Cape Peninsula University of Technology

The Design of a Robotic Process Automation-Based System for the Assessment of Academic Performance in South African Universities

by

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Thesis submitted in fulfilment of the requirements for the degree

Doctor of Philosophy: Informatics

in the Faculty of Informatics and Design

at the Cape Peninsula University of Technology

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Cape Town

July 2024

DECLARATION

I, Denise Darnell Lakay, declare that the contents of this dissertation represent my own unaided work and that the dissertation has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

Signed **Date:**

17 September 2024

ABSTRACT

Pass rate and throughput remain low in South African universities. Despite efforts by the government and various universities in the country, the problem persists. This study aimed to design a robotic process automation (RPA)-based system that can be used to guide a system to improve students' academic performances. Based on the aim, the study seeks to understand the factors that influence students' academic performances and examine and understand the systems and approaches currently used to provide support to students in their academic activities.

Qualitative methods involving the case study approach were applied. Two South African universities were selected to participate in the study. Data was collected from the two universities using the semi-structured interview technique. A set of criteria was used to select the participants. There were three categories of participants: academic staff, non-academic staff, and students. The data collection stopped at a point of saturation, which means no new information was forthcoming. The data was analysed using the actor-network theory (ANT) as a lens. From the analysis, mechanisms for measuring, automated Obligatory Passage Point (OPP), systems integration and connectivity, contractualisation, leverage synergy, and operationalisation were found to be the factors that can influence an RPA-based system design.

The factors were divided into technical: mechanisms for measuring, automated OPP, systems integration, and connectivity; and non-technical: contractualisation, leverage synergy, and operationalisation. This helps to gain better insights from two fronts: (1) how the factors can influence an RPA-based system design from various perspectives; and (2) how humans can interact with the factors in assessing students' academic performances using an RPA-based system. Based on the understanding of the purported relationships and interactions between the actors (factors and humans), a framework was developed, as presented and discussed in Chapter 6.

The study contributes methodologically, practically, and theoretically. Methodologically, the study affirms the advances of ANT in information systems research. Also, the use of ANT as a lens to examine the study in which an RPA-based system is proposed adds a fresh dimension to research. Practically, the study proposes a design that can be used to develop an RPA-based system. Also, it highlights influencing factors that can guide IT specialists and management in developing an RPA-based system for

assessing students' academic performances. Theoretically, the study adds to existing literature. Additionally, it highlights the significance of interactions between human and non-human actors in developing and implementing a system that has many stakeholders within institutions of higher learning.

Based on the findings and an RPA-based system design, recommendations were made. The recommendations have implications for the stakeholders. Finally, the study suggests areas for further study.

Keywords: Robotic Process Automation, Actor-network Theory, moments of translation, academic performance, academic institutions.

ACKNOWLEDGEMENTS

I wish to thank:

- First and foremost, God, for giving me the strength and ability to complete this thesis. I am always reminded that I can do all things through Christ who strengthens me.
- My supervisor, Prof Tiko Iyamu, for encouraging and believing in me even when I doubted myself. Prof Iyamu, you have become a teacher, a mentor and a friend. Thank you for availing yourself when I needed to talk. I also want to thank you for having a setting where I could share my experiences with other students in our research group.
- Donovan Martin Jacobs and Ecclesia Kingdon Community for praying with me through the thesis, especially during my most challenging times. A special thank you to Sheldon Nanton and Mandy Moyce.
- Wendy da Silva, who regularly just checked up on me. I am grateful for your interest in me.
- Dr Kabaso and Prof Alexander, who mentored and believed in my abilities. Without you, I would not have attempted and finished this task.
- The institutions that allowed me to do my research there.

To God be the glory for the great things He has done.

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DEDICATION

I embarked on this journey to show my children that they can also achieve great things. That is why I dedicated this thesis to my children, Andrea Mikaela Lakay and Jared Antonio Lakay, the two people who supported me at home. Andrea always made sure supper was ready, and Jared made me tea when I stayed up late. Many people might see these gestures as small, but for me, they meant a lot. May you achieve more than me.

I further dedicate this thesis to:

- My mother, Margaret Jacobs, for always praying for me.
- My sister and brothers, Rochelle Hendricks, Herschel and Abraham Jacobs, and their families. When I called, you all answered, thank you.
- To everyone who believed in me.

You have been there for me and my children. Thank you for your support and love.

PUBLICATIONS

- Lakay, D. & Iyamu, T., 2022. Examining academic performance through ANT towards RPA-based system in South Africa. Education and Information Technologies. 27(7):9437-9454.
- Lakay, D. & Mlambo, N., 2022. November. Activity Theory Analysis of RPA and Workforce in Financial Institutions. In European Conference on the Impact of Artificial Intelligence and Robotics. 4(1):173-180

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CHAPTER 1
INTRODUCTION

1.1. Introduction and Background

1.1.1 Introduction

Performance can simplistically be referred to as a demonstration of skills, ideas, knowledge, and understanding of concepts (Tuckman, 1975). Student success and performance impact funding and employability (Yang & Li, 2020; York, Gibson & Rankin, 2015), and on this basis, it is paramount to manage students' academic performances effectively. Performance can be subjective; hence, institutions of higher learning have required standards and criteria as yardsticks for evaluation. According to the assessment conducted by the Department of Higher Education and Training, academic performances in institutions of higher learning are declining. However, the challenges experienced with academic performance are not only in South Africa (Rodríguez-Hernándeza, Cascallara & Kyndt, 2020; D'Aquila, Wang & Mattia, 2019). Hence, many studies have been conducted in this regard in both developed countries (Abbad, 2021; York, Gibson & Rankin, 2015; Crosnoe, Johnson & Elder, 2004) and developing countries (Qureshi et al., 2023. Mbiti, 2016; Dasuki & Quaye, 2016; Asikhia, 2010).

Also, owing to the vast significance associated with the subject, studies have been conducted from different disciplines and professions, such as sociology (Postiglione et al., 2017), applied sciences (Elhadary et al., 2020; Mehmood & Taswir, 2013), management sciences (Safdar et al., 2020; Mushtaq & Khan, 2012), and psychiatry (Mekonen et al., 2017). The challenge of students' performances has come a long way. According to Mann (1985), the challenges with students' performances continue to persist and are difficult to resolve. This resurfacing difficulty makes it increasingly crucial to find a solution that can help address the problem. Even though students' academic performance remains a top priority for institutions of higher learning, the problem does not seem to be going away. Various studies have employed different variables in attempts to find solutions. Mehmood and Taswir (2013) explored the effect of social networks on students' academic performance. Crosnoe et al. (2004) examined the family factor. Thus, the persistence of the challenge necessitates a fresh and alternative approach, such as a system based on the robotic automation process.

In the context of this study, a system is computer software that can execute processes, including sensing, reasoning, and acting (Hamond, 2015), as components of RPA. Pupkov (2016) explains that an RPA system combines the interaction of humans with processes that work independently. Through these processes, decisions are made based on knowledge and information to produce an objective. An RPA system can interpret data from different sources to achieve specific goals and tasks through flexible adaptation (Haenlein & Kaplan, 2019). In some universities, the systems are integrated with online learning software (Al-Tameemia & Xueb, 2019) but are not linked to the administrative systems that capture students' academic performances.

Currently, most South African universities use the Integrated Tertiary Software (ITS) system (Kiwana, Johansson & Carlsson, 2015). It captures students' demographic data, accommodation, human resources, and financial information or fees (Mashabela & Pillay, 2017). It is not an automated process and does not focus on assessing and managing students' academic performances. According to Chipeperekwa (2017), the ITS system is not an RPA-based system but an enterprise resource planning (ERP) system. The system does not have the capability and automation functionality to produce the overall student performance statistics per qualification (Tshitake, 2016).

Robotic process automation (RPA) is defined by Zhang and Liu (2019) as a software robotic tool that can imitate human actions with computer systems to automate routine or repetitive tasks. Gartner (2019: 1) provides another but similar definition of RPA: "RPA is a productivity tool (sold as licensed software) that allows a user to configure one or more scripts (which some vendors refer to as "bots") to activate specific keystrokes in an automated fashion." The RPA-based systems involve new technologies, including machine language, natural language processing, and the study of self-regulating systems (Kumar & Balaramachandran, 2018). The RPA operations include content migration, which allows organisations to connect legacy systems to produce timely reports (Madakam, Holmukhe & Jaiswa, 2019). With timeous and accurate information, academic departments can produce reports to make decisions regarding academic monitoring, measuring, and managing performances.

1.1.2 Background

The overall academic performance of students in South African universities is steadily falling. In the report compiled by BusinessTech (2019), which used the 2010 cohort of students, the pass rate at South African universities was 22%. These students passed and completed their qualification within the prescribed timeframe of three (3) years. Using the 2010 cohort, as stated in the report, only 39% passed in four (4) years, and

56% passed in years (6) years. This means there was a 44% dropout rate in South African universities. Mutanga (2020) and Abed, Ajoodha, and Jadhav (2020) have indicated that this is still a problem. As a result, management at the institutional level often requires the previous year's statistics from the different academic departments within the first three (3) months of each year. This statistic was to enable remedial action toward improving the academic throughput rate and reducing the dropout rate. This downward situation of academic performance affects the National Development Plan (NDP) vision of 2019, which is to prepare young adults in society with the skills and knowledge to boost the country's economy. Therefore, the NDP plan was to increase the number of graduates from 1 in 17 to 1 in every 6, increasing the pass rate to over 75% by 2030. The increase in graduates means that monitoring and evaluations are essential to reaching this target (CPUT, 2020). This needs the enablement and support of information systems solutions. The solution should be automated to increase the data facilitation, reliability, and accuracy.

1.2. RESEARCH PROBLEM

In 2010, it was found that the pass rate in South African universities was below 50% within the prescribed periods of study. The situation seems to be getting worse ten years later. The increasing poor performance could be attributed to the lack of a system that provides timeous and holistic information about students' academic performances (Tshitake, 2016). The low pass rate negatively impacts the development and growth of the academic system and, ultimately, the country's economy. To this extent, the government has included this academic challenge in its vision and agenda to increase the pass rate in the universities (NDP, 2019). Despite escalating the low pass rate to the national government level, the situation has not changed. Many universities have information systems used for academic processes and activities, yet the problem persists. Thus, some universities are in dire need of different approaches. The RPA can enhance and improve academic performance, but it is not used in South African universities (Job, 2019).

1.2.1. Problem Statement

There is no automated system to monitor and assess student's performance, which has been attributed to poor academic performance in South African universities despite the many support structures provided for the students.

1.3. OBJECTIVES, RESEARCH QUESTIONS

1.3.1. Research Aim

The study aims to design a robotic process automation (RPA) based system for assessing students' academic performance in South African universities.

1.3.2. Research Objectives

Based on the aim, the objectives of the study are as follows:

(i) Understand the factors that influence students' academic performances.
(ii) Examine and understand the systems and approaches currently used to provide support to students in their academic activities.
(iii) Based on the findings from the above objectives, design an RPA-based system that can be used for assessing students' academic performance toward improving throughput in South African universities.

1.3.3. Research Questions

In achieving the objectives of the study as stated above, the following research questions were formulated:

(i) What are the factors that influence students' academic performances?
(i) What are the systems and approaches currently used to provide support to students in their academic activities?
(ii) How can an RPA-based system be designed primarily to improve academic performances and increase the pass rate of students in South African universities?

1.4. LITERATURE REVIEW

The assessment of academic performance is often enabled and supported by IT solutions. Students' performance has been a challenge in South African higher education in general. Institutions have grappled with this for many years but support something they do not understand because it is still a problem. Numerous authors have written about this, ranging from web conferencing-based tutorials (Coetzee et al., 2018), teaching approaches (Erasmus & Fourie, 2018), developing a support framework that reduces attrition (Netandaa et al., 2019) and self-determination (Naude et al. 2016). Many institutions are trying to address this challenge through various means of support, and it does not seem to be getting better, meaning performance and pass rates are not improving.

Different departments within universities organise various types of academic support for students. These activities are funded within and externally, such as government-funded support. In their article, Penn-Edwards and Donnison (2011) look at academia as a place where students get support to reach their full potential; this includes engaging in these academic activities. Student support also includes all the services and support required to develop their academic skill. Numerous authors have written about improving the throughput rate (Mudaly & Mtshali, 2018; Paideya & Bengesai, 2017; Onsongo, 2006). However, it still is a problem; the 2030 National Development Plan's guidelines are to increase participation and graduation rates by combining four-year degree programmes with bridging courses (NDP, 2019).

Factors influencing this support for higher education institutions have numerous challenges. The following factors were mentioned: pass rates, which include poor performance; attendance, profiling of students' background; programme evaluation, which includes dropouts; and students' underestimation of support programmes (Mudaly & Mtshali, 2018; Paideya & Bengesai, 2017; Onsongo, 2006). Mudaly and Mtshali (2018) included personal, financial and social support that institutions should consider. All the institutions provide support, but are they measuring this support to see if it improves performance? Performance is measured by grading knowledge and learning by giving a mark (York, Gibson & Rankin, 2015), but how is support measured?

Monitoring and management are critical in attempts to improve students' academic performance. Roberts et al., 2006 noted that management must have proper management and incentives relating to teaching materials. Management should have tighter processes in place for accepting and reaccepting excluded students to the programmes.

Currently, many South African universities use the following Information Technology (systems) solutions: namely, Tertiary Management Systems (Higher Education Management Information System (HEMIS), Integrated Tertiary Software (ITS), Student Online Service (SOS), Marks Administration System (MAS)), Learner Management System (Blackboard; Moodle, etc), and Academic Management System (HDC Digital System).

Below is a description of some of the systems used at institutions.

(i) The HEMIS system is used at all South African HE institutions to record all the students who pass through the HE system (Cosser, 2018). It uses students' identity numbers to track their historical information.

(ii) ITS contains student data and activity (Scholtz et al., 2018). This system allows the student to register online (Mashabela & Pillay, 2017), see their fees, print class lists, upload assessment marks, and manages the institutions' finances and human resources (Kiwana et al., 2015.)

(iii) The MAS tracks students' marks (Tshitake, 2016).

(iv) Students use the Student Online Service (SOS) system anytime to register, print registration information, change contact information, view their performance after term assessments and check and pay their fees online.

(v) HDC Digital is an administrative system used to monitor the progress of postgraduate students.

The institution has these systems, but monitoring remains a problem; thus, the National Development Plan has included this in its 2030 plan for Higher education. The fourth industrial revolution has changed how business and governmental institutions look at technology and information systems—interconnectivity and how these systems work, including the data they produce. Institutions require software that has RPA capabilities to handle tasks faster and more accurately in calculating and determining performances in accordance with academic programmes and context.

RPA is an example of how technology has advanced. This advancement influences business in the future (Danilova, 2019). Madakam, Holmukhe, and Jaiswa (2019) list the benefits of using RPA: accuracy of operations, compliance, low technical barriers, productivity, reliability, consistency, improved employee morale, and non-invasive technology. According to Yrjänä (2020), the triple-win model is where stakeholders, customers, and employees benefit from the system. In a higher institution context, the stakeholders are the following groups' educational bodies and management, namely, DHET, CHE, and the institution's management, the customers, who are the students and employees, and lecturers and domain leaders. Osman (2019) mentions that RPA interacts with other systems through the front-end. The front-end is the user interface that interacts with the user. Osman (2019) highlights the fact that RPA also aims to improve processes and decision support. Kumar and Balaramachandran (2018) mentioned on numerous occasions that RPA gives a competitive advantage by looking at factors that influence customer experience, data security and privacy, reliability, and usefulness. However, the optimisation of resources and ease of use need to be researched. RPA is part of technology advancement. This digital transformation has

impacted businesses, primarily in how these businesses operate (Danilova, 2019). Osman (2019) states that RPA saves money by reducing workload errors. As a front-end IT solution, this can be used in many industries. Zhang and Lui (2019) mention the following industries that use RPA: financial, telecommunications, banking, and legal; Santos, Pereira, and Vasconcelos (2020) discussed some advantages and benefits of RPA. Firstly, the user does not need programming skills, as the software uses drag-and-drop functions. Secondly, no additional infrastructure is required, as there is a user interface to access the application. Finally, as it reduces repetitive work, the employee can concentrate on other tasks.

1.5. UNDERPINNING THEORY

The sociotechnical theory, actor-network theory (ANT), underpins this study. Sociotechnical theories have increasingly underpinned IS studies in the last three decades (Lei 2016; Müller 2015). According to Sekgweleo, Makovhololo, and Iyamu (2018), the theories are employed to guide data analysis and interpret findings. Sekgweleo et al. (2017) further argue that using theory is a step towards achieving the objectives of the phenomenon studied. The remainder of this section provides an overview of ANT, where the literature is expanded holistically in chapter 2 of the thesis.

Among other sociotechnical theories, such as contingency theory, diffusion of innovation and technology acceptance model, that were explored, ANT was considered most suitable for this study. Also, based on the study's objective, as stated in section 3, the selection was based on the study's objectives and influenced by the theory's focus. The negotiation factor is a vital aspect of this study, as multiple groups of stakeholders are involved. ANT focuses on shifting negotiation, including understanding how networks are formed and stabilised (Callon, 1986; Iyamu, 2018). These focuses are unique to ANT, hence its selection.

1.5.1.Actor-Network Theory

The actor-network theory (ANT) is a sociotechnical theory that focuses on shifting and transforming an entity through negotiation and interpretation (Latour, 1996; Callon, 1986). The theory addresses the elements of science and technology in a social system (Latour, 1987). The central tenets of ANT are actor, network, and translations (Cresswell, Worth & Sheikh, 2010). In ANT, actors are any entity that can make a difference, both human and non-human (Iyamu, 2018; Callon, 1986). Actor-network consists of actors with allied interests (Modell et al., 2017). Iyamu (2018) explains how translation involves the association of networks and how the actors' interests align with a common objective.

Primarily, ANT is concerned with how networks came into being, the traces of associations, how actors are enrolled, and how stability is achieved (Cresswell et al., 2010). Czarniawska (2014) explains that to understand the phenomena better, the researcher has to shadow and follow the actors. By following the actor, an understanding is gained about their actions and how they translate from one stage to another. As shown in Figure 1.1, translation in ANT consists of four moments: problematisation, interessement, enrollment, and mobilisation (Callon, 1986).

Problematisation is the first moment when a problem is defined by the focal actor (Hossain & Fazio, 2009; McBride, 2003). Iyamu (2018:3) clarifies that "in ANT, a problem is not necessarily something broken or negative, but an innovative improvement of a situation". Heeks & Stanforth, 2015) describe Interessement as a stage of imposition, where the focal actor systematically locks others into a situation of accepting the problematised item. Enrolment is a stage where actors identify with the problematised item and are assigned tasks (Cresswell et al., 2010). When a network becomes stable, actors or actors act as spokespersons, referred to as mobilisation (Callon & Blackwell, 2007).

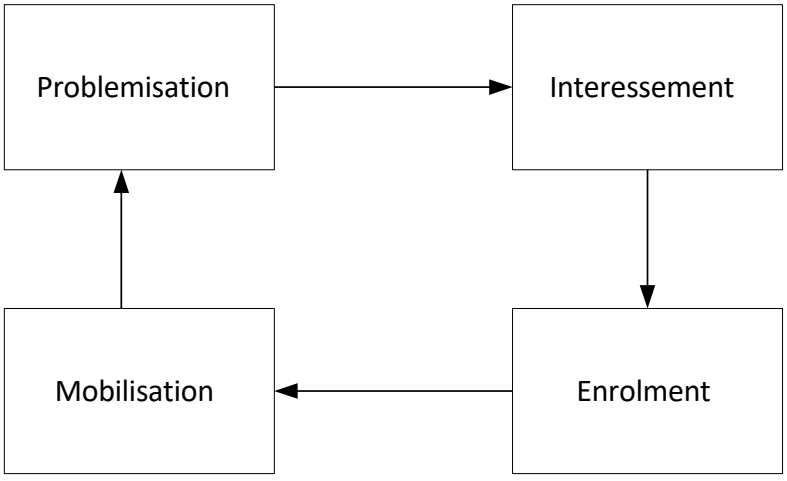

Figure 1.1: Moments of translation (Callon, 1986)

The theory is considered relevant and valuable in analysing technology and development (Heeks & Stanforth, 2015). One of the strengths of ANT is its use "to analyse situations in which it is difficult to separate humans and non-humans, and in which the actors have varying forms and competencies (Callon & Blackwell, 2007: 274).

1.6. DESIGN, METHODOLOGY and ETHICS

The research methodology is based on philosophical assumptions, methods, approaches and techniques.

1.6.1. Philosophical Assumption

The philosophical assumption is essential in information systems (IS) research to avoid misleading outcomes and ensure rigour and insightfulness (Hassan, Mingers and Stahl, 2018). This rigour and insightfulness are attributed to two main things: firstly, it provides a way of thinking (Chiasson, Davidson, & Winter, 2018), and secondly, it helps shape selections of approaches, methods and techniques (Hassan et al., 2018). The two most popular philosophical assumptions in IS research are ontology and epistemology (Hultin, 2019; Silva, 2007).

Ontology relates to the study of being and the nature of being. It means determining "what is" and "how it is" in the world (Becker & Niehaves, 2007). Ontology refers to what exists in a social system and the assumptions about its reality (Hultin, 2019). Philosophy is also concerned with how reality exists, for example, if they are independent of human interpretation.

Epistemology is about the science of knowing and how people react to this knowledge (Becker & Niehaves, 2007). Epistemology happens by constituting knowledge and the processes through which this knowledge is created (Babbie, 2013). Epistemology deals with what the researcher knows and how the researcher knows it, which are the means and conditions for knowledge. The knowledge includes how what exists can be known (Chiasson et al., 2018). Also, epistemology concerns the nature of knowledge and ways of knowing and learning about social reality.

The philosophies are increasingly employed in information systems research mainly because they add rigour to studies (Hassan et al., 2018). Rowe (2018:1) argues that "being critical is good, but better with philosophy". Both ontology and epistemology are philosophies that are intertwined, particularly in interpretive research (Goldkuhl, 2012). This study seeks to first understand the systems and approaches that institutions currently use to monitor and manage students' academic performances. Secondly, to examine how RPA can be used to improve performances and increase the pass rate of students. The philosophies of ontology and epistemology are complementarily employed.

This research paradigm is interpretivism as the investigation into the social world relates to academic monitoring in South African Universities. According to Quinlan (2011), interpretivism assumes that all knowledge can be interpreted depending on the perspective from which the problem is viewed.

1.6.2. Research Approach

There are two main approaches, inductive and deductive, in information systems research. The two approaches combined are referred to as the abductive approach. Even though the three approaches are discussed in this section, only one is followed based on the study's objectives stated in section 3.

The inductive reasoning approach is a logical model in which the general principles developed are from specific observations (Babbie, 2013). Deductive inquiry is when specific expectations of a hypothesis are developed based on general principles. This approach moves from asking the question of why and moves to testing an observation, and the reasoning is whether this occurs (Babbie, 2013). This approach might have a statement that needs to prove that "30 per cent of all registered students pass within three years". Abduction, on the other hand, is a combination of induction and deductive approaches. This form of logical interpretation goes from small observations of an event to a hypothesis (McGregor, 2014).

The inductive approach is used in this research primarily to develop a framework from a theory. The inductive approach aligns well with the interpretivism approach from the ontological and epistemological perspectives.

1.6.3. Research Methods

There are two main types of research methods: qualitative and quantitative. Like the research approach, the two methods can be combined, referred to as the mixed method (Quinlan, 2011). Venkatesh, Brown and Bala (2013) argue that the mixed method focuses on developing rich insights into a phenomenon that cannot be fully understood. Quantitative research usually focuses on gathering numeric data or data in numerical form, i.e. data in numbers. This numerical representation and manipulation of observations describe and explain the phenomena that those observations reflect. Quantitative research is deductive and objective (Quinlan, 2011; Cooper & Schindler, 2014). The quantitative method is not applied since this study does not require numeric data.

This research employs qualitative research primarily because it focuses on words rather than numbers when collecting data. This non-numerical examination, understanding, and interpretation of observations are used to discover underlying meanings and patterns of relationships. Qualitative research uses various techniques to collect data, such as observations, interviews, and documentation (Conboy, Fitzgerald &

Mathiassen, 2012). Qualitative research as a research strategy is inductive and subjective (Cooper & Schindler, 2014; Quinlan, 2011). The methods are increasingly widely used in IS research (Conboy et al., 2012).

1.6.4. Research Design

Common in information systems research are case study methods, experimental methods, and surveys. The decision is to select the case study method based on the objectives of the study. Yin (2009) explains that a case study aims to help answer questions that ask who, how, or why, which this research seeks to achieve. Thus, the case study approach is considered the most appropriate and suitable method for this study.

Two South African universities, a traditional university and a university of technology, were selected and used as cases in the study. The selected traditional university represents other traditional universities, as the academic culture and settings of the universities are the same. Thus, universities were selected based on access and willingness to participate in the study.

1.6.5. Data Collection

Various techniques can be employed in the process of collecting data. Some techniques are observation, survey, interviews, document analysis and questionnaires (Quinlan, 2011). Also, there are different types of interviews, which are structured, semi-structured and unstructured (Cooper & Schindler, 2014). A structured interview is usually open-ended and organised in a specific order; an unstructured interview starts with a participant's narrative. The questions that follow are directed to the participant and have no order. In contrast, the semi-structured interview starts with specific ordered questions, and then the interviewer probes the following questions to clarify the responses (Cooper & Schindler, 2014). The data collection process is guided by two primary factors: (1) the study's objectives and (2) the methods and approaches selected in the study.

The techniques used in this study are structured interviews and document analysis. The two techniques align with the qualitative methods and inductive approach discussed above. The structured interviews are face-to-face interviews to gather critical information by asking the participants questions. The technique was selected because it allows instant probing of participants' responses to much more information (Quinlan, 2011). Specific criteria for selecting the participants are listed below. These criteria are

mainly to ensure that quality data is gathered. Participants selected are from significant student academic performance stakeholders: students, non-academic personnel, and academic staff. The criteria used are as follows:

i. Participants worked in a unit that provided academic support to the students for at least two academic sessions (years).
ii. Students have been studying for more than 24 months and understand the institution's systems and support structures.
iii. Academic staff have taught for more than two years, understanding the systems used and the support structures in the institution.

Two years (or 24 months) is considered long enough for an employee (or academic staff) to gain valuable experience and insight into the environment and the objectives of his/her unit. These criteria aim at increasing the richness of the data.

These criteria are purposely to ensure that the participant understands the higher education system and environment, including the student's needs, and to provide information that can add richness to the sets of data. Data collection stopped after reaching the point of data saturation. According to Alam (2021), data saturation happens when nothing new can be added.

The document analysis technique used to collect data complemented the interview data. The types of documents include (1) documentary evidence, (2) policy documents, (3) financial reports, and (4) strategic documents.

1.6.6. Data Validity and Credibility

Data validity, as described by Babbie (2013), is a measure of accuracy in research. The interviews were recorded with the participants' permission. This process ensures the interview process's credibility, including the criteria met with the participants.

1.6.7. Data Analysis

As defined by Quinlan (2011, 479), data analysis is "the process of exploring and examining data with a view of uncovering meaning". This data was analysed, where the information was summarised, and trends, relationships, and patterns were uncovered. Actor-network theory (ANT) was used as a lens in the analysis, as discussed below.

The actor-network theory was used to examine and understand:

i. How networks are formed
ii. The relationship that exists between the actors (students, academic and non-academic staff) in providing and receiving academic support
iii. The roles of the various actors in the academic activities of the students

These (above) intend to understand the actors' motivations and actions (human and non- human) and how they link by associating heterogeneous networks of similar interests.

1.6.8. Units of Analysis

The analysis was split into units, as shown in Table 1. These units have three main categories: academic staff, non-academic staff, and students. Academic staff provides academic support such as lectures and other learning materials to students through various means.

Table 1.1: Units of analysis

Academic staff	Lecturing and providing learning materials.
Non-academic staff	Provides support such as ICT, Infrastructure, and funding.
Studentship	Accessing learning materials and other supports provided by the university.

The non-academic staff provides different types of support built into the universities' systems operationally and strategically used in an attempt to improve the students' performances. Whereas the students also have their contributions to their academic performances.

1.6.9. Ethical Consideration

Throughout this study, the researcher ensured that all ethical guidelines of the Cape Peninsula University of Technology Research Committee were observed and obeyed to ensure the privacy of participant identities. Privacy ensures the security of the data obtained from the participants. All participants who volunteered had to give consent to contribute to the study. The participant can withdraw in the middle of the interview if they feel uncomfortable being part of the process.

The study is not harmful to any human being, mentally, physically, emotionally or psychologically. When in doubt about any ethical matter during the research process, the researcher sought the constructive advice of either the supervisors or any other person who could append constructive advice.

1.7. DELINEATION

For this study, two South African universities were selected, namely a traditional university and a university of technology, as cases in the study.
All participants have worked or studied at their respective institutions for two years (or 24 months). A deeper understanding is considered an appropriate timeframe for understanding the environment and the objectives of his/her unit.

1.8. CONTRIBUTION and SIGNIFICANCE

1.8.1. Contributions

Based on the aim and objectives stated in section 3, there would be contributions from three angles: theoretical, practical, and methodological.

The main theoretical contribution was using ANT as a lens to guide the data analysis. Using this theory brings a fresh perspective to the study concerning RPA in South Africa's academic institutions. Another theoretical contribution is that publications from this work added to the existing literature in three vital areas: RPA and ANT (information systems research), academic institutions, and developing countries.

The practical contribution comes from the design of an information system. Practically, the design can guide the development of an automated information system (software) that focuses on improving students' academic performance. Also, the designed information system can be used in practice to amend the universities' academic policies and procedures, focusing on supporting students. The amendments are mainly for the policymakers in the universities.

Methodologically, the study's contribution comes from using ANT in an RPA-based study in the context of an academic institution. This RPA-based information system for assessing academic performance at a university would be a new system that would be designed.

1.8.2. Significance of the Study:

The study is significant to three vital primary stakeholders: universities, students, and Higher education.

It is critical for universities to improve their pass rate, as this influences government funding.

i. The students would be pleased to see their academic performance assessed and monitored timeously for improvement purposes.
ii. The National Development Plan has indicated that Higher Education has to improve the pass rate. An increased academic pass rate would be advantageous to the country's economy.

1.9. Summary

In the next chapter, the literature review, a thorough examination of all the research components, is presented in the literature review chapter below. All the key components are discussed comprehensively in Chapter 2.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter is dedicated to the literature review, which explores various academic support systems implemented in universities to improve students' academic performance, robotic process automation, and theories to be employed for the study. The first part covers the academic support systems within universities, understanding student's academic performances, and enabling technology structures. The second part covers robotic process automation, the benefits of RPA, the application of RPA in industries, the challenges of robotic process automation, and information systems. Lastly, the chapter focuses on the underpinning theories, namely activity and actor-network theories.

2.2 Academic Support Systems within Universities

The issue of academic performance has been a long-standing discourse for many institutions of higher learning (Elliott, 2007). However, different institutions have explored the support systems from various angles. These support systems or structures are composed of several decisions and rules (Cabrerizo et al., 2015). They include support for all staff (academic and non-academic) and students to improve academic performances (Zander et al., 2018). Academic support is considered any assistance or interventions provided to enhance students' academic performance, which includes teaching and learning, where the student is assisted in catching up for remedial purposes (Mishra, 2014) or any other service that helps the student academically, financial support (Mudaly & Mtshali, 2018), medical support, and extramural support. Senior students' mentoring and tutoring are also support given to students (Maharaj, Blair & Burns, 2021).

Higher education plays a crucial part in helping students remain in university and graduate by providing a supportive setting to successfully navigate academic challenges (Borrelli et al., 2019). The function of the academic support systems in the university means understanding this environment. The academic environment consists of universities (traditional and universities of technology), faculties, academic departments (assignments, classroom atmosphere including academic support within the departments (Robison, Fawley & Marshall, 2018), services that support the academic students, and extramural activities. This environment also includes academic and non-academic staff who assist students with academic and

administrative issues.

Support systems are intended to provide access to useful information such as personal information, financial aid data, and information that can enable and ease academic activities (Helal et al., 2018). One of the benefits of institutions is that they can provide adequate support structures that notify students of their academic progress or potential risk status (Paideya & Dhunpath, 2018). Students have benefitted from tutoring or peer support, as many students' first language is not English, and these tutors typically explain concepts in their home language (Lavhelani, Ndebele & Ravhuhali, 2020). These support structures are essential to the academic department, increasing pass and graduation rates. The more successful students become, the more funding is issued to the departments and institutions by the government.

Many students in South Africa require financial support to complete their studies. On the other hand, parents take out bank loans, but the majority of students rely on government support. The students apply for the National Student Financial Aid Scheme (NSFAS) funding, but even though they apply, they only get the responses late, which leads to emotional stress (Cosser, 2018). Another factor that impacts student performance is the lecturer's attributes, such as teaching style, lecturer's assessment, and attitude in a classroom. In some cases, there is an absence of skilled or a shortage of experienced lecturers in specialised areas, such as programming (Dasuki & Quaye, 2016).

Students frequently struggle to adjust to university academic expectations (Robison et al., 2018). Many students feel that the environment is competitive, especially where academic results are significant. Also, students feel that this environment is toxic and challenging, even before starting their academic careers (Grace, 2018). Students' lack of comprehension of the academic support system leaves them unable to overcome obstacles because they are left to their own devices to acquaint themselves with and use available resources and support (Borrelli et al., 2019).

2.2.1 Understanding Academic Performances

Results determine student performance (Alaslani & Alandejani, 2020). These results are determined by how well the student does in assessments, tests, as well exams. In higher learning institutions, the expected pass mark is 50% (Egieyeh et al., 2021). The percentage of students who pass out of the total number of students registered determines the pass rate. On the other hand, throughput is the number of students that graduate within the minimum time for the qualification they have registered for (Mbuvha et al., 2021). Despite the many systems and increasing structures to support

and ultimately improve students' academic performances, challenges persist. The challenges are in various forms, categorised into factors such as alignment with institutional goals (Elliott, 2007), limited access to learning material (Cabrerizo et al., 2015), and culture and practices through support networks (Zander et al., 2018). In addition, students and academic staff often disagree on critical success factors relating to their performances (Alhabeeb & Rowley, 2018).

Daily, students face numerous challenges that affect their performance in assessments. Some of the many challenges are finances (Oliveira de Freitas & Melo dos Santos, 2019), time management (Johnson et al., 2020), adjusting to academic life (Lavhelani et al., 2020), medical challenges (Li, Hafeez & Zaheer, 2020), disability adjustment (Shahiri & Husain, 2015), writing skills (Badenhorst et al., 2015) and programming skills (Dasuki & Quaye, 2016). If these challenges are not dealt with, it affects the student's performance, which leads to students dropping out or extending their study period within these institutions.

Many of these challenges exist based on various rationales and factors. Some examples are:

(1) staff have different ideas and perceptions when presenting or facilitating courses (Ankrah, Agbodza & Atuase, 2019). Some of these approaches discourage some students from attending lectures; (2) students' subjective expectations (Alhabeeb & Rowley, 2018). Some students expect academic activities to be flexible to their comfort (Pullan, 2011). When that does not happen, they are reluctant to participate in academic activities, which affects their performances; (3) there is limited access to infrastructure and learning materials in some universities (Vicente, Lucas, & Carlos, 2020; Haddad & Jurich, 2002), and some universities do not understand their students' challenges (Abubakar, Hilman & Kaliappen, 2018; York, Gibson & Rankin, 2015). Importantly, despite support structures, there is no proper monitoring of these programmes (Lavhelani et al., 2020).

2.3 University Support Structures

Institutions like universities, to support students, must have structures to assist these students in their educational journey. These support structures are there to assist students in navigating their studies and other services that contribute to any medical and social assistance (Paideya & Dhunpath, 2018). These structures or processes are divided into computerised and non- computerised support that the department uses to assist the students. At an institutional level, there are systems to capture the students' information from the time they apply until they graduate. As registered students progress

from their first year to their final year, all documentation is recorded in the computer systems. These processes or systems are application, registration, progress, and all the students' marks, irrespective of whether they pass or fail. But are these systems integrated to assist the student? Are these support system structures there to assist them so that they do not struggle (Mashabela & Pillay, 2017)? Collected student information is used for different functions. At the departmental level, this information is used to determine the type of support the student requires, whereas the same information gathered is used for statistical data at the faculty level (Netanda, Mamabolo & Themane, 2019).

2.3.1 Enabling Technology Solutions

The fourth industrial revolution (4IR) has introduced new technologies (Bigliardi, Bottani & Casella, 2020). The introduction of these new technologies into the educational institutions' systems is to enhance support to the students within these organisations. Institutions have Information Communication Technology (ICT) infrastructure that captures and processes student information (Ramjeawon & Rowley, 2020). These technological infrastructures include learning management systems (LMS) and systems that can assist students' experiences at higher learning institutions. However, according to Coccoli et al. (2014), universities have the potential to utilise data analytics to identify deficiencies or issues, ultimately resulting in cost savings that can be redirected towards enhancing teaching and implementing new cloud- based infrastructures. They also propose that through the use of a range of technologies and services accessible via the Internet, universities can provide more innovative and interactive learning environments, thereby fostering the capabilities and mindsets of individuals.

2.4 Robotic Process Automation

With the evolution of ICT over the years, newer advanced technologies have been developed. Robotic process automation (RPA) is one such technology (Madakam, Holmukhe & Jaiswal, 2019). As an emerging technology, this technology has slowly become part of the computer processes being run by organisations. RPA consists of 3 concepts, namely robots, processing and automation. Robots are programmable by a computer and can do a series of actions automatically; processing is where a task moves from start to finish, and automation means that the process is done automatically (Madakam et al., 2019). RPA is a software tool used to automatically run routine, repetitive tasks by mirroring human actions (Vijai, Suriyalakshmi & Elayaraja, 2020).

2.4.1 Benefits of Robotic Process Automation

RPA reinvents every part of the working process to help organisations embrace digital

change and business disruption (Zhang & Liu, 2018). According to Madakam et al. (2019), these benefits include (1) accuracy, (2) productivity, (3) compliance, (4) non-invasive technology, (5) reliability and (6) consistency to enable organisations to embrace this emerging technology. The accuracy within the RPA environment is where the bots would always accurately calculate (Siderska, 2020) compared to the human workforce, where errors can be made. The reduction of repetitive tasks done by the workforce ultimately increases productivity within the organisation and reduces time and costs (Hofmann, Samp & Urbach, 2020).

Therefore, when using the software bot, these bots must comply with the rules and regulations within the organisation and department where that bot is used (Kumar, 2020). RPA is a minimal to non-invasive technology that interacts with the current systems; there are no changes or adaptations to the existing systems within the organisation. This software uses "drag and drop" icons where the code is automatically generated (Money, 2020). The reliability of the programmed software robots means that the dependability comes from their consistent adherence to a prescribed workflow, which improves process consistency and compliance (Siderska, 2020). Therefore, consistency in RPA relates to the accuracy and reliability of the usage of RPA, meaning that the organisation would be at ease knowing that the bot executed would produce the same results every time (Vijai et al., 2020).

Deploying software bots should benefit the business and the information technology functions within that business (Aguirre & Rodriguez, 2017). Even though it is essential to look at the benefits of applying RPA, this technology or the software bots needs to be reviewed as something that influences or benefits the company over a long time (Hofmann et al., 2020).

2.4.2 Application of Robotic Automation in Industries

Applying RPA enables hardware and software to be combined. RPA also includes understanding networking and the fact that automation means simplifying things (Madakam et al., 2019). The adoption of RPA is mainly used in developed countries (Zhang & Liu, 2018), even though it is slowly being adopted in developing countries. Within these countries, RPA is used in several industries, such as banking and financial services, insurance, healthcare, manufacturing, energy utilities and telecom (Madakam et al., 2019).

RPA is being used in software testing in all industries, as testing can be done without human intervention and in the background (Yatskiv et al., 2019; Montero, Ramirez &

Enríquez, 2019). Also, Yatskiv et al. (2019) mention some components of automation testing, which can be applied to (1) the design environment, where the executable code is called a software robot, and (2) to the execution environment, where the bot is executed on the virtual machine, (3) to the management environment, where multiple bots are employed to run all the functions in the organisation (4) and the process analysis environment where reporting happens. Since automation testing can be implemented in various processes, it could also become challenging (Syed et al., 2020).

2.4.3 Challenges of Robotic Process Automation

Organisations may find costing a challenge for implementing RPA. Yatskiv et al. (2019) argue that there is no licence cost if open source is used. There is a lack of understanding of RPA. Staff confuse a software bot with actual robotics. This misunderstanding leads to the team reacting negatively to the implementation of RPA (Santos, Pereira & Vasconcelos, 2020). If a company's management does not handle this issue early on, system integration can become a challenge (Money, 2020). Siderska (2020) highlights various obstacles associated with implementing RPA. It is crucial to accurately identify processes that are suitable for RPA automation to prevent inefficiency and failure.

Additionally, it was noted that RPA is only a part of a larger intelligence automation platform and should be integrated with other automation technologies. However, the constant advancement of RPA and AI is hard to keep up with, which is also a major challenge (Madakam et al., 2019). Software bot maintenance is essential, especially for handling exceptions (Syed et al., 2020). Even though there are challenges, this emerging technology is being used more and more. This technology can also use the existing systems.

2.4.4 Robotic process automation and information systems

An information system can be broken into several components, namely (1) the technology that consists of the hardware, software, and network and how these components interact with each other; (2) the activities or the type of industry it is defined by, e.g., health, education etc. (3) the people that interact with the systems, namely, the programmers, managers, users etc. (Zemmouchi-Ghomari, 2021). All these elements must collaborate effectively to achieve success. Various kinds of systems exist to assist various levels of management. These systems encompass transaction processing systems, management information systems, decision support systems, and specialised business intelligence systems (Al-Mamary, Shamsuddin & Aziati, 2014). Even though these systems work, companies require on-demand information for

decision-making. RPA is a software bot that does not change any system, meaning it is non-invasive.

2.5 Underpinning Theories

This study was based on Actor-network Theory, a sociotechnical theory. In the area of information systems and technology, various sociotechnical theories have been used, such as activity theory, actor-network theory, structuration theory, and technology acceptance theory. Sociotechnical theories provide the understanding that people and technology are interdependent. These theories' basic idea is that people's behaviour is influenced by technology, and people influence technology (Klein, 2014; Westbrook et al., 2007).

2.5.1 Why were actor-network theories chosen and not other theories?

Actor-network theory was used as a theory, such as TAM; Contingency theory has shortcomings that do not link to the study's objective (Iyamu, 2022). ANT does not differentiate between humans and objects, as all participants are equal. On the other hand, ANT focuses on the relationships of all the actors, humans and non-humans, by performing specific objectives (Paledi & Alexander, 2017). Other theories, like structuration theory, focus on the structure within a social system (Jones & Karsten, 2008). Technology acceptance theory emphasises technology acceptance (Alduaij, 2019), and diffusion of innovation focuses on accepting new technology (Iyamu, 2022).

2.5.2 Actor-network Theory

ANT refers to a sociotechnical theory that centres on the process of negotiating and interpreting an entity to bring about change and transformation (Callon, 1986; Latour, 1996). ANT comprises a network in which both human and non-human actions take on an identity (Hossain & Fazio, 2009). Both the human and non-humans are classified as equals within the network. Non-humans can be processed, such as lectures and funding in the education system. At the same time, the humans in the education system, namely, the lecturers and other individuals, are just as crucial in improving performance. Within this network, there is an interaction between the human and the non-human actors. This heterogeneous network is formed through actors with aligned or similar interests within an environment (Islam, Mäntymäki & Turunen, 2019). An actor is an entity that can make a difference in an environment; thus, the interactions lead to negotiations between the actors (Tunggal, 2017).

An actor in ANT can be defined as "any element which bends space around itself, makes other elements dependent upon itself and translates their will into its language" (Callon

& Latour, 1981:286). Actors, according to Latour (1991), can encompass social and technical entities, which may consist of individuals, groups of individuals, organisations, ideologies, methodologies, concepts and artefacts like hardware and software. Furthermore, Latour (1987, 1991) explains that actors can integrate social and technical components. According to ANT, "an actor is made to act by many others" (Latour, 1987, p. 46). The actor is the entity that can make a difference.

Tatnall (2005) explains that ANT is founded on three principles: agnosticism, generalised symmetry, and free association, aimed at treating both human and non-human actors fairly and equally. The first principle, agnosticism, requires maintaining analytical impartiality toward all stakeholders involved, whether human or non-human. Generalised symmetry suggests a method for expressing contradictory views of different actors using a neutral vocabulary that applies to both human and non-human participants (Iyamu, 2022). Lastly, free association requires eliminating all pre-existing boundaries between technological or natural and social phenomena (Iyamu, 2022).

An actor-network is a heterogeneous network of aligned interests encompassing individuals, organisations and standards. ANT aims to bridge the gap between social and technical aspects by refuting the existence of purely technical or exclusively social relationships (Tatnall, 2005). In ANT, both human and non-human actors possess interests that must be harmonised for the successful adoption of technology within the network. Whether an actor is human or non-human, they are regarded as having equal importance and are deemed to contribute equally to a network (Wernick et al., 2008). Consequently, ANT focuses on the connections formed between the actors, leading to the establishment and transformation of stable networks. Through negotiations, the associations and integration of humans and non-humans are created over time (Iyamu, 2022).

The network's primary goal is to facilitate collaboration among individuals from different fields to address a problem or innovate (Maletzky et al., 2018). Some of the tenets of ANT are inscription, blackbox, punctualisation, immutable mobile and irreversibility, which are briefly described, but this research focuses on translation. Inscription is the process that ascribes meaning to artefacts to protect the actor or actors' interests (Wickramasinghe, Bali & Tatnall 2007). Uncovering activities and events that manifest into a blackbox is a process of understanding the governing rules and applying technology that simplifies actions (Valls Canudas et al., 2021). Blackbox was used in an article by Lakay & Iyamu (2022) to examine how academic performance is handled at academic institutions.

The network could become powerful and stable if the process of punctualisation takes place, as punctualisation entails a series of patterns that mask the struggles within a network by making them disappear temporally so that the network passes as a stable one (Law, 2007). Temporary disappearance of a process in a network means that if the process is hidden then it means the process is stable. Immutable mobile is a precondition for transporting and circulating scientific facts and technological artefacts. Latour's "immutable mobile" is a well- defined, unambiguous, and stable object. It can be mobile, move and spread to other locations precisely because the network in which it circulates helps to keep all the elements and relations stable and, in so doing, fixes and reproduces the object so that it is identical.

The degree of irreversibility of a network may be regarded as institutionalisation. Irreversibility occurs when it becomes impossible to return to where alternative possibilities exist (Callon, 1991). Each of the above is a tool or an approach that can be used to underpin a study.

The core of ANT's approach is translation, where one actor recognises and arranges their functions with other actors (Tatnall, 2005). Establishing technology requires the aligning of the interests of actors within the network. As actors' interests within the network are aligned, the network becomes stable, and the technology is then firmly established. ANT suggests that aligning actors' interests in the network involves translating those interests into a common interest in adopting and using the technology—translating people's effect into their value and the subject's resources (Alexander & Silvis, 2014).

Actors have a wide range of interests right from the beginning, and they must be able to interpret, reinterpret, represent, or take over others' interests as their own to achieve stability. By translating the same interest or expectation, they can gain broader support. Transforming an actor or group of actors into a network happens through moments of translation. In actor- network theory (ANT), there are various stages of translation, which are called moments of translation.

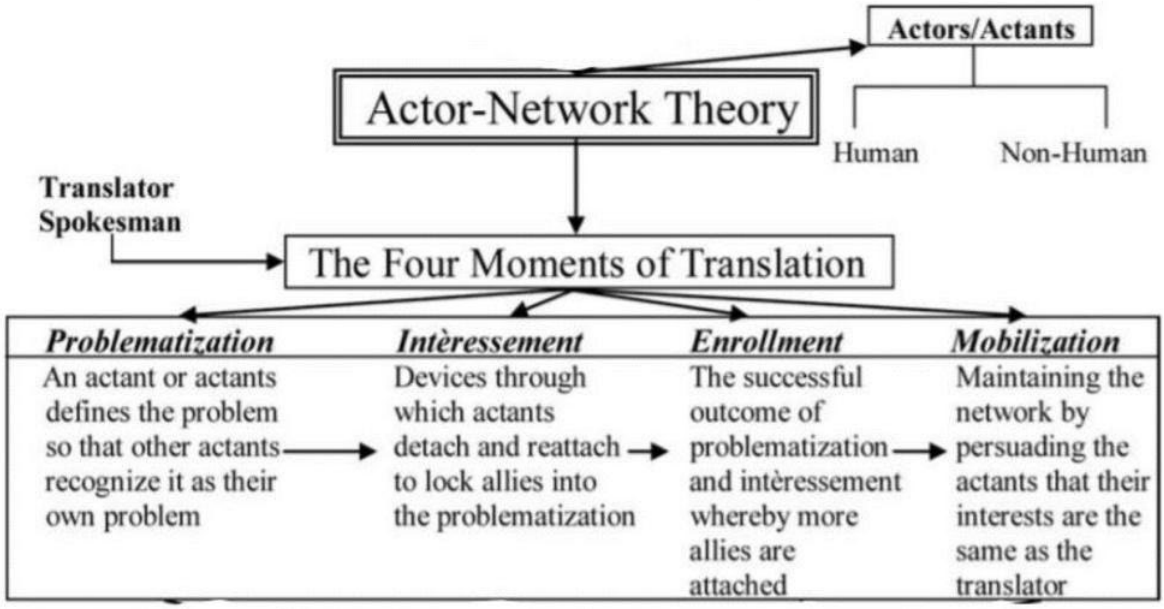

Figure 2.1: Moments of translation (Rhodes, 2009)

There are four stages or moments of translation (figure 2.1):

I. Problematisation is when actors define a relevant problem and identify the actors involved. The focal actor starts creating alliances regarding the issue or the problem at hand and even suggests solutions to the problem (Gunawong & Gao, 2017). Problematisation is also about the recruiting of new actors (Paledi & Alexander, 2017). This focal actor (also known as the initiator) would try to be indispensable to the resolution. At this point, being indispensable to the problem is known as the Obligatory Passage Point (OPP), a place of negotiation for the resolution starts (H Farhangi et al., 2020).

II. Interessment is when these key individuals attempt to convince others to invest in or adopt their programme, and the allies begin to embrace the concepts of this key individual (Williams, 2020).

III. Enrolment involves actors assigning qualities and meaning to other actors or allies and defining their respective roles. The solution is accepted by the allies through acceptance, and their roles are defined. The solution has been formatted and inscribed through documentation that has been approved (Grimaldi & Barzanò, 2014; Becerril, 2017).

IV. Mobilisation is when the organisation has accepted the solution. Thus, when the formed network gains wider acceptance by making durable and potentially

irreversible translations, it is called mobilisation (H Farhangi et al., 2020; Gunawong & Gao, 2017).

In the context of this study, ANT looks at the academic institution holistically as a system. This system provides support to the students, who, after receiving it, use this support to improve their performance.

2.6 Summary

In summary, this chapter explored various academic support systems implemented in universities to improve students' academic performance, RPA and actor-network theory. The next chapter, the research methodology section, outlines the methods and research design used in a study and explains how the data was collected.

CHAPTER 3
RESEARCH METHODOLOGY

3.1. Introduction

This study aims to design an information system based on robotic process automation to assess students' academic performance, timeously and holistically, in South African universities. This chapter presents the design and methodology to achieve the study's aim and objectives. This chapter also includes the philosophical assumptions, the research design, and the data collection methods. The research instrument used for data collection and the selection of the participants are discussed, and the ethical considerations relating to the study are explained at the end of the chapter.

3.2. Research Philosophical Assumption

Every research project is supported by a conceptual context that demonstrates the worldview under which the research is conducted and is visible during the research process. At this point, "fit" becomes important (Quinlan, 2011). The study must flow from the research question to the aims and objectives and continue into the research design, data gathering, and, finally, the analysis and findings.

A philosophical assumption is a theoretical framework researchers employ to gather, analyse, and interpret evidence in a specific field of study (Ochieng, 2009). As this study follows the interpretivist philosophical approach, it seeks to understand the experiences of individuals. It would establish the background of these individuals used to come to conclusions or make decisions (Remenyi, Pather & Klopper, 2011).

3.2.1 Ontology

Ontology is a branch of philosophy concerned with studying being, its existence, and our ways of being in the universe (Quinlan, 2011). It reflects the nature of science or the nature of reality. In scientific research, the philosophical stance of the researcher describes how a researcher ontologically reports facts within a field of knowledge (Neuman, 2014).

This research looks at multiple realities relating to academic performance from the students and academic and non-academic perspectives. The study explores the participants' views on academic performance, discovering what exists at any institution and what influences academic performance from different perspectives. These perspectives allow the research to explore and explain how academic performance is assessed and monitored.

3.2.2 Epistemology

Epistemology is concerned with science, including what comprises knowledge and how knowledge is acquired (Quinlan, 2011). It reflects the relationship between someone as an inquirer and the object of inquiry, how a researcher reflects on the nature of knowledge or reports the truth about knowledge gained or how we get to know this knowledge (Remenyi, Pather & Klopper, 2011). Knowledge within the interpretivism philosophical assumption is based on abstract descriptions of meanings and is constituted through people's lived experiences (Neuman, 2014).

The researcher seeks to understand how these realities exist for students, academics, and non-academics. How does academic performance influence throughput? Understanding these factors that lead to academic performance, whether negative or positive, would lead to understanding the realities of the environment of a university.

3.2.3 Axiology

Axiology reflects a researcher's values concerning the research environment (Gilliland, 2014:86). From a philosophical assumption, the axiology within this study would refer to the participants' values and how they relate to the study of academic performance within the institution's perspective.

3.3. Philosophical Stance

A philosophical stance is a philosophically informed view about reality, what knowledge is, and ways to gain knowledge (Hathaway, 1995). It is a guiding perspective about the nature of change and human behaviour and thus is the very foundation for research.

3.4. Research Approach

There are three main approaches to computing: inductive, deductive, and abductive. However, there is another approach called retroductive. These are the research approaches used in research.

3.4.1 Inductive reasoning

An inductive reasoning approach is used in this study. Babbie (2013) states that inductive reasoning moves from "whether" to "why" logic. This type of reasoning is when a researcher draws inferences from observations to make generalisations and draws from observations to derive a general law (Cooper & Schindler, 2014). This approach is in line with qualitative research methods (Cresswell, 2009:22)

This research focuses on understanding the factors that influence academic performance, which allows the investigation into the activities of academics, non-academics and students using qualitative research methods. This method includes how the data would be gathered through interviews and document collections to understand the factors that affect academic performance (Alam, 2020). However, there are other types of reasoning, such as deductive, abductive and retroductive. These approaches were not considered suitable for this study for the following reasons.

3.4.2 Deductive reasoning

Researchers use deductive reasoning to prove that an inference results logically from a collection of premises. Babbie (2013) indicates that deductions start with asking the question "Why" and move to "Whether" when observing phenomena. Deductive reasoning is mainly used in quantitative studies where hypotheses are tested (Johnson & Onwuegbuzie, 2004; Neuman, 2014). Based on what deductive reasoning is, the researcher would not be using this reasoning type, as deductive reasoning does not allow the in-depth exploration of academic performance in a university setting.

3.4.3 Abductive reasoning

Abductive reasoning is a combination of deductive and inductive reasoning. Abductive logic tends to be the foundation for all new idea generation. (Cooper and Schindler, 2014). This type of reasoning is when a researcher considers a collection of apparently unrelated data and uses intuition to conclude that they are somehow linked. On the other hand, according to Pietarinen and Bellucci (2014), abductive inferences are

intended to answer inquiries made of a specific source of knowledge. According to Neuman (2014), abduction entails progressively applying and evaluating the efficacy of various frameworks while creatively reframing or rephrasing facts and ideas. Abduction rarely produces a clear-cut answer; instead, it frequently rules out some possible options while promoting a more profound understanding. Due to this, this study finds this approach unsuitable.

3.4.4 Retroductive reasoning

Retroductive research is not a popular research approach in information systems or information technology (Mukumbang, Kabongo & Eastwood, 2021). This approach focuses on the mode of inferences in which events are clarified by hypothesis, defining mechanisms capable of generating them are indicated, and retroductive reasoning is used. Retroductive reasoning happens when one makes an inference to justify what is already understood (common course). Retroduction is unsuitable for this research, as this approach combines the most effective aspects of two research methodologies to create reliable representations of social life (Sæther, 1998).

3.5. Research Methods

Kumar (2011) breaks research into three perspectives: using the study's objectives, the mode of enquiry for conducting the study, and applying the research study findings. The sections below explore the various methods used for conducting this research and why the method was used or not.

3.5.1 Qualitative Research Methods

Cooper and Schindler (2014) argue that qualitative research is an interpretive technique that aims to characterise, decode, and otherwise understand the meaning of a phenomenon. The research explores the different aspects that influence academic performance. Therefore, qualitative methods are applied in this study. Qualitative research focuses on the participants' experiences and perceptions and the way they understand and make sense of their environment. It also means there is an event or a phenomenon involving a behaviour. This type of research also focuses on the phenomenon's process and the outcome. The data is reported in words, diagrams or graphs. Qualitative research does not focus on the sample size but on the quality of the research as it is conducted in the actual environment, rendering the complexity of the situation (Klenke, 2016)

3.5.2 Quantitative Research

Quantitative research seeks to determine the frequency of a phenomenon. Data in this type of research is always quantifiable (Chapman, Hopwood & Shields, 2007:400). Sukamolson (2007) indicated that quantitative research focuses on measuring phenomena by searching for reality using measurements, i.e. measuring variables. Klenke (2016) further suggests that this kind of research is objective due to its statistical methods. It was not used based on what quantitative is, as it is unsuitable for this research.

3.5.3 Mixed Method

The research method draws from qualitative and quantitative research to understand and interpret phenomena (Venkatesh, Brown & Bala, 2013). This method is usually done in phases, using multiple data collection, analysis and interpretation methods (Barak, Hussein- Farraj, & Dori, 2016; Nixon & Cooper, 2020). This method was not used based on what mixed method research is, which rendered it unsuitable for this research.

This study uses the qualitative research method, not the mixed or quantitative method. The qualitative method is used because the lived experiences of research participants are emphasised when using the qualitative approach. This research needs to understand the reality filtered through the perspectives of the individuals within the organisation rather than highlighting the issues by measuring the variables or combining the methods.

3.6. Research Design

The design of a research project starts from conceptualisation to the final written report. According to Babbie (2013:117), the research design chooses the correct strategy that aligns with the study, including the population choice and the research methods.

3.6.1 Data Collection Techniques

Data collection methods are how the data is gathered for a study to obtain rich and thorough information about individuals' or groups' experiences, perceptions, and viewpoints (Quinlan, 2011). Qualitative research employs various data collection methods such as observations, interviews, focus groups, document analysis and questionnaires. According to Iyamu (2018b), the researcher has to consider the following when collecting data: the ethical guidelines, data collection guidelines,

interview pilot, criteria for selecting the participants, and the participants' demographics.

Documents Analysis

A research technique called document analysis involves looking at already-existing records, documents, or other written resources to learn more about a research subject. It entails gathering and analysing various documents, such as official records, personal documents, books, newspapers, diaries, emails, social media postings, photos, and other items (Morgan, 2022). Researchers use this document analysis method to find themes, patterns, and meanings pertinent to their study subject (Wood, Sebar & Vecchio, 2020). However, researchers must also be aware of potential restrictions, such as the potential for biased or incomplete materials or the risk of missing crucial context. Document analysis should be used with other methods, as with any research approach, to provide a thorough knowledge of the research subject (Bowen, 2009).

Interviews

Open-ended questions are used in interviews to probe participants' viewpoints, beliefs, attitudes, and experiences (Chan, Fung & Chien, 2013). This method enables researchers to gather comprehensive and in-depth information about people's experiences and perspectives. Depending on the research design and the availability of participants, interviews may be performed in person, over the phone, or using an online platform.

Focus Groups and Observation

There are other means of data collection, namely, focus groups and participant observation, which the researcher considered but did not use. Focus groups involve bringing together a small group of participants to discuss a specific topic or issue (Neuman, 2014). The group dynamic can generate a range of perspectives and ideas that might not emerge in individual interviews. Even though focus groups are useful for exploring how individuals interact and negotiate meanings within a group setting, the researcher needed to gather information from different types of participants in different environments. On the other hand, participant observation involves immersing oneself in a social environment and observing the participants' activities, behaviours, and interactions. This technique allows researchers to collect data on social processes, cultural norms and practices irrelevant to this research project.

3.6.2 Data Collection Guidelines

Data collection is how the data was collected for the research project (Quinlan, 2011).

The research was conducted and concluded with integrity, reliability, and validity. The qualities of integrity, reliability, and validity were carried throughout the entire research project. This section discusses the guidelines on the ethical treatments used to collect data and the treatment of the participants. Rather than providing a specific and definitive transparency statement, the researcher outlines a series of criteria explaining the data collection approach below. These guidelines guide the researcher and the participants in addressing ethical dilemmas and alleviate the researcher's bias.

The researcher followed the following guidelines:

I. The research questions and objectives were looked at when working on the questions to ask the participants. This allowed the researcher to look at each research question. After writing up all the possible questions that could be asked to collect the data, the researcher selected the most relevant ones that aligned with the research objectives. When looking at the methodology and the various data collection methods, the researcher decided to use interviews.

II. When the interview method was selected, the participants had to be selected from each participant group: the students, academics and non-academics. All the support units were listed, and academics were selected from different faculties' departments.

III. The criteria for selecting the participants and their demographics are essential and should be carefully considered. Institutions have many faculties, and this research randomly selected two departments from each faculty. The main criterion was that the participants were at the institution for over two years. This included academics, non-academics, and students.

IV. All the participants were given a consent form beforehand, where they were asked to consent to be part of the project and were informed that if they felt they did not want to continue, they could discontinue as it is voluntary to be part of it. Part of the consent form was that they were ensured of their privacy.

V. Before the interview, the participant is debriefed about the project and how their understanding of academic performance can add to it. After data collection, the researcher debriefed the participants (Olivier, 2009).

3.6.3 Interview Guidelines

I. Firstly, the researcher had a set of questions prepared beforehand and permission to research that institution. Once a participant was selected, the researcher sent the participant an email. The email indicated they could suggest another person in their department if the participants were unavailable. The permission and consent letters were emailed once the participants

acknowledged that they would participate.

II. Before the interview, the researcher would give the participant an idea of the research and ask if they had read the consent letter and were comfortable with the interview.

III. The researcher would ask the questions, and if the participant required clarification, the researcher rephrased it or gave the necessary clarification.

3.6.4 Participants' Demographic

A study's demographic section is crucial because it offers contextual information about the participants (Rainer & Wohlin, 2022). This study involves three types of participants: academic staff, non-academic staff, and students. The academic staff who participated should have worked within the department for more than two years in a specific department. Two academic staff would be selected from each faculty. The selection of these staff members would be the staff members who are willing to participate.

The non-academic staff should also have been working within a service department that supports the academic staff within the organisation. The institution has numerous service departments. The chosen departments would be where academic performance is linked to or requires the student to participate.

The students that participate in this study should have been students at the institution for more than two years, and this is to ensure that the student understands how the service department operates within the institution they are studying. The students who participated were linked to the department from which the academic staff were selected. This study focuses on the participants' beliefs about academic performance, which would be useful to the investigation.

3.7. Data Analysis Techniques

The process of cleansing and transforming data to find relevant information for decision- making is known as data analysis (Islam, 2020). Exploring and analysing data to discover significance is the data analysis process, as described by Quinlan (2011). Therefore, finding patterns and trends in the data that was collected requires analysis.

The first step in analysing this data is to describe it. This means that the data that is seen or read is described. The next step is where the researcher now interprets the data. After this, a conclusion is derived from what the researcher sees and what they analyse from that data. Actor-network theory strongly emphasises the interactions

among actors (human and non- human) and the networks' role in influencing the social world. ANT defines a network as a web of connections between actors and objects that work together to generate a specific result. To find patterns and links that might not be immediately obvious, data analysis in this context entails following the networks of interconnections between actors and objects in the data. For instance, the relationships between people and the elements that influence their behaviour can be found using ANT (O'Connell, Ciccotosto & De Lange, 2014). ANT highlights the relationships between actors and objects. This lens can find patterns, linkages, and elements that affect an activity or system's success or failure.

3.8. Ethical Considerations

Ethics in information technology research is how the researcher applies ethical principles and standards to the research process (Quinlan, 2011; Tanga & Luggya, 2022). Therefore, several factors must be considered when human participants are involved. Firstly, the institutional Ethics Committee must approve the research, and secondly, to ensure credibility, the researcher had a process to provide the ethical treatment of the participant.

The first was informed consent, in which the participants were told the context of the study. To ensure credibility when the consent forms are given, the researcher disclosed the procedure and what would be required from the participants (Olivier, 2009). All the participants were sent a copy of an invitation and the ethical clearance form that was approved at the relevant institution. This allowed the participants not to be over- and under-informed but to have an idea of the research and what the researcher was gathering data about (Kvale, 1996). This meant that participants could choose whether or not to participate in the study (Orb, Eisenhauer, & Wynaden, 2001). The consent forms were given to the participants and were signed by them.

The second ethical treatment was regarding anonymity and confidentiality. This study ensured the protection and non-disclosure of the participants. To eliminate deception, the researcher spent 5 minutes before the interview on what the study entailed so that the interviewee could withdraw if they wanted to (Cooper & Schindler, 2014). The participants' rights to privacy were explained. Neither their names nor their colleagues' names would be mentioned (Quinlan, 2011), and their participation was voluntary (Babbie, 2013:32). The research ensured that the data would be protected and secure, especially after the analysis and when the completed project is released (Kruger & Welman, 2001). This included the fact that all resources would be referenced (Olivier, 2009; Quinlan, 2011)

3.9. Summary

This chapter presented the design and methodology used to create an intelligent information system based on robotic process automation to assess students' academic performance in South African universities. The chapter discussed the research's philosophical assumptions, the research design, and the data collection methods, including the research instrument used for data collection and the selection of participants. The ethical considerations relating to the study were also explained. The philosophical assumption of interpretivism was used, and the inductive reasoning research approach was applied to gather data through interviews and document collections. The study aims to understand the different perspectives on academic performance and how it is assessed and monitored.

CHAPTER 4
THE CASE STUDY OVERVIEW

4.1 Introduction

This chapter is divided into four main sections. The first section introduces the chapter. The second discusses the University of Cape Point, while the third discusses Table Mountain University. The chapter is summarised in the fourth section.

As discussed in Chapter One and Three, this study used two academic institutions as cases. The institutions are the University of Cape Point (UCP) and Table Mountain University (TMP). Also, the criteria for selecting the institutions are discussed in Chapter Three. This chapter presents detailed information about the two academic institutions. This study is based on a case study, as, in research, a case study allows an in-depth insight into a phenomenon, namely a university (Babbie, 2013).

4.2 University of Cape Point

The University of Cape Point was founded over thirty years ago. The institution is situated in the Western Cape province. It is one of the largest universities in the country. It has a student enrollment of over 30,000 yearly. The institution is divided into two main divisions: academic and non-academic. Another aspect is the students, which makes it three central bodies of the institution. The academic division of the institution focuses on academic matters, processes, and activities. The non-academic division supports academic and student matters, covering academia and support services and, finally, the students enrolled at the institution.

4.2.1 Studentship

The category of students is divided into two groups, namely, the undergraduate and postgraduate. With more than 30,000 students, undergraduates make up more than 80% of students, and postgraduate students make up less than 20%. Undergraduate students are registered for four years to complete their studies. The four years constitute a 3-year diploma and a one-year advanced diploma. The minimum time for students to complete the first qualification is three years, but most students complete their base qualification in a normal time plus one year. There are also short courses that students can attend.

The postgraduate students are registered for one of the following programmes: postgraduate, master's or doctoral studies. A master's qualification can be either course-based or thesis- based. The minimum time for these studies ranges from 1 year to 3 years. The maximum number of years of study can be five years for a doctoral qualification, which is full research.

4.2.2 Academic division

The academic division focuses on teaching, learning, and research. It offers more than 70 different programmes from the teaching and learning aspect. The different programmes are clustered into six faculties, which include Engineering, Sciences, and Business. The seventy academic programmes are spread across the six faculties in the institution at various undergraduate and postgraduate levels.

4.2.3 Academic Faculty

Each faculty is structured into departments focusing on specific disciplines or areas of specialisation. Each faculty has a head referred to as the Dean.

Faculty of Engineering: The Engineering Faculty covers various engineering disciplines, including construction, chemical, civil, electrical, and electronic engineering. There are about five departments in the faculty. Each department focuses on a discipline. Some of the departments are briefly described in the remainder of this section.

Faculty of Sciences: The Faculty of Sciences focuses on healthcare, wellness, higher education, and global health concerns in South Africa and Africa. It has eight departments. Each department uses technology, and the faculty aims to become a leader in health and wellness education, research, and innovation. The faculty states its goal is to train healthcare professionals who are adaptable, ethically responsive, and committed to learning. Also, the faculty claims to conduct pioneering research and clinical innovation to improve the well-being of individuals, with a particular focus on global and local health.

The Business Faculty prepares skilled graduates for success in economic and business sectors through various business qualifications. The faculty aims to be a leading provider of business education in Africa and beyond. It prioritises innovation, quality programmes, strong relationships, resource sustainability, leadership, and reputation excellence to achieve its vision through several programmes such as Hospitality, Tourism, Retail, Marketing, Real Estate and Accounting.

The institution has a strategic plan for 2030 for these faculties to operate smoothly. This plan is aimed at all the academic and administrative staff and to provide just-in-time information access through the implementation of new technologies and systems. The plan highlights the importance of increased user satisfaction and the availability of timely information through document archiving and retrieval. It also outlines a focus on providing a smart, holistic student experience. This plan involves equipping students with the skills and knowledge to participate in meaningful co-curricular and pre-university programmes, engage in a transformative first- year experience, and prioritise their wellness. The plan also aims to include a suite of comprehensive and quality services for students that are integrated, responsive, and focused on supporting students' holistic well-being and academic success and supported by smart technologies. The plan emphasises the importance of consistently high standards of service provision across all institutional services and facilities.

4.2.4 Academic Staff

The academic staff conducts the teaching of all the registered students. These staff members use Blackboard, where all the learning material relating to the subject they teach and the subject guides are uploaded. This platform is used to inform students about assignments and assessment dates. These assessments can either be online or a written test; when marked, they are uploaded to the marks system. The timeous marks can assist the student to view their progress regularly.

Any additional materials to enhance the students' learning are also uploaded on this platform. These staff members are given a certain amount of time to teach a module, depending on the credit value of a module. These teaching periods can be either practical or theoretical, linked to the venue, which can be full of computers or not.

4.2.5 Non-academic division

Institutional support structures are essential for addressing teaching and learning in South Africa (Fisher & Scott, 2011). These support structures are viewed from different perspectives. The sections below discuss the students and academic and administrative issues.

The Department of Student Affairs (DSA) is the department that enhances student experience and promotes academic success. The DSA educates students beyond the classroom and enriches their experience at UCP. The departments include Sport, Student Governance, Residence Services, Health, HIV/AIDS, Counselling, and Disability.

4.2.6 Administrative

Administrative departments and staff are all those that render a service to the students that is not classified as academic services. These staff members are not linked directly to the academic programme but indirectly.

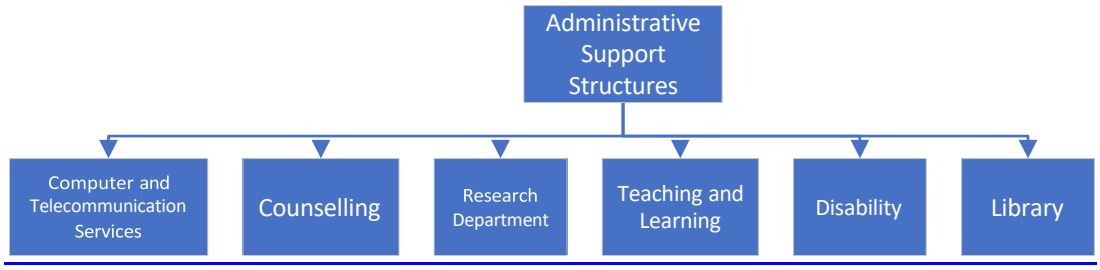

Figure 4.1: UCP Support Structures

The above diagram lists some of the administrative departments that support the students. The Computer and Telecommunication Services (CTS) assist the students with all the information services they require to navigate themselves on the Learning Management System and Students Online Services (SOS). This unit ensures the students have access to the LMS, emails, passwords, and the ability to view their assessment results and financial statements.

The Counselling Department looks after the students holistically and offers services to individuals, offers career counselling, offers wellness workshops, and creates student support groups. The wellness programme offers guidance and education on a healthy and balanced lifestyle. The workshops and activities cover various topics, including maintaining mental health and well-being, learning about mental health challenges, healthy coping strategies, relaxation, self-care, mindfulness, and establishing healthy relationships while managing personal boundaries.

The Research Department oversees all the postgraduate students. This unit tracks the students from the moment they register for a postgraduate qualification till the student graduates. Workshops are offered to assist students in creating a research title, proposal writing, article writing, and more. The institution has an inclusion policy, which means that any student with special needs can register and get assistance from the disability unit. This unit assists the student with assistive devices and with assessments and assignments. A student can indicate at the point of application if they are deemed to have a disability, and the disability unit can then contact the student.

The library assists both undergraduate and postgraduate students. They offer information literacy to the undergraduates and assist the postgraduates with resources and advice on the numerous databases.

The teaching and learning unit assists the students in integrating well into the institution. They offer programmes for first-year students during orientation. They offer writing skills to all the students and train selected students to assist the academic staff with mentoring and teaching.

4.3 Table Mountain University

This institution was created over 60 years ago, starting with 166 students, but only gained university status in 1970. This university is home to over 23000 undergraduate and postgraduate students in seven faculties, including the Faculty of Economic and Management Sciences. Around 2400 professional, academic, and support staff members oversee these students. Table Mountain University, including the registrar, has a DVC for Academics, Research and Innovation and Student Development and Support. This institution is interested in all its students and values them as holistic individuals. For this reason, student development and support have a dedicated DVC within that institution.

The vision of TMP for 2035 is to build relationships by having effective partnerships with other universities within and beyond Africa.

4.3.1 Studentship

The students here are also separated into undergraduate and postgraduate. With more than 23,000 students, tutors and teaching assistants are essential. Peer learning is promoted by having these tutors for all levels of students registered for the bachelor's degree programme. Undergraduate students are registered for four years to complete their degrees. The four-year extended programme constitutes a 3-year degree. The degree is the first qualification.

As a traditional university, research is of high importance. This institution has a DVC for research, so research supervision and output would be ranked high. The Honours programme is, Masters and Doctoral studies are linked to the Postgraduate studies.

4.3.2 Academic Division

The academic division of the institution is also divided into faculties. As a traditional university, there are additional faculties like the faculty of Dentistry, Law and Theology. The Arts and Humanities and Natural Sciences faculty is more of the traditional faculty. These faculties are further divided into departments and units.

4.3.3 Academic Faculty

The Faculty of Dentistry is committed to promoting oral health through teaching, service, research, and community engagement. They do this by having teaching centres which are health facilities within the Western Cape. They are also linked to the Department of Health within the Provincial Government of the Western Cape.

The Faculty of Law is envisaged to be amongst the top law faculties by 2035. Their vision is to be known internationally for their academic programmes, research publications, and the nurturing and development of their graduates.

The Faculty of Arts and Humanities is linked to studying English, Afrikaans, and foreign languages. Many of the subjects taught in this faculty are the base subjects for other qualifications within other faculties. The units within the faculties are the research chairs within each faculty.

4.3.4 Academic Staff

Tutors and teaching assistants support the academic staff in this institution highly. These staff members have regular meetings with these students so that they can assist the students. The academic staff drives the teaching and learning as well as the research. Supervising students from the honours to the doctoral level is vital as it enhances research impact. This institution is ranked in the top 10 for research according to the Scimago Institutions Ranking.

4.3.5 Academic Support Staff

All the support units in the institution are considered non-academic, as are services rendered outside the academic departments. Examination and graduation also form part of this unit's function, which supports the student's academic performance. These support units include the Centre for Student Support Services, the library and the Writing Centre.

4.3.6 Administrative Support Staff

The academic administration within this institution is focused on student enrollment and IT support for the entire institution. All the IT infrastructure is maintained and seen by the ICT department.

4.4 Fieldwork

Conducting the fieldwork was first done to determine the data sources, as presented in Chapter Three. The semi-structured interviews were conducted face-to-face and online (via Zoom and MS Teams) to collect the data.

4.4.1 University of Cape Point

The data was collected from three groups: students, academic staff, and non-academic staff. The following process was applied:

I. The participant was first approached for their availability.
II. Once they agreed, the researcher sent the participants the consent and ethical clearance forms.
III. They were briefed about the study and answered any questions that they had. They were also briefed about the recording that was done.
IV. After that, semi-structured interviews were done.
V. Each participant was asked the same questions within the same category. These questions guided the interviewer to be consistent in asking each of the participants the same questions. Questions were rephrased depending on the participant.
VI. The recording was downloaded after the interview. Then, the raw data was saved, and after that, the data was cleaned. The naming convention was done in the following manner: the academics, administrative or non-academic staff and students numbered UCP01 to UCP24.

4.4.2 Table Mountain University

Fieldwork at this institution was managed through the academic deputy registrar. Once approved, this person then emailed all the participants on behalf of the researcher. Follow-up had to be done on these emails.

The following process was applied:

I. The participant was selected from the website.
II. Emails with the consent and ethical clearance forms were sent to them from the registrar's office.
III. After this approval process, not many responses were returned, so the

researcher emailed staff individually and received some responses. The same was true for the non-academic units that responded. Students were emailed through referrals from staff and other students.

IV. These participants were interviewed at the institution, online, in coffee shops and even in the researcher's vehicle.

V. Semi-structured interviews were done with these participants. The same questions were asked each participant, as at the University of Cape Point.

VI. The recording was done on the recorder as well as Zoom. After the interview, the recording was downloaded. It was transcribed. The naming convention for this institution was TMP01 to TMP11.

4.4.3 Coding of the interviews

Below is a list of the interview codes used.

University of Cape Point

Table 4.1: Codes for the University of Cape Point (UCP)

Unit	Code Name	No of Pages
Academic	UCP_ACA_01	456
	UCP_ACA_02	427
	UCP_ACA_03	518
	UCP_ACA_04	305
	UCP_ACA_05	308
	UCP_ACA_06	297
	UCP_ACA_07	377
	UCP_ACA_08	370
	UCP_ACA_09	462
	UCP_ACA_10	373
Non-academic	UCP_NAC_01	504
	UCP_NAC_02	349
	UCP_NAC_03	404
	UCP_NAC_04	262
	UCP_NAC_05	290
	UCP_NAC_06	367
	UCP_NAC_07	419
Student	UCP_STU_01	342
	UCP_STU_02	144
	UCP_STU_03	258
	UCP_STU_04	112

	UCP_STU_05	200
	UCP_STU_06	166
	UCP_STU_07	204
	UCP_STU_08	415
	Total Lines	8329

Table Mountain University

Table 4.2: Codes for Table Mountain University (TMP)

Unit	Code Name	No of Pages
Academic	TMP_ACA_01	466
	TMP_ACA_02	770
	TMP_ACA_03	312
	TMP_ACA_04	392
Non-academic	TMP_NAC_01	339
	TMP_NAC_02	458
Student	TMP_STU_01	281
	TMP_STU_02	522
	TMP_STU_03	283
	TMP_STU_04	326
	TMP_STU_05	264
	Total Lines	4413

The above codes assist in referencing the data during the analysis.

4.5 Summary

This chapter overviews UCP and TMP and their institutional support structures. Support structures are viewed from different perspectives, including administrative, academic, and student perspectives. As mentioned above, the fieldwork for the study was conducted using semi-structured interviews with various students, academic staff, and non-academic staff.

CHAPTER 5
DATA ANALYSIS

5.1. Introduction

The previous chapters, Three and Four, provide details about the data type, including how and where data were collected for the study. Based on the study's aim, the data were analysed, guided by actor-network theory (ANT). The aim and objectives of the study are stated in Chapter One and revisited in Chapter Three. ANT is comprehensively discussed in Chapter Two. This chapter presents the data analysis.

The chapter is organised into five main sections. The first section is the introduction to the chapter. The second section provides an overview of the analysis. The data analysis is presented in the third section. The findings follow this. In the last section, a summary of the chapter is presented.

5.2. Overview of the Analysis

Qualitative data were collected based on the study's objectives, as explained in Chapter Three. The case study approach was most suitable, also discussed in Chapter Three. Following the approach, two public universities were selected as cases for the study. Data were gathered from individuals at the point of saturation from both universities (cases). In the process, the universities and the persons who participated in the study were assigned pseudonyms to avoid the disclosure of identities. The universities were assigned to the University of Cape Point (UCP) and Table Mountain University (TMP), respectively. The individuals who participated from UCP in the study were assigned codes for the academic, [UCP_ACA01-UCP_ACA10] non-academics UCP_NAC01-UCP_NAC07 and students UCP_STU01-UCP_STU08. From TMP, the codes for the participants were academic [TMP_ACA01-TMP_ACA04, non-academics TMP_NAC01-TMP_NAC02 And students are [TMP_STU01 to TMP_STU05.

The data were analysed using the thematic technique from the interpretive approach perspective. The analysis was guided using actor-network theory (ANT) as a lens. The justification for selecting the theory is discussed in Chapters One and Three. Thus, the moments of translation (Figure 5.1) of ANT are used to guide the data analysis.

The relevance of ANT is based on its focus on the interactions between human and non- human entities in an environment. The interactions happen in stages, which are the four moments of translation, as shown in Figure 5.1. Also, ANT does not differentiate between humans and non-humans, which enabled a critical view of the entities in the context of this study. When integrating these entries, a network is formed, which can be heterogeneous. ANT is thus a framework for mapping these entries. Another important aspect of the analysis is the consideration of the ANT mantra, which is 'follow the actors'. Latour (2007) emphatically explains that we follow the actors to travel traces left behind by their activities.

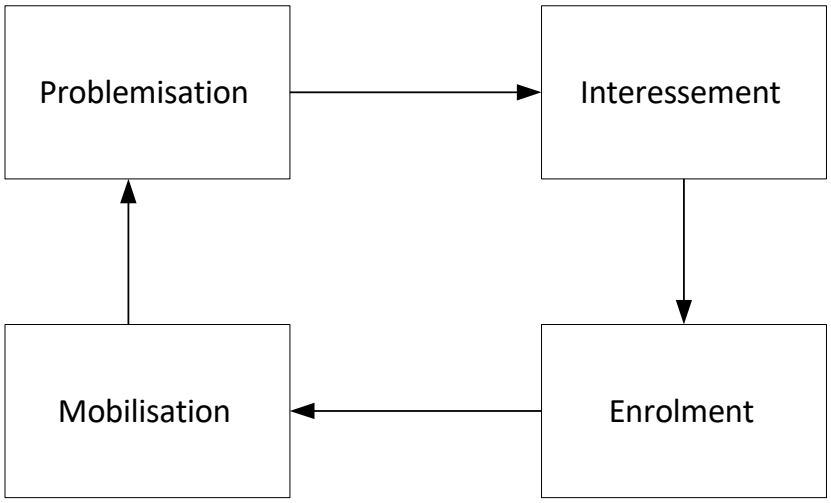

Figure 5.1: Moments of translation (Callon, 1986)

The four moments are problematisation, interessment, enrolment, and mobilisation (Callon, 1984; Iyamu, Sekgweleo & Mkhomazi, 2013). These moments helped to follow the actors, including the activities, interactions, and relationships between the actors, to gain a deeper understanding of the systems and approaches that are currently used to provide support and services to students in their academic activities, including how certain factors influence students' academic performances. This includes examining how negotiations shifted in human actors carrying out activities that influence students' academic performances in the universities that participated in the study.

The theory was used as a lens to guide the data analysis. ANT is applied first to understand the actors. A comprehensive justification for the order of use of the theories is presented in Chapter One. In the analysis, the data were referenced to enhance the empirical nature of the study. Thus, a referencing format was formulated. The format contains the key aspects of the nomenclature that help to identify the data sets. These

are the institution, participant, page number, and line number of the documents. The referencing format for the University of Cape Point is as follows: UCP_ACA01, P2: 3-4. The UCP represents the University (case); ACA01 represents the academic participant; P2 represents the page number; and 3-4 represents the line numbers of the transcribed document. Table Mountain University represents the format as follows: TMP_STU01, P3:12-18. The TMP represents the university (case): STU01 for the student participant, P3 for page number, and 12-18 for the line numbers for the transcribed documents.

5.3. Data Analysis

The data analysis is split into two parts. The first part of the analysis focuses on understanding the actors and their roles in the activities that contribute to student's academic support and services. The second part of the analysis is guided by the moments of translation.

5.3.1. Actor

In ANT, an actor can be human or non-human (Shim & Shin, 2016). The human actors at UCP include academic staff, non-academic staff, and registered students. The non-human actors included information technology (IT) solutions and processes. The IT solutions included personal computers (PCs), IT systems such as the Learning Management System (LMS), research management systems, computer networks, and the Internet. The processes consist of rules, governance, and policies. These actors are employed by different campuses, faculties, and departments that facilitate academic performance in various ways. One of the participants briefly stated:

> "There are policies that focus on student support. One of the Deputy Vice- Chancellors (DVC) is the custodian of the policies. However, the implementation might differ from one faculty and department to another" (TMP_ACA04, P1:16-17).

The academic staff (actors) are assigned various functions: manager, researcher, and lecturer. The managers are the heads of academic departments, deans of faculties, and deputies to the Vice-Chancellor (VC). Each function aims to provide services to the students to improve their academic performances. The actors provide the services to students at different levels, from undergraduate to postgraduate. Thus, the actors are expected to be available to the students regularly during academic sessions. The purpose of availability includes consultation on academic-related matters such as lectures and examination queries. One of the academic staff explained as follows:

> "We would facilitate and guide the students on how to navigate

> through the processes and environment, in helping them to gain experiences" (UCP_ACA03, P5:199-200).

The non-academic staff provides complementary academic duties and administrative support services to students. This includes administration of funds, access to infrastructure such as internet services, and access to library resources. In doing so, the human actors rely on IT systems to provide support to the students. For example: (1) the librarians ensure that the necessary books and articles are available and accessible to the students, and (2) administrators use IT systems to follow the actors by tracking students' activities, academic status, and development. Additionally, the non-academic staff supports the academics in enhancing their capacity to deliver improved services to the students. This includes ensuring that the infrastructure in each classroom works and teaching materials are available when needed. According to one of the administrative staff:

> "Everything and anything relating to administration is what we do in the Faculty Office to provide support to the students" (UCP_NAC04, P1:20-21). For example, "With applications, our office is the first point, so if students apply and want more information on the programmes, fees and admission requirements, they would contact us. If they require assistance with the application form, they would also call the Faculty Office for assistance. With registrations if the students also require assistance with their registrations, they will come to us. … Even if it's something as small as just changing their surname, or the address if it's related to subjects they're registered for, which they haven't registered for, or they've erroneously cancelled, it would be referred to us" (UCP_NAC04, P1:10-18).

How these support and services are provided remains critical and challenging. It is critical in that the students rely wholly or partially on the administrative staff to perform their academic obligations. The challenges are whether they receive the support and services when and how they need them. This remains a controversial circumstance because the institutions do not have measuring tools or mechanisms for following the actors or assessing their activities. The institutions rely on a quantitative mechanistic approach, which is either a failure or pass, for assessing students' performances.

As in every institution of higher education, the students at UCP are at different levels of their studies. They depend on the academic and non-academic staff to complete their studies and use educational technologies and processes to supplement their studies. These actors have different needs and require different support structures at different times of the year or levels of study, namely financial, academic, and mental support. The students come from different backgrounds, communities, and schooling systems. The systems and processes used for the students assess their academic performance and give them technological support.

> "Students need to have academic support, not just teaching and learning support but services support because that speaks to the entire portfolio that we would give that student because that speaks to the entire experience" (UCP_ACA03, P4:162-164).
>
> "The administrative computer department offers different technical support to the students" (UCP_NAC03, P1:5). Examples of this support are when the students have an issue with their emails, be it a licence that needs to be assigned or a password that needs a reset. We support students who need a licence for other applications on Microsoft package, such as Word, Excel, PowerPoint, and Teams. We assist with OPA logins. If a student can't log in to OPA, we will first do troubleshooting to check what could be the issue. Sometimes, the account gets blocked when a student has not used OPA for a long time. (UCP_NAC03, P1:18-24).

The students, academic or non-academic staff, including the tools or facilities, do not exist or act in isolation. They act as constituents, knowing or unknowing. ANT refers to the constitution of a network. Thus, in ANT, the actor and network are inseparable. This concept called generalised symmetry within ANT explains that humans, i.e. the students, lecturers and non- academics, cannot be separated from the networks they are part of within their units (Iyamu, 2022). Facilities like the writing centre and the disability unit, even though they work in isolation, are linked to the department by assisting students who approach them with their assessments. These support departments are as important to the network as the academics.

5.3.2. Actor-Network

An actor-network is an intricate and dynamic structure of interrelated human and non-human actors that cooperate to accomplish a specific objective (Williams-Jones & Graham, 2003). At UCP, there are many networks, and each network has a specific function and goal to achieve. However, neither the actors nor the networks are static.

This means that an actor or network replicates itself in another network. According to Montenegro and Bulgacov (2014), one is never clear on who and which actor is acting and in which network, which means that actors and networks become heterogeneous.

The networks are cross-horizontal and vertical settings of the institutions. Horizontally, the formation of networks was in two dimensions. Firstly, UCP has many campuses. This ensures proximity to the students, thereby providing services that enhance their academic performances. Within UCP, the institution has consciously divided specific areas of specialisation into faculties. Some campuses host departments of more than one faculty. Secondly, multidisciplinary efforts and collaboration between faculties or campuses induced alliances in the environment. Vertically, there are departments and specialised units or disciplines within a faculty. The networks are formed based on the organisational (institutional) structure. This means that the networks exist because there are actors. For example, a network is formed, students start to enrol, and humans are employed to oversee the activities. Networks ultimately exist because humans work and study together, and these are formed consciously and unconsciously in ANT (Iyamu & Mgudlwa, 2018).

During multidisciplinary cooperation, in which students are involved, the support and services, including ownership and accountability, are shared among parent faculties. This is challenging in many ways. For example, the faculty does not have enough funds to lead the alliance, a collaborative effort, but has the students' capability. In this scenario, the sponsoring faculty demonstrates its power, which is the funds, relationship by show of power. This type of relationship has come a long way. According to Foucault (1982), a power relationship is often founded on two elements: indispensability and the ability to act. From an ANT standpoint, Iyamu (2017) suggests that a power relationship enables and, at the same time, constrains IT projects. The struggle for power in a relationship involving students derails activities aggressively or in a subtle way. This influences the services or support provided to the students.

Faculties play an important role in practically applying the mission and vision of the institution. This can include the application of policies, teaching and learning, as well as innovation and research. These core aspects of activities and guidance. The networks created within these faculties, therefore, look at the functioning of the environment. The faculty oversees the professional development of the staff as well as the students' performances. For specialisation and unique purposes, each faculty is divided into departments, which are further divided into units. The units manage the day-to-day functioning of the teaching and learning as well as the infrastructure to operationalise

the department smoothly. For the department to accomplish the outcome for the student to graduate, the application of the policies has to be understood and incorporated into the teaching, e.g. graduate attributes.

The non-academic is a division of the university. Like the academic, the division is divided into many units. The division focuses on providing various forms of support to both the academic staff and students. The support that they provide to the academic staff enables the lecturer to render services and support to the students are aimed at improving their performances. Some of these supports are automated, which is the use of IT solutions. Some units include information technology (IT), counselling, and research services.

The IT unit provides computing-related support and services to the non-academic staff, academic staff, and students. The non-academic staff rely on the IT unit to provide support, such as processing students' enrolment, funding applications, and examination activities. The academic staff depend on the IT unit to enable their service offering tools, such as automation of teaching and learning materials, including the Internet and learning management systems (LMS). To the students, the IT unit ensures that technology infrastructure such as the Internet and computer network are regularly available. Increasingly, students depend on these infrastructures to conduct many activities and source academic materials, potentially to improve their performances. According to one of the participants:

> "The administrative computer department offers different technical support to the students. We offer Student Online Support Password [SOS Pin] support. If students have forgotten their SOS PIN, they will call us to retrieve it. Without this password, students cannot access the Learning Management System, and it will affect their academic performance" (UCP_NAC03, P1:5).

The counselling unit offers several support services to the students on campus. This includes mental health and psychological issues. This network can hardly offer its services without collaborative effort. This is because the unit does not have direct access to the students. Thus, the unit extends to other departments. ANT refers to such a setting as a network of heterogeneous actors. Law (1992) argues that ANT is distinctive because it insists that networks are materially heterogeneous. According to Schäfer (2017:38), ANT traces heterogeneous links between elements and analyses the transitions between actants and the shifts that occur in each instance. The alliance enables the lecturers to gain better comprehension and refer students encountering

challenges to the unit for assistance. An employee of the unit explained as follows:

> "We offer individual counselling and therapy. That's the core service that we offer. Also, we offer online support groups for students, which is different to the usual physical presence" (UCP_NAC02, P1:5-6).

The research unit's attention is on the postgraduate students at the institution. This is because the postgraduate students focus on research. Funding and provision of research materials are some of the supports the unit provides to postgraduate students. The network extends across faculties and departments, providing services and support for students as required. In doing so, this unit has a system that is only used and accessed by postgraduate students. According to some students:

> "There are workshops or seminars that we, as postgraduate students, can attend that are organised by the research department throughout the year" (UCP_STU04, P1:11-12).
>
> "I'm going to speak for the postgraduates because that is where I'm at now. There's quite a bit of support for full-time students" (TMP_STU02, P1:5-6).

5.3.3. Moments of Translation

This is the second part of the analysis. It focuses on the four moments of translation, as shown in Figure 5.1: problematisation, interessement, enrolment, and mobilisation. This includes how negotiations between actors shifted in providing support and services to the student. According to Schäfer (2017:39), in ANT, "any association must always be understood as a translation because the specific qualities of every element involved in a network alter the qualities of the whole network and change the course of any action that is distributed therein." Table 5.1 presents a summary of the four moments of translation applied as a lens to guide this analysis.

Table 5.1: Summary of translation in four moments

1	Problematisation	2	Interessement
	The entities, support and services provided by both academic and non-academic staff of the institutions, UCP and TMP, toward improving students' academic performances were problematised at various, strategic and operational levels. Each aspect or component of the entities enlisted by the problematisation can be integrated into a state of OPP (Sage, Dainty & Brookes, 2011) using the institutions' contracts and policies as enforcers.		Interessement consists of "trials of strength" (Callon, 1986: 203) where the claims of the problematisation are operationalised. The key actors were students and academic and non-academic staff of the institutions. At this moment of translation, individuals and groups of students and employees of the institutions were persuaded to accept that there was a problem of students' poor academic performance. Therefore, support and services needed to be intensified.
4	Mobilisation	3	Enrolment
	In mobilisation, human actors who were connected with academic activities were engaged in fulfilling the tasks and roles required to improve students' academic performances. Thus, heads of faculties, departments, and units engaged employees with the intent of providing support and services to improve students' academic performances.		In enrolment, key roles and practices were defined for the employees. These were operationalised by assigning tasks to individuals and groups (departments and units) in the network. The tasks were both strategic and operational, and they were technical (IT solutions) and non-technical (processes).

Table 5.1 should be read with the subsections that follow to gain a better understanding of the analysis. The Table highlights the key entities that are expanded in the four moments.

Moments of translation: Problematisation

A problem in ANT is when an issue is problematised (Tatnall, 2019). This issue does not have to be negative, but it can be any phenomenon that needs to be investigated or an opportunity that needs a solution (Carroll, 2014). Problematisation is the first phase of four phases in moments of translation. At this stage, the focal actor identifies the problem with another actor (Iyamu, 2022).

The institutions strive to improve students' academic performances. In doing so, both the University of Cape Point (UCP) and Table Mountain University (TMP) formulate strategies that focus on providing support and services to the students. The strategies entail strategic and operational components. At the time of this study, the strategies

were enacted through academic and non-academic staff of the institutions. Thus, the support and services to the students aimed to improve their academic performances were problematised at various levels, from both strategic and operational perspectives. It begins with the head (Vice Chancellor), who problematises the strategies to both academic and non-academic arms of the institution to improve students' performances on all academic fronts.

The problematisation of academic support and services to improve students' performances was hierarchical. Thus, the head of each unit is the focal actor who is indispensable based on the structure of the institution. On the academic front, the strategies were problematised by the deans of the faculties on behalf of the institution. The deans problematise the strategies from a strategic standpoint for the heads of departments (HOD) and other members of the faculty. Thereafter, the HODs problematise the operationalisation of the strategies to the academic staff in the departments. Some of the strategic support and services are research initiatives, research funding for academic purposes, and academic development. Examples of operational support and services are finances (fees) and student counselling. Through the hierarchic approach, the strategies drill down to all levels, including the students. Some of the participants briefly explained from both strategic and operational perspectives as follows:

> "Strategically and policy-wise, it would be linked to all graduate outputs, graduate attributes vision 2030 faculty strategic plan" (UCP_ACA04, P3:117- 119).
>
> "The institution can listen to the students' voices that come as they provide feedback about their experiences" (UCP_ACA04, P1:6-7).

In both UCP and TMP, the hierarchic approach enables the alliance of a collaborative effort among those responsible for problematising academic support and services at various levels. Despite the significance, collaboration remains challenging primarily because of a lack of performance appraisal. As a result, it was difficult to enforce obligations and accountability in the two UCP and TMP institutions that participated in this study. In ANT, the obligatory passage point is a mandatory point of collective action and accountability (Walton, 2013). This has an impetuous effect on the academic performances of the students. According to two participants in the study:

> "There's such a lack of consistency in how each faculty deals with a call that comes through regarding academic support" (UCP_ACA04, P2:79-80).

> "We are now partnering with the SRC so that they can also assist us in our advocacy stream. We did an activity with the SRC just recently. We knew that the lift in that building was not working and we asked the SRC if you needed crutches to get to the second floor. It was eye-opening to them" (UCP_NAC01, P13:500-502).

The academic hierarchy (Deans and HODs) employs two main methods in problematising the issue of improving academic performance in UCP and TMP. The first method is through podcasts, used to disseminate important information to employees and students. The other method is itemised in the agenda at both departmental and faculty meetings. The communication is translated by individuals and groups to associate meaning to them. Thereafter, they find ways to implement their understanding. The staff varies their understanding with each other towards providing improved support and services to the students using various means, including IT solutions such as the Blackboard, automated processes, and management learning systems.

In UCP and TMP, some lecturers (academics) problematise issues through the representatives of the students. For example, a lecturer informs the representative about the forthcoming assessment and the mode to be followed. The lecturers employed various media such as technology (e.g., Blackboard) to problematise the issues with the students' representatives. The class representative also uses several means to disseminate the information to classmates. At the time of this study, WhatsApp application was the common technology used by students to disseminate information and communicate within their networks. Translation of the problematised issues is not always successful (Callon, 1986). Hence, a student may contact or consult with lecturers directly to get further clarification. One of the students explained:

> "Once we met our lecturers and tutors, they gave us their WhatsApp numbers and put us in the WhatsApp group so we could contact them whenever we needed help" (TMP_STU05, P2:39-41).

The non-academic unit focuses on both academics and students in UCP and TMP. Like academics, the non-academic problematises the goal to provide support and services towards improving students' academic performances through units and levels in the institutional structure. The support and services offered by the non-academic units include funding, healthcare, and counselling. These support and services are critical. Some of the students and staff briefly related their experiences concerning these units as follows:

> "There's a massive attrition rate, failure rate, and dropout rate at all levels in the institution" (UCP_ACA09, P2:46).
> "tracking academic performance" (UCP_ACA04, P6:230).

The non-academic units support both students and academics through tasks assigned to individuals (human) using IT solutions and automated processes (non-human) means such as IT solutions. Another common factor in UCP and TMP was a lack of performance appraisal. Even though there is no performance appraisal to measure the tasks, some employees in both institutions had contractual agreements with the institutions. This is a form of systematic OPP. The systematic approach in the institutions can be viewed from two angles. First, it enabled the contractual agreement, which helps to follow the actors and trace the tasks when they are carried out. Second, how to account for the translation of improvement of students' academic performance initiative becomes problematic. Problematisation requires that the focal actor (head of unit) brings together all the actors through an OPP means. The effect is explained by some participants:

> "The writing centre is such an important facility for the students; the whole thing is about student success. I think one of the reasons they're not interested in the writing centre is because they can't measure it. They want to have things that they can measure. I don't know how and to what extent they're measuring their first-year experience and whatever other things that they're implementing that are putting more resources into" (TMP_NAC02, P5:172-176).
> "Especially with exams, we can be oversubscribed, and we are understaffed. Let me explain: we are five staff members at the disability units, and we have approximately 400 students with disabilities" (UCP_NAC01, P2:48-50).

In UCP, academic performance involves everyone who encounters the customers, who are the students. This process is ongoing, with shifting alliances as the needs of the students change or expand. According to Bengtsson and Ågerfalk (2011), a process of shifting alliances makes a network unstable. The instability creates a challenge for the problematisation process in some units, which forces the intervention of the Student Representative Council (SRC) and trade unions. The intervention of these entities further creates instability in some units, which affects the quality of support and services. One of the participants briefly explained:

> "We feel like TMP's top management needs to change, and I don't think they're progressive enough for modern times. I think they are

> stuck in the old ways. For example, if students are protesting and maybe you know on the side, you don't call the police on students on their campus. Students are meant to feel comfortable on campus" (TMP_STU04, P6:183-186).

There are fundamental factors in the problematisation of academic improvement of the students from two primary perspectives. On the one hand, the alliances are more vertical than horizontal, which suggests that the academic and non-academic staff are embroiled in weak relationships. This is despite having a common interest in providing support and services to the institution's academic activities. On the other hand, through the alliances, the goal to improve students' performance is translated. However, the operationalisation of materialism (such as text and podcasts) remains challenging. Hardy and Williams (2008) suggest that such initiatives must be translated into local practice, which is from top to down levels, using the OPP notion. Through this approach, the interest, including the types of interest, can be identified, and a better understanding of the trajectory can be gained.

Moments of Translation: Interessement

Interessement is the second phase of moments of translation. According to Nehemia-Maletzky, Iyamu and Shaanika (2018), this phase is where the actors are motivated by the problematised issue and become part of the network. Within this phase, the actors have accepted the roles and tasks given to them within the university, especially regarding academic performance (Iyamu, 2022). According to Callon (1986: 203), "Interessment is the group of actions by which an entity attempts to impose and standardise the identity of the other actors it defines through its problematisation".

As in problematisation, interessement is an ongoing process and not a once-off exercise (Mpazanje, Sewchurran & Brown, 2013). At the interessement stage, actors employ various strategies and mechanisms in convincing other actors to join the network. Although the institutions, UCP and TMP have problematised their visions to improve students' academic performances, individual and group translation influenced interest. Thus, the actors within different networks (faculties, departments, and units) have different interests in students' academic performance. In addition to translation to attract interest, roles and responsibilities influence the interest of the support and service providers (academic and non-academic staff). Also, the preferences of mechanisms for providing support and services sway the interest. One of the participants shared her views as follows:

> "When there is a case, we would also want support from the

> Transformation Department. It's an intricate field because there are human rights attached to disability. We also work with legal" (UCP_NAC01, P13:481-483).

Some academic staff were assigned subjects, not their first choice or preference. Lecturing choice or preference is determined by specialisation and experience. However, certain circumstances arose where limited resources and a lack of availability of lecturers resulted in allocating personnel to teach certain subjects. Consequently, some lecturers' interests were waived. When this happens, some lecturers often avoid the students because they are worried they may be confronted with difficult questions in subjects they are not deeply knowledgeable about. Some of the students shared their experiences as follows:

> "It is very discouraging when you work hard on your assignment. You want to submit it just before the deadline, and you're struggling, and sometimes students give up. I had this one lecturer. I struggled to submit the assignment and just emailed him the assignment, and he instructed us not to email him assignments. We must submit it on Blackboard. I told him I tried to get hold of CTS, and they are not picking up. Can you please accept my assignment? And he did not want to. I could just imagine students giving up" (UCP_STU03, P3:86-91).
>
> "You find yourself in a predicament, and you need support to sort out your predicament, be it a thesis submission or a supervisor who is not doing their job. And that is, for me, a big struggle, especially if that is a designated person for that specific task or for that support that you need, but then that person is not doing their job" (TMP_STU02, P5:196-200).

However, there were opportunities for negotiation between the academic head and the subordinates. Despite such an opportunity, some academic heads in both UCP and TMP continued to demonstrate that the relations between them and their subordinates are based on power. In ANT, a power relationship infers, at least in potential, a tactic or scheme of struggle between two or more entities. Interessement allows the practice of continuous negotiations through which claims are tested and positions are shifted (Sage, Dainty & Brookes, 2011).

Also, the HODs judgementally allocate subjects to the lecturers using the power bestowed on them through the institutional structure. As a result, some lecturers were

more favoured than others. This often causes conflicts, which affect the interest shown in the problematised issues to provide support and services to the students at all levels. It is in such similar circumstances that Sage, Vitry and Dainty (2020) suggested that the interessement process is both rational and effective. One of the lecturers briefly explained:

> "I deal with a lot of administration, making sure the students' registration issues are taken care of. I do student appeals. I manage the appeals and marks processes and ensure everyone's assessments are marked on time and uploaded. I go into their blackboards to check that they are doing their work. How on earth has that become the job of another academic? I still don't understand how you have to go and check people who are permanently and full-time employed in an institution of higher academia. You have to check that they are doing their jobs. It is shocking" (UCP_ACA03, P5:180-186).

At UCP and TMP institutions, the students show interest in many departments. This ranges from using the library to going to the counselling unit. From the management perspective, interest is shown in the academic performance and the retention of the students. Reciprocally, students began to show interest in the support services offered by the units. This was based on three fundamental factors: attractiveness, limited options, and essentiality. First, the support and services in TMP became more attractive due to a change of approach by the responsible authorities and staff. Second, some students showed interest in certain services because of the limited options they had. For example, students have been approaching the counselling unit, as they are not just there to see the students emotionally, but they deal with students holistically, even supplying food parcels when required. Third, financial aid, counselling, and healthcare offered by the institutions, UCP and TMP, were essential to the students. As a result, they embraced the services irrespective of how they were provided. Some of the students shared their views and experiences:

> "Leverage technologies and information resources for recruitment and retention efforts and support student services" (UCP_DOC1_Objective 1, P10, 335-357).
>
> "Students are pre-booking, showing interest in something, *in the counselling unit*" (UCP_NAC02, P3:89).

The non-academic staff show interest by attending meetings relating to students and staff. The interest is informed by various factors such as contractual obligation and accountability. Some employees' interests were based on delegated responsibility in

both UCP and TMP. Consciously and sometimes unconsciously, the meetings were used to coax colleagues to show interest in improving the efficiency and effectiveness of their services to students. Also, some non-academic staff had relations (family members) in the studentship, which motivated them to show interest in the activities of improving the student's academic performances through the institutions, UCP and TMP strategies. Two staff members at UCP and TMP explained:

> "We had a meeting last week where one of our HODs said they've got stressed students, and their department's returning students don't want to continue anymore because they don't have residence. That has an impact on the students emotionally and mentally. So much so that they want to cancel the programme, which will also have a knock-on effect on academic performance. That is also something that I don't think even I, as a faculty office person, take into consideration, especially since these students are so stressed with residence" (UCP_NAC02, P7:242-247).
>
> "There are also the student peer facilitator groups. We have now recently established, in the department at our university, an IT society focusing on IT students where they've set up mentoring and support for fellow students. It's run by students for students. So they will assist those students who are struggling with learning Java, for instance, or learning Python, and set up meetings with them whenever they are available" (TMP_ACA03, P1:20-24).

The academic staff is part of several meetings where interest in academic performance or student success is shown and discussed. From the students' side, they are interested in their academic performances and successes. The students showed their interest by going to the library, the writing centre, and e-learning. This interest enabled them to form networks with their colleagues and academics (lecturers). The student networks were formed within departmental and subject colleagues to fortify support units and study groups. Indeed, as Callon (1986: 209) fathomably puts it: "It is certainly difficult to silence human beings definitively, but it is more difficult to speak in the name of entities that do not possess an articulate language: this supposes the need for continuous adjustments and devices of interessement that are infinitely more sophisticated". Consequently, enrolment becomes crucial to the extent it is fundamental to success.

Moments of Translation: Enrolment

In this stage of translation, human actors need to participate in the activities. Enrolment

is defining the key roles and practices in the network (Callon, 1986). As actors enrol, they account for the translation of 'knowledge' that they have gathered from the problematisation to interessement moments. The knowledge is no longer imaginative but practically useful in finding solutions to the problematised social construct, which is students' academic performances. Hardy and Williams (2008) argue that this means translating an "idea" into practice, which includes traversing the obligatory passage points and inscribing the meaning to the participating human actors.

Both students and the institution participate in the events, activities, and processes intended to improve students' academic performances. Thus, both institutions, UCP and TMP, had several programmes for the benefit of the students. The UCP had programmes that allowed the students to experience matters to assist them in their studies and also in preparing the students on how to create a CV and have the ability to attend and interview successfully. The department prepares the student for the world of work. Also, despite the enthusiasm informed by interest to participate in academic activities such as assessments, some students did not have the necessary infrastructure such as a computer. In such circumstances, UCP and TMP provide infrastructure support. Some of the students shared their experiences as follows:

> "So, we offer both of those, or the institution offers final year experience and 1st-year experience, and we participate in that as a faculty" (UCP_ACA04, P3:93-95).
>
> "When writing online tests, some of us have to go to the IT Centre, where there is free access to computers and the Internet" (UCP_STU08, P6:209).

In enrolling for academic support and services in both UCP and TMP, the use of IT solutions was critical at the time of this study. Therefore, how the IT solutions were applied remained crucial because it enables and constrains as well. Thus, human actors employed their power to account for and demonstrate their knowledge about IT solutions where support and services to students were concerned. From both enablement and constraint perspectives, power dynamism was often employed in the implementation and use of IT solutions. Also, from both perspectives, IT solutions consist of connectivity, integration, and automation.

From an enablement angle, IT solutions enable access (connectivity) to the university computing network and the Internet. The IT solutions were employed to integrate systems and subsystems, and automation of processes. Employees, mostly non-academics of the university, were assigned the tasks, roles, and responsibilities of

executing (implementing) the use of IT solutions. The task allocation was hierarchised, covering the strategic to operational levels. It begins from the top management (strategic level), including the VC, deputies to the VC, deans and directors, through to heads of departments and units. The heads of departments and units operationalised the tasks of providing support and services to students to improve academic performance. The allocation was defined according to roles and responsibilities guided by the structure of the institutions, UCP and TMP. One of the participants explained as follows:

> "Our university has executives, the normal rector VC, and one for academic research innovation. We've got student development and support, an executive and titles like Deputy Vice Chancellor for student development and support" (TMP_ACA01, P1:14-16).

From the strategic to operational levels, the allocation of tasks was defined by three main factors: areas of focus, specialisation, and skillset. Depending on the tasks, such as computing network administration and systems management, tasks were assigned to improve students' academic performance. The allocation of tasks was enacted by the contract between the employees and the institutions. The unit heads further assign the tasks to the employees contractually. The success of a support mechanism depends on the available skills and knowledge of the services to the students. Individual skills and levels within the institutions' structure helped to define the allocations of tasks. For example, the disability unit has been tasked to deal with students with any disability. This department understands that it cannot be the sole unit to service the students. It works with other departments such as counselling, maintenance and legal. Together, these units can service these students holistically, which assists them in achieving success.

The allocations of tasks were intended to ease students' access to the university computing network, to access resources such as online books from the library and to upload assignments. However, the integration of systems and subsystems was not always easy. One of the reasons for this was that the systems and subsystems were overly centralised. On the one hand, the centralisation was to enforce the standardisation of IT solutions across the institutions. On the other hand, negotiation hardly shifted, which led to the stagnation of systems and subsystems' functions. One of the participants explained certain satisfaction that manifested into poor service delivery, as follows:

> "Electricity interruption causes the computing network and the internet to be unavailable. As a result, I can't access online resources. This has

> significantly impacted my studying and learning" (UCP_STU05, P2:68-69).

Both students and the institution's employees encounter constraints in providing and receiving support and services to improve students' academic performances. The constraints were embedded in technical (IT solutions) and non-technical (processes) factors because they impact one another. Some of the key constraints were the durability of materials, availability of resources, and the contractualisation of participation. The durable materials (resources) were not embodied as a set of relations between actors' needs and provision. Resources (humans and non-humans) were limited in some areas. For example, there was a lack of skill in the writing centre and disability unit in both UCP and TMP institutions in terms of providing services. The contracts between the employees and UCP and TMP were also impediments. The tasks could not be enforced through an OPP, which affected some services that were provided to the students.

Moments of Translation: Mobilisation

Mobilisation is the last stage of moments of translation. The stage is regarded as successful when the actors in the network start drawing other actors to become involved (Iyamu & Mgudlwa, 2018). Mobilisation is a process driven by spokespersons (Callon, 1986). The spokespersons are either appointed or volunteered. At both UCP and TMP, the heads of faculties, departments, and units were appointed, and they acted as spokespersons to the problematised entity. Also, the heads delegated others when and where necessary. This expanded the group of spokespersons, which increased the chances of getting more alliances from both studentship and staff into the network.

Mobilisation occurred as human actors or alliances began to support the initiative to improve students' academic performances. Also, mobilisation was vested in the dynamism of the power that existed within the institutional structures. This made shifting negotiations between the actors limited, which potentially derailed the initiative. This includes, on the one hand, a challenge that existed between academics and students and non-academics and students. On the other hand, the challenge created conflict between academic and non-academic staff. The limitations in shifting negotiation in the process of mobilisation affected services to the students. Some of the students shared their views as follows:

> "For the student counselling department, there is a waiting period, I think, for two months or so that's a big problem because I feel like if you have a problem and want to see like a counsellor now. Some

> people can end up doing something they were not thinking about, like maybe if they are under pressure or something they are not, they end up doing things because it takes a long time for them to respond" (UCP_STU08, P4:114-117).
>
> "The fact that I don't have access or struggle with my password at times does affect my academic performance because it also hampers me from getting, let's say, a slideshow I wanted to quickly just double check something. Now, I can't access the PowerPoint with the notes on it, and I don't know how to wrap up this chapter. So yes, access affects my academic performance" (TMP_STU02, P4:338-342).

Thus, senior management takes leadership in driving the initiative (or strategy) to improve students' academic performances. Several mechanisms, including workshops and training programmes, were used to mobilise human actors to be part of the initiative. Some of the mechanisms were an automated OPP and delegations. The mechanisms were applied at various levels within the structures of the institutions, UCP and TMP.

The faculties, departments, and units remain unstable primarily because not all the human actors align with the initiative of promoting the academic performance of students. Callon (1986) explains that when all the actors within the network are satisfied, according to the interests attributed to them by the focal actor, it has passed an OPP and stability is reached. However, many employees do not execute the assigned tasks, which creates instability in the network (department and units) in the context of ANT. However, there are automated OPPs in some areas and activities within the academic sphere of both UCP and TMP institutions. For example, as mentioned by two participants as follows:

> "So last year we had two part-time staff because we had two staff members going on maternity leave. We're happy for them, and I was dealing with two staff members because the handover was not effective. After doing the handover interviews, I ended up babysitting the staff members in addition to my workload" (UCP_ACA03, P5:190-193).
>
> "We have a vision of what we want to achieve, and management asked us to do strategic planning. So, if you are totally understaffed, how can we plan strategically" (TMP_NAC02, P6:225-227)?

In attempts to mobilise and increase a high number of employees and improve the

support and services that are provided to students, some heads delegated roles and responsibilities to other actors. These actors do not only buy into the initiative, but they also become spokespersons due to their new roles. The non-academic units, such as Student Affairs, understand the importance of their roles and responsibilities, and they strive to align with the academic faculties and departments. This is intended to gain a better understanding of other factors that influence students' performances. Two of the participants who seem to echo others' sentiments explained as follows:

> "We had a meeting last week where one of the HODs reported that some returning students in his department were stressed students. A lack of accommodation contributes to the stress. As a result, some of them do not wish to continue with their studies" (UCP_NAC04, P7:242-244).
>
> "For the first-year experience, we work with student counselling. However, we also work on the final-year experience and student counselling when we do webinars and workshops for students leaving the university, preparing them for a working world. So, we have a diverse view and programme within student affairs, which will also align us" (UCP_NAC01, P6:215-218).

Challenges of mobilisation are because of contextual issues between the studentship and the institutions. Mobilisation is a continuous process which unpacks and shapes the trajectory of the initiative to improve students' academic performances. Callon (1984) argues that actors buy into the process by being part of the process. However, students are often not included in the planning or processes. In addition to the contextual issues, many students are unaware of some support and services that are of benefit to them. For more students to buy-in, there is a need for awareness of the service.

Another method used in mobilising the staff was through programmes. The Department of Higher Education initiated the Extended Curriculum Programme (ECP), and then the institutions bought into this programme. The programme was filtered down to the department and unit level by the spokesperson. Some departments have bought into the ECP programme, and they have become ingrained in it and inscribed the idea into the employees who operationalised it. This increases the number of spokespersons and continuously supports the programme. Some participants shared their views as follows:

> "Instead of having the underprepared compete with a very prepared student in the same classroom, that is how ECP was conceptualised" (UCP_ACA09, P2:51-53).
>
> "So, we went with each other's strengths and what it is that you like to

help the students" (UCP_ACA10, P2:53-54).

"We support our academic interventions through our assessments and teaching strategies. We identify who needs extra help or where we could assist the student." (UCP_ACA10, P2:56-58).

Within the institution, there are human and non-human actors, and ANT uses these actors to see how they impact the academic performance of students. In the section above, we discussed how humans problematised issues. By following the human actor's influence on academic performance, the non-human aspects of the institution should enhance this aspect to a higher level.

5.4. Findings from the analysis

From the analysis of the data presented above, the factors influencing the systems used in providing support to students in their academic activities, including their academic performances, were revealed. The factors, as listed below, are from technical (technology) and non-technical (human) perspectives:

i. Mechanism for measuring
ii. Contractualisation
iii. Leverage synergy
iv. Automation – automated OPP
v. Operationalisation – strategic and operational
vi. Integration
vii. Connectivity

The factors are interpreted and discussed in the chapter that follows.

5.5. Summary

The chapter presents the analysis of data collected from two institutions, UCP and TMP. Comprehensively, the analysis was guided using actor-network theory. The analysis focuses on examining and gaining a better understanding of the systems and approaches used in providing support to students in their academic activities. Understand the factors that influence, from the analysis factors influencing students' academic performances are highlighted from human and technological perspectives. The findings are discussed in the following chapter.

CHAPTER 6
INTERPRETATION OF FINDINGS

6.1 Introduction

As discussed in Chapter 3, data was collected from two academic institutions, the University of Cape Point (UCP) and Table Mountain University (TMP). In Chapter 5, the data analysis is presented, and the findings are listed. This chapter presents the interpretation. The findings are based on the analysis of the data collected. The interpretation aimed to provide a system design for the development of a Robotic Process Automation (RPA) system.

This chapter is organised into five main sections. The first section is the introduction. The second section provides an overview of the findings. The interpretation of the findings of the previous chapter as per the objectives of the study is discussed in the third section. The next section discusses the design of the RPA system for academic performance. The last section summarises the chapter.

6.2 Overview

A tenet of Actor-network theory known as the moments of translation was used as a lens to guide the analysis of the data collected from the two universities, as presented in Chapter 5. The findings from the analysis were also listed in Chapter 5. This chapter presents the interpretation of the findings following the subjective approach. The interpretation of the findings is aimed at achieving the objectives of the study. The subjective approach is employed in the interpretation of the findings for the following reasons: (1) the study is qualitative and allows for an interpretive approach, which enables different views from both ontological and epistemological standpoints (Iyamu, 2020); (2) therefore, it enables the researcher to socially construct meaning (Sahaym et al., 2023; Wall & Palvia, 2022); and (3) through the social construct, new insights can emerge and be induced into the phenomenon being studied.

The study has two objectives. The first objective is to understand the factors and challenges that influence students' academic performances. The second objective is to examine and understand the systems utilised in the universities and the approaches used to provide support to students in their academic activities. The study thus aims to design a robotic process automation (RPA) based system for assessing students' academic performance in South African universities.

6.3 Interpretation and Discussion of Findings

The interpretation focuses on how the findings manifest into other factors towards achieving the study's aim and objectives. Thus, the interpretation is conducted in three steps, but it is related. The first step categorises the factors (findings) into technical and non-technical entities. The second step focuses on how the factors manifest. In the third step, both technical and non-technical factors are combined, and the links (relationship) between the factors are shown.

Step #1: it distinguishes the findings into technical and non-technical factors, which make up the requirements that determine a system design for an RPA system development. The factors are categorised into technical and non-technical factors. The categorisation is in this context, as revealed from the data analysis. This answers the first research question and, by default, achieves the first research objective, as presented in Chapter 1 and revisited in Chapter 3. As shown in Table 6.1, there are four and three factors for technical and non-technical entities, respectively. The factors are discussed in subsections 6.3.1 and 6.3.2.

Table 6.1: Systems Influencing Factors

Findings	Technical	Non-technical
Measurement Mechanism	X	
Contractualisation		X
Leverage Synergy		X
Automated OPP	X	
Operationalisation		X
Systems Integration	X	
Connectivity	X	

Step #2: A further interpretation was conducted to gain a deeper understanding of how universities utilised systems to support students in their academic activities. Thus, the interpretation's second step focused on how technical and non-technical factors manifest into various attributes. The attributes reveal the roots of influence in the systems and approaches used in providing support and services to students for their academic activities in both the UCP and TMP institutions that participated in this study. This achieves the study's second objective, which was to examine and understand the systems utilised and the approaches used in providing support to students in their academic activities. The manifestations of both technical and non-technical factors are shown in Figures 6.1 and 6.2, respectively. The factors are highlighted in colour, while the attributes are plain.

Step #3: A further detailed process consisting of two phases was employed at this stage. In the first phase, technical and non-technical factors were combined, as shown in Figures 6.1 and 6.2. In the second phase, the manifestations of the factors revealed from the second step of the interpretation were further examined. Based on this, links and relationships between the factors, which are the connecting elements, were articulated. As shown in Figure 6.3 (System Design for RPA), the links are captioned with the elements. Thus, it provides a design guide that can be used to develop an RPA-based system to assess and improve students' academic performance in South African universities. The system design is presented and discussed in section 6.4 below. Therefore, the study's aim, as stated in Chapter 1, is achieved.

6.3.1 Technical Factors

The technical factors influence how IT solutions are deployed and used to facilitate the institutions' operations. Table 6.1 presents the technical factors influencing the institutions, UCP and TMP environments: Measurement Mechanism, Automated OPP, Systems Integration, and Connectivity. This means that the factors can enable and, at the same time, constrain the deployment of IT solutions in the UCP and TMP environments. The IT solutions include systems, computing networks, and databases. The factors are critical because they influence technological innovation and productivity, focusing on improving the efficiency and effectiveness of support and services provided to the students.

The technical factors help to understand the systems and approaches that were used in providing better support to students in their academic activities. More importantly, these factors shape the design of future systems and innovations.

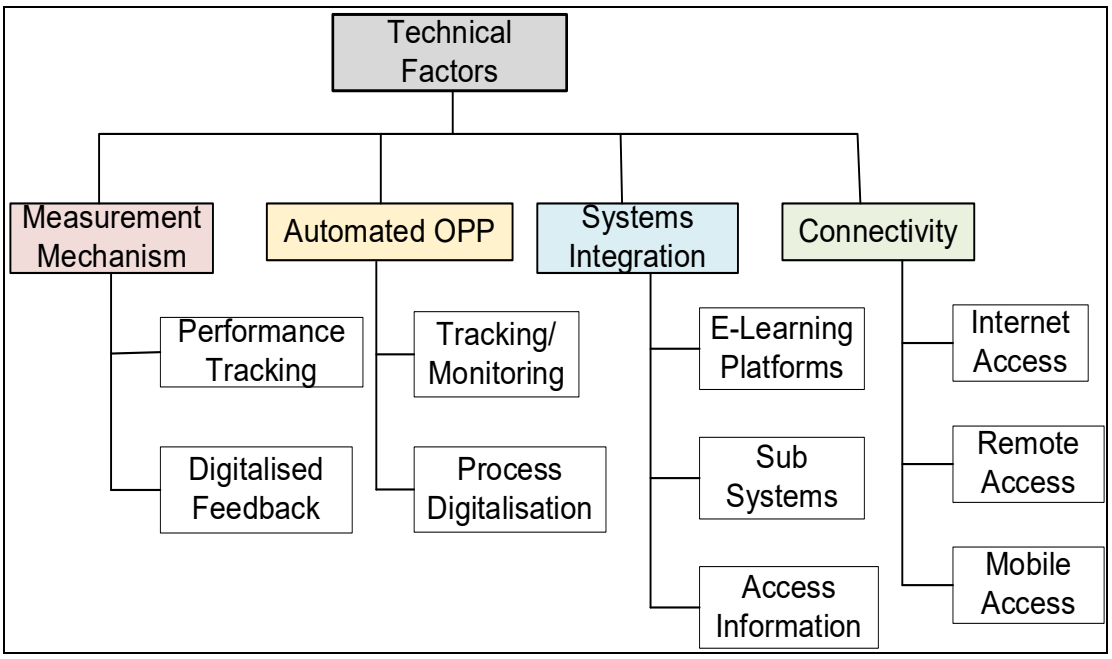

Figure 6.2: Technical factors

Measurement mechanism

Measurement is a technique for determining the properties of an entity. Measurement is fundamental to the application of processes and activities, including task deliverables. Bagozzi (2011) suggests that measurement is important because it provides conceptual specifications of the constructs for which the indicators are proposed to measure. Although measurement is often associated with numbers such as amount and extent, it also applies to quality. Thus, it is embedded with a mechanism, a means or process of expressing an outcome prescriptively and descriptively. The mechanism enables a process of achieving goals, objectives, and aims based on the justificatory knowledge underlying the system (Gregor, Chandra Kruse & Seidel, 2020). Through mechanisms, processes can be reconfigured to create and recreate value (Shollo et al., 2022). It modifies input into a set of outputs towards desires. RPA appropriately fits. It configures a programme that is rule-based and uses a sequence to automatically complete processes (Mishra et al., 2019).

The measurement mechanism conceptually defines the construct, strategically identifies the value variables, and operationally highlights the benefits and challenges of the outcomes. The measurement mechanisms couple both technical and non-technical aspects (Iannacci, Simeonova & Kawalek, 2022). The measurement mechanism routinises analysis for assessability, which is required in improving the support and services provided to the students of UCP and TMP. In doing so, the RPA is most appropriate for digitalising students' feedback and tracking their performances. Allam (2022) argues that *analytics empowers RPA to make a more informed decision, adapt*

to environments, and enhance performance.

Connectivity

Connectivity is the ability to connect IT solutions using various devices. The university employs computing systems to carry out its processes and activities, including a learning management system (LMS), databases for students' academic records, and academic performance analytics. Sonnad et al. (2022) argue that institutions increasingly employ systems primarily to improve connectivity, interact with other systems, and deliver data to the administration at any time. For example, the Internet allows students to access information, including learning materials. Internet access enables students to work remotely, which allows them flexibility and convenience (Alanzi & Alfraih, 2023). Also, the connectivity enables both academic and non- academic staff to work remotely, providing support and services to students when necessary. Therefore, connectivity enhances learning and improves academic performance because of access to course content.

The effects of not having access means that resources become inaccessible, and students cannot communicate with their lecturers or peers. Hybrid or online classes are becoming more acceptable; for this reason, students who apply are not residents within the immediate area. Student learning and postgraduate supervision are increasingly conducted remotely. Therefore, poor or a lack of connectivity derails academic activities. One of the significance of this is that academic sessions are semesters, which makes the time factor critical. Thus, remote access must not become challenging when connecting to online classes and uploading assignments (Shibambu & Mojapelo, 2024). With technological advancements, such as RPA, connectivity should be improved. An RPA-based system can limit or eradicate connectivity disruption, allowing employees (academic and non-academic staff) to improve their effectiveness and efficiency. According to Syed et al. (2020), RPA helps to reduce common errors such as incorrect data inputs.

Systems Integration

Systems integration is about the consolidation of technological resources to increase accessibility, enhance availability, and reduce complexity (Atabek, 2020). The systems integration focuses on e-learning, consolidating subsystems, and digitalisation in accessing information in both UCP and TMP. Thus, technology integration measures how students and academic staff use digital technologies to perform learning activities (Schmitz et al., 2023). From an education environment perspective, Antonietti et al. (2023) argued that integration enables interactive construct among scholars and

learners. For example, E-learning has always allowed students access to course content and online assessments (Alhabeeb & Rowley, 2018). Also, each subsystem has its functionality and is used in different aspects to improve the management of activities and data. However, some systems, including the e- learning application, are standalone, which causes disparity, duplicated efforts, and complexity. The systems can be better integrated using RPA. Syed et al. (2020) explained that with RPA, efficient processes have been experienced, and staff productivity has improved in many organisations.

Institutions have multiple systems, which can either stand alone or be integrated. These systems are interconnected to enhance academic performance. According to Lacity, Willcocks, and Craig (2016), RPA software can easily access all systems and manage infrastructure. This software does not alter information but can extract it. RPA is also a user- friendly tool that provides solutions for application integration, automating applications, and handling other IT tasks and processes.

Automated Obligatory Passage Point

Automated OPP is two concepts. Automation and obligatory passage point (OPP) are merged. Simplistically, automation is the application of technology to automatically produce an outcome. Automation solves problems relating to processes (Mishra et al., 2019). The concept of OPP from ANT does not provide an option. It is where the decision is made as legitimate knowledge, and it is irreversible (Walton, 2013). It is the result of "translations", after which the human actors would have no choice but to accept the OPP (Callon, 1986). Thus, automated processes are enacted with OPP. RPA automates processes that have passed through OPP to power UCP and TMP to improve the efficiency and effectiveness of support and services.

Process automation prevents unnecessary human interference in processes and in the tracking of student's academic activities. This includes monitoring of students' progress. Also, automation can enable the gathering of feedback from students in terms of support and services provided to them towards improvement. Automation allows students' performance, attendance, and participation to be tracked automatically to detect and identify students with poor academic records and allow for interventions (Mishra, 2014). Digitising administrative and academic processes can reduce time spent searching for information and reduce manual tasks. This process also fosters greater accuracy of the information due to less human intervention. Digitisation allows for convenient information access. These automated processes can assist with feedback and progress tracking With an RPA system, the systems can be integrated,

and due to digitisation, academics and students have current, timely information. In an RPA environment, process digitalisation leads to accurate and efficient information (Shidaganti et al., 2021). Using this software can lead to improved services for students, academics, and non-academics. These authors argue that RPA can be used for data, customer, and process tracking.

6.3.2 The Non-technical Factors

As shown in Figure 6.2, the non-technical factors include communicative, management, and interpersonal entities. In this study, as revealed from data analysis, the non-technical factors are leverage synergy, operationalisation, and contractualisation. Baysal et al. (2016) suggest that non-technical factors can significantly influence outcomes. According to Ibitomi and Iyamu (2023), non-technical factors influence the challenging constraints of IT solutions in many organisations. Non-technical factors influence students' academic performances in both UCP and TMP, as discussed below.

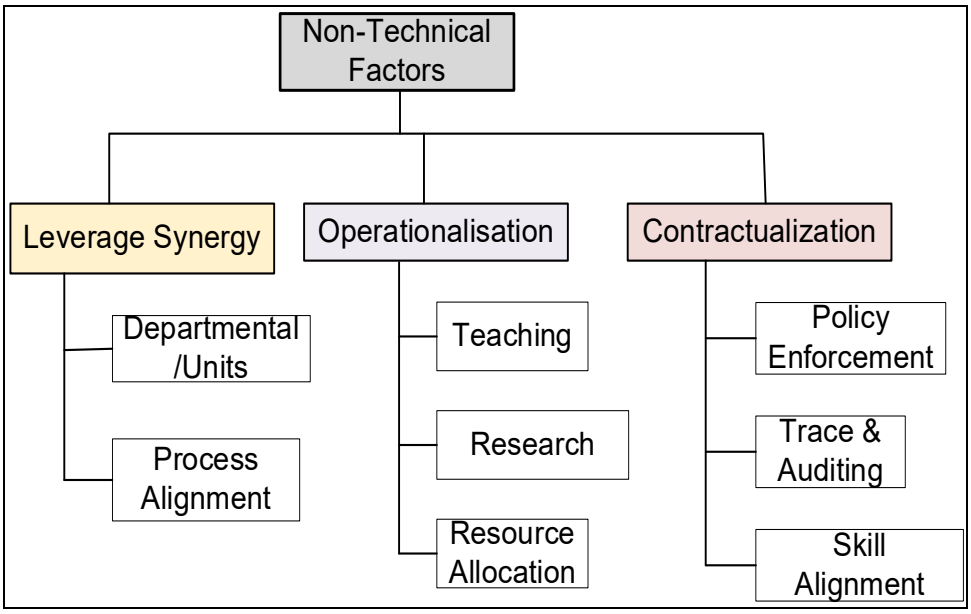

Figure 6.3: Non-technical Factors

Leverage Synergy

Leveraging direct force towards transformation and synergy entails the complementarity of processes and activities. Consequently, leveraging a synergy necessitates the dismantling of parallelism and enforcement of amplification of the relationship between departments and units. Many institutions have struggled to create process alignment between their departments or units (Tafti et al., 2022). This is despite the premise that leverage enables the ability to apply the process and activities of departments and units. The challenge is attributable to the fact that leveraging synergies is limited in the literature (Yoshikuni & Dwivedi, 2023; Rehm & Goel, 2017).

Effectively, leveraging synergy extends the resource base for collaborative efforts and engaging in multiple innovation actor-networks.

Leveraging synergy allows the institutions to take advantage of the strengths and identify their weaknesses or gaps. Also, leveraging the notion of synergy allows for the flexibility of processes and the allocation of resources to improve performance effectively (Nguyen et al., 2023). The departments and units can create synergies by translating their activities and processes towards providing services and support to students. Leveraging synergy enacts transparency into the complexity of processes and activities of autonomous structures (departments and units). The concept of leveraging synergy provides insight into process alignment (Tafti et al., 2022). Despite its challenges, leveraging synergy can be achieved through an inclusive approach to creating dynamic innovation networks (Rehm & Goel, 2017). Thus, leveraging synergy enables the mobilisation of innovative efforts, such as robotics systems, to provide improved student support and services.

Operationalisation

To operationalise is to put into practice. Therefore, to put the strategy of a higher education institution into practice, there are three fundamental attributes, which are teaching, research, and resource allocation. It involves identifying the attributes that are critical to educational institutions. Cui, Tong and Tan (2022) explained how operationalisation is used to support quality and growth activities. Operationalisation entails processes that must be defined clearly and ambiguities avoided. The processes enable the attributes to be observed and measured to improve students' academic performance and achieve the institution's goal. Butler (2022) suggests that through these processes, the attributes are identified and compiled for operationalisation to achieve goals and value. Hence, developing and employing an RPA- based system is critical to facilitate the operationalisation of the universities' processes and activities.

Although the operationalisation of processes and activities is a catalyst of a differentiator in an institution, the challenges remain. This is because how operationalisation manifests in the processes and activities of teaching, research, and resource allocation is unknown from an empirical perspective. Empirically, Heeks and Ospina (2019) revealed that when the operationalisation of attributes is skewed, resilience is challenged. According to Iyamu and Batyashe (2020:2), this challenge is primarily caused by the lack of an understanding of the factors that influence or dictate operationalisation in an organisation. Through operationalisation, teaching and research, including allocation of resources, can systematically (an RPA-based system)

be put into practice in full by involving all the actors in problematising the phenomena.

Contractualisation

Contractualisation is a practice of hiring and managing the relationship between the employer and employees within a legal threshold. It entails policy enforcement, tracing and auditing of activities, and skill alignment. Contractualisation is increasingly one of the most controversial practices in many countries and educational institutions, including those that participated in this study (Russo et al., 2018). Understanding the role and the factors that influence contractualisation has never been easy (Parwez & Meena, 2021). One of the reasons is that each term is subjected to various interpretations and meanings. This can be minimised or eradicated by employing a robotic contractualisation process. Hence, each term requires an obligation passage point. However, if the passage points are not automated, it is highly likely to cause further conflict because of the subjectivism employed in areas such as aligning skills with tasks.

The contractualisation of services is deployed in an ecosystem to maximise the added value and improve functionalities and productivity. Morlat, Mougenot and Pinto-Silva (2014) linked functionality with utility within an ecosystem. Passera and Haapio (2011) suggested that contractualisation caused researchers to show more interest in contracting capabilities of strategic intents. It exposes employees and employers to shifting negotiation in terms of policy enforcement, auditing and tracing of tasks, and skills alignment. It causes actors to perceive and employ their power to shift negotiation in the transformation of trends towards contractualisation in the interest of rights (Robertson, 2015). It is one thing to protect the rights of employees, and it is another thing to get the employees to perform their tasks or duties as contractually defined.

6.4 A Design of a System for Robotic Process Automation System

As explained at the beginning of this chapter, an analysis was conducted based on the data collected using ANT as a lens. From the analysis, findings were grouped into two categories: technical and non-technical. The findings were interpreted as presented above. Based on the interpretation following the subjectivism approach, a system design is developed, as shown in Figure 6.3. The design is aimed at an RPA-based system development to improve the efficiency and effectiveness of support and services provided to students at UCP and TMP

The system design defines the architecture, interfaces, and purposes, guided by empirical evidence (specific requirements), consisting of both technical and non-

technical factors. Following the discussion in the previous section (6.3), the system design fulfils the requirements and justifies the need for a coherent and efficient RPA system. As shown in Figure 6.3, the design is structured into three domains: communicative, structure, and governance. Within the domains, the system design focuses on human actors' (stakeholders) expectations and needs, technical requirements, and logical decompositions.

The lines in the system design are captioned with elements that indicate the stakeholders' logic. Logic forms part of the system function conditionality. The elements codification, assimilation, coactive, relationship, correlation, collaboration, synchronisation, interaction, systematism, durability, enactment, and configuration are some of the attributes and characteristics of RPA. Also, the lines help to provide a dialectic process in achieving a balance between human-centred system outcomes and the design of an effective RPA solution. The domains are discussed below. The discussion should be read with Figure 6.3 (systems design).

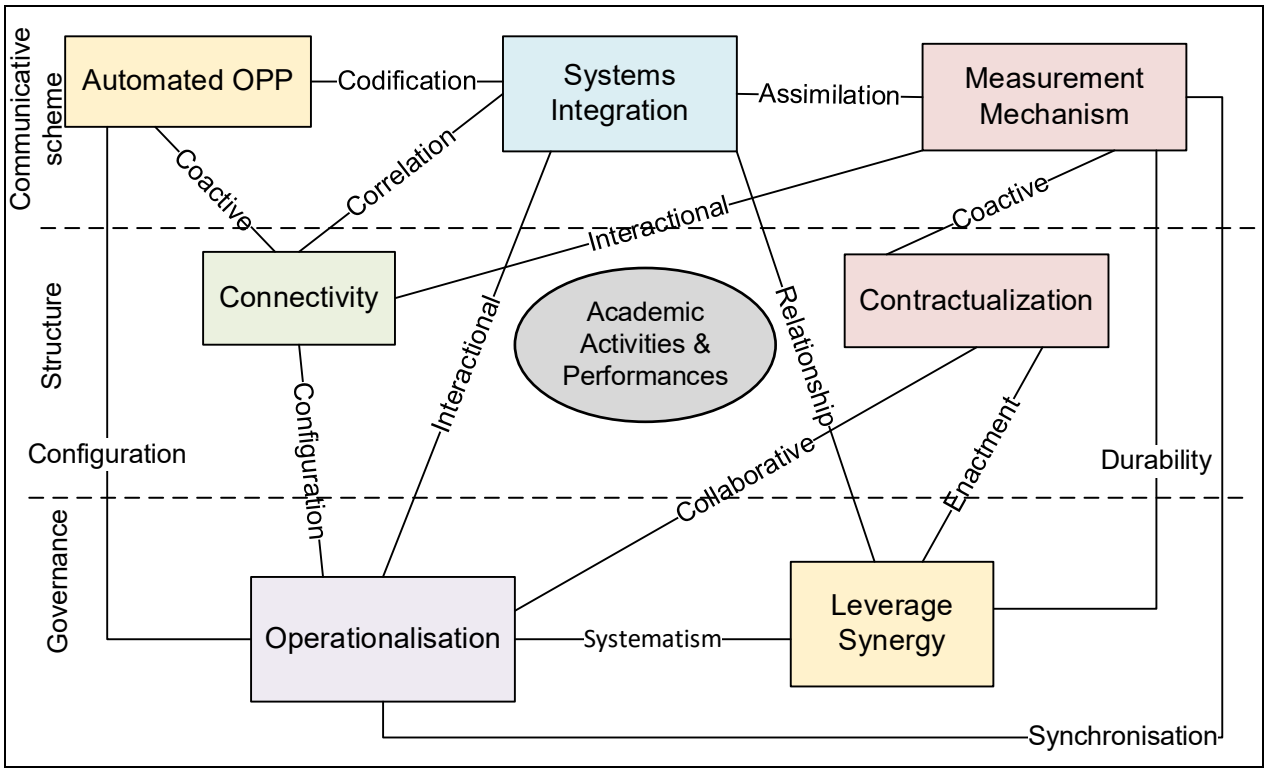

Figure 6.4: Design for RPA Systems Development

i. Communicative scheme

In the context of the study, a communicative scheme is the capability to consolidate and automate technology solutions efforts through elements such as codification, assimilation and correlation, as elements of attributes that emanated from influencing factors. Thus, the elements of a communicative system promote and sustain

effectiveness in the performance- tracking mechanism, which is essential for academic performance (Lin & Chiu, 2013). Tracking allows the actors to be followed, which paves the way for negotiations involving human actors (student and institution representatives). In addition to tracking a student's performance, academic performance increases feedback using the digital format or platform (Sedrakyan et al., 2023). Digitalised or online feedback gives a student detailed information on assessments.

The system design (Figure 6.3) provides effectiveness in developing an RPA-based system intended to enable efficient automated reports, real-time analysis, monitoring, and reporting on the students' activities and performances using an RPA-based system. Codification embeds actions and processes logically. According to Wijnhoven (2022), RPA employs codifying rules for managing persons independently, increasing intelligent decision-making. Attili, Mathew and Sugumaran (2022) explained how assimilation details innovation, including its utilisation and institutionalisation. Shetty et al. (2021) affirmed that correlation provides measures of the cohort elements and attributes of systems. Coactivity necessitates a relational and automated process of interactions between actors (van Dun & Wilderom, 2021). Organisations must allow interaction with environments in a single mode: digital enactment (Shinkle et al., 2021).

ii. Structure

The structure domain organises the factors, attributes, and elements into a strengthened capability to fortify links for automation purposes. Also, the domain facilitates the dimension of services in an automated form. This includes the amalgamation of the learning management system (LMS) and e-learning platform. As shown in the system design (Figure 6.3), the domain connects with other domains through factors such as contractualisation. Morlat et al. (2014) suggest that the contractualisation of a functional solution covers the link between functionality and utility in an ecosystem in its entirety.

Increasingly, IT solutions are being updated to solve connectivity challenges (Sonnad et al., 2022). Chandra, Shirish and Srivastava (2022) described interactional as a human-like conversational between systems, including enabled integration using AI agents. The configurational approach allows the customisation of automated processes and activities (Sandrin et al., 2022). Thus, Shinkle et al. (2021) argued that institutions must limit or stop human interpretation and implement digital enactment systems, where digital technologies autonomously create and act upon information. The interactional process between service systems offers profound insights into the

involved actors, activities, and interconnected relationships (Li & Tuunanen, 2022). The design guides the durability of an automated RPA- based system. Systems can be assessed using durability as a criterion (Zeiss et al., 2021).

iii. Governance

Governance defines the roles of actors (humans and non-humans) in the RPA-based system. IT solutions are operationalised from functionality and utility perspectives to ensure inclusivity and collectivism (Cui et al., 2022). Butler (2022) suggests that the governance domain entails identifying and compiling entities for operationalisation and value achievement. The tasks of identifying and compiling entities are enforced by systematism and synchronisation. Systematism increases the formulation and support of goals and objectives through automation. Yu and Zuo (2022) explained how systematism allows logical relationships between subsystems consisting of a set of indicators. Synchronisation enables integrated optimisation of processes and activities to improve effectiveness (Yan & Wang, 2024). From a governance perspective, systematism and synchronisation are techniques for enforcing the practices that empower academic and non-academic staff in providing student support and services.

The academic departments have distinctive focus and areas of specialisation, which makes their activities autonomous to a certain degree. As revealed from the data analysis, this has both positive and negative impacts on the support and services provided to the students, including complementarity with the non-academic units. There is a need for collaboration between human efforts and RPA-based systems to complement capabilities (Vössing et al., 2022). Relationships between two or more factors or subsystems are measurable through correlation (Kaur, Kaur & Goyal, 2023).

The designed system and study aim.

The design provides a guide for the development of RPA-based systems that can be used in assessing students' performances and, subsequently, enable the improvement of students' academic activities. This achieves the study aim as stated in Chapter 1 and revisited in Chapter 3. In addition, the study, through the system design, achieves the following:

i. Based on the findings from data analysis and interpretation of the findings, there is a need for a dialectic process in the systems and approaches employed by UCP and TMP. The dialectic process is purposely to achieve a balance between human-centred system outcomes and the design of an effective IT solution (RPA).

ii. The design instils meanings, and the influencing factors are translated into actionable entities using the RPA-based systems.

RPA is an embedment of technologies that enables the automation of routine and repeatable activities. Mishra et al. (2019) described it in more technical terms, that RPA is a configurable rule-based solution that uses a sequence of actions. Thus, it is intended to transform how support and services are provided to students to improve their academic performances.

6.5 Summary

This chapter represents the interpretation and discussion of the study's findings and the analysis of the data gathered from two institutions, TMP and UCP. The interpretation revealed factors that impacted academic performance in universities, which were categorised into technical and non-technical. A further interpretation was made to understand the systems and approaches used in providing support. The non-technical aspects focused on management and communication related to academic performance. Based on these factors, a design for an RPA-based system was developed to transform how institutions can improve academic performance. The next chapter presents the conclusion and recommendations of the study.

CHAPTER 7
CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

Chapter 7 looks at the conclusions of the research on academic performance in universities. It also presents the recommendations based on the previous chapter and future research ideas. This research aims to design an RPA-based system to provide timely information for academics to determine if students require support to improve their academic performance. This study adopted the interpretivism paradigm to subjectively understand the support systems used for academic activities and the factors that influence academic performance. The study used a university of technology and a traditional university as a case to gain this information. The data was collected by interviewing students, academics and non-academics through semi-structured interviews and document analysis.

The conclusion and recommendations chapter is organised into five sections. It first introduces the chapter. The following section provides an overview of the findings. The interpretation of the previous chapter's findings as per the study's objectives is discussed in the third section. The following section discusses the design of the RPA system for academic performance. The last section summarises the chapter.

7.2 Summary of the study

The research consists of seven chapters, each covering a specific area of the thesis. Below is a summary of each chapter:

Chapter 1: Introduction

The study starts with the introduction in Chapter 1. This chapter introduces the problematised problem, the aim of the study, the research objectives, and the questions. The problem is that even though universities have tried many solutions to improve academic performance, this problem still exists. One objective is to investigate the systems and approaches currently used to support students in their academic activities. This means the study looks at the university's technology and support units and how they function. The literature review sections in this chapter introduce the main areas of the study, namely university support structures, the study's methodology, and the theory used.

Chapter 2: Literature Review

This chapter consists of the literature review, which provides a background to academic performance and various support structures and systems within universities aimed to enhance students' success. The chapter also discusses the importance of support structures within universities, such as tutoring, financial aid, and counselling, in improving student outcomes and reducing stress and emotional strain caused by factors like delayed responses from financial aid systems. The role of academic and non-academic staff in providing a supportive environment and the administrative processes are highlighted as crucial for student success.

The benefits and challenges of robotic process automation across industries and how it impacts the educational sector were discussed, and the theory was used as a lens. Actor- network theory was discussed in this chapter. The literature used was retrieved from the databases used at the institution, using peer-reviewed articles. The in-text citations acknowledge the authors used as sources.

Chapter 3: Research Methodology

This study aims to develop an information system based on robotic process automation for evaluating academic performance in South African universities. This chapter provides a background on the philosophy, ontology, and methodology. First, it looks at the interpretivist philosophical approach to understanding the experiences influencing decisions related to academic performance and highlights qualitative research for data gathering. The research explores the concept of reality from the perspectives of students, academics, and non- academics, investigating the factors influencing academic performance and their implications on university environments. It employs inductive reasoning to move from observations to generalisations, utilising interviews and document analysis to uncover factors affecting academic performance. This chapter then examines the methodology used, the research design, data collection methods, data analysis, and ethical considerations related to the two case studies conducted at two universities.

Lastly, the chapter explains the importance of philosophical assumptions in research, encompassing ontology, epistemology, and axiology, to guide understanding the knowledge, reality, and values within the academic evaluation context.

Chapter 4: The Case Overview

Chapter 4 provides information relating to the 2 cases used by examining the two academic institutions, the University of Cape Point (UCP) and Table Mountain

University (TMP). The chapter outlines the structure, including an introduction, discussions on both universities and a conclusion.

UCP is highlighted for its large student enrollment exceeding 30,000, and its division into academic, non-academic, and student bodies. The chapter details UCP's student demographics, distinguishing between the majority undergraduate population and the lesser postgraduate segment, and describes the academic division's focus on teaching, learning, and research across over 70 programmes in six faculties. The institution's strategic plan, which is to target 2030, aims to improve operations, technology integration, and student experience, is also discussed.

Table Mountain University registers over 23,000 undergraduate and postgraduate students across seven faculties. The university has a staff of about 2400, ranging from academic, professional, and support roles, with a strong emphasis on research, which is evident in its ranking among the top 10 for research according to the Scimago Institutions Rankings. The university is committed to holistic student development, supported by dedicated Deputy Vice- Chancellors (DVCs) for Academics, Research and Innovation, and Student Development and Support. Looking forward, its vision for 2035 focuses on building effective partnerships with other universities across and beyond Africa, demonstrating its commitment to academic excellence and growth.

Fieldwork was conducted to collect data from students' academic and non-academic staff through face-to-face and online semi-structured interviews after obtaining consent and providing information about the study and its recording process. The interviews across two cases were consistent in their questioning, with adjustments made for clarity with each participant, and the data collected was carefully recorded, saved, cleaned, and categorised with specific naming conventions. The interviews were coded in tables listing academic, non- academic, and student participants with unique identifiers for each group.

Chapter 5: Data Analysis

The chapter utilised a qualitative data approach through a case study of two universities, the University of Cape Point (UCP) and Table Mountain University (TMP), to protect the identities of participating individuals who were given specific codes. This unique referencing format documents and references the data collected accurately. Data analysis was conducted using the thematic technique from the interpretive approach perspective, guided by actor-network theory (ANT), which focuses on the interactions between human and non-human entities without differentiation. This

theory's four moments of translation were applied to understand the systems and influences on students' academic performances, identifying how actors and their activities relate within the academic environment.

Problematisation identifies the support and services academic and non-academic staff can provide, supported by the institutional policies as frameworks. Interessement involves convincing all stakeholders of the need to address students' poor academic performances, effectively bringing them on board for the necessary interventions. Enrolment is where the roles and responsibilities are assigned to staff members to ensure improved support and services, combining both technical and non-technical activities. Mobilisation activates human resources within the institution, emphasising their role in fostering improved student academic performance. The chapter concludes by listing the findings of the analysis discussed in Chapter 6.

Chapter 6: Interpretation

Chapter six outlines the interpretation of data collected from the University of Cape Point and Table Mountain University regarding developing a Robotic Process Automation (RPA) system. Using the Actor-network theory, it aims to provide insights into the system's design through a subjective approach, highlighting the qualitative nature of the study. The chapter focuses on categorising findings into technical and non-technical factors, which are essential for determining the system design for the RPA system. These factors are divided into these two categories to reveal their impact on the universities' academic support systems and how they contribute to student performance. A structured three-step interpretation process analyses relationships between these factors to fulfil the study's objectives of understanding the existing systems and enhancing student academic performances.

This chapter lays the foundation for the design of an RPA-based system to assess and improve students' academic performance in South African universities. This analysis sets the stage for creating an RPA system to improve student's educational experience and outcomes at the involved universities.

Chapter 7: Conclusion and Recommendation

This final chapter provides a comprehensive overview of the previous six chapters to conclude the study, which focused on designing an RPA-based system to improve academic performance. Moreover, this chapter critically reviewed the study, examining its distinctive contributions to the existing knowledge in this field. The evaluation covers the study's theoretical, methodological, and practical impacts.

Additionally, the recommendations resulting from the findings were outlined, considering any limitations experienced during the research process and suggesting potential directions for future research.

7.3 Evaluation of the Study

This section examines how the researcher evaluates the study on academic performance in institutions. The journey was evaluated from the start of the study to the conclusions drawn from the research aim and objectives. The research title is “The Design of a Robotic Process Automation System for Assessment of Academic Performance in South African Universities”. How the research aims, questions, and objectives align with the research title is explained below. The sections were divided into how the research questions were answered, how the objectives were achieved, and what contribution the study made.

7.3.1 How Did the Study Achieve the Research Questions?

This section explores how the research questions were achieved. This includes the main question and the sub questions. The following research questions were formulated:

Main research question:

I. How can a robotic process automation (RPA)-based system be designed to assess students' academic performance in South African universities?

   This study explored the use of an emerging technology called robotic process automation, which does not need any changes to the existing systems. It aimed to evaluate student performance and generate reports that could help the department implement interventions to enhance academic achievement.

Sub-research questions.

I. What are the factors that influence students' academic performances?
II. What are the systems and approaches currently used to provide support to students in their academic activities?
III. How can a system based on RPA be designed primarily to improve academic performances to increase the pass rate of students in South African universities?

To address these inquiries, it is necessary to examine the relevant literature. Chapter 2 examined four specific areas.

Understanding Academic Performance within Universities

The study focused on understanding if an automated system would contribute to academic performance. Academic performance is where the students are evaluated on their performance in an assessment by either writing an exam or handing in an assignment or a project. Due to students underperforming, institutions were led to develop support systems for staff and students, aiming to improve academic outcomes through understanding a student's environment. Student academic performance is tied to assessment outcomes, emphasising the importance of passing grades in higher education institutions.

What Academic Support Systems Are Available in Universities

Chapter 2 further explains that the role of higher education institutions is crucial in providing a supportive environment for students to successfully navigate their academic journey from the time they register till they graduate. Institutions provide services within the academic programme, such as tutoring and teaching assistance, to assist with academic interventions. Support units that directly assist the departments include the writing centre and library. Some support units available require the students to approach them and make appointments or register with them for assistance, such as counselling and disability units. Institutions have many more support structures within units, activated when students approach them with issues encountered.

Understanding Support Structures Available to Students

Support units assist students in personal, financial, and academic information accessibility to aid students' academic activities. Additionally, financial constraints pose a significant challenge for South African students, with many relying on government support, which can be delayed. Chapter 2 also touches on the impact of lecturer attributes on student performance and the struggle students face adjusting to university expectations.

Students have to access the support units in various ways. They have to make appointments by email or by walking into the units. The individual departments then have various ways of responding to them.

Importance of Robotic Process Automation in Universities

RPA has become essential in various industries as it delivers precise and timely information. Its significance extends to academic institutions, where it streamlines repetitive tasks, enhances efficiency, and generates prompt reports to support efforts aimed at enhancing academic performance. This, in turn, allows educators to dedicate

more time to teaching and research at universities while enabling management to focus on strategic planning. The integration of RPA with existing systems elevates decision-making abilities and accelerates report generation.

7.3.2 How Did the Study Achieve the Research Objectives?

The aim and the objectives are discussed below as formulated in Chapter 1.

Research Aim

The study aims to design a robotic process automation (RPA)-based system for assessing students' academic performance in South African universities.

An RPA-based system was designed based on Figure 6.3.

The objectives of the study are as follows:

I. Understand the factors that influence students' academic performances

   To accomplish this goal, an in-depth analysis of the seven factors was conducted to understand their impact on academic performance comprehensively.

II. Examine and understand the systems and approaches currently used to provide support to students in their academic activities.

   The seven factors were divided into four technical and three non-technical factors to understand the factors influencing academic performance. This is represented in Figure 6.1 and Figure 6.2.

III. Based on the findings from the above objectives, design a system based on RPA that can be used for assessing students' academic performance towards improving throughput in South African universities.

   The specified objective was met through the data analysis and the attainment of the first and second objectives. This process led to the development of the criteria for factors for designing a system to improve academic performance.

7.3.3 The study was further evaluated on the contribution made.

What new perspectives has the research contributed?

This study contributes to the design of an RPA-based system. The design can be used for improving academic performance in departments and faculties. Technical and non-technical factors can be addressed in relation to the effectiveness of RPA-based IT

solutions that improve academic performance.

Would the study improve academic performance at academic institutions?

Academic performance has always been under the spotlight for many years. This study does not only look at academic performance from a student perspective but also from a support structure perspective. This means that the participants came from non-academic, academic and student viewpoints. For this reason, the study determined technical and non-technical factors that influence academic performance.

How well was the study carried out?

This study was conducted in a logical format. In Chapter 1, the research problem was problematised, and the research aim, objectives, and questions were formulated. An introduction to the literature was provided in Chapter 1, and a comprehensive literature review was conducted in Chapter 2. The methodology was introduced in Chapter 1, and Chapter 3 discussed how the methodology was applied to the study. The data was collected over 15 months from two cases, which was discussed in Chapter 4. Chapter 5 discusses the analysis and findings using ANT's moment of translation using the data gathered by structured interviews. In Chapter 6, the interpretation was explored, and based on this, the design of the RPA-based system was made. In the last chapter, the overview and the evaluation of the study were discussed. Recommendations and any further research were explained.

Why is this subject significant to practitioners and academics?

Academic performance is a term discussed at all levels and meetings. The topic is significant to academics from a research perspective, and all the staff within the institution would be practitioners of academic performance. Students need to pass assessments, and if they have any problems, the support units are where they receive remedial action or medical assistance.

So, from the duty of the vice chancellor to the academic, policies are enforced and applied to assist students in improving their performance. For this reason, this study is of utmost importance as it looks at academic performance and support structures from a different perspective.

On the one hand, assessment and timely feedback are essential for students to adjust their learning. The significance for academics, on the other hand, is that they can monitor students' performance and provide feedback and interventions when required. This includes institutions that must evaluate their processes concerning support structures

to improve academic performance. The National Development Plan is to improve employability, which means employing an RPA system would expedite interventions to improve performance.

Who would be interested in this study?

This research is relevant to the academic environment and interests of academic staff and management. The study aims to leverage IT solutions to improve academic performance by enhancing efficiency and effectiveness. Additionally, RPA software developers may find value in utilising these factors to enhance future systems developed with this software.

7.4 Contribution of the research

The study aimed to design an RPA-based system, for assessing students' academic performance in South African universities. From the aim perspective, the study contributes in three ways: theoretical, methodological, and practical. Below is an explanation of the contributions.

7.4.1 Theoretical Contribution

Theoretically, the study adds to existing literature. At the time of this study, it was difficult to find studies relating to RPA where ANT was applied. Additionally, the study highlights the significance of interactions between human and non-human actors in the development and implementation of a system that has many stakeholders within institutions of higher learning.

7.4.2 Methodological Contribution

Methodologically, the study affirms the advances of ANT in information systems research. Also, the use of ANT as a lens to examine the study in which an RPA-based system is proposed adds a fresh dimension to IS research using a sociotechnical theory to underpin a study. The four moments of translation of ANT as a lens to examine three significant aspects of the study: (1) how networks were formed, consciously or unconsciously; (2) the relationships between actors and how humans interacted with the current system in providing services to students; and (3) how negotiations continue to shift between actors in providing and receiving academic-related services.

7.4.3 Practical Contribution

Practically, the study proposes a design that can be used to develop an RPA-based system. Also, the study highlights the influencing factors: (1) for IT specialists, which can be used to guide the development of an RPA-based system for assessing students' academic performances; and (2) for management, based on which policies can be formulated to guide the use of RPA in the environment.

Also, from a practical perspective, communication between the academic department and support units is vital as this would improve the alignment of the process. Leveraging synergies allows allocating resources and staffing to improve the performance of the support units and academic departments. From an operational perspective, the mandate of institutions is to teach and conduct research. If these activities are not addressed, resource allocation can become frenetically scarce or misused.

7.5 Benefits of the Study

The benefits of the study are at all levels, including the institutional level. This study has highlighted that support structures are essential within the institution.

Benefits from a technical perspective:

The technical aspects highlighted that performance tracking and digital feedback are essential as measurement mechanisms for academic performance. This includes monitoring these tracking mechanisms and the process of digitalisation. To further enhance student success, there has to be an integration of systems and easy access to these systems. Finally, convenience is vital, as without this, students cannot learn, and lecturers cannot teach without internet or remote access.

Benefits from a non-technical perspective

The research has highlighted that the academic departments and the support units must work together to align their process. From an operational perspective, the institution has to see that sufficient resources are allocated and that the teaching and research within the departments are aligned with their skills. Institutions should enforce policies to improve academic performance from the management level to the students.

7.6 Recommendations

After analysing the data and interpreting it, some gaps were identified. The gaps are listed under academic, non-academic and student and are discussed below.

Systems Integration

The study revealed that this is one of the critical aspects of designing a system. The systems must be able to process digitalisation and track and monitor academic performance. Institutions have many systems, and even though the information is there, there are duplicate or stand-alone systems. This makes the process of gathering data to determine academic performance, at times, a tedious process. The process of producing reports to determine students who require interventions is challenging.

The study recommends that institutions integrate their IT systems to allow academics to upload without duplicating the process. Heads of departments cannot determine students who are at risk without getting information from each lecturer. Management of these systems could assist the department in putting interventions in place on time.

Academic activities

For students, core academic activities include attending classes and doing assessments. The institutions understand that students require support. First-year students attend orientation at the beginning of the year, where all these support structures are introduced. Students may, at times, forget these sessions after the introduction to these support units.

Departments should establish relationships with support units, and these support units should actively promote their services to students. The study suggests that institutions should assess the operations and encourage collaboration among departments and staff.

7.7 Limitations of the research

This study has identified a few limitations.

I. This study focused on South African public universities and excluded privately owned universities. The inclusion of private universities may bring different dimensions to the findings.
II. The study did not include the development of a system. This is the main limitation of the study.

7.8 Further research

Institutions have long been concerned with academic performance. This study examined academic performance from the actor-network theory (ANT)

perspective, highlighting technical and non-technical factors. The study recommends further research on the factors discussed in Chapter 6 to enhance academic performance.

The research has introduced a proposed design for an RPA-based system to enhance academic performance. The subsequent phase involves the actual development of the system. Additional research is necessary to advance the development of this RPA- based system further.

7.9 Summary

This section summarises the study by summarising the previous six chapters on the significance of academic performance in higher education. It highlighted the problem and showed that by gathering input from all stakeholders, relevant factors can be considered when developing a system to provide timely information to enhance academic performance. This section also includes recommendations for future research.

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1 September 2021

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Reference no: 182005712/2021/26

Project title: The Design of a Robotic Process Automation System for Assessment of Academic Performance in South African Universities

Approval period: 1 September 2021 – 31 December 2023

This is to certify that the Faculty of Informatics and Design Research Ethics Committee of the Cape Peninsula University of Technology approved the methodology and ethics of Ms Denise Lakay (182005712) for the Doctor of Philosophy in Informatics (DGINMR).

Any amendments, extension or other modifications to the protocol must be submitted to the Research Ethics Committee for approval.

The Committee must be informed of any serious adverse event and/or termination of the study.

A/Prof I van Zyl
Chair: Research Ethics Committee
Faculty of Informatics and Design
Cape Peninsula University of Technology

Title: The Design of a Robotic Process Automation System for Assessment of Academic Performance in South African Universities

Data Collection: Semi-structured interview

Interview guidelines

Participating group (Academic Staff)

1. How does the university determine the types of service/support to offer the students?
2. In your view, how do you think the university determines who gets service/support?
3. How does the university offer this support or service to the student?
4. As an academic staff, what support do you offer students?
   4.1. In your view, why do you think the students need this support?
   4.2. How do you offer this support?
5. What are some of the challenges that you think affect students' academic performances?
   5.1. Why do you think these challenges exist?
   5.2. How do you think these challenges can be addressed?
6. In your view, do you think using computer systems to support the students will be better?
   6.1. If so (or not), why do you think so? Please give me an example.
7. Do you think an interactive system will assist with providing services/supporting student performance?
8. Why do you think so? Give an example.
9. How do you think the interactive system will work?

Title: The Design of a Robotic Process Automation System for Assessment of Academic Performance in South African Universities

Data Collection: Semi-structured interview

Participating group (Non-Academic Staff)

1. What are some of the services/ supports your unit/department offers to the students?
2. How (tools, mechanism, computer systems) do you provide these services/supports to the students?
3. What challenges do you encounter in using these tools in providing services to the students?
   3.1. In your view, why do you think these challenges exist?
   3.2. How do you think these challenges can be addressed?
4. In your view, do you think your service influences the students' performance?
   4.1. If so, why do you think so? Please give an example.
5. How do you communicate (or interact) with the students in providing your services, and do you use a computer system?
6. From your experience, what are some of the challenges with this type of communication?
7. How do the students initiate the requests for services from you? Do they use a computer system where they request your service/assistance?
   7.1. In your view, what are some of the challenges in using this approach?
8. Do you think an interactive system will assist with providing services/supporting student performance?
   8.1. Why do you think so? Give an example.
   8.2. How do you think the interactive system will work?

Title: The Design of a Robotic Process Automation System for Assessment of Academic Performance in South African Universities

Data Collection: Semi-structured interview

Participating group (Students)

1. What type of support/services do your department or the university offer?
2. How do you access these supports/services?
   2.1. Through a computer system (such as online) or walk into the unit/department.
   2.2. Why do you think these supports/services are accessed in that manner or through such means?
3. What are some of the challenges in accessing the support or services?
   3.1. Why do you think these challenges exist?
   3.2. How do you think that these challenges can be addressed?
   3.3. If these challenges are addressed, how do you think they will assist in improving your academic performance?
4. Do you think an interactive system will assist you in receiving services/support from your departments or university?
   4.1. Why do you think so? Give an example.
   4.2. How do you think the interactive system will work?

List of researchers researching specific areas – See below.

The thesis is well organized and below are some of my cosmetic suggestions:			
1.	Include tables that list researchers that have done research on:		
	a.	Assessment of academic performance.	Rodríguez-Hernándeza, Cascallara & Kyndt, 2020; D'Aquila, Wang & Mattia, 2019
		RPA is an example of how technology has advanced.	Danilova, 2019
		RPA is part of the advancement of technology.	Madakam, Holmukhe, and Jaiswa, 2019 Vijai, Suriyalakshmi & Elayaraja, 2020
		The sociotechnical theory actor-network theory (ANT)	Iyamu, T. 2022. Latour, 1996 Callon, 1986
		Academic support systems within universities	Elliott, 2007 Cabrerizo et al., 2015
		Understanding Academic Performances	Alaslani & Alandejani, 2020 Egieyeh et al., 2021
		University support structure	Paideya & Dhunpath, 2018 Mashabela & Pillay, 2017
		Robotic process automation	Pupkov, 2016 Zhang and Liu, 2019
		Benefits of Robotic Process Automation	Madakam, Holmukhe, and Jaiswa, 2019
		Application of robotic automation in industries	Madakam, Holmukhe, and Jaiswa, 2019 Zhang & Liu, 2018
		Challenges of Robotic Process Automation	Siderska, 2020 Money, 2020
		Robotic process automation and information systems	Zemmouchi-Ghomari, 2021
		Actor-network theory	Iyamu, T. 2022. Latour, 1996 Callon, 1986