption and use of HPC technology. Implementing these suggestions would improve the validity and applicability of future research, advancing the understanding and adoption of HPC systems.

5.5 RECOMMENDATIONS FOR FUTURE RESEARCH STUDY

Based on the findings, the study recommends that universities and research institutions provide training and awareness programs to enhance researchers' understanding of HPC systems. Additionally, institutions should provide affordable access to HPC systems to increase utilisation, and researchers should collaborate and share HPC systems to mitigate the cost and technical expertise concerns. The researcher suggests that assigning an experienced individual to maintain the HPC system weekly could ensure its daily operation, which may draw the interest and perceptions of all researchers at the University of Venda towards utilising the HPC system. Moreover, development of framework is encouraged as the result of the findings of this study. Lastly, the Department of Higher Education and Training would chip in to help understand HPC through encouraging provisions of lessons on it.

5.6 CHAPTER SUMMARY

The section presented the research findings, categorized into qualitative and quantitative. The qualitative results consisted of participants' awareness, comprehension, perceptions, and factors influencing the utilisation of HPC systems. The quantitative results comprised demographic statistics, reliability analysis, exploratory factor analysis, and the four hypotheses' results achieved through correlation and regression. Furthermore, the chapter concluded by summarising several study findings, providing recommendations and conclusions, and highlighting the study's limitations.

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~~Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425-478.~~

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ANNEXURE A: COVER LETTER

Dear Participant.

My name is Reginald Mulalo Ndwamai, and I am a student at the University of Venda pursuing a master's degree in Human Resource Management (HRM). As part of the requirements for the award of this degree, I am expected to do a research project. The project is titled "Factors that influence the utilisation of High-Performance Computing system at the University of Venda." All information supplied will be kept personal and anonymous and will only be used for the purpose intended. Participation is voluntary and you are free to withdraw from participating at any time.

By answering these questions, you confirm that you have understood the above and consent to participate in this study.

______________________________ 09 February 2022

Researcher's signature Date

ANNEXURE B: INTERVIEW GUIDE AND QUESTIONNAIRE

Section A: Demographic Profile

Please respond to the following questions by marking with an ***X*** *in the appropriate box.*

1. Gender.

Male		Female	

2. What is your age group in years?

20-39 years		40-49 years		50-59 years		60 years and Above	

3. Indicate the class that you belong to.

Master's degree		Doctoral degree		Supervisor	

4. What is your department?

Section B: Perceptions towards the utilisation of High-Performance Computing System

Please answer the following questions.

1. What is your understanding of High-Performance Computing System?
2. What is the level of your awareness about High-Performance Computing System which is at the University of Venda?
3. What are your perceptions toward the utilisation of High-Performance Computing System?
4. Elaborate on how the factors below influence your attitude towards the actual use of High-Performance Computing System:
   i. Organisational support
   ii. Perceived ease of use
   iii. Perceived usefulness
   iv. Actual use.

Section C: Factors toward the utilisation of High-Performance Computing System

Please indicate the extent to which you agree with the following statements where SA= Strongly Agree, A= Agree, N= Neutral, SD= Strongly Disagree, D= Disagree. Kindly place an ***X.***

NO	STATEMENTS	SA	A	N	SD	D
	Organisational support					
1	Training on the utilisation of High-Performance Computing System is provided.					
2	Learning to use High-Performance Computing System is easy for me.					
3	Using High-Performance Computing System saves time.					
4	High-Performance Computing System training increases the performance of the researchers.					
5	I need full support from the management.					
6	As a researcher, I am not struggling with data analysis, while running the software through High-Performance Computing System.					
7	I need more training on how to use High-Performance Computing System.					
8	I feel very confident in using High-Performance Computing System with the support from Information Technology specialists.					
9	Interacting with High-Performance Computing System does not require a lot of mental effort.					
10	Using High-Performance Computing System requires much of creativity.					
11	It would be easy to become more skillful at using High-Performance Computing System if the organisation assigns someone to provide lessons about using the machine.					
	Perceived ease of use					
12	Seems simple to process small and big data through High-Performance Computing System.					
13	High-Performance Computing System usage will make me to process data in an effective and efficient way.					
14	It is easy to interact with High-Performance Computing System.					
15	I would love to use High-Performance Computing System always.					
16	I think using High-Performance Computing System every week can be a good thing.					

17	I am comfortable with research data being stored on the High-Performance Computing System.						
18	I have knowledge necessary to use for High-Performance Computing System.						
19	I find it simple to get computers to do what I want to do.						
	Perceived usefulness						
20	Using High-Performance Computing System adds value in my research work.						
21	Using High-Performance Computing System enhances my effectiveness.						
22	Using High-Performance Computing System increases level of my productivity in research.						
23	High-Performance Computing System is useful on the retrieval of data.						
24	Using High-Performance Computing System increases quality of my work and results.						
25	It is simple to use High-Performance Computing System.						
26	Computers make work more interesting.						
27	It is fine and interesting to work remotely.						
28	It is more effective and efficiently to use High-Performance Computing System.						
	Actual use						
29	My interaction with other general computers is clear and understandable.						
30	I will use High-Performance Computing System in future if given opportunity to use it.						
31	I am planning to use High-Performance Computing System often.						
32	I will use technology on a regular basis in future.						
33	I like to use fastest computers in running the programs that analyse data.						
34	I like and embrace new technologies.						
35	I am ready to use High-Performance Computing System in my research.						

Thank you for participation.

ANNEXURE C: ETHICAL CLEARANCE CERTIFICATE

ETHICS APPROVAL CERTIFICATE

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Mr RM Ndwamai

STUDENT NO:
15006092

PROJECT TITLE: **Factors that influence the utilisation of High Processing Big Data Computers in higher education.**

ETHICAL CLEARENCE NO: FMCL/22/HRM/13/1003

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Prof H Ngirande	UNIVEN, Human Resource Management and Labour Relations	Supervisor
Prof R Shambare	University of Western Cape, Human Resource Management and Labour Relations	Co - Supervisor
Mr RM Ndwamai	UNIVEN, Human Resource Management and Labour Relations	Investigator – Student

Type: **Masters Research**
Risk: **Minimal risk to humans, animals, or environment (Category 2)**
Approval Period: **March 2023 – March 2025**

The Research Ethics Social Sciences Committee (RESSC) hereby approves your project as indicated above.

General Conditions
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following.

- The project leader (principal investigator) must report in the prescribed format to the REC:
  - Annually (or as otherwise requested) on the progress of the project, and upon completion of the project.
  - Within 48hrs in case of any adverse event (or any matter that interrupts sound ethical principles) during the course of the project.
  - Annually a number of projects may be randomly selected for an external audit.
- The approval applies strictly to the protocol as stipulated in the application form. Would any changes to the protocol be deemed necessary during the course of the project, the project leader must apply for approval of these changes at the REC. Would there be deviated from the project protocol without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.
- The date of approval indicates the first date that the project may be started. Would the project have to continue after the expiry date; a new application must be made to the REC and new approval received before or on the expiry date.
- In the interest of ethical responsibility, the REC retains the right to:
  - Request access to any information or data at any time during the course or after completion of the project,
  - To ask further questions; Seek additional information; Require further modification or monitor the conduct of your research or the informed consent process.
  - withdraw or postpone approval if:
  - Any unethical principles or practices of the project are revealed or suspected.
  - It becomes apparent that any relevant information was withheld from the REC or that information has been false or misrepresented.
  - The required annual report and reporting of adverse events was not done timely and accurately,
  - New institutional rules, national legislation or international conventions A it necessary

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE
Date Considered: February 2023

Name of the RESSC Chairperson of the Committee: Prof TS Mashau

Signature

UNIVERSITY OF VENDA
OFFICE OF THE DIRECTOR
RESEARCH AND INNOVATION
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ANNEXURE D: EDITORIAL LETTER

**ENVIROSTAT CONSULTING
(PTY) LTD**

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envirostatconsulting@gmail.com | +27746865819 | +27662995195

6 July 2023

TO WHOM IT MAY CONCERN

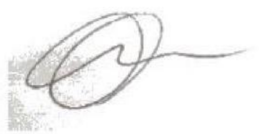
This is to certify that I have edited the Dissertation by Reginald M Ndwamai titled,

"FACTORS THAT INFLUENCE THE UTILISATION OF HIGH-PERFORMANCE COMPUTING SYSTEMSYSTEMS AT A SELECTED HIGHER EDUCATION INSTITUTION"

Submitted for the Masters of Commerce Degree in Human Resource Management and Labour Relations at the University of Venda.

Kindly contact me should you have any queries.

Yours sincerely



James Chapangara Mugabe

Editor

ANNEXURE E: PLAGIARISM REPORT

FACTORS THAT INFLUENCE THE UTILISATION OF HIGH-PERFORMANCE COMPUTING SYSTEMS AT A SELECTED HIGHER EDUCATION INSTITUTION

ORIGINALITY REPORT

18%	16%	8%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	hdl.handle.net Internet Source	1%
2	univendspace.univen.ac.za Internet Source	1%
3	researchspace.ukzn.ac.za Internet Source	<1%
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