A MODEL FOR INTERNET MANAGEMENT AT A HIGHER EDUCATION INSTITUTION

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DECLARATION

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DECLARATION:

In accordance with Rule G4.6.3, I hereby declare that the above-mentioned treatise/ dissertation/ thesis is my own work and that it has not previously been submitted for assessment to another University or for another qualification.

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ABSTRACT

The management of the Internet at the Nelson Mandela Metropolitan University (NMMU), an Higher Education Institute (HEI) in the Eastern and Western Cape area in South Africa (SA) was the focus of this research. The investigation was conducted into the level of Internet usage by determining for what purpose the Internet is used by the people at NMMU. The empirical data was collected, analysed and interpreted. From these findings a proposed Internet Management Model was created that will assist NMMU with its Internet management obligations.

It has become a standing practice at HEIs for its Internet management and relevant Information and Communication Technology (ICT) resources to be continuously investigated by HEI Management as well as by its users. The reason is that the Internet has become the foundation on which most ICT resources function and therefore is labelled as a distinctive competency for the HEI. HEIs have limited ICT Internet resources and are expected to utilise these resources optimally, to ensure efficient and effective Internet connectivity on all campuses and to all users and systems. This is a daunting task for various reasons, amongst which are: guidelines, best practices, governance influences, etc. are not readily available to assist with decision-making processes; the number of devices that require Internet connectivity is increasing almost on a daily basis; the content found on the Internet has become extremely resources-demanding; the Internet is no longer being utilised only during working hours but on a 24/7 basis; and lastly, the Internet is increasingly being abused by its use for non-work related activities which hinder the required connection and resources requirements for those who are using the Internet for work and research purposes.

The purpose of this research study was to provide a proposed Internet Management Model to address all weaknesses and threats, currently being experienced at NMMU. This was created by firstly; determining what was considered best practices regarding Internet management at HEI; secondly, determining what the NMMU Internet users were utilising the Internet for and lastly; using the combined findings to draw conclusions and thereafter create an Internet Management Model for the HEI. This can assist the NMMU ICT Management team to re-align the Internet resources to match the current business and customer requirements. This will ensure that the NMMU Internet resources are effectively and efficiently utilised, which in turn will confirm that the availability of the Internet to its users and systems becomes a reliable and pleasant experience. The ICT Management team can then focus their undivided attention on other ICT-related matters.

This treatise is an exploratory, mixed method study which comprises of literature studies, surveys and cross-sectional studies. The literature studies were conducted on secondary sources to identify the national and international governance structures that influence Internet management. The empirical study which consisted of two surveys (questionnaires) was compiled from existing questionnaires as well as from literature studies, and was completed by its respective respondent groups. The first survey was used to gain an insight into what was considered best practices regarding Internet management at HEIs in South Africa. The survey consisted of questions regarding demographic data and various ICT Internet resources. Respondents were asked to identify the practices relevant to their HEI. The second survey was used to gain an insight into what the Internet was being used for at NMMU by staff and students. The survey consisted of questions regarding demographic data and the various uses, frequency and periods of Internet usage. These respondents were then asked to identify the practices relevant to their Internet usage patterns. A cross-sectional study was then used to compare the two different population groups, which were NMMU staff and students, at a single point in time. Both Descriptive and Inferential Statistical methods were used for the analysis of the data.

The HEI Internet management survey samples were of various sizes with each sample having its Internet resources specifically aligned with its environment. The common stereotypes regarding their Internet resources were mostly not present. The findings indicated that the Internet and its relevant resources are extremely important to all HEIs. All Human Resources, Financial Resources, Physical Resources and Organisational Resources regarding the Internet were carefully selected according to a common structure in most HEIs. Therefore, most resources were aligned and consequently common to most HEIs, but emphasis was placed on the actual setup and implementation of each HEI to ensure that the Internet resources align with the HEI's culture and strategic vision. The common trends were extracted and these constituted the HEI Internet management best practices.

The NMMU Internet usage survey indicated that there was a wide gap between how the Internet was used by the staff and students. This gap focused on age (Generation X, Y and Z), Internet usage requirements, preferred method of access and size of population. The staff and students have a wide range of requirements and expectations from the NMMU's Internet with some similarities amongst these needs. These overlapping requirements were generally linked to their affiliation with the HEI, meaning their main purpose for being at the HEI. Other than this (non-work related), the staff and students had very different requirement for Internet usages. These requirements for the Internet also varied depending on the time of day and

day of the week. It was apparent that there were also differences in the Internet requirements of the academic and administrative staff. Furthermore, the staff were very much aware of the Internet and its policies and procedures as opposed to the students, who in most cases were not informed. This included the operational and technical policies available to all users. The students seem frustrated or unhappy about some management practices or were generally unaware of the Internet resources assigned and available to them.

The study concluded with the development of a proposed Internet Management Model for the HEI, with recommendations and considerations on how to improve the current NMMU Internet management strategy. The treatise makes a contribution towards the body of knowledge by identifying and discussing current national and international IG practices. It continues by providing insight into the various practises in HEI Internet management. Furthermore, it offers an understanding into the NMMU users' current Internet usage and patterns of use. The treatise will therefore assist the readers with the management of their Internet usage requirements and the provision of Internet resources.

Keywords: Internet Governance, Internet Management, Internet Management Model, HEI, NMMU.

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronyms & Abbreviations	Terms in full
MBA	Masters in Business Administration
NMMU	Nelson Mandela Metropolitan University
HEI	Higher Education Institution(s)
SA	South Africa
ICT	Information and Communication Technology
GDP	Gross Domestic Product
IG	Internet Governance
IETF	Internet Engineering Task Force
ITU	International Telecommunication Union
ICANN	Internet Corporation for Assigned Names and Numbers
W3C	World Wide Web Consortium
ISO	International Organization for Standardization
ISP	Internet Service Provider
RO_X	Research Objectives
RQ_X	Research Questions
SLA	Service Level Agreement
BYOD	Bring Your Own Device
IoT	Internet of Things
IoE	Internet of Everything
VOIP	Voice over IP
HEIIMS	HEI Internet Management Survey
NMMUIUS	NMMU Internet Usage Survey
REC-H	Research Ethics Committee – Human
TPC/IP	Transmission Control Protocol/Internet Protocol
DNS	Domain Name Servers
WIPO	World Intellectual Property Organization
OSI Model	Open Systems Interconnection Model
IAB	Internet Architecture Board
IRTF	Internet Research Task Force
RFC	Request for Comments
IGF	Internet Governance Forum
CFRG	Crypto Forum Research Group
DTNRG	Delay-Tolerant Networking Research Group
GAIA	Global Access to the Internet for All Research Group
ICCRG	Internet Congestion Control Research Group
ICNRG	Information Centric Networking Research Group
NFVRG	Network Function Virtualisation Research Group

Acronyms & Abbreviations	Terms in full
NMRG	Network Management Research Group
NWCRG	Network Coding Research Group
SDNRG	Software Defined Networking Research Group
ISOC	Internet Society
RIPs	Regional Internet Registries
AFRINIC	Africa Network Information Centre
APNIC	Asia Pacific Network Information Centre
ARIN	American Registry for Internet Numbers
LACNIC	Latin American and Caribbean Internet Address Registry
RIPE NCC	Reseaux IP Europeens
WEF	World Economic Forum
DG	Distribution Group
SARUA	South African Regional Universities Association
MANCO	Management Committee
ASAUDIT	Association of South African University Directors of Information Technology
TENET	Tertiary Education and Research Network of South Africa
df	Degrees of Freedom
p-value	Probability Value
ANOVA	Analysis of Variance
MANOVA	Multivariate ANOVA
KPI	Key Performance Indicator
PII	Personal Identifiable Information
AD	Active Directory
MDM	Mobile Device Management
VPN	Virtual Private Network
SANS	South African National Standard
HE	Higher Education

Table A.1: List of acronyms and abbreviations.

1. INTRODUCTION

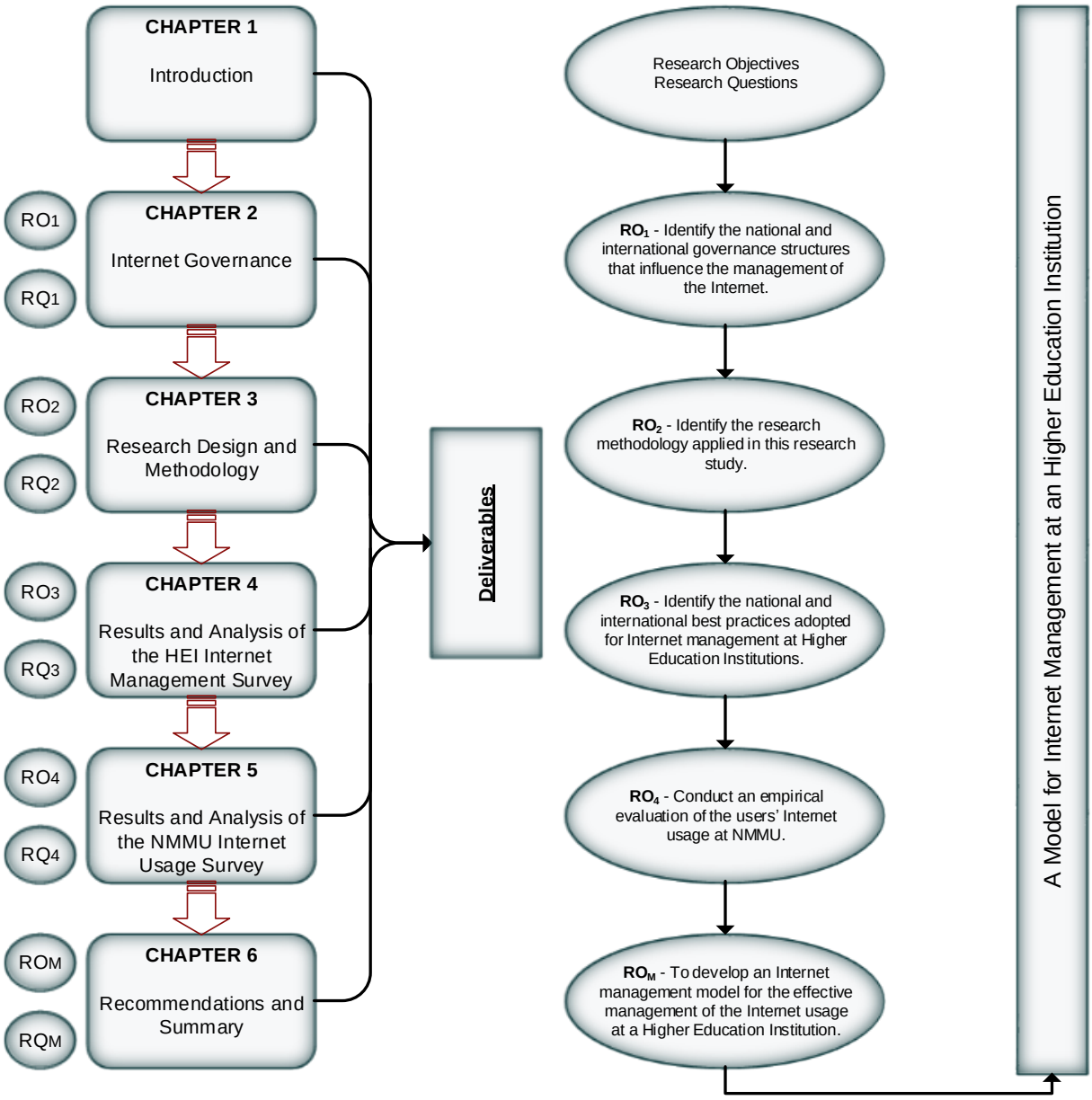

Figure 1.1: Structural overview of Treatise.

1.1. Background

The Internet has had a substantial impact on the world since its inception in 1995. It is arguably one of the most successful implemented technologies of all time because of the way it has changed our standards of living, the way we work, the way we teach and are educated, the way we entertain ourselves and others, political participation and above all, by the way we socially interact. The Internet has fixed itself into almost every citizen's life to such an extent that it would be impossible for any person, government or economy to continue to function adequately without its presence (Almeida, 2014). The Internet has therefore become an indispensable pillar whose scale and pace of change is still accelerating at a rapid rate.

As at June 2014, the Internet had 3,035 million active users which was around 40 percent of world's population (Miniwatts Marketing Group, 2015). This is due to the fact that more users want access to the Internet for various reasons, and more methods have been unveiled that allows these users to quickly and easily gain access to the Internet.

According to a study by Boston Consulting Group, the Internet amounts to 4,1 percent of the Gross Domestic Product (GDP), or $2,3 trillion across the G-20 countries. Currently, the Internet is contributing up to 8 percent of the GDP in some economies, which promotes exponential growth and assists with creating jobs. The Boston Consulting Group study continued by stating that if the Internet were to be considered a national economy, it would be ranked fifth in the world, between India which is fourth and Germany which is sixth (Dean, et al., 2012).

It is without a doubt that the Internet provides many benefits to all its users. There are, however, some drawbacks associated with being connected through the Internet as well. Due to the Internet's size, decentralisation, openness and insecurity, many risks have been exposed. These include cyber-attacks, global surveillance, cybercrime, commercial espionage, threats to critical national infrastructure etc. (Savage & McConnell, 2014). Effective countermeasures must therefore be created, implemented and managed to ensure that users, systems and their information are adequately protected at all times when utilising the Internet. These risks relate to the necessity of the Internet to be governed to ensure that risks are kept at an acceptable level by proper management of all Internet resources (Bauer & Dutton, 2015).

Internet Governance (IG) is the term used to describe the management of the Internet resources, public policy issues such as safety and security, development aspects and

addresses issues pertaining to the proper use of the Internet (Swinehart, 2007). The 2005 Tunis Agenda on IG contains the following definition for Internet Governance:

"A working definition of Internet governance is the development and application by Governments, the private sector and civil society, in their respective roles, of shared principles, norms, rules, decision-making procedures, and programmes that shape the evolution and use of the Internet" (WSIS, 2005, p. 6).

It can therefore be argued that the Internet is a multi-stakeholder environment which is not directed and controlled by one party but by many stakeholders. The management of the Internet by these stakeholders encompasses both public policy and technical issues (International Telecommunication Union, 2013). Amongst these stakeholders are Internet Engineering Task Force (IETF), International Telecommunication Union (ITU), Communication Corporation and National Law, Internet Corporation for Assigned Names and Numbers (ICANN), World Wide Web Consortium (W3C), International Organization for Standardization (ISO) with others, each having its own responsibilities towards ensuring the world continues to enjoy the benefit of a properly governed Internet.

The International Telecommunication Union (2013), responsible for the standardisation of telecommuniucation, recognises the WSIS (2005) Multi-Stakeholder IG model as discussed above. ITU highlights its multi-stakeholder memberships to include organisations, regulators, financial institutions, industry, international organisations (non-governmental and intergovernmental), academic institutions, equipment vendors, broadcasters, satellite companies, Internet Service Providers, and civil society amongst others (International Telecommunication Union, 2013). These stakeholders are tasked to ensure that all respective networks can communicate with each other through a system of open network standards in an efficient and effective manner, thus keeping the Internet 'alive' (ICC's Commission on E-Business, IT and Telecoms, 2004).

Many of these shareholders have realised the benefits of using the Internet to gain a competitive advantage and as such have implemented it. The Internet allows these shareholders to improve their brand visibility, have a close relationship with their consumers and develop loyalty. These shareholders can now compete on a global scale with no limit on office hours (open 24/7 instead of nine to five). These shareholders can also enter into more markets more quickly and easily than before, and then be placed on the same footing with larger or multinational businesses. The Internet therefore allows for these stakeholders to

increase their market share quicker, enhance their public image and achieve return on investment (Apăvăloaie, 2014).

The stakeholders need to manage all aspects of these valuable Information and Communication Technology (ICT) resources correctly before they start to realise any advantages. There are many ICT resources involved that must be managed efficiently and effectively to ensure that the Internet is used to its full potential. For example, overall budget allocation, hardware and software costs, maintenance costs and Internet Service Provider (ISP) costs must be considered. Additional consideration includes what controls must be implemented and maintained to ensure proper usage and to limit misuse. These controls may include traffic prioritisation, website monitoring, usage monitoring and instilled policies and procedures. If these ICT resources are not managed correctly the business may experience a range of difficulties hindering the use of the Internet, reversing this competitive advantage and turning it into a competitive disadvantage. Some examples of outcomes of improper ICT resource management include limited Internet speed, over- or under-spending of budget, unauthorised access to restricted sites, constant hardware and software failure and abuse of the Internet by users which leads to a loss of productivity.

The following section focus on the problem statement of this research study. This will be followed by the Research Objectives (RO_X), Research Questions (RQ_X) and scope and delimitation where the key concepts for each will be defined. The significance of the research study will then be highlighted, followed by the research paradigm, design and methodology utilised. The process and level of ethics clearance received for this study will then be discussed, followed by a written and graphical structural overview of this treatise. See Figure 1.2 for the structural overview of Chapter 1.

1.2. Problem Statement

As discussed in the previous section, various stakeholders have been identified and are tasked with the control over Internet-based technologies and the policies and procedures that support them. These stakeholders therefore need to properly manage their ICT Internet resources to comply with the stipulated IG requirements to ensure all resource feed into the higher purpose. Furthermore, they need to do so in a manner to ensure they fully embrace the technological advancements of the Internet in their own capacity, to recognise a competitive advantage for the business itself. It is therefore clear that these stakeholders must address the fundamental business Internet requirements in such a manner that it realises the overarching IG requirements.

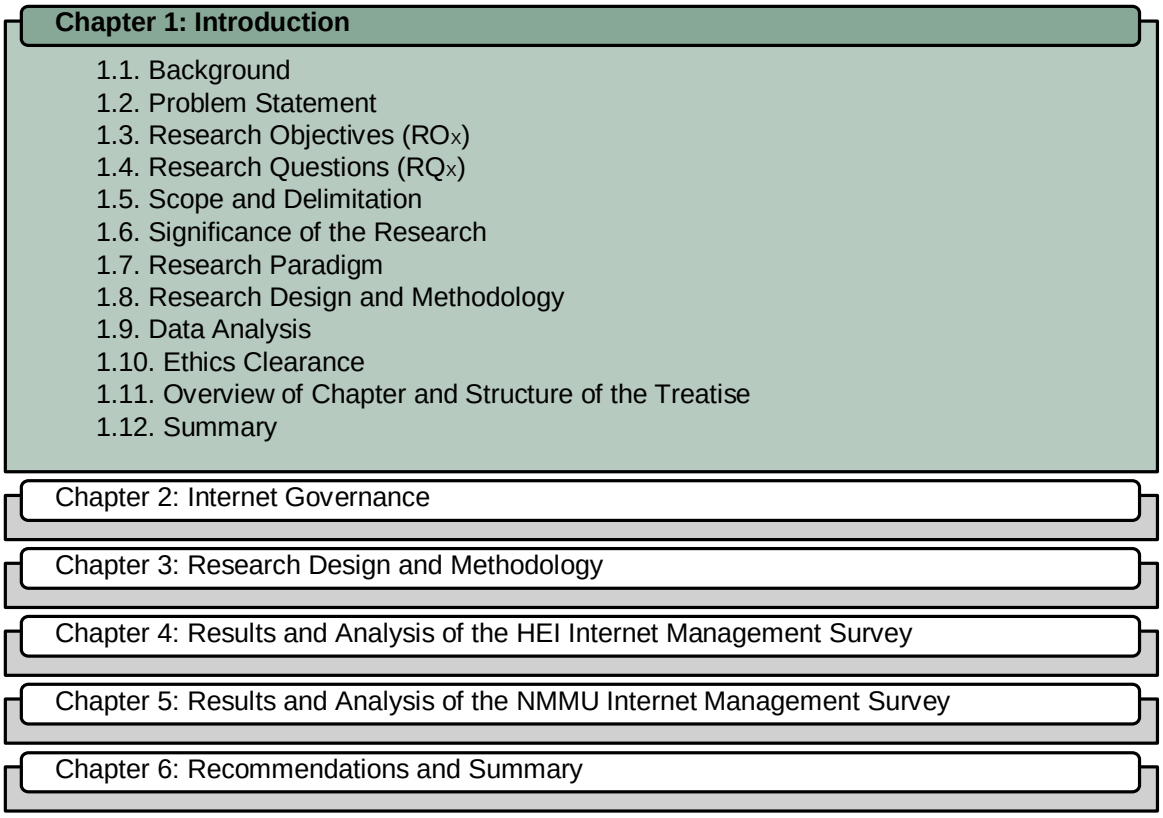

Figure 1.2: Structural overview of Chapter 1.

Higher Education Institutions (HEI), utilises the Internet as an essential service for research, teaching and learning, administration, but private communication and collaboration have become extremely difficult. For these services to serve with a distinctive competence over their rivals, HEIs are expected to deliver high speed, reliable Internet connectivity with the ability to support flexible and secure online systems. This will ensure that HEIs perform better in this competitively important activity to turn their adequacy into a competitively superior resource strength.

Unfortunately, HEIs are finding it increasingly more difficult to manage their ICT Internet resources adequately according to the signed Service Level Agreement (SLA). This is mainly due to the fact that HEIs are experiencing exponential growth in Internet traffic which leads to an increased cost of maintenance. Furthermore, HEIs have to do this whilst they are experiencing tighter budgetary conditions (Broucek, et al., 2011).

Additional strain is added onto these ICT Internet resources as more devices are added to the network which also require active Internet connections. These devices communicate over the Internet and add more traffic to the already congested network and Internet bandwidth. In some cases, the traffic on the network has doubled due to the amount of traffic being

experienced. Furthermore, the content being accessed requires more bandwidth due to its richness. These devices include, Bring Your Own Device (BYOD), Internet of Things (IoT) or its latest adaptation Internet of Everything (IoE), Voice over IP (VOIP) and Cloud computing.

Another factor that is well known by employers is the fact that employees are using the Internet for non-work matters during office hours. According to Staff Monitoring Solutions (2015) during a working day, employees spend 30 to 40 percent of their Internet browsing time on non-work related matters (Staff Monitoring Solutions, 2015). Stewart (2003), states that employees' Internet abuse costs businesses $54 billion annually in loss of productivity. This is due to the fact that those employees that are using the Internet for non-work related matters are draining the limited amount of allocated bandwidth and therefore reducing the Internet capacitiy for those using it for work purposes.

HEIs are expected to turn all these weaknesses into strengths and threats into opportunities, and this without any formal Internet management model or framework at their disposal to use as a guide on how to effectively manage these ICT Internet resources. The research question arising from these problems are:
"What are the components of an Internet Management Model that will ensure effective management of Internet usage at an Higher Education Institution?"

Therefore, the problem this research study will address is; Higher Education Institutions have limited ICT Internet resources (funds, hardware, software and support staff) available to implement and manage the Internet connectivity in the work environment. Users generally misuse their privileges by using the Internet for non-work related matters. The problem will be addressed by examining an HEI Internet usage, and then by linking this to HEI Internet management best practices. From this data, a proposed Internet Management Model will be developed for the effective management of the Internet usage at an HEI.

1.3. Research Objectives (RO_X)

The Main Research Objective (RO_M) of this study is as follows:

RO_M - *To develop an Internet Management Model for the effective management of the Internet usage at an Higher Education Institution.*

In order to achieve the Main Research Objective, the following secondary objectives need to be achieved first:

RO_1 - *Identify the national and international governance structures that influence the management of the Internet;*

RO_2 - *Identify the research methodology applied in this research study;*

RO_3 - *Identify the national best practices adopted for Internet management at Higher Education Institutions; and*

RO_4 - *Conduct an empirical evaluation of the users' Internet usage at NMMU.*

1.4. Research Questions (RQ_X)

The Main Research Question (RQ_M) was formulated based on the Main Research Objective (RO_M) and is stated as follows:

RQ_M - *What are the components of an Internet Management Model that will ensure effective management of Internet usage at an Higher Education Institution?*

In order to analyse the main research problem effectively, the following research questions as based on the secondary research objectives, need to be answered first:

RQ_1 - *What national and international governance structures are available that influence Internet management?*

RQ_2 - *What research methodology can be utilised for this study?*

RQ_3 - *What are the national best practices for Internet management at Higher Education Institutions?*

RQ_4 - *How is the Internet utilised at NMMU by staff and students?*

The Research Questions (RQ_X), Research Objective (RO_X) and the various chapters in which they are addressed are linked in the simplified research storyline is illustrated in Table 1.1.

Research Questions (RQ_X)	Research Objectives (RO_X)	Chapters
RQ_1 - *What national and international governance structures are available that influence Internet management?*	**RO_1** - Identify the national and international governance structures that influence the management of the Internet.	**Chapter 2 - INTERNET GOVERNANCE**
RQ_2 - *What research methodology can be utilised for this study?*	**RO_2** - Identify the research methodology applied in this research study.	**Chapter 3 - RESEARCH DESIGN AND METHODOLOGY**
RQ_3 - *What are the national best practices for Internet management at Higher Education Institutions?*	**RO_3** - Identify the national best practices adopted for Internet management at Higher Education Institutions.	**Chapter 4 - RESULTS AND ANALYSIS OF THE HEI INTERNET MANAGEMENT SURVEY**
RQ_4 - *How is the Internet utilised at NMMU by staff and students?*	**RO_4** - Conduct an empirical evaluation of the users' Internet usage at NMMU.	**Chapter 5 - RESULTS AND ANALYSIS OF THE NMMU INTERNET USAGE SURVEY**
RQ_M - *What are the components of an Internet Management Model that will ensure effective management of Internet usage at an Higher Education Institution?*	**RO_M** - To develop an Internet Management Model for the effective management of the Internet usage at an Higher Education Institution.	**Chapter 6 - FINDINGS, RECOMMENDATIONS AND CONCLUSIONS**

Table 1.1: Research Questions (RQ_X), Research Objectives (RO_X) and Chapter Outline.

See Appendix A – Research Alignment Plan for the full alignment plan for this research study.

1.5. Scope and Delimitation

This treatise will be limited to the ICT Internet usage in NMMU, an HEI with five campuses in Port Elizabeth, Eastern Cape and one in George, Western Cape. The scope of this study will be focused on the Internet traffic activities of staff and students sourced through questionnaires answered by users. All sources from where the Internet is accessed will also be included. These may include amongst others, personal computer, laptops, notebooks, netbooks, smartphones, smartwatches, tablets, phablets.

1.6. Significance of the Research

This treatise aims to provide insight, through the use of an Internet Management Model, into what is considered best practice regarding effective management of the Internet usage at an HEI.

Furthermore, this treatise will be useful for:

- Understanding what South African HEIs are using to manage their ICT Internet resources;
- Understanding what the users say they use the Internet for by means of completing questionnaires; and
- Managing the Internet usage and provision of resources.

1.7. Research Paradigm

A research paradigm is the philosophical framework that guides researchers on how their scientific research should be conducted. There are two main paradigms, positivism and interpretivism (Collis & Hussey, 2014).

Positivism will be adopted for the study. Positivism provides a framework for research to be completed in the natural sciences. The paradigm stems from the belief that we are independent from reality whilst theories are discovered through empirical research. The paradigm allows the act of investigating social reality to have no effect on the environment being examined (Creswell, 2014). The knowledge derived from this act can be scientifically verified by means of mathematical equations (Collis & Hussey, 2014).

1.8. Research Design and Methodology

The section will discuss the research design and methodology used to conduct the research for this treatise. The discussion will be divided into sub-sections which include the research design, data collection, population and response rate.

1.8.1. Research Design

A mixed method research approach will be used for this research study. This incorporates elements of both ends of the paradigm continuum, which are quantitative and qualitative approaches. The collection of data will therefore involve both quantitative and qualitative data, integrating these approaches with one another and then using distinct designs that may involve philosophical assumptions and theoretical frameworks. A complete understanding of the research problem will therefore be realised, which is not possible by utilising each approach in isolation (Creswell, 2008).

1.8.1.1. Literature Study

The literature study will be performed to determine what factors constitute IG structures, nationally and internationally. Thereafter, another two literature studies will be performed to determine the factors that constitute best practice for Internet management in HEIs and Internet usage within an HEI. The literature studies will be combined with both surveys which will be elaborated on in the next sub-sections.

Both will be accomplished by means of collecting secondary research data which is already available in processed formats. The data will be collected from internal and external sources, and in any processed format. Sources may include databases, publications, or records (Wegner, 2012). This will be completed by a thorough analysis of current literature studies.

1.8.2. Research Methodology

The following sub-sections will elaborate on the research methodology used to collect the data, how it will be analysed and how the proposed data will be interpreted for this study.

1.8.2.1. Data Collection

Surveys are one of the most common methods of collecting primary or secondary data from samples through direct questioning of respondents using questionnaires to structure and records the collection of data (Wegner, 2012). The results are then analysed and generalised to the population of the study (Collis & Hussey, 2014). For this research study, electronic

questionnaires will be used as a form of structured interviewing which will force all respondents to answer the same questions in the same format (Krippendorff, 2012).

The HEI Internet Management Survey (here forth known as HEIIMS) questionnaire will be drafted in Microsoft Word Developer by means of the Design Mode function and distributed to selected HEIs in South Africa (SA). The respondent will be either the Director of the ICT Department or the Internet Manager. The questionnaire will include a demographic section as well as sections referring to general practices regarding Internet management. Information obtained from the literature studies will be used to strengthen the foundation of the questions used in this questionnaire.

The purpose of the questionnaire will therefore be to collect the HEI Internet management practices. This will allow the researcher to gain insight into the HEI practices and from these combined finding list the HEIs Internet management best practices. It should be acknowledged that in the context of this treatise the term best practices refers to the most common practise across the HEI environment.

The NMMU Internet Usage Survey (here forth known as NMMUIUS) questionnaire will be drafted on the NMMU survey management platform and distributed to all NMMU administrative and academic staff, as well as the NMMU student population. The questionnaire will include a demographic section as well as sections covering probing questions on their NMMU Internet usage and patterns. Information obtained from the literature studies will be used to strengthen the foundation of the questions used in this questionnaire.

The purpose of the NMMUIUS questionnaire will therefore be to collect the NMMUs' users (academic staff, administrative staff and students) Internet usage data. This will allow the researcher to gain insight into the Internet usage requirements and patterns of the users from the users' perspective. Full ethical clearance for both surveys will be covered in more detail in Section 1.10.

1.8.3. Sample

A sample is a subset of data value derived from the population. A sample is used when it is not possible to record every data value from the entire population, mainly due to cost, time and possible destruction of the object being measured, counted or observed (Wegner, 2012).

RQ_3 refers to the population of all HEIs' Internet Managers. Therefore, the population of this HEIIMS refers to the population of HEIs' Internet Managers. RQ_4 refers to the population of all NMMU users. Therefore, the population of the NMMUIUS is constructed from the sample group namely, NMMU users. The following sub-sections will elaborate on each group respectively.

1.8.3.1. HEIs' Internet Managers

The HEIs' Internet Managers sample group consists of 23 Internet Managers in various HEI across South Africa. These Internet Managers combined, constitute the entire population of South African HEIs' Internet Managers. These are the individuals that can best describe the current Internet management best practice at their respective Higher Education Institution.

The sampling method use for the HEIs' Internet Managers would be judgement sampling as the researcher used his judgement alone to select the best sampling units to include in the sample (Wegner, 2012). In this study, the researcher were seeking the best individuals that are overall responsible for management of the HEI's Internet resources.

1.8.3.2. NMMU Users

The NMMU users' sample group consists of groups of 1 611 NMMU staff (administrative and academic) and 26 119 NMMU students. These groups combined, constitute the entire NMMU population. It is therefore clear that all NMMU Internet users in these categories qualify for this research study and would consequently be invited to participate.

The sampling method use for NMMU users would be cluster random sampling as the targeted population can be naturally divided into clusters with similar profiles (Wegner, 2012). These profiles are academic staff, administrative staff and students.

1.9. Data Analysis

The HEIIMS questionnaire will be forwarded to the selected HEI ICT Director or Internet management staff member and invited to participate. All qualified respondents willing to participate will then be requested to complete and submit the questionnaire.

The NMMUIUS questionnaire will be forwarded to the NMMU user population and invited to participate. All respondents willing to participate will then be requested to complete and submit the questionnaire.

Once received, both questionnaires will be automatically tabulated in the required format by the NMMU online survey tool. This information can then be exported into Microsoft Excel format which will simplify the analysis process. All data will then be checked for reliability and validity, and all corrupt or incomplete data will be removed from the datasheet. Descriptive and Inferential Statistical methods will then be used to analyse the collected data.

1.10. Ethics Clearance

Full ethics clearance will be obtained from the NMMU Business School through the Research Ethics Committee – Human (REC-H). The accepted ethical clearance form will be attached in Appendix B – Ethical Clearance Form E with Resolution Number.

1.11. Overview of Chapters and Structure of the Treatise

The preliminary layout of this treatise is graphically depicted in Figure 1.3. The flow of the treatise is as follows:

1.11.1. Chapter 1: Introduction

Chapter 1 begins with the significance and importance of the Internet in our daily lives. This chapter then continues by arguing how difficult it has become to manage the ICT Internet resources, especially from an HEI perspective. Various examples of these difficulties are highlighted to support the main argument towards the value that this treatise will give the research community and HEIs. It was then suggest that an Internet management model would aid HEIs to manage the ICT Internet resources effectively and efficiently. In doing so the main research objective, as well as the related research questions were decided. Therefore, the purpose of this chapter was to create a holistic view of what is to be expected in this treatise.

1.11.2. Chapter 2: Internet Governance

Chapter 2 will identify and discuss the national and international governance structures that influence the management of the Internet. Therefore, the purpose of this chapter is aimed at answering RQ_1, which questions "*What national and international governance structures are available that influence Internet management?*". This is realised by reviewing current literature studies concerning this specific research area.

1.11.3. Chapter 3: Research Design and Methodology

Chapter 3 will provide a comprehensive explanation of the research methodology followed in this treatise, which would aid reproduction in future studies. This chapter will specifically elaborate on the research methodology used with specific reference to the research paradigm, sampling design and measuring instruments used. Therefore, the purpose of this chapter is aimed at answering RQ_2, which questions "*What research methodology can be utilised?*".

1.11.4. Chapter 4: Results and Analysis of the HEI Internet Management Survey

Chapter 4 will identify the national best practices adopted for Internet management at HEIs by means of the collected empirical data for the HEIIMS. This is realised by analysing each research question in the HEIIMS and presenting the common findings in a clear and logical manner. Therefore, the purpose of this chapter is aimed at answering RQ_3, which questions "*What are the national best practices for Internet management at Higher Education Institutions?*".

1.11.5. Chapter 5: Results and Analysis of the NMMU Internet Usage Survey

Chapter 5 will provide a comprehensive analysis of the collected empirical data for the NMMUIUS. This will be compiled by analysing each research question and presenting these findings in a clear and logical manner. Therefore, the purpose of this chapter is aimed at answering RQ_4, which questions "*How is the Internet utilised at NMMU by staff and students?".*

1.11.6. Chapter 6: Recommendations and Conclusion

Chapter 6 will offer recommendations on how to improve the HEI ICT Internet management strategy. Therefore, the purpose of this chapter is aimed at answering RQ_M, which questions "*What are the components of an Internet Management Model that will ensure effective management of Internet usage at an Higher Education Institution?".* This chapter will conclude by discussing possibilities for future research and limitations of this study.

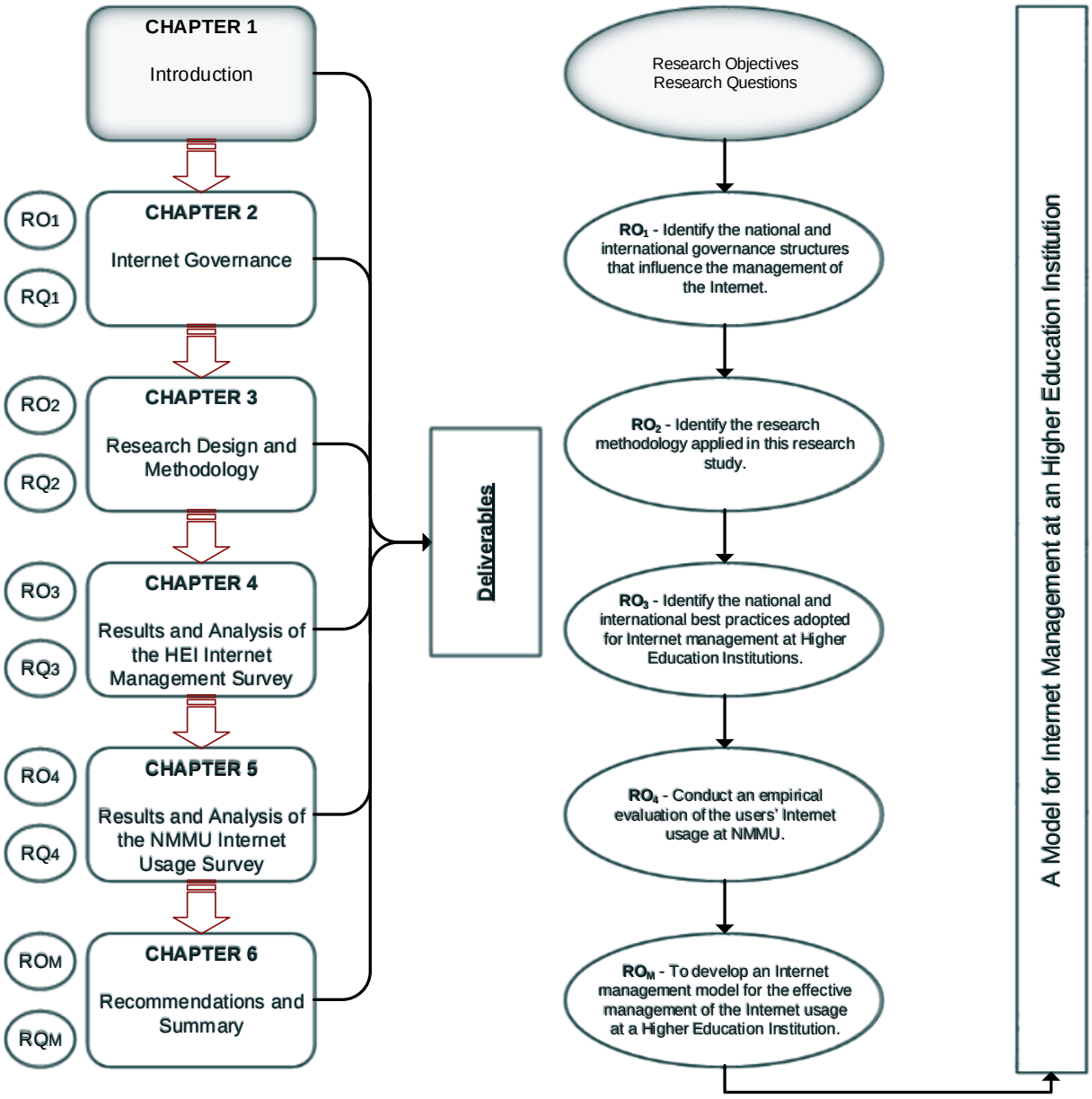

Figure 1.3: Preliminary layout of the Treatise.

1.12. Summary

This chapter provided a background to the use of the Internet in general and its importance in our daily lives. IG and Internet management are then discussed in general, followed by how difficult it has become to manage the ICT Internet resources, especially from an HEI perspective. Various examples of these difficulties were highlighted to support the importance and need for this research study. The research paradigm, research design and methodology and data analysis used in this research study were then discussed. This chapter therefore laid the foundation to what is to be expected in this treatise.

Chapter 2 will identify and discuss the national and international governance structures that influence the management of the Internet. Therefore, the research objective of this chapter will be focused on RO_1, which is to identify the national and international governance structures that influence the management of the Internet. This will be achieved by asking RQ_1, which questions "*What national and international governance structures are available that influence Internet management?*".

Chapter 2

2. INTERNET GOVERNANCE

2.1. Introduction

Chapter 1 presented an outline of the treatise by discussing the background to this research study and the research problem. The problem statement was linked to the research questions and research objectives which must be investigated to ensure that the problem is adequately addressed. Chapter 1 briefly discussed the research methodology that will be used for the study to ensure it is deemed reliable and valid in the research community.

Chapter 2 will be completed by means of reviewing current literature which will assist the researcher to critically summarise current knowledge in the respective field of study. This will allow for the removal of potential weaknesses in previous research and in this study. In addition, the literature review will provide a contextual view within which the research study is placed.

This chapter will address RQ_1 which states "*What national and international governance structures are available that influence Internet management?*". The objective of the chapter is to identify the national and international governance structures that influence the management of the Internet. Current literature studies will be reviewed to find a suitable answer to the identified research question. See Figure 2.1 for an overview of the research question and research objective of this chapter.

Chapter 2 will review what IG models are available to govern the Internet resources. After this review, the current, implemented national and international IG structures will be discussed. The different role players and their respective duties towards maintaining the Internet's global interoperability will be highlighted. Chapter 2 will continue by discussing the IG ecosystem which is a framework used to address any new IG issues experienced. See Figure 2.2 for a Structural overview of Chapter 2.

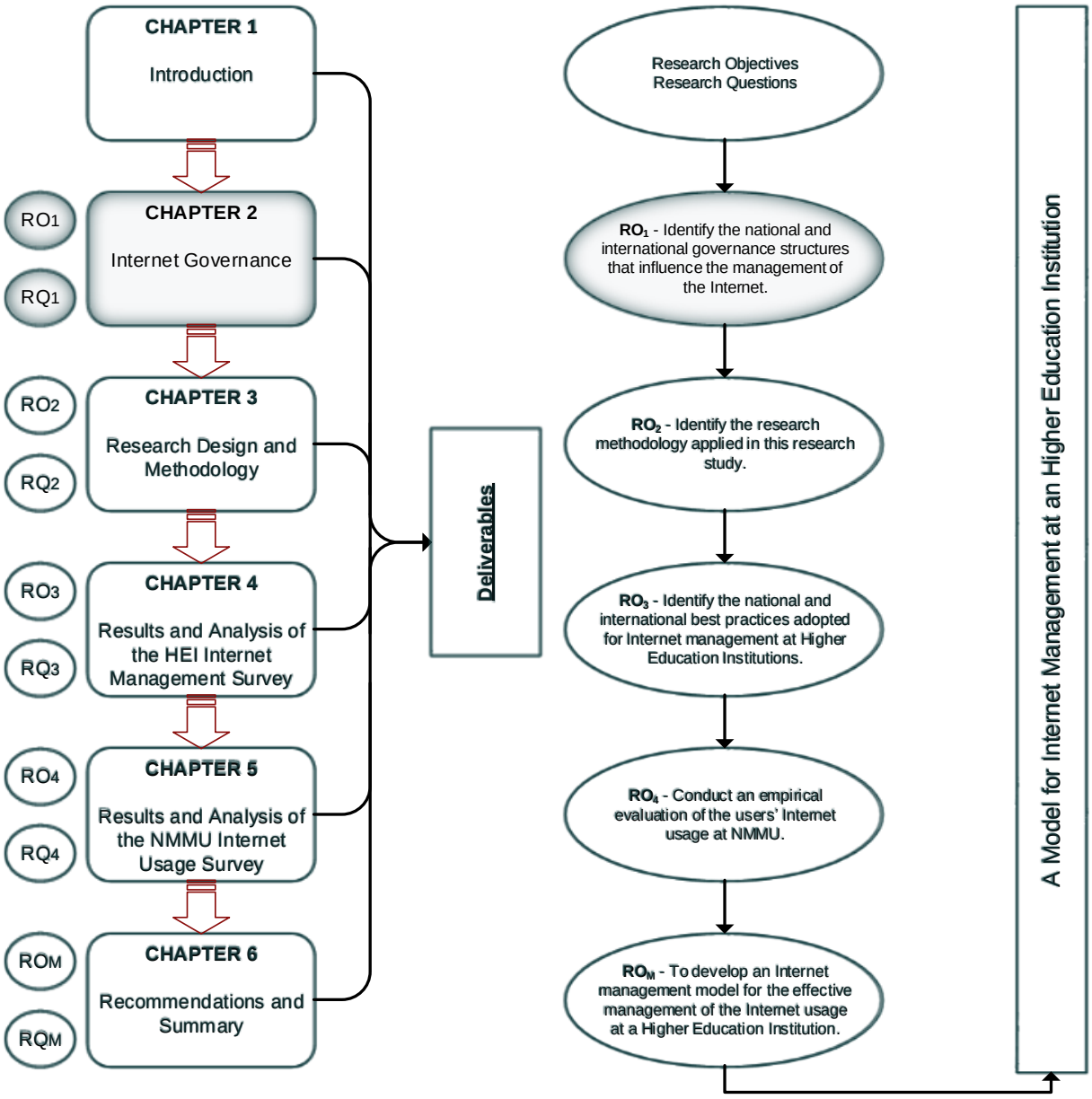

Figure 2.1: Chapter 2 Research Question and Research Objective.

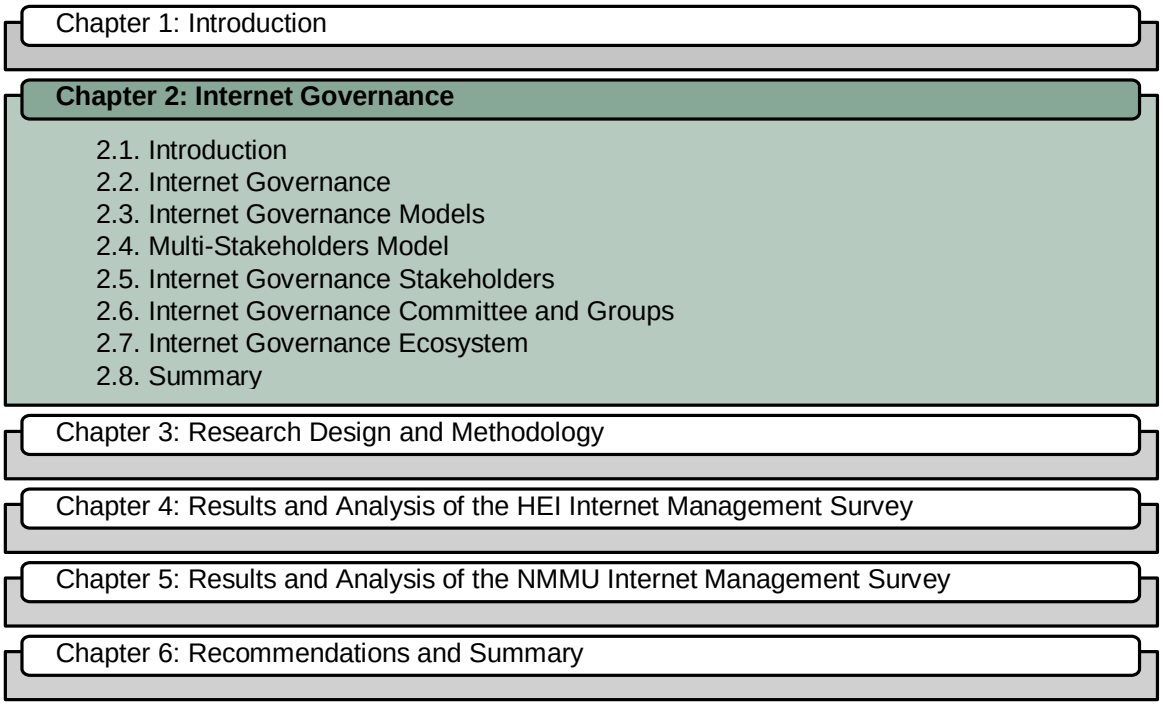

Figure 2.2: Structural overview of Chapter 2.

2.2. Internet Governance

The Internet is a global information transaction network spanning across multiple economies and has disruptive and substantial effects on all. The Internet is known as a general-purpose technology that has become one of the most important global communication systems in the 21st century. It has introduced surges of economic growth and productivity, thus paving ways for new industries to enter the market place and establishing new rules for the remaining industries. The Internet brought about a disruptive path of innovation which introduced pricing transparency, thus unsettling commercial relationships, increased customer expectations and superseded to old business models (McKinsey Global Institute, 2013).

The Internet constitutes an organic system of millions of Internet-connected devices that are able to communicate and share information with one another (Negron, 2012). It consists of interconnected networks of communication between networks via communication protocols, currently Transmission Control Protocol/Internet Protocol (TCP/IP). In its most common form, the Internet is a fusion of hardware and software technical infrastructure with applications that run on it. These applications communicate and generate content, which is then shared over these networks (Solum, 2008).

It is clear that the Internet is an extremely large and powerful technology spanning the globe and affecting a major portion of our lives. It must be realised, the Internet is made up of

millions of devices, running countless applications, which are generating, manipulating and sharing a vast array of information over an open medium, continuously. This raises the following questions, "*Who is entitled to regulate the Internet in its entirety?",* "*What do these role players do to ensure it is regulated adequately for the benefit of all?*", "*Why are they needed and in what capacity?*" and "*How do they govern the Internet?*". These role players must have sufficient knowledge to address *policy issues,* as well as address the technical issues related to the Internet, two very diverse skills sets. Due to the immense size, scatter impact and continuous growth of the Internet, it must be regulated in some way or form.

IG is the practice ultimately responsible for the regulation of the Internet as it develops and changes over time. As the Internet is a shared and open medium of communication, IG's main aim must be to create shared policies and standards for the benefit of the wider Internet community. The Internet should therefore be transparent, multifaceted and democratic available to all, with equal delivery of resources, simplified access for all users and with a stable, safe and secure Internet environment (Kowack, 1997).

There are currently two types of simple scope definition available in the research community. The first scope definition is known as the 'narrow' definition which argues that IG is geared towards the administration and management of the technical infrastructure and architecture of the Internet. The second scope definition is known as the 'broad' definition which argues that not only is IG responsible for regulating the technical infrastructure and architecture such as Domain Name Servers (DNS), IP numbers, routing protocols, etc., but it is also ultimately responsible for policy and political issues such as child pornography, freedom of speech, privacy, security, international organisation, etc. (King, 2004; Solum, 2008). From these two scope definitions it is understandable that there is a relationship between the two definitions as one cannot be fully accomplished without the other. In other words, the technical infrastructure and architecture are directly connected to the policy issues that regulate the human element of the Internet, and vice versa.

2.3. Internet Governance Models

It is apparent that there is a vast amount of interest in governing the Internet. The proper management structures must therefore be in place where all Internet resources, technical and policy-related, are amply sustained. Solum (2008) identified five models of IG which are centered around the thought process associated with IG. The two thought processes are 'what or who determines where the responsibilities must lie?' and 'what operational level is associated with these responsible parties?'. Therefore, each one of the five models is

consequently fixated on a contextual environment and line of throught. These models are reinforced by Collins (2007), however, they are referred to as myths and are grouped into three. These are Network Organisations, Horizontal vs Vertical and Hierarchy, and Markets. Furthermore, Pavan, et al. (2009) incorporate elements of the model into four areas known as commons. These are Social commons, Infrastructure commons, Service commons and Access commons. These commons are however not in line with the thought process and would therefore not be included in their entirety in the chapter. For the purpose of this treatise the focus would be on the model at its most simple level, therefore the five models as covered by Solum (2008) will be discussed. The following sub-section will elaborate on each of the five models of IG.

2.3.1. Cyberspace and Spontaneous Ordering Model

The Cyberspace and Spontaneous Ordering model is built on the ideology that the Internet is a self-governing, separate realm of individual rights, not related to the 'real world' by any means. The Internet is classified as a distinct place with no physical boundaries associated with it. In the 'real world', law and legal institutions are enclosed within existing borders and controlled by the respective governments. Consequently, in Cyberspace legal rights and responsibilities cannot be determined by geographical borders as the 'law space' or 'law map' does not apply. The characteristics of the 'real world' can therefore not be imprinted onto that of the Internet as one may assume (Collins, 2007; Johnson & Post, 1996; Solum, 2008).

In this model, it is argued that governments should not be encouraged to dominate rule-making for the Internet. The entire Internet community will subsequently be affected by the imposed rules, which is not always beneficial to all. There would be severe consequences if China was able to install its 'Great Firewall' rules and regulations for the entire Internet community. The Internet experience would be a very limited and a controlled one if that was the case. Beyond this, it would be extremely costly for any nation's government to attempt to monitor and regulate all content, policies, and technical and architectural issues associated with the Internet, because the source could be from any physical location, anywhere in the world. Furthermore, the technical and architectural nature of packet switching and routing associated with traffic communication will also impose some difficulties as one digital conversation does not travel by the same route to its destination (Johnson & Post, 1996; Solum, 2008).

This however does not mean that the Internet is a 'lawless space'. There is an increase in law-making institutions within Cyberspace that support this argument. There is, however, a fine line that needs to be understood, especially when attempting to pin-point cyber activity to

a physical jurisdiction. Johnson and Post (1996), claim that the structures covered in this model are better suited to address the Internet legal issues (Johnson & Post, 1996; Solum, 2008).

2.3.2. Transnational Institutions and International Organisations Model

The Transnational Institutions and International Organisations model incorporates the Cyberspace and Spontaneous Ordering model's characteristic of being a self-governing, separate realm of individual rights, not related to the 'real world' by any means. The model perceives transnational institutions and international organisations as the most relevant institutions for IG, which are founded on contractual arrangements. At its core, Transnational Institutions and International Organisations both instil an institutional structure that is not confined by national boundaries.

The main difference between the two is that transnational institutions are outside the control of governments and report to the Internet community whilst international organisations are inside the control of governments and report to their respective government. Two current examples include the Internet Corporation for Assigned Names and Numbers (ICANN) and Internet Engineering Task Force (IETF) which are transnational institutions, and World Intellectual Property Organization (WIPO) and International Telecommunication Union (ITU) which are international organisations. Both are present in the current implemented IG model (Collins, 2007; Solum, 2008). Historically, transnational institutions have been better received and accepted, while international organisations have failed to gain the high level of authority as perceived by transnational institutions.

Collins (2007) combines the first two models, Cyberspace and Spontaneous Ordering and Transnational Institutions and International Organisations, into one model which the titled 'Network Organisation'. All characteristics remain simular as discussed above.

2.3.3. Code and Internet Architecture Model

The Code and Internet Architecture model is based on the concepts that the Internet is built on code and architecture, and therefore the decisions regarding it must be made by technical individuals and on a technical level. After all, the natural environment of the Internet is made up of software and hardware which are integrated by various levels of code. In order to regulate the Internet, the governance must be inline with the nature of the implemented code. The code, by itself, will permit some activities while denying others, in the same sense as the walls of a building (born from the building's architecture) guide users in specific directions.

Anything outside the scope will be irrelevant as it does not address the source. This logic makes code the prime regulator of the Internet (Solum, 2008).

The Code and Internet Architecture's inner workings can best be described by an examination of the Open Systems Interconnection model (OSI Model). The OSI Model logically divides the network architecture into seven logical layers (Collins, 2007). These layers are the central architecture that defines the Internet. The layers are 7 – Application, 6 – Presentation, 5 – Session, 4 – Transport, 3 – Network, 2 – Data Link, 1 – Physical, in a stacked fashion. Each layer has a specific function that it must complete that contributes to the entire network system. For example, the Application layer specifies the methods used to accomplish the user-initiation tasks and the Physical layer specifies the connectors, data rates, encoding methods, etc. Each one of the layers forms a relationship with the directly connected layer and translates and communicates the data received to the other layers, which are either above or below, depending on whether the data is being sent or received (Fall & Stevens, 2012). Each layer of the OSI Model therefore represents a function of the code and Internet architecture.

Figure 2.3 depicts a typical transaction that is sent from one user (left top corner) to another user (top right corner) over the Internet (or any network). The sent data originates from the top layer, the application layer, and is communicated downwards. The data then travels thought the Presentation layer, Session layer, Transport layer, Network layer, Data Link layer and ends at the Physical layer. The data then leaves the source device and travels over the Internet to the destination device. The Internet is represented by the Network layer, Data Link Layer and Physical layer; the number of layers depends on the route the data travels. Each time the data packet is 'opened' to determine where the destination address is, it is then closed and forwarded in the direction of the destination device. This process is repeated every time data enters a new network segment in the Internet. When the data reaches the destination device, the data enters the Physical layer of the device and is translated and communicated in reverse order. The data is finally received in the Application layer and the data is displayed to the user in its original form. This is the basis of one transaction.

As previously mentioned, the TCP/IP is the network communication protocal that makes the connection of networks materialise. TCP/IP was created to address the growing needs of the initial Internet architecture. It was created as a software-only protocol which was free from any physical hardware resources. It is in essence 'pure code' that governs the architecture of the Internet. The Code and Internet Architecture model is consequently the governance of TCP/IP (Solum, 2008).

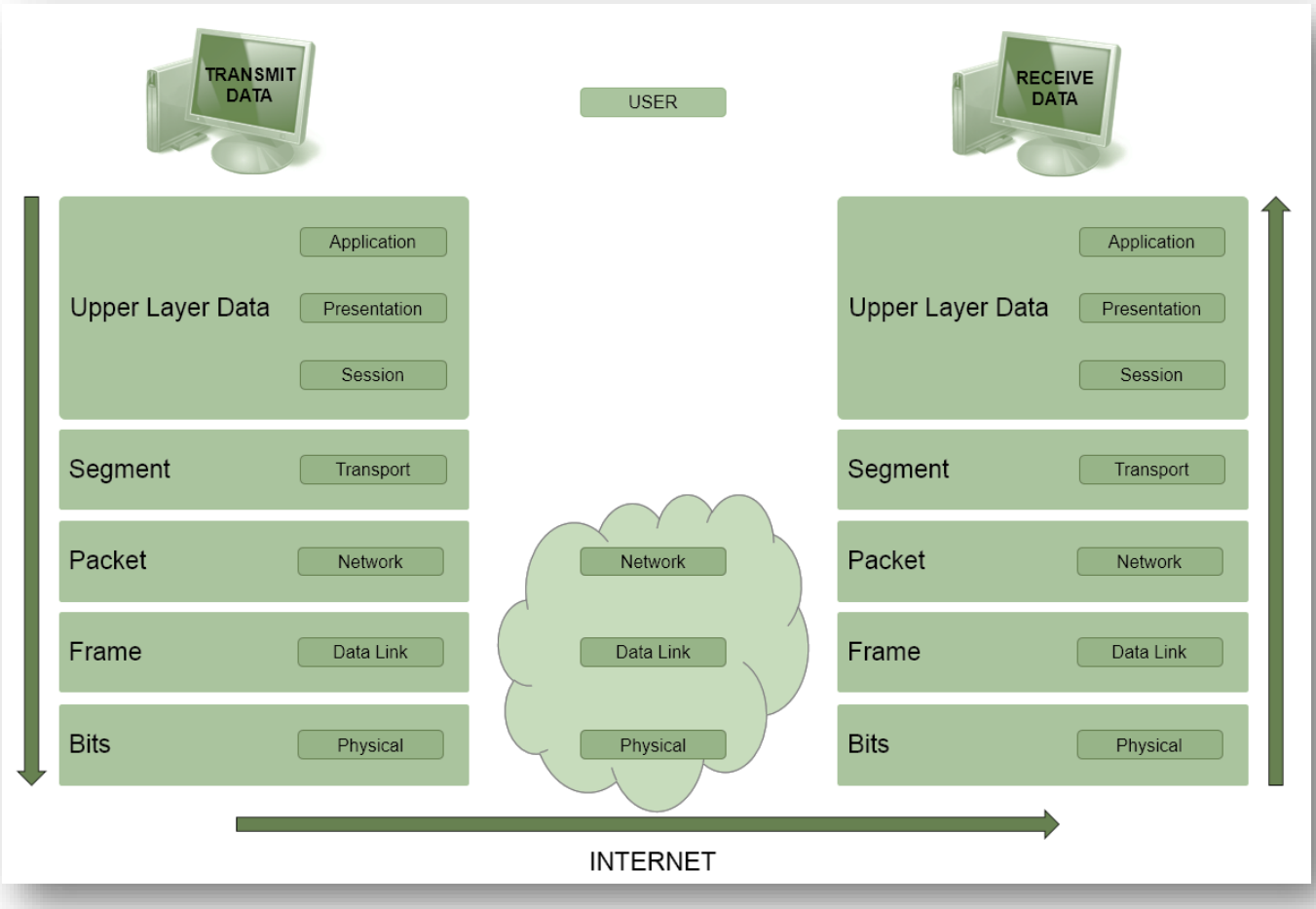

Figure 2.3: ISO 7 Layer Model of Communication.

Collins (2007) refer to this model as 'Horizontal v Vertical' whilst Pavan, et al. (2009) refer to it as Infrastructure commons. All characteristics remain similar as discussed above.

2.3.4. National Government and Law Model

The National Government and Law model focuses on the ideology that national governments should control the Internet by means of legal regulation for the same reason as it controls its citizens (Collins, 2007). The national government will therefore be entitled to make important, fundamental, regulatory decisions on the Internet-related activities that take place within its jurisdiction. The model therefore requires the national government to have full power over its territory and for the users to gain access to the Internet only from within its borders. It should be acknowledged that in most cases, Internet regulations within the country are already in place to some extent due to the national government's position related to the regulation of the country. For this reason, Internet-related markets are already established by most national governments which assists with other Internet regulation modalities as well (Solum, 2008).

There are some difficulties associated with the National Government and Law model. The first difficulty that may be experienced is with the fundamental Internet architecture (Xing, 2011). As previously discussed in Section 2.3.3 Code and Internet Architecture model, the Internet at its most basic level is extremely technical in nature, which means that the national government can only do so much before it is required to enter and request changes to the technical architecture of the Internet. Historically, no national government has had enough influence to force a global Internet architecture modification. Put differently, the Internet is not designed to be regulated by one national government only. The second difficulty that may be experienced is accessing content that was created outside the national government's jurisdiction, which may be in direct violation of the government's regulations. This will require national governments to restrict certain content by law, which can be an extremely difficult and expensive task to perform. It is argued that the best method to accomplish this would be to remove the content from the Internet, globally. This decision will affect the Internet community at large, meaning that one national government would have monopoly over the content (Solum, 2008).

A fundamental issue that adds fuel to the flames is the fact that there is a large number of freely available technologies that will aid users in bypassing the implemented national government's regulations. For instance, proxy servers allow your device to appear as if it is located in another country. This practice allows a user to not adhere to the regulations of his/her country of origin. This allows a relatively large percentage of the population to disobey the regulatory requirements of the nation. This is clearly the case with China. This argument, combined with the immense costs incurred as discussed earlier, will not allow the National Government and Law model to be considered as a complete solution to IG (Xing, 2011).

2.3.5. Market Regulations and Economics Model

The Market Regulations and Economics model assumes that market forces must drive the essential decision making process regarding the nature of the Internet (Solum, 2008). IG within these models would therefore be addressed by the demands of the economy within the jurisdiction of the national boundaries, which are guided by the supply and demand of Internet-related products and services. In a market economy, the resources should therefore be regulated according to how much products and services are desired by the consumers and how much the market can offer. Market economy allows for resources to be allocated in the most efficient way possible (Hirschey, 2009). The Market Regulations and Economics model therefore highlights that the market forces, as caused by market economics, should drive the decision-making process that governs the Internet.

A typical example will include the use of Domain Name System (DNS). DNS is the naming system used to translate the IP addresses of computers, services and any other resources connected to the Internet into easily remembered names for users. The more common names and root will be in high demand and would therefore come with a higher price such as www.google.com, whilst the uncommon names and root would not be in high demand and would therefore come at a reduced cost such as www.glrtpgnsyw.rfjd--lswu. An additional example could be that of web content. Some content may be highly desirable and/or valuable and therefore frequently accessed, while other content may not be so desirable and/or valuable and will therefore be less frequently accessed.

Collins (2007) combines the last two models, National Government and Law and Market Regulations and Economics models, into one model which is titled 'Hierarchy and Markets'. All characteristics remain as discussed above.

The five IG models discussed above all have their advantages and disadvantages. It is apparent that there is no single model that is adequate in providing an all-rounded solution to all IG problems experienced. Although each model brings forth valuable benefits to IG, each model also presents various inadequacies. It is also clear that the needs of the stakeholders will not be addressed by only one model. An alternative strategy must therefore be considered to ensure that IG is sufficiently regulated to ensure an improved Internet experience for the wider Internet community. The following section will examine what is currently in place as an IG solution.

2.4. Multi-Stakeholder Model

The previous section concluded the analyses of the available models of Internet Governance, the next step is to analyse the performance of the current adopted model being utilised. The definition that has been most widely accepted by the Internet community and other stakeholders will help to answer the questions previously raised. These were "*Who is entitled to regulate the Internet in its entirety?",* "*What do these role players do to ensure it is regulated adequately?*", "*Why are they needed and in what capacity?*" and "*How do they govern the Internet?*".

WSIS (2005), states that "Internet Governance is the development and application by governments, the private sector and civil society, in their respective roles, of shared principles, norms, rules, decision-making procedures, and programmes that shape the evolution and use of the Internet." (WSIS, 2005, p. 4). IG is consequently the coordination of many related

factors which include technical infrastructures and architecture standards, and policy matters which constitute how the Internet works and should be used. IG can only be achieved through various stakeholders' involvement which includes governments, private sectors and civil societies. The model is known as the Multi-Stakeholder model.

The Multi-Stakeholder IG model has been widely publicised as the global model of choice for many years. It has been widely accepted and it is argued that the success of the Internet is founded from this model (Savage & McConnell, 2014). Civil Society and Internet users, the Private Sector, Governments, National and International Organisations, Research, Academic and Technical communities all contribute in their respective roles to the current and future state of the Internet. The model therefore allows for greater collaboration and coordination on various Internet regulation issues and to collectively address these issues through the sharing of expertise (International Telecommunication Union, 2013). It also allows support on handling of various layers of traffic over the Internet through all mediums which span over different government regimes. The outcome is a shared network of networks that is beneficial to all who wish to use it. It is therefore clear that the Multi-Stakeholder model taps into each of the five models previously discussed and aims to emphasise the core advantages of each model whilst trying to exclude the disadvantages associated with them. The following section will highlight the various stakeholders involved with IG.

2.5. Internet Governance Stakeholders

Stauffacher and Kleinwächter (2005) identified four respective stakeholders that are key to IG. These stakeholders play a key role in the regulation of the Internet in its entirety. The four groups are governments, the private sector, civil society and international and regional institutions. They continue to provide insight into each stakeholder and their respective roles in IG as follows:

- Governments – They are overall responsible for the creation and implementation of their nation's electronic strategies (e-strategies) which must be in the best interest of the country and the people. Private sector and civil society will play a counselling role in this regard;
- Private Sector – This is a key player in the development and distribution of information and communication technologies, for applications, content and infrastructure. The private sector is a key player in the market as well as in wider sustainable development environment;
- Civil Society – This is a key player in implementing ICT-related technologies as well as building the Information Society; and

- International and regional institutions (a.k.a Transnational Institutions and International Organisations) – These institutions and organisations, which includes international financial institutions, combined have a vital role in integrating the use of information and communication technologies in the growth process and providing the necessary Internet resources for building the Information Society. These institutions and organisations are then responsible for monitoring progress (Stauffacher & Kleinwächter, 2005; WSIS, 2005).

This section addressed the question "*Who is entitled to regulate the Internet in its entirety?",* The following section will briefly examine the committees and groups that comprise the stakeholders previously recorded.

2.6. Internet Governance Committees and Groups

The stakeholders on their own will not have the required influence, knowledge and skills to address IG in its entirety. It is because of these reasons that various committees and groups have been formed that address various IG issues. Each committee and group focuses on a specific IG issue. Stakeholders are then called upon to serve on a committee or group, according to the committee and group requirements. All stakeholders are thus granted permission to provide input, according to their expertise, on how the Internet must be governed. This allows capable committees and groups to address identified IG issues. The following sub-section will highlight each committee and group and briefly discuss their purpose.

2.6.1. Internet Architecture Board (IAB)

The Internet Architecture Board (IAB), previously known as Internet Activity Board, was created in 1983. Its main purpose is to serve and help the Internet Engineer Task Force (IETF) and Internet Research Task Force (IRTF). Its duties include:

- Manage the engineering and technical development of these two committees;
- Provide oversight of the architecture for the protocols and procedures used by the Internet;
- Manage the process used to create Internet Standards and attend to any improper executions thereof;
- Manage the writing and publication of the Request for Comments (RFC) document series and the administration of the various Internet assigned numbers; and
- Act as a source of guidance and advice for the Internet Society's Officers and Board of Trustees regarding the architectural, technical, procedural and respective policy matters (Internet Architecture Board, 2015).

In summary, the IAB engages in the following spectrum of Internet issues: Advice, Community Engagement, Policy, Research and Standards.

2.6.2. Internet Corporation for Assigned Names and Numbers (ICANN)

The Internet Corporation for Assigned Names and Numbers (ICANN) is a not-for-profit, public-benefit organisation which was created in 1998. Its main purpose is to operate the Internet's Domain Name System (DNS) as well as manage the unique identifiers for the Internet's systems. The unique identifiers include IP addresses, protocol parameter registries and top-level domain space (DNS root zone). In addition, ICANN aids the Internet communities globally which support the process of keeping the Internet safe and secure, stable and interoperable. Furthermore, ICANN helps to develop Internet policy and competitive markets in the domain name space (Internet Corporation For Assigned Names and Numbers, 2013).

In summary, the ICANN engages in the following spectrum of Internet issues: Community Engagement, Operations, Policy and Services.

2.6.3. Internet Engineer Task Force (IETF)

The Internet Engineering Task Force (IETF) is the Internet's leading technical standards body. Its main focus is on short term engineering and standards. It develops and markets an extensive range of best practice technical documents which are used by the Internet community to design, use, and manage the Internet. IETF subdivided its duties by creating various working groups which then take responsibility for a specific technical area. These areas are security, transport and routing (The Internet Engineering Task Force, 2015).

In summary, the IETF engages in the following spectrum of Internet issues: Community Engagement, Policy and Standards.

2.6.4. Internet Governance Forum (IGF)

The Internet Governance Forum (IGF) is an open forum group of various stakeholder, who debate on policy issues related to the Internet. Although IGF has no negotiated outcome, it encourages those in the public and private sectors with policy-making power to address the highlighted issues. This is accomplished through networking events where information and general good practices are exchanged, which in turn increases Internet opportunities and also addresses known problematic areas in the Internet (Internet Governance Forum, 2015).

In summary, the IGF engages in the following spectrum of Internet issues: Advice, Community Engagement and Policy.

2.6.5. Internet Research Task Force (IRTF)

The Internet Research Task Force (IRTF) endorses long term research issues on Internet topics such as Internet protocols, architecture, applications and technologies. This is accomplished through focused research groups which required long term membership. Membership is approved per individual instead of at an organisational level.

The research groups include: Crypto Forum Research Group (CFRG), Delay-Tolerant Networking Research Group (DTNRG), Global Access to the Internet for All Research Group (GAIA), Internet Congestion Control Research Group (ICCRG), Information Centric Networking Research Group (ICNRG), Network Function Virtualisation Research Group (NFVRG), Network Management Research Group (NMRG), Network Coding Research Group (NWCRG) and Software Defined Networking Research Group (SDNRG) (Internet Research Task Force, 2015).

In summary, the IRTF engages in the long term research spectrum of Internet issue.

2.6.6. Governments and Inter-Governmental Organisations

The Governments are responsible for the development of laws, regulations and policies related to the Internet within their jurisdiction, whilst participants in multi-stakeholder and multilateral national and international opportunities on Internet governance are from Inter-Governmental Organisations (Creative Commons Attribution, 2013).

In summary, Governments and Inter-Governmental Organisations engage in the following spectrum of Internet issues: Community Engagement and Policy.

2.6.7. International Organization for Standardization, Maintenance Agency (ISO 3166 MA)

The International Organization for Standardization, Maintenance Agency (ISO 3166 MA) outlines names and postal codes of countries, dependent territories and geographic special areas of importance. These are letters and/or numbers that are usable when referring to countries and their relevant subdivisions. A typical example includes '.za' for South Africa, '.fr' for France and '.au' for Australia (International Organization for Standardization, 2015).

In summary, the International Organization for Standardization, Maintenance Agency (ISO 3166 MA) engages in the standards spectrum of Internet issues.

2.6.8. Internet Society (ISOC)

The Internet Society (ISOC) creates and endorses principles that are aimed at encouraging governments to make Internet-related decisions that are aligned with the current and future needs of the Internet community. In addition it:

- defends public policies that enable open access;
- promotes the open development, growth and use of Internet resources; and
- invests in networking events and opportunities to promote knowledge sharing (The Internet Society, 2015).

In summary, the ISOC engages in the following spectrum of Internet issues: Community Engagement, Education, Policy and Services.

2.6.9. Five Regional Internet Registries (RIPs)

The Five Regional Internet Registries (RIPs) manage the designated regional allocation and registration of Internet number resources which include IP addresses and Autonomous System Numbers. The five regions of the world are:

- Africa Network Information Centre (AFRINIC), which covers Africa;
- Asia Pacific Network Information Centre (APNIC), which covers Asia Pacific;
- American Registry for Internet Numbers (ARIN), which covers Canada and the United States;
- Latin American and Caribbean Internet Address Registry (LACNIC) which covers Latin America and Caribbean; and
- Reseaux IP Europeens (RIPE NCC), which covers Europe, the Middle East and parts of Central Asia (Internet Corporation For Assigned Names and Numbers, 2001).

In summary, the Five RIPs engage in the following spectrum of Internet issues: Operations, Policy and Services.

2.6.10. World Wide Web Consortium (W3C)

The World Wide Web Consortium (W3C) develops guidelines and protocols to ensure the long term evolution of the Internet. It creates standards that allow for the world wide web to be universal for user and device, therefore allowing easy access and use of the Internet for the Internet community (W3C, 2015).

In summary, the World Wide Web Consortium (W3C) engages in the standards spectrum of Internet issues.

2.6.11. Internet Network Operators' Groups

The Internet Network Operators' Groups are informal groups that discuss and influence matters related to Internet network operations and regulation within forums. These groups have no formal power, however, the individual member in most cases do have some form of affiliation with other committees (Creative Commons Attribution, 2013).

In summary, the Internet Network Operators' Groups engage in the following spectrum of Internet issues: Advice, Operations, Policy and Services.

The committees and groups permit an all rounded IG approach which uses experts in their respective fields to address all technical and policy issues through open debate processes. It is no wonder that the management of the Internet is considered one of the largest cooperative efforts ever undertaken by mankind and has consequently been identified as one of the most successful technologies of all time.

These sub-sections addressed the questions of "*What do these role players do to ensure the Internet is regulated adequately?*", "*Why are the role players needed and in what capacity?*" and "*How do they govern the Internet?"*. The following section will discuss the IG ecosystem, which was created to address the gap created by the rapid evolution of the Internet.

2.7. Internet Governance Ecosystem

During 2013 and 2014, a number of global stakeholders consisting of governments, civil society, the private sector, the technical community and international organisations formed a panel called the Global Internet Cooperation and Governance Mechanisms. The initiative was made possible through the partnership between the ICANN and the World Economic Forum (WEF). The purpose of this panel was to advance discussion on IG issues, specifically to create a framework, identify principles and processes to evolve the IG ecosystem and to produce a roadmap which highlights the global Internet cooperation evolution (Global Internet Cooperation and Governance, 2014).

The Global Internet Cooperation and Governance Mechanisms reaffirmed the Multi-Stakeholder model as the best model for IG and have subsequently identified three fundamental design properties that must be included in the IG ecosystem. These include

distribution, participation and layering. Distribution insists on including various stakeholders to build and operate through several structures and governance systems. Participation insists on inviting all stakeholders to contribute with IG issues. Layering insists on following the hierarchical structure of IG (Global Internet Cooperation and Governance, 2014).

The framework that was created by the panel can be seen in Figure 2.4. As previously discussed, the aim of this framework is to address the gaps created by the evolution of the Internet. The framework identifies four elements of the IG process, working from the outside in. These are Issues Identification, Solution Mapping, Solution Formulation and Solution Implementation.

Figure 2.4: Internet Governance Ecosystem Sphere (SOURCE: Global Internet Cooperation and Governance, 2014, p. 10).

- Issues Identification – The source of the issue must be identified by the stakeholders before the group can address it. The issue must be identified as technical or non-technical in nature. This is followed by identifying the sphere, meaning, is the issue local, national, regional or global. The desired type of solution must then be identified, which includes best practice, specifications, standards or policy model;
- Solution Mapping – Once the issue is clear, the appropriate Distribution Group (DG) must be either created by means of stakeholder engagement or issued to the existing DG;
- Solution Formulation – The DG then addresses the issue through solution formulation. The solution must be in line with the set principles; and
- Solution Implementation – The last step in the process is to implement the solution as developed by the DG.

The end result is a well-thought-through process which produces an all rounded solution that stems from a DG, equipped with effective and supportable structures, mechanism and thus qualifies to address any new IG issue that may arise (Global Internet Cooperation and Governance, 2014). The following section will conclude Chapter 2.

2.8. Summary

This chapter addressed RQ_1 which states "*What national and international governance structures are available that influence Internet management?*". The chapter completed the RO_1 which was to identify the national and international governance structures that influence the management of the Internet.

Chapter 2 defined IG and reviewed the five available IG models as defined by Solum, (2008) with support from Collins (2007) that can be used to govern the Internet. It was clear from the discussion that each model cannot address the immense responsibilities and requirements of IG. This led to an investigation into ascertaining what the current implemented national and international IG structures entails. The Multi-Stakeholder model was therefore investigated, which presented the various stakeholders involved with IG and the respective committees and groups they created to address specific IG issues. The chapter concluded by discussing the recently implemented IG ecosystem which is a framework used to address any new IG issues experienced.

The review of the current, employed model led to the realisation that it is a combination of the five IG models, therefore making it a hybrid model. The Multi-Stakeholder model incorporates

the benefits of each model whilst trying to exclude their respective drawbacks. Note should be taken that IG is sophisticated by its very nature and therefore requires complex regulatory mechanisms to ensure that it is properly managed. The most respective IG model therefore requires an optimal mix of transnational institutions, international organisations, national governments, and market regulations with respect to the Internet's congruent technical and policy environment. The Multi-Stakeholder model satisfies this need.

Chapter 3 will provide a comprehensive explanation of the research methodology followed in this treatise. Therefore, the research objective of this chapter would be focused on RO_2, which would be to identify the research methodology applied in this research study. This will be achieved by asking RQ_2, which questions *"What research methodology can be utilised?*".

3. RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction

Chapter 2 presented the five available IG models that can be used to regulate the Internet. Thereafter, the current national and international IG structures were discussed. The IG ecosystem which is used to address any new issues that are presented in the ever evolving Internet environment was then discussed. The chapter concluded by highlighting the presence of all five IG models within the already implemented Multi-Stakeholder model.

Chapter 3 will provide a comprehensive explanation of the research design and methodology followed in this treatise, which will aid reproduction for future studies. This chapter will specifically elaborate on the research design and methodology with reference to the layered approach as used by the research onion. These references include the research philosophy, research approaches, research strategies, time horizons and techniques and procedures.

This chapter will address RQ_2 which states "*What research methodology can be utilised?".* The objective of the chapter is to identify the research methodology applied in this research study. Current research methodology practices will be reviewed and the suitable research methodologies will be extracted and presented. See Figure 3.1 for an overview of the research question and research objective of this chapter.

Chapter 3 will highlight the research design by referring to the research onion. The chapter will commence with a discussion on what is meant by research and what research design will be utilised for this study. The chapter will continue with a detailed analysis of each step of the research onion: research philosophy, research approaches, research strategies, time horizons and techniques and procedures. The chapter will conclude by summarising the followed research methodology for this treatise. See Figure 3.2 for a Structural overview of Chapter 3.

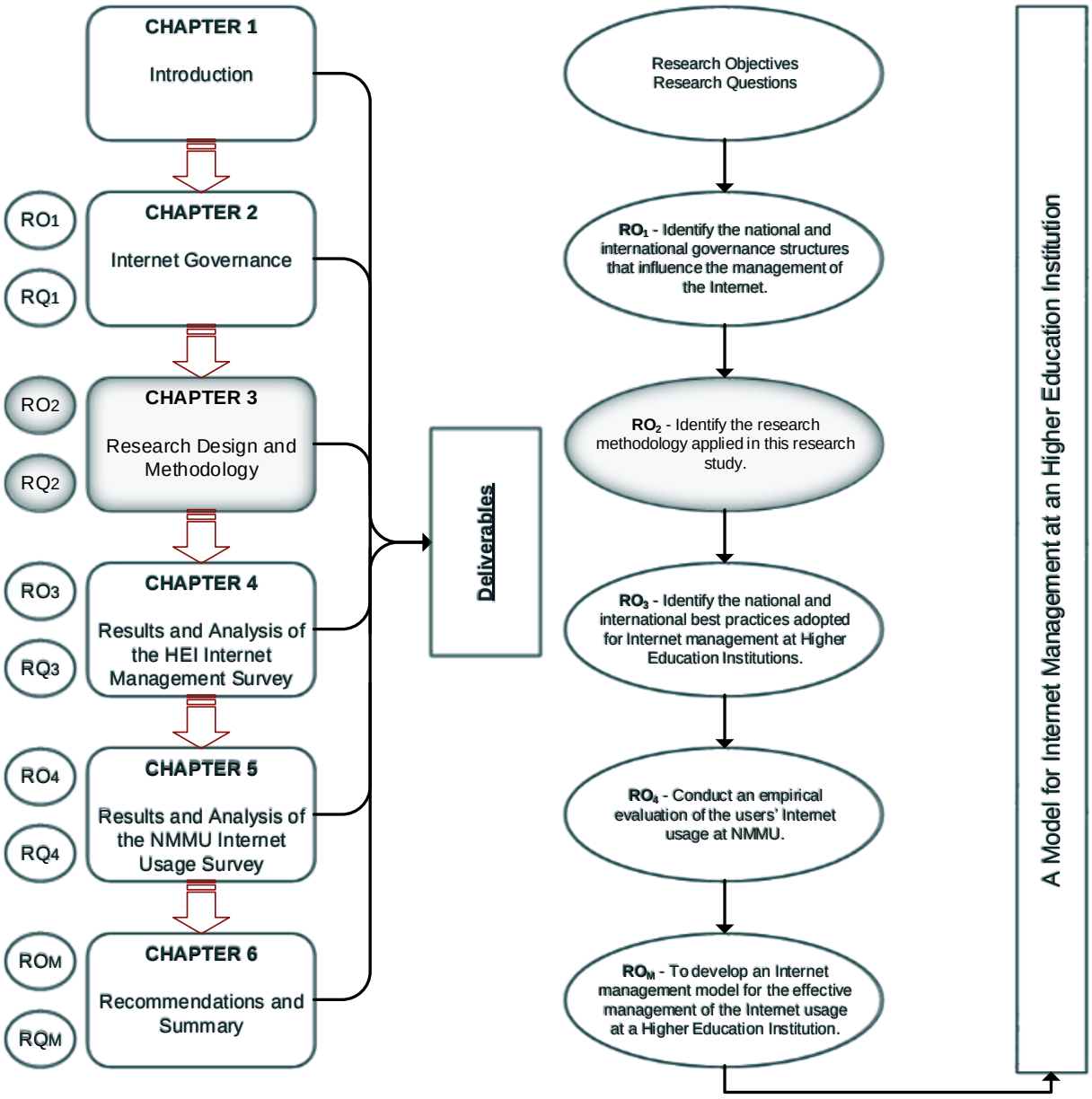

Figure 3.1: Chapter 3 Research Question and Research Objective.

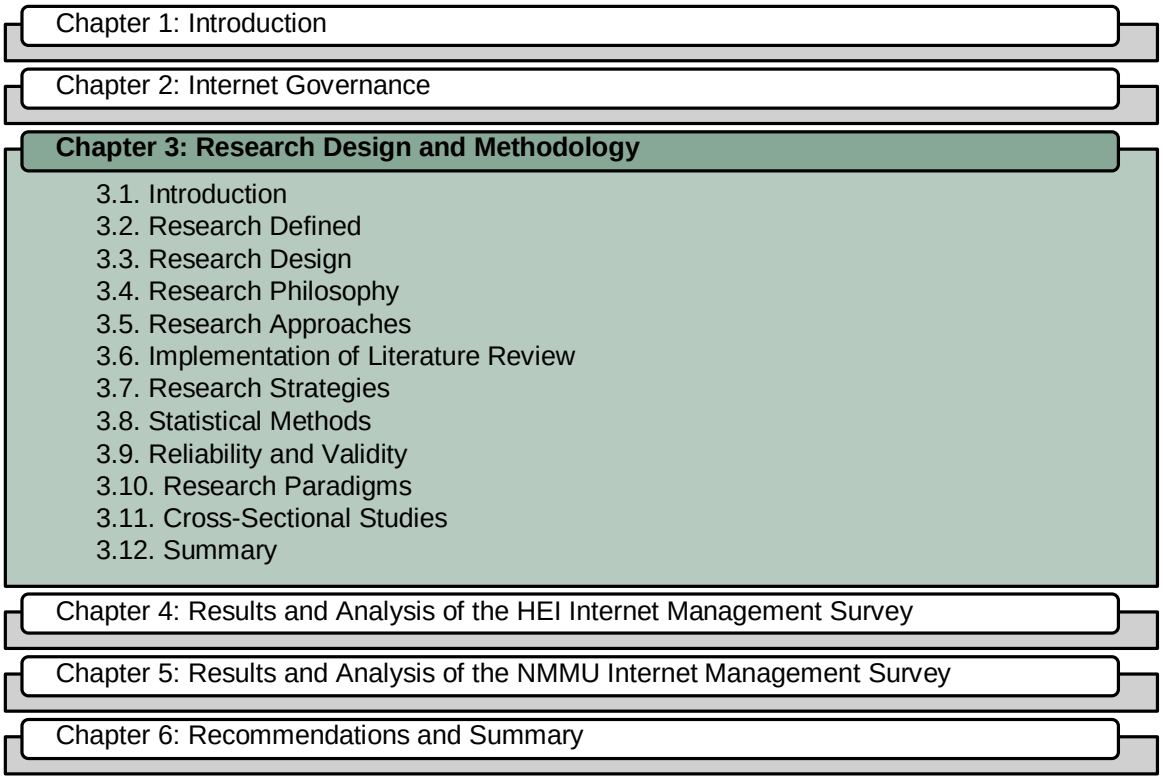

Figure 3.2: Structural overview of Chapter 3.

3.2. Research Defined

Research in most basic terms is identified as the use of systematic methods to find answers to questions. This definition does, however, leave numerous gaps in the term as required for this study. Kumar (2008), states that research is an original contribution to the existing body of knowledge to ensure its progression. It is focused on the quest for truth with the aid of study, observation, comparison and experiment. Therefore, research is the search for knowledge by means of applying objective and systematic methods to identifying and presenting a solution to the identified problem. The system approach concerning the preparation of a theory and generalisation is also part of research (Kumar, 2008). This argument stems from various definitions from experts in the research field.

The definition of research highlights a number of key points that must be present for a study to be classified as research. Firstly, the study must be an *original contribution* to the existing body of knowledge. Secondly, the purpose of the study must be to raise questions and then apply *scientific and systematic procedures* to these set questions to obtain the answers. Thirdly, the investigation must be on a *specific subject or specific field* of knowledge. Finally, the research must be undertaken to *establish principles or facts* (Kumar, 2008). The following section will define and discuss research design.

3.3. Research Design

Research design is the process of identifying and discussing the overall design or structure that will be used to test the thesis statement (Krippendorff, 2012). It allows the researcher to answer the main thesis statement as clearly as possible with the obtained evidence (data). Therefore, before collecting or analysing commences, the evidence needs to be identified which must answer the research question, test the theory, evaluate the programme or correctly describe the phenomenon (de Vaus, 2005). Only after the required evidence has been identified can the researcher focus on how the evidence will be obtained.

Obtaining the evidence must follow a sound and systematic research process for it to be deemed as a noteworthy scientific contribution. The research onion can be used as guidelines to develop a fitting and coherent research design which can be both justified and explained. In addition, it provides context and boundaries within which evidence collection techniques and analysis procedures must be selected (Saunders & Tosey, 2013).

This chapter will follow the analogy used by Saunders, et al., (2012) who describes the process as 'peeling back' each of the subsequent onion layers whilst considering the implications of methodological choice, strategy(ies) and the time horizon for design. The layers of the research onion are depicted in Figure 3.3. The outer layer focuses on the research philosophy which emphases on identifying the applicable philosophy needed for this research study (Section 3.4). The second layer focuses on identifying the research approach to be used in this research study (Section 3.5). These approaches includes deductive or inductive. The third layer focuses on identifying the research strategy (ies) to be utilised in the research study (Section 3.7). This will highlight the plan on how the research questions will be answered or addressed. The fourth layer focuses on identifying the time horizons used in the research study (Section 3.11). This last layer or inner core of the research onion focuses on identifying the techniques and procedures used for the data collection and data analysis of the research study (Sub-sections 3.7.1.4 – 3.7.1.6 and 3.7.2.3 – 3.7.2.5).

To simplify the reader's experience, the two strategies or two surveys will be individually elaborated. The data collection and data analysis of each strategy will also be described under each strategy, respectively. Thereafter, the time horizons, which are true to both research strategies will conclude the research onion's description. It should be noted that the research onion was followed and thereafter, the findings were logically grouped to contribute to the process flow of the research study. The final process flow adopted for this study will ensure

that each research strategy with data collection and data is elaborated on in full before concluding this chapter.

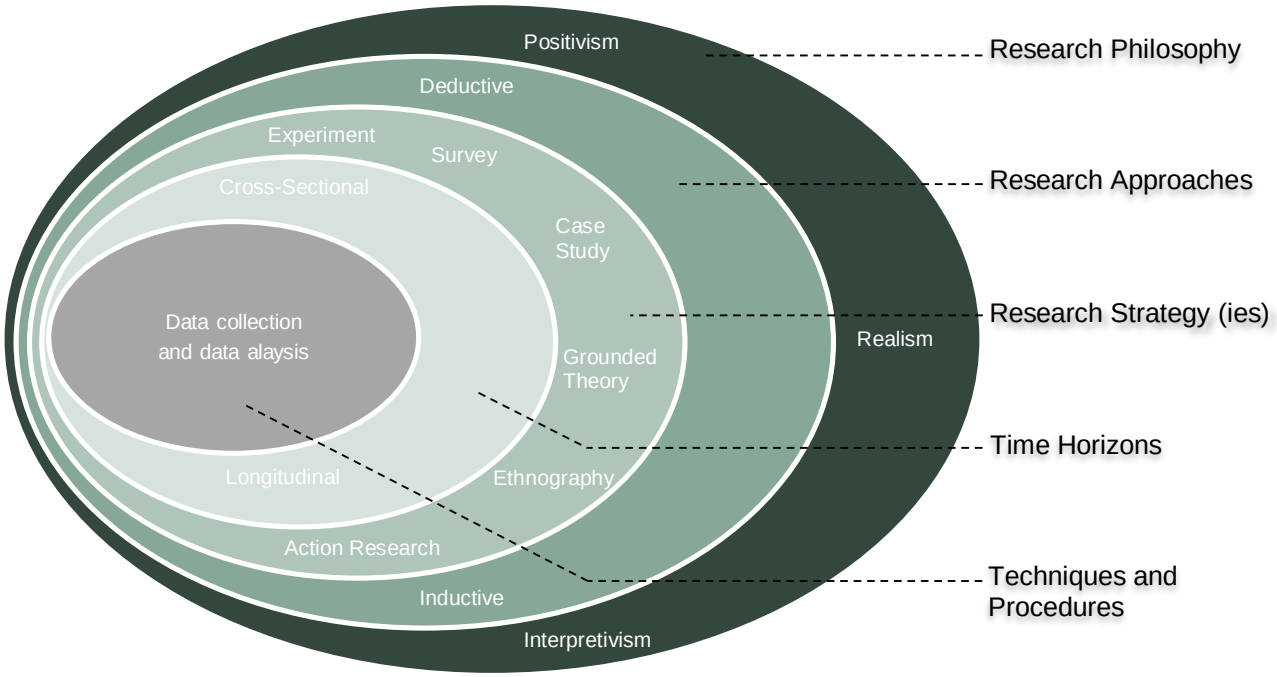

Figure 3.3: The Research Onion (Adapted from Saunders & Tosey, 2013, p. 59).

The following section will identify the three research philosophies and highlight the research philosophy utilised in this study.

3.4. Research Philosophy

The first layer of the research onion is focused on the research philosophy. The term philosophy refers to the advancement of knowledge and the nature of that knowledge. Research philosophy is built around the assumptions about the way in which the researcher, and consequently the research study, views the world. These assumptions will form the foundation to the research strategy and research methodology. A determining factor on which research philosophy should be followed stems from how the researcher views the relationship between knowledge and the process by which it is developed. Some researchers may be concerned with facts while other researchers may be concerned with feelings and attitudes. The research strategies and research methodologies adopted by these researchers would vastly differ (Saunders, et al., 2012).

There are three major ways of thinking about research philosophy. These three ways are positivism, interpretivism and realism. Each way of thinking has important differences which

will influence the way in which the research process is addressed. The three major ways of thinking will be discussed in the following sub-sections, starting with the positivism way of thinking.

3.4.1. Positivism

Positivism adopts a philosophical stance of natural science, meaning that the researcher will prefer to work in an observable, social reality which will lead to the construction of credible data. The researcher would be external or independent to the process of data collection and can therefore neither influence nor be influenced by the subject of the research. The research strategy adopted would most likely focus on the use of existing theory to develop hypotheses (Saunders, et al., 2012). A hypothesis will then be tested and either accepted or not accepted, in whole or part. This will lead to the further development of the theory which will be tested by further research. The positivist way of thinking will be adopted in this research study.

3.4.2. Interpretivism

Interpretivism adopts the stance that the social world is far too complex to be defined by a set of generic 'laws'. This approach allows the researcher to gain insight into the complex world and allows him or her to view the context and the situation as each is different. It is argued that the insight is forfeited with the positivist way of thinking. A critical aspect of the interpretivism is that the researcher has to take an empathetic stance. The researcher therefore enters the social world of the subject being researched and tries to understand the world from the subject's point of view. This is done to gain a deeper understanding of the subject's motives, actions and interactions. Interpretivism is relevant in the ever-changing business and management research areas, especially in the field of marketing, organisational behaviour and human resources management (Saunders, et al., 2012).

3.4.3. Realism

Realism, like positivism, is a way of thinking that relates to a scientific approach to the development of knowledge and is focused on the fact that reality is independent of the human mind and beliefs. Therefore, it emphasises that objects have an existence independent of the human mind and identifies what the human senses can 'sense' as the truth (Saunders, et al., 2012). Unlike positivism, realism argues that no form of science relies exclusively on observable empirical evidence. Realism believes that there are always hidden aspects of any form of reality that are hidden beneath the observed subject. The focus would therefore be to reveal the hidden aspects that bring about the observable regularities (UK Essays, 2013). As indicated previously, in this study the research philosophy positivism will be utilised. The

following section will discuss the research approaches and the research approach used in this research study.

3.5. Research Approaches

The second layer of the research onion focuses on the research approaches. There are two broad approaches to research, namely deductive and inductive reasoning. These two research approaches with their differences are graphically illustrated in Figure 3.4.

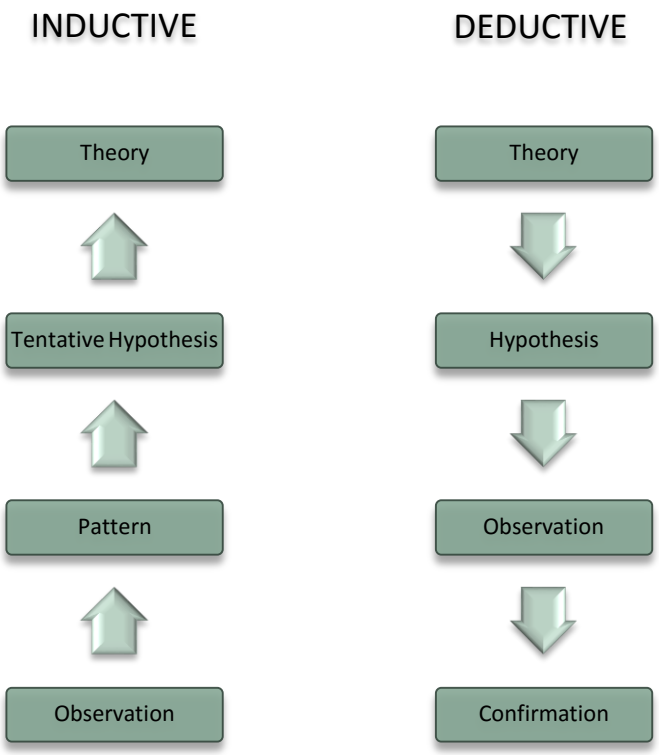

Figure 3.4: Inductive vs. Deductive Reasoning (Adapted from Trochim, 2006).

Deductive is referred to as the 'top-down' approach as it works from the more general to the more specific. It begins with a theory about a topic and consequently narrows it down to a more specific hypothesis that can be tested. The process then continues by further narrowing when observations are collected to address the hypothesis. This allows the researcher to test the hypothesis with specific data on the identified theory (Trochim, 2006).

Inductive is referred to as the 'bottom-up' approach which moves from more specific observations to broader generalisations and theories. The approach begins by making a specific observations. Thereafter patterns and consistencies are detected which allows for

the formulation of a hypothesis that can be explored. The end result is the development of some general conclusions or theories (Trochim, 2006).

For the purpose of this research study, inductive reasoning will be adopted as the study moves from more specific observations to broader generalisations and theories. The following section will discuss the literature review process used for this research study.

3.6. Implementation of Literature Review

The following sub-sections will define literature review, explain what the purpose is of a literature review and explain the process of the literature review for this study.

3.6.1. Literature Review Defined

Collis and Hussey (2014) defines a literature review as "a critical evaluation of an existing body of knowledge on a topic, which guides the research and demonstrates that the relevant literature has been located and analysed" (Collis & Hussey, 2014, p. 306). The literature that is reviewed should be current and cover all the major questions and issues in the field of study. The literature that must be reviewed includes text books, journal articles, conference papers, film, presentations and lectures, legislation, archival sources, websites, dissertations, treatises and theses, in other words, any work previously published in the identified field of study (Collis & Hussey, 2014).

3.6.2. Purpose of Literature Review

A literature review allows the researcher to understand what studies have been conducted before, their strengths and weaknesses and significance. A literature review provides insight into the field of study, which cannot be accomplished without prior literature reviews. This allows the researcher to gain subject knowledge from which will stem new ideas, perspectives and approaches (Kumar, 2008). This will ensure that the study builds on and strengthens the existing body of knowledge. A thorough literature review must therefore be comprehensive, critical and contextualised and must be conducted on prior research studies, reviews of literature and theoretical articles (Hofstee, 2006).

The review of literature should describe, summarise, evaluate and clarify literature reviews. A thorough, substantive, sophisticated literature review lays the foundation for a respected research study that is able to advance collective understanding as well as contribute to the existing body of knowledge (Boote & Beile, 2009).

3.6.3. Literature Review Process for this Study

Keywords are words or phrases that capture the core concept or focus area of the specific subject of field of study. These keywords were used in online search fields to acquire the relevant literate reviews. Before the study commenced, the researcher identified keywords for the field of study, in general, as well as keywords for specific focused areas within the field of study. Boolean operators were used extensively to narrow or broaden the search as required. These keywords were enhanced as the research continued.

The OPAC System (NMMU Library research system), Google Scholar and Google Books were used extensively to find current online publications. In addition, hardcopy textbooks were utilised which were especially supportive in the specific focused areas of research. The online search method of academics and into other databases presented the following advantages:

- Ease of access from the device – The researcher gain access to the online material with ease;
- Currency – The most up-to-date readily and available publications;
- Cross-disciplinary searching – Permits the search of multiple areas with one search;
- Flexibility – Permits the researcher to use whichever keywords he/she seemed fit for the relevant search; and
- Speed – Allows the researcher to search through millions of publications in seconds to those that are relevant (Collis & Hussey, 2014).

The researcher activated the advanced search tabs which allowed for the 'hits' to be listed from latest to oldest. The advanced search excluded all publications older than 2000. The researcher then downloaded and reviewed the articles according to relevance and currency. All downloaded publications were stored in their respective folders e.g. Internet management articles in the Internet management folder and Internet Governance articles in Internet Governance folder. Each article was then scrutinised using Adobe Acrobat XI Pro and the respective important areas were highlighted, commented on and bookmarked. This allowed the researcher to quickly and easily return to the area as needed. The processed literature reviews were then discussed with the researcher's supervisor for input and approval. The following section will discuss the research strategies.

3.7. Research Strategies

The third layer of the research onion is focused on the research strategy (ies). Research strategy is the complete plan which stipulates how the research will be conducted. The research strategy originates from the research questions and clearly identifies the focus areas

or research objectives which must be addressed before the research is complete. To aid the process of achieving the research objectives, the research strategy should take into account the risks posed by the study and mitigation processes to address these risks were implemented. It is therefore clear that the research strategy is a guiding document which directs the planning, execution and monitoring of the research study with special emphasis on the research methodology's strengths, weaknesses and constraints (Krippendorff, 2012).

According to Saunders and Tosey (2013), the following research strategies can be utilised by which research can be conducted. These include:

- Experiment;
- Survey;
- Case Study;
- Grounded Theory;
- Ethnography; and
- Action Research (Saunders & Tosey, 2013).

For the purpose of this research study, two surveys were used to achieve the required objectives. The two surveys are the Higher Education Institute (HEI) Internet Management Survey (HEIIMS) and the NMMU Internet Usage Survey (NMMUIUS). Both surveys will be elaborated on individually in the following sub-sections. The first survey is the HEIIMS.

3.7.1. HEIIMS

The following sub-sections will define survey research and elaborate on the survey description, survey scale, validity and reliability, survey respondents, survey distribution and data analysis of the HEIIMS.

3.7.1.1. Surveys Research Defined

A survey, which is generally associated with a positivist study, is a methodology that is designed to collect primary or secondary data from a limited, yet reliable number of individuals (sample) who are presumed to have the required information. The intention of the study is to generalise the collected information to the defined body of people (population). Surveys are especially valuable if there is a need to gain insight into the defined body of people's opinions, desires, and attitudes. Surveys can be highly structured questionnaires such as postal and Internet self-completion questionnaires, to unstructured in-depth interviews such as telephone and face-to-face-interviews (Collis & Hussey, 2014; Hofstee, 2006).

Structured interviewing in the form of a survey was used as the data collection method in this research study. All respondents were asked the same questions and were required to provide feedback on the same options. Both studies used the same procedure.

3.7.1.2. HEIIMS Description

The covering letter to the reader of the HEIIMS introduces the topic, field of study, background and purpose of study, confidentiality statement and benefits of participating for both the respondent and the industry. The introduction in the HEIIMS again highlighted the importance of the study as well as the expected time to complete it. The introduction continued by emphasising that personal information would be kept confidential and that participation provided automatic consent. The introduction concluded with the researcher's contact details and acquired REC-H reference number. See Appendix C – HEIIMS.

The HEIIMS was created using Microsoft Word Developer. The HEIIMS was structured in such a way that it 'forced' the respondents to follow the programmed question structures. All questions were very focused on the outcome and were therefore kept to a minimum. This ensured that all questions appeared straightforward and therefore required minimal assistance or guidance from the researcher.

The HEIIMS was divided into six sections. These were:

- Section 1: Biographical Information captured the respondent's biographical information which included, Title, Name and Surname, Email Address, Job Title, Faculty/Department and Duration in this position. This information will only be used to identify the credibility of the respondent and to provide feedback if requested;
- Section 2: General University Details captured the relevant details of the respondent's HEI identity; and
- Section 3: Human Resources to Section 6: Organisational Resources raised probing questions regarding the HEI Internet resources. These included Human Resources, Financial Resources, Physical Resources and Organisational Resources.

The majority of the questions were in the form of structured questions such as multiple choice and 5 point Likert Scale type questions. Additional open ended question boxes were added to selected fields to allow the respondent to elaborate on some answers.

3.7.1.3. HEIIMS Scale, Validity and Reliability

The structure of the questions stems from a previously processed Internet management questionnaire created by the South African Regional Universities Association (SARUA), which at that time was the South African Universities Internet Service Provider. The aim of the survey was to determine the Internet resources of each HEI to better align their products and services to their customer's needs. The survey was analysed, updated and amended to suite the requirements of this study. Thereafter, an additional NMMU Internet management report was incorporated into the survey. The report was drafted, submitted and approved by the NMMU Management Committee (MANCO) in January 2015 which presented the NMMU Internet management practices and environment to Top Management in business terms. This report served as a great survey alignment structure.

The new survey (HEIIMS) was based on the current organisational resource structures which are focused on Internet management. Each resource structure covered questions relevant to that specific organisational resource. For example, the financial resources relating to Internet management covered the budgetary requirements of Universities and the Organisational resources relating to Internet management covered the currently implemented operational and technical settings according to the scope of the resources. It is therefore evident that all aspects of the Internet resources were listed, and the individuals only had to indicate if they use it, and in some cases, how they use it.

The scales that were used ranged from closed questions such as Multiple choice (fact), to Multiple choice (opinion), ranking, Intensity rating scales and open questions. All questions were kept as structured as possible and all questions were mandatory, excluding some questions which were not dependent on a previous response. Each respondent was asked to indicate his/her view on the respective question. These questions were formulated to address each identified topic or area and ensured that the relationship to the primary research question and the two secondary research questions were maintained.

The HEIIMS was then verified by the NMMU Deputy Director: ICT Services and the NMMU Systems Engineer: Firewall/Databases. These two individuals are responsible for the management of the Internet at NMMU on a strategic and operational level. They together have more than 20 years Internet management experience. Their input on the current Internet practices ensured that all aspects of Internet management were covered in the survey. The survey went through two revisions phases before it was approved by them.

3.7.1.4. HEIIMS Respondents

The fifth layer of the research onion focuses on identifying the techniques and procedures used for data collection and data analysis. Every person in the population group for the HEIIMS is an HEI Internet Manager. RQ_2 requires a sample of HEI Internet Managers as these are the individuals who can indicate what is considered best practice Internet management at their respective Higher Education Institutions.

The HEIIMS required one Internet Manager or responsible person who manages the University's Internet resources to complete the survey. These individuals, one from each University, were the target audience. Unfortunately the researcher had no contact with these respondents before this study, fortunately a committee titled the Association of South African University Directors of Information Technology (ASAUDIT) was approached who had access to these individuals. ASAUDIT was a platform where all University ICT Directors served in order to facilitate collaboration amongst the various ICT Departments in the various SA Universities. ASAUDIT served as the first means of reaching these Internet Managers. The secretary, who served as gatekeeper of this committee was contacted and she agreed to distribute the request and HEIIMS to all ICT Directors. These Directors then approved and forwarded the request to the responsible party in the University to complete. This process produced four completed surveys.

Once the ASAUDIT link was exhausted, the Tertiary Education and Research Network of South Africa (TENET), all South African Universities Internet Service Provider, was approached via email. The Executive Officer: Technical and Operations at TENET responded as this individual had a direct line of communication with all University Internet Managers. A list containing contact details of the remaining Internet Managers' was generated and used as an additional method of direct contact. This list of contact details allowed the researcher to communicate with the respondents directly. This request spawned an additional four completed surveys.

There was only one precondition set for respondents to qualify for participation in the study. This was that the respondent had to be the key individual responsible for the management of the respective University's Internet. This respondent would therefore have the required knowledge that was required.

3.7.1.5. HEIIMS Distribution

The HEIIMS was created in Microsoft Word 2013 by means of the Design Mode function. This ensured that only the answer fields were editable. The order of the questions was also hardcoded, therefore ensuring that once a question was answered, the capture field would automatically jump to the next question's answer field. This allowed for a quick and easy completion of the survey process.

Email was used for the distribution and collection of the survey. The HEIIMS was attached to the survey and was sent to the ASAUDIT gatekeeper for distribution. A total of 22 emails was sent. When this method was exhausted, the respondents were emailed directly by means of the list received from TENET. This method was used as a last resort to achieve the required number of responses to meet the minimum requirements for reliability and validity. A total of 18 emails were sent. See Appendix D – HEIIMS Distribution Email. In total, 8 Internet Managers responded to the email. All respondents met the set preconditions.

3.7.1.6. HEIIMS Data Analysis

The data from the HEIIMS was captured into Microsoft Word by the respondents. Thereafter, the data was transferred, processed and tabled into Microsoft Excel by the researcher. At the same time, the data was reviewed and all incomplete and corrupt records were removed from the datasets. The data was then analysed by a NMMU statistician, Dr Danie Venter. Descriptive and Inferential statistics techniques were utilised to analyse the results and to draw conclusions.

The analysis of the findings will only be conducted on the most important/relevant findings to ensure that the research study stays within the set scope. Furthermore, the percentages for the findings were rounded off to 0 decimal places for visual purposes, however, the calculations included in the documented analysis were not rounded off. In addition, Cronbach alphas were calculated to establish the reliability of the instruments. The following sub-sections will elaborate on the research strategy for the NMMUIUS.

3.7.2. NMMUIUS

The following sub-sections will define survey research and elaborate on the survey description, survey scale, validity and reliability, survey respondents, survey distribution and data analysis of the NMMUIUS.

3.7.2.1. NMMUIUS Description

The covering letter of the NMMUIUS introduced the topic, field of study, background and purpose of study, confidentiality statement and benefits of participating for both the respondent and the university to the reader. The introduction in the survey again highlighted the importance of the study as well as the expected time for completion. The introduction continues by emphasising that no personal information would be captured in the study. The introduction concluded with the researcher's contact details and acquired REC-H reference number. See Appendix E – NMMUIUS.

The NMMUIUS was created using NMMU Online External Survey Toolkit. The NMMUIUS was structured in such a way that 'forced' the respondents to follow the programmed question structures. All questions were very focused on the outcome and were therefore kept to a minimum. This ensured that all questions appeared straightforward and therefore required minimal assistance or guidance from the researcher.

The NMMUIUS was divided into six sections. These were:

- Section 1: Demographical Information captured the respondent's demographical information which included Gender, Age, On what Campus are you mainly situated?, Are you administrative staff, academic staff or a student? and Do you have an active Internet connection at home?;
- Section 2: Governance captured the governance aspects of the Internet at NMMU which included knowledge of the NMMU General ICT and Acceptable Use policy. It continued by asking the number of devices used and the main device to access the NMMU's Internet;
- Section 3: Usage and Access Duration to Section 5: Primary Purpose raised probing questions regarding specific Internet usage habits. These included Usage and Access Duration, Content and Primary Purpose; and
- Section 6: Management asked the respondents to rate the Management practices of NMMU's Internet Services.

The majority of the questions were in the form of structured questions such as multiple choice and 5 point Likert Scale type questions. No open-ended question boxes were used in this survey.

3.7.2.2. NMMUIUS Scale, Validity and Reliability

The structure of the questions was based on the areas or topics highlighted from other available surveys. The majority of the Internet usage surveys follow a similar trend in questions. These questions were analysed and adapted to suit the NMMU environment. Table 3.1 presents the list of Internet usage surveys as discussed. The NMMU Internet management report (MANCO report) again served as a guideline to the current NMMU environment and requirements.

Survey Name	Survey Website Address
Internet Behaviour Questionnaire	http://www.idemployee.id.tue.nl/g.w.m.rauterberg/ibq/ibq_engl.html
Internet Usage Survey	http://www.questionpro.com/a/showSurveyLibrary.do?surveyID=170821
Survey of Computer and Internet Use	http://www.haverford.edu/psychology/ddavis/webforms/ma.paper.02.q1.html
Web and Internet Usage Questionnaire	http://www.cc.gatech.edu/gvu/user_surveys/survey-1998-10/questions/use.html
Internet Usage Questionnaire	https://www.surveymonkey.com/r/?sm=oh969UNLuYNmoLYEFVaCcoYj9ZPfsmdnEf1NJylP7QM%3d

Table 3.1: Survey items literature sources.

Likert Scale was used for the majority of the questions. The Likert Scale, also known as intensity rating scale, is the most commonly used information gathering scale in the social sciences, medicine, marketing, and business fields. The Likert Scale is ideal when insight is required into individuals' emotions, personalities, attitudes, opinions, and their descriptive environment. It attempts to quantify constructs which in many cases are not directly measurable. This issue is consequently addressed by asking the individuals to respond to each statement in terms of their own level of agreement or disagreement. This is typically in the form of the one to five responses rating scale which is Strongly Disagree, Disagree, Neither Agree or Disagree, Agree and Strongly Agree (Collis & Hussey, 2014; Gliem & Gliem, 2003). These findings will then be listed in the survey and assigned a 5 point Likert Scale rating. The ratings from the NMMUIUS included:

- None (1), Less than 1 hour (2), 1-3 hours (3), 4-5 hours (4) and More than 5 hours (5).
- Daily (1), Weekly (2), Monthly (3), Less Often (4) and Never (5).
- Very Poor (1), Poor (2), Average (3), Good (4) and Excellent (5).

In addition to these scales, multiple choice (fact) questions were also used for specific questions only. For example, 'Yes', 'No' and 'Not Applicable' scales. All questions were mandatory. Each respondent was asked to indicate his/her view on the respective question or statement. These questions or statements were formulated to address each identified topic or area and ensured that the relationship to the primary research question and the secondary research questions was maintained.

For both surveys, the questions used in the questionnaire adhered to the "Questionnaire Content" guidelines as provided by Hofstee (2006) and Collis and Hussey (2014). In addition, after both questionnaires were compiled they were scrutinized by two senior Professors at NMMU, Professor André Calitz (Computer Sciences) and Professor Margaret Cullen (MBA Business Unit). After it was accepted by both, it was presented to the NMMU Statistical consultant, Dr Danie Venter, who fine-tuned the survey to ensure it was aligned for reliability and validity purposes. Thereafter, both surveys were submitted to the REC-H. The Committee reviewed the surveys and made recommendations. In addition, a few requirements were set to ensure reliability and validity. All the set requirements were met as stipulated e.g. minimum and maximum required participants for each survey.

3.7.2.3. NMMUIUS Respondents

This sub-section forms part of the fifth layer of the research onion which is focused on identifying the techniques and procedures used for data collection and data analysis. The population group for the NMMUIUS are all NMMU Internet users. RQ_4 requires a sample of NMMU Internet users as this group would best describe the utilisation of NMMU Internet.

The NMMUIUS required all current NMMU Internet users to complete the survey. An email was compiled which contained a link to the survey and was distributed via the NMMU Marketing and Corporate Relations Department by means of a NMMU-Communique to all NMMU students and staff members.

There were two preconditions set for respondents to qualify for participation in the study. Firstly, each respondent had to be an NMMU student or staff member at the time of the completion of the survey and secondly, the respondent had to use the NMMU University's Internet on a regular basis.

3.7.2.4. NMMUIUS Distribution

The NMMUIUS was created using the NMMU external survey tool (Our Web Survey vs 1.3). The NMMU external survey tool is a professional survey creation toolkit, and is therefore confined to the general requirements when creating an online survey.

An email was used for the distribution of the survey. The NMMUIUS was attached to the survey and was sent to the NMMU Marketing and Corporate Relations Office which served as the gatekeeper for distribution. An NMMU-Communique was sent, which means it was sent to all NMMU students and staff members. See Appendix F – NMMUIUS Distribution Email. In total, 632 Internet users responded and all met the set preconditions.

3.7.2.5. NMMUIUS Data Analysis

As previously discussed, an online survey tool called Our Web Survey vs 1.3 was used to create the NMMUIUS. Therefore the captured data was automatically processed and tabulated into Microsoft Excel by the export functionality of the tool. The data was then reviewed and all incomplete and corrupt records were removed from the datasets. The data was then analysed by a NMMU statistician, Dr Danie Venter. Descriptive and Inferential statistics techniques were utilised to analyse the results and to draw conclusions.

The analysis of the findings will only be conducted on the most important/relevant findings to ensure that the research study stays within the set scope. Furthermore, the percentages for the findings were rounded off to 0 decimal places for visual purposes, however, the calculations included in the documented analysis were not rounded off. In addition, Cronbach alphas were calculated to establish the reliability of the instruments. The following sub-section will highlight the strengths and weaknesses of the data collection methods used.

3.7.3. Strengths and Weaknesses of the Data Collection Methods Used

The online survey distrubution and collection methods used in this study have the following strengths:

- It is easy to administer;
- It can easily be changed if needed and will reflect in real-time;
- It is easy to monitor the process;
- It is an easy way of gathering data (reach large numbers quickly);
- It is inexpensive;
- Data is collected, handled and processed automatically;
- Survey platforms are relatively free from errors;

- Increased response rate as respondents can complete it at their own pace, when they have time and in their prefered access medium; and
- It is flexible in design (Gingery, 2011; Sincero, 2012; Wyse, 2012).

The online survey distrubution and collection methods used in this study have the following weaknesses:

- Absence of the interviewer (when uncertainty is experienced and there is lack of clarification and probing methods);
- Difficulty in reaching challeging population and cooperation problems;
- Respondents may not feel encouraged to provide honest and accurate answers; and
- Misinterpretation of questions (Gingery, 2011; Sincero, 2012; Wyse, 2012).

The following section will discuss the stratistical methods adopted in this research study.

3.8. Statistical Methods

The analysis of the qualitative data which is based on an interpretative research philosophy will be collected through open-ended questions. The data will be captured, categorised, coded and sorted which will aid with the analysis and interpretation of the data. Patterns and relationships are then recognised and conclusions are drawn which are accommodated by a narrative summary. Content analysis will be utilised to analyse the data. During the content analysis process, theories and frameworks will be taken into account (Hofstee, 2006).

Both descriptive statistics and inferential statistics were used during the analysis of the quantitative data. Descriptive statistics is used to organise, summarise and extract essential information and turn it into meaningful information. The main focus of the descriptive statistics is on the measurement of the central tendency and spread. Central tendency includes mean, mode and median and spread includes range, quartiles, absolute deviation, variance and standard deviation (Wegner, 2012). The statistical analyses included the Cohen's d practical significance test, chi^2 test with Cramér's V test for practical significance and the paired difference t-test.

Cohen's d practical significance test measures the practical significance of inferential tests based on the group's means. It emphasises how many standard deviation intervals the experimental group's mean falls below or above the control groups' mean (Rubin, 2013, p. 91). The interpretation intervals used for the Cohen's d test are Not Significant: < 0.20, Small: $0.20 < |d| < 0.49$, Medium: $0.50 < |d| < 0.79$ and Large: $|d| > 0.80$. A number of questions

included in the surveys utilised in this study will be tested with the Cohen's d test (Gravetter & Wallnau, 2009, p. 264).

Significance testing is the testing method used to detect patterns such as the relationship between variables occurring by chance alone. The variables utilised in significance testing include the degrees of freedom *(df)* and the probability (p-value). If the p-value is < 0.05 then a statistical significant relationship exists between the variables. If the p-value is ≥ 0.05 then no statistically, significant relationship exists between the variables. The size of the sample is imperative when conducting statistical significance of relationships between variables (Wegner, 2012).

Cramer's V is the most popular of the Chi^2 based measures of association between two variables within a table. Cramér's V gives good norming from 0 to 1 regardless of table size, when the row marginal equal the column marginal. Table 3.2 illustrates the different practical significance interpretation intervals used to interpret the significance of certain research findings captured in the surveys (Gravetter & Wallnau, 2009). For a 5 point Likers scale, the interpretation intervals are Very Negative: 1.0 - 1.79, Negative: 1.80 - 2.59, Neutral: 2.6 - 3.5, Positive: 3.41 - 4.20 and Very Positive: 4.21 - 5 will be utilised.

The paired-tailed test, also known as the paired t-test, can be used to compare two population means where two samples can be paired with one another. These samples must be identical and must be subject to different conditions (Shier, 2004). The Chi^2 tests are based on frequency count data which allows the researcher to compare a set of expected frequencies that describes the null hypothesis to a set of observed frequencies obtained from a random sample. The Chi^2 test measures by how much the observed frequencies differ from the expected frequencies. If the difference is < 0.05 indicating that there is a 5% confidence level, the null hypothesis is likely to be accepted meaning that the results are statistically significant. If the difference is < 0.05 indicating that there is a 95% confidence level, the null hypothesis is likely to be rejected meaning the results are not statistically significant (Wegner, 2012).

One-factor analysis of variance (One-factor ANOVA) was used to determine whether there is a statistical relationship between the factor and the response variable, indicating if the two measures are statistically dependent or not. A statistical relationship is found between the factor and the response variable only when the minimum mean of the sample of one level is found to be different from the mean of the other sample. No statistical relationship is found when the factor has no influence on the outcome of the response variable and the two

measures are statistically independent of each other. Multivariate ANOVA (MANOVA) was used where a multiple, dependent variable and independent variable had to be included in one ANOVA model (Wegner, 2012).

Practical Significance Interpretation Intervals			
Inferential Test: Statistic	**Small**	**Moderate**	**Large**
t-Test: Cohen's *d*	$0.2 < d < 0.49$	$0.5 < d < 0.79$	$d > 0.8$
ANOVA: Eta squared	$\eta^2 < .09$	$.09 < \eta^2 < .25$	$\eta^2 > .25$
Chi² Test: Cramér's *V*			
***df** = 1**	$.10 < V < .30$	$.30 < V < .50$	$V > .50$
***df** = 2**	$.07 < V < .21$	$.21 < V < .35$	$V > .35$
***df** ≥ 3**	$.06 < V < .17$	$.17 < V < .29$	$V > .29$
Correlation: *r*	$.10 < r < .30$	$.30 < r < .50$	$r > .50$
**** df* = minimum (Rows – 1, Columns – 1)**			

Table 3.2: Practical significance interpretation intervals (Gravetter & Wallnau, 2009).

Type I and/or Type II errors must be avoided at all cost whilst conducting hypothesis tests. A Type I error, also known as error of the first kind, arises when the researcher rejects the null hypothesis when it is in fact actually true. Type I errors are in essence a false positive. Applying a more stringent level of significance will help control the type of errors. For example, assign a p value of < 0.01 rather than < 0.05. A Type II error, also known as error of the second kind, arises when the researcher does not reject the null hypothesis when it is false. Type II errors are in essence a false negative. This type of error can be controlled by increasing the sample size or reducing the level of significance. For example, reduce the p value from < 0.20 to < 0.05. Note should be taken that Type I and Type II errors are interlinked, meaning that decreasing the presence of one will increase the presence of another one, and vice versa (Wegner, 2012). A balance must therefore be maintained.

3.9. Reliability and Validity

There are two characteristics of the credibility of research findings, namely reliability and validity (Collis & Hussey, 2014). Reliability and validity of the measuring procedures are influenced by the probability of being able to learn something from the study, the probability of drawing statistical significance and the degree to which meaningful conclusions can be drawn from the data analysis (Leedy & Ormrod, 2015). Reliability and validity must therefore be met for the research study to be deemed as a valuable contribution and consequently accepted

into the research community. Figure 3.5 portrays the differences between reliability and validity.

Figure 3.5: Reliability and Validity of data (Shuttleworth, 2009).

The following sub-sections will elaborate on these two aspects individually.

3.9.1. Reliability

Reliability refers to the accuracy and precision of the measurement and the degree of the consistency of the measurement procedure over time (Collis & Hussey, 2014). If the same score with equal values is returned by the total population when the same test is repeated in the same environment, the research study is believed to be reliable (Thanasegaran, 2009). This is graphically depicted in Figure 3.5. Reliability tends to be high in positivist studies and of little importance in interpretivism studies (Collis & Hussey, 2014).

For research to be considered as reliable, it must meet the following characteristics:

- Dependable;
- Trustworthy;
- Consistent;
- Replicable across participants;
- Replicable over time; and
- Replicable with the instrument used (Cohen, et al., 2011).

There are a number of tests at the researcher's disposal which can be used to test the reliability of a research study. These include:

- Stability (Test-Retest Correlation)

  The stability test, also known as test-retest correlation, provides an indication of stability over time (Shah, 2009). This is accomplished by completing the test and thereafter doing a retest on the same population and in the same environment. The results of both tests are then analysed and compared using correlation coefficients. A correlation coefficient measurement close to one indicates a high reliability whilst a measurement close to zero indicates a low reliability. An obvious weakness with the stability test is that the respondents may recall their previous answers and therefore provide the same response. This will create an artificially high reliability (Collis & Hussey, 2014).

- Equivalence

  The equivalence test involves using the same instrument but different investigators to measure the same population and in the same environment (Collis & Hussey, 2014). Alternatively, the researcher may also measure the same concept with different instruments; which is known as multiple-forms reliability (Shah, 2009). The equivalence test will not be effected by the memory affect as in the stability test.

- Homogeneity (Internal Consistency)

  The homogeneity test, also known as the internal consistency test, involves the calculation of the internal consistency by measuring the instrument responses. Cronbach's alpha coefficient is used to measure the internal consistency and to determine how closely related a set of items is as a group. Important to note, Cronbach Alpha is not as statistical test, but a coefficient of reliability. The set intervals for Cronbach Alpha are as follows:
  - Cronbach Alpha ≥ 0.90 - high reliability;
  - Cronbach Alpha ≥ 0.80 - moderate reliability;
  - Cronbach Alpha ≥ 0.70 - low reliability; and
  - Cronbach Alpha ≤ 0.70 - unacceptable reliability (Collis & Hussey, 2014; Maree, et al., 2012; Nunnally, 1978).

It is clear from the intervals above that a high coefficient value indicates a high reliability whilst a low coefficient value indicates an unacceptable reliability. For basic or exploratory research, the Cronbach Alpha value of 0.50 and higher is reasoned to be acceptable (Collis & Hussey, 2014; Maree, et al., 2012; Nunnally, 1978).

There are three ways to check internal consistency:

a) Split-half correlation

The split-half correlation test involves splitting the measurement procedure into two separate instruments. The two instruments are then analysed separately and the correlation coefficients are compared for the two sub-scales to determine if they are highly correlated (Collis & Hussey, 2014; Shah, 2009).

b) Average inter-item correlation

The average inter-item correlation determines internal consistency on each question. The results are for each question on the index. The instruments are then analysed and are considered homogeneous when each question is highly collated (Shah, 2009).

c) Average item-total correlation

The average item-total correlation determines internal consistency of each question when compared to the total score instrument. This method provides a holistic view of internal consistency of all items (Shah, 2009).

Table 3.3 presents the different ways of establishing reliability. It emphasises the fact that two or more independent observations of the same sample are required to establish any form of reliability. The more independent observations that are taken on a measurement of a concept different points of time or forms, the more freedom there is to establish reliability (Shah, 2009).

		Time Dimension	
		Multiple-Time-Point Study	**Single-Time-Point Study**
Forms	**Multiple**	Equivalence Stability	Equivalence
	Single	Stability	
Items	**Multiple**	Homogeneity Stability	Homogeneity
	Single	Stability	

Table 3.3: Types of Reliability (Adapted from Shah, 2009).

3.9.2. Validity

Validity refers to whether the research study truly measures what the researcher wants it to measure and how truthful these results are (Collis & Hussey, 2014). In other words, does the research study hit 'the bull's eye' of the set research objectives? This consistency requirement is graphically depicted in Figure 3.5.

There are several validity assessment strategies. These include:

- Criterion (Pragmatic) Validity

  Criterion (Pragmatic) validity is the use of a well-established measurement procedure (i.e. criterion) to create a new procedure to measure the construct. Possible measuring procedures include, surveys, structured interviews etc. and must generate quantitative data. There are two criterion (pragmatic) validity tests which are based on different timeframes that can be utilised. According to Lund Research Ltd, (2012), these are:

  a) Concurrent Validity

  Concurrent validity is the use of an existing, well-established measurement procedure to create a new measurement procedure and is completed when two different measurement procedures are performed concurrently.

  b) Predictive Validity

  Predictive validity is used to examine whether a measurement procedure can be used to make accurate predictions and must be completed in accordance with theory.

- Construct Validity

  Construct validity relates to the problem that there are a number of phenomena that are not directly observable such as satisfaction, motivation, ambition and anxiety. It is assumed that these hypothetical constructs exist as factors that explain the observable phenomena. Construct validity is vital in business research (Collis & Hussey, 2014).

There are three types of evidence that can be obtained for construct validity which is based on the research problem. These are convergent validity, discriminant validity and hypothesis-testing (Lund Research Ltd, 2012).

- Face Validity

  Face validity, also known as logical, surface or appearance validity, involves ensuring that the measurement procedure used does in fact represent or measure what it is

intended to represent or measure (Collis & Hussey, 2014). It is the most common form of validity as it is the easiest form of validity to produce. Note should be taken that it is the weakest form of validity based on subjective logic, meaning the researcher will look at the items and agree that the test is a valid measurement procedure just on the face of it (Lund Research Ltd, 2012; Shah, 2009).

- Content Validity

  Content validity is the degree to which the elements within a measurement procedure are representative and relevant to the content that it will be measuring (Lund Research Ltd, 2012). Content validity is permanently led by a judgment that the content of the measure is representative of the universe of content of the concept being measured (Shah, 2009).

In addition to the validity of the measurement procedure, it is vital that the research study as a whole, also complies with the validity requirements. The researcher must aim to make the correct interpretations about the actually study (internal validity) as well as that the results must be generalised to the wider population (external validity). This permits the researcher to draw meaningful and strong conclusions about the study as a whole (Persson & Wallin, 2012). These are two sub-categories to research validity, namely internal- and external validity, and will be discussed next.

- Internal Validity

  Internal validity is affected by factors within the research study itself. This includes not controlling some of the major variables (i.e. a design problem) or problems with the research instrument (i.e. a data collection problem). Any independent variables that have an effect or cause change in the dependent variables may cause the study to be considered as internally invalidity (Berg & Latin, 2008). Campbell and Stanley (1966) identifies eight types of extraneous factors that can affect internal validity, if they are not controlled. These are history, maturation, testing, instrumentation/task sensitivity, statistical regression, selection, experimental mortality and selection interactions.

- External Validity

  External validity of the research study refers to the extent to which the findings can be generalised to a larger population or other environments. If the findings of the research study cannot be applied to the contexts outside the scope of the study, the study is considered as externally invalid (Berg & Latin, 2008). Campbell and Stanley (1966)

identified four factors that adversely affect a research study's external validity. These are interaction, pretesting, setting and multiple treatments/interventions.

Table 3.4 depicts the different types of validity available to establish validity and the particular three criteria which differentiate them. The three criteria are 'where to start' the validation, the 'evidence' and 'criteria' for establishing validity. Construct validity can be the most demanding due to the fact that both theory and empirical data must be present during the validity process. On the other hand, this characteristic makes it the most valuable in theory construction (Shah, 2009).

Validity Types	Where to Start	Evidence	Criteria
Judgmental (Pre-Data)			
Face Validity	Indicator	Judgmental	What's there
Content Validity	Concept	Judgmental	What's not there
Data-Based (Post-Data)			
Criterion-Related Validity **1. Concurrent** **2. Predictive**	Criterion Group 1. Criterion manifesting currently 2. Criterion occurring in the future	Empirical	Empirical Criterion Prediction
Construct Validity	Theory	Empirical	Theoretical Criterion Convergent Discriminant Hypothesis-testing

Table 3.4: Types of Validity (Adapted from Shah, 2009).

The following section will define research, explain the three research paradigms and identify the research paradigm utilised in this study.

3.10. Research Paradigms

A research paradigm is the philosophical framework that guides researchers on how their scientific research should be conducted. The two paradigms are positivism (quantitative) and interpretivism (qualitative). There are two main approaches within the two paradigms, these are quantitative research and qualitative research (Collis & Hussey, 2014; Morgan & Smircich, 1980, Yilmaz, 2013).

3.10.1. Quantitative Research

Quantitative research focuses on conducting research in the natural sciences and these methods are still widely used in social sciences today (Collis & Hussey, 2014). It is a type of empirical research that explains phenomena according to numerical data which is analysed by means of mathematical equations, such as statistics (Yilmaz, 2013). Quantitative approaches state that valid knowledge stems from objective evidence that can be scientifically verified. Quantitative research relies on deductive reasoning processes to interpret and structure the meaning as derived from data. A quantitative approach endorses the view that believes that the social and psychological phenomena have an objective reality external to the studied subjects (Collis & Hussey, 2014; Yilmaz, 2013). The researcher can thus be seen as having an 'outsider view', hence the researchers should put distance between themselves and what is being researched (Mason, 2002). Quantitative research is therefore focused on maintaining an independent and objective stance towards this static reality. It is therefore assumed that the act of investigating social reality has no effect on reality (Collis & Hussey, 2014).

3.10.2. Qualitative Research

Qualitative data is classified as the opposite of quantitative data. The findings are therefore not derived from statistical procedures or other means of quantification (Yilmaz, 2013). Qualitative research relies on inductive reasoning processes to interpret and structure the meaning derived from data. The qualitative approach approves a view that believes that the social reality is subjective and shaped by human perceptions (Collis & Hussey, 2014). The researcher is seen as having an 'insider view', and therefore develops a close, empathetic relationship with the studied subjects (Creswell, 2007; Mason, 2002). Qualitative researchers seek to study research problems by investigating the interpretations, understandings, perceptions, and meanings which individuals or groups ascribe to a social or human problem (Creswell, 2007; Mason, 2002). An emerging qualitative research approach is then utilised to collect the data in a natural setting that is sensitive to the subject data being studied (Creswell, 2007). Quantitative research therefore tries to understand how a social experience is created and given meaning, which stems from the inextricably connected relationship between the knower and the known (Yilmaz, 2013). The collected data are seen as the primary source of data for research (Collis & Hussey, 2014).

3.10.3. Mixed Methods

Mixed methods are the combination of quantitative and qualitative research techniques, methods, concepts, languages or approaches into a single study method. It allows for multiple

kinds of data to be collected through different strategies and methods in ways that build on the selected method's strengths, discarding its weaknesses and offsets certain method biases. Mixed methods therefore allow for increased value as well as potential complexity (Harwell, 2011).

3.10.4. Research Paradigm for this Study

For the purpose of this research study, the mixed method approach will be utilised with the major portion being qualitative research. The researcher aims to gain insight into the knowledge and experience of the individuals in the given research issue. The data collected will be used to assist the researcher in interpreting and structuring the information that is derived from the data to better understand the complex reality of the research problem. In addition, numeric data will be collected in a systematic and objective manner from the selected sample in order to generalise the findings to the greater population. This will be accomplished through hypothesis testing. The following section will elaborate on cross-sectional studies.

3.11. Cross-Sectional Studies

The fourth layer of the research onion focuses on the research time horizons. The following sub-sections will define cross-sectional studies, explain what the purpose of cross-sectional studies is and then explain the use of cross-sectional studies for this study.

3.11.1. Cross-Sectional Studies Defined

Cross-sectional studies, also known as prevalence studies, are used when the researcher wants to measure findings across sections of a population at approximately the same time (single time point) or over a short period. Cross-section means that a broad sample is used which includes people of different ages, different income levels, different religions, different educational levels etc. This provides a 'snapshot' of the particular situation which allows for the comparison of many different captured variables at that approximate timeframe. A cross-sectional study is an observational one, meaning that the data is recorded without any interference or manipulation of the subject or its environment by the researcher. (Bailey, 1994; Hair, et al., 2011; Monsen & Van Horn, 2008)

3.11.2. Purpose of Cross-Sectional Studies

Most surveys are in theory cross-sectional studies, which is the case for this research study. The aim of cross-sectional studies is to describe a population with respect to the commonness of the captured variables of interest specific at approximately the same time or over a short period (Levin, 2006).

3.11.3. Cross-Sectional Studies for this Study

As previously discussed, the NMMUIUS was compiled and distributed amongst NMMU staff and students which was used to determine their Internet usage patterns at NMMU. Therefore a cross-sectional study will be used to compare the two different population groups, being NMMU staff and students, at a single point in time. Internet usage before and after this timeframe will not be in the scope of this study. This allows the researcher to compare many different variables at the same time and draw conclusions as required.

3.12. Summary

This chapter addressed RQ_2 which states "*What research methodology can be utilised?*". The chapter completed the RO_2 which was to identify the research methodology applied in this research study. Current research methodology practices were reviewed and suitable research methodologies applicable to this research study were extracted and presented.

Chapter 3 commenced by defining what is meant by research. This was followed by discussion the research design with emphasis on the research onion. Thereafter, the chapter used the research onion model and 'peeled back' the layers of the research onion. Each discussion therefore focused on the research philosophy, research approaches, research strategies, time horizons and techniques and procedures. The chosen methods for this research study are positivism, inductive reasoning, surveys and cross-sectional studies. These are the method utilised in the study as per each layer of the research onion.

Chapter 4 will identify and discuss the national best practices adopted for the management of the Internet Higher Education Institutions. Therefore, the research objective of this chapter will be focused on RO_3, which will be to identify the national best practices adopted for Internet management at Higher Education Institutions. This will be achieved by asking RQ_3, which questions "Identify the national best practices adopted for Internet management at Higher Education Institutions?".

Chapter 4

4. RESULTS AND ANALYSIS OF THE HIGHER EDUCATION INSTITUTE INTERNET MANAGEMENT SURVEY

4.1. Introduction

Chapter 3 presented the research design with reference to the research onion. The research onion offered a layered approached which was used to describe the research philosophy, research approaches, research strategy (ies), time horizons and techniques and procedures in general and with reference to this research study. The chapter concluded by summarising the followed research methodology of this treatise.

This chapter will address RQ_3 which states "*What are the national best practices for Internet management at Higher Education Institutions?".* The objective of the chapter is to identify the national best practices adopted for Internet management at Higher Education Institutions. Current literature studies were reviewed to find a suitable answer to the identified research question according to the resources groupings as found in all organisations. These resources are Human Resources, Financial Resources, Physical Resources and Organisational Resources. From these findings, the HEIIMS was compiled and distributed to all 23 South African universities. The HEIIMS focused on determining what they currently use to manage their Internet resources. The combined findings will constitute HEI Internet management best practices and will therefore be presented in this chapter. See Figure 4.1 for an overview of the research question and research objective of this chapter.

Chapter 4 will review what overall organisational resources are available that contribute to the efficient and effective running of the Internet within HEIs. Once this is reviewed, the best practices for each resource found in the collected HEIIMS data will be presented in a logical and clear manner. Chapter 4 will conclude by listing the HEI Internet management best practices. See Figure 4.2 for a Structural overview of Chapter 4.

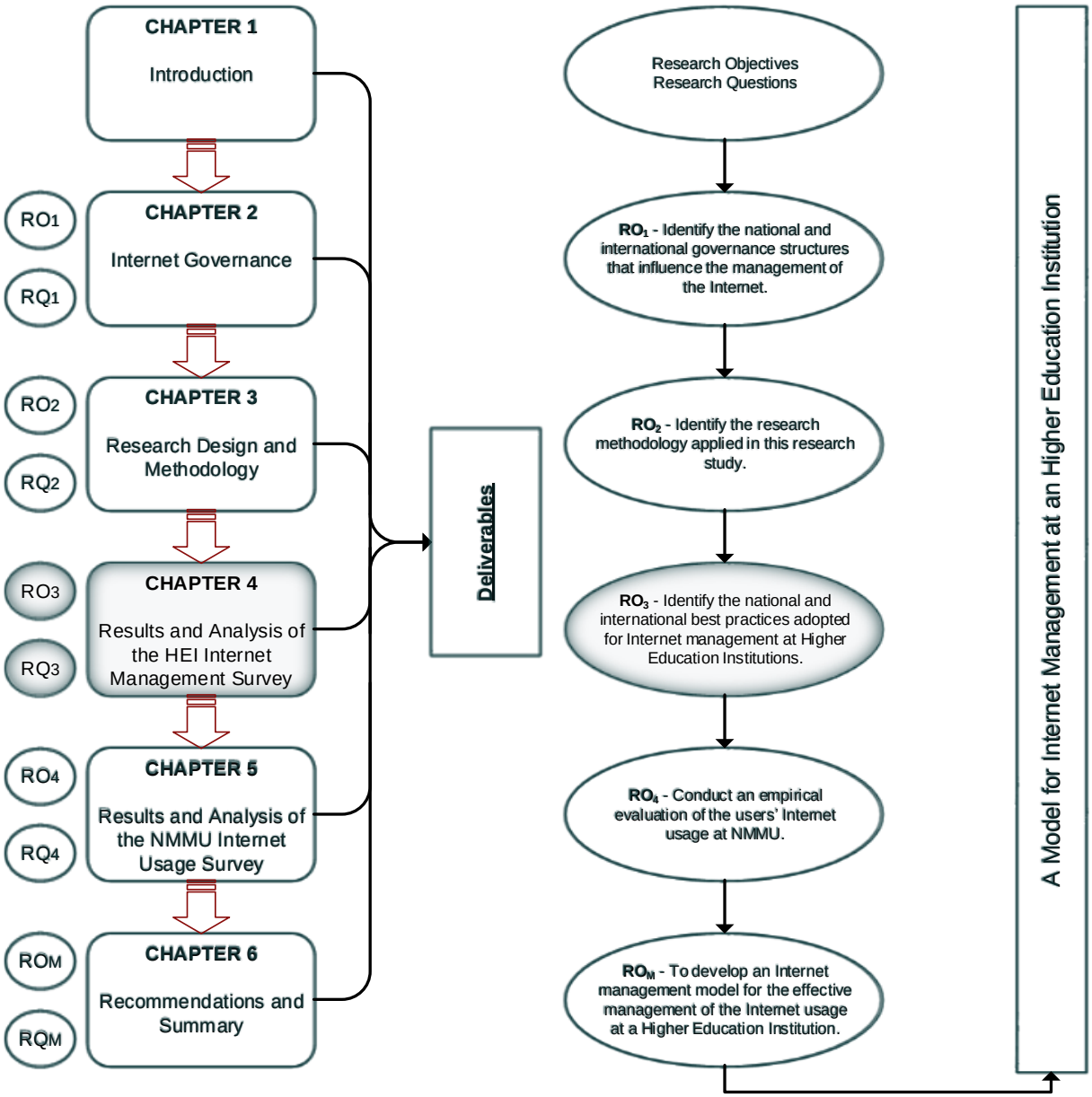

Figure 4.1: Chapter 4 Research Question and Research Objective.

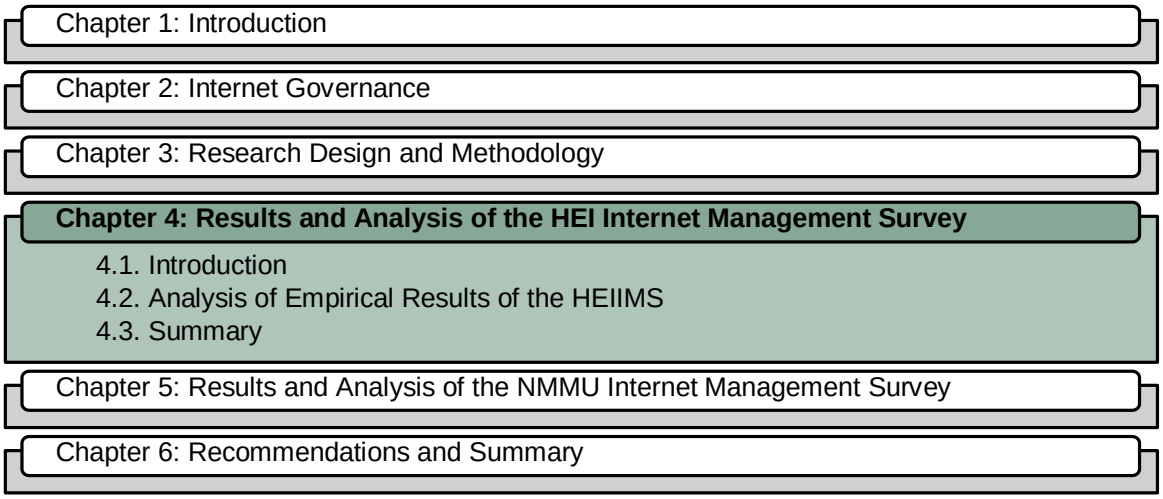

Figure 4.2: Structural overview of Chapter 4.

4.2. Analysis of Empirical Results of the HEIIMS

The respondents that participated in this study were all Internet Managers at South African Higher Education Institutions. In the context of this treatise, the term Internet Managers refers to the person's KPIs (Key Performance Indicator) and not the job title. All respondents were requested to provide their input on their respective Internet management practices employed at their university. Therefore, the areas covered in the HEIIMS included general university details, their Internet management human-, financial-, physical- and organisational resources practices. These resources all related to the management of their HEIs' Internet. These findings combined provide for a holistic view of the Internet management best practice landscape at Higher Education Institutions.

4.2.1. HEIIMS Response Rate

The HEIIMS was distributed via the ASAUDIT gatekeeper to 23 potential respondents via email. As the researcher was not in control of the distribution, the number of undelivered emails is unknown. The researcher is also not sure if the ICT Director (ASAUDIT representative) forwarded the HEIIMS to the correct individual (Internet Manager) in the Institution. A total of 4 responses was received through this distribution channel.

The second method of distribution was via direct email communication to 18 potential respondents. 3 of these emails were returned as undelivered. It was argued that the list as received by TENET could be outdated. A total of 4 responses were received through this distribution channel.

Through both communication channels, a total of 8 HEIs responded. All responses were adequately completed and met the preconditions that were set for this study. This equates to a response rate of 44 percent. The NMMU statistician, Dr Danie Venter, deemed the number of responses to be acceptable for statistical analysis.

4.2.2. Main Study HEIIMS

The HEIIMS used for this study consisted of six data gathering sections. See Appendix C – HEIIMS. These are:

- Section 1 – Biographical Information;
- Section 2 – General University Details;
- Section 3 – Human Resources;
- Section 4 – Financial Resources;
- Section 5 – Physical Resources; and
- Section 6 – Organisational Resources.

Section 1 – Biographical Information and Section 2 – General University Details were used to collect the respondents' demographic information which were used to understand the representation and distribution of the participants. In addition, the feedback also served as a screening method to ensure that only appropriate and qualified individuals completed the HEIIMS. The design of the questions was based on short, open-ended questions which allowed the user to complete his/her personal and university-related information. Section 3 – Human Resources was used to collect information regarding the importance of the Internet for the different user profiles and human resources requirements for managing the Internet. The design of the questions was based on the Likert Scale (various sizes), multiple choice (fact) with values of 'Yes' and 'No' and one long, open-ended question.

Section 4 – Financial Resources was used to collect information regarding the financial resources requirements for managing the Internet at the university. The design of the questions was based on the Likert Scale (various sizes), multiple choice (fact) with values of 'Yes' and 'No', multiple choice (fact) with various values and one long, open-ended question. Section 5 – Physical Resources was used to collect information regarding the physical resources' requirements for managing the Internet at the university. The design of the questions was based on the Likert Scale (various sizes), multiple choice (fact) with various values, multiple choice (opinion) with various values, short, open-ended questions and one long, open-ended question. Section 6 – Organisational Resources was used to collect information regarding the requirements of organisational resources for managing the Internet

at the university. The design of the questions was based on the Likert Scale (various sizes), multiple choice (fact) with various values, multiple choice (opinion) with various values, short, open-ended questions and one long, open-ended question. The following sub-section will elaborate on the findings for Section 1 – Biographical Information.

4.2.2.1. Section 1 – Biographical Information

The HEIIMS started by collecting biographical information on the respondents which was used to understand the representation and distribution of the participants. The collected information also served the purpose of screening the participants to ensure only appropriate and qualified individuals completed the HEIIMS. The fields in this section included:

- Title;
- Name and Surname;
- Email Address;
- Job Title;
- Faculty/Department; and
- Duration in this position.

Due to the nature of the questions, requests were made not to elaborate on the Personal Identifiable Information (PII) within this section. Therefore, title, name and surname and email address will not be included in the discussion. The confidentiality of the information will therefore be maintained.

As previously discussed, a total of 8 responses was received. All HEIIMSs were completed by ICT staff members who work in the HEI's Information and Communication Technology Department. Amongst these participants were two System Engineers, two Network Managers, one ICT Manager, one ICT Director and two Executive Directors or CIOs. They had an average (mean) of 7,5 years (seven and a half), median of 8 years and mode of 8 years length of service in this position. The minimum service length is 4,5 years (four and a half) and the maximum service length is 11 years. All participants therefore met the requirement to participate in this research study. The information listed above cross-referenced with the list of Internet Managers received from TENET confirmed that the respondents were all adequately equipped to complete the HEIIMS. The following sub-section will elaborate on the findings for Section 2 – General University Details.

4.2.2.2. Section 2 – General University Details

The second section in the HEIIMS extended the biographical information to a higher level, being the HEI itself. Hence, Section 2 collected biographical information on the HEI which were used to understand the representation and distribution of the participating Universities. The fields in this section included:

- Name of University;
- Number of Register Students;
- Number of Academic Staff;
- Number of Administrative Staff; and
- Three question regarding consent and general feedback on the results of the study.

The participating Universities can be grouped into:

- 2 Large Universities;
- 1 Comprehensive University;
- 2 Universities of Technologies; and
- 3 Smaller Universities.

The average number of registered students is 23 635 and the median number of registered students is 26 500. It is therefore evident that HEIs have a relatively large customer base that uses the implemented Internet and respective Internet resources for educational purposes. The minimum number of registered students is 7 485 and the maximum number of registered students is 34 600. The standard deviation of registered students is 9 464. The findings therefore indicate that there is representation of various HEIs present in this study.

The average number of total staff is 3 441 and the median number of total staff is 2 700. The workforce that will be utilising the Internet resources is therefore relatively high when compared to an average company. The minimum number of total staff is 650 and the maximum number of total staff is 8 512. The standard deviation of total staff is 2 858. The number of total staff varies radically amongst the responding HEI. Providing a reliable and user-friendly Internet experience is key to all HEIs. In addition, it is expected that the Internet resources should be aligned with the size of the HEI's registered students and staff numbers to ensure that the Internet resources are not over- or underutilised. The following sub-section will elaborate on the findings for Section 3 – Human Resources.

4.2.2.3. Section 3 – Human Resources

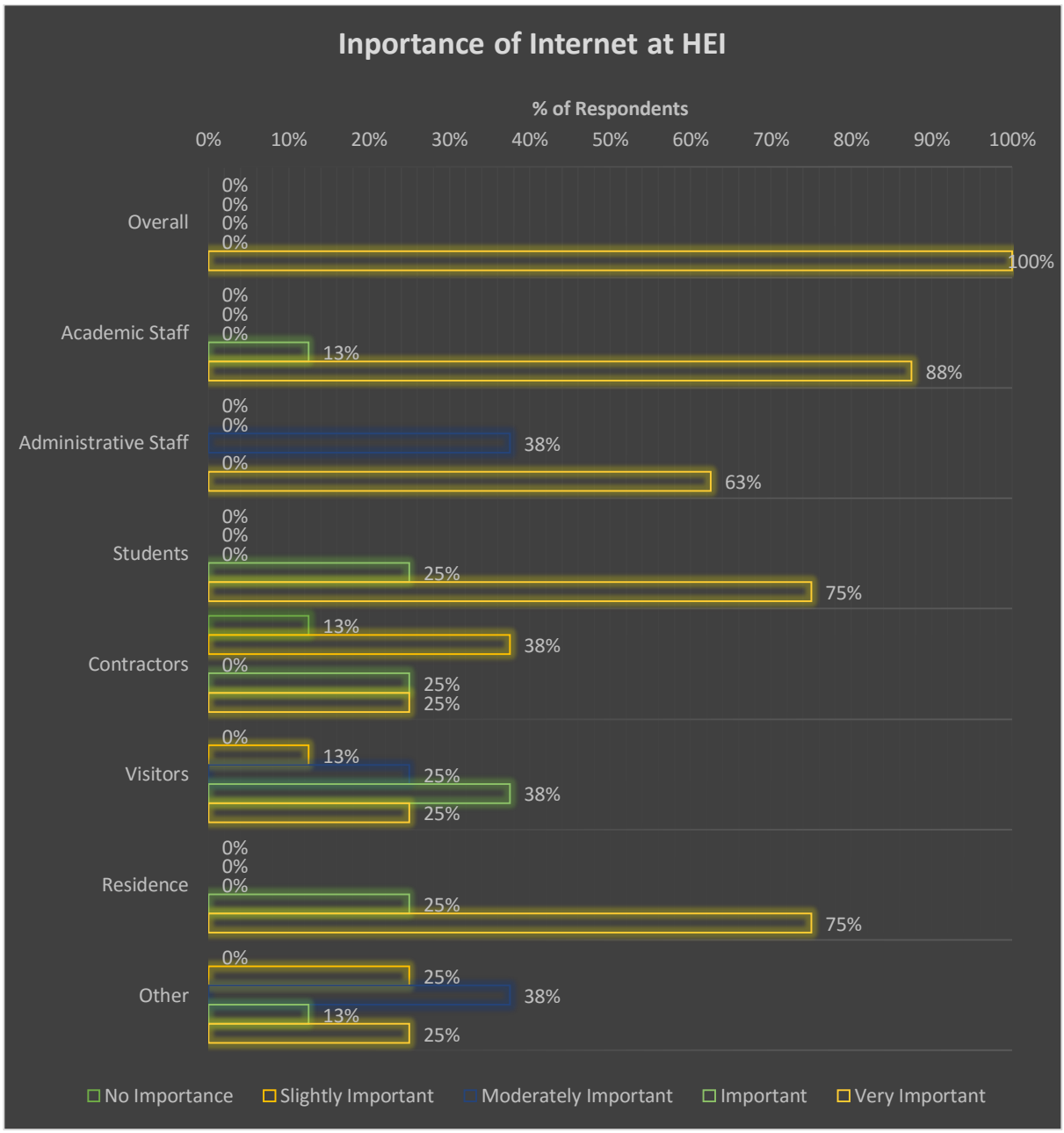

Figure 4.3: Importance of Internet at HEI.

Figure 4.3 depicts the responses received (n = 8) for the statement 'Please rate how important reliable high speed Internet services are to these customers'. The statement then continued by listing the following groups: Overall, Academic Staff, Administrative Staff, Students, Contractors, Visitors, Residence and Other. Each group will be elaborated on individually:

- Overall

  All respondents indicated that they consider providing a reliable high speed Internet service to be very important in general to the HEI (overall). It is therefore clear that

providing high speed reliable Internet services to all stakeholders is imperative to all HEIs.

- Academic Staff

  One respondent indicated that providing a high speed reliable Internet services was important while the remaining seven respondents indicated that providing a reliable high speed Internet service is very important to academic staff.

  The majority of HEIs therefore consider providing reliable high speed Internet services to be of great importance to academic staff. The academic staff are identified as the 'primary staff' and they require the Internet for teaching, learning and research purposes. The scope of Internet requirement is therefore very broad but centred around their field of study. These are all primary activities that generate revenue for the HEI.

- Administrative Staff

  Three respondents indicated that they consider providing a reliable high speed Internet service to be moderately important while the remaining five respondents indicated that providing a reliable high speed Internet service is very important to administrative staff.

  The majority of HEIs therefore consider providing a high speed reliable Internet services to be of great importance to administrative staff while some HEIs consider providing a reliable high speed Internet service to be moderately important to administrative staff. Administrative staff are identified as the 'secondary staff' and they require the Internet for general work purposes. The scope of Internet requirement is therefore very focused around the job requirements of each individual post. These are all secondary activities that provide support to the primary activities.

- Students

  Two respondents indicated that they consider providing a high speed reliable Internet services to be important while six respondents indicated that providing a reliable high speed Internet service is very important to students.

  The majority of HEIs therefore consider providing a reliable high speed Internet service to be of great importance to students while some HEI consider providing a reliable high speed Internet service to be important to students. The students are identified as the 'customers' and they require the Internet for teaching, learning and research purposes.

The scope of Internet requirement is therefore very broad but centred around the field of study. In addition, there is a drive towards improving the student life on campus. Providing a reliable high speed Internet service to students addresses this corporate strategy. The customers are the ones who make use of our services and therefore provides the income to the HEI.

- Contractors

  Three respondents indicated that they consider providing a reliable high speed Internet service to be slightly important to contractors. Two respondents indicated that they consider providing a reliable high speed Internet service to be important to contractors. Two respondents indicated that they consider providing a reliable high speed Internet service to be of great importance to contractors.

  From the findings it is clear that there are more HEIs that consider providing a reliable high speed Internet service to be slightly important to contractors while other HEIs consider providing a high speed reliable Internet services to be important and of great importance to contractors. The contractors are paid to deliver a service or product to the HEI, some for extended periods of time. Depending on the scope of work, these contractors' Internet requirements should be very focused around their duties during the work period. The quicker the work is completed the better for the HEI. Providing a reliable high speed Internet service to these contractors could ensure a speedy completion of their project(s).

- Visitors

  Two respondents indicated that they consider providing a high speed reliable Internet services to be moderately important to visitors. Three respondents indicated that they consider providing a high speed reliable Internet services to be important to visitors. Two respondents indicated that they consider providing a high speed reliable Internet services to be of great importance to visitors.

  From the findings it is clear that there are more HEIs that consider providing a reliable high speed Internet service is important to visitors while other HEI consider providing a reliable high speed Internet service to be moderately important and of great importance visitors. Visitors, for example, conference attendees, are not seen as regulars to the HEI environment. They only come once in a while for a specific purpose and leave shortly thereafter. Providing a reliable high speed Internet service to the visitors would

be of great benefit, especially from a marketing perspective. This could, however, be a high risk for the HEI. It would be ideal to monitor their activities to ensure this is not abused, especially because they have no long term relationship or obligation to the HEI.

- Residence

  Two respondents indicated that providing a reliable high speed Internet service is important while the remaining six respondents indicated that they consider providing a reliable high speed Internet service to be very important to residences.

  From the findings it is clear that the majority of HEIs consider that providing a high speed reliable Internet services to be of great importance to residences while other HEIs consider that providing a reliable high speed Internet service to be important to residence. Residence are provided to students as on-or-off campus accommodation. The Internet requirements would consequently be the same as for students, therefore being used for teaching, learning and research purposes. The scope of Internet requirements is therefore very broad but centred around the field of study. In addition, providing a reliable high speed Internet service also supports the strategic goal implemented in the HEI environment which is aimed at increasing the student life experience on campus.

- Others

  Two respondents indicated that they consider providing a reliable high speed Internet service to be slightly important to others. Three respondents indicated that they consider providing a high speed reliable Internet services to be moderately important to others. Two respondents indicated that they consider providing a high speed reliable Internet services to be of great importance to others.

  The findings indicate that there are more HEIs that consider providing a reliable high speed Internet service to be moderately important to others while other HEI consider providing a high speed reliable Internet services to be slightly important or great importance to others. The grouping others refers to any other individual or group that falls outside the groupings as listed above such as High School students, consultants etc. As with contractors, others are not seen as regulars in the HEI environment. They only come once in a while for a specific purposes and leave shortly thereafter. Providing a reliable high speed Internet service to others would be of great benefit, especially from a marketing perspective. This could, however, be a high risk for the HEI. It would be

ideal to monitor their activities to ensure it is not abused, especially because they have no long term relationship obligations to the HEI.

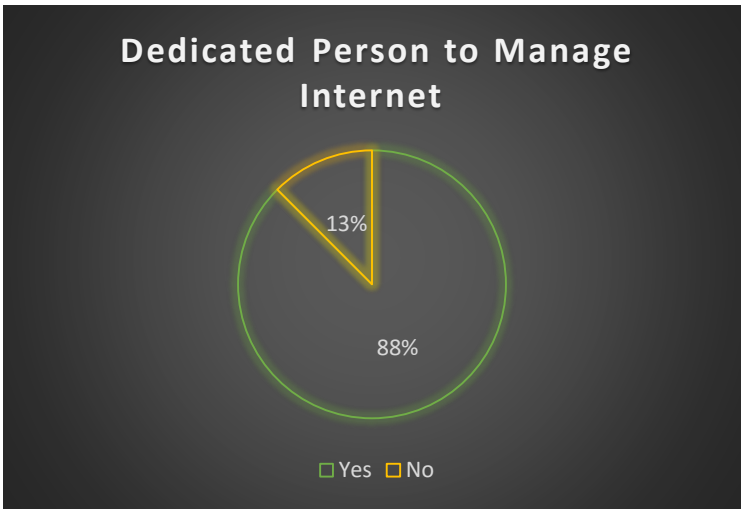

Figure 4.4: Dedicated person to manage Internet.

Figure 4.4 depicts the responses received (n = 8) for the question 'Is there a dedicated person(s) whose job description includes Internet management at your University?'. Seven respondents indicated 'Yes' that they do have a dedicated person that manage the Internet resources at their HEI while one respondent does not have a dedicated person managing the Internet resources for the HEI.

The majority of the respondents therefore have a dedicated person to manage their Internet resources. It is therefore evident that the Internet, which lays the foundation for all digital software and communication, requires a dedicated person who will take responsibility for the Internet resources. This is especially true if the Internet is core to the required HEI's strategy and service delivery as seen in the previous listings of importance. A dedicated uptime and level of sufficient capacity as per the set SLA would therefore have to be maintained by this individual. Any downtime or ineffective settings may hinder the service delivery of the Internet and cause interruptions to the business processes across the HEI. This could lead to experiencing a negative impact on the revenue streams.

Figure 4.5 depicts the responses received (n = 7) for the question 'If yes, on what Peromnes level is the post?'. Four respondents indicated that the Internet Manager post is on a Peromnes level 8, two respondents indicated Peromnes level 6. The remaining responses contribute no significant value to the findings.

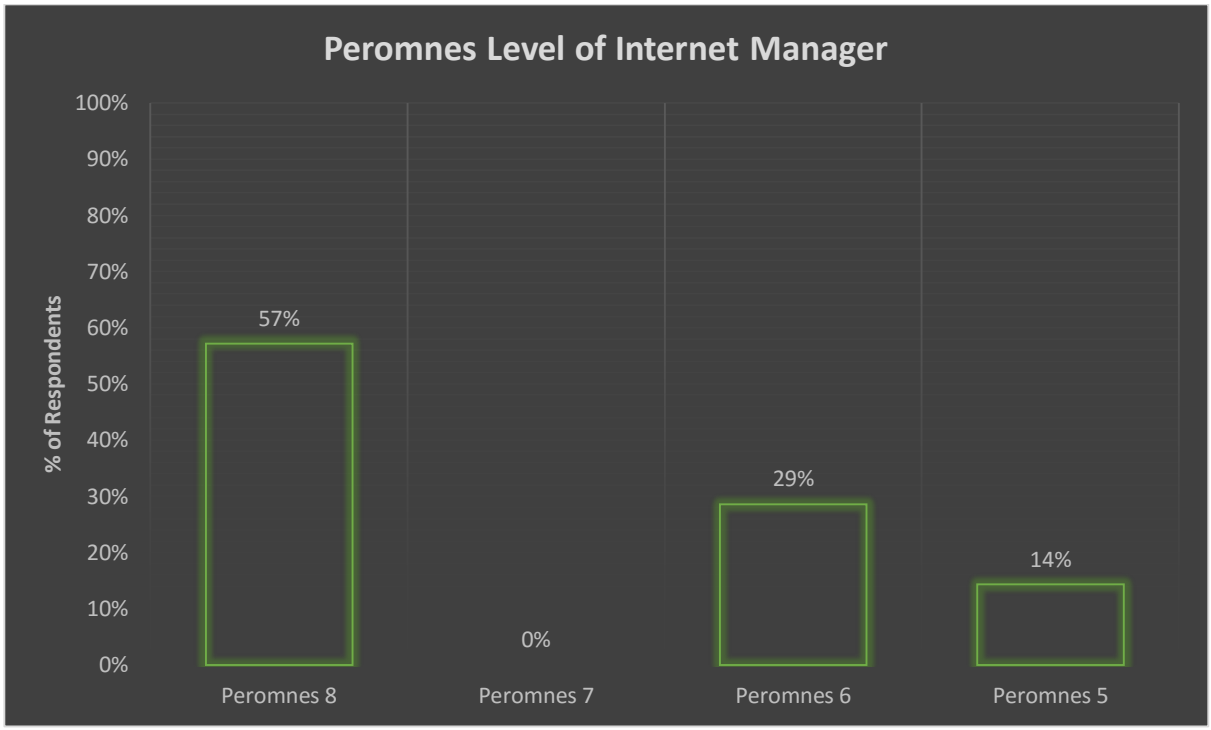

Figure 4.5: Peromnes level of Internet Manager.

The findings show that most of the Internet Managers are on a Peromnes level 8 and a few are on a Peromnes level 6. Note should be taken that the Internet Manager spends less that 50 percent of his/her time on Internet management responsibilities (see question 'What percentage of his/her time is dedicated/spent on Internet management?'). It can therefore be argued that the other responsibilities will play a more important role in the grading of the position and consequently the Peromnes level. However, the position of Internet Manager is most commonly rated on a Peromnes level 8 as per the findings.

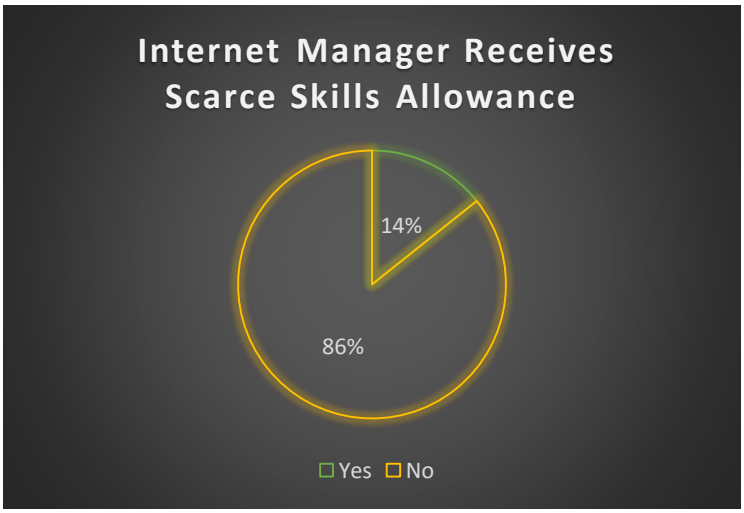

Figure 4.6: Internet Manager receives scarce skills allowance.

Figure 4.6 depicts the responses received (n = 7) for the question ‘Does this post receive a scarce skills allowance?’. One respondent indicated ‘Yes’, the Internet Manager does receive a scarce skills allowance whilst six respondents indicated ‘No’, the Internet Manager does not receive a scarce skills allowance.

The majority of the respondents therefore do not provide a scarce skills allowance to the Internet Manager. This could be due to the fact that this is not the Internet Managers sole responsibility as seen in the next question. This could also be that it may take some time to set up the Internet with the correct settings etc. but thereafter it only needs to be monitored and adjusted when outliers are experienced or changes are requested.

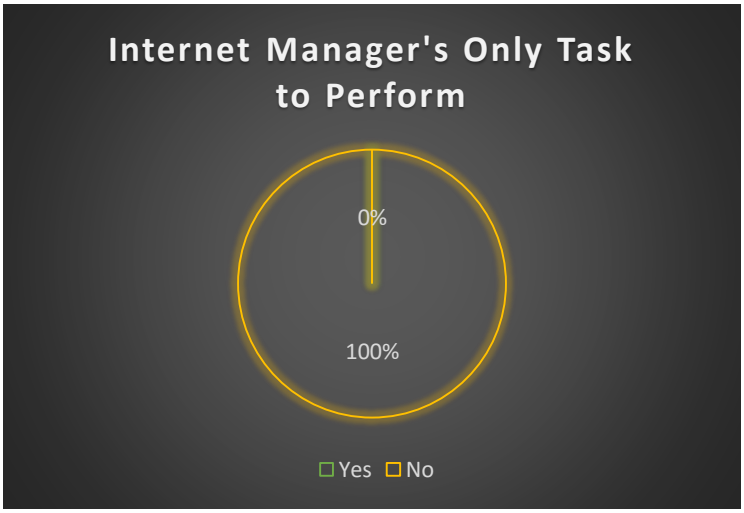

Figure 4.7: Internet Manager’s only task to perform.

Figure 4.7 depicts the responses received (n = 7) for the question ‘Is Internet management this person’s only task to be performed?’. All respondents indicated ‘No’ and therefore indicate that the Internet Manager has various other responsibilities as well.

Therefore, all respondents indicated that Internet management is not the individual’s only responsibility and various other tasks must be performed, unrelated to Internet management. It could be that the Peromnes level 8 and above require a specific amount of tasks, time and effort, which Internet management alone cannot fulfil. This argument is supported in the following question which focuses on the percentage of time dedicated on managing the Internet, which mainly accounts for 20 – 29% of their time.

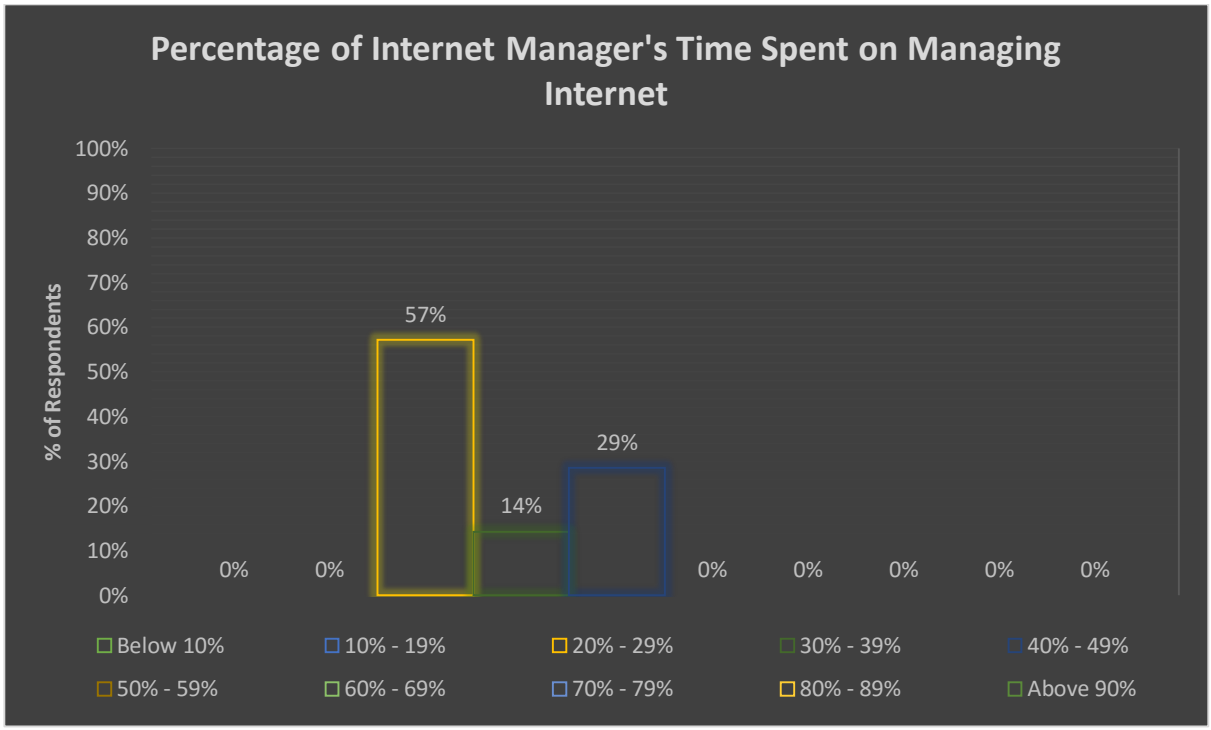

Figure 4.8: Percentage of Internet Manager's time spent on managing Internet.

Figure 4.8 depicts the responses received (n = 7) for the question 'What percentage of his/her time is dedicated/spent on Internet management?'. Four respondents indicated that the Internet Manager post dedicated/spent between 20% – 29% of his/her time on Internet management and two respondents indicated that the Internet Manager dedicated/spent between 40% – 49% of their time on Internet management. All responses therefore fall within the 20% – 49% category with the 20% – 29% category being the majority. The KPI of Internet management therefore only plays a relatively smaller role within his/her full portfolio of duties. Other duties that may be incorporated into this position are Database, Messaging or Networking duties. Internet management responsibilities are not heavy and this could stem from the fact that once the initial setup of the Internet is complete, the monitoring, reporting and upgrading require minimal effort (as compared to other duties). These factors will also directly influence the current Peromnes level of the position.

Figure 4.9 depicts the responses received (n = 8) for the question 'Do you have an ICT Data Engineer (or position with similar KPIs) at your university?'. Two respondents have an ICT Data Engineer (or position with similar KPIs) at their HEI. The remaining six respondents indicated they do not have ICT Data Engineer (or position an with similar KPIs) at their HEI.

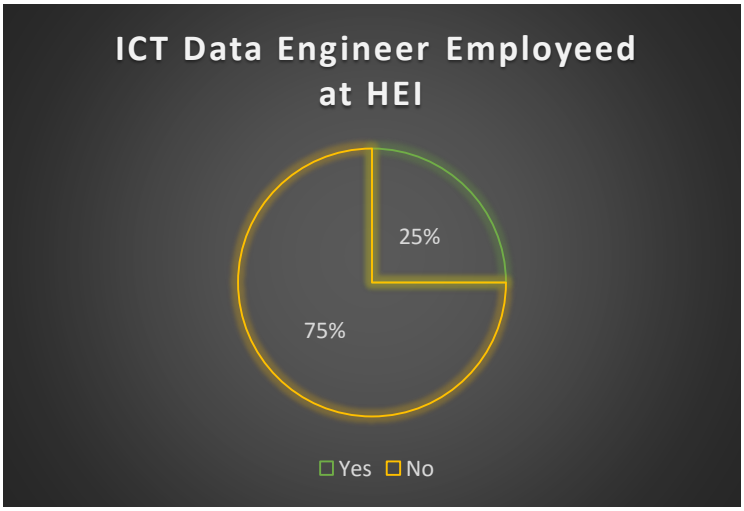

Figure 4.9: ICT Data Engineer employed at HEI.

The majority of the respondents, therefore, indicated they do not have an ICT Data Engineer (or position with similar KPIs) whilst a small number do have an ICT Data Engineer (or position with similar KPIs). Currently there is a trend/need to employ an ICT Data Engineer to analyse and process large amounts of data (also known as Big Data). The ICT Data Engineer then can use the information to report on information usage within the HEI. For example, the ICT Data Engineer can analyse firewall logs to determine the restructuring of the firewall settings as required by the current usage trends. This will ensure a properly aligned firewall infrastructure according to the usage patterns. This position does not necessarily have to reside in ICT, but is imperative for ICT Services to have access to this individual.

Some additional comments were raised at the end of this section by the respondents (n = 6) who provided their overall views/concerns/recommendations regarding the Human Resources puzzle piece of Internet management. Four respondents indicated that a shortage in human resources is a true reflection in their HEI. Some added that this directly raises continuity/succession planning concerns as it influences the service delivery of the Internet. One respondent indicated that Internet management can be very time-consuming if done without access to subscription resources. Allowing security providers like Fortinet and McAfee to provide filter and URL matching list changes the workload to handling exceptions only. Subscribing to such services reduces the human resources cost albeit at an annual cost to the operational expenses. This comment therefore supports to some extent the previous responses received (shortage in human resources). The remaining one respondent indicated that the ICT Director makes the final decision and often does not go according to the stipulated recommendations. Two respondents had no comments. From the comments it is clear that a shortage in human resources is a common concern amongst Internet Managers.

Implementing additional subscription resources may assist in this regard. This however directly influences the outsourcing budget (Financial Resources).

This argument supports the finding that the Internet is of great importance to ICT Services but contradict the finding that indicated that the majority of Internet Managers spend 20% – 29% of their time on managing the Internet. Additional research may be conducted to find a correct balance in the area of a dedicated person managing the Internet, the amount of time spent on Internet management and importance of the Internet to the HEI. The available Financial Resources must also be taken into consideration. The following sub-section will summarise the research findings of Section 3.

4.2.2.4. Summary of Research Findings in Section 3

Section 3 – Human Resources was used to collect information regarding the importance of the Internet for the different user profiles and human resources requirements for managing the Internet. The following common HEI practices were extracted in accordance with the findings from Section 3 – Human Resources as discussed in detail above.

According to common HEI practice, the ranking of the user profile grouping as per their importance is as follows:

1. Overall (HEI Community)
2. Academic Staff
3. Students and Residence (equally)
4. Administrative Staff
5. Visitors
6. Other
7. Contractors

The ranking of 1 to 4 are all captured as ‘Great Importance’ to HEI and ranking 5 to 7 are all captured as ‘Important’ to the HEI.

The second sub-section in the Human Resources section covered the human support function in the management of the Internet at the HEI. The combined findings showed that it is common practice for a designated person to be employed to manage the HEI Internet resources. This position would most commonly be on a Peromnes level 8. The position would not be linked to a scarce skills allowance package as this would not be the Internet Manager’s sole responsibility. The Internet Manager would have a KPI of Internet management which would have a ranking value of between 20 – 29% of their time. In is a common feeling that there is

a shortage in human resources regarding the management of the Internet. Furthermore, it is not common practice to employ an ICT Data Engineer for analysis of Big Data related to the Internet such as the analyses of Internet traffic. Elements of the service provided by an ICT Data Engineer may be completed by an additional system as described later in this chapter. The following sub-section will elaborate on the findings for Section 4 – Financial Resources.

4.2.2.5. Section 4 – Financial Resources

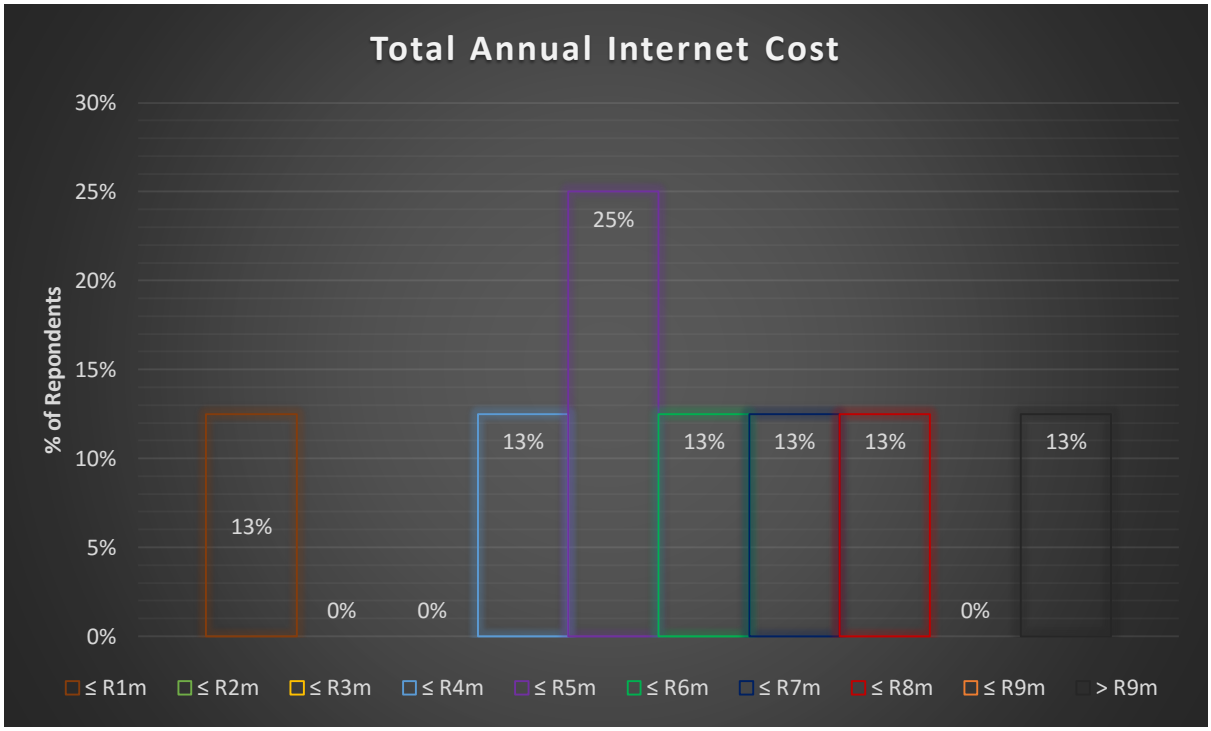

Figure 4.10: Total annual Internet cost.

Figure 4.10 depicts the responses received (n = 8) for the question 'Please indicate the total annual Internet cost?'. Two respondents indicated that the total annual Internet cost are ≤ R5m while the other respondents individually indicated ≤ R1m, ≤ R4m, ≤ R6m, R7m, ≤ R8m and > R9m. No responses were captured for the remaining response categories. It is clear from the findings that the frequency distribution of the total annual Internet costs is diverse with the category ≤ R5m having the most responses. This could be directly linked with the amount of Internet resources available and Internet resources required to deliver a reliable and effective Internet experience for the customer base. This is also directly linked to the physical size, geographical location and number of campuses. The findings, therefore, indicate that each HEI's Internet management budget is unique and requires an internal environment and budgetary analysis to determine the correct amount needed.

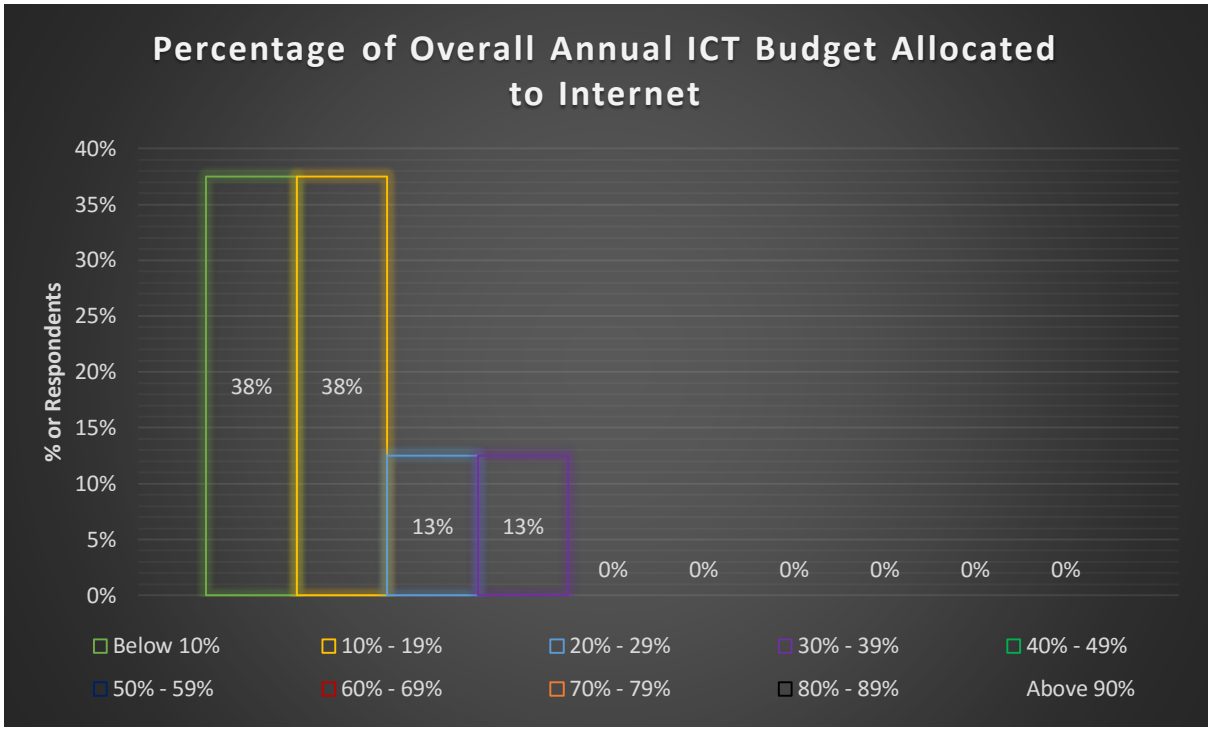

Figure 4.11: Percentage of overall annual ICT budget allocated to Internet.

Figure 4.11 depicts the responses received (n = 8) for the question 'What percentage of your overall annual ICT allocated budget is dedicated to your annual Internet cost?'. Three respondents indicated that below 10% of their overall annual ICT allocated budget is dedicated to their annual Internet cost and another three respondents indicated that between 10% – 19% of the overall annual ICT allocated budget is dedicated to their annual Internet cost. The remaining responses contribute no significant value to the findings.

The findings indicate that all responses lie between 0% – 39%, with the majority of responses distributed between below 10% and 10% – 19%, equally. The cost of managing the Internet is therefore relatively low when compared to the other costs within the ICT department. As the ICT Department has diverse sections and disciplines, the relatively small portion dedicated to Internet management is understandable. A comparison made between this question and the previous question indicates that all HEIs do have different budget portfolios but they are still calculated according to the amount of Internet resources available and Internet resources required to deliver a reliable and effective Internet experience for the customer base.

It should be acknowledged that this refers to the overall percentage of costs and not the actual costs. The term relatively low, therefore does not mean that the cost of the management of the Internet is low. As can be seen in the previous question, the costs of running the Internet are in the millions range.

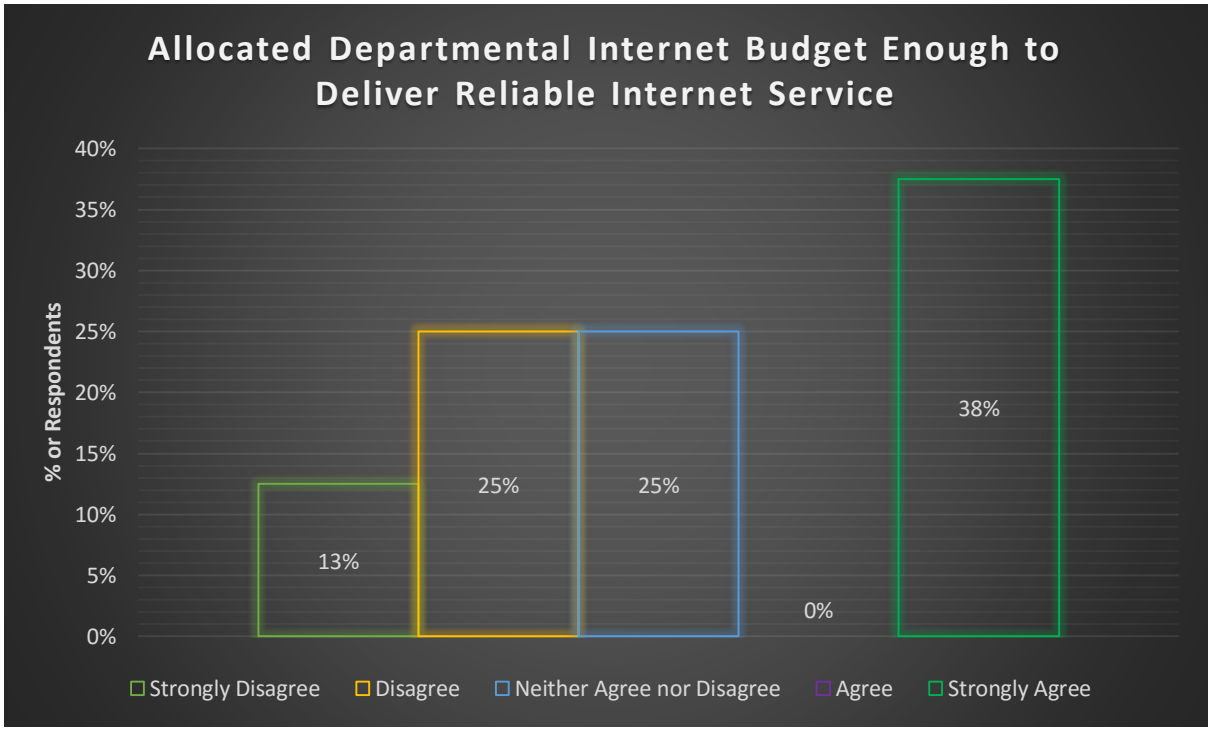

Figure 4.12: Allocated departmental Internet budget enough to deliver reliable Internet service.

Figure 4.12 depicts the responses received (n = 8) for the question 'Do you feel that the allocated Departmental Internet budget is enough to provide a reliable and effective Internet experience to your University?'. Two respondents indicated that they disagree, two respondents indicated that they neither agree nor disagree and three respondents indicated that they strongly disagree that their allocated Departmental Internet budget is enough to provide a reliable and effective Internet experience to the University. The remaining responses contribute no significant value to the findings.

From the findings it is apparent that three respondents indicated that they have a negative response, two respondents indicated that they have a neutral response and three respondents indicated that they have a positive response to their allocated Departmental Internet budget being enough to provide a reliable and effective Internet experience to their HEI. The findings are equally divided between positive and negative responses and therefore present no clear direction.

A further analysis was conducted to determine if there were a relationship between allocated Internet costs as a percentage of Internet budget when compared the overall ICT budget and the view as expressed in this question. For example, the HEI with smaller allocated Internet costs have a positive response to this question while HEI with bigger allocated budgets have

a negative response to this question. The results showed that there is no relationship between these three variables.

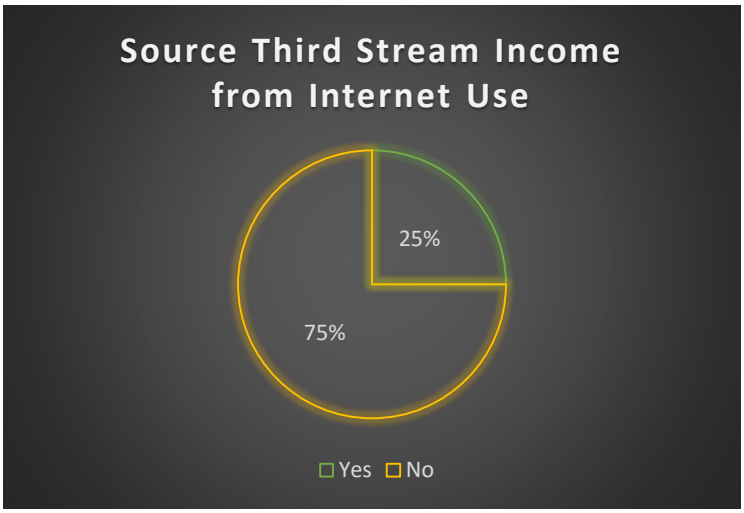

Figure 4.13: Source third stream income from Internet use.

Figure 4.13 depicts the responses received (n = 8) for the question 'Do you source third stream income to add to your bandwidth budget?'. Two respondents indicated they do source third stream income to add to the bandwidth budget. The income is sourced directly from the students. The remaining six respondents indicated they do not source third stream income to add to the bandwidth budget. The majority of the respondents therefore indicated they do not source third stream income to add to the bandwidth budget whilst a small number do source third stream income.

Sourcing third stream income to add to the bandwidth budget would be an ideal business model to adopt as it would lessen the budgetary strain caused by a demanding customer base. This, however, causes additional problems as the customers will have a higher level of expectations as they are now paying for the services and products. The ICT Service Department would consequently have to increase their Internet resources to support this 'paid for' service and product. For example, an Internet Manager would have to be appointed who spends 100% of his time managing the HEI Internet as a 100% uptime and reliability would be expected. Many HEIs have opted not to adopt this business model as it creates the expectation of a 'best effort' service and product and does not allow for some degree of grace with regards to downtime, latency, packets being dropped etc. This is especially true for those who emphasise their wireless network rollouts. The positives and negatives of such a business model would therefore have to be scrutinised thoroughly before being adopted.

A further analysis was conducted to determine if there were a relationship between sourcing third stream income and the view that the allocated Departmental Internet budget is enough to provide a reliable and effective Internet experience to their HEI. The results are, however, inconclusive as the respondents (n = 2) that do source third stream income had mixed views that their allocated Departmental Internet budget was enough to provide a reliable and effective Internet experience.

Some additional comments were raised at the end of this section by the respondents (n = 3) who provided their overall views/concerns/recommendations regarding the Financial Resources puzzle piece of Internet management. Two respondents indicated that the allocated ICT Internet management budget was sufficient. This is supported by the decrease in the HEI ISP's costs as well as by the drop in hardware costs. The third respondent indicated that the allocated ICT Internet management budget was not sufficient, specifically the international bandwidth budget. From the comments, however, it is clear that the overall costs are sufficient to manage the HEI Internet resources. This is due to a drop in ISP and hardware costs, which could be directly linked to globalisation. The following sub-section will summarise the research findings of Section 4.

4.2.2.6. Summary of Research Findings in Section 4

Section 4 – Financial Resources were used to collect information regarding the financial resources requirements for managing the Internet at the university. The following common HEI practices were extracted in accordance with the finding from Section 4 – Financial Resources as discussed in detail above.

The common findings indicate that each HEI has a total annual Internet cost unique to its environment and situation. Consequently, the participants HEIs had no common annual costs. Less than 39% of overall annual ICT budget is allocated to managing the Internet resources with the HEIs using less than 19% of their budget for managing their Internet resources. The respondents' views that the allocated Departmental Internet budget is enough to provide a reliable and effective Internet experience to their Internet community are mixed. No consensus was reached regarding this question as the responses were equally divided between positive and negative responses. It is common practice amongst HEIs not to source third stream income to add to the bandwidth budget. The small portion of respondents that do source third stream income to add to their bandwidth budget do so from their students. The following sub-section will elaborate on the findings for Section 5 – Physical Resources.

4.2.2.7. Section 5 – Physical Resources

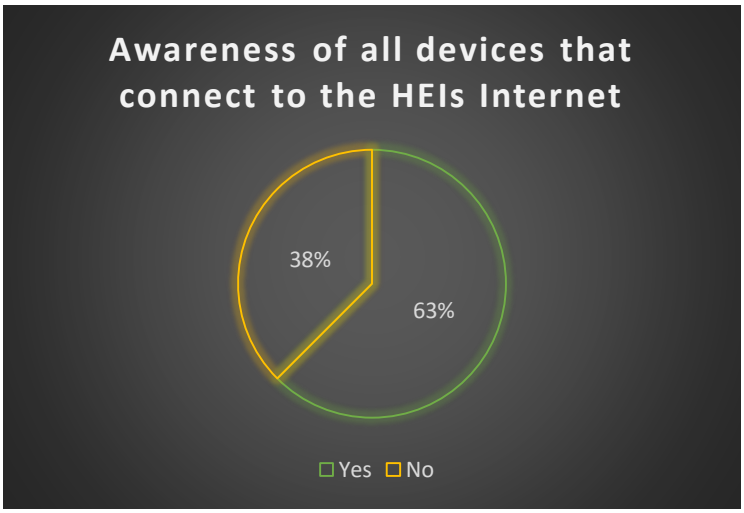

Figure 4.14: Awareness of all devices that connect to the HEIs Internet.

Figure 4.14 depicts the responses received (n = 8) for the question 'Are you aware of all devices that connect to your University's Internet connection?'. Five respondents indicated they are aware of all devices that connect to their Internet while the remaining three respondents indicated they were not aware of all devices that connect to their Internet.

The findings show that there are more HEIs that are aware of all devices connected to their Internet than those who are not aware. BYOD and IoT have introduced many new technologies that are brought into the HEI environment and consequently are connected to the HEIs Internet. HEIs requires analytical tools that can detect and adapt the Internet requirements to support these technologies. There are therefore a drive towards gaining access to analytical and real time tools to detect these technologies. From the findings it is clear that some have adopted these technologies whilst a smaller number of HEIs have not.

Figure 4.15 depicts the responses received (n = 8) for the question 'Do you cater for all devices that connect to your University's Internet connection?' Five respondents indicated they do cater for all devices that connect to their Internet while the remaining three respondents indicated they do not cater for all devices that connect to their Internet. The respondents that do cater for all devices that connect to their Internet (n = 5), do so by using Active Directory (AD) logon credentials, implementing Wi-Fi Authentication and by isolating identified subnets from the production environment, using settings on the Proxy and Firewall and lastly, by forcing the registration of devices when first connecting and by segregating the network into undergraduate students, residences, and labs from other parts of the network. The last respondent did not specify how these devices are managed.

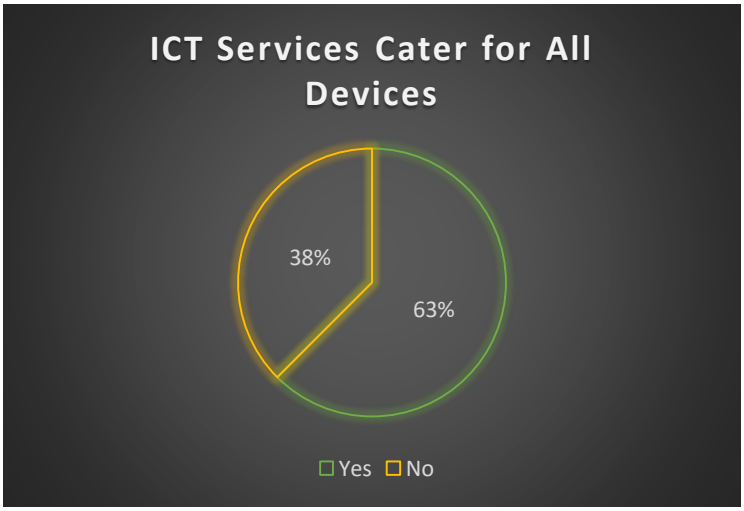

Figure 4.15: ICT Services cater for all devices.

The findings show that there are more HEIs that cater for all devices that connect to their Internet than those that do not provide this facility. The most common method used to manage these devices is through authentication and network segregations. It can be argued that the responses from the previous question that the HEI that is aware of all devices on its Internet is from the same respondents who cater for these devices.

As previously discussed, BYOD and IoT have introduced many new technologies that are brought into the HEI environment and are consequently connected to the HEI's Internet. It would be ideal for HEIs to cater for all devices that connect to their Internet while keeping in mind that 'one cannot manage what one cannot measure'.

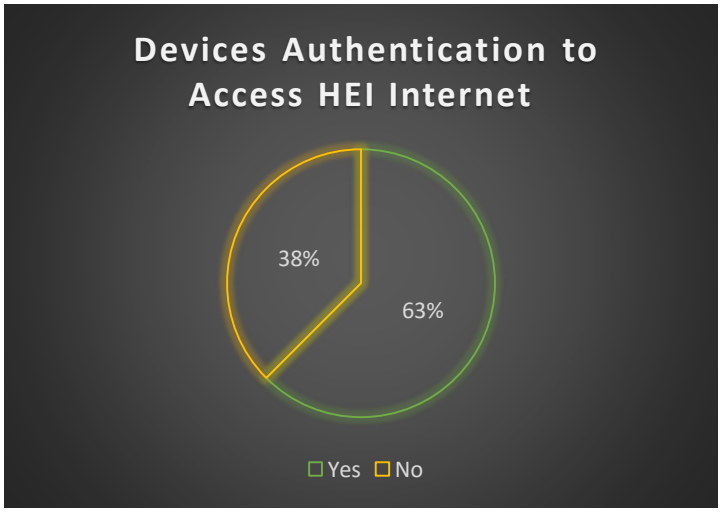

Figure 4.16: Devices authentication to access HEIs Internet.

Figure 4.16 depicts the responses received (n = 8) for the question 'Does a device need to authenticate before being granted access to the Internet?'. Five respondents indicated that devices do need to authenticate to the Internet before being granted access to the Internet while the remaining three respondents indicated that devices do not need to authenticate to the Internet before being granted access to the Internet.

The findings indicate that there are more Internet authentication protocols instilled than those who do not have any form of Internet authentication protocols active. Having no authentication protocols active allows any device or system to connect and use the HEI's Internet resources. This can add strain to the Internet capacity and exhaust the available resources provided for authorised individuals. This will also allow unauthorised individuals to access the HEI Internet, which may lead to undesirable or unethical usage. Authentication protocols are therefore very effective in managing access to the resources and allow devices and systems to be held responsible for their actions. Therefore, from a security and management perspective, having and active authentication method that controls access to these valuable resources would be ideal.

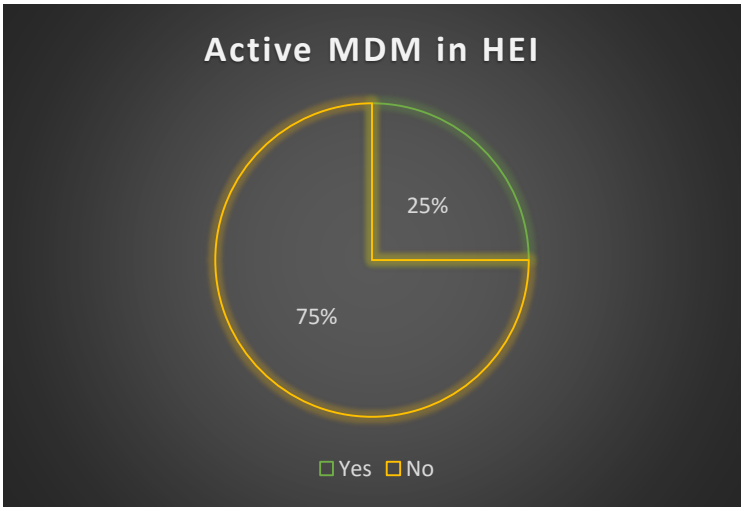

Figure 4.17: Active MDM in HEI.

Figure 4.17 depicts the responses received (n = 8) for the question 'Do you have an active Mobile Device Management (MDM) system in your University to manage connected mobile devices?'. Two respondents indicated they have an active MDM while the remaining five respondents indicated they do not have an active MDM.

The findings show that the majority of staff do not have a MDM in their environment. MDM is a mobile device management software package used to manage HEI owned and personally

owned mobile devices that connect onto the HEI's Internet. It is therefore ideal to have such a package active in the environment. MDMs are however extremely expensive and are still in their infancy stage, meaning that the system does come with some management issues. In addition, many argue that the cost of such a package does not justify the value, especially due to some features are already covered by already implemented software packages and possible free smaller applications.

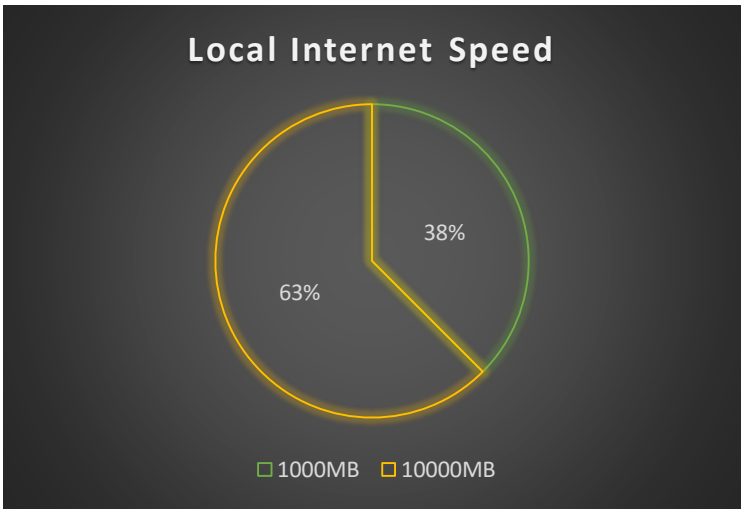

Figure 4.18: Local Internet speed.

Figure 4.18 depicts the responses received (n = 8) for the question 'What is the speed of your local (South African) Internet traffic?'. Three respondents indicated that their local Internet traffic speed is 1 000MB and five respondents indicated that their local Internet traffic speed is 10 000MB. The findings show that there are more HEIs that have a 10 000MB local Internet traffic line that those that have a 1 000MB local Internet traffic line. One would assume that the larger HEI would implement the 10 000MB line while the smaller HEI would implement the 1 000MB lines. This, however, is not the case according to the staff and student capacity as some HEIs in the same capacity range have different local Internet traffic speeds. In addition, there is no connection between the HEI budget size and the local Internet speed.

Figure 4.19 depicts the responses received (n = 8) for the question 'What is the speed of your international Internet traffic?'. All respondents indicated their unique international Internet speed.

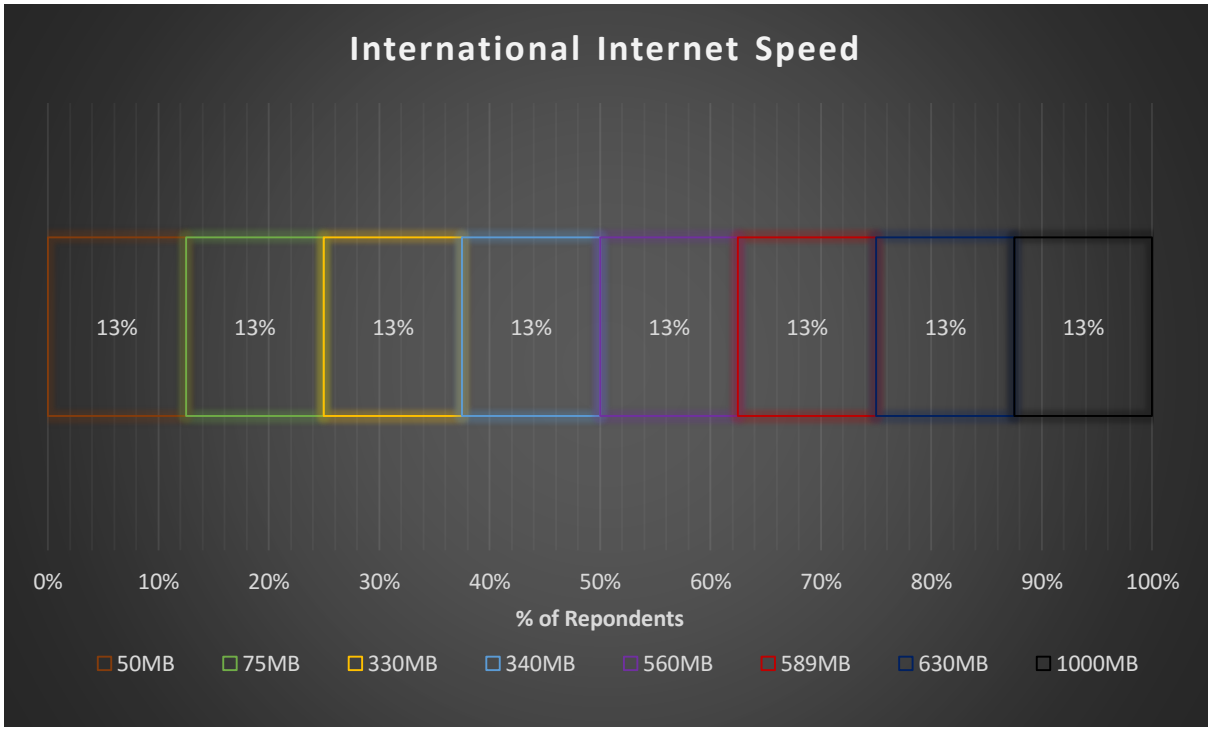

Figure 4.19: International Internet speed.

The findings show that there is no set package when buying international Internet speed. Each HEI therefore negotiated an international Internet speed to suit its environment and paid a specific price for that speed. International Internet speed is much more expensive that local Internet speed and this could be why this route of individual calculation is followed. The findings therefore indicate that each HEI's international Internet speed is unique and requires an internal environment and budgetary analysis to determine the required speed.

Figure 4.20 depicts the responses received (n = 7) for the question 'What percentage of your Internet bandwidth is allocated to staff?'. Two respondents indicated that 20% – 29% of the Internet bandwidth is allocated to staff while three respondents indicated that above 90% of the Internet bandwidth is allocated to staff. The remaining responses contribute no significant value to the findings.

From the findings it is clear that more respondents indicated that staff are allocated above 90% of the Internet bandwidth. This could mean that academic and administrative staff are seen as an important user group of the HEI's Internet (see Importance of Internet at HEI). Alternatively, the bandwidth could be open on a 'first come first serve' meaning that all user groups would have 100% allocated to all and they have to 'fight' for their share (as compared Percentage of Internet bandwidth allocated to students). In addition, some HEIs only provide staff 20% – 29% and 30% – 39% of the Internet bandwidth. This could be because of the size

of the user group compared to its counterpart, students, who are the majority at HEIs. As can be seen from the findings, three respondents allocate less than 49% of the Internet to the staff while four of the respondents allocate more that 50% of the Internet bandwidth to staff with above 90% in most cases.

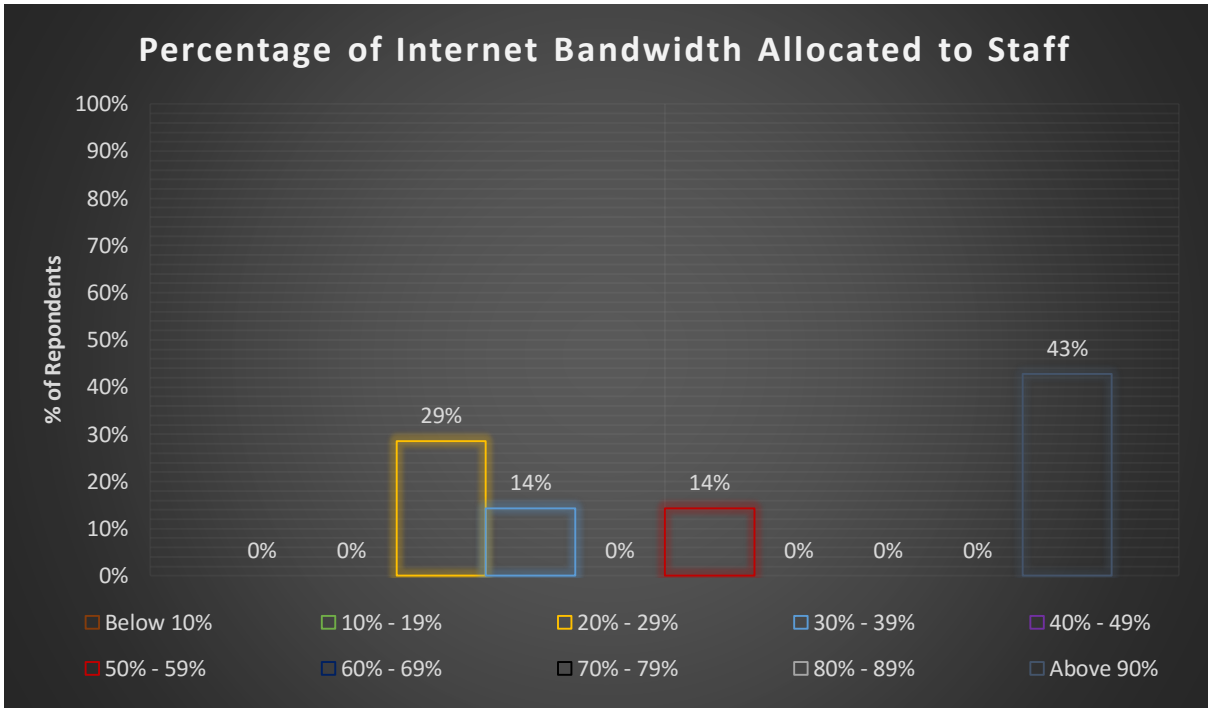

Figure 4.20: Percentage of Internet bandwidth allocated to staff.

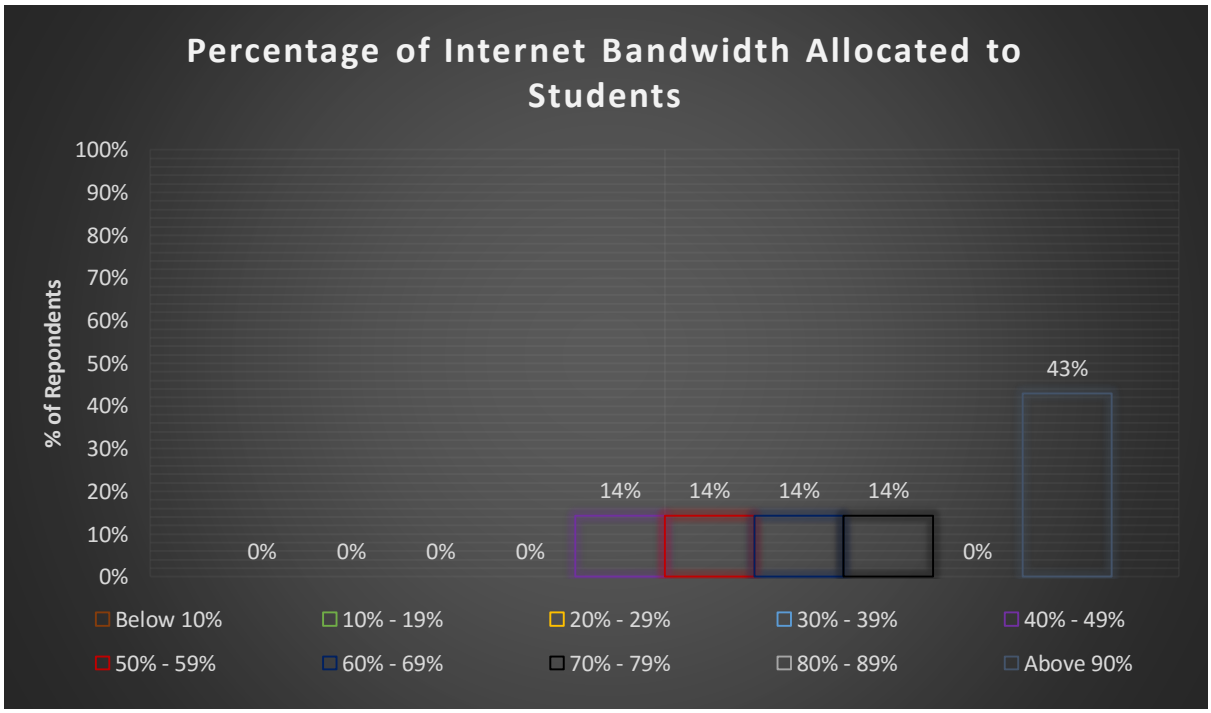

Figure 4.21: Percentage of Internet bandwidth allocated to students.

Figure 4.21 depicts the responses received (n = 7) for the question 'What percentage of your Internet bandwidth is allocated to students?'. The categories 40% – 49%, 50% – 59%, 60% – 69% and 70% – 79% each received one response. Three respondents indicated that above 90% of the Internet bandwidth is allocated to students.

From the findings, it is clear that more respondents indicated that students are allocated above 90% of the Internet bandwidth. This could mean that registered students are seen as an important user group of the HEI Internet (see Importance of Internet at HEI). Alternatively, the bandwidth could be open on a 'first come first serve' meaning that 100% is allocated to the groups and individuals have to 'fight' for their share (as compared percentage of Internet bandwidth allocated to staff). As can be seen from the findings, one respondent allocate less than 49% of the Internet to the students while six respondents allocate more that 50% of the Internet bandwidth to students with above 90% in most cases.

When the percentage of bandwidth allocation between staff and students is compared, it is clear that the combined findings indicate that there is a cluster of respondents above 90% and between 20% – 59%. The percentage of bandwidth allocation to students is clustered at above 90% and between 40% – 79%. When the combined findings are examined, students receive a bigger portion of allocated Internet bandwidth than staff. This would be ideal in most situations as the difference is size between the two groups is a major determining factor. These facts are supported in the Importance of Internet at HEI findings.

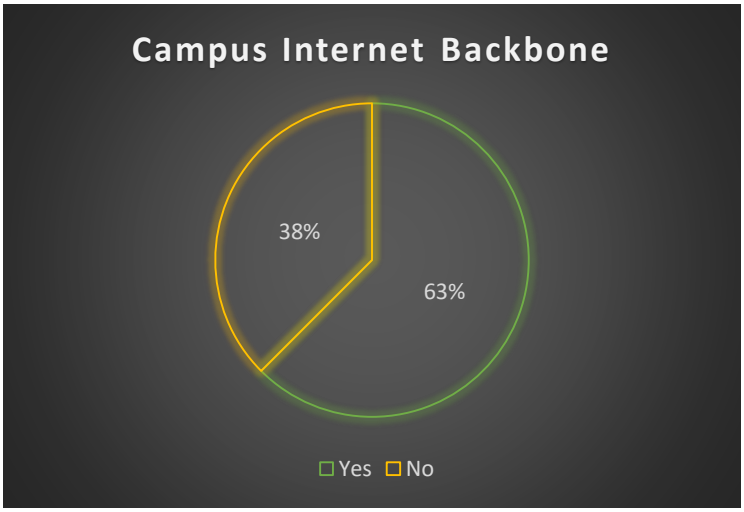

Figure 4.22: Campus Internet backbone.

Figure 4.22 depicts the responses received (n = 8) for the question 'Does your University have a Campus Internet backbone?'. Five respondents indicated they have a Campus Internet backbone while three respondents indicated they do not have a Campus Internet backbone.

The findings show that there are more HEIs that have a Campus Internet backbone than those who do not. The Internet backbone is the data paths between large, strategically interconnected networks and core switches and routers within the HEI environment. In the case of this question, it refers to between campuses. Backbones will always be present inside a network infrastructure as data needs to be transferred from one network segment onto another. Campus backbones are usually between campuses and are used to transfer large amounts of data and for load balancing and redundancy. It is therefore ideal for large HEIs to have Campus Internet backbones but unnecessary for smaller sites. In the findings, there is, however, no relationship between the size of the Campus and having an active backbone.

Figure 4.23 depicts the responses received (n = 5) for the statement 'Please indicate the type of WAN Technology used in your University'. The statement required the Internet Manager to provide the site name, the technology used and relevant connection speed. For the purpose of confidentiality, the site name will be excluded from the findings.

- WAN – Fiber Optic

  A total of six respondents indicated that they have a Fiber Optic Backbone Connection implemented between their HEI and relevant ISP. From these six respondents, only five participated in this question. One respondent indicated they do not have a Fiber Optic WAN between their campuses. One respondent indicated they have one Fiber Optic WAN between their campuses. Two respondents indicated they have two Fiber Optic WAN between their campuses. One respondent indicated they have seven Fiber Optic WAN between their campuses. The mean number of Fiber Optic WAN between their campuses is 2,40 with a standard deviation of 2,70. The median number of Fiber Optic WAN between their campuses is **2** with the minimum being 0 and maximum being 7.

- WAN Wireless

  One respondent indicated that there is no Wireless WAN between their campuses. Two respondents indicated they have one Wireless WAN between their campuses. One respondent indicated there are two Wireless WAN between their campuses. One respondent indicated there are three Wireless WAN between their campuses. The mean number of Wireless WAN between their campuses is 1,40 with a standard

deviation of 1,14. The median number of Wireless WAN between their campuses is **1** with the minimum being 0 and maximum being 3.

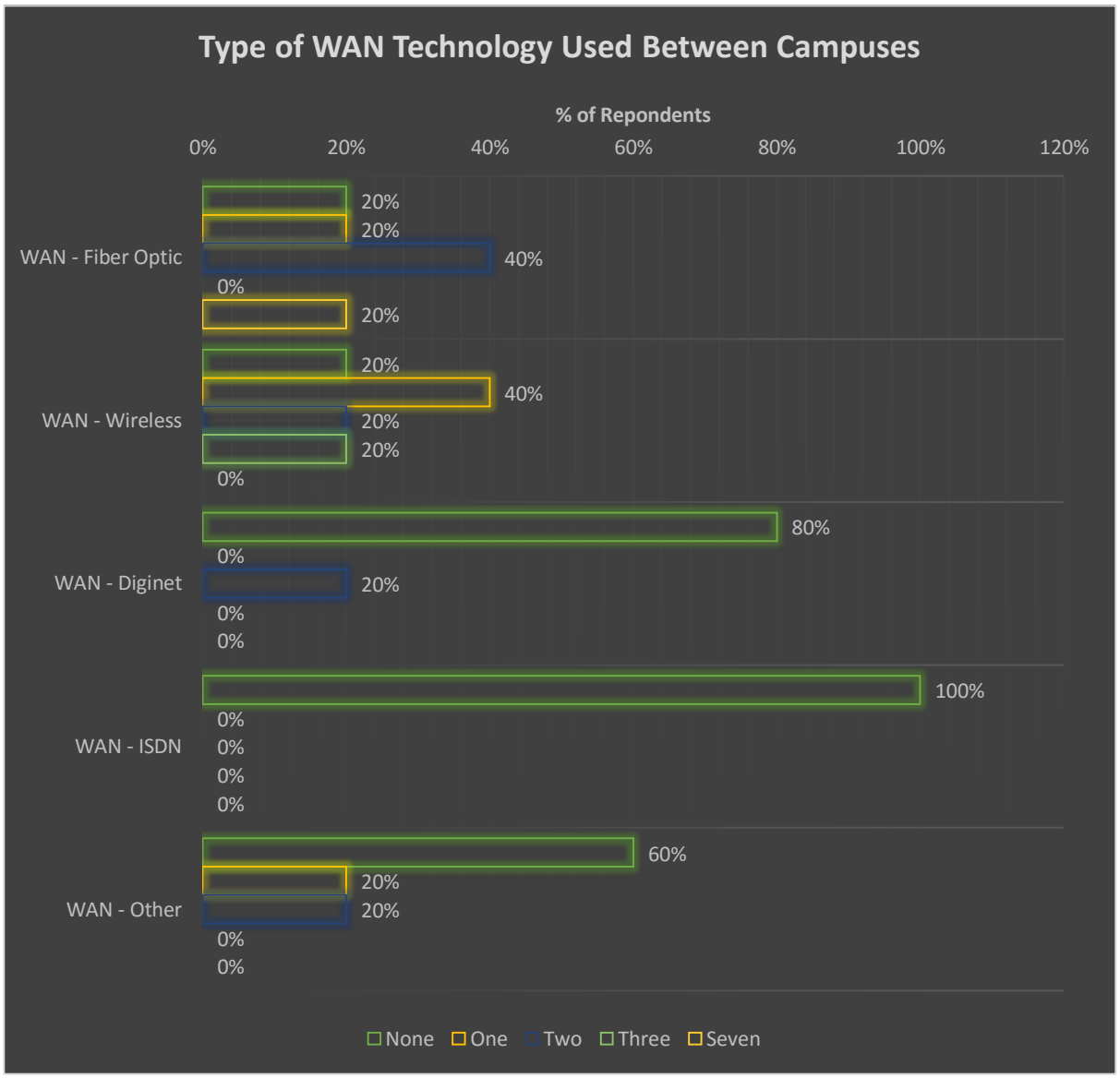

Figure 4.23: Type of WAN Technology used between campuses.

- WAN Diginet

  Four respondents indicated they do not have a Diginet WAN between their campuses. One respondent indicated there are two Diginet WAN between their campuses. The mean number of Diginet WAN between the campuses is 0,40 with a standard deviation of 0,89. The median number of Diginet WAN between their campuses is **0** with the minimum being 0 and maximum being 2.

- WAN ISDN

  All respondents indicated they do not have an ISDN WAN between their campuses.

- WAN Other

  Three respondents indicated they do not have Other WAN between their campuses. One respondent indicated there is one Other WAN between their campuses. One respondent indicated there are two Other WAN between their campuses. No responses were captured for the remaining response categories. The mean number of Other WAN between the campuses is 0,60 with a standard deviation of 0,89. The median number of Other WAN between their campuses is **0** with the minimum being 0 and maximum being 2.

The respondents each had their uniquely allocated types of WAN Technology low speeds used between campuses. The low speeds provided included 64KB, 20MB, 25MB, 100MB and 1 000MB. The mean number of WAN Technology low speeds used between campuses is 229,1MB with a standard deviation of 432,66. The median number of WAN Technology low speed used between campuses is **25MB** with the minimum being 64KB and maximum being 1 000MB. With the high speeds, one respondent had a 54MB high WAN Technology speed used between campuses, one respondent had a 1 000MB high WAN Technology speed used between campuses and lastly, three respondents had 10 000MB high WAN Technology speed used between campuses. The mean number of WAN Technology high speed used between campuses is 6 210,80MB with a standard deviation of 5 199,34. The median number of WAN Technology high speed used between campuses is **10 000MB** with the minimum being 54,00MB and maximum being 10 000MB.

Some additional comments were made at the end of this section by the respondents (n = 3) which showed their overall views/concerns/recommendations regarding the Physical Resources puzzle piece of Internet management. One respondent indicated that the WAN connections between campuses are overloaded and must be increased in the near future. This will have an effect on the Internet management's financial resources. One respondent indicated that their fibre optics are unstable and consequently requires a 150MB/s wireless backup to ensure continuity. One respondent indicated that due to the financial constraints, there is only partial upstream redundancy, meaning that they have two providers, but one greatly exceeds the other. From the comments it is clear that each HEI has its own areas of concern. There is consequently no common area of concern with regards to Physical Resources. The following sub-section will summarise the research findings of Section 5.

4.2.2.8. Summary of Research Findings in Section 5

Section 5 – Physical Resources were used to collect information regarding the physical resources requirements for managing the Internet at the university. The following common HEI practices were extracted in accordance with the findings from Section 5 – Physical Resources as discussed in detail above.

Generally, the majority of HEIs are aware of all devices that connect to their Internet on a daily basis. It is common practice for HEIs to cater for all these devices that connect to their Internet by means of authentication and network segregations. Before these devices can connect to the HEI's Internet, however, they are requested to authenticate themselves, which in turn will grant them their required rights and permissions. The majority of HEIs do not use MDM in their environment for this purpose but instead rely on other technologies to manage these devices.

As previously mentioned, the two major user groups in all HEIs are staff and students. These are the users that access the HEI's Internet on a daily basis. It is common practice for HEIs to dedicate above 90% of the Internet bandwidth to both staff and students. Those HEIs that do alter this setting generally dedicate more bandwidth to students. In order to be able to provide a reliable Internet service to the user groups, the HEI must buy local and international Internet bandwidth packages from their ISP (in this case, TENET). Currently, the majority of HEIs have implemented 10 000MB local Internet bandwidth with a smaller HEI portion having 1 000MB local Internet bandwidth. Due to the expense of international bandwidth, packages are created as per the HEI budget and environment. There is consequently no set or common international bandwidth packages amongst HEI.

HEIs have to implement Campus Internet backbone to ensure connectivity between their diverse campuses. According to the findings, it is common practice for an HEI to have a Campus Internet backbone. The preferred Campus Internet backbone technologies are ranked below according to popularity:

1. Fiber Optic
2. Wireless
3. Other
4. Diginet
5. ISDN

Generally, these HEIs prefer to use WAN Technology low speeds of 25MB and a WAN Technology high speeds of 10 000MB between their campuses. The following sub-section will elaborate on the findings for Section 6 – Organisational Resources.

4.2.2.9. Section 6 – Organisational Resources

Section 6 – Organisational Resources are divided into three sub-sections. These sub-sections are Governance, Technology and Monitoring. The first sub-section will analyse the Governance resources.

- Governance

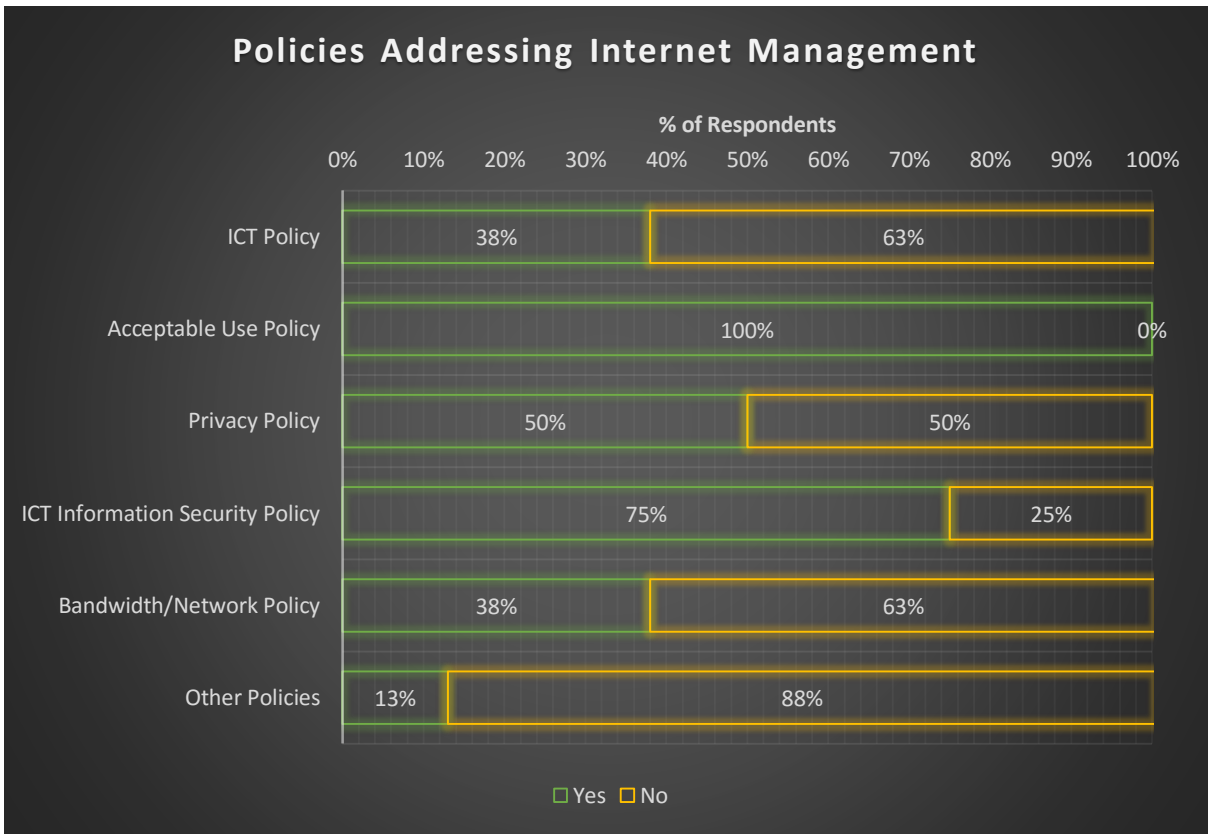

Figure 4.24: Policies addressing Internet management.

Figure 4.24 depicts the responses received (n = 8) for the question 'Does your University have any of the following policies in place that address Internet management issues?'. Three respondents indicated they have a General ICT Policy in place to addresses Internet management issues while the remaining five respondents indicated they do not. All respondents indicated they have an Acceptable Use Policy in place to address Internet management issues while no respondents indicated they do not. Four respondents indicated they have a Privacy Policy in place to address Internet management issues while the remaining four respondents indicated they do not. Six respondents indicated they have an

Information Security Policy in place to address Internet management issues while two respondents indicated they do not. Three respondents indicated they have a Bandwidth/Network Policy in place to address Internet management issues while five respondents indicated they do not. One respondent indicated they have Other Policies in place to address Internet management issues while seven respondents indicated they do not.

The findings show that the most commonly used policy for address Internet management issues is an Acceptable Use policy (n = 8). Second, is the ICT Information Security Policy (n = 6) followed by the Privacy Policy (n = 4). In fourth position is the ICT Policy and Bandwidth/Network Policy with an equal number of responses (n = 3) and lastly, is Other Policies (n = 1).

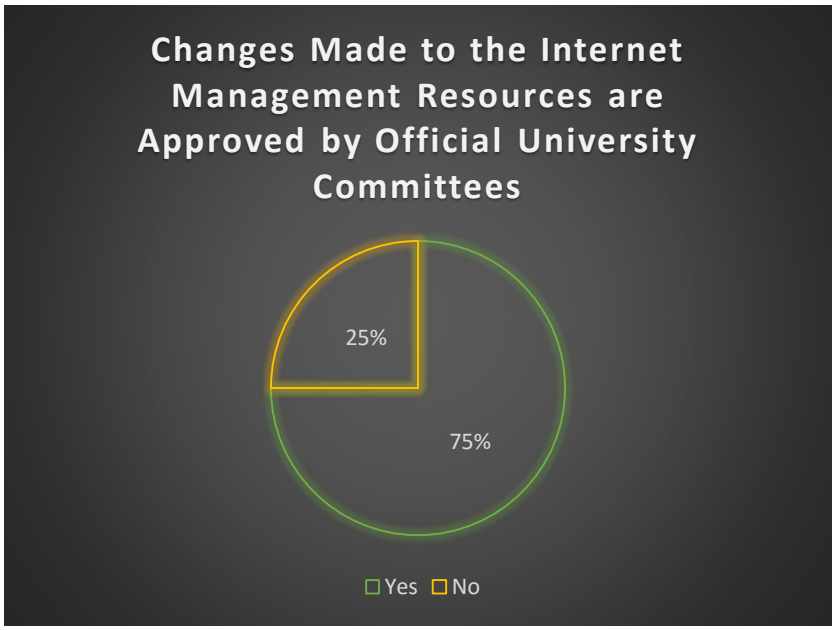

Figure 4.25: Changes made to the Internet management resources are approved by Official University Committees.

Figure 4.25 depicts the responses received (n = 8) for the question 'Are changes made to the Internet management resources approved by Official University Committees before implementation?'. Six respondents indicated that changes to the Internet management resources do need to be approved by an Official University Committee before being implemented while the remaining two respondents indicated they can make changes to the Internet management resources without Official University Committee approval.

The findings indicate that in the majority of HEIs, all changes made to the Internet management resources must be approved by Official University Committees before

implementation. At most HEIs, a formal Governance procedure must be followed as set by King III. Therefore, getting approval regarding a change made to a critical resource such as the Internet is imperative, especially if it will have repercussions on the entire HEI network infrastructure. Following the correct procedures will ensure that the correct authorities are consulted and that all aspects of the change are reviewed and approved. This will similarly ensure that the changes contribute to the overall strategic goals of the HEI. A formal resolution must then be kept of the approval process.

The changes must be of a certain frequency, event type or category and contain a specific impact level before they are reported. Small or insignificant changes do not have to be reported.

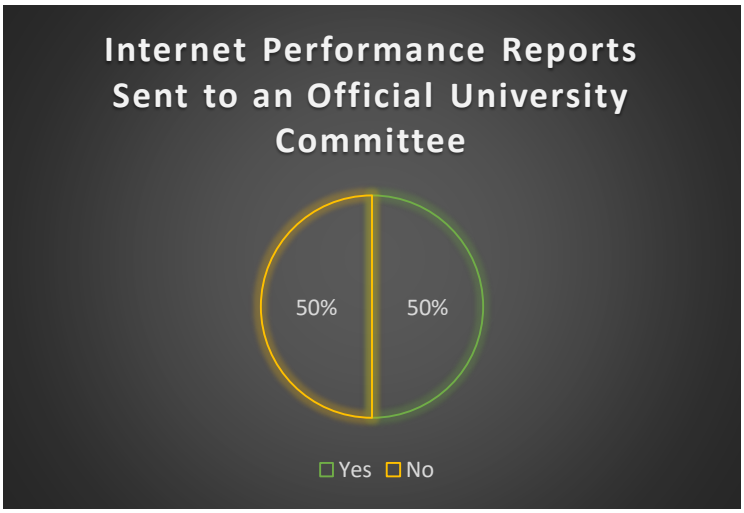

Figure 4.26: Internet performance reports sent to an Official University Committee.

Figure 4.26 depicts the responses received (n = 8) for the question 'Are Internet performance reports sent to an Official University Committee on a regular basis?'. Four respondents indicated they do submit Internet performance reports to an Official University Committee on a regular basis while the remaining four respondents indicated they do not. From the four respondents who do submit regular reports, one indicated that it is sent to the ICT Director who then reports to the Senate Committee on the findings and the remaining three indicated they send the reports to the Information Technology Steering Committee (named differently at each HEI but providing a similar function).

The findings show an exact split with regard to submitting Internet performance reports to an Official University Committee on a regular basis. The majority of those that do send the Internet performance report to an Official University Committee on a regular basis, do so to the

Information Technology Steering Committee. In general, reviewing regular reports assists the managers to plan for the future by examining current trends. This will assist with planning for Internet resources such as budgetary changes, capacity changes, settings changes etc. This will also assist with preventing predictable surprises, meaning they analyse the current trends that may indicate they are heading towards a disaster. Regular feedback on Internet performances to an Official University Committee will assist to keep the Internet as a competitive resource and to stay abreast of the Internet driving forces.

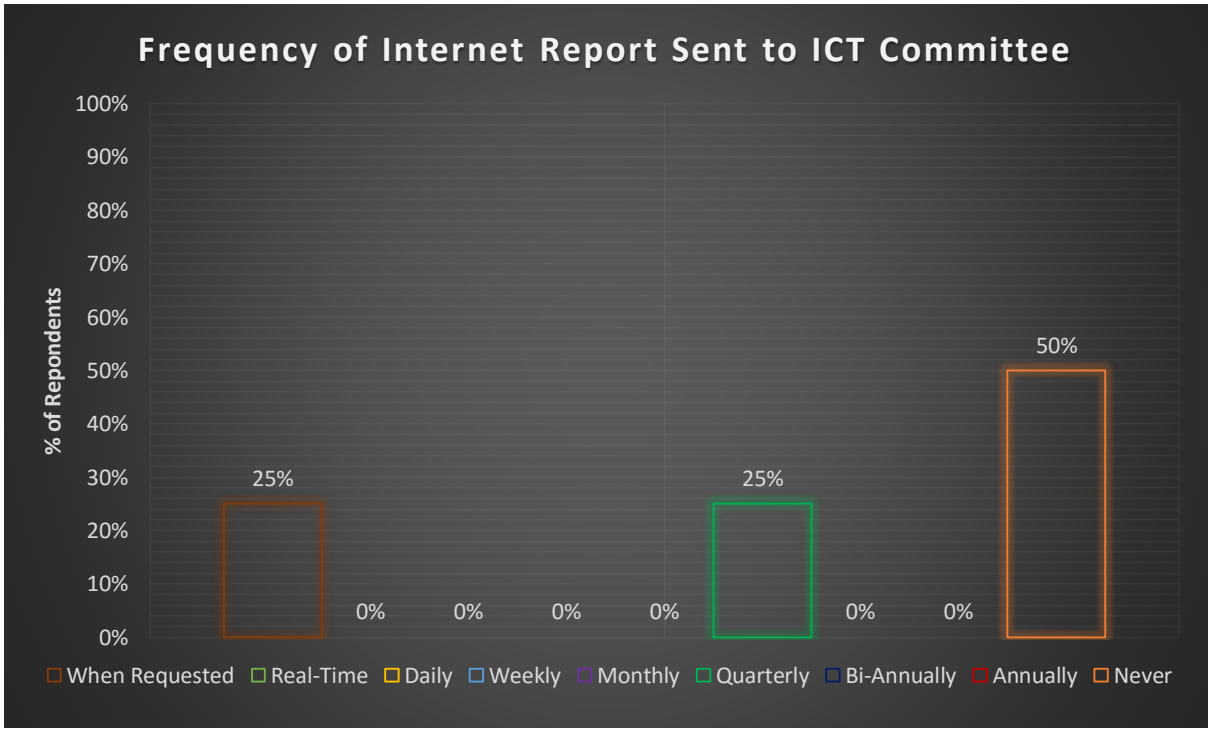

Figure 4.27: Frequency of Internet report sent to ICT Committee.

Figure 4.27 depicts the responses received (n = 8) for the question 'How frequently are Internet performance reports sent to an Official University Committee?'. Two respondents indicated that Internet performance reports are sent to an Official University Committee when requested. Two respondents indicated that Internet performance reports are sent to an Official University Committee on a quarterly basis. Four respondents indicated that Internet performance reports are never sent to an Official University Committee.

The majority of findings therefore indicate that Internet performance reports are never sent to an Official University Committee. This could mean that the Internet performance reports do not fall within the Committee's scope. These performance reports would therefore be reviewed and processed by the ICT Management team, internally. These reports are also not easy documents to compile and required time-consuming resources to complete such a report.

This could be why two respondents indicated that Internet performance reports are sent to an Official University Committee quarterly and another two respondents indicated when requested. It could also be argued that such a report would only be requested if there are changes to be made (e.g. an upgrade to be conducted) or when issues are experienced with the Internet's performance. This forms part of the next question.

It should be acknowledged that this finding, therefore, contradicts the previous question. The previous question was inconclusive as the four respondents indicated they do submit Internet performance reports to an Official University Committee on a regular basis while the remaining four respondents indicated they do not submit Internet performance report to an Official University Committee on a regular basis. According to this question there are more respondents who submit Internet performance reports to an Official University Committee on a regular basis than those who do not. The findings in this question would therefore override the previous question's findings as this question's findings are presented in greater detail.

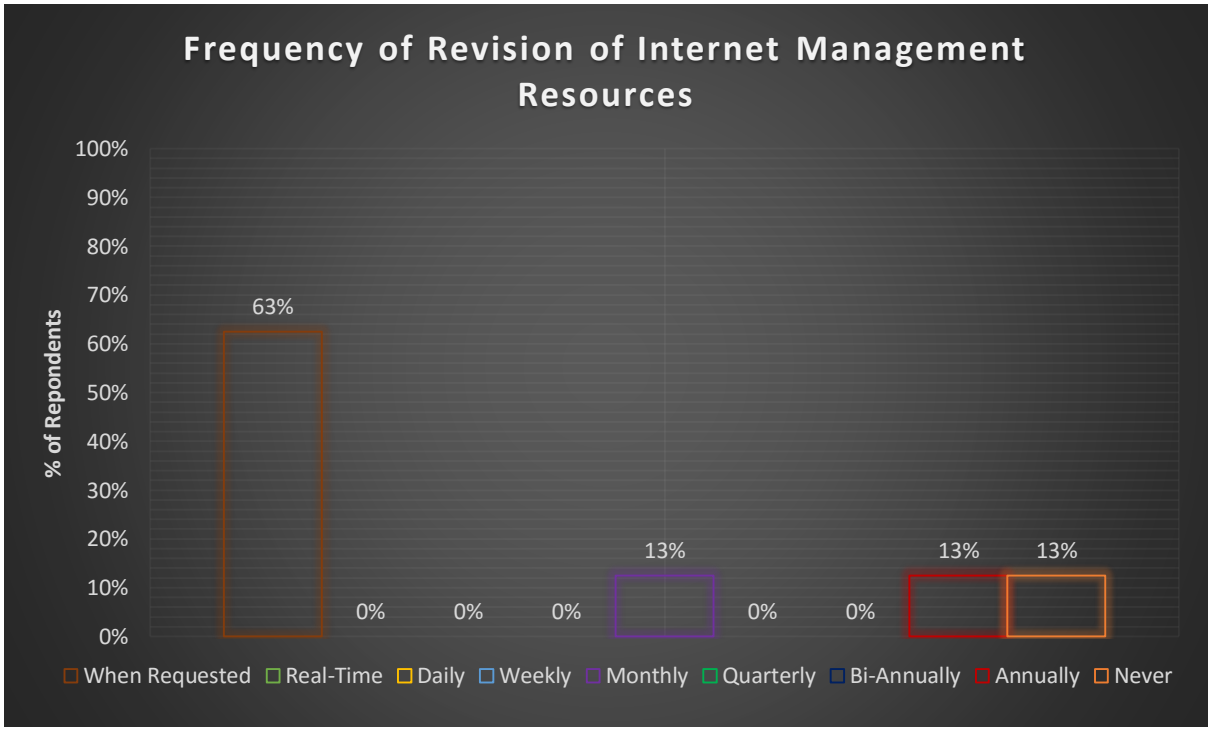

Figure 4.28: Frequency of revision of Internet management resources.

Figure 4.28 depicts the responses received (n = 8) for the question 'How often do you review your Internet management resources to ensure their effectiveness and relevancy?'. Five respondents indicated that the Internet management resources are reviewed when requested. One respondent stated they were received monthly, annually and never, respectively.

The findings show that the majority of HEIs review the Internet management resources when requested. This supports the argument made before, that such a process can be extremely resource-consuming and could in some cases impact the performance of the Internet. The reviewing of Internet management resources is, however, still vital to the HEI as it ensures that the Internet resources stay current and adapt to the changing needs of the business requirements, customer base and industry-driving forces. An increase in the frequency of the requested reports will directly increase the percentage of time spent on managing the Internet (see Percentage of Internet Manager's time spent on managing Internet) by the Internet Manager. The following sub-section within the Organisational Resources section will focus on the Technology resources.

- Technology

The first question from the Technology sub-section was 'What is the main tool (technology/software package) that you use to manage your Internet?' The responses received (n = 8) included Fortigate 1000C Firewall, Firewall, Fortigate, Firewall, Firewalls, proxy and TENET graphs, CheckPoint Firewall with squid proxy, Firewall Fortinet and lastly, a combination of technologies which include layer 7 firewalls, caching proxy servers, routing policy (eBGP), etc.

It is therefore clear that all respondents (100 percent with n = 8) use their Firewall as the main tool (technology/software package) to manage the HEI's Internet. Some respondents have added some additional technologies to support the overall management of the Internet. These technologies contribute towards the management of the Internet.

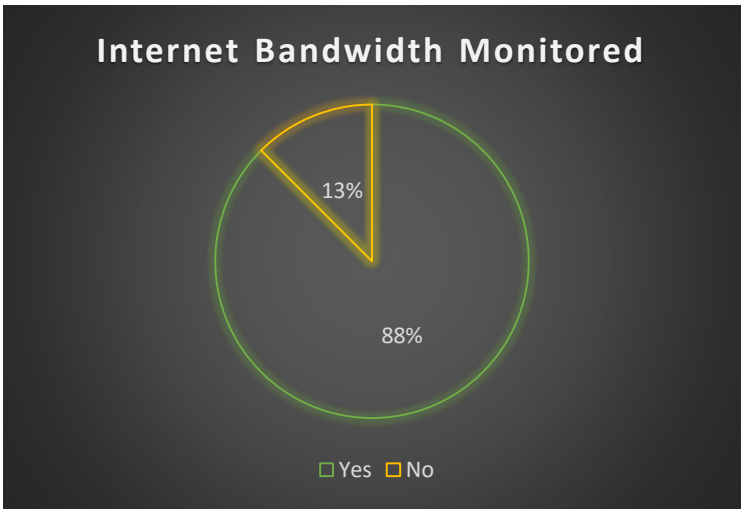

Figure 4.29: Internet bandwidth monitored.

Figure 4.29 depicts the responses received (n = 8) for the question 'Do you monitor you Internet bandwidth?'. Seven respondents indicated they do monitor their Internet bandwidth while the remaining one respondent indicated they do not monitor their Internet bandwidth. The technologies used by those who do monitor their Internet bandwidth (n = 7), are Fortigate Firewall and Sawmill for log processing, Firewall technology as a reporting tool for the Firewalls and Zabbix for the proxy graphs, Multi Router Traffic Grapher (MRTG) graphs, Fortinet Firewall, Cisco PRIME Infrastructure and TENET Graphs, Forefront Threat Management Gateway (TMG) Firewall and security software, Observium, Netgraph and SNMP/Cacti.

It is apparent from these findings that the majority of the respondents do monitor their Internet bandwidth. The most common technology being used is the Firewall with an additional supporting technology which possibly extends the monitoring and reporting capabilities of the Firewall. These additional technologies are selected to suit the requirements of the specific HEI and are uniquely setup to fulfil these needs. These approaches serve as a passive technology, meaning they are only used to view what is happening on the network or what has already happened on the network.

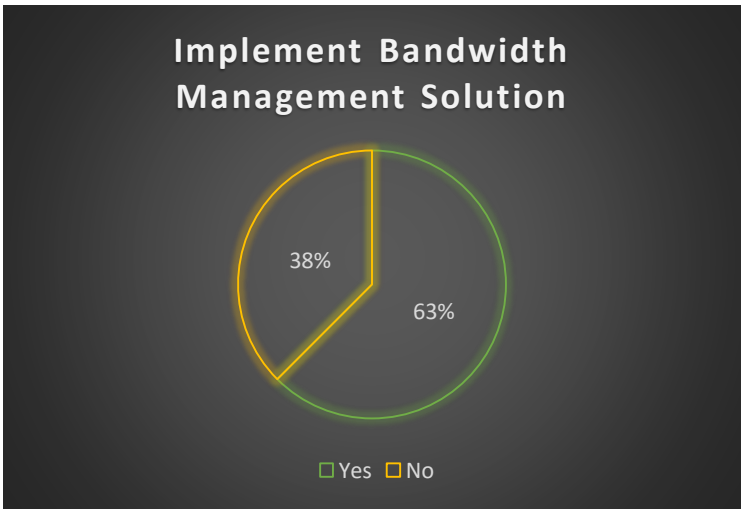

Figure 4.30: Implement bandwidth management solution.

Figure 4.30 depicts the responses received (n = 8) for the question 'Do you have a bandwidth management solution in place?'. Five respondents indicated they do have an Internet bandwidth management solution in place while three respondents indicated they do not. The technologies used by those who do manage their Internet bandwidth (n = 5), are Fortigate Firewall shaping rules, Checkpoint Firewall application filter, Fortigate Firewall, Bandwidth Splitter and an In-house developed system.

The findings indicate that there are more HEIs that have an Internet bandwidth management solution in place than those who do not. The most common technology being used is the Firewall settings. These approaches serves as an active technology, meaning it is used to interact and change settings on the network.

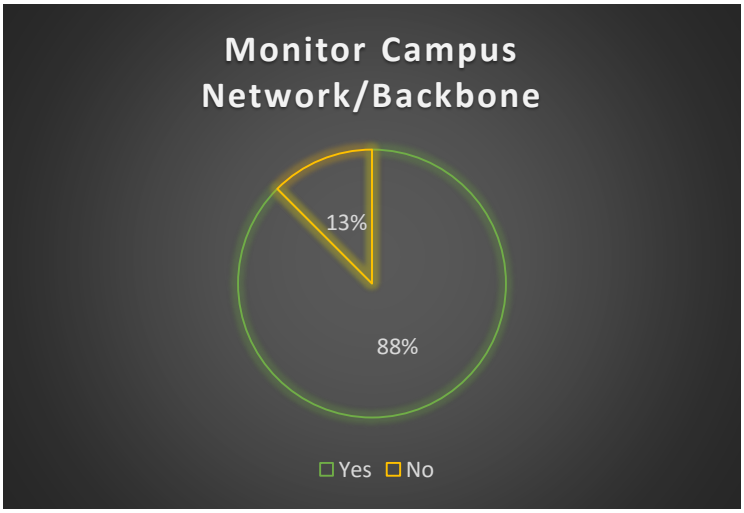

Figure 4.31: Monitor campus network/backbone.

Figure 4.31 depicts the responses received (n = 8) for the question 'Do you monitor your campus network/backbone?'. Seven respondents indicated they do monitor their campus network/backbone while only one respondent indicated the campus network/backbone is not monitored.

The findings show that the majority of respondents do monitor their campus network/backbone. The technologies used by those who do monitor their campus network/backbone (n = 7), are OpenNMS and Cacti, the TENET graphs, Cisco Prime and Watsup, Cisco Prime, Intelligent Management Center (IMC), Observium, and SNMP/Cacti with Weathermap. It is apparent from these findings that the majority of the respondents do monitor their campus network/backbone. The technologies being used are various with Cisco Prime being the only technology being used by two respondents. The majority of respondents have two technologies that are used to monitor the campus network/backbone. These technologies, therefore, complement one another to ensure the campus network/backbone is monitored properly and sufficiently.

Figure 4.32 depicts the responses received (n = 8) for the question 'Do you have a web caching solution in place?'. Four respondents indicated they do have a web caching solution in place while the remaining four respondents indicated they do not have a web caching

solution in place. The technologies used by those who do have an implemented web caching solution in place (n = 4), are Squid proxy servers, Forefront Threat Management Gateway (TMG) Firewall and security software, Fortigate Firewall and another Squid proxy server.

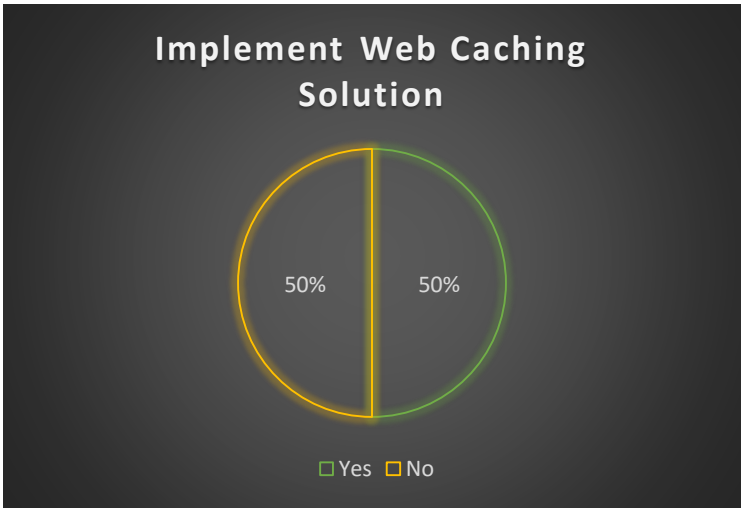

Figure 4.32: Implement web caching solution.

The findings show an even split between the responses having a web caching solution in place at and those that do not. From those that do have a web caching solution in place, the most common technology being used is Squid proxy servers. The findings are therefore inconclusive. A web caching solution assists to reduce bandwidth usage, perceived lag and server load by temporary caching or storing accessed web information (web pages, documents, images, videos etc.). If one is to access the stored information again, no bandwidth will be used as it will already be available on the network. The advantages of using a web caching solution are therefore apparent, especially to those that have limited bandwidth capacity.

Figure 4.33 depicts the responses received (n = 8) for the question 'Do you implement per profile limits?'. Four respondents indicated they do implement per profile limits while the remaining four respondents indicated they do not. The technologies used by those who do have implemented per profile limits (n = 4) are Fortigate rules, Inhouse internet billing system, another Fortigate and lastly a combination of data-gathering methods instilled to create a per user profile according to logs (proxies) and parsing netflow traffic (edge routers).

The findings represent an even split between the responses who implementing per profile limits and those that do not. From those that do, the technology is split between the Fortigate Firewall and in-house billing systems. The findings are therefore inconclusive. Per profile

limits assist by limiting specific groups, such as students, staff, residences and non-university devices. This allows the HEI to balance and control the use of bandwidth between user groups.

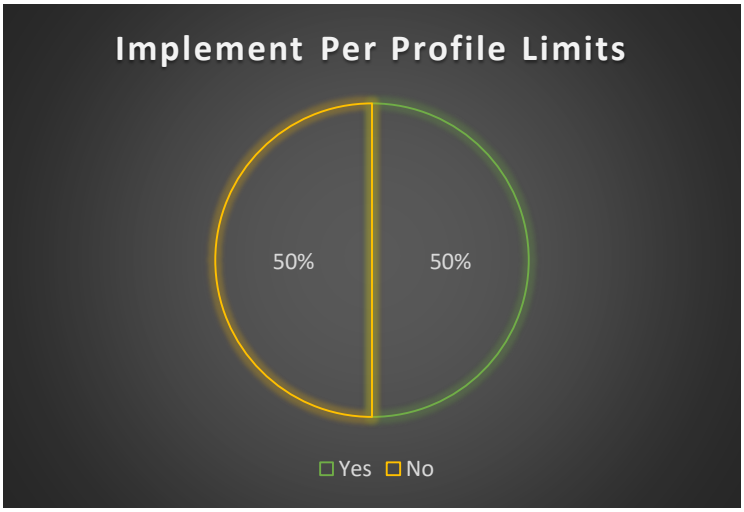

Figure 4.33: Implement per profile limits.

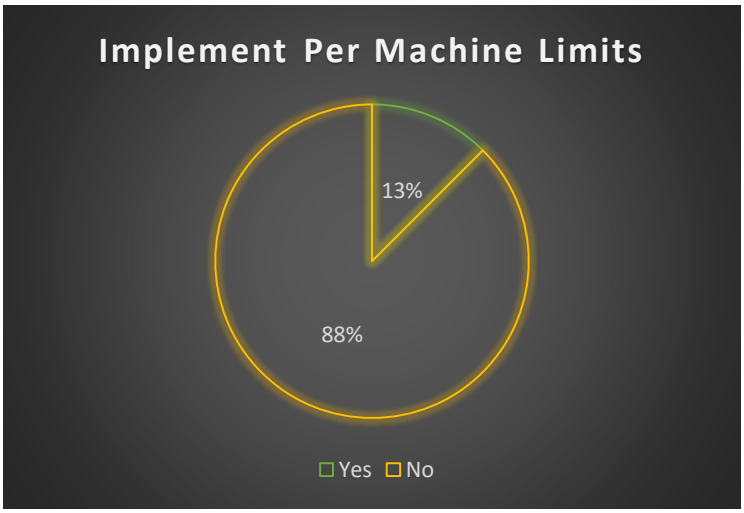

Figure 4.34: Implement per machine limits.

Figure 4.34 depicts the responses received (n = 8) for the question 'Do you implement per machine limits?'. One respondent indicated they do implement per machine limits while the remaining seven respondents indicated they do not. The technology used by the HEIs that do implement per machine limits (n = 1) is by means of a combination of data-gathering methods instilled to create a per user profile according to logs (proxies) and parsing netflow traffic (edge routers).

The findings show that the majority of the respondents do not implement per machine limits. Per machine limits assist the HEI by limiting devices on an individual basis. This can, however, be a daunting task to setup and maintain, especially with the numbers and frequency of staff and student turnover. The advantage includes that each device is classified and treated as an individual and the Internet machine profile is setup according to his/her job and study requirement.

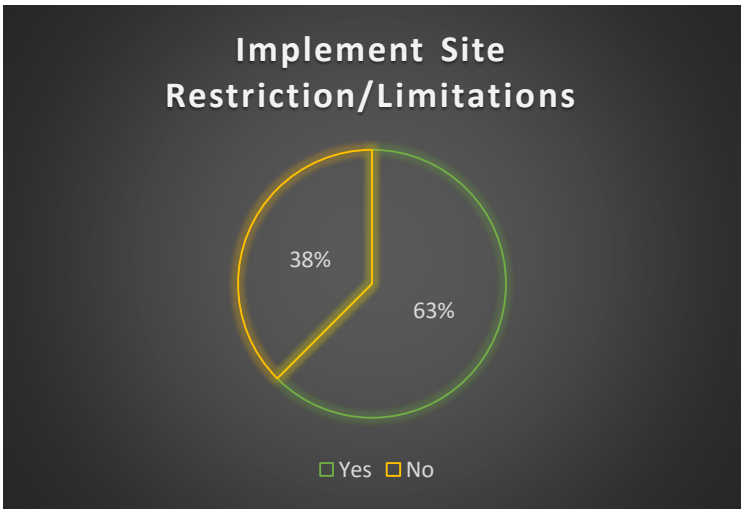

Figure 4.35: Implement site restriction/limitations.

Figure 4.35 depicts the responses received (n = 8) for the question 'Do you have site restriction/limitations in place?'. Five respondents indicated they do implement site restriction/limitations while three respondents indicated they do not. The technologies used by those who do have site restriction/limitations (n = 5) are Fortigate categories, Fortigate web Filtering (aka Fortigate categories), cloud mark filtering services, Fortigate (aka Fortigate categories) and the last respondent elaborated on how it is done and what is used to do it.

The findings indicate that there are more HEIs that implement site restriction/limitations than those who do not. The majority of these respondents that do use implement site restriction/limitations use the Fortigate Firewall categories. Site Restriction/Limitations are a great way of controlling what users' access and at what frequency. It is especially helpful to ensure that they do not access malicious sites or other sites that may exhaust the HEI's resources.

Figure 4.36 depicts the responses received (n = 8) for the question 'What do you do with the unknown Internet traffic that you capture?'. Three respondents indicated that they do nothing. Two respondents indicated that they drop the unknown Internet traffic that they capture. Two

respondents indicated that they combine the unknown Internet traffic that they capture with other categories.

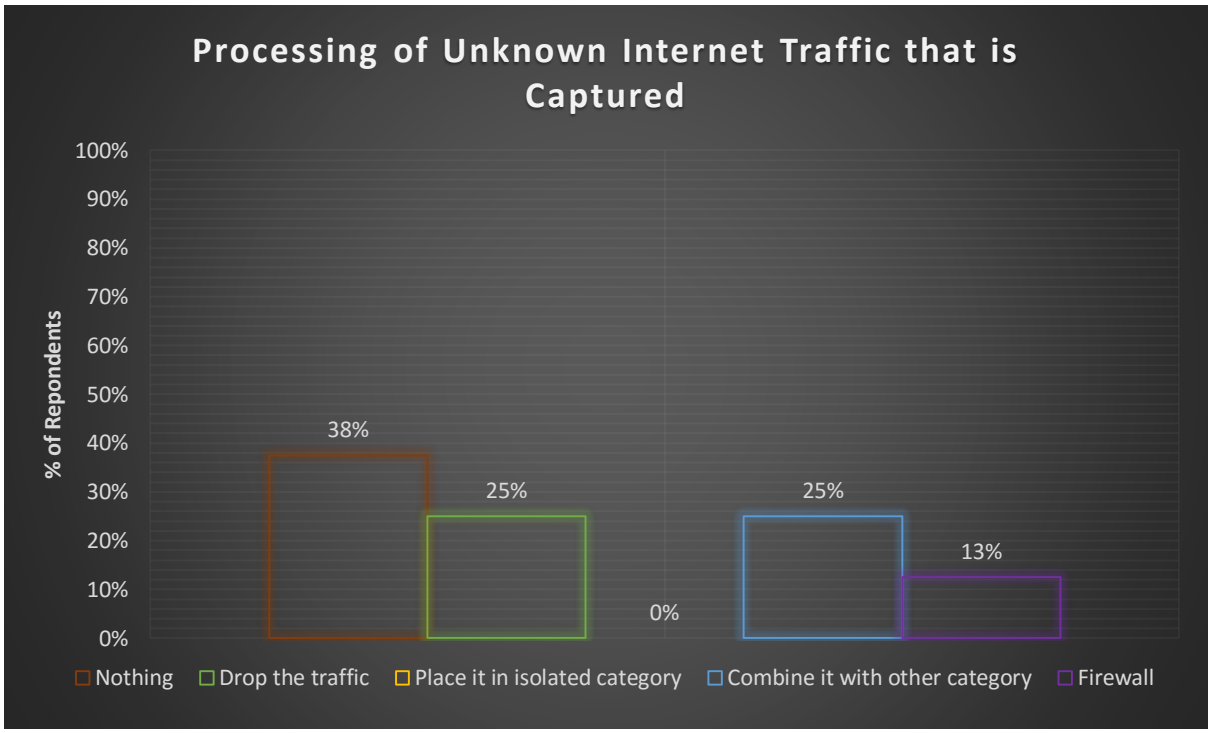

Figure 4.36: Processing of unknown Internet traffic that is captured.

The findings show that there are more HEIs that do nothing with the unknown Internet traffic that they capture. The other less preferable but still popular options are to drop the traffic or combine it with other categories. This, however, means that valuable data could be lost or classified and processed according to other rules and regulations. This could be a risky process. On the other hand, doing nothing with unknown traffic may ensure that the unknown traffic does reach it destination, but this may ensure that malicious traffic may also reach its destination without being scrutinised.

Figure 4.37 depicts the responses received (n = 8) for the question 'Do you implement hard cap?'. One respondent indicated they do implement hard cap while the remaining seven respondents indicated they do not.

The findings show that majority of HEIs do not implement hard cap. The respondents that do implement hard cap do so by monitoring logs (proxies) and parsing netflow traffic (edge routers) and processing accordingly. Hard capping is a technique used to cut off Internet access once a certain limit or rule is reached, usually exceeding an assigned Internet limit. For example, a user is assigned 10GB Internet quota per month and once the quota is reached

then his/her Internet access is revoked until the next month. Implementing hard cap can assist the HEI to control the Internet user(s) who over-utilise or abuse the Internet resources, in cases where bandwidth intense content is accessed continuously. On the other hand, those that use the Internet resources for actual work purposes are crippled when they reach their limit and still have work left to do.

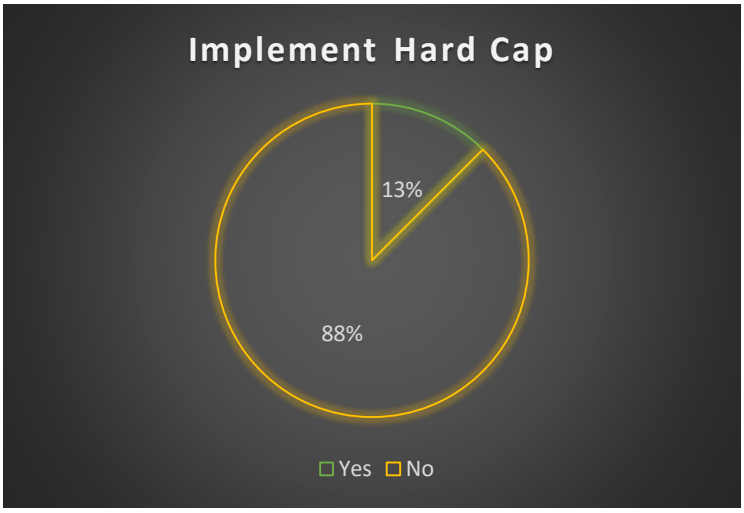

Figure 4.37: Implement hard cap.

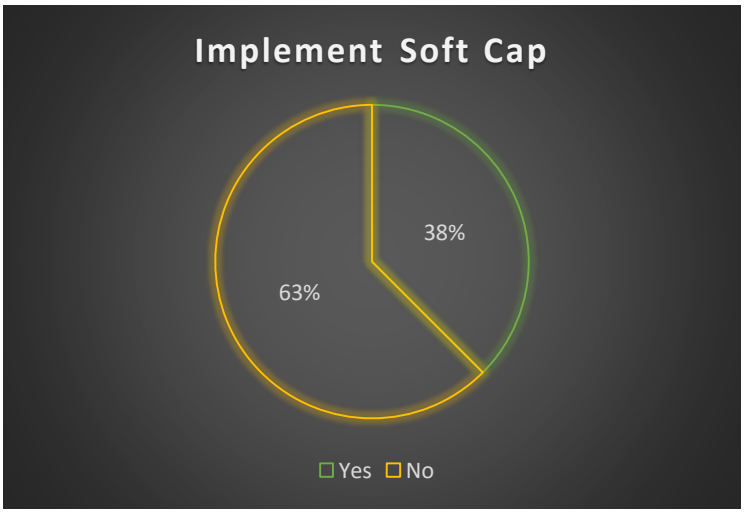

Figure 4.38: Implement soft cap.

Figure 4.38 depicts the responses received (n = 8) for the question 'Do you implement soft cap?'. Three respondents indicated they do implement soft cap while five respondents indicated they do not.

The findings indicate that more respondents do not implement soft cap than those who do. The respondents that do implement soft cap (n = 3) do so by monitoring logs (proxies) and

parsing netflow traffic (edge routers), notifying/warning the users by means of emails and by means of an In-house Internet billing system. Soft capping is a technique used to limit the assigned Internet traffic quota once the quota is reached, meaning that the user will still be able to access the Internet with some reduced functionality. For example, if a user is assigned 10GB Internet quota per month, once the quota is reached his/her Internet speed will be reduced and possibly be restricted from websites which contain rich content. Implementing soft cap can assist the HEI to control the Internet user(s) who over-utilise the Internet resources, in cases where bandwidth intense content is accessed continuously. An additional advantage over hard cap is that the user will still be able to use the Internet but at a reduced capacity, instead of being cut off completely. This means that the affected user will still be able to continue with his/her duties.

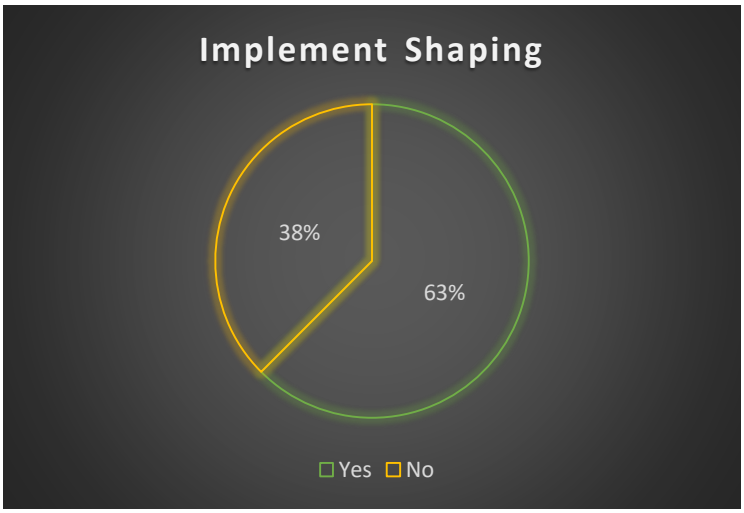

Figure 4.39: Implement shaping.

Figure 4.39 depicts the responses received (n = 8) for the question 'Do you implement shaping?'. Five respondents indicated they do implement shaping while three respondents indicated they do not.

The findings show that there are more HEIs that do implement shaping than those who do not. The respondents that do use shaping (n = 5) all use their Firewall as the preferred shaping technology. Shaping is the process of manipulating, managing or controlling Internet traffic by assigning an allocated bandwidth consumption based on the type of activity. For example, the quality of youtube videos' is reduced to ensure that users do not play the videos on full High Definition (HD) (extremely resource intensive), therefore the quality is reduced and subsequently its bandwidth consumption is reduced whilst still providing an adequate speed

and quality. Shaping therefore assists HEIs to place more stringent control on selected types of traffic, therefore allowing for a better-managed Internet.

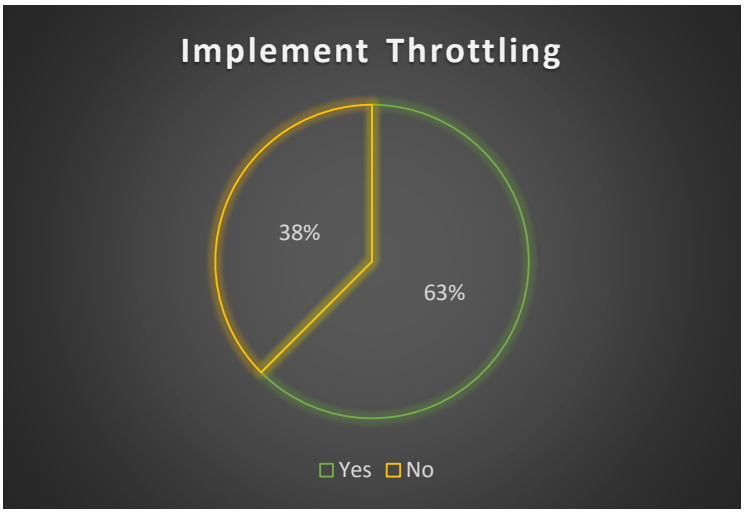

Figure 4.40: Implement throttling.

Figure 4.40 depicts the responses received (n = 8) for the question 'Do you implement throttling?'. Five respondents indicated they do implement throttling while three respondents indicated they do not.

The findings show that more HEIs implement throttling than those who do not. From the respondents that do implement throttling, three respondents indicated they do so by means of their Firewall and the remaining two respondents failed to identify the technology. Throttling refers to the process of regulating the flow of packets into a network. If an abundance of traffic is detected on a user or group account, his/her/their speed is reduced for a period of time therefore limiting bandwidth consumption for a predetermined period of time. Throttling therefore assists HEIs to place more stringent control on traffic, therefore allowing for a better-managed Internet.

Figure 4.41 depicts the responses received (n = 8) for the question 'Do you implement distinctions between business hours and non-business hours regarding these controls?'. Six respondents indicated they do implement distinctions between business hours and non-business hours while two respondents indicated they do not.

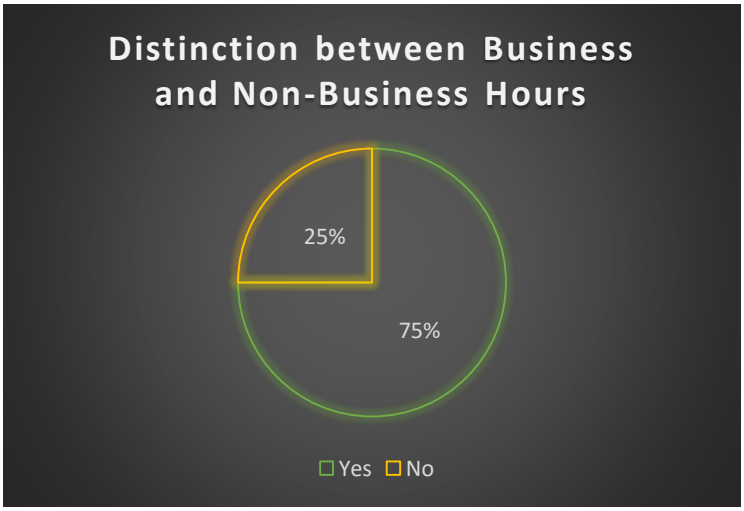

Figure 4.41: Distinction between business and non-business hours.

The findings show that the majority of respondents do implement distinctions between business hours and non-business hours. Three respondents that do implement distinctions between business hours and non-business hours do so by the assignment of a lower cost structure to the user groups. One respondent removes the set shaping and throttling rules outside the normal academic or business hours. One respondent indicated that they do so by means of the firewall application filers and the last respondent gave no answer. In general, the respondents indicated that they implement distinctions between business hours and non-business hours by having less stringent controls in place after hours. This assists with the management of the Internet by reducing the strain on peak times by giving 'incentives' to those who move unnecessary workloads to off-peak periods. For example, the downloading of patches is done during off-peak periods not to hinder the Internet capacity of those who are using the Internet for legitimate reasons during peak periods. The following sub-section within the Organisational Resources section will be focused on Monitoring resources.

- Monitoring

Figure 4.42 depicts the responses received (n = 8) for the question 'Do you process and store Internet logs?'. Seven respondents indicated they do process and store Internet logs while one respondent indicated they do not process and store Internet logs.

The findings indicate that the majority of HEIs do process and store Internet logs. The technologies used by those who do have site restriction/limitations (n = 7) are Sawmill, Checkpoint Eventia, Webalizer (for squid proxy logs), FortiAnalyzer, Forefront Threat Management Gateway (TMG) and In-house system. The last respondent (n = 1) did not specify the technology being used but instead indicated that the logs are used for billing only

and reporting. Consequently, no standard technology is used to process and store Internet logs. Instead, each HEI uses a technology that is either already available by means of a system already in place or a system that was created or bought specifically to address the requirement. Processing and storing Internet logs assists with determining current trends with regard to Internet traffic. This assists with planning for Internet resources such as budgetary changes, capacity changes, settings changes etc. This will also assist with preventing predictable surprises as previously discussed. Regular processing and reviews of the Internet traffic will assist with these Internet resources issues.

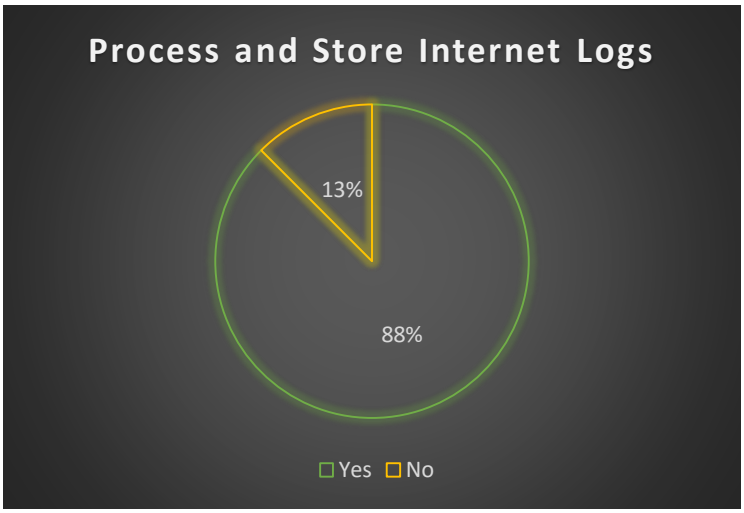

Figure 4.42: Process and store Internet logs.

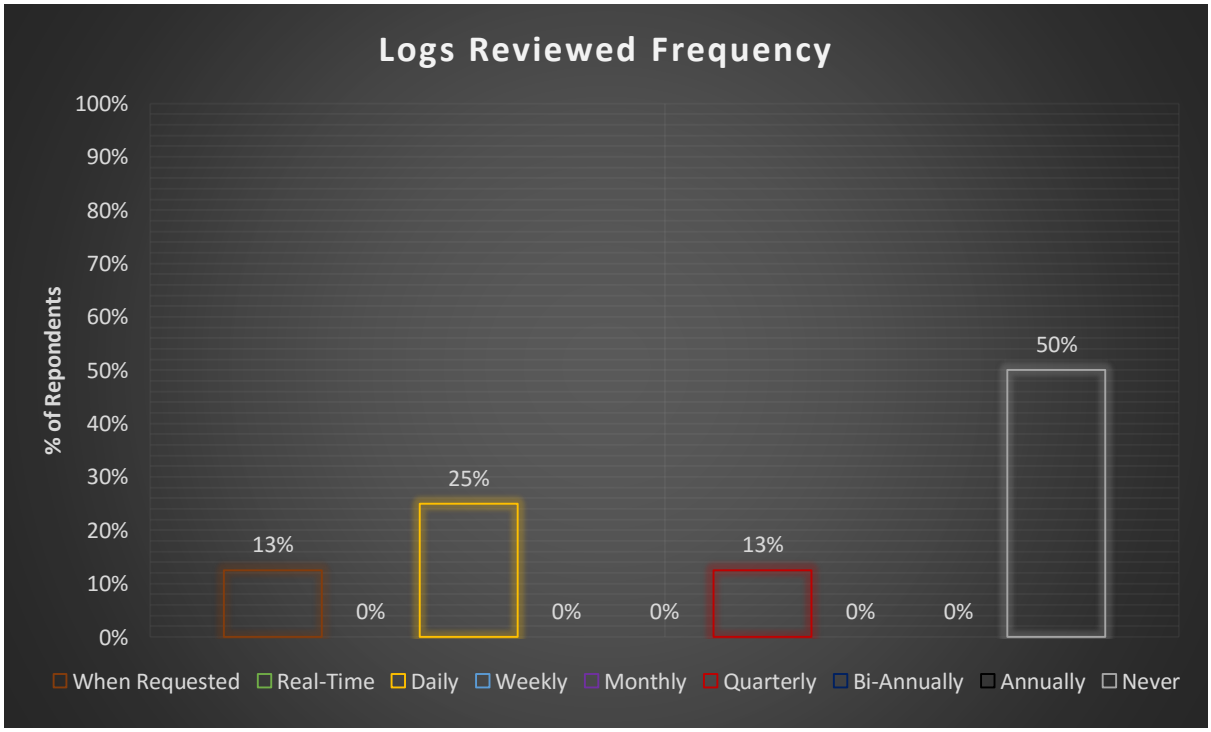

Figure 4.43: Logs reviewed frequency.

Figure 4.43 depicts the responses received (n = 8) for the question 'How often are these logs reviewed?'. One respondent indicated that they review the Internet logs when requested to do so. Two respondents indicated that they review the Internet logs on a daily basis. Four respondents indicated that they never review the Internet logs.

The HEIs that do review the Internet logs (n = 3) do so to inform top users of their usage profiles, to be used for management reports and to serve as information. Another respondent (n = 1) indicated that in terms of privacy policy, logs can only be reviewed under very limited circumstances. This could support the fact that the majority of HEIs never review the Internet Logs. In addition, due to the immense size of the Internet logs and the resources required to process them, processing logs unnecessarily could be a waste of Internet resources and could influence other Internet resources such as the percentage of time spent by the Internet Manager on managing the Internet. On the other hand, the Internet logs could assist greatly with re-aligning the Internet resources to suit the needs of the customer base as well as to gain insight into possible Internet misuse which will be covered in the following questions.

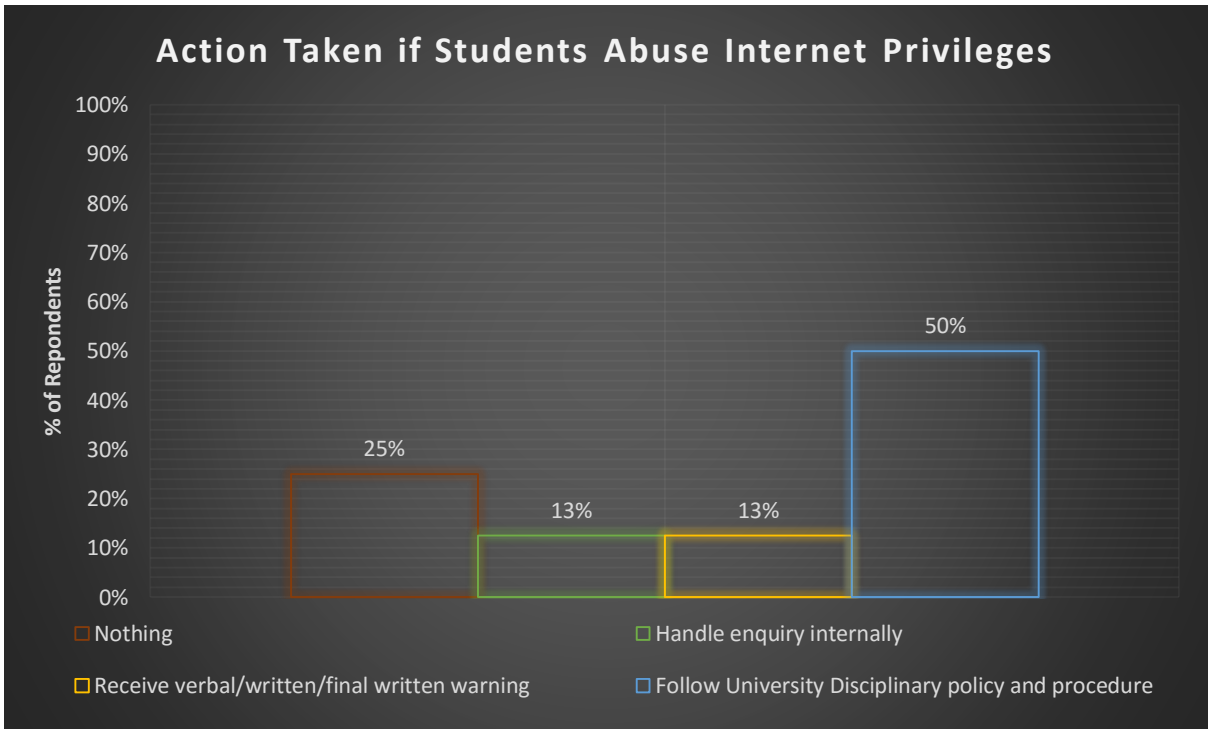

Figure 4.44: Action taken if students abuse Internet privileges.

Figure 4.44 depicts the responses received (n = 8) for the question 'What do you do with students that abuse their Internet privileges?'. Two respondents indicated that they do nothing. Four respondents indicated that they follow the University's Disciplinary policy and

procedure with regard to students who abuse their Internet privileges. The remaining responses contribute no significant value to the findings.

The majority of HEIs therefore follow the university's disciplinary policy and procedure with regard to students who abuse their Internet privileges. Only a small number of these incidents would have been detected via an Internet log analysis while the majority of these incidents would have been noted from an internal complaint.

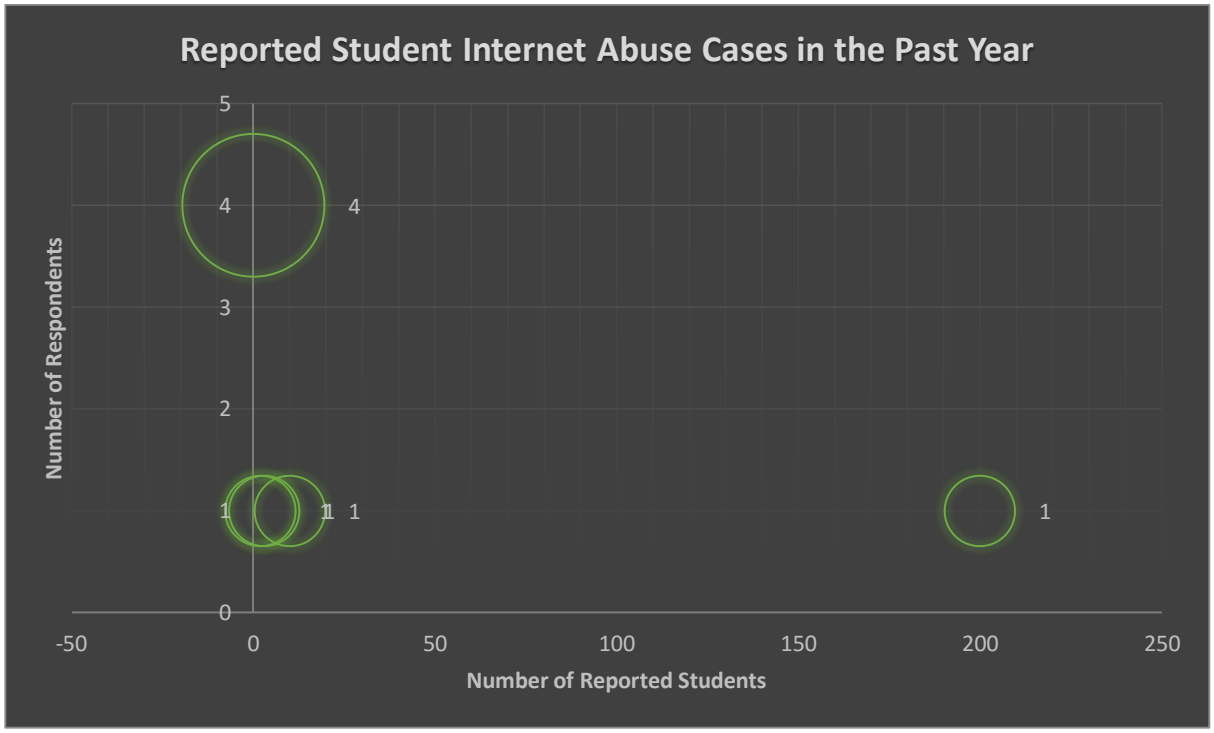

Figure 4.45: Reported student Internet abuse cases in the past year.

Figure 4.45 depicts the responses received (n = 8) for the question 'How many reported student Internet abuse cases have you had in the past year?'. Four respondents indicated that they had no reported student Internet abuse cases in the past year. One respondent indicated that they had 2 reported student Internet abuse cases in the past year. One respondent indicated that they had 3 reported student Internet abuse cases in the past year. One respondent indicated that they had 10 reported student Internet abuse cases in the past year. One respondent indicated that they had 200 reported student Internet abuse cases in the past year.

The majority of findings therefore indicate that it is common practice for HEIs not to report student Internet abuse cases. It could be expected that these HEIs do not review the Internet logs. It could be expected that those that do review their Internet logs are the HEIs that have

a number of student Internet abuse cases in the past year. Another option could be that the students are in fact not abusing their Internet privileges.

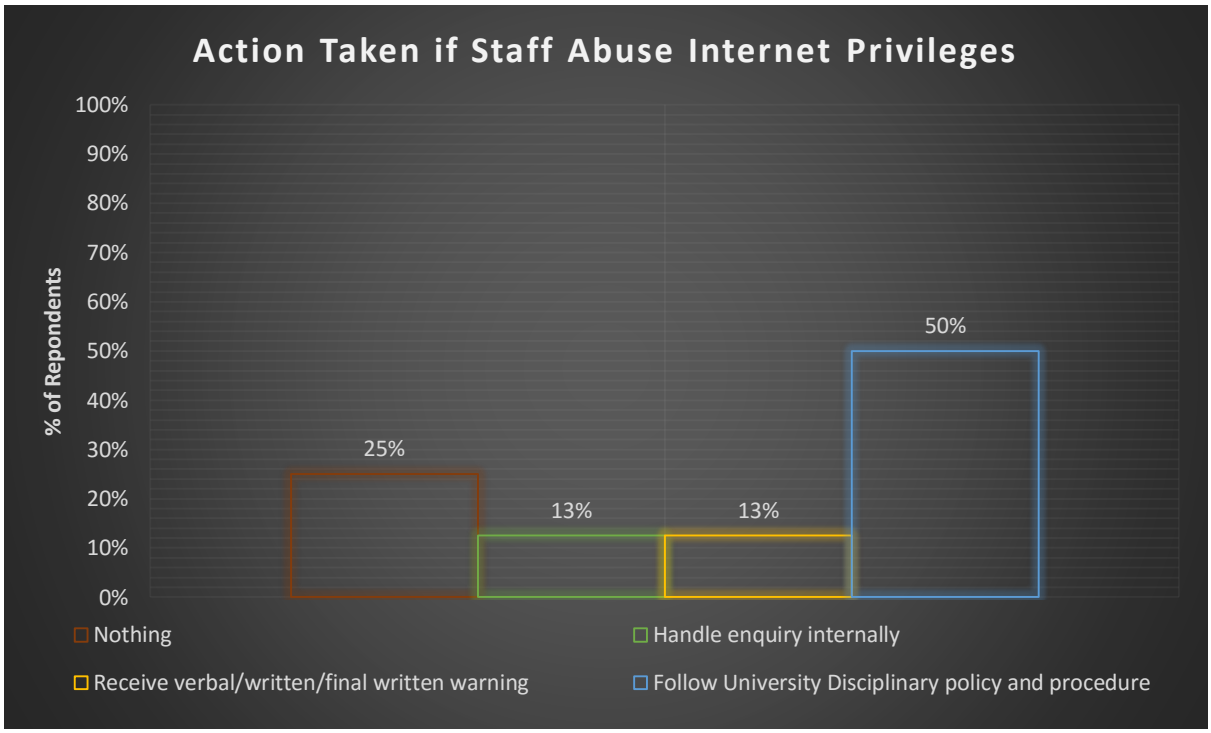

Figure 4.46: Action taken if staff abuse Internet privileges.

Figure 4.46 depicts the responses received (n = 8) for the question 'What do you do with staff that abuse their Internet privileges?'. Two respondents indicated that they do nothing with staff who abuse their Internet privileges. Four respondents indicated that they follow the university's disciplinary policy and procedure with regard to staff who abuse their Internet privileges.

The majority of HEIs therefore follow the university's disciplinary policy and procedure with regards to staff who abuse their Internet privileges. Furthermore, it appears that action taken against staff and student who abuse their Internet privileges are the same. Only a small number of these incidents would have been detected via an Internet log analysis while the majority of these incidents would have been noted via an internal complaint.

Figure 4.47 depicts the responses received (n = 8) for the question 'How many reported staff Internet abuse cases have you had in the past year?'. Seven respondents indicated that they had no reported staff Internet abuse cases in the past year. One respondent indicated that they had 4 reported staff Internet abuse cases in the past year.

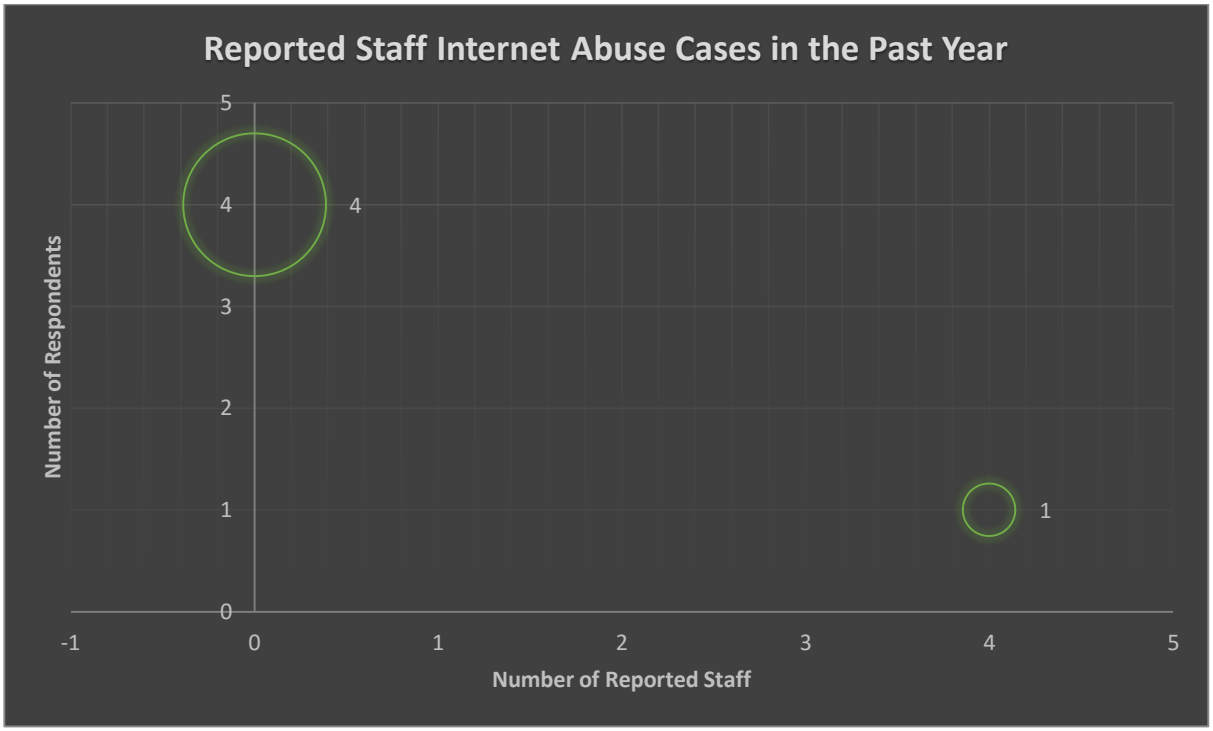

Figure 4.47: Reported staff Internet abuse cases in the past year.

The majority of findings therefore indicate that there were no reported staff Internet abuse cases in the past year. It could be expected that these HEIs do not review the Internet logs. It could be expected that those that do review their Internet logs are the HEIs that have had a number of staff Internet abuse cases in the past year. Another option could be that the staff are in fact not abusing their Internet privileges.

Some additional comments were raised at the end of this section by the respondents (n = 5) who provided their overall views/concerns/recommendations regarding the Governance Resources puzzle piece of Internet management. One respondent indicated that there is insufficient communication between ICT Services and the users who cause confusion about shaping and throttling. In addition, some users have discovered that making a lot of noise can get them preferential treatment. A possible solution would be to properly enforce the ICT policies and procedures evenly. This is clearly a governance issue. One respondent indicated that the staff disciplinary policy required the direct line manager to chair the process (disciplinary hearing), which does not make sense for offenses that may have been committed outside the work context. One respondent indicated that there is a major issue with the funding of Internet bandwidth. The tremendous growth of Internet users brought on by BYOD and IoT puts additional strain on the wireless network. This statement is supported in the Financial Resources section. One respondent indicated that they are currently using TMG, which is a software based firewall, and they are in a process of migrating to hardware based firewall.

One respondent indicated that they desire a dedicated Internet Manager. This statement is supported in the Human Resources section.

From the comments it is clear that there is no common trend with regard to the overall views/concerns/recommendations and that each HEI has their own areas of concern. The following sub-section will summarise the research findings of Section 6.

4.2.2.10. Summary of Research Findings in Section 6

Section 6 – Organisational Resources were used to collect information regarding the organisational resources requirements for managing the Internet at the university. The following common HEI practices were extracted in accordance with the finding from Section 6 – Organisational Resources as discussed in detail above.

The first sub-section in the Organisational Resources section covered the Governance aspects of Internet management. According to the findings, HEIs use the following policies, according to ranking, to address Internet management issues:

1. Acceptable Use Policy
2. ICT Information Security Policy
3. Privacy Policy
4. General ICT Policy and Bandwidth/Network Policy
5. Other Policy

It is common practice for HEIs to review the Internet management resources only when requested. Once these reviews are reviewed and processed, the changes that will be made must be submitted for approval to the Official University Committees before implementation. It is not common HEI practice to send an Internet performance report to an Official University Committee on a regular basis. Those HEIs that do send Internet performance reports to an Official University Committee on a regular basis, do so when requested or quarterly.

The second sub-section in the Organisational Resources section covered the Technology aspects of Internet management. According to the findings, it is common practice for all HEI to use their firewall as the main tool (technology/software package) to manage the HEI Internet. It is also common practice to add some additional technologies to support the overall management of the Internet. HEI also uses their firewalls with an additional technology to monitor and manage their Internet bandwidth. It is common practice for an HEI to monitor the campus network/backbone, implement site restriction/limitations, shaping and distinctions between business hours and non-business hours. It is uncommon for HEIs to implement per

machine limits, hard cap, soft cap and throttling. HEIs are inconclusive on the use of web caching solution and per profile limits. Lastly, HEIs generally do nothing with the unknown Internet traffic that they capture.

The third sub-section in the Organisational Resources section covered the Monitoring aspects of Internet management. It is common practice for HEI to process and store Internet logs, however, they never review these Internet logs. If or when a staff or student abuses Internet privileges, it is common practice for the HEI to follow their university's disciplinary policy and procedure. In most HEIs there were, however, no staff and student Internet abuse cases in the past year. The following section will summarise the chapter.

4.3. Summary

This chapter addressed RQ_3 which states "*What are the national best practices for Internet management at Higher Education Institutions?*". The chapter completed RO_3 which was to identify the national best practices adopted for Internet management at Higher Education Institutions.

Chapter 4 was focused on the compiling, distribution, collection, analysis and presentation of the findings of the HEIIMS. The HEIIMS was created by means of reviewing current literature studies which were aligned with the overall research question and research objective. The identified areas provided for a holistic Internet management practice document which covered most aspects of Internet resources as found in an HEI. The document was then grouped in common organisational resources categories and the statements converted into questions. These categories were Human Resources, Financial Resources, Physical Resources and Organisational Resources. The HEIIMS was then distributed to all 23 South African HEIs. The results were collected, analysed and presented in a logical and clear manner. The combined findings constitute HEI Internet management best practices and was presented in this chapter.

The HEIIUS representation were of various sizes with each having their Internet resources specifically aligned with their environment. The common stereotypes regarding their Internet resources are mostly not present. For example, a large HEI will have big budgets with strong controls while a small HEI will have a small budget with weak controls. In this chapter it is clearly not the case. The findings show that the Internet and relevant resources are very important to all HEIs. All Human Resources, Financial Resources, Physical Resources and Governance Resources regarding the Internet are carefully selected according to a common

structure in most HEIs. Therefore, most resources are aligned and consequently common to most HEIs but emphasis is placed on the actual setup and implementation to ensure the Internet resources align with the HEI culture and instilled strategic vision. These common trends as well as uniqueness are present throughout this chapter.

Chapter 5 will provide a comprehensive analysis of the collected empirical data of the NMMUIUS. This will be compiled by analysing each research question and presenting these findings in a clear and logical manner. Therefore, the research objective of this chapter would be focused on RO_4, which is to conduct an empirical evaluation of the users' Internet usage at NMMU. This will be achieved by asking RQ_4, which questions "*How is the Internet utilised at NMMU by staff and students?*".

5. RESULTS AND ANALYSIS OF THE NMMU INTERNET USAGE SURVEY

5.1. Introduction

Chapter 4 reviewed what organisational resources are available that contribute to the efficient running of the Internet within an HEI. Thereafter, the best practices regarding each HEI Internet resource collected through HEIIMS data was presented. The chapter concluded with a summary of the HEI Internet management best practices.

This chapter will address RQ_4 which states "*How is the Internet utilised at NMMU by staff and students?*". The objective of the chapter is to conduct an empirical evaluation of the users' Internet usage at NMMU. Current literature studies were reviewed to find a suitable answer to the identified research question. From these findings, an NMMUIUS was compiled and distributed to all NMMU staff and students. The NMMUIUS focused on determining what they currently use the NMMU's Internet for. The combined findings will be presented in this chapter. See Figure 5.1 for an overview of the research question and research objective of this chapter.

Chapter 5 will provide a comprehensive analysis of the collected empirical data. This will be compiled by analysing each research question and presenting these findings in a clear and logical manner. A summary of the findings will then conclude the chapter. See Figure 5.2 for a Structural overview of Chapter 5.

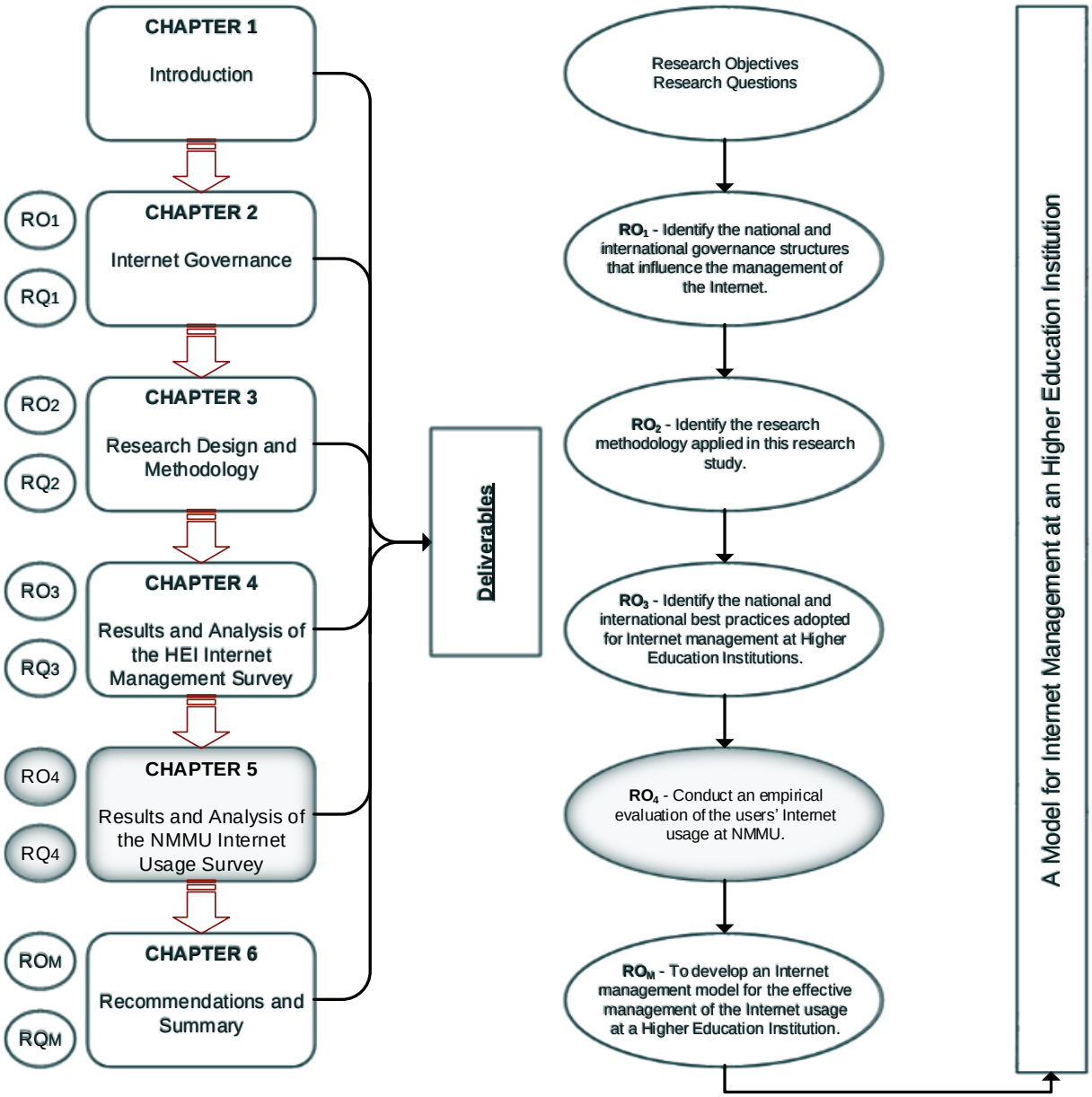

Figure 5.1: Chapter 5 Research Question and Research Objective.

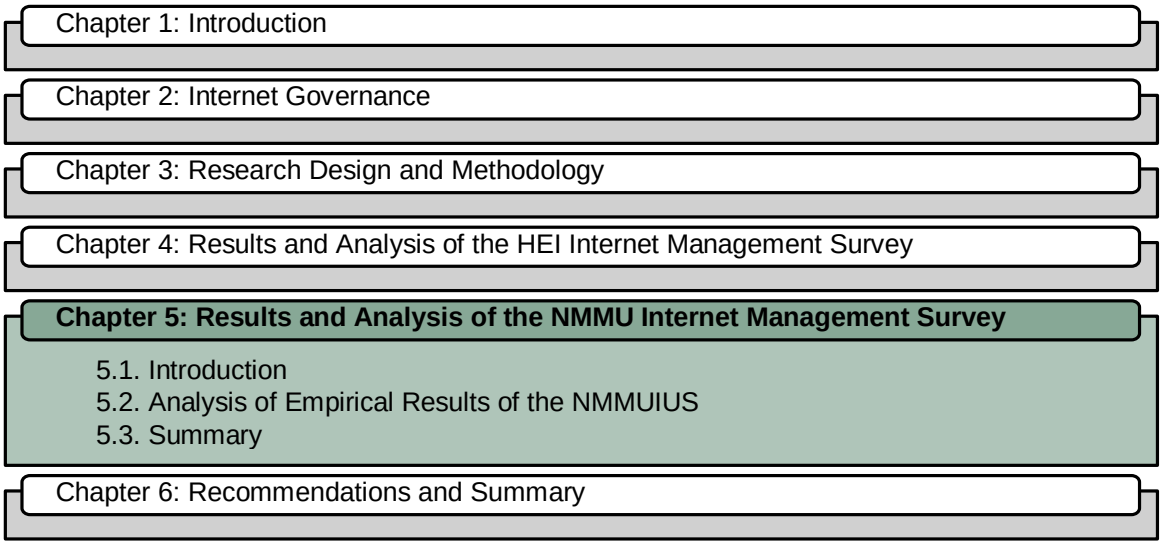

Figure 5.2: Structural overview of Chapter 5.

5.2. Analysis of Empirical Results of the NMMUIUS

The respondents that participated in this study were all current staff and students from NMMU which is a South African Higher Education Institute situated in the Eastern Cape and Western Cape. The respondents were asked to give their input on Internet usage and their Internet usage patterns. Therefore, the areas covered in the NMMUIUS included general Internet *governance* questions, their *usage and access durations* patterns, the *content* they access, the *primary purpose* they use the NMMU Internet for and their general view on the *management* thereof. These findings combined provide for a holistic view of the end users Internet experience at NMMU.

5.2.1. NMMUIUS Response Rate

The NMMUIUS was distributed via NMMU-Communique which contained a hyperlink to the online survey to 28 337 NMMU Internet users. The population of this group consists of 382 NMMU staff members and 27 955 NMMU students. As the researcher was not in control of the distribution, the number of undelivered emails is unknown. A total of 632 responses was received through this distribution channel. The 632 responses comprised, out of 500 registered students, 57 academic staff and 75 administrative staff (132 staff members in total). All responses were adequately completed and met the two preconditions that were set for this study. The required response rate as stipulated by REC-H was minimum 100 and maximum 500. The responses therefore exceeded the maximum rate as required by the REC-H. This equates to a response rate of 2,3%. The NMMU statistician, Dr Danie Venter, deemed the number of responses to be acceptable for statistical analysis.

It should be acknowledged that the NMMUIUS is focused on the respondents' primary capacity at NMMU. There may be some cases where individuals are represented in both groups. For example, a staff member may also be studying towards a formal degree, hence is a part-time student, or a student may also be hired as a part-time lab technician or lecturer. The focus would therefore be on capturing the data relevant to their primary purpose at NMMU. Secondary purpose (part-time) was not captured during the NMMUIUS.

5.2.2. Main Study NMMUIUS

The NMMUIUS used for this study consisted of six data-gathering sections. See Appendix E – NMMUIUS. These are:

- Section 1: Demographic Information;
- Section 2: Governance;
- Section 3: Usage and Access Duration;
- Section 4: Content;
- Section 5: Primary Purpose; and
- Section 6: Management

Section 1: Demographic Information was used to collect the respondents' demographic information which was used to understand the representation and distribution of the participants. Section 2: Governance was used to determine their level of awareness of the current governance structures in place that guide Internet usage within NMMU. The design of the questions was based on the Multiple choice (fact) with values of 'Yes', 'No' or 'Not Applicable' and the Likert Scale (1 – 5). Section 3: Usage and Access Duration were used to collect information regarding the duration of time the Internet was accessed for various purposes. The design of the questions was based on the Likert Scale (1 – 5). Section 4: Content was used to collect the respondents' use of content according to the Fortiguard Categorisation Criteria. The design of the questions was based on the Likert Scale (1 – 5). Section 5: Primary Purpose was used to collect the respondents' primary purpose for utilising the NMMU's Internet during the various timeframes. The design of the questions was based on Multiple choice (fact) with various options to be selected which were again focused on the various timeframes. Section 6: Management was used to collect the respondents' general rating on the management of NMMU's Internet. The design of the questions was based on the Likert Scale (1 – 5). The following sub-section will elaborate on the findings for Section 1: Demographical Information.

5.2.2.1. Section 1: Demographical Information

The NMMUIUS started by collecting biographical information on the respondents which was used to understand the representation and distribution of the participants. No PII was captured as to ensure anonymity. The fields in this section included:

- Gender;
- Age;
- NMMU Campus Placement;
- Student, Academic Staff or Administrative Staff; and
- Active Internet Connection at Home.

See Appendix G – NMMUIUS's Demographic Information.

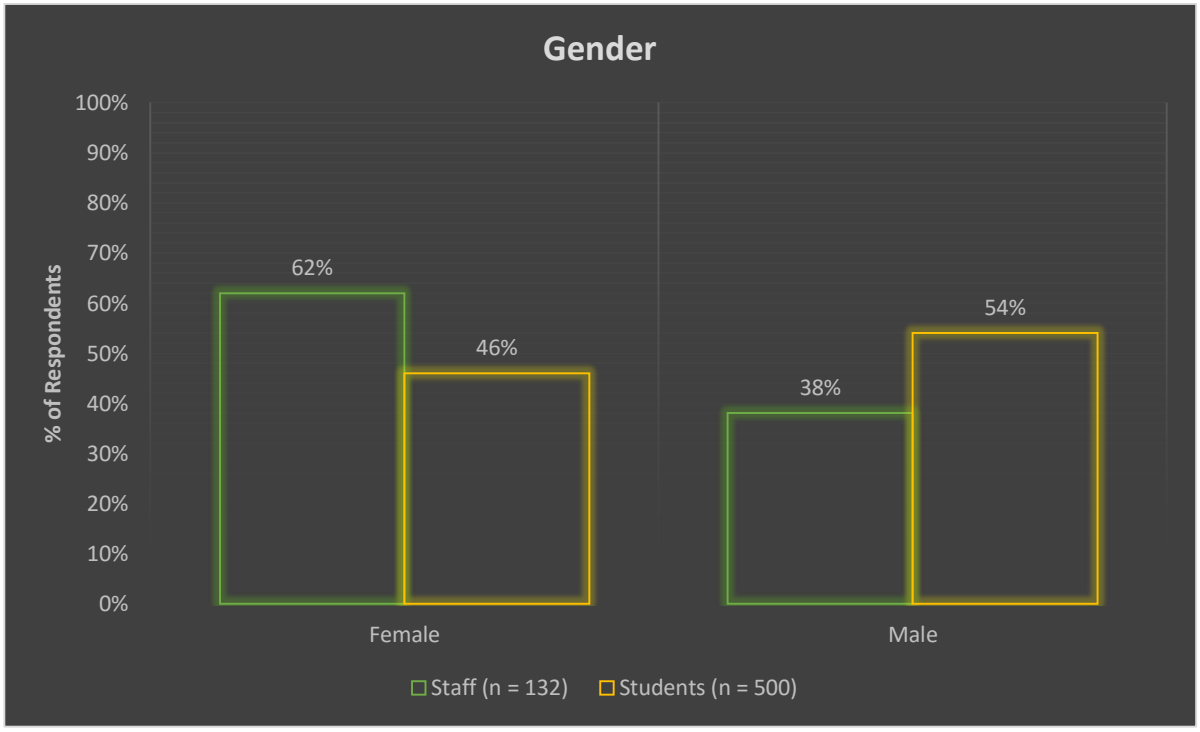

Figure 5.3: Gender.

Figure 5.3 is focused on the gender distribution of all respondents and is divided between staff and students. It indicated that of all the staff members that participated (n = 132) in this study, 65 percent (n = 82) are female and 38 percent (n = 50) are male. Of all the registered students that participated (n = 500) in this study, 46 percent (n = 230) are female and 54 percent (n = 270) are male. The total of female respondents is 49 percent (n = 312) and the total of male respondents is 51 percent (n = 320). This constituted a well-balanced and diverse response portfolio.

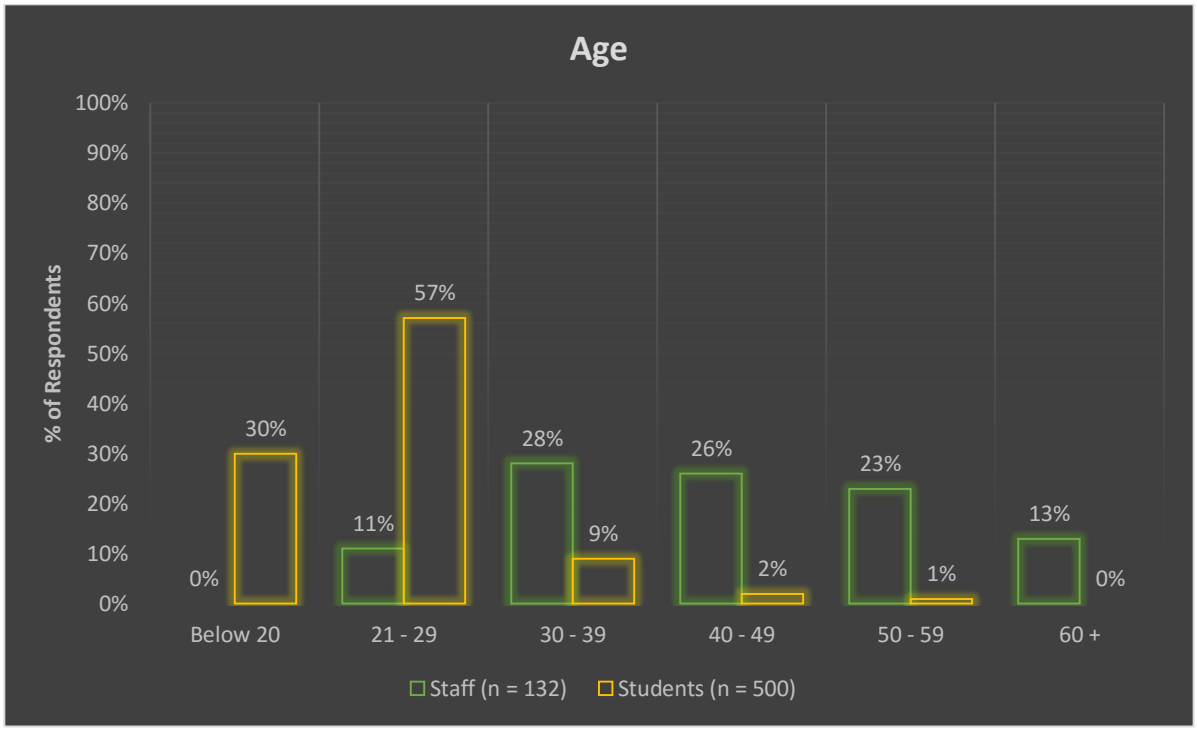

Figure 5.4: Age.

Figure 5.4 is focused on the age distribution of all respondents (n = 632) and is divided between staff (n = 132) and students (n = 500). It indicates that there are no staff members (n = 0) below age 20 whilst 30 percent of student (n = 149) are below age 20 who participated in this study. For the age group 21 – 29 there is 11 percent staff (n = 14) representation and 57 percent student (n = 286) representation. This category encapsulates the majority of student participants. In the age group 30 – 39 there is 28 percent staff (n = 37) representation and 9 percent student (n = 46) representation. In the age group 40 – 49 there is 26 percent staff (n = 34) representation and 2 percent student (n = 16) representation. In the age group 50 – 59 there is 23 percent staff (n = 30) representation and 1 percent student (n = 3) representation. In the age group 60 + there is 13 percent staff (n = 17) representation and no student (n = 0) representation.

The findings indicate that the staff participants are primarily represented in the 30 – 39 age group, 40 – 49 age group and 50 – 59 age group, with a minor decline visible from young to old. This clustering (30 – 59) therefore represents the majority of staff respondents. The student population is primarily focused in the 21 – 29 age group with a great number also present in the below 20 age group. There is a small and decreasing participation rate as from 30 – 39 towards 60 +.

The combined participation (staff and students) of all respondents below age 20 is at 24 percent (n = 149). This is the second highest number of participants in the study group. The numbers increase and peak at age group 21 – 29 where the participants account for 57 percent (n = 300). From there the numbers steadily decline to 13 percent (n = 83) in age group 30 – 39, 8 percent (n = 50) in age group 40 – 49, 5 percent (n = 33) in age group 50 – 59 and 3 percent (n = 17) in age group 60 +.

These findings show that the majority of participants are within the 21 – 29 age category with some representation in the group below age 20 and a little fewer in age group 30 – 39. This clustering, therefore, represents the majority of all participants. All Internet resources would consequently have to speak to the needs of these participant age groupings with special consideration for the student Internet resources requirements/policies to include Generation Y and Z characteristics and with special consideration for the staff Internet resource requirements/policies to include Generation X and Y characteristics.

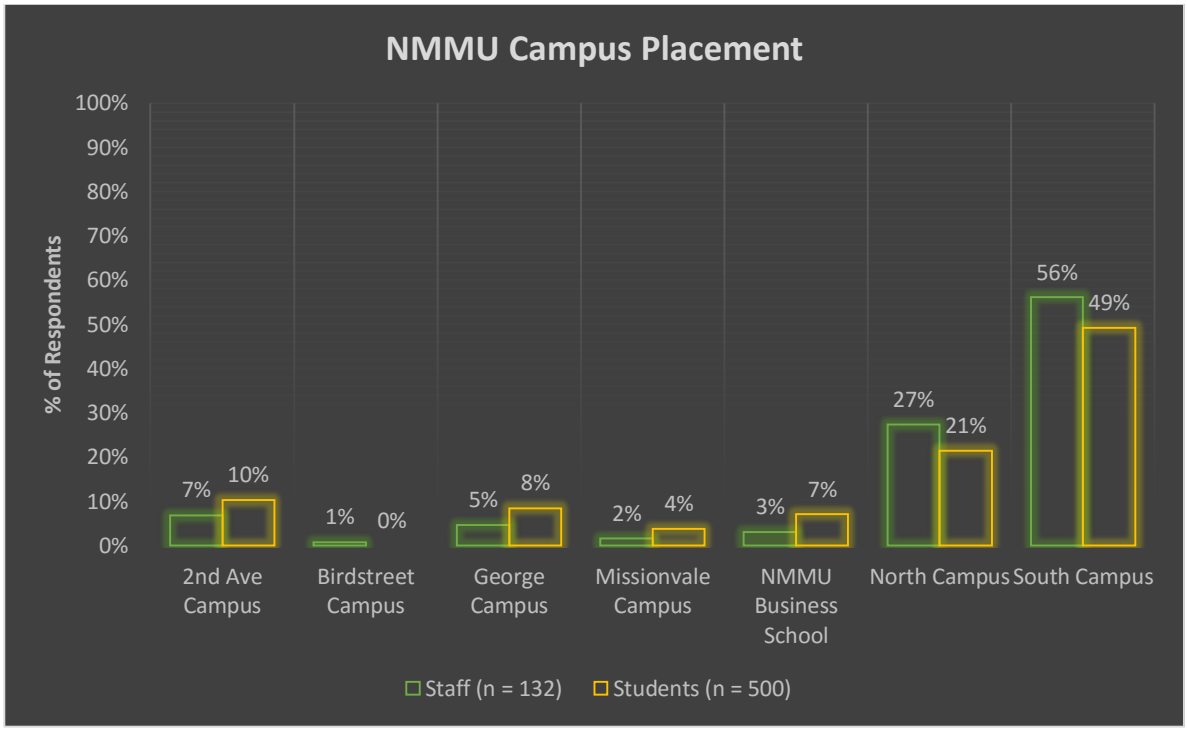

Figure 5.5: NMMU campus placement.

Figure 5.5 is focused on the NMMU campus placement distribution of all respondents (n = 632) and is divided between staff (n = 132) and students (n = 500). On 2nd Avenue Campus, there are 7 percent staff (n = 9) representation and 10 percent student (n = 51) representation. The total number of 2nd Avenue participants accounts for 9 percent (n = 60). On Birdstreet Campus, there are 1 percent staff (n = 1) representation and no student (n = 0) representation.

The total number of Birdstreet Campus participants accounts for 0 percent (n = 1). Birdstreet Campus has the smallest participation rate in this study. On George Campus, there are 5 percent staff (n = 6) representation and 8 percent student (n = 42) representation. The total number of George Campus participants account for 8 percent (n = 48). On Missionvale Campus, there are 2 percent staff (n = 2) representation and 4 percent student (n = 19) representation. The total number of Missionvale Campus participants accounts for 3 percent (n = 21). In NMMU Business School, there are 3 percent staff (n = 4) representation and 7 percent student (n = 35) representation. The total number of NMMU Business School participants account for 6 percent (n = 39). On North Campus, there are 27 percent staff (n = 36) representation and 21 percent student (n = 107) representation. The total number of North Campus participants account for 23 percent (n = 143). North Campus represents the 2nd largest Campus at NMMU and this is apparent in the respondents' participation statistics. On South Campus, there are 56 percent staff (n = 74) representation and 49 percent student (n = 246) representation. The total number of South Campus participants accounts for 51 percent (n = 320). South Campus is the main/primary NMMU site which houses the most staff and students. The findings therefore support this statement as the majority of participants are stationed at South Campus.

From the findings discussed above it is evident that the largest number of staff and students are situated at South Campus and the second largest number on North Campus. The other NMMU sites are still adequately represented as according to their relative size. The Internet resources such as capacity and the amount of resources dedicated to that site should reflect the size of the facilities as well as the number of staff and students present. In addition, the link capacity between sites should also be sufficient for the amount of traffic that may be communicated. All Internet resources should not be over- or underutilised as this leads to a waste of resources.

It should be acknowledged that the Birdstreet Campus was being renovated during the course of this research study. The staff and students were therefore relocated to temporary offices to ensure business continuity. This action could be why Birdstreet Campus is not fully represented in this study. Consequently, the permanent Birdstreet Campus staff and student would have selected their temporary site location during the survey completion.

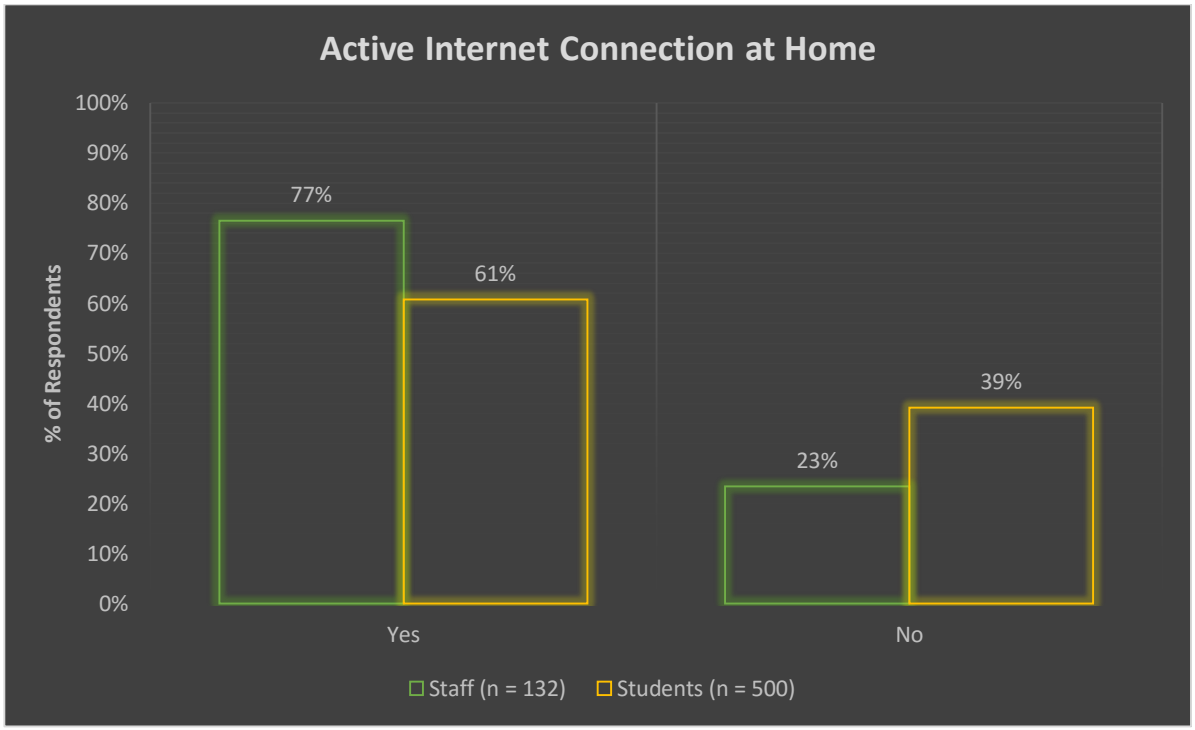

Figure 5.6: Active Internet connection at home.

Figure 5.6 depicts the Internet connectivity at home distribution of all respondents (n = 632) is divided between staff (n = 132) and students (n = 500). It indicates that from all the staff members that participated (n = 132) in this study, 77 percent (n = 101) have an active Internet connection at home and 23 percent (n = 31) do not. From all the registered students that participated (n = 500) in this study, 61 percent (n = 304) have an active Internet connection at home and 39 percent (n = 196) do not. A total of 64 percent (n = 405) of all respondents have an active internet connection at home whilst 36 percent (n = 227) do not.

It is therefore evident that the majority of staff and students have an active Internet connection at home. Staff members have a slightly higher positive rating than the registered students, this however does not constitute a vast difference. It is argued that respondents with an active Internet connection at home are more likely to use the NMMU's Internet in an acceptable manner as they can access non-work related content from home. The following sub-section will elaborate on the findings for Section 2: Governance.

5.2.2.2. Section 2: Governance

The following should be acknowledged before commencing with the Internet Governance section. Due to a limitation in the research instrument, the questions 'Have you read and understood it?' and 'Do you agree with it?' had 'Yes', 'No', and 'Not Applicable' as possible answers categories. This was implemented as these were follow-up questions for those who

answered ‘Yes’ to the previous question. This was misunderstood by some and therefore the answer category and response of ‘Not Applicable’ was removed as it did not contribute to the flow, and the results, in this sub-section.

Figures 5.7 – 5.12 depicts the responses received from the staff (n = 132) and students (n = 500) regarding the NMMU Internet governance structures. The NMMU Internet governance structures supported the awareness, understanding and agreement of the NMMU General ICT Policy and NMMU Acceptable Use Policy. Each question will be elaborated on individually below.

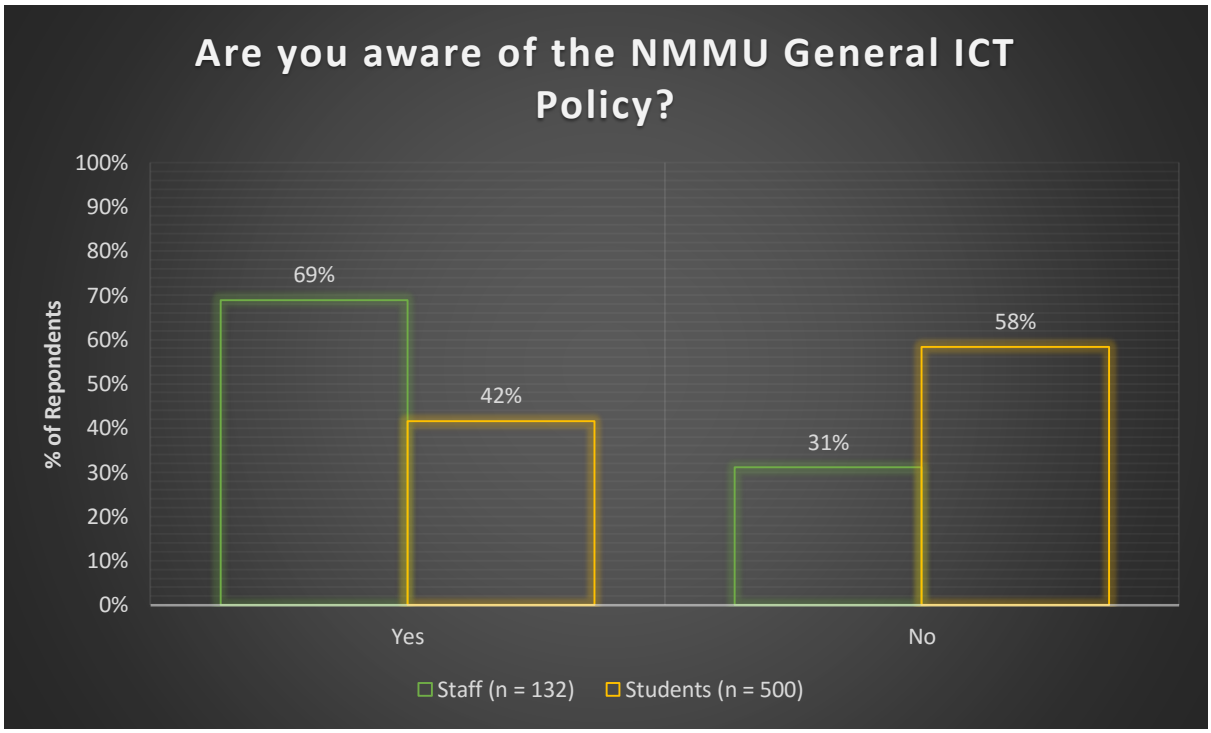

Figure 5.7: Are you aware of the NMMU General ICT Policy?

Figure 5.7 depicts the responses (n = 632) received for staff (n = 132) and students (n = 500) for the question ‘Are you aware of the NMMU General ICT Policy?’. 69 percent (n = 91) of the staff respondents indicated ‘Yes’ while 42 percent (n = 208) of the student respondents indicated ‘Yes’. 31 percent (n = 41) of the staff respondents indicated ‘No’ while 58 percent (n = 292) of the student respondents indicated ‘No’. These findings produced $Chi^2 = 31.31$ which stems from d.f. = 1 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.22 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings show that the majority of staff are aware of the NMMU General ICT Policy while only a small portion of the students being aware of the NMMU General ICT Policy. The majority of students were not aware of the NMMU General ICT Policy. The NMMU General ICT Policy is located on the Institutional Regulatory Code website which is accessible from both the staff and students websites. The NMMU General ICT Policy is used by NMMU Management to influence or help to stipulate the course of action that NMMU takes regarding its ICT resources. These ICT resources include: Acceptable Use, BYOD, Development, Email and other messaging systems, Internet Access, Remote access to ICT Infrastructure, Telecommunications, Use of SMS for business purposes, Information Security, Privacy and confidentiality of individuals, ICT Procurement, Web Services and general roles and responsibilities of staff and students. It is imperative that all NMMU ICT resource users familiarise themselves with the NMMU General ICT Policy to ensure they are aware of the set of values or norms instilled around the ICT resources. Due to this reason, the NMMU General ICT Policy is well advertised to both staff and students.

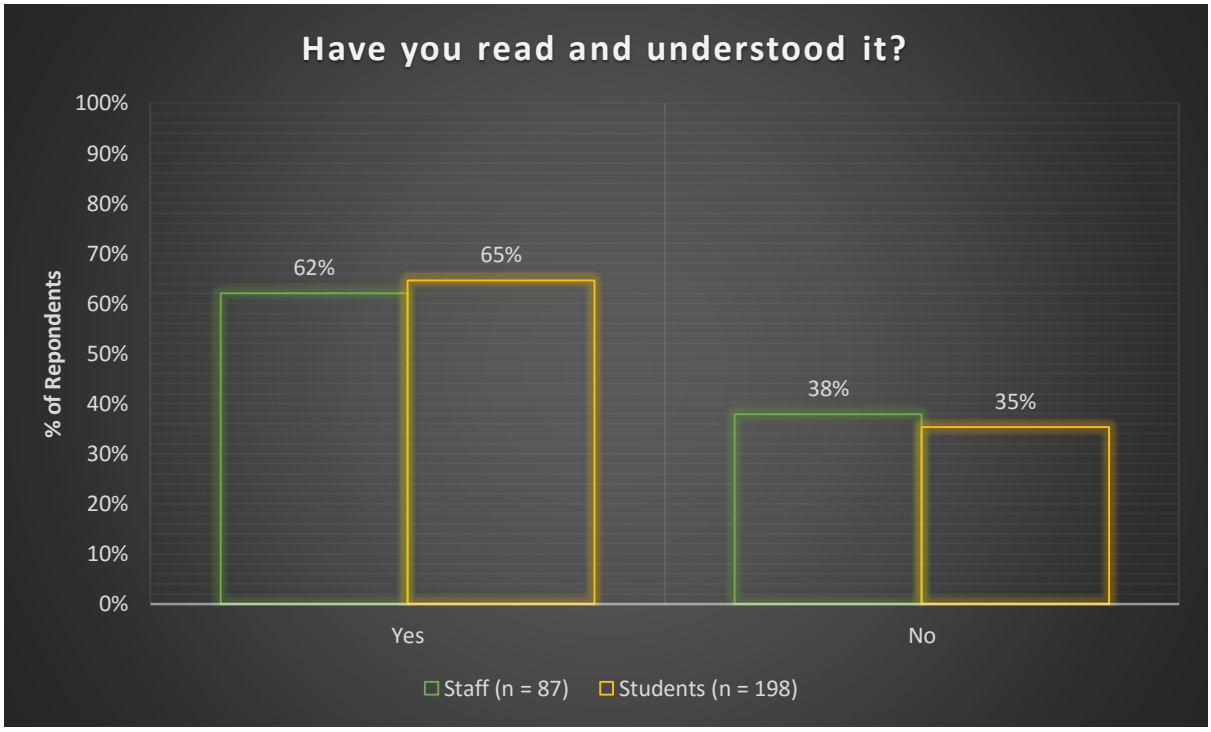

Figure 5.8: Have you read and understood it?

Figure 5.8 depicts the responses (n = 285) received for staff (n = 87) and students (n = 198) for the question 'Have you read and understood it?'. This serves as a follow-up question to those who responded 'Yes' to the previous question. 62 percent (n = 54) of the staff respondents indicated 'Yes' and 65 percent (n = 128) of the student respondents indicated 'Yes'. 38 percent (n = 33) of the staff respondents indicated 'No' while 35 percent (n = 70) of

the student respondents indicated ‘No’. The findings produced Chi² = 0.17 which stems from d.f. = 1 and n = 285. p = .677 which indicates that no statistical, significant relationship exists between the variables.

The findings indicate that the majority of staff and students have read and understood the NMMU General ICT Policy. In addition, there are some staff and students that are aware of the NMMU General ICT Policy but have failed to read and understand it. It is vital that both staff and students read and understand the NMMU ICT General ICT Policy as ignorance of an official policy may lead to unwanted behaviour.

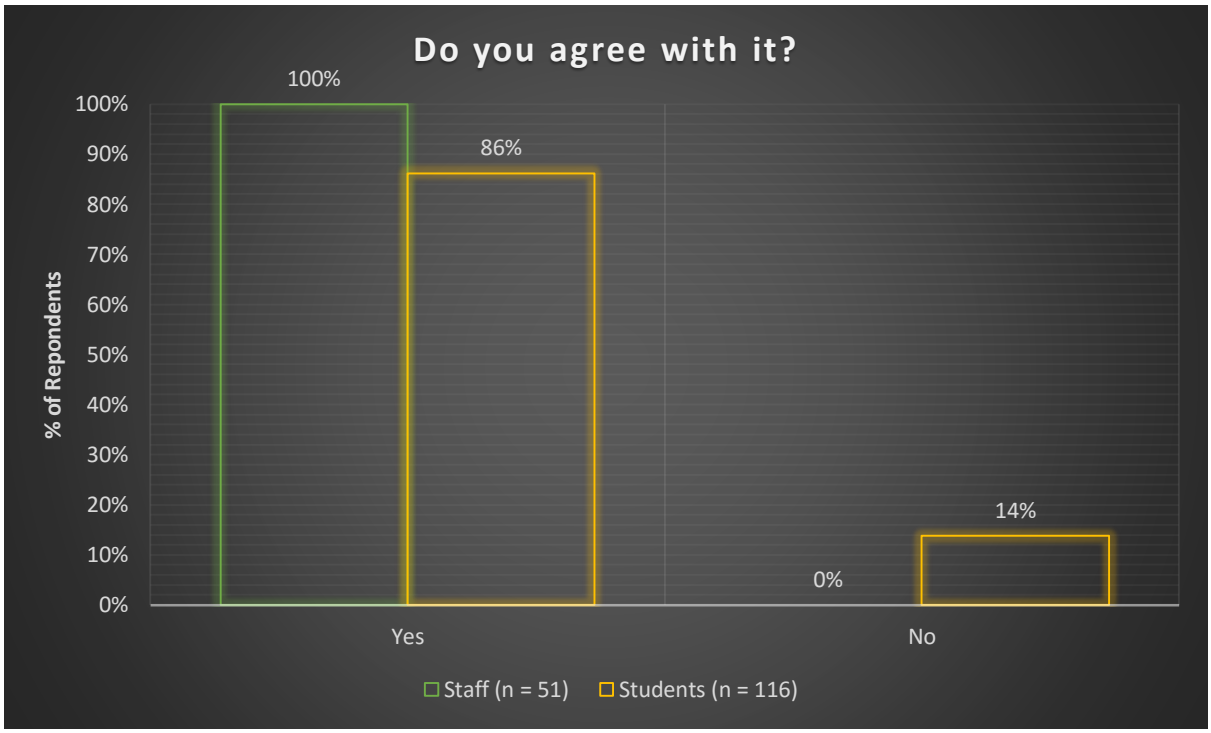

Figure 5.9: Do you agree with it?

Figure 5.9 depicts the responses (n = 167) received for staff (n = 51) and students (n = 116) for the question ‘Do you agree with it?’. This serves as a follow-up question to those who responded ‘Yes’ to the previous question. 100 percent (n = 51) of the staff respondents indicated ‘Yes’ while 86 percent (n = 100) of the student respondents indicated ‘Yes’. 0 percent (n = 0) of the staff respondents indicated ‘No’ while 14 percent (n = 16) of the student respondents indicated ‘No’. The findings produced Chi² = 6.09 which stems from d.f. = 1 and n = 167. p = .014 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.19 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. 1 was added to each cell to meet minimum expected frequency requirements.

The findings show that all staff agree with the NMMU General ICT Policy while the majority of students also agrees with the NMMU General ICT Policy. It has been proven that if one agrees with the ICT General ICT Policy, he/she is more enthusiastic to adhere to its set rules and guidelines. If staff and students fail to agree with the NMMU General ICT Policy it will be an uphill battle to get their acceptance and participation in this matter.

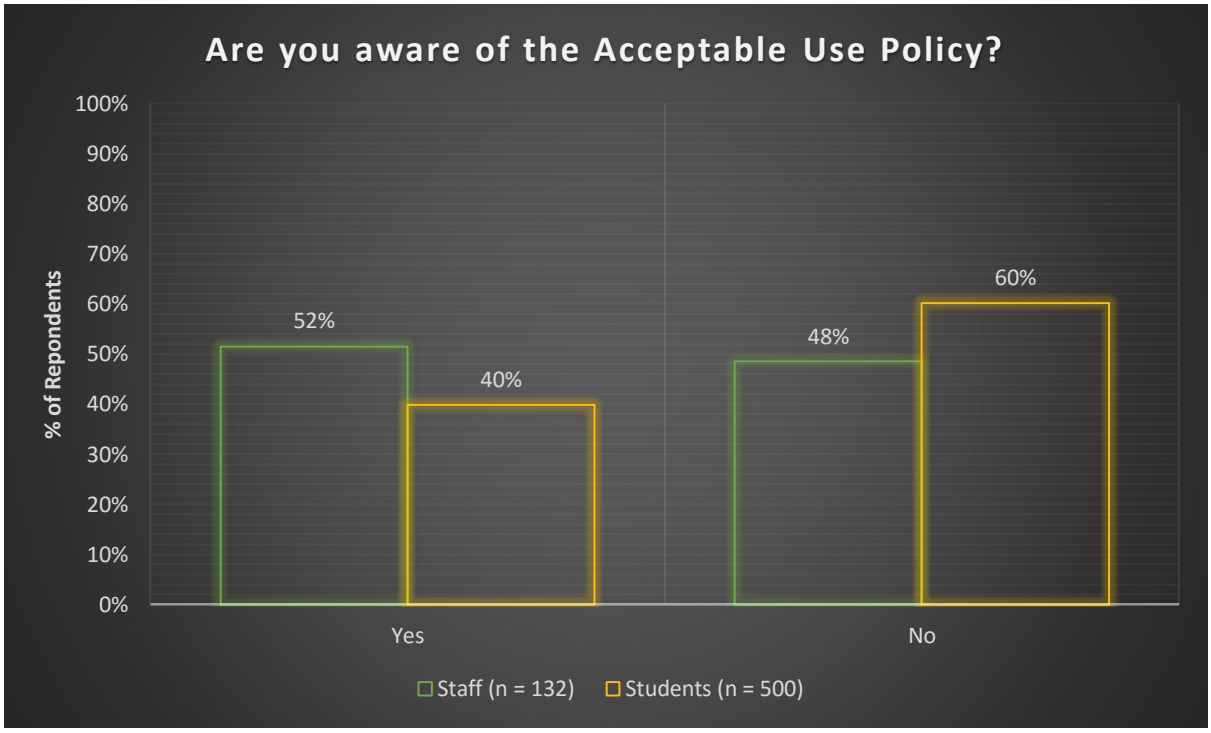

Figure 5.10: Are you aware of the Acceptable Use Policy?

Figure 5.10 depicts the responses (n = 632) received for staff (n = 132) and students (n = 500) for the question 'Are you aware of the Acceptable Use Policy?'. 52 percent (n = 68) of the staff respondents indicated 'Yes' while 40 percent (n = 199) of the student respondents indicated 'Yes'. 48 percent (n = 64) of the staff respondents indicated 'No' while 60 percent (n = 301) of the student respondents indicated 'No'. The findings produced $Chi^2 = 5.87$ which stems from d.f. = 1 and n = 632. p = .015 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.10 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings show that there are more staff that are aware of the Acceptable Use Policy and more students are not aware of the Acceptable Use Policy. The Acceptable Use Policy is included in the NMMU General ICT Policy. Furthermore, all student lab devices are programmed to display the rules and regulations of the Acceptable Use Policy on the

computer's logon screen. Students must click on 'ACCEPT' before they can log onto the device. It is, however, discussed later that the preferred devices by students are smartphones and laptops, meaning that the majority of students will not see the Acceptable Use Policy on the logon screen. An Acceptable Use Policy is the set of rules which is provided by Management that dictate what is allowed and what is not allowed regarding the use of the ICT resources. It is imperative that all staff and students familiarise themselves with the Acceptable Use Policy as found in the NMMU General ICT Policy and the logon screen of all lab devices as to ensure they are aware of the fair use of the ICT resources.

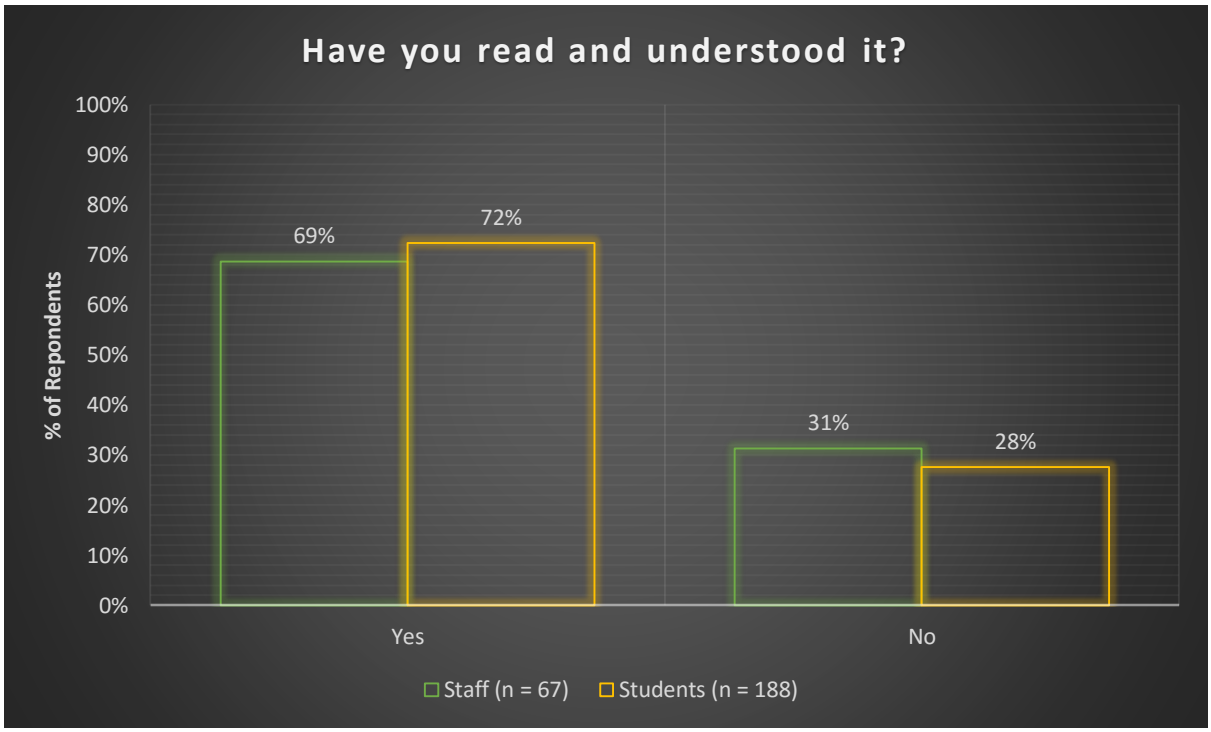

Figure 5.11: Have you read and understood it?

Figure 5.11 depicts the responses (n = 255) received for staff (n = 67) and students (n = 188) for the question 'Have you read and understood it?'. This serves as a follow-up question to those who responded 'Yes' to the previous question. 69 percent (n = 46) of the staff respondents indicated 'Yes' while 72 percent (n = 136) of the student respondents indicated 'Yes'. 31 percent (n = 21) of the staff respondents indicated 'No' while 28 percent (n = 52) of the student respondents indicated 'No'. The findings produced $Chi^2 = 0.33$ which stems from d.f. = 1 and n = 255. p = .567 which indicates that no statistical, significant relationship exists between the variables. The findings show that the majority of staff and students have read and understood the Acceptable Use Policy. In addition, there are some staff and students that are aware of the Acceptable Use Policy but have failed to read and understand it. It is vital

that staff and students familiarise themselves with the Acceptable Use Policy as ignorance in an official policy will lead to unwanted behaviour.

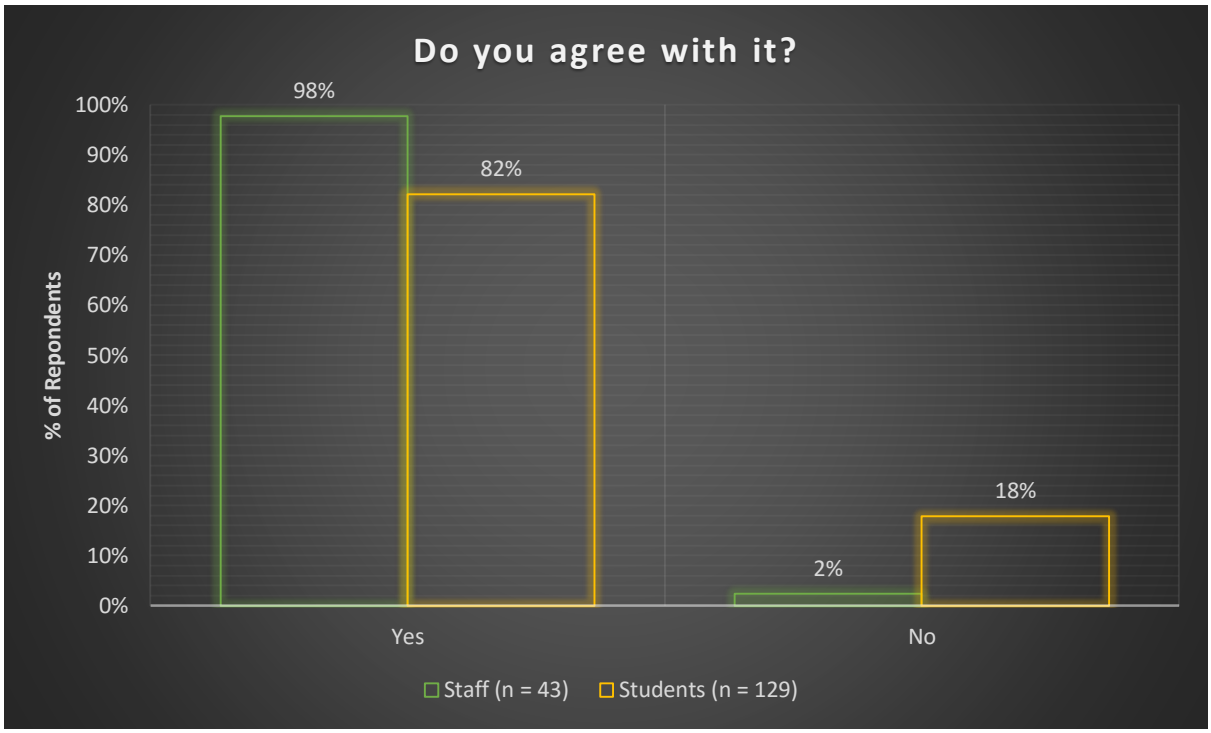

Figure 5.12: Do you agree with it?

Figure 5.12 depicts the responses (n = 172) received for staff (n = 43) and students (n = 129) for the question 'Do you agree with it?'. This serves as a follow-up question to those who responded 'Yes' to the previous question. 98 percent (n = 42) of the staff respondents indicated 'Yes' while 82 percent (n = 106) of the student respondents indicated 'Yes'. 2 percent (n = 1) of the staff respondents indicated 'No' while 18 percent (n = 23) of the student respondents indicated 'No'. The findings produced $Chi^2 = 6.46$ which stems from d.f. = 1 and n = 172. p = .011 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.19 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings show that the majority of staff and students agree with the Acceptable Use Policy. It has been proven that if one agrees with the Acceptable Use Policy he/she is more enthusiastic to adhere to its set rules and guidelines. If staff and students fail to agree with the NMMU Acceptable Use Policy it will be an uphill battle to get their acceptance and participation.

The combined findings for staff and student NMMU Internet governance structures are different in some questions but similar in others. It is clear that staff are better informed about the NMMU General ICT Policy as well as the Acceptable use Policy. This could be due to the fact that staff are assigned a dedicated NMMU device, they are introduced to the NMMU policies during staff indications, and they are more grounded in their office environment (thus receiving policy update emails and reading them). These NMMU devices are also the preferred device for accessing the NMMU Internet as supported by the findings that follows. Staff in general have access to more Internet resources and should be monitored more closely to reduce Internet abuse cases. The HEI common practices, however, also indicated that there are very few reported staff abuse cases. This could be due to staff being aware of the set ICT policies and procedures.

Students on the other hand are more 'free' to come and go as they please. NMMU has dedicated computer labs that students can use to gain access the Internet. From the findings that follows it is clear that these desktop computers are not their preferred devices. Lastly, according to the importance of Internet findings as seen in Chapter 4, it is common practice for students to receive greater importance from the Internet resources than staff. These findings indicate that at NMMU the roles are in reverse. The HEI Internet management best practices also indicated that there are some reported student Internet abuse cases. This could be due to students not being that up-to-date with the set ICT policies and procedures. It should be noted that both findings for staff and students are not up-to-standard and that emphasis should be placed on a better marketing and awareness strategy, with greater emphasis on students.

Lastly, according to the HEI Internet management best practices, the Acceptable Use Policy is the most preferred method for addressing Internet management issues whilst the General ICT Policy is the fourth most preferred method for stipulating the required Internet management practices. According to the findings above, these roles are reversed. NMMU is placing more weight on its ICT General Policy than on the Acceptable Use policy. It is vital that attention be given to the content and thereafter to its marketing and awareness strategy. In addition, the message should be directed to with the audience.

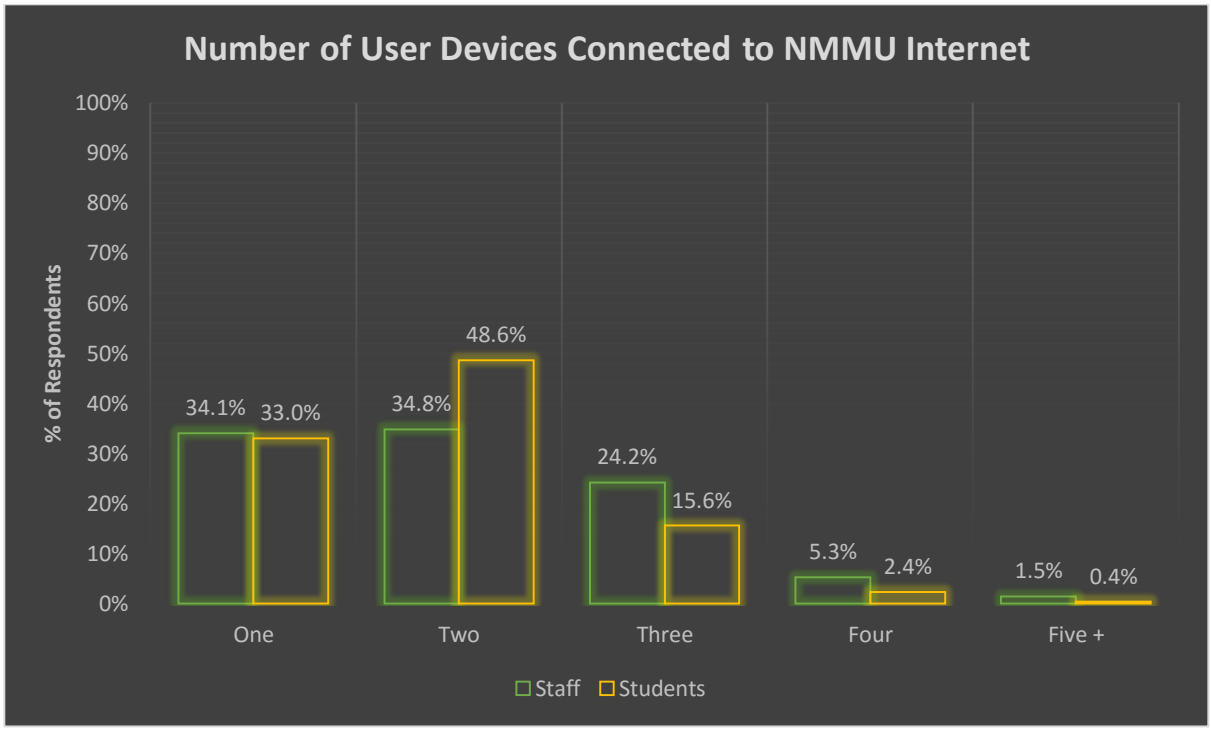

Figure 5.13: Number of user devices connected to NMMU Internet.

Figure 5.13 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'How many devices to you use to connect to NMMU's Internet?'. 34 percent (n = 45) of the staff respondents indicated 'One Device' whilst 33 percent (n = 165) of the student respondents indicated 'One Device'. In total, 33 percent (n = 210) of all respondents said they use 'One Device' to connect to the NMMU's Internet. Individually and combined, one device is the second most common number of devices used to connect to the NMMU's Internet.

35 percent (n = 46) of the staff respondents indicated 'Two Devices' whilst 49 percent (n = 243) of the student respondents indicated 'Two Devices'. In total, 46 percent (n = 289) of all respondents said they use 'Two Devices' to connect to the NMMU's Internet. Individually and combined, two devices is the most common number of devices used to connect to the NMMU's Internet.

24 percent (n = 32) of the staff respondents indicated 'Three Devices' whilst 16 percent (n = 78) of the student respondents indicated 'Three Devices'. In total, 17 percent (n = 110) of all respondents said they use 'Three Devices' to connect to the NMMU's Internet. Individually and combined, three devices is the third most common number of devices used to connect to the NMMU's Internet.

5 percent (n = 7) of the staff respondents indicated ‘Four Devices’ whilst 2 percent (n = 12) of the student respondents indicated ‘Four Devices’. In total, 3 percent (n = 19) of all respondents said they use ‘Four Devices’ to connect to the NMMU's Internet. Individually and combined, four device is the fourth common number of devices used to connect to the NMMU's Internet.

2 percent (n = 2) of the staff respondents indicated ‘Five or More Devices’ whilst 0 percent (n = 2) of the student respondents indicated ‘Five or More Devices’. In total, 1 percent (n = 4) of all respondents said they use ‘Five or More Devices’ to connect to the NMMU's Internet. Individually and combined, five or more devices is the fifth common number of devices used to connect to the NMMU's Internet.

The findings show that the majority of staff and students have two devices that they use to connect to the NMMU’ Internet. The findings also indicated that the second largest number of staff and students have only one device which they use to connect to the NMMU’s Internet. Lastly, the findings indicated that a handful of staff and students have three devices which they use to connect to the NMMU’s Internet.

The findings produced $Chi^2 = 13.82$ which stems from d.f. = 4 and n = 632. p = .008 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.15 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The number of devices connected to the network at all times is directly linked to BYOD as previously discussed. As can be seen in the following question, most commonly, students prefer smartphones and laptops while staff prefer desktops computers and laptops. More and more users are bringing these devices onto the NMMU environment and connecting them to the NMMU’s Internet. This action puts additional strain on the NMMU Internet resources as there are now more devices connected than was originally planned. For example, a snapshot was taken on 19 October 2014 which indicated that 6 669 devices were connected to the NMMU wireless network on that day. A recent snapshot was taken on 21 September 2015 and indicated that 9 707 were connected to the NMMU wireless network on that day. This was a growth of 46 percent (3 038 devices) from 2014 to 2015. A similar percentage increase was experienced between 2013 and 2014. These devices also present a security risk as some devices are not adequately updated or protected, therefore introducing security risks into the

NMMU environment. Internet resources as well as technical and operational controls must be aligned to address and/or support these findings.

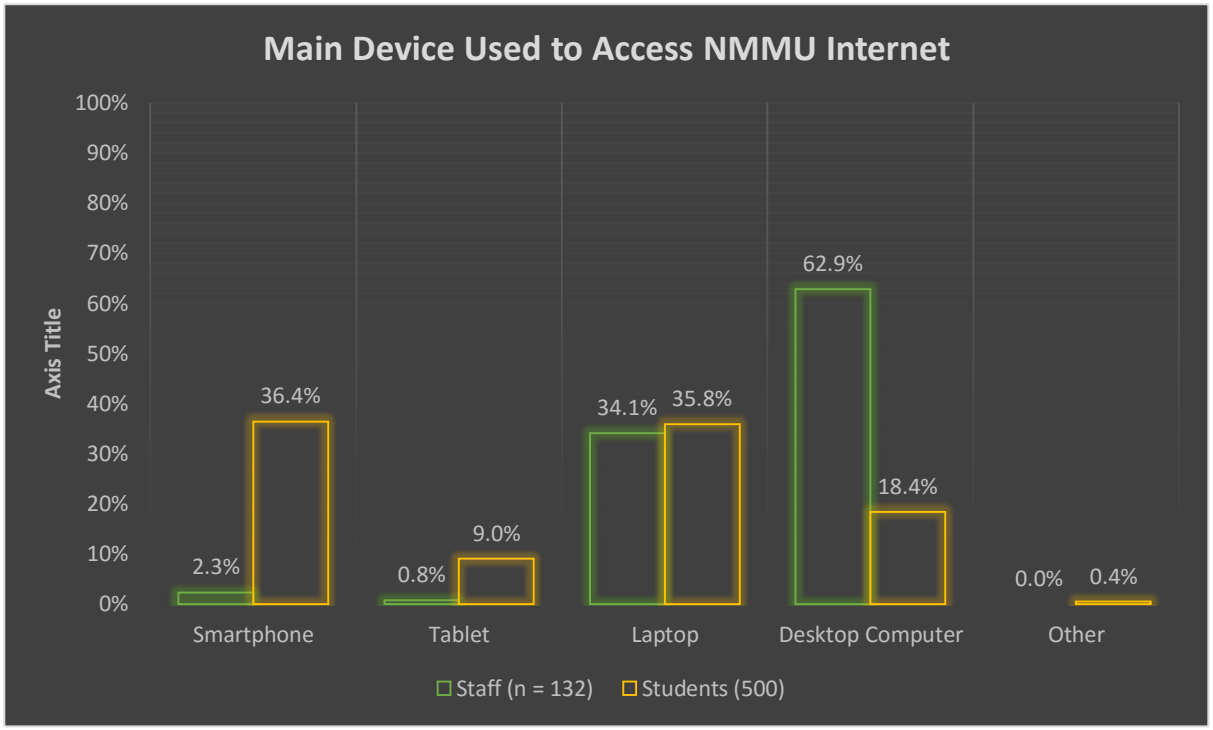

Figure 5.14: Main device used to access NMMU Internet.

Figure 5.14 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) to the question 'What type of device do you mainly use to connect to NMMU's Internet?'. 2 percent (n = 3) of the staff respondents indicated 'Smartphone' whilst 36 percent (n = 182) of the student respondents indicated 'Smartphone'. Connecting via a Smartphone to the NMMU's Internet is the third preferred method for staff and the most preferred method for students. In total, 29 percent (n = 185) of all respondents said they mainly use a 'Smartphone' when connecting to the NMMU's Internet. Overall, smartphones are the second most popular device to use when connecting to the NMMU's Internet.

1 percent (n = 1) of the staff respondents indicated 'Tablet' whilst 9 percent (n = 45) of the student respondents indicated 'Tablet'. Connecting via a tablet to the NMMU's Internet is the fourth preferred device for staff and students. In total, 7 percent (n = 46) of all respondents said they mainly use a 'Tablet' when connecting to the NMMU's Internet. Overall, tablets are the fourth most popular device to use when connecting to the NMMU's Internet.

43 percent (n = 45) of the staff respondents indicated 'Laptop' whilst 36 percent (n = 179) of the student respondents indicated 'Laptop'. Connecting via a laptop to the NMMU's Internet

is the second preferred device for staff and students. In total, 35 percent (n = 224) of all respondents said they mainly use a 'Laptop' when connecting to the NMMU's Internet. Overall, laptops are the most popular device to use when connecting to the NMMU's Internet.

63 percent (n = 83) of the staff respondents indicated 'Desktop Computer' whilst 18 percent (n = 92) of the student respondents indicated 'Desktop Computer'. Connecting via a desktop computer to the NMMU's Internet is the most preferred device for staff and the third preferred device for students. In total, 28 percent (n = 175) of all respondents said they mainly use a 'Desktop Computer' when connecting to the NMMU's Internet. Overall, desktop computers are the third most popular device to use when connecting to the NMMU's Internet.

0 percent (n = 0) of the staff respondents indicated 'Other Device' (such as a normal cellular phone or smartwatches) whilst 0 percent (n = 2) of the student respondents indicated 'Other Device'. Connecting via other devices to the NMMU's Internet is the least preferred device for staff and students. In total, 0 percent (n = 2) of all respondents said they mainly use an 'Other Device' when connecting to the NMMU's Internet. Overall, other devices are the least popular device to use when connecting to the NMMU's Internet.

The findings produced $Chi^2 = 126.52$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.45 which indicates that there is a medium variation from the mean and consequently the individual numbers to each other within the data set.

As can be concluded from the findings, students prefer smartphones and laptops while staff prefer desktops computers and laptops, in that order. It is therefore clear that students would mostly connect to the wireless network while staff would connect to the physical local area network. The authentication methods, possible MDMs, physical and technical infrastructure, bandwidth allocation etc. must all be aligned to ensure that each group is provided with their unique Internet service as per their requirements. It is imperative that NMMU knows the number of devices as well as types of devices connected to the NMMU Internet at all times. This is common practice amongst HEIs.

A study conducted in 2014 by Mr Shaun Meyer from the NMMU Blended Learning Department supports these findings. The study had a total of 1 719 responses which comprised of 1 420 students, 88 academic staff and 211 administrative staff. The question was 'Which of the following computing devices do you currently use?'. The respondents were allowed to select

all options relevant to them. The study found that students preferred laptops (n = 855 or 60,21 percent) and secondly smartphones (n = 749 or 52,75 percent). Academic staff preferred laptops (n = 45 or 90,00 percent) and secondly smartphones (n = 34 or 68,00 percent). Administrative staff preferred desktop computers (n = 132 or 79,52 percent) and secondly smartphones (n = 104 or 62,65 percent). Further analysis of the combined staff indicated that the preferred devices are firstly, desktop computers (n = 165 or 26,96 percent) and secondly, laptop (n = 144 or 23,53 percent). It is clear that staffs' preferred devices and their ranking remained the same when compared to the students' preferred devices which also stayed the same, however, a small shift in the order between the two research studies are noted (Meyer, 2015). The following sub-section will summarise the research findings of Section 2.

5.2.2.3. Summary of Research Findings in Section 2

Section 2: Governance was used to determine the level of awareness of the current governance structures in place that guides Internet usage within NMMU. The findings indicated that the majority of staff are aware of the NMMU General ICT Policy while the majority of students were not aware of the NMMU General ICT Policy. The majority of staff and students that are aware of the NMMU General ICT Policy have read and understood it. The majority of staff and students that have read and understood the NMMU General ICT Policy, agree with its content.

Most staff are aware of the Acceptable Use Policy while more students were not aware of the Acceptable Use Policy. The majority of staff and students that are aware of the Acceptable Use Policy have read and understood it. The majority of staff and students that have read and understood the Acceptable Use Policy, agree with its content.

Most staff and students are connected to the NMMU's Internet via a work device as well as a personal device. There is also a relatively large number of staff and students that only use one device to connect to the NMMU's Internet. This could be the disadvantaged students that are using the lab computers or the senior staff who do not use additional Internet-enabled devices. An alternative argument could be that the staff and students already have an active Internet connection at home and therefore only access the NMMU's Internet through their primary work device. Lastly, a smaller number of staff and students uses three devices to connect to the NMMU's Internet. These could be the early adopters or tech-savvy staff and students that are constantly buying and testing new devices. The high speed NMMU Internet connection allows them quickly and easily to surf the Internet, play online games and download or upgrade software for the devices.

The most preferred devices for staff are desktop computers and laptops. In most cases these desktop computers and laptops are assigned to the respective staff member for work purposes. This is supported in the question about the number of devices. The most preferred devices for students are smartphones and laptops. The computer labs dedicated for students are fitted with desktop computers, which makes it clear that students prefer to work on their personal devices. The following sub-section will elaborate on the findings for Section 3: Usage and Access Duration.

5.2.2.4. Section 3: Usage and Access Duration

Figures 5.15 – 5.23 depict the responses (n = 632) received from the staff (n = 132) and students (n = 500) regarding their Internet usage and access durations. The questions on usage and access durations are focused on determining the usage of the NMMU's Internet resources for general purposes, work/academic purposes and non-work/non-academic purposes during office hours on weekdays, after office hours on weekdays and weekends. Each question will be elaborated on individually below.

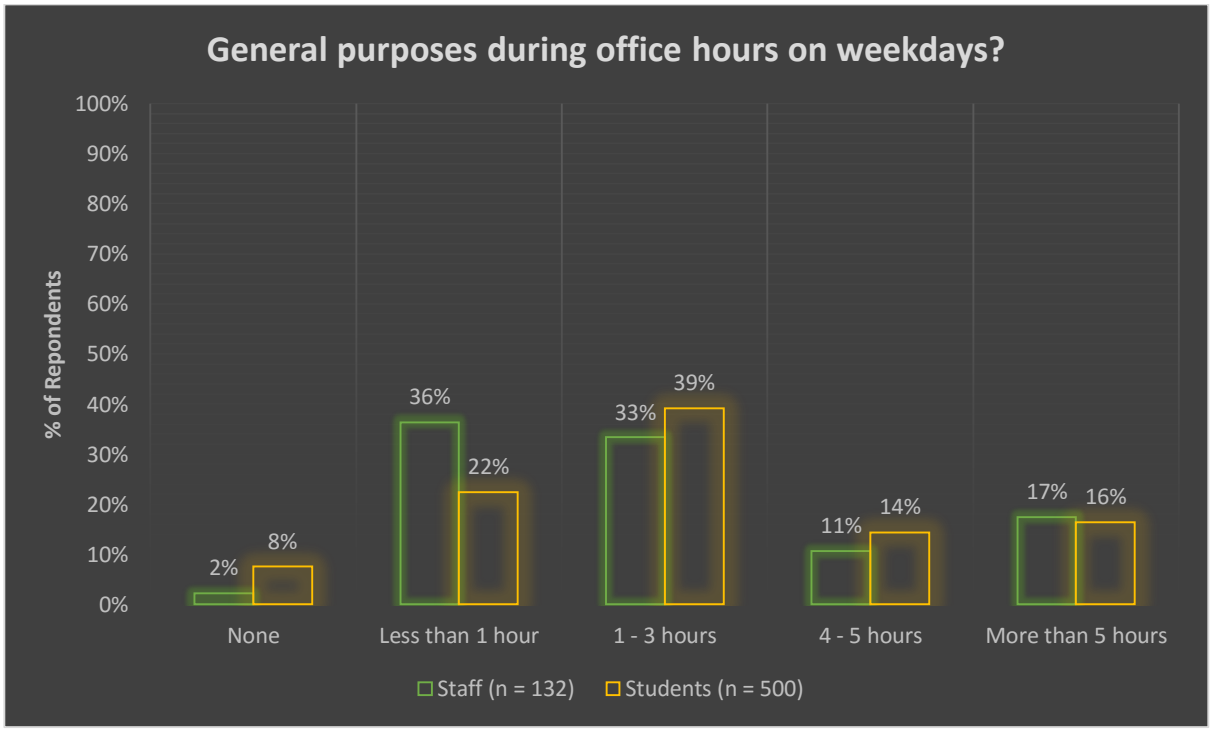

Figure 5.15: General purposes during office hours on weekdays?

Figure 5.15 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'How many hours per day on average do you use NMMU's Internet for general purposes during office hours on weekdays?'. 2 percent (n = 3) of the staff respondents indicated 'None' while 8 percent (n = 38) of the student respondents indicated 'None'. 36

percent (n = 48) of the staff respondents indicated ‘Less than 1 hour’ per day while 22 percent (n = 112) of the students indicated ‘Less than 1 hour’ per day. 33 percent (n = 44) of the staff respondents indicated ‘1 – 3 hours’ per day while 39 percent (n = 136) of the staff respondents indicated ‘1 – 3 hours’ per day. 11 percent (n = 14) of the staff respondents indicated ‘4 – 5 hours’ per day while 14 percent (n = 72) of the student respondents indicated ‘4 – 5 hours’ per day. Lastly, 17 percent (n = 23) of the staff respondents indicated ‘More than 5 hours’ per day while 16 percent (n = 82) of the student respondents ‘More than 5 hours’ per day.

The findings produced $Chi^2 = 14.73$ which stems from d.f. = 4 and n = 632. p = .005 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.15 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings show that there are more staff that access the NMMU’s Internet for general purposes during office hours on weekdays for less than 1 hour per day with 1 – 3 hours per day being a close second. In comparison, the majority of students access the NMMU’s Internet for general purposes during office hours on weekdays between 1 – 3 hours per day. This could be due to staff having a structured work day (e.g. 08:00 to 17:00 with 45 minute lunch break and 2 x 15 minute tea times) while the majority of students have class throughout the day with regular breaks, some extending to 3 hours at a time. In general, students have more free time to spend on Internet surfing.

Figure 5.16 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question ‘How many hours per day on average do you use NMMU's Internet for general purposes after hours on weekdays?’. 43 percent (n = 57) of the staff respondents indicated ‘None’ while 32 percent (n = 162) of the student respondents indicated ‘None’. 33 percent (n = 44) of the staff respondents indicated ‘Less than 1 hour’ per day while 21 percent (n = 105) of the student respondents indicated ‘Less than 1 hour’ per day. 20 percent (n = 26) of the staff respondents indicated ‘1 – 3 hours’ per day while 27 percent (n = 136) of the student respondents indicated ‘1 – 3 hours’ per day. 2 percent (n = 2) of the staff respondents indicated ‘4 – 5 hours’ per day while 8 percent (n = 39) of the student respondents indicated ‘4 – 5 hours’ per day. Lastly, 2 percent (n = 3) of the staff respondents indicated ‘More than 5 hours’ per day while 12 percent (n = 58) of the student respondents indicated ‘More than 5 hours’ per day.

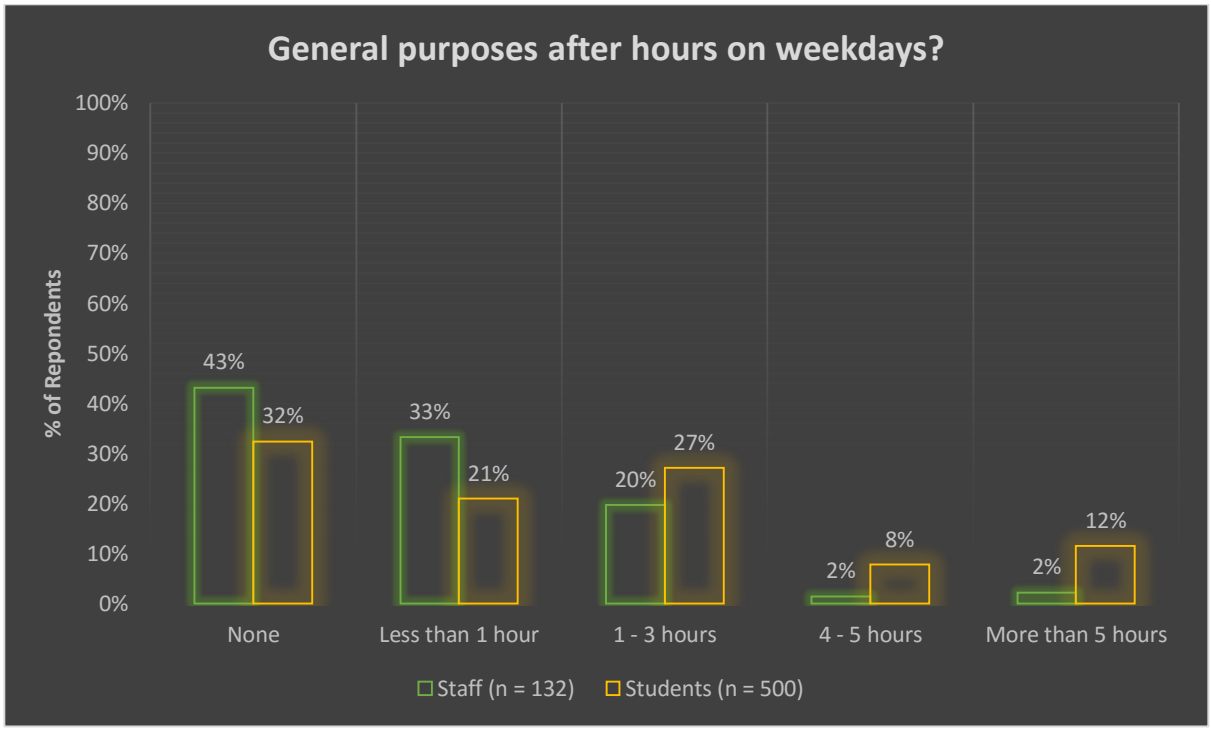

Figure 5.16: General purposes after hours on weekdays?

The findings produced $Chi^2 = 28.31$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exist between the variables. Variance = 0.21 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings indicate that the majority of staff do not access the NMMU's Internet for general purposes after hours on weekdays. Furthermore, the second most frequent time period also shows that NMMU's Internet is being accessed after hours on weekdays for less than 1 hour per day. In comparison, there are more students who do not access the NMMU's Internet for general purposes after hours on weekdays with 1 – 3 hours per day being a close second. It is therefore clear that more staff and students do not have access the NMMU's Internet for general purposes after hours on weekdays. There are, however, some staff and students that stay after hours to use the NMMU's Internet for general purposes. This could include the 23 percent (n = 31) of staff and 39 percent (n = 196) of students who do not have an active Internet connection at home. Consequently, there should be some arrangement implemented to accommodate these staff and students.

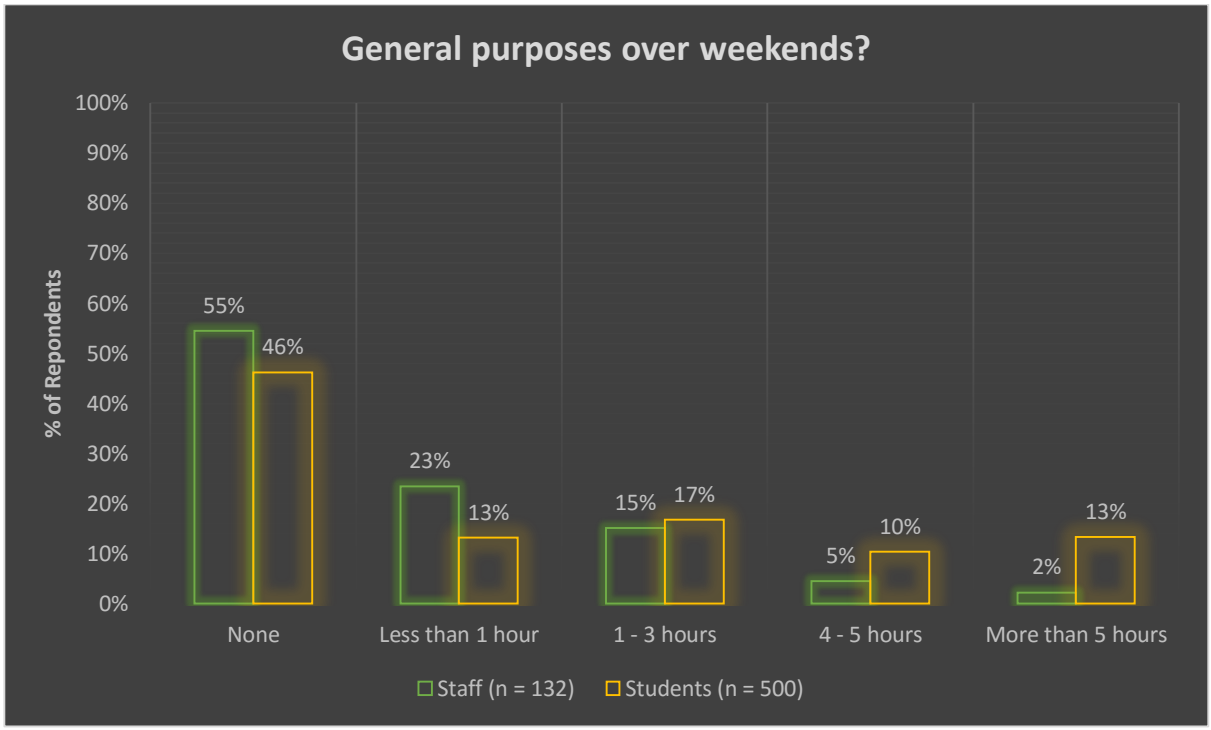

Figure 5.17: General purposes over weekends?

Figure 5.17 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'How many hours per day on average do you use NMMU's Internet for general purposes over weekends?'. 55 percent (n = 72) of the staff respondents indicated 'None' while 46 percent (n = 231) of the student respondents indicated 'None'. 23 percent (n = 31) of the staff respondents indicated 'Less than 1 hour' per day while 13 percent (n = 66) of the student indicated 'Less than 1 hour' per day. 15 percent (n = 20) of the staff respondents indicated '1 – 3 hours' per day while 17 percent (n = 84) of the student respondents indicated '1 – 3 hours' per day. 5 percent (n = 6) of the staff respondents indicated '4 – 5 hours' per day while 10 percent (n = 52) of the student respondents indicated '4 – 5 hours' per day. Lastly, 2 percent (n = 3) of the staff respondents indicated 'More than 5 hours' per day while 13 percent (n = 67) of the student respondents indicated 'More than 5 hours' per day.

The findings produced $Chi^2 = 24.46$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.20 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings show that the majority of staff and students do not access the NMMU's Internet for general purposes over weekends. This could be due to the fact that most of the NMMU academic and administrative offices are closed. There are some labs that are open to students

and some lectures conducted on Saturdays. These are, however, only accessible if a student follows the official security procedures. The staff that do access the NMMU ICT resources can do so via a Virtual Private Network (VPN) connection from home. However, for general purposes they would in most cases use their personal Internet connection without VPN activation.

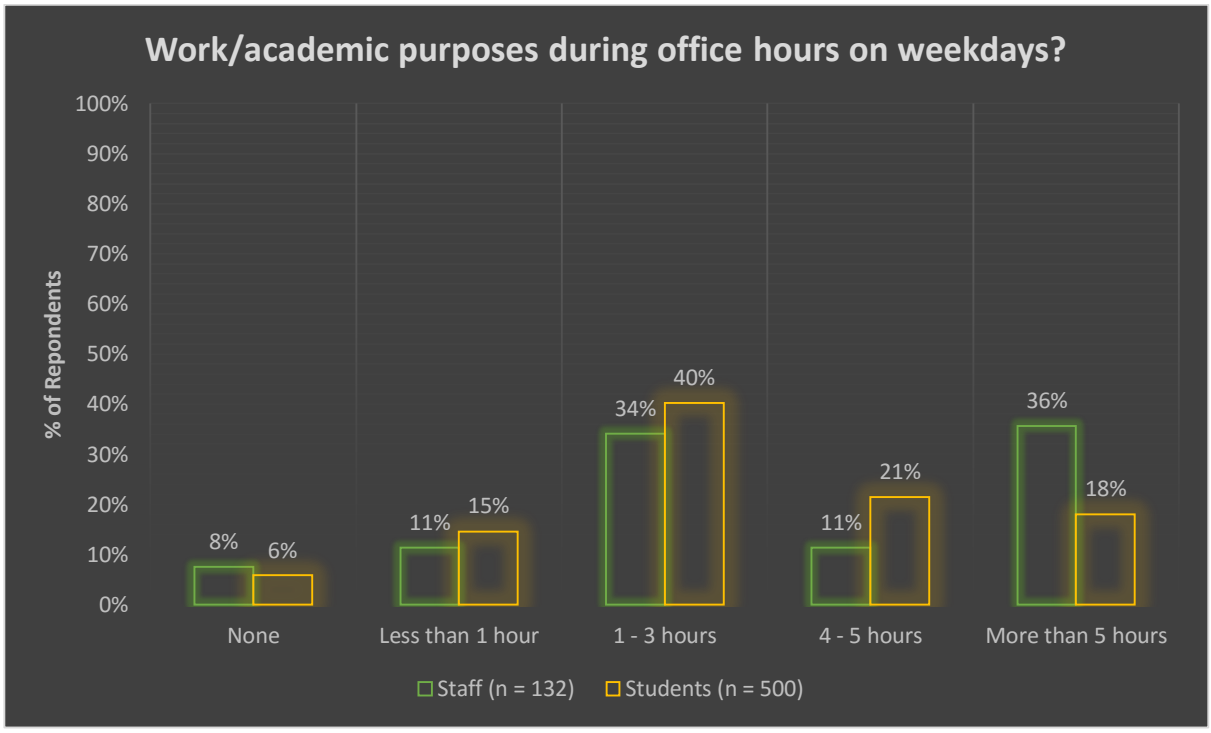

Figure 5.18: Work/academic purposes during office hours on weekdays?

Figure 5.18 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'How many hours per day on average do you use NMMU's Internet for work/academic purposes during office hours on weekdays?'. 8 percent (n = 10) of the staff respondents indicated 'None' while 6 percent (n = 29) of the student respondents indicated 'None'. 11 percent (n = 158) of the staff respondents indicated 'Less than 1 hour' per day while 15 percent (n = 73) of the student respondents indicated 'Less than 1 hour' per day. 34 percent (n = 45) of the staff respondents indicated '1 – 3 hours' per day while 40 percent (n = 201) of the student respondents indicated '1 – 3 hours' per day. 11 percent (n = 15) of the staff respondents indicated '4 – 5 hours' per day while 21 percent (n = 107) of the student respondents indicated '4 – 5 hours' per day. Lastly, 36 percent (n = 47) of the staff respondents indicated 'More than 5 hours' per day while 18 percent (n = 90) of the student respondents indicated 'More than 5 hours' per day.

The findings produced $Chi^2 = 22.70$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.19 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings for staff indicate a very close response rate between accessing the NMMU's Internet for work/academic purposes during office hours on weekdays between 1 – 3 hours per day and more than 5 hours per day. In comparison, the majority of students access the NMMU's Internet for work/academic purposes during office hours on weekdays between 1 – 3 hours per day. As previously discussed, staff have a 'set' work day (e.g. 08:00 to 17:00 with 45 minute lunch break and 2 x 15 minute tea times) while the majority of students have class throughout the day with regular breaks, some breaks extending to 3 hours at a time. Therefore, the biggest portion of the day should be dedicated to staff and students focusing on work or research. Staff may access the NMMU's Internet at different periods as they have different roles and responsibilities. In general, it is required of academic staff to be more active on the Internet (e.g. more than 5 hours) whilst administrative staff would be less active (1 – 3 hours, depending on function). The importance of the Internet to these user groups should be reflected in the ICT resources management settings.

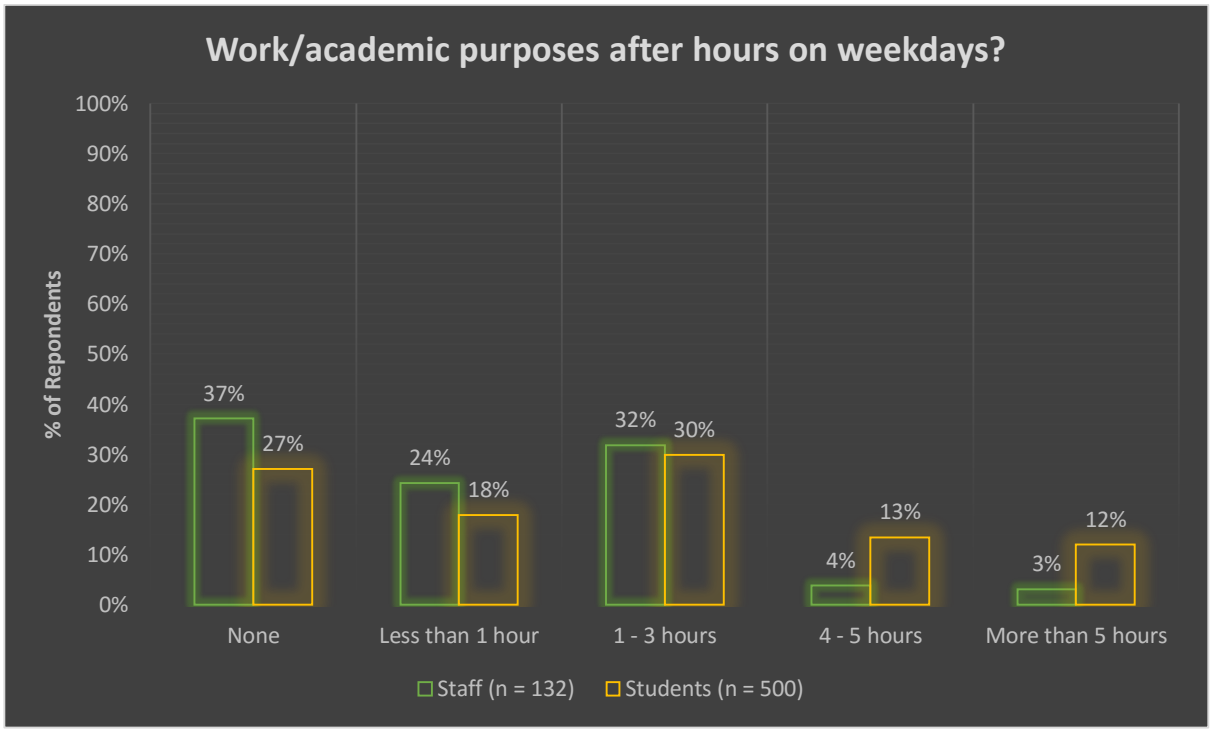

Figure 5.19: Work/academic purposes after hours on weekdays?

Figure 5.19 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'How many hours per day on average do you use NMMU's Internet for work/academic purposes after hours on weekdays?'. 37 percent (n = 49) of the staff respondents indicated 'None' while 27 percent (n = 135) of the student respondents indicated 'None'. 24 percent (n = 32) of the staff respondents indicated 'Less than 1 hour' per day while 18 percent (n = 89) of the student respondents indicated 'Less than 1 hour' per day. 32 percent (n = 43) of the staff respondents indicated '1 – 3 hours' per day while 30 percent (n = 149) of the student respondents indicated '1 – 3 hours' per day. 4 percent (n = 5) of the staff respondents indicated '4 – 5 hours' per day while 13 percent (n = 67) of the student respondents indicated '4 – 5 hours' per day. Lastly, 3 percent (n = 4) of the staff respondents indicated 'More than 5 hours' per day while 12 percent (n = 60) of the student respondents indicated 'More than 5 hours' per day.

The findings produced $Chi^2 = 22.85$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.19 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings show that more staff do not access the NMMU's Internet for work/academic purposes after hours on weekdays with 1 – 3 hours per day being the second preferred access period. In comparison, most students who access the NMMU's Internet for work/academic purposes after hours on weekdays between 1 – 3 hours per day with zero hours per day being the second preferred access period. It is clear that the access period are reversed between the two user groups. This could be because the majority of administrative offices close at around 16:30 while the majority of academic offices (lectures) only close at around 20:30. Therefore most administrative staff would leave at around 16:30 and most academic staff would leave at around 20:30. A number of students are therefore still on campus after hours on weekdays.

Figure 5.20 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'How many hours per day on average do you use NMMU's Internet for work/academic purposes over weekends?'. 48 percent (n = 64) of the staff respondents indicated 'None' while 40 percent (n = 198) of the student respondents indicated 'None'. 17 percent (n = 22) of the staff respondents indicated 'Less than 1 hour' per day while 14 percent (n = 68) of the student respondents indicated 'Less than 1 hour' per day. 20 percent (n = 26) of the staff respondents indicated '1 – 3 hours' per day while 22 percent (n = 111) of the

student respondents indicated '1 – 3 hours' per day. 8 percent (n = 11) of the staff respondents indicated '4 – 5 hours' per day while 13 percent (n = 65) of the student respondents indicated '4 – 5 hours' per day. Lastly, 7 percent (n = 9) of the staff respondents indicated 'More than 5 hours' per day while 12 percent (n = 58) of the student respondents indicated 'More than 5 hours' per day. The findings produced $Chi^2 = 7.12$ which stems from d.f. = 4 and n = 632. p = .129 which indicates that no statistical, significant relationship exists between the variables.

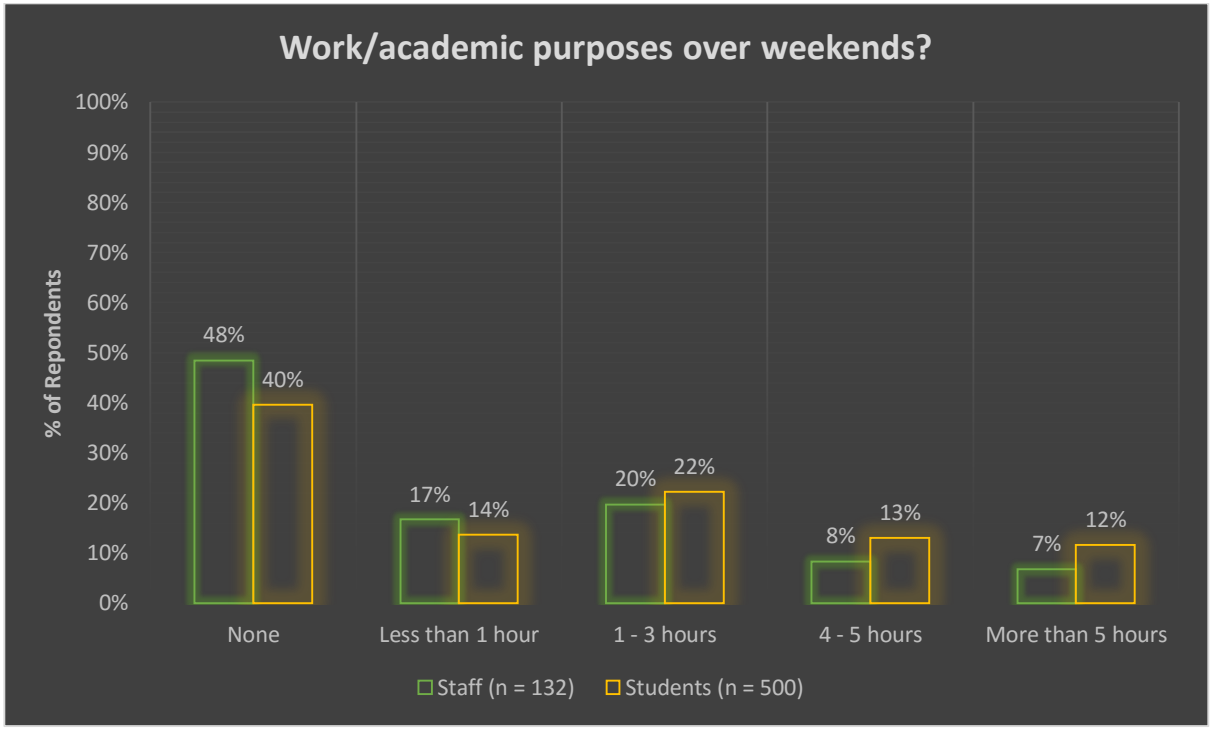

Figure 5.20: Work/academic purposes over weekends?

The findings indicate that the majority of staff and students do not access the NMMU's Internet for work/academic purposes over weekends. As previously discussed, a large number of the NMMU academic and administrative offices are closed. As previously discussed, the majority of NMMU academic administrative offices are closed on weekends. There are some labs that are open to students and some lectures are conducted on Saturdays. These are, however, only accessible if a student follows the official security procedures. The staff that do access the NMMU ICT resources can do so via a VPN connection from home. However, for work/academic purposes they would in most cases use their personal Internet connection unless the resources are located within the NMMU environment.

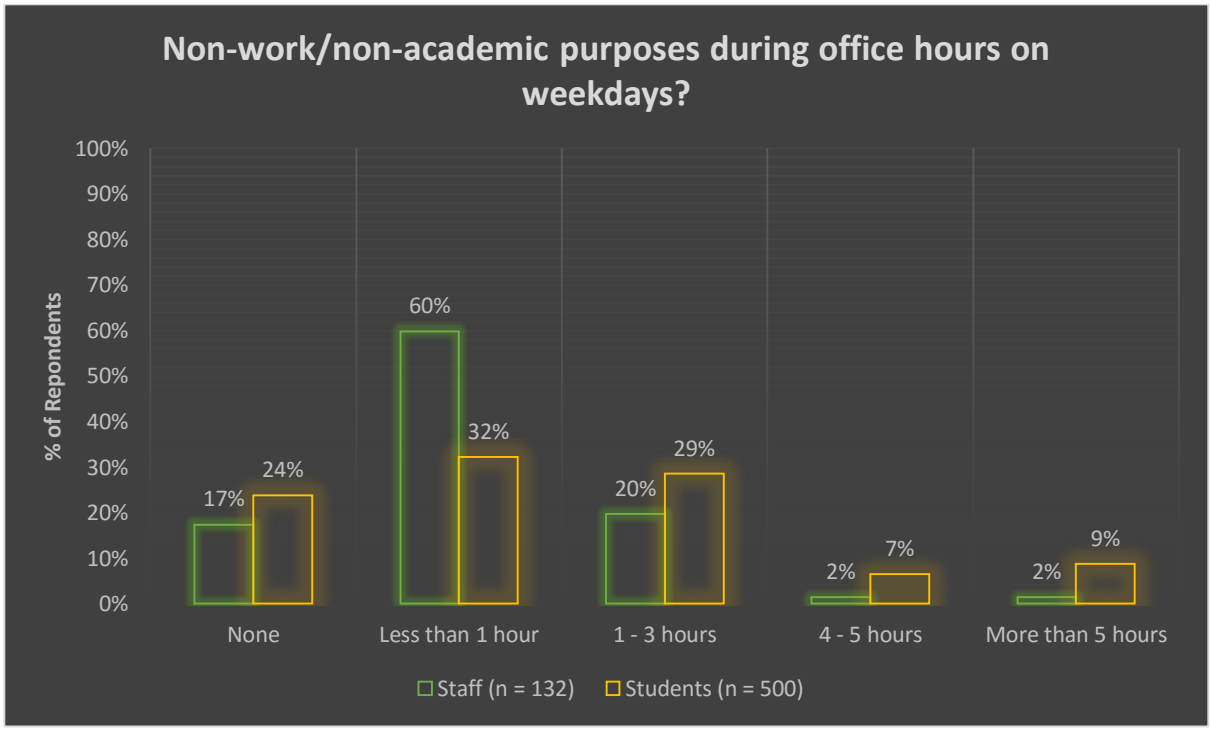

Figure 5.21: Non-work/non-academic purposes during office hours on weekdays?

Figure 5.21 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'How many hours per day on average do you use NMMU's Internet for non-work/non-academic purposes during office hours on weekdays?'. 17 percent (n = 23) of the staff respondents indicated 'None' while 24 percent (n = 119) of the student respondents indicated 'None'. 60 percent (n = 79) of the staff indicated 'Less than 1 hour' per day while 32 percent (n = 161) of the student respondents indicated 'Less than 1 hour' per day. 20 percent (n = 26) of the staff indicated '1 – 3 hours' per day while 29 percent (n = 143) of the student respondents indicated '1 – 3 hours' per day. 2 percent (n = 2) of the staff respondents indicated '4 – 5 hours' per day while 7 percent (n = 33) of the student respondents indicated '4 – 5 hours' per day. Lastly, 2 percent (n = 2) of the staff respondents indicated 'More than 5 hours' per day while 9 percent (n = 44) of the student respondents indicated 'More than 5 hours' per day.

The findings produced $Chi^2 = 38.50$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.25 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings represent that the majority of staff access the NMMU's Internet for non-work/non-academic purposes during office hours on weekdays for less than 1 hour per day. In

comparison, there are more students who excess the NMMU's Internet for non-work/non-academic purposes during office hours on weekdays for less than 1 hour per day followed by the 1 – 3 hours per day period. The NMMU policy does indicate that the use of the NMMU Internet non-work/non-academic purposes is acceptable, but not in excess and it should not interfere with his/her duties. These activities should therefore be monitored via general observation and possibly by the ICT resources (e.g. logs, shaping, throttling, capping, machine or profile limitations). As per the staff findings, it does appear that accessing non-work/non-academic conforms to the lunch and tea breaks. The profiling of the students is, however, not as clear-cut as one may think as each qualification has its own schedule.

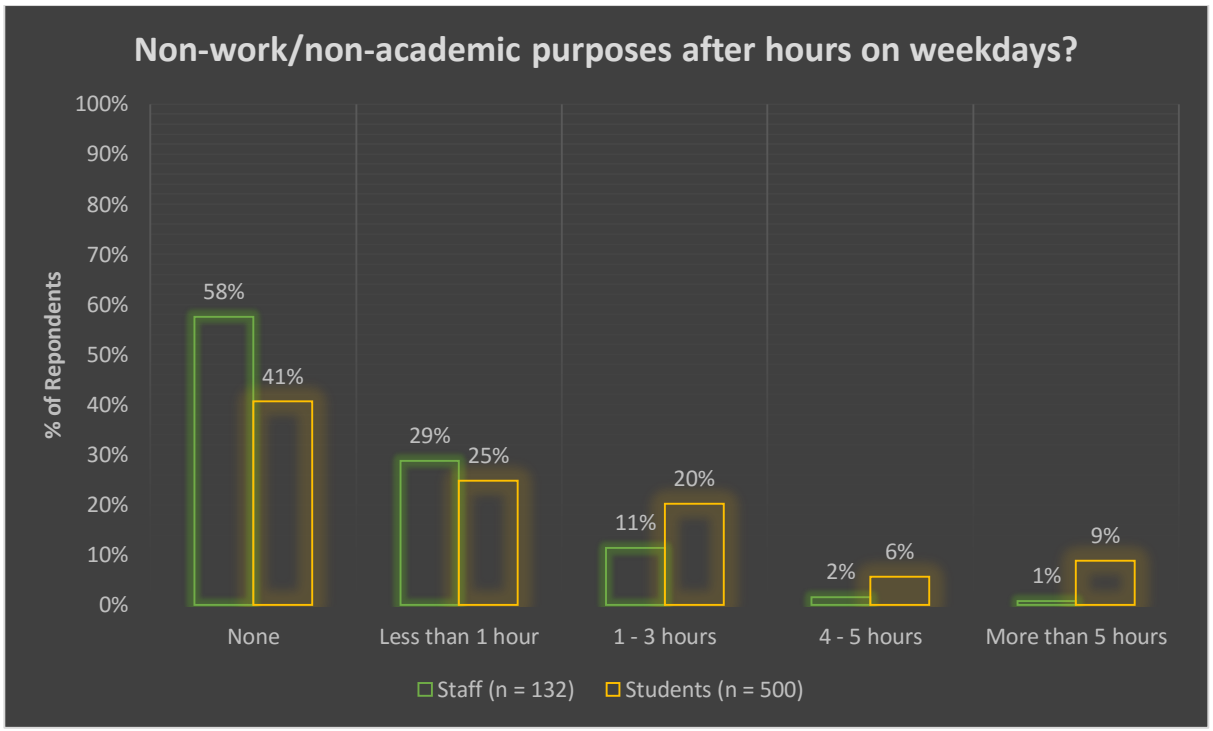

Figure 5.22: Non-work/non-academic purposes after hours on weekdays?

Figure 5.22 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'How many hours per day on average do you use NMMU's Internet for non-work/non-academic purposes after hours on weekdays?'. 58 percent (n = 76) of the staff respondents indicated 'None' while 41 percent (n = 203) of the student respondents indicated 'None'. 29 percent (n = 38) of the staff respondents indicated 'Less than 1 hour' per day while 25 percent (n = 124) of the student respondents indicated 'Less than 1 hour' per day. 11 percent (n = 15) of the staff respondents indicated '1 – 3 hours' per day while 20 percent (n = 101) of the student respondents indicated '1 – 3 hours' per day. 2 percent (n = 2) of the staff respondents indicated '4 – 5 hours' per day while 6 percent (n = 28) of the student respondents indicated '4 – 5 hours' per day. Lastly, 1 percent (n = 1) of the staff respondents indicated

'More than 5 hours' per day while 9 percent (n = 44) of the student respondents indicated 'More than 5 hours' per day.

The findings produced $Chi^2 = 25.06$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.20 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings show that the majority of staff and students do not access the NMMU's Internet for non-work/non-academic purposes after hours on weekdays, with staff being the majority in this grouping. There is, however, a small number of staff and students that access the NMMU's Internet for non-work/non-academic purposes after hours on weekdays for less than 1 hour per day. As previously discussed, the majority of administrative offices close at around 16:30 while the majority of academic offices (lectures) only close at around 20:30. Therefore, most administrative staff would leave at around 16:30 and most academic staff would leave at around 20:30. Some students are therefore still on campus after hours on weekdays.

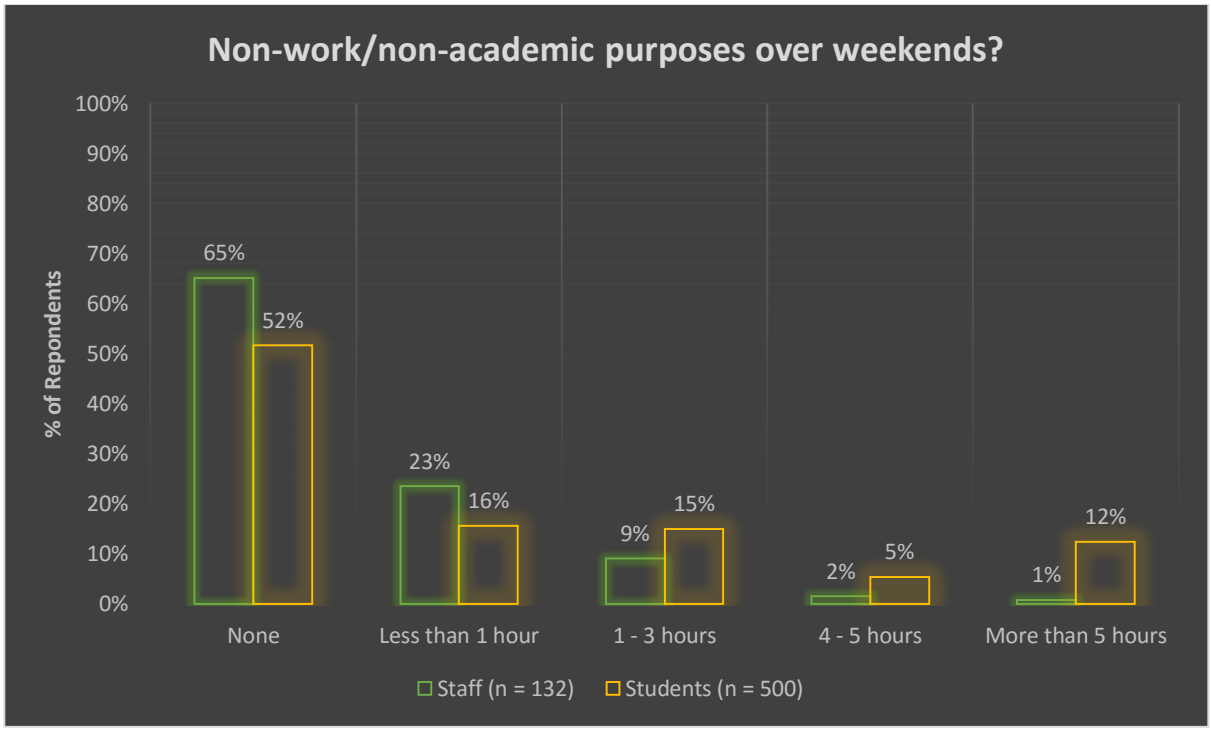

Figure 5.23: Non-work/non-academic purposes over weekends?

Figure 5.23 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'How many hours per day on average do you use NMMU's Internet for non-work/non-academic purposes over weekends?'. 65 percent (n = 86) of the staff

respondents indicated ‘None’ while 52 percent (n = 258) of the student respondents indicated ‘None’. 23 percent (n = 31) of the staff respondents indicated ‘Less than 1 hour’ per day while 16 percent (n = 78) of the student respondents indicated ‘Less than 1 hour’ per day. 9 percent (n = 12) of the staff respondents indicated ‘1 – 3 hours’ per day while 15 percent (n = 75) of the student respondents indicated ‘1 – 3 hours’ per day. 2 percent (n = 2) of the staff respondents indicated ‘4 – 5 hours’ per day while 5 percent (n = 27) of the student respondents indicated ‘4 – 5 hours’ per day. Lastly, 1 percent (n = 1) of the staff respondents indicated ‘More than 5 hours’ per day while 12 percent (n = 62) of the student respondents indicated ‘More than 5 hours’ per day.

The findings produced $Chi^2 = 27.57$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.21 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings represent that the majority of staff and students do not access the NMMU’s Internet for non-work/non-academic purposes over weekends. As previously discussed, the majority of NMMU academic administrative offices are closed on weekends. There are some computer labs that are open to students and some lectured conducted on Saturdays. These are, however, only accessible if a student follows the official security procedures. The staff that do access the NMMU ICT resources can do so via a VPN connection from home. However, for non-work/non-academic purposes they would in most cases use their person Internet connection. The following sub-section will summarise the research findings of Section 3.

5.2.2.5. Summary of Research Findings in Section 3

Section 3: Usage and Access Duration were used to collect information regarding the duration of time used to access the Internet for various purposes. The findings for this section indicate that both staff and students are very active on the Internet during office hours on weekdays with work/academic activities. This would be expected as most will be present at NMMU during this time frame. This is followed by both groups using the NMMU’s Internet for general purposes during office hours. Lastly, as would be expected, both parties are not very active on the Internet with Non-work/non-academic purposes. Regarding the evening, it is evident that work/academic activities still remain the preferred activity. This is followed by Non-work/non-academic activities and lastly general purposes.

Over weekends, there is an overall low rate of not accessing the NMMU Internet. As per the responses, the NMMU's Internet is seldom used for general activities. This is followed by non-work/non-academic purposes, which although still uncommon, it is more common than general activities. Lastly, work/academic activities are the most preferred season for using the NMMU's Internet. This is, however, still not common practice amongst both groups.

In general, non-work/academic purposes are the activity that is least active on the NMMU's Internet. This is followed by general activities. Lastly, NMMU's Internet over the provided periods is used mostly for work/academic purposes.

It is evident that staff and students follow similar trends regarding accessing the NMMU's Internet for different activities. The only difference between staff and students is the frequency distribution within the different time periods as can be detected by the figures and descriptions. ICT Management should recognise these differences and reflect them in the operational policies (Acceptable Use Policy and NMMU General ICT Policy), technical policies (peak and off-peak Internet bandwidth policies) and management/monitoring tools (hard cap, soft cap, per profile limits, per machine limits etc.). The following sub-section will elaborate on the findings for Section 4: Content.

5.2.2.6. Section 4: Content

Figures 5.24 – 5.36 depict the responses (n = 632) received from the staff (n = 132) and students (n = 500) regarding their Internet content preference. The questions are focused on determining what categories of content are accessed at what frequencies. 45 Fortigate Firewall Internet content categories were listed and required the respondents to indicate the frequency of access to each category. Only the most relevant and significant findings will be elaborated on individually below. See Appendix H – NMMUIUS's Content for full list of findings for staff and students.

Figure 5.24 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of Business. 23 percent (n = 30) of the staff respondents indicated 'Never' while 45 percent (n = 224) of the student respondents indicated 'Never'. 40 percent (n = 254) of all respondents indicated 'Never'. 29 percent (n = 38) of the staff respondents indicated 'Less Often' while 28 percent (n = 140) of the student respondents indicated 'Less Often'. 28 percent (n = 178) of all respondents indicated 'Less Often'. 11 percent (n = 14) of the staff respondents indicated 'Monthly' while 6 percent (n = 29) of the student respondents indicated 'Monthly'. 7 percent (n = 43) of all respondents indicated 'Monthly'. 12 percent (n =

16) of the staff respondents indicated 'Weekly' while 12 percent (n = 62) of the student respondents indicated 'Weekly'. 12 percent (n = 78) of all respondents indicated 'Weekly'. Lastly, 26 percent (n = 24) of the staff respondents indicated 'Daily' while 9 percent (n = 45) of the student respondents indicated 'Daily'. 13 percent (n = 79) of all respondents indicated 'Daily'.

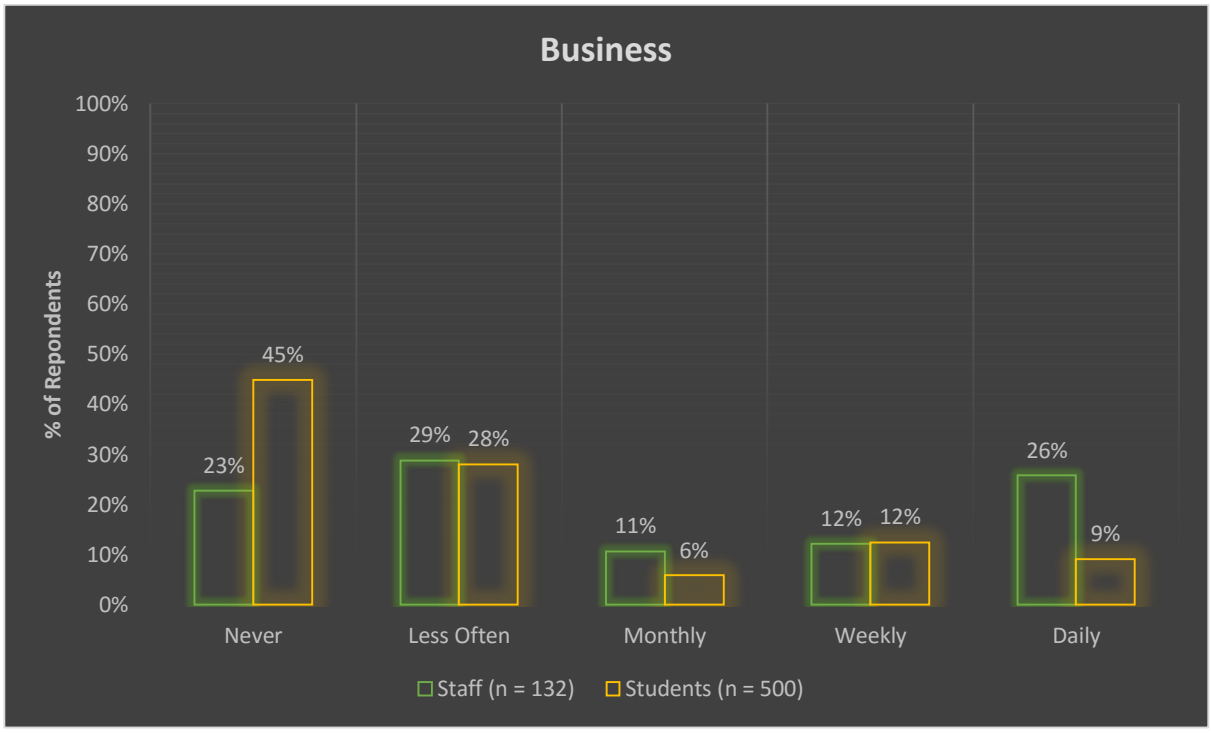

Figure 5.24: Business.

The findings produced $Chi^2 = 39.70$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.25 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings indicate that more staff indicated that they access business-related content less often, with a smaller, however, still relatively large number of staff indicating daily. The majority of students indicated that they never access business-related content followed by some students who access business-related content on a less often basis. It is clear from the findings that the staff access business-related content which must be linked to their KPIs. Some staff are responsible for managing their Sections/Departments/Faculties or doing research in the field of business and are therefore required to stay up-to-date with the business trends. Alternatively, some staff access business–related content to satisfy their own curiosity. Students, however, do not access business-related content as often as staff. Those students

that do access business content are most probably business students or students wishing to stay up-to-date with what is happening in the business world.

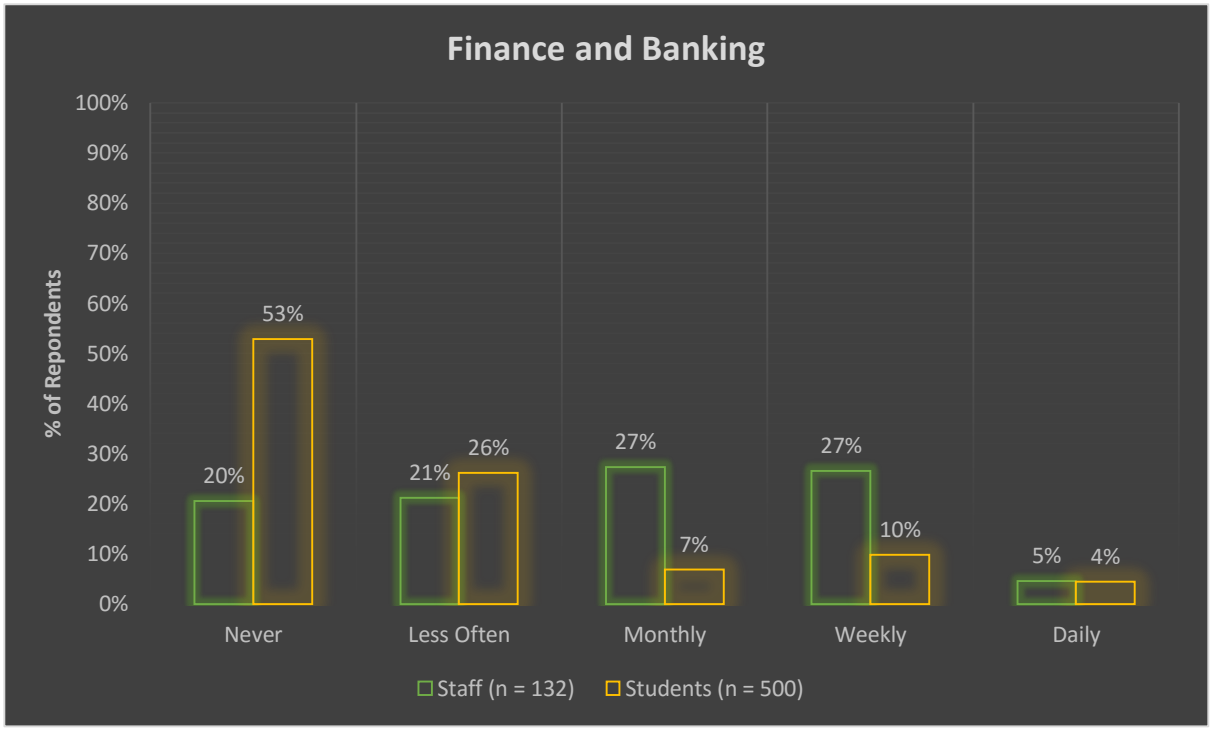

Figure 5.25: Finance and Banking.

Figure 5.25 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of Finance and Banking. 20 percent (n = 27) of the staff respondents indicated 'Never' while 53 percent (n = 264) of the student respondents indicated 'Never'. 46 percent (n = 291) of all respondents indicated 'Never'. 21 percent (n = 28) of the staff respondents indicated 'Less Often' while 26 percent (n = 131) of the student respondents indicated 'Less Often'. 25 percent (n = 159) of all respondents indicated 'Less Often'. 27 percent (n = 36) of the staff respondents indicated 'Monthly' while 7 percent (n = 34) of the student respondents indicated 'Monthly'. 11 percent (n = 70) of all respondents indicated 'Monthly'. 27 percent (n = 35) of the staff respondents indicated 'Weekly' while 10 percent (n = 49) of the student respondents indicated 'Weekly'. 13 percent (n = 84) of all respondents indicated 'Weekly'. Lastly, 5 percent (n = 6) of the staff respondents indicated 'Daily' while 4 percent (n = 22) of the student respondents indicated 'Daily'. 4 percent (n = 28) of all respondents indicated 'Daily'.

The findings produced $Chi^2 = 86.24$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance =

0.37 which indicates that there is a medium variation from the mean and consequently the individual numbers to each other within the data set.

The findings indicate that there are more staff that access finance and banking content on a weekly and monthly basis with some accessing it less often. The majority of students indicated that they never access finance and banking content with a smaller number indicating less often. It is expected that staff (Generation X and Y) would have more financial and banking responsibilities than students (Generation Y and Z). This could be for their work as well as for personal reasons. In addition, due to the security controls implemented in the NMMU environment, it is expected that some staff and students will prefer to conduct Internet banking within this secure environment. It is, however, clear that staff feel safer within this secure environment than students. This is also evident in the question as was found later in this chapter which focuses on their views on the security controls in place.

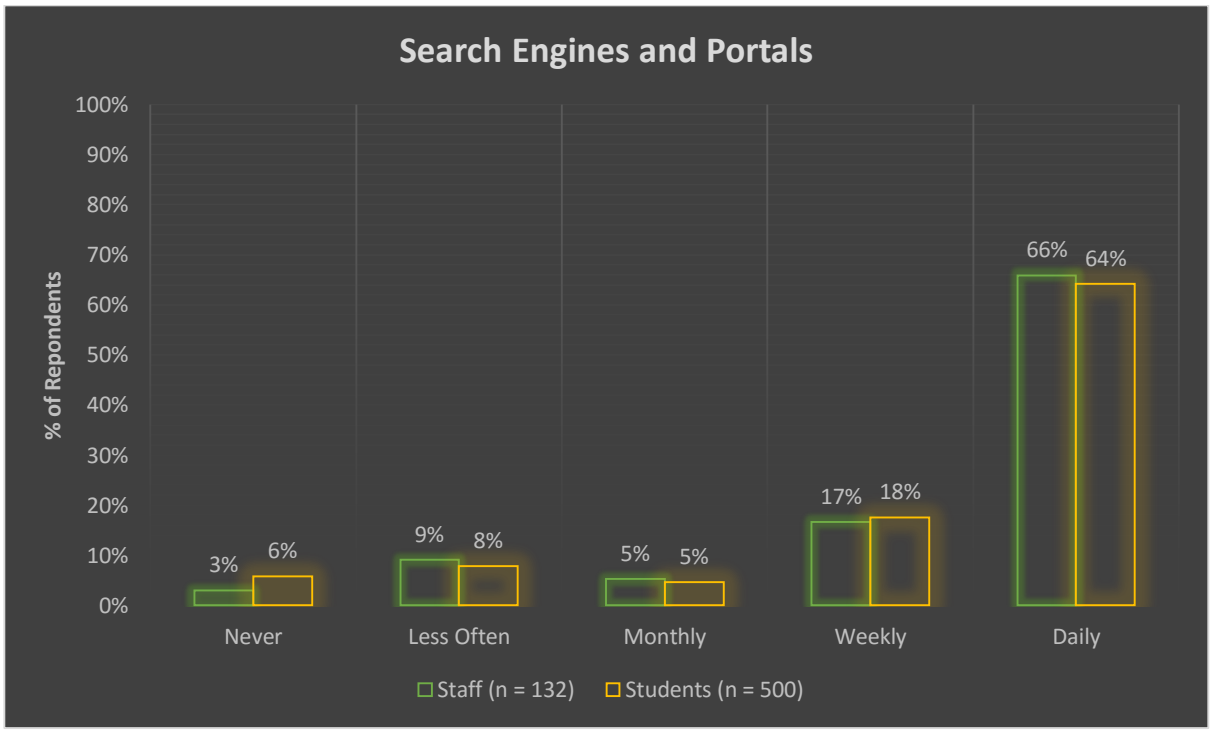

Figure 5.26: Search Engines and Portals.

Figure 5.26 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category, Search Engines and Portals. 3 percent (n = 4) of the staff respondents indicated 'Never' while 6 percent (n = 29) of the student respondents indicated 'Never'. 5 percent (n = 33) of all respondents indicated 'Never'. 9 percent (n = 12) of the staff respondents indicated 'Less Often' while 8 percent (n = 39) of the student respondents indicated 'Less Often'. 8 percent (n = 51) of all respondents indicated 'Less Often'. 5 percent

(n = 7) of the staff respondents indicated 'Monthly' while 5 percent (n = 23) of the student respondents indicated 'Monthly'. 5 percent (n = 30) of all respondents indicated 'Monthly'. 17 percent (n = 22) of the staff respondents indicated 'Weekly' while 18 percent (n = 88) of the student respondents indicated 'Weekly'. 17 percent (n = 110) of all respondents indicated 'Weekly'. Lastly, 66 percent (n = 87) of the staff respondents indicated 'Daily' while 64 percent (n = 321) of the student respondents indicated 'Daily'. 65 percent (n = 408) of all respondents indicated 'Daily'. The findings produced $Chi^2 = 1.96$ which stems from d.f. = 4 and n = 632. p = .743 which indicates that no statistical, significant relationship exists between the variables.

The findings indicate that the majority of staff and students access search engines and portals on a daily basis. Search engines and portals are the gateway to content scattered access the Internet. Search engines and portals help users to find and retrieve content quickly and easily from the Internet or from the Internet NMMU staff and student portals.

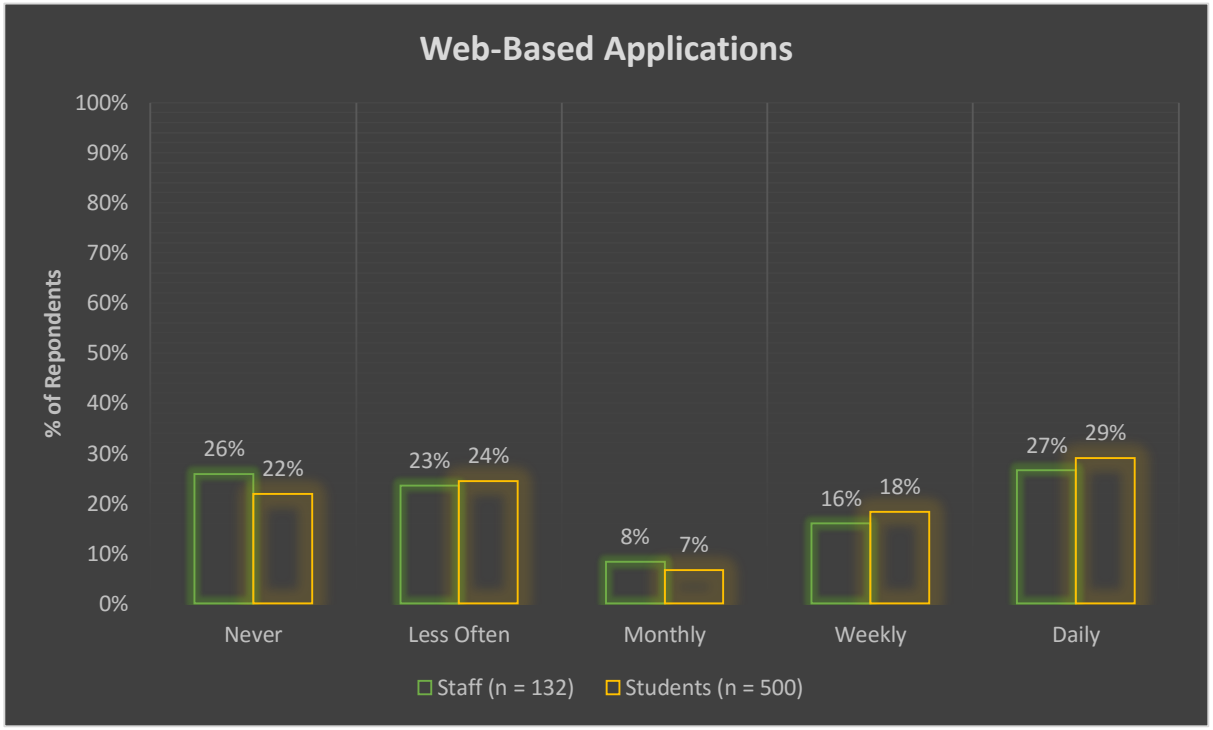

Figure 5.27: Web-Based Applications.

Figure 5.27 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of Web-Based Applications. 26 percent (n = 34) of the staff respondents indicated 'Never' while 22 percent (n = 109) of the student respondents indicated 'Never'. 23 percent (n = 143) of all respondents indicated 'Never'. 23 percent (n = 31) of the staff respondents indicated 'Less Often' while 24 percent (n = 122) of the student respondents indicated 'Less Often'. 24 percent (n = 153) of all respondents indicated 'Less Often'. 8

percent (n = 11) of the staff respondents indicated 'Monthly' while 7 percent (n = 33) of the student respondents indicated 'Monthly'. 7 percent (n = 44) of all respondents indicated 'Monthly'. 16 percent (n = 21) of the staff respondents indicated 'Weekly' while 18 percent (n = 91) of the student respondents indicated 'Weekly'. 18 percent (n = 112) of all respondents indicated 'Weekly'. Lastly, 27 percent (n = 21) of the staff respondents indicated 'Daily' while 29 percent (n = 145) of the student respondents indicated 'Daily'. 28 percent (n = 180) of all respondents indicated 'Daily'. The findings produced $Chi^2 = 1.75$ which stems from d.f. = 4 and n = 632. p = .782 which indicates that no statistical, significant relationship exists between the variables.

The findings indicate that there are more staff and students who access Web-Based Applications on a daily basis. This is followed with some staff and students accessing Web-Based Applications never and less often. A large portion of the NMMU's software is built on Web-Based Applications. These could therefore be the users who have to access this content in order to complete the daily obligations. The remaining users would only have to use these application on a less often basis or they are not required to access this content.

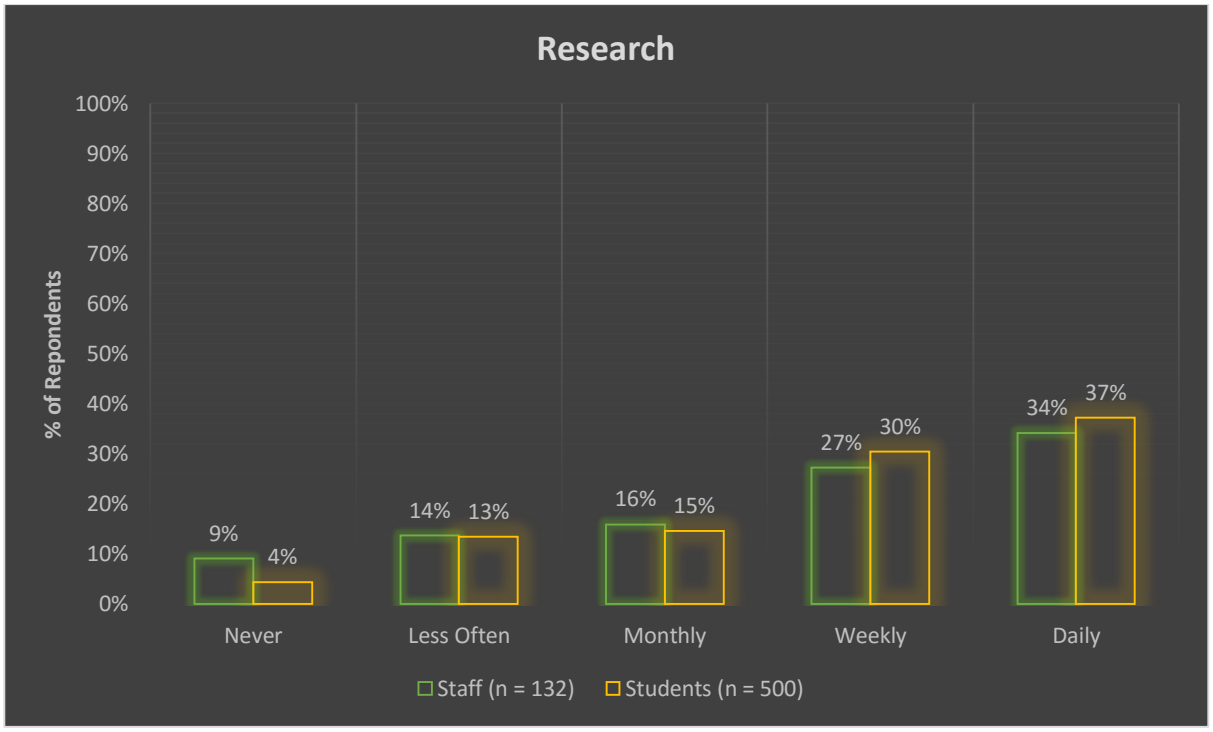

Figure 5.28: Research.

Figure 5.28 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of Research. 9 percent (n = 12) of the staff respondents indicated 'Never' while 4 percent (n = 22) of the student respondents indicated 'Never'. 5 percent (n =

35) of all respondents indicated ‘Never’. 14 percent (n = 18) of the staff respondents indicated ‘Less Often’ while 13 percent (n = 67) of the student respondents indicated ‘Less Often’. 13 percent (n = 85) of all respondents indicated ‘Less Often’. 16 percent (n = 21) of the staff respondents indicated ‘Monthly’ while 15 percent (n = 73) of the student respondents indicated ‘Monthly’. 94 percent (n = 15) of all respondents indicated ‘Monthly’. 27 percent (n = 36) of the staff respondents indicated ‘Weekly’ while 30 percent (n = 152) of the student respondents indicated ‘Weekly’. 30 percent (n = 188) of all respondents indicated ‘Weekly’. Lastly, 34 percent (n = 45) of the staff respondents indicated ‘Daily’ while 37 percent (n = 186) of the student respondents indicated ‘Daily’. 37 percent (n = 231) of all respondents indicated ‘Daily’. The findings produced $Chi^2 = 5.02$ which stems from d.f. = 4 and n = 632. p = .286 which indicates that no statistical, significant relationship exists between the variables.

The findings indicate that the majority of staff and students access research-related content on a daily basis, followed by some staff and students who access research-related content on a weekly basis. Research is one of the three HEI pillars which is one of NMMU’s main sources of income, and the findings clearly indicate that this is being realised.

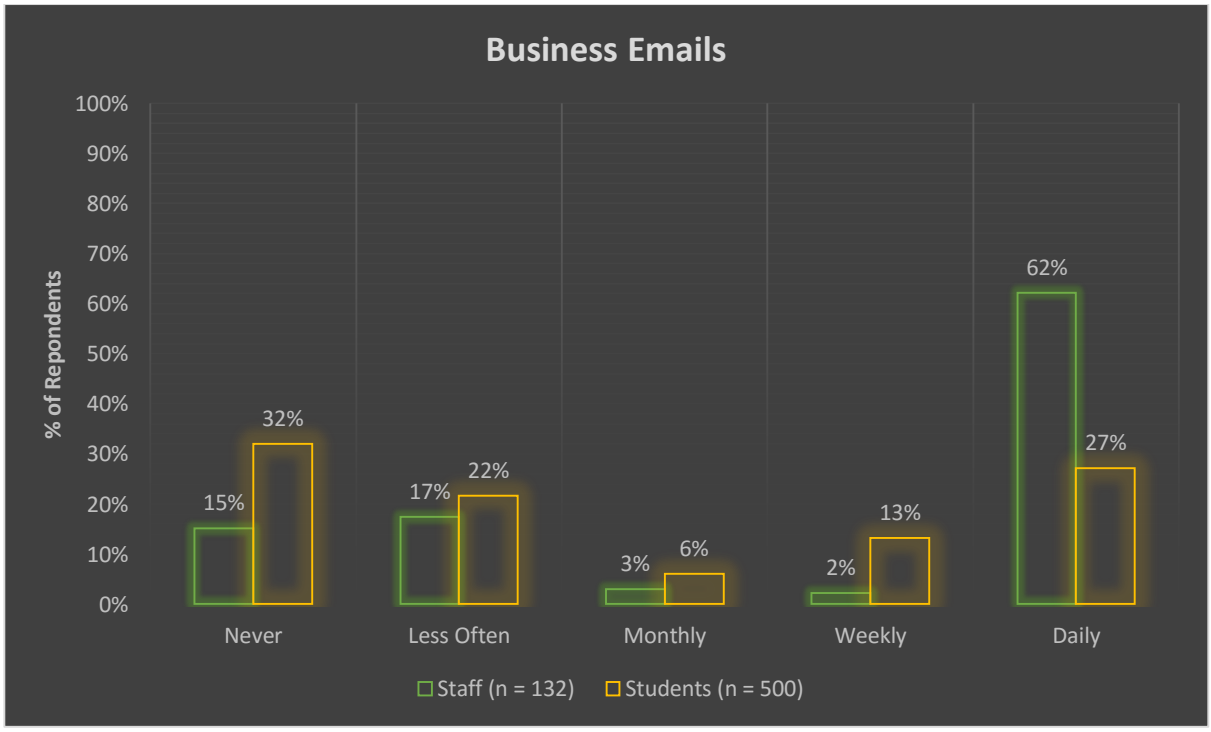

Figure 5.29: Business Emails.

Figure 5.29 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of Business Emails. 15 percent (n = 20) of the staff respondents indicated ‘Never’ while 32 percent (n = 160) of the student respondents indicated ‘Never’. 28

percent (n = 180) of all respondents indicated 'Never'. 17 percent (n = 23) of the staff respondents indicated 'Less Often' while 22 percent (n = 108) of the student respondents indicated 'Less Often'. 21 percent (n = 131) of all respondents indicated 'Less Often'. 3 percent (n = 4) of the staff respondents indicated 'Monthly' while 6 percent (n = 30) of the student respondents indicated 'Monthly'. 5 percent (n = 43) of all respondents indicated 'Monthly'. 2 percent (n = 3) of the staff respondents indicated 'Weekly' while 13 percent (n = 66) of the student respondents indicated 'Weekly'. 11 percent (n = 69) of all respondents indicated 'Weekly'. Lastly, 62 percent (n = 82) of the staff respondents indicated 'Daily' while 27 percent (n = 136) of the student respondents indicated 'Daily'. 34 percent (n = 218) of all respondents indicated 'Daily'.

The findings produced $Chi^2 = 61.34$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.31 which indicates that there is a medium variation from the mean and consequently the individual numbers to each other within the data set.

The findings indicate that the majority of staff access business emails on a daily basis while more students never access business emails followed by some students who access business emails on a daily basis. It is argued that the staff and students who access business emails on a daily basis are employees of either NMMU or an external company. Those that do not access business emails could be staff that are not office bound and full-time students.

Figure 5.30 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of Education. 8 percent (n = 10) of the staff respondents indicated 'Never' while 10 percent (n = 52) of the student respondents indicated 'Never'. 10 percent (n = 62) of all respondents indicated 'Never'. 25 percent (n = 33) of the staff respondents indicated 'Less Often' while 14 percent (n = 72) of the student respondents indicated 'Less Often'. 17 percent (n = 105) of all respondents indicated 'Less Often'. 17 percent (n = 23) of the staff respondents indicated 'Monthly' while 9 percent (n = 43) of the student respondents indicated 'Monthly'. 10 percent (n = 66) of all respondents indicated 'Monthly'. 27 percent (n = 35) of the staff respondents indicated 'Weekly' while 22 percent (n = 111) of the student respondents indicated 'Weekly'. 23 percent (n = 146) of all respondents indicated 'Weekly'. Lastly, 23 percent (n = 31) of the staff respondents indicated 'Daily' while 44 percent (n = 222) of the student respondents indicated 'Daily'. 40 percent (n = 253) of all respondents indicated 'Daily'.

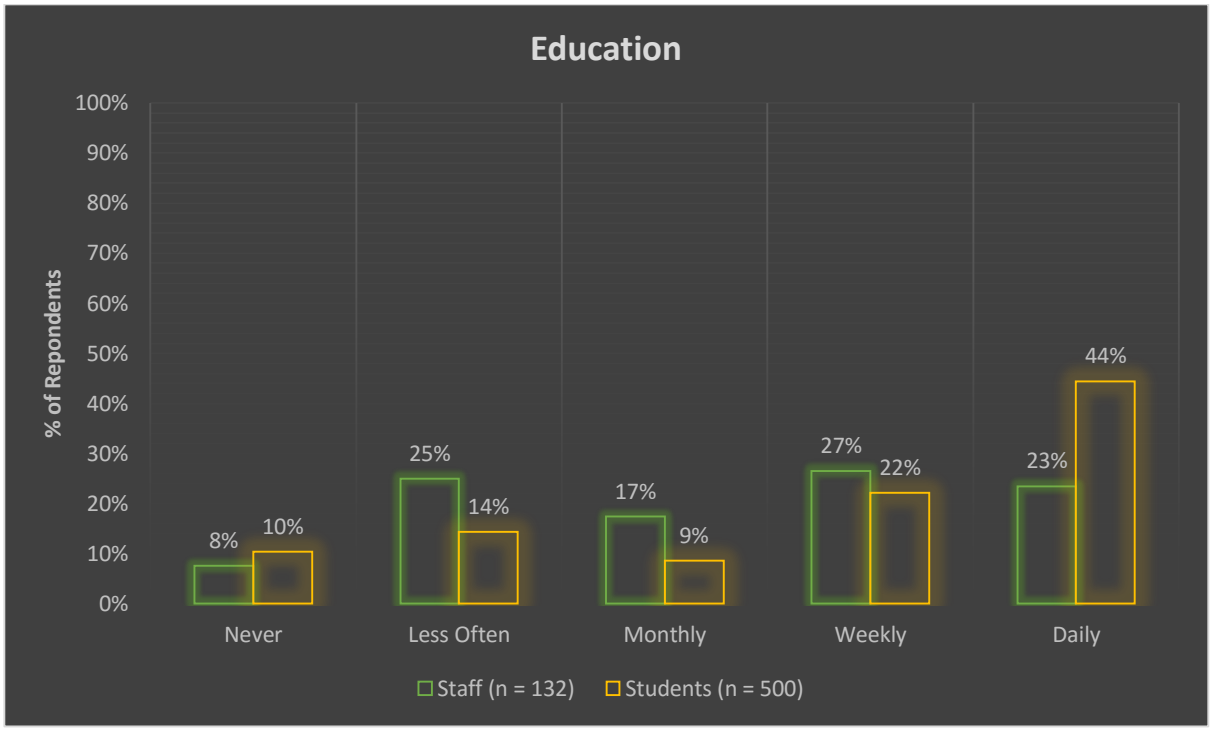

Figure 5.30: Education.

The findings produced $Chi^2 = 27.95$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.21 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings indicate that there are more staff who access educational content on a weekly basis followed by less often and daily. The majority of students access educational content on a daily basis. The staff that do access educational content regularly could be academic staff, staff that have education related KPIs and staff that are studying part-time. Those that do not are most likely administrative staff who are not required to access this type of content for their work circumstances. The students that access educational content are those who do so for their students. It is expected that the students that access educational content less often are those that are handed the material required for the course in class or use physical books from the library to access their educational content.

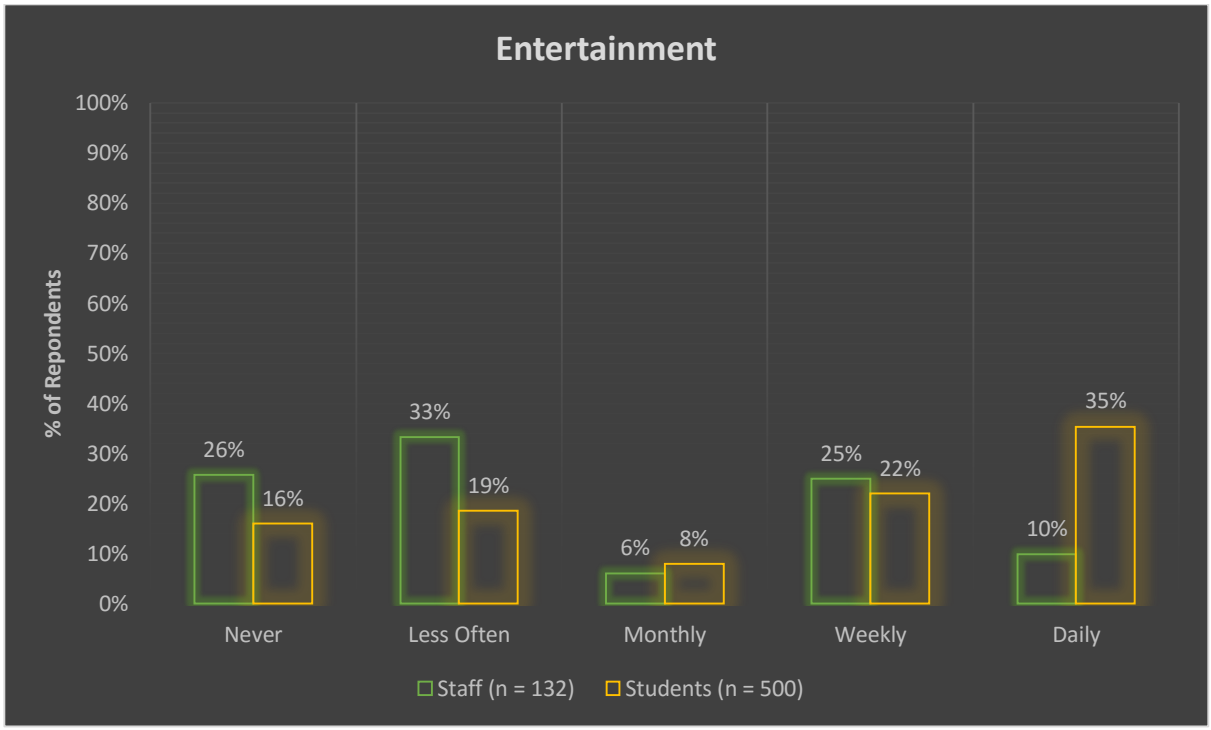

Figure 5.31: Entertainment.

Figure 5.31 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of Entertainment. 26 percent (n = 34) of the staff respondents indicated 'Never' while 16 percent (n = 80) of the student respondents indicated 'Never'. 18 percent (n = 114) of all respondents indicated 'Never'. 33 percent (n = 44) of the staff respondents indicated 'Less Often' while 19 percent (n = 93) of the student respondents indicated 'Less Often'. 22 percent (n = 137) of all respondents indicated 'Less Often'. 6 percent (n = 8) of the staff respondents indicated 'Monthly' while 8 percent (n = 40) of the student respondents indicated 'Monthly'. 8 percent (n = 48) of all respondents indicated 'Monthly'. 25 percent (n = 33) of the staff respondents indicated 'Weekly' while 22 percent (n = 110) of the student respondents indicated 'Weekly'. 23 percent (n = 143) of all respondents indicated 'Weekly'. Lastly, 10 percent (n = 13) of the staff respondents indicated 'Daily' while 35 percent (n = 177) of the student respondents indicated 'Daily'. 30 percent (n = 190) of all respondents indicated 'Daily'.

The findings produced $Chi^2 = 39.58$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.25 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings show that there are more staff who access entertainment-related content less often followed by never and weekly. The majority of students access entertainment-related content on a daily basis. It is argued that the staff and students that do access entertainment related content during breaks or less busy periods as this is not related to most business requirements.

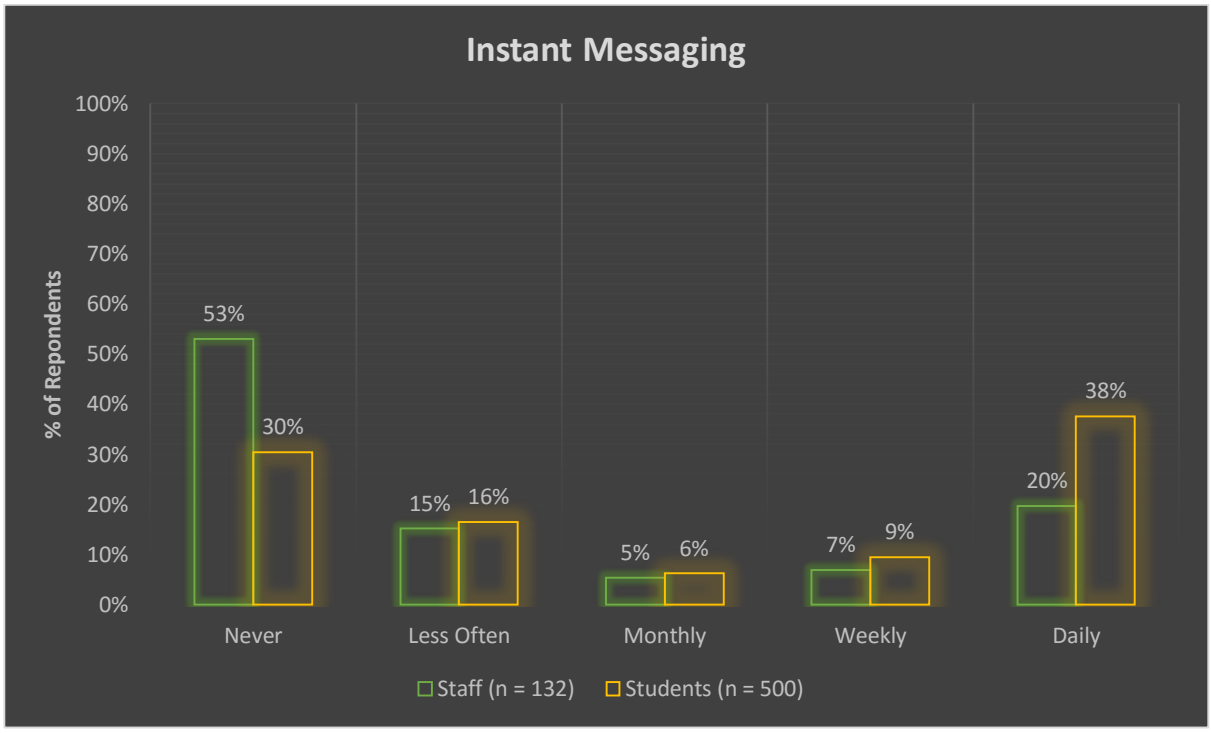

Figure 5.32: Instant Messaging.

Figure 5.32 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of Instant Messaging. 53 percent (n = 70) of the staff respondents indicated 'Never' while 30 percent (n = 152) of the student respondents indicated 'Never'. 35 percent (n = 222) of all respondents indicated 'Never'. 15 percent (n = 20) of the staff respondents indicated 'Less Often' while 16 percent (n = 82) of the student respondents indicated 'Less Often'. 16 percent (n = 102) of all respondents indicated 'Less Often'. 5 percent (n = 7) of the staff respondents indicated 'Monthly' while 6 percent (n = 31) of the student respondents indicated 'Monthly'. 6 percent (n = 38) of all respondents indicated 'Monthly'. 7 percent (n = 9) of the staff respondents indicated 'Weekly' while 9 percent (n = 7) of the student respondents indicated 'Weekly'. 9 percent (n = 56) of all respondents indicated 'Weekly'. Lastly, 20 percent (n = 26) of the staff respondents indicated 'Daily' while 38 percent (n = 118) of the student respondents indicated 'Daily'. 34 percent (n = 214) of all respondents indicated 'Daily'.

The findings produced $Chi^2 = 26.14$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.20 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings indicate that the majority of staff never access Instant messaging content. There are more students who access Instant messaging content on a daily basis followed by some who never access Instant messaging content. These findings are supported in the question found later in this chapter which focuses on the primary purpose for the use of the NMMU's Internet.

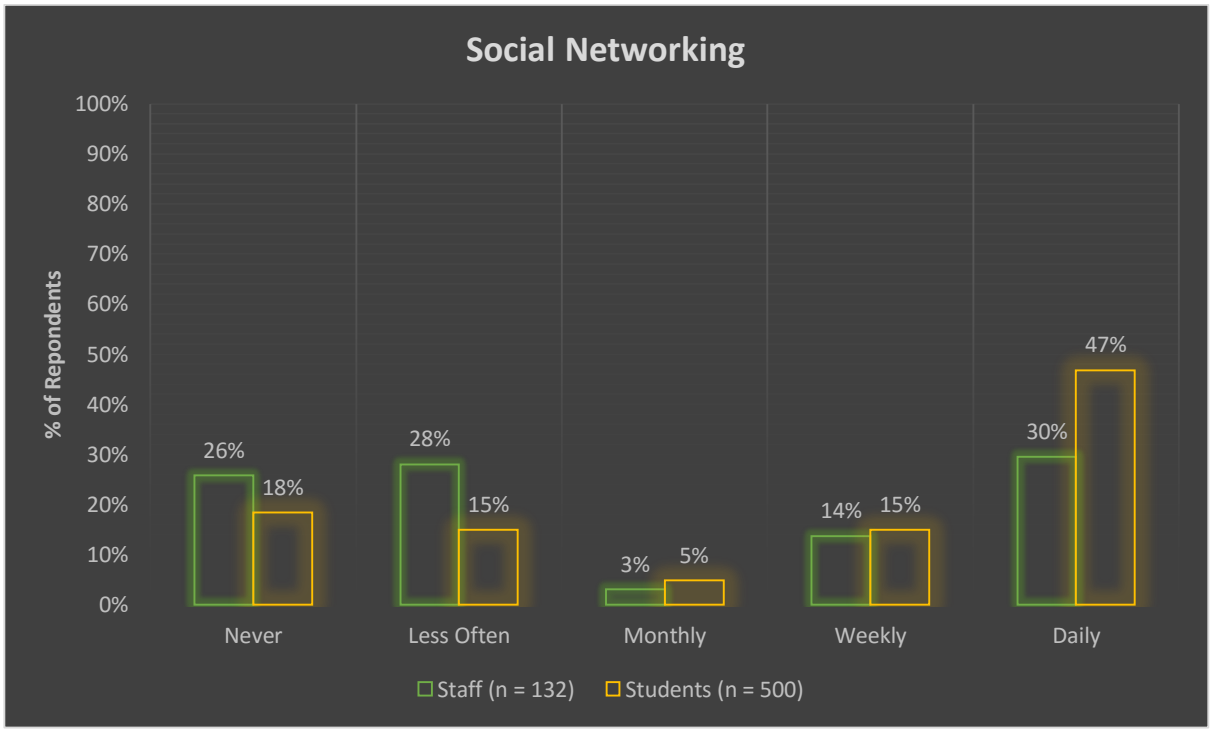

Figure 5.33: Social Networking.

Figure 5.33 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of Social Networking. 26 percent (n = 34) of the staff respondents indicated 'Never' while 18 percent (n = 92) of the student respondents indicated 'Never'. 20 percent (n = 126) of all respondents indicated 'Never'. 28 percent (n = 37) of the staff respondents indicated 'Less Often' while 15 percent (n = 75) of the student respondents indicated 'Less Often'. 18 percent (n = 112) of all respondents indicated 'Less Often'. 3 percent (n = 4) of the staff respondents indicated 'Monthly' while 5 percent (n = 24) of the student respondents indicated 'Monthly'. 4 percent (n = 28) of all respondents indicated 'Monthly'. 14 percent (n = 18) of the staff respondents indicated 'Weekly' while 15 percent (n

= 75) of the student respondents indicated 'Weekly'. 15 percent (n = 93) of all respondents indicated 'Weekly'. Lastly, 30 percent (n = 39) of the staff respondents indicated 'Daily' while 47 percent (n = 234) of the student respondents indicated 'Daily'. 43 percent (n = 273) of all respondents indicated 'Daily'.

The findings produced $Chi^2 = 20.91$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.18 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings show that there are more staff that access social networking content on a daily basis followed by less often and never. The majority of students access social networking content on a daily basis. This supports the generation difference as highlighted in the age section found earlier in this chapter. Those staff that do access social networking content could do so during breaks or as part of their daily work obligations. Students on the other hand are dependent on staying connected with friends and family via social networking.

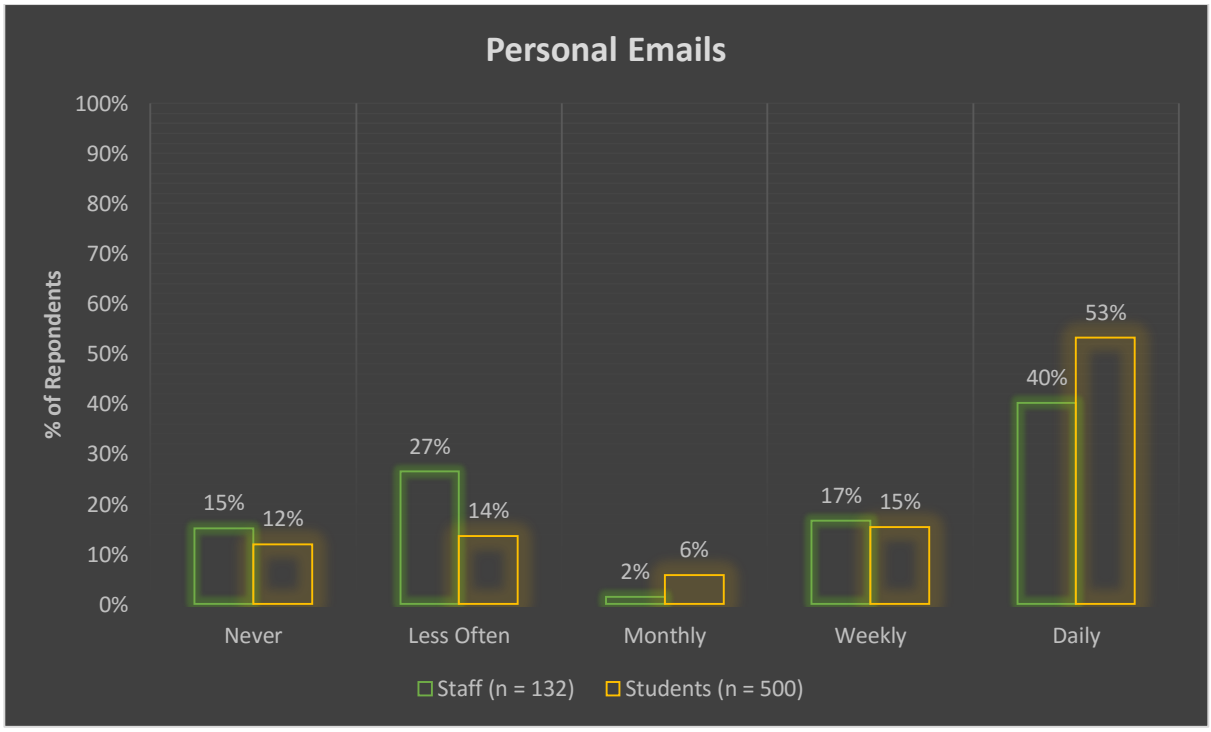

Figure 5.34: Personal Emails.

Figure 5.34 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of Personal Emails. 15 percent (n = 20) of the staff respondents indicated 'Never' while 12 percent (n = 60) of the student respondents indicated 'Never'. 13

percent (n = 80) of all respondents indicated ‘Never’. 27 percent (n = 35) of the staff respondents indicated ‘Less Often’ while 14 percent (n = 68) of the student respondents indicated ‘Less Often’. 16 percent (n = 103) of all respondents indicated ‘Less Often’. 2 percent (n = 2) of the staff respondents indicated ‘Monthly’ while 6 percent (n = 29) of the student respondents indicated ‘Monthly’. 5 percent (n = 31) of all respondents indicated ‘Monthly’. 17 percent (n = 22) of the staff respondents indicated ‘Weekly’ while 15 percent (n = 77) of the student respondents indicated ‘Weekly’. 16 percent (n = 99) of all respondents indicated ‘Weekly’. Lastly, 40 percent (n = 53) of the staff respondents indicated ‘Daily’ while 53 percent (n = 266) of the student respondents indicated ‘Daily’. 50 percent (n = 319) of all respondents indicated ‘Daily’.

The findings produced $Chi^2 = 19.05$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.17 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings indicate that the majority of staff and students access their personal emails on a daily basis. This could pose a security risk as the email accounts are not monitored and filtered as are the business emails. Therefore, this could introduce threats into the NMMU environment which may include malicious content, malware, leaked sensitive business information etc.

Figure 5.35 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of News and Media. 7 percent (n = 9) of the staff respondents indicated ‘Never’ while 16 percent (n = 82) of the student respondents indicated ‘Never’. 14 percent (n = 91) of all respondents indicated ‘Never’. 31 percent (n = 41) of the staff respondents indicated ‘Less Often’ while 16 percent (n = 82) of the student respondents indicated ‘Less Often’. 14 percent (n = 91) of all respondents indicated ‘Less Often’. 9 percent (n = 12) of the staff respondents indicated ‘Monthly’ while 10 percent (n = 51) of the student respondents indicated ‘Monthly’. 10 percent (n = 63) of all respondents indicated ‘Monthly’. 18 percent (n = 24) of the staff respondents indicated ‘Weekly’ while 24 percent (n = 119) of the student respondents indicated ‘Weekly’. 23 percent (n = 143) of all respondents indicated ‘Weekly’. Lastly, 35 percent (n = 46) of the staff respondents indicated ‘Daily’ while 34 percent (n = 169) of the student respondents indicated ‘Daily’. 34 percent (n = 215) of all respondents indicated ‘Daily’.

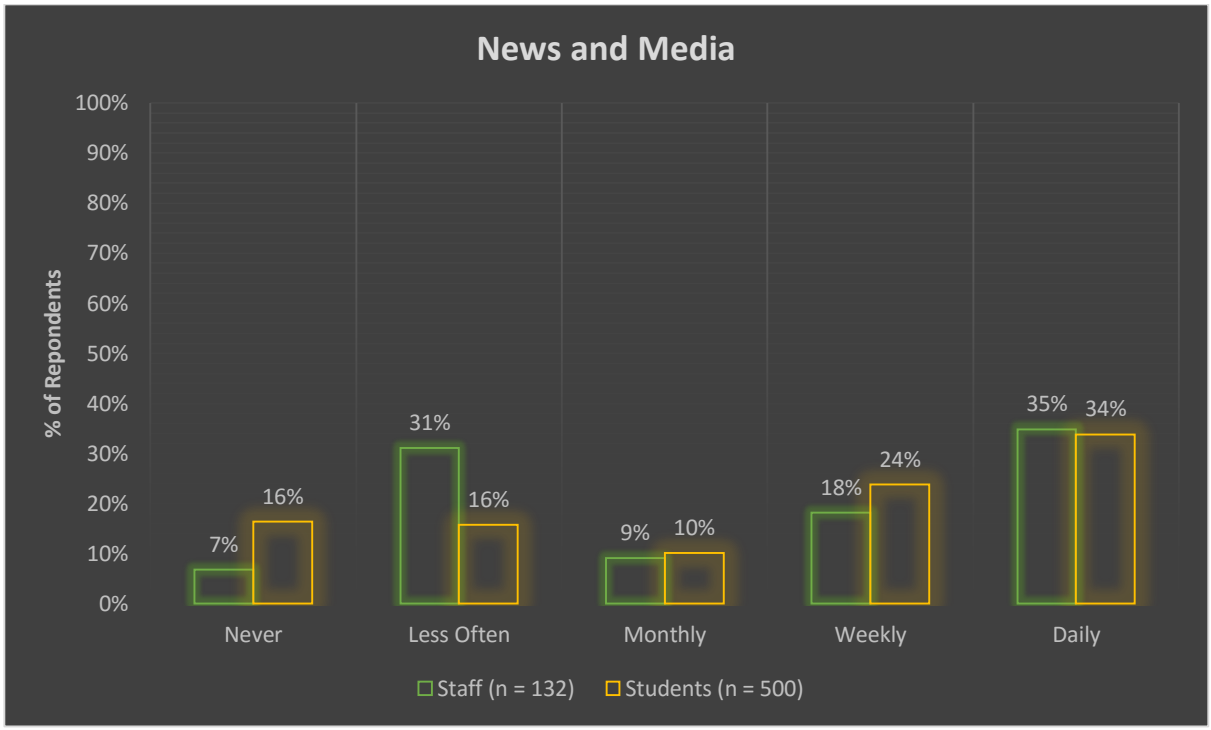

Figure 5.35: News and Media.

The findings produced $Chi^2 = 21.09$ which stems from d.f. = 4 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.18 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

The findings indicate that there are more staff and students who access News and Media content on a daily basis. In addition, there are some staff that access News and Media less often. In most cases this is not a KPI per se, but helps the users stay up-to-date with the national and international activities.

Figure 5.36 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the category of Secure Websites. 17 percent (n = 22) of the staff respondents indicated 'Never' while 16 percent (n = 81) of the student respondents indicated 'Never'. 16 percent (n = 101) of all respondents indicated 'Never'. 11 percent (n = 14) of the staff respondents indicated 'Less Often' while 17 percent (n = 87) of the student respondents indicated 'Less Often'. 16 percent (n = 101) of all respondents indicated 'Less Often'. 11 percent (n = 14) of the staff respondents indicated 'Monthly' while 7 percent (n = 36) of the student respondents indicated 'Monthly'. 8 percent (n = 50) of all respondents indicated 'Monthly'. 19 percent (n = 25) of the staff respondents indicated 'Weekly' while 17 percent (n = 86) of the student respondents indicated 'Weekly'. 18 percent (n = 111) of all respondents

indicated ‘Weekly’. Lastly, 43 percent (n = 57) of the staff respondents indicated ‘Daily’ while 42 percent (n = 210) of the student respondents indicated ‘Daily’. 42 percent (n = 267) of all respondents indicated ‘Daily’. The findings produced $Chi^2 = 4.78$ which stems from d.f. = 4 and n = 632. p = .311 which indicates that no statistical, significant relationship exists between the variables.

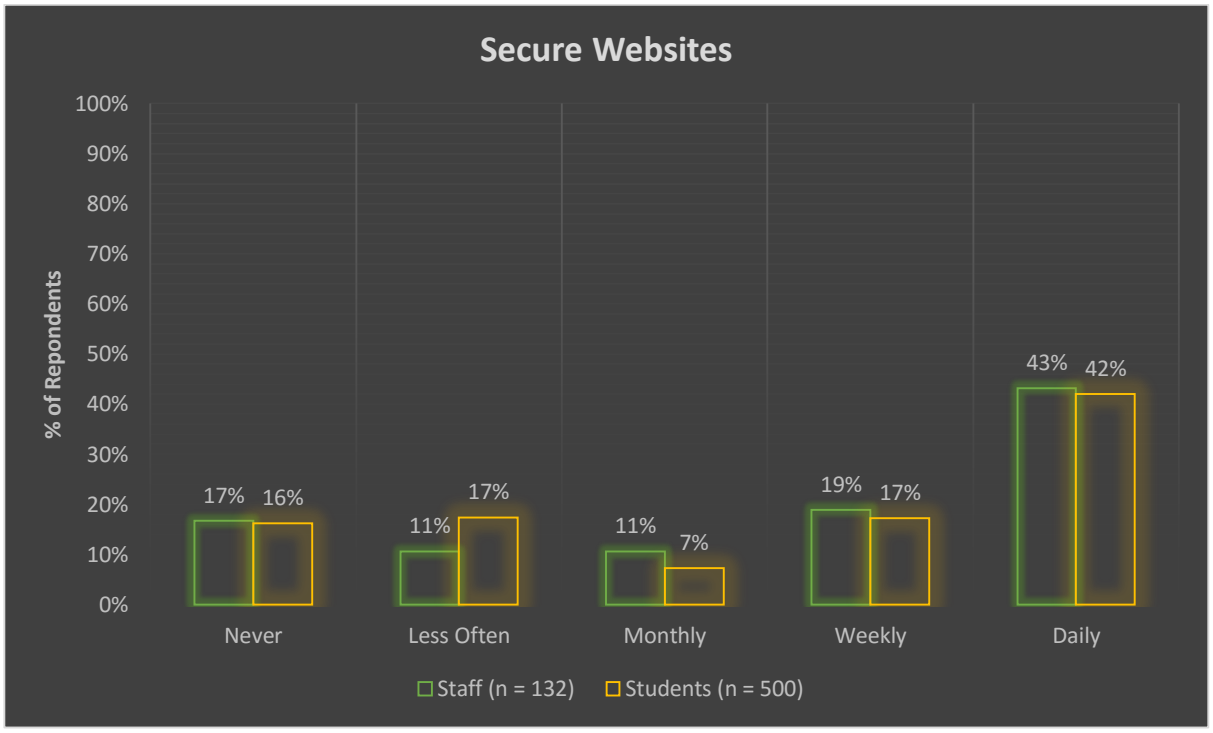

Figure 5.36: Secure Websites.

The findings show that the majority of staff and students access secure websites on a daily basis. In light of the Edward Snowden saga, most websites have opted to move towards being secure. These findings are therefore expected. On the other hand, some websites are created to hide the users’ activities to allow them to engage in illegal activities. These activities are, however, extremely difficult to track as the only method to view the activities is to perform a ‘Man-in-the-Middle’ attack which is an invasion of privacy. It is vital than NMMU ensure that the NMMU ICT General Policy or Acceptable Use Policy clearly indicates what activities are allowed and what is not allowed. The following sub-section will summarise the research findings of Section 4.

5.2.2.7. Summary of Research Findings in Section 4

Section 4: Content was used to collect the respondents’ content usage according to the Fortiguard Categorisation Criteria. The section highlighted the most relevant and significant findings from all 45 categories. The top content categories are Business, Finance and

Banking, Search Engines and Portals, Web-Based Applications, Research, Business Emails, Education, Entertainment, Instant Messaging, Social Networking, Personal Emails, News and Media and Secure Websites. These emphasised categories are important but not relevant to both staff and students. The frequency of access to these categories does differ between the two groups. Table 5.1 lists the top business-related content usage and Table 5.2 lists the top personal-related content usage for both staff and students. These categories are indicated as per the findings in this section. Therefore, some categories may not be fully populated as the findings indicated that the remaining categories is not of significance to the other group.

Ranking	Staff	Students
1	Business emails	Education
2	Research	Research
3	Web-based applications	Web-based applications
4	Education	
5	Business	

Table 5.1: Top business-related content usage.

Ranking	Staff	Students
1	Search engines and portals	Search engines and portals
2	Secure websites	Personal emails
3	Personal emails	Social networking
4	News and media	Secure websites
5	Social networking	Instant messaging
6	Finance and Banking	Entertainment
7		News and media

Table 5.2: Top personal-related content usage.

The top content categories as highlighted above need to be considered when creating NMMU policies (operational and physical). The business-related content must receive top priority over and above the personal-related content. The personal-related content should receive top priority within the personal-related content policies. These changes will allow the staff and students to have enough Internet resources allocated to their top requirements for Internet usage. The other categories that was listed but did not make it onto the list may receive a very small percentage of bandwidth as these are clearly not being accessed and utilised fully by staff and students. These top categories should then be cross-referenced with the Usage

and Access Duration as previously discussed in this chapter. The following sub-section will elaborate on the findings for Section 5: Primary Purpose.

5.2.2.8. Section 5: Primary Purpose

Figures 5.37 – 5.39 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) regarding their primary purpose for accessing the NMMU's Internet during office hours, after office hours and weekends. The respondents were asked to identify only the top three primary purposes for accessing the NMMU's Internet during each timeframe from the list provided. Due to a fault in the research instruments, the respondents could select as many as they wanted. Some participants therefore did not adhere to the top three activities as requested. Each question will be elaborated on individually below.

Figure 5.37 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'What are your TOP 3 PRIMARY uses for NMMU's Internet during office hours on weekdays?'. 23 percent (n = 31) of the staff respondents indicated 'File Storage and Sharing' while 18 percent (n = 92) of the student respondents indicated 'File Storage and Sharing'. The findings produced $Chi^2 = 1.72$ which stems from d.f. = 1 and n = 632. p = .189 which indicates that no statistical, significant relationship exists between the variables.

11 percent (n = 14) of the staff respondents indicated 'Instant Messengers' while 32 percent (n = 160) of the student respondents indicated 'Instant Messengers'. The findings produced $Chi^2 = 23.96$ which stems from d.f. = 1 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.19 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. 26 percent (n = 34) of the staff respondents indicated 'News and Sports' while 23 percent (n = 116) of the student respondents indicated 'News and Sports'. The findings produced $Chi^2 = 0.38$ which stems from d.f. = 1 and n = 632. p = .539 which indicates that no statistical, significant relationship exists between the variables.

61 percent (n = 81) of the staff respondents indicated 'Research' while 68 percent (n = 338) of the student respondents indicated 'Research'. The findings produced $Chi^2 = 1.82$ which stems from d.f. = 1 and n = 632. p = .178 which indicates that no statistical, significant relationship exists between the variables. 23 percent (n = 30) of the staff respondents indicated 'Social Networking' while 39 percent (n = 197) of the student respondents indicated 'Social Networking'. The findings produced $Chi^2 = 12.61$ which stems from d.f. = 1 and n =

632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.14 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

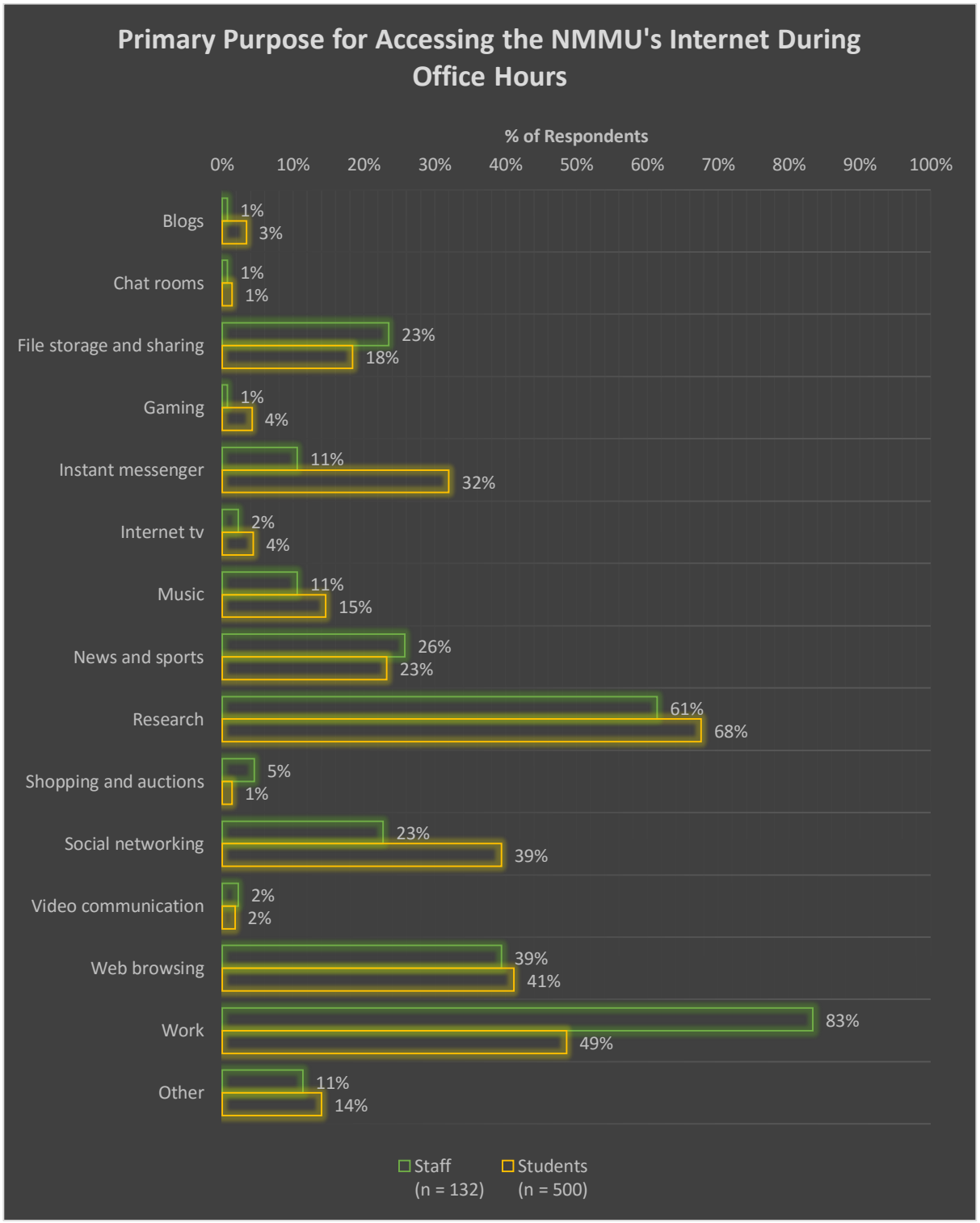

Figure 5.37: Primary purpose for accessing the NMMU's Internet during office hours.

39 percent (n = 52) of the staff respondents indicated 'Web Browsing' while 41 percent (n = 206) of the student respondents indicated 'Web Browsing'. The findings produced $Chi^2 = 0.14$ which stems from d.f. = 1 and n = 632. p = .707 which indicates that no statistical, significant relationship exists between the variables. 83 percent (n = 110) of the staff respondents indicated 'Work' while 49 percent (n = 243) of the student respondents indicated 'Work'. The findings produced $Chi^2 = 51.09$ which stems from d.f. = 1 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.28 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. The staff responses had a standard deviation of 0,95 and the students had a standard deviation of 1,52.

From the findings it is clear that the top six primary purposes for staff, in order of preference are Work, Research, Web Browsing, News and Sports, Fire Storage and Sharing and Social Networking. The top six primary purposes for students, in order of preference are Research, Work, Web Browsing, Social Networking, Instant Messaging and News and Sports. The primary purposes of staff and students are therefore extremely similar with the only exceptions being File Storage and Sharing (staff reference) and Instant Messaging (students).

Figure 5.38 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'What are your TOP 3 PRIMARY uses for NMMU's Internet after office hours on weekdays?'. 9 percent (n = 12) of the staff respondents indicated 'File Storage and Sharing' while 14 percent (n = 70) of the student respondents indicated 'File Storage and Sharing'. The findings produced $Chi^2 = 2.23$ which stems from d.f. = 1 and n = 632. p = .135 which indicates that no statistical, significant relationship exists between the variables.

5 percent (n = 6) of the staff respondents indicated 'Instant Messengers' while 31 percent (n = 155) of the student respondents indicated 'Instant Messengers'. The findings produced $Chi^2 = 38.50$ which stems from d.f. = 1 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.25 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. 7 percent (n = 9) of the staff respondents indicated 'Music' while 25 percent (n = 125) of the student respondents indicated 'Music'. The findings produced $Chi^2 = 20.66$ which stems from d.f. = 1 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.18 which indicates that

there is a small variation from the mean and consequently the individual numbers to each other within the data set.

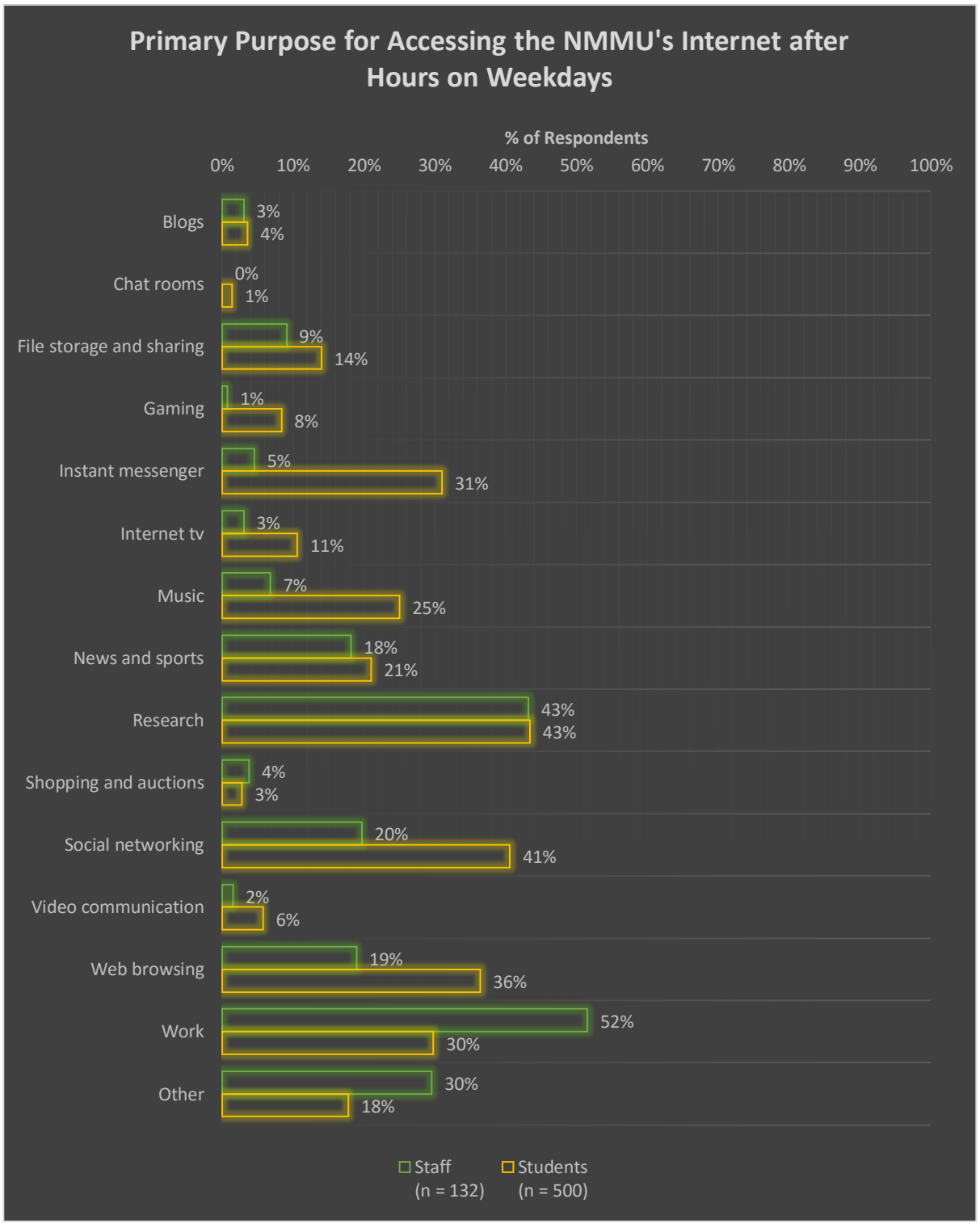

Figure 5.38: Primary purpose for accessing the NMMU's Internet after hours on weekdays.

18 percent (n = 24) of the staff respondents indicated ‘News and Sports’ while 21 percent (n = 105) of the student respondents indicated ‘News and Sports’. The findings produced Chi^2 = 0.51 which stems from d.f. = 1 and n = 632. p = .475 which indicates that no statistical, significant relationship exists between the variables. 43 percent (n = 57) of the staff respondents indicated ‘Research’ while 43 percent (n = 217) of the student respondents indicated ‘Research’. The findings produced Chi^2 = 0.00 which stems from d.f. = 1 and n = 632. p = .964 which indicates that no statistical, significant relationship exists between the variables.

20 percent (n = 26) of the staff respondents indicated ‘Social Networking’ while 41 percent (n = 203) of the student respondents indicated ‘Social Networking’. The findings produced Chi^2 = 19.75 which stems from d.f. = 1 and n = 632. p < .0005 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.18 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. 19 percent (n = 25) of the staff respondents indicated ‘Web Browsing’ while 36 percent (n = 182) of the student respondents indicated ‘Web Browsing’. The findings produced Chi^2 = 14.46 which stems from d.f. = 1 and n = 632. p < .0005 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.15 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

52 percent (n = 68) of the staff respondents indicated ‘Work’ while 30 percent (n = 149) of the student respondents indicated ‘Work’. The findings produced Chi^2 = 21.84 which stems from d.f. = 1 and n = 632. p < .0005 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.19 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. 30 percent (n = 39) of the staff respondents indicated ‘Other’ while 18 percent (n = 89) of the student respondents indicated ‘Other’. The findings produced Chi^2 = 8.92 which stems from d.f. = 1 and n = 632. p = .003 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.12 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. The staff responses had a standard deviation of 1,03 and the students had a standard deviation of 1,66.

The findings indicate that the top six primary purposes for staff, in order of preference are Work, Research, Other, Social Networking, Web Browsing and News and Sports. The top six primary purposes for students, in order of preference are Research, Social Networking, Web

Browsing, Instant Messaging, Work, and Music. The primary purposes amongst staff and students are therefore extremely similar with the only exceptions being News and Sports and Other (staff) and Instant Messaging and Music (students).

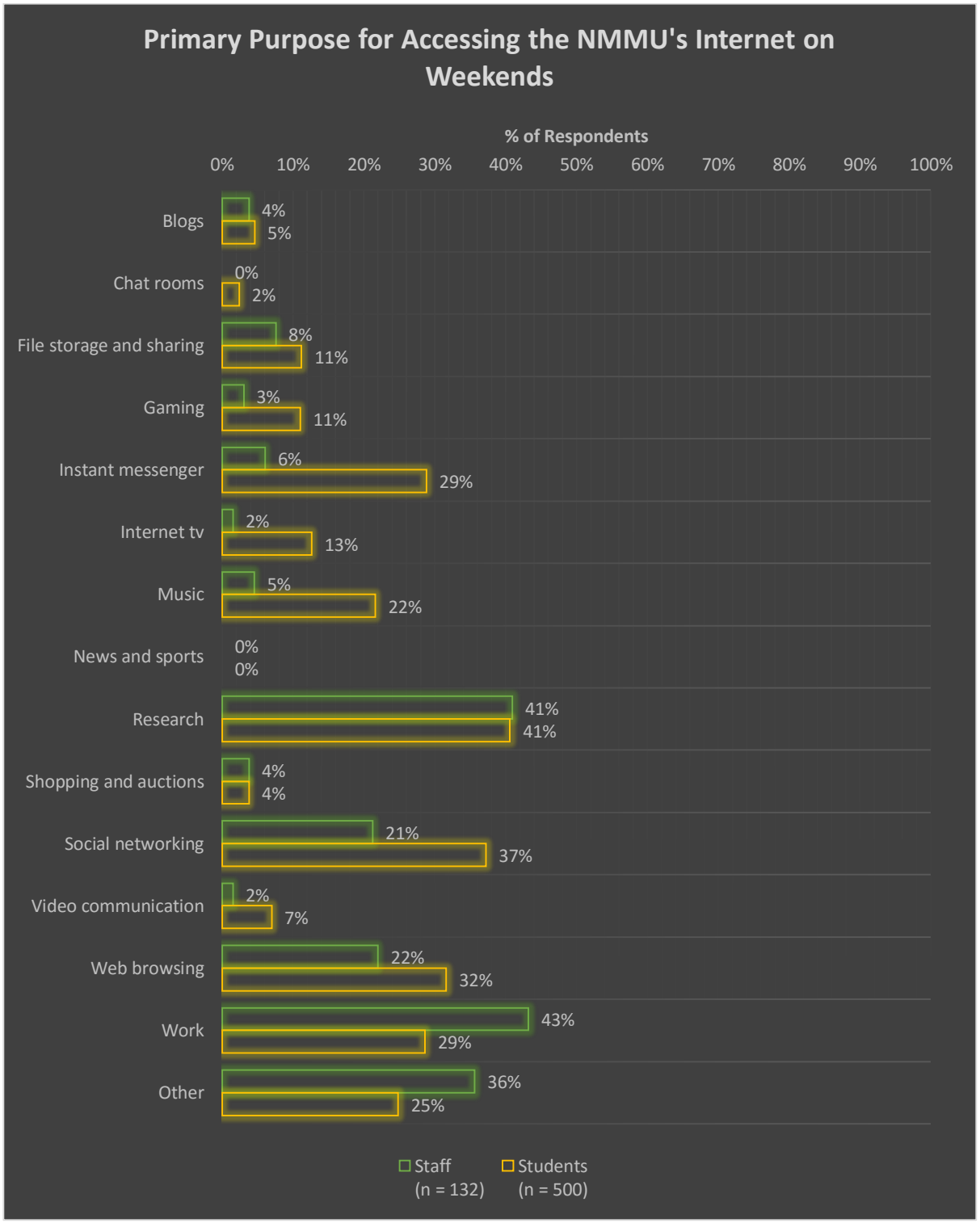

Figure 5.39: Primary purpose for accessing the NMMU's Internet on weekends.

Figure 5.39 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the question 'What are your TOP 3 PRIMARY uses for NMMU's Internet over weekends?'. 8 percent (n = 10) of the staff respondents indicated 'File Storage and Sharing' while 11 percent (n = 55) of the student respondents indicated 'File Storage and Sharing'. The findings produced $Chi^2 = 1.47$ which stems from d.f. = 1 and n = 632. p = .226 which indicates that no statistical, significant relationship exists between the variables.

6 percent (n = 8) of the staff respondents indicated 'Instant Messengers' while 29 percent (n = 144) of the student respondents indicated 'Instant Messengers'. The findings produced $Chi^2 = 29.56$ which stems from d.f. = 1 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.22 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. 41 percent (n = 54) of the staff respondents indicated 'Research' while 41 percent (n = 203) of the student respondents indicated 'Research'. The findings produced $Chi^2 = 00.00$ which stems from d.f. = 1 and n = 632. p = .949 which indicates that no statistical, significant relationship exists between the variables.

4 percent (n = 5) of the staff respondents indicated 'Shopping and Auctions' while 4 percent (n = 19) of the student respondents indicated 'Shopping and Auctions'. The findings produced $Chi^2 = 00.00$ which stems from d.f. = 1 and n = 632. p = .995 which indicates that no statistical, significant relationship exists between the variables. 21 percent (n = 28) of the staff respondents indicated 'Social Networking' while 37 percent (n = 186) of the student respondents indicated 'Social Networking'. The findings produced $Chi^2 = 11.92$ which stems from d.f. = 1 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.14 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set.

43 percent (n = 57) of the staff respondents indicated 'Work' while 29 percent (n = 143) of the student respondents indicated 'Work'. The findings produced $Chi^2 = 10.27$ which stems from d.f. = 1 and n = 632. p = .001 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.13 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. 36 percent (n = 47) of the staff respondents indicated 'Other' while 25 percent (n = 124) of the student respondents indicated 'Other'. The findings produced $Chi^2 = 6.18$ which stems from d.f. = 1 and n = 632. p = .013 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.10 which indicates that there is a small variation from the mean

and consequently the individual numbers to each other within the data set. The staff responses had a standard deviation of 1,04 and the students had a standard deviation of 1,65.

From the findings it is clear that the top six primary purposes for staff, in order of preference are Work, Research, Other, Web Browsing, Social Networking, and Fire Storage and Sharing. The top six primary purposes for students, in order of preference are Research, Social Networking, Web Browsing, Instant Messaging, Work and Other. The primary purposes amongst staff and students are therefore extremely similar with the only exceptions being File Storage and Sharing (staff) and Instant Messaging (students). The following sub-section will summarise the research findings of Section 5.

5.2.2.9. Summary of Research Findings in Section 5

Section 5: Primary Purpose was used to collect the respondents' primary purpose for utilising the NMMU's Internet during the various timeframes. The findings for this section indicate that the majority of staff and student do use the NMMU's Internet for a select few primary purposes and these are common for most periods. There are however a few minor differences visible between the staff and students as well as the different periods. Table 5.3 highlights these trends. Note that each activity is highlighted with the same colour for ease of reading/tracking.

	During Office Hours		After Office Hours		Weekends	
	Staff	**Students**	**Staff**	**Students**	**Staff**	**Students**
1	Work	Research	Work	Research	Work	Research
2	Research	Work	Research	Social Networking	Research	Social Networking
3	Web Browsing	Web Browsing	Other	Web Browsing	Other	Web Browsing
4	News and Sports	Social Networking	Social Networking	Instant Messaging	Web Browsing	Instant Messaging
5	Fire Storage and Sharing	Instant Messaging	Web Browsing	Work	Social Networking	Work
6	Social Networking	News and Sports	News and Sports	Music	Fire Storage and Sharing	Other

Table 5.3: Top 6 primary purposes.

The Internet resources such as Internet bandwidth allocation to the groups, technologies and monitoring systems should be aligned to support these activities and the specific level of requirement during office hours on weekdays, after office hours on weekdays and weekends. It would therefore assist that different profiles be created to address each activity in each period. These policies will reflect minor shifts to accommodate these activity requirements. The following sub-section will elaborate on the findings for Section 6: Management.

5.2.2.10. Section 6: Management

Figures 5.40 – 5.45 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) regarding their general rating on the management of NMMU's Internet resources. The respondents were asked to rate the Internet speed designated to them for work and personal use, the availability of the Internet (coverage areas) in the NMMU environment, the support they receive from ICT Services staff regarding the Internet services, the security controls in place to protect them when surfing the Internet and their overall perception/feeling of the Internet at NMMU. Each question will be elaborated on individually below.

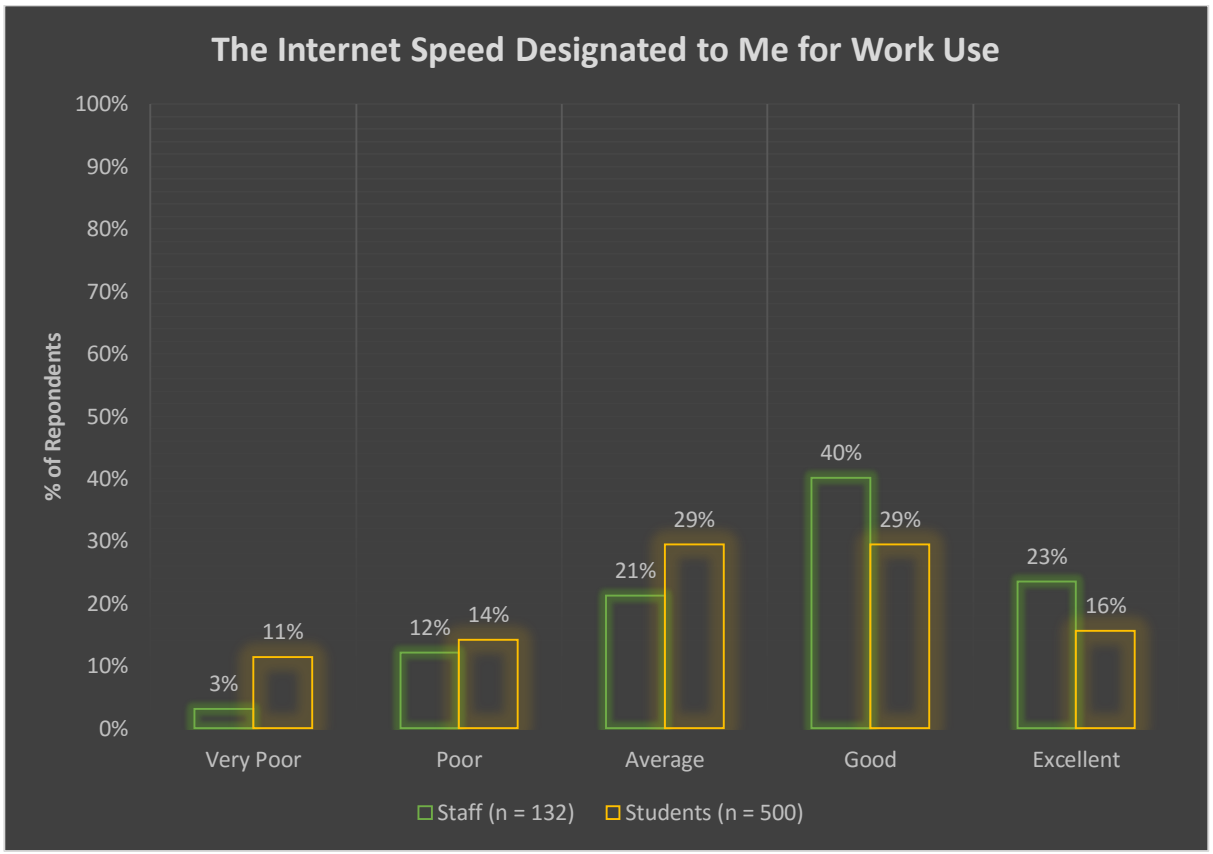

Figure 5.40: The Internet speed designated to me for work use.

Figure 5.40 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the ranking statement 'The Internet speed designated to me for work use'. 3 percent (n = 4) of the staff respondents indicated 'Very Poor' while 11 percent (n = 57) of the student respondents indicated 'Very Poor'. 12 percent (n = 16) of the staff respondents indicated 'Poor' while 14 percent (n = 71) of the student respondents indicated 'Poor'. 21 percent (n = 28) of the staff respondents indicated 'Average' while 29 percent (n = 147) of the student respondents indicated 'Average'. 40 percent (n = 53) of the staff respondents indicated 'Good' while 29 percent (n = 147) of the student respondents indicated 'Good'. 23 percent (n = 31) of the staff respondents indicated 'Excellent' while 16 percent (n = 78) of the student respondents indicated 'Excellent'.

15 percent (n = 20) of the staff respondents had a negative response while 26 percent (n = 128) of the student respondents had a negative response. 23 percent (n = 148) of all respondents had a negative response. 21 percent (n = 28) of the staff respondents had a neutral response while 29 percent (n = 147) of the student respondents had a neutral response. 28 percent (n = 175) of all respondents had a neutral response. 64 percent (n = 84) of the staff respondents had a positive response while 45 percent (n = 225) of the student respondents had a positive response. 49 percent (n = 309) of all respondents had a positive response.

The mean number of staff responses is 3,69 with a standard deviation of 1,06. The median number of staff responses is 4 with the minimum being 1 and maximum being 5. The mean number of student responses is 3,24 with a standard deviation of 1,21. The median number of student responses are 3 with the minimum being 1 and maximum being 5. The difference between the staff and student means is 0,45. The findings produced $Chi^2 = 14.82$ which stems from d.f. = 2 and n = 632. p = .001 which indicates that a statistical, significant relationship exists between the variables. Variance = 0.15 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. t = 3,93 and Cohen's d = 0,38 which indicates a small significance based on the group's means.

The majority of staff indicated that the Internet speed designated to them for work purposes is good (sufficient) with some indicating excellent and average. The students indicated that they are evenly split between the Internet speed designated to them for work purposes being average and good. Other student respondents indicated excellent. It is clear that both staff and students are positive towards the Internet speed designated to them. It is, however, apparent that staff are more positive towards this speed than students. This could be due to the fact that staff are allocated more Internet bandwidth with less stringent controls than

students. If this gap is to be addressed, a review of the assigned Internet capping allocation to the groups, technologies and monitoring systems should be revised to support these activities. A good revision would be to re-align the activities as per the period of use as highlighted in the previous question.

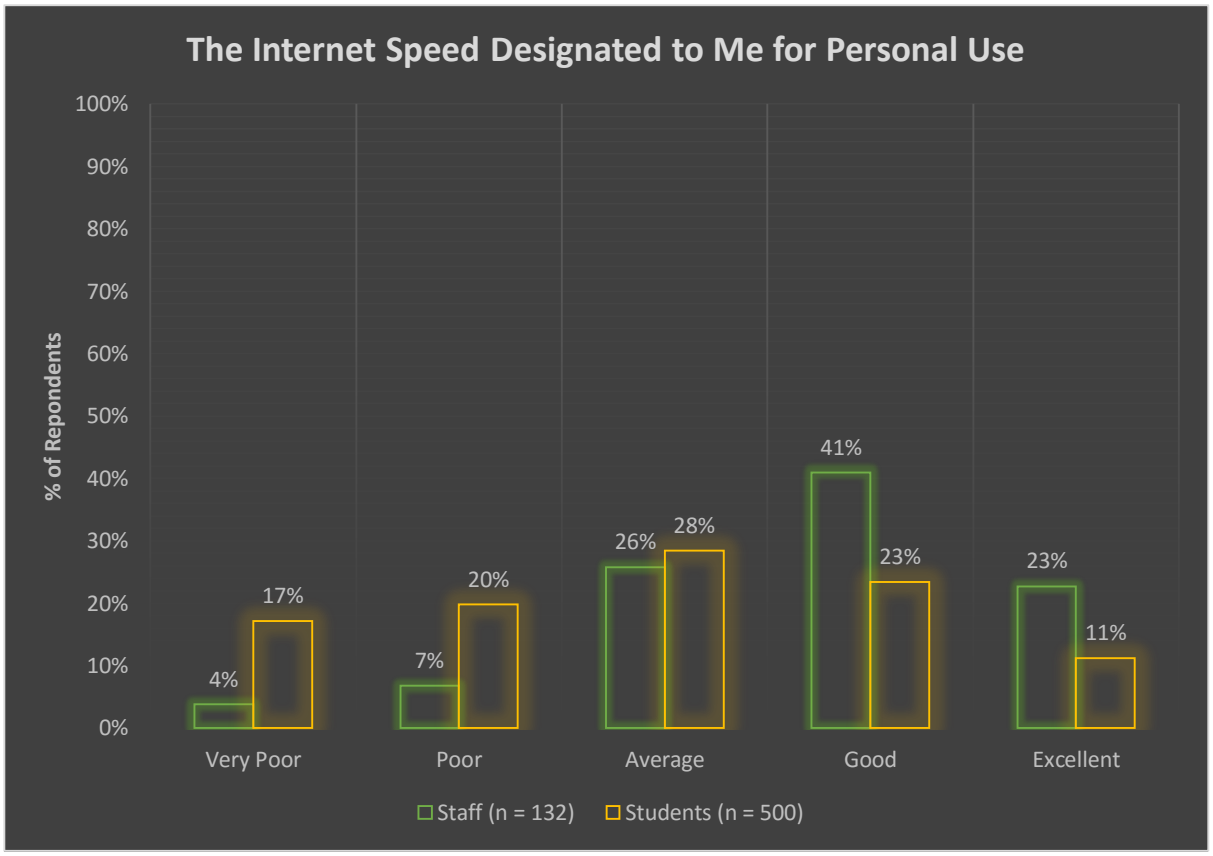

Figure 5.41: The Internet speed designated to me for personal use.

Figure 5.41 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the ranking statement 'The Internet speed designated to me for personal use'. 4 percent (n = 5) of the staff respondents indicated 'Very Poor' while 17 percent (n = 86) of the student respondents indicated 'Very Poor'. 7 percent (n = 9) of the staff respondents indicated 'Poor' while 20 percent (n = 99) of the student respondents indicated 'Poor'. 26 percent (n = 34) of the staff respondents indicated 'Average' while 28 percent (n = 142) of the student respondents indicated 'Average'. 41 percent (n = 54) of the staff respondents indicated 'Good' while 23 percent (n = 117) of the student respondents indicated 'Good'. 23 percent (n = 30) of the staff respondents indicated 'Excellent' while 11 percent (n = 56) of the student respondents indicated 'Excellent'.

11 percent (n = 14) of the staff respondents had a negative response to the ranking while 37 percent (n = 185) of the student respondents had a negative response. 31 percent (n = 199) of all respondents had a negative response. 26 percent (n = 34) of the staff respondents had a neutral response while 28 percent (n = 142) of the student respondents had a neutral response. 28 percent (n = 176) of all respondents had a neutral response. 64 percent (n = 84) of the staff respondents had a positive response while 35 percent (n = 173) of the student respondents had a positive response. 41 percent (n = 257) of all respondents had a positive response.

The mean number of staff responses is 3,72 with a standard deviation of 1,01. The median number of staff responses is 4 with the minimum being 1 and maximum being 5. The mean number of student responses is 2,92 with a standard deviation of 1,25. The median number of student responses is 3 with the minimum being 1 and maximum being 5. The difference between the staff and student means is 0,80. The findings produced $Chi^2 = 45.02$ which stems from d.f. = 2 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.27 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. t = 6,81 and Cohen's d = 0,67 which indicates a medium significance based on the group's means.

The majority of staff indicated that the Internet speed designated to them for personal purposes is good with some indicating average and excellent. More students indicated that the Internet speed designated to them for personal purposes is average followed by good and poor. It is clear that the staff are positive towards the Internet speed designated to them for personal use while students are negative towards the Internet speed designated to them for personal use. The poor rating from students could be that they access rich content, such as high definition video streaming, which quickly drains the NMMU's Internet resources. The rich content has been monitored over the past few years and has been throttled. The NMMU General ICT policy states that personal use should be limited and therefore these controls are implemented to control abuse. These controls can be revisited as the capacity of the NMMU Internet resources increases as it can serve as a valuable research and business tool. For example, staff may view a 'how to install windows' on youtube.com to assist with the proper setup of the Operating System while student may view 'an introduction to micro economics' to assist with an upcoming test or exam.

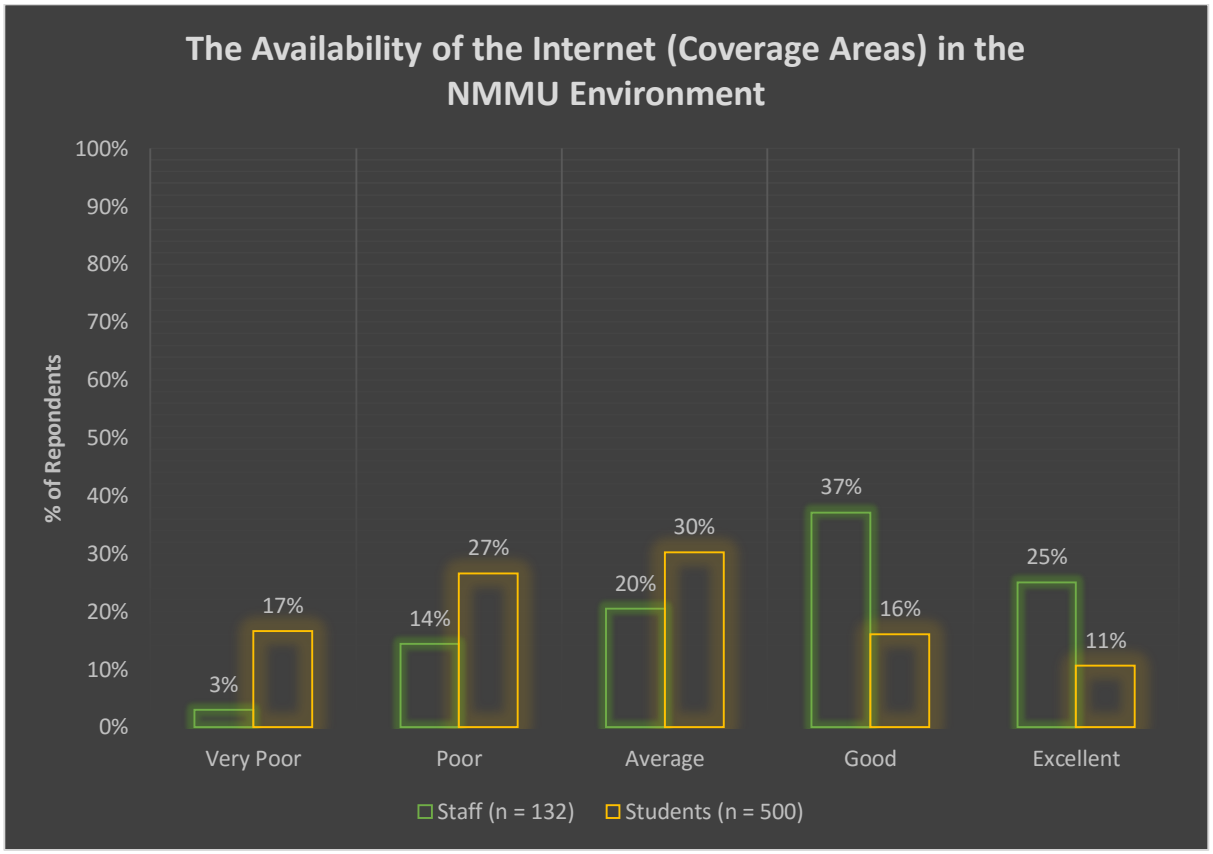

Figure 5.42: The availability of the Internet (coverage areas) in the NMMU environment.

Figure 5.42 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the ranking statement 'The availability of the Internet (coverage areas) in the NMMU environment'. 3 percent (n = 4) of the staff respondents indicated 'Very Poor' while 17 percent (n = 83) of the student respondents indicated 'Very Poor'. 14 percent (n = 19) of the staff respondents indicated 'Poor' while 27 percent (n = 133) of the student respondents indicated 'Poor'. 20 percent (n = 27) of the staff respondents indicated 'Average' while 30 percent (n = 151) of the student respondents indicated 'Average'. 37 percent (n = 49) of the staff respondents indicated 'Good' while 16 percent (n = 80) of the student respondents indicated 'Good'. 25 percent (n = 33) of the staff respondents indicated 'Excellent' while 11 percent (n = 53) of the student respondents indicated 'Excellent'.

17 percent (n = 23) of the staff respondents had a negative response while 43 percent (n = 216) of the student respondents had a negative response. 38 percent (n = 239) of all respondents had a negative response. 20 percent (n = 27) of the staff respondents had a neutral response while 30 percent (n = 151) of the student respondents had a neutral response. 28 percent (n = 178) of all respondents had a neutral response. 62 percent (n = 82) of the staff respondents had a positive response while 27 percent (n = 133) of the student

respondents had a positive response. 34 percent (n = 215) of all respondents had a positive response.

The mean number of staff responses is 3,67 with a standard deviation of 1,10. The median number of staff responses is 4 with the minimum being 1 and maximum being 5. The mean number of student responses is 2,77 with a standard deviation of 1,21. The median number of student responses is 3 with the minimum being 1 and maximum being 5. The difference between the staff and student means is 0,89. The findings produced $Chi^2 = 60.60$ which stems from d.f. = 2 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.31 which indicates that there is a medium variation from the mean and consequently the individual numbers to each other within the data set. t = 7,68 and Cohen's d = 0,75 which indicates a medium significance based on the group's means.

The majority of staff indicated that the availability of the Internet (coverage areas) in the NMMU environment is good with some indicating excellent. More students indicated that availability of the Internet (coverage areas) in the NMMU environment is average followed by poor and very poor. It is clear that the staff are positive towards the availability of the Internet (coverage areas) in the NMMU environment while students are negative towards the availability of the Internet (coverage areas) in the NMMU environment. According to the previous findings, staff prefer desktop computers and laptops, which means they are bound to their Department and mostly office environment. Students on the other hand prefer smartphones and laptops, which are built for mobility. In most cases, only the buildings and close-by areas are covered by Wi-Fi. NMMU are aware of these restrictions and have an aggressive Wi-Fi expansion strategy in place which is aimed at addressing the students' requirements as well as the BYOD and IoT trends. In addition, the NMMU Wi-Fi website indicates all coverage areas to assist staff and student in finding the best possible position in a specific location for optimal W-Fi coverage.

Figure 5.43 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the ranking statement 'The support I receive from ICT Services staff regarding the Internet services'. 3 percent (n = 4) of the staff respondents indicated 'Very Poor' while 10 percent (n = 51) of the student indicated 'Very Poor'. 2 percent (n = 3) of the staff respondents indicated 'Poor' while 12 percent (n = 61) of the student respondents indicated 'Poor'. 12 percent (n = 16) of the staff respondents indicated 'Average' while 40 percent (n = 200) of the student respondents indicated 'Average'. 32 percent (n = 42) of the staff respondents

indicated ‘Good’ while 21 percent (n = 106) of the student respondents indicated ‘Good’. 51 percent (n = 67) of the staff respondents indicated ‘Excellent’ while 16 percent (n = 82) of the student respondents indicated ‘Excellent’.

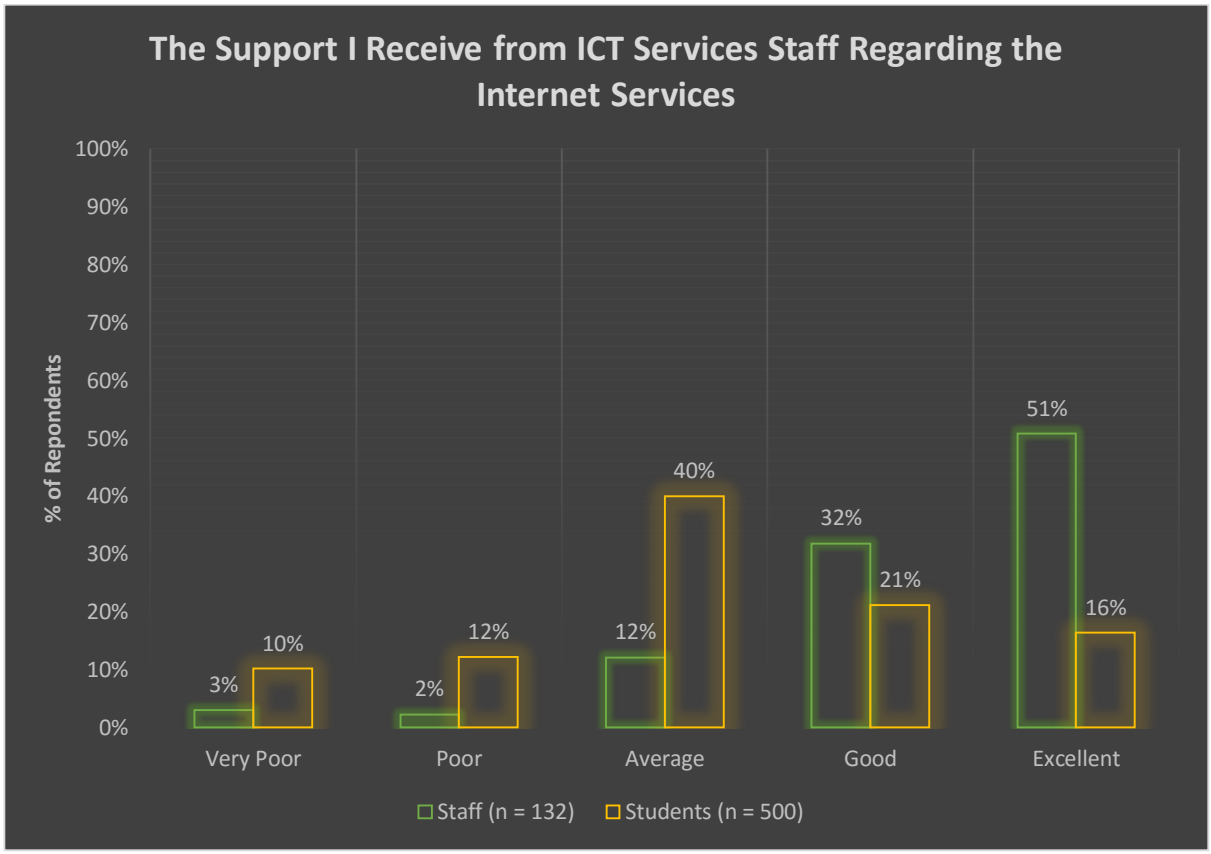

Figure 5.43: The support I receive from ICT Services staff regarding the Internet services.

5 percent (n = 7) of the staff respondents had a negative response while 22 percent (n = 112) of the student respondents had a negative response. 19 percent (n = 119) of all respondents had a negative response. 12 percent (n = 16) of the staff respondents had a neutral response while 40 percent (n = 200) of the student respondents had a neutral response. 34 percent (n = 216) of all respondents had a neutral response. 83 percent (n = 109) of the staff respondents had a positive response while 38 percent (n = 188) of the student respondents had a positive response. 47 percent (n = 297) of all respondents had a positive response.

The mean number of staff responses is 4,25 with a standard deviation of 0,97. The median number of staff responses is 5 with the minimum being 1 and maximum being 5. The mean number of student responses is 3,21 with a standard deviation of 1,16. The median number of student responses is 3 with the minimum being 1 and maximum being 5. The difference between the staff and student means is 1,04. The findings produced $Chi^2 = 84.91$ which stems from d.f. = 2 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship

exists between the variables. Variance = 0.37 which indicates that there is a medium variation from the mean and consequently the individual numbers to each other within the data set. t = 9,40 and Cohen's d = 0,92 which indicates a large significance based on the group's means.

The majority of staff indicated that the support they receive from the ICT Services staff regarding the Internet services is excellent with some indicating good. More students indicated that the support they receive from the ICT Services staff regarding the Internet services is average followed by good and excellent. It is clear that the staff are positive towards the support they receive from the ICT Services staff regarding the Internet services while students are neutral towards the support they receive from the ICT Services staff regarding the Internet services. It should be noted that staff Internet enquiries are handled by trained Helpdesk staff while student Internet enquiries are handled by student assistants (in most cases students who are studying towards a formal Diploma or Degree in ICT at NMMU) who are stationed at the Student Support Centre. The level of experience is therefore very low in the Student Support Centre. In addition, there is only one Student Support Centre which is located at South Campus. In some cases, students are referred to the ICT Helpdesk for unresolved issues. The students' frustration can therefore be understood. If this first line of problem solving (ICT Helpdesk and Student Support Centre) is not able to address the issue, the problem is referred to the Internet Manager or Network Manager, depending on the source of the issue. This is, however, seldom as the Internet Manager is responsible for the entire NMMU's Internet and not an individual's Internet problems and the 'Network Manager' are responsible for the internal routing of network traffic. For example, if NMMU loses international traffic connectivity then the Internet Manager would respond. If a desktop computer is unable to connect to the Internet then the Network Manager would respond. If a student struggles to connect his/her personal smartphone to the NMMU Wi-Fi, the Student Support Centre would assist with best effort. It should also be acknowledged that in most cases students will have issues with their personal devices (smartphones and laptops) and not the NMMU-owned devices (desktop computers).

Figure 5.44 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the ranking statement 'The security controls in place to protect me when using the Internet'. 1 percent (n = 1) of the staff respondents indicated 'Very Poor' while 5 percent (n = 27) of the student respondents indicated 'Very Poor'. 2 percent (n = 3) of the staff respondents indicated 'Poor' while 9 percent (n = 46) of the student respondents indicated 'Poor'. 17 percent (n = 22) of the staff respondents indicated 'Average' while 30 percent (n = 149) of the student respondents indicated 'Average'. 37 percent (n = 49) of the staff respondents indicated 'Good' while 32 percent (n = 159) of the student respondents indicated 'Good'. 43

percent (n = 57) of the staff respondents indicated ‘Excellent’ while 24 percent (n = 119) of the student respondents indicated ‘Excellent’.

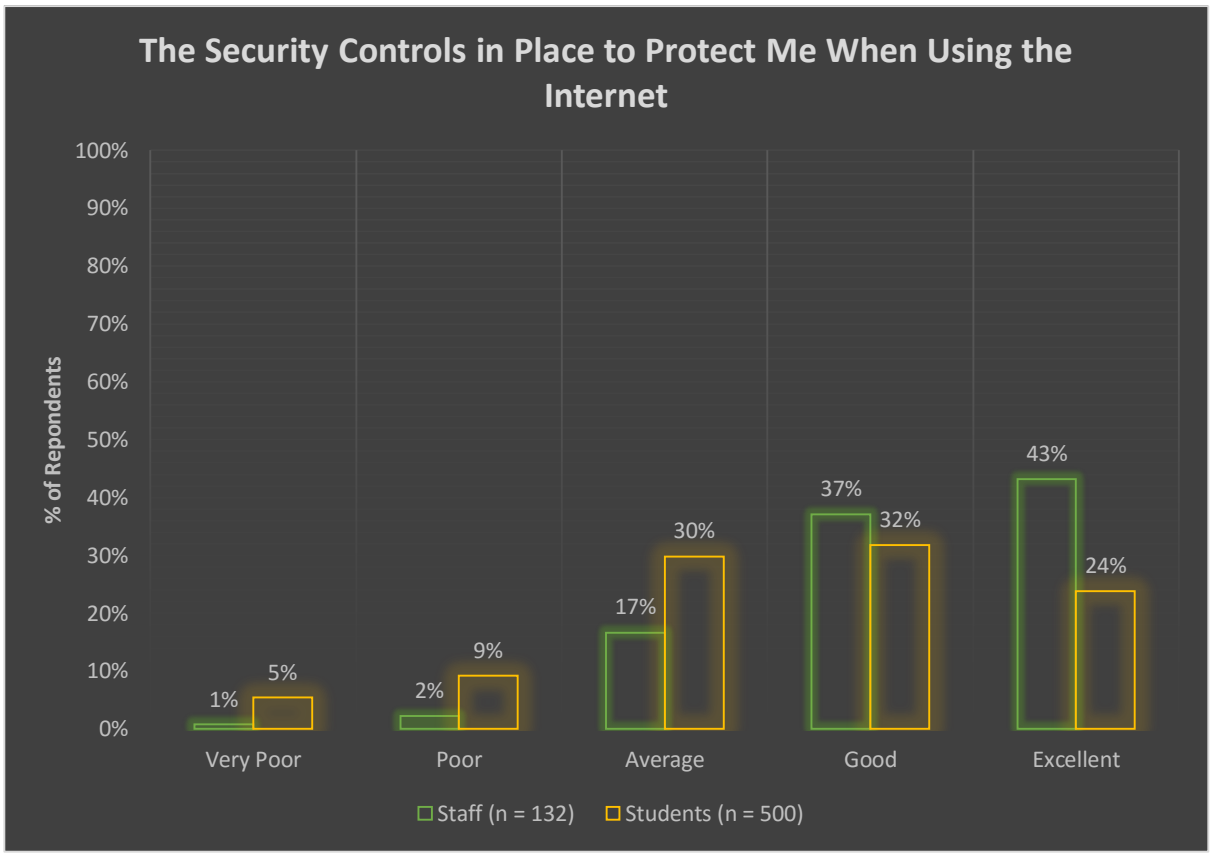

Figure 5.44: The security controls in place to protect me when using the Internet.

3 percent (n = 4) of the staff respondents had a negative response while 15 percent (n = 73) of the student respondents had a negative response. 12 percent (n = 77) of all respondents had a negative response. 17 percent (n = 22) of the staff respondents had a neutral response while 30 percent (n = 149) of the student respondents had a neutral response. 27 percent (n = 171) of all respondents had a neutral response. 80 percent (n = 106) of the staff respondents had a positive response while 56 percent (n = 278) of the student respondents had a positive response. 61 percent (n = 384) of all respondents had a positive response.

The mean number of staff responses is 4,20 with a standard deviation of 0,85. The median number of staff responses is 4 with the minimum being 1 and maximum being 5. The mean number of student responses is 3,59 with a standard deviation of 1,11. The median number of student responses is 4 with the minimum being 1 and maximum being 5. The difference between the staff and student means is 0,60. The findings produced $Chi^2 = 28.62$ which stems from d.f. = 2 and n = 632. $p < .0005$ which indicates that a statistical, significant relationship

exists between the variables. Variance = 0.21 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. t = 5,81 and Cohen's d = 0,57 which indicates a medium significance based on the group's means.

The majority of staff indicated that the security controls in place to protect them when using the Internet is excellent with some indicating good. More students indicated that the security controls in place to protect them when using the Internet is good followed by average and excellent. It is clear that the staff and students are positive towards the instilled security controls to protect them when surfing the Internet. NMMU's Information Security Section, with support from all Engineers, is continuously reviewing/auditing the security controls in place and upgrading where necessary. The South African National Standard (SANS) 27001 audit guidelines assisted the Section to implement the relevant controls as and where needed. The move towards mobility does, however, bring forth some issues. An MDM should assist greatly in addressing the security gap caused by IoT and BYOD. It should, however, be noted that students tend to prefer their own device over NMMU-owned devices which means the security controls imparted are mostly outside the control of the NMMU's Information Security Section (privacy reasons).

Figure 5.45 depicts the responses (n = 632) received from the staff (n = 132) and students (n = 500) for the ranking statement 'My overall perception/feeling of the Internet at NMMU'. 3 percent (n = 4) of the staff respondents indicated 'Very Poor' while 9 percent (n = 47) of the student respondents indicated 'Very Poor'. 2 percent (n = 3) of the staff respondents indicated 'Poor' while 14 percent (n = 70) of the student respondents indicated 'Poor'. 16 percent (n = 21) of the staff respondents indicated 'Average' while 31 percent (n = 154) of the student respondents indicated 'Average'. 43 percent (n = 57) of the staff respondents indicated 'Good' while 30 percent (n = 149) of the student respondents indicated 'Good'. 36 percent (n = 47) of the staff respondents indicated 'Excellent' while 16 percent (n = 80) of the student respondents indicated 'Excellent'.

5 percent (n = 7) of the staff respondents had a negative response while 23 percent (n = 154) of the student respondents had a negative response. 20 percent (n = 124) of all respondents had a negative response. 16 percent (n = 21) of the staff respondents had a neutral response while 31 percent (n = 154) of the student respondents had a neutral response. 28 percent (n = 175) of all respondents had a neutral response. 79 percent (n = 104) of the staff respondents

had a positive response while 46 percent (n = 229) of the student respondents had a positive response. 53 percent (n = 333) of all respondents had a positive response.

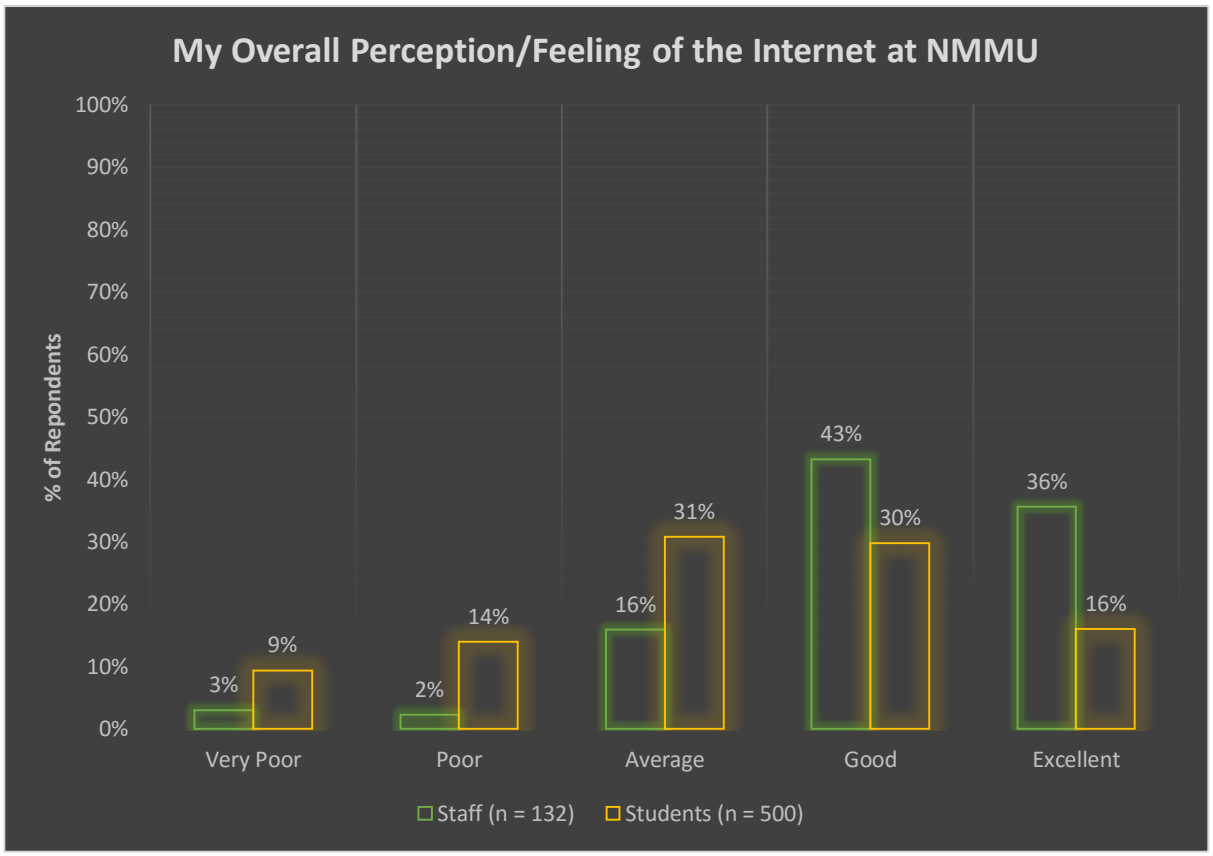

Figure 5.45: My overall perception/feeling of the Internet at NMMU.

The mean number of staff responses is 4,06 with a standard deviation of 0,94. The median number of staff responses is 4 with the minimum being 1 and maximum being 5. The mean number of student responses is 3,29 with a standard deviation of 1,17. The median number of student responses is 3 with the minimum being 1 and maximum being 5. The difference between the staff and student means is 0,77. The findings produced $Chi^2 = 47.36$ which stems from d.f. = 2 and n = 632. $p < .005$ which indicates that a statistical, significant relationship exists between the variables. Variance = 0.27 which indicates that there is a small variation from the mean and consequently the individual numbers to each other within the data set. t = 6,99 and Cohen's d = 0,68 which indicates a medium significance based on the group's means.

The majority of staff indicated that their overall perception/feeling of the Internet at NMMU is good with some indicating excellent. More students indicated that their overall perception/feeling of the Internet at NMMU is average followed by good. It is clear that the majority of staff and students are positive towards their overall perception/feeling of the

Internet at NMMU. In most implemented policies (and mostly due to the size difference) staff have less stringent controls that students. These controls are regularly adjusted to ensure that users receive an exceptional Internet experience as per their requirements. In addition, previous findings indicated that staff are more aware of the set NMMU Internet related policies and procedures than students. This could mean that students are less satisfied with the Internet's performance due to them not being aware of how the Internet resources are managed and in what way as stipulated in the NMMU policies and procedures. The following sub-section will summarise the research findings of Section 6.

5.2.2.11. Summary of Research Findings in Section 6

Section 6: Management was used to collect the respondents' general rating of the management of NMMU's Internet. The findings for this section indicate that the majority of staff indicated that the Internet speed designated to them for work and personal purposes is good. The majority of students indicated that they are evenly split between the Internet speed designated to them for work purposes being average and good and for personal use, average. The majority of staff indicated that the availability of the Internet (coverage areas) in the NMMU environment is good while more students indicated that availability of the Internet (coverage areas) in the NMMU environment is average. The majority of staff indicated that the support they receive from the ICT Services staff regarding the Internet services is excellent while more students indicated that the support they receive from the ICT Services staff regarding the Internet services is average. The majority of staff indicated that the security controls in place to protect them when using the Internet are excellent while more students indicated that the security controls in place to protect them when using the Internet are good. The majority of staff indicated that their overall perception/feeling of the Internet at NMMU is good while more students indicated that their overall perception/feeling of the Internet at NMMU is average.

It is clear from this section that the overall Internet management for staff is better than students. Staff are better informed than students about policies and procedures and this introduces a better understanding of what the SLA encompasses. Staff are assigned an NMMU-owned device (desktop computer and/or laptop) which is managed, monitored and regulated by all NMMU policies (technical and operational policies). NMMU ICT Services are therefore able to detect and resolve anomalies faster compared with devices that are owned by students. The student devices are not the property of NMMU and cannot be fully managed as are the staff devices. These staff devices are optimally placed within the NMMU network to ensure optimal coverage is maintained. Student devices are mobile, meaning they are not bound to a specific building, department, lecture room etc. Being mobile will allow students to

setup their devices in areas which are not fully covered by Wi-Fi. These students will then experience a delay in Internet traffic. The support provided to staff and consequently NMMU-owned devices is of a much higher quality than that provided for students who use personally owned devices for obvious reasons. The following section will conclude this chapter.

5.3. Summary

This chapter addressed RQ_4 which states "*How is the Internet utilised at NMMU by staff and students?*". The chapter completed the RO_4 which was to conduct an empirical evaluation of the users' Internet usage at NMMU.

Chapter 5 was focused on the compiling, distribution, collection, analysis and presentation of the findings of the NMMUIUS. The NMMUIUS was created by means of reviewing current literature studies which were aligned with the overall research question and research objective. The identified areas provided for a holistic view of Internet usage patterns and practices. These usage patterns and practices were then grouped into categories to ensure the correct flow of the NMMUIUS. These categories were Governance, Usage and Access Duration, Content, Primary Purpose and Management. The NMMUIUS was then distributed to all NMMU Internet users. The results were collected, analysed and presented in a logical and clear manner. The combined findings will contribute towards the Internet Management Model for NMMU which will be discussed in the next chapter.

The findings as highlighted in this chapter show there is a wide gap between the staff and students at NMMU that use the NMMU's Internet. This gap focused on age (Generation X, Y and Z), Internet usage requirements, and size of population. The staff and students have a wide range of requirements and expectations from the NMMU's Internet with some similarities amongst these needs. These overlapping requirements are generally linked to their affiliation with the HEI, meaning their main purpose for being the HEI. Other than this (non-work related), the staff and students have very difference usages for the NMMU's Internet. The requirement for the Internet also varies depending on the time of day and day of the week. It is apparent that there are differences in the Internet requirements between the academic and administrative staff. In addition, the staff and students are treated very differently by the NMMU Internet management team or NMMU ICT Services and this is obvious in the Management section. The staff are very much aware of the Internet and its surroundings as opposed to the students, who in most cases are not kept up-to-date. This includes the operational and technical policies instilled for all users. The students seem frustrated or

unhappy towards some of these management practices or are generally unaware of the Internet resources assigned to them.

The main findings in this chapter includes:

- There is an clear age difference between the user groups;
- Importance of each group does not align with the HEI Internet management best practices and does not support the size of NMMU;
- There is a gap between the technical and operational policies and the business and customer needs;
- The awareness strategy is not adequately aligned with each respective user group. The staff are better informed about the policies and procedures that students;
- The controls implemented for each group does not always match the scope of their work and personal requirements as well as their Internet requirements for the time of day and day of the week;
- There are numerous Internet community members that have been grouped into the two main groups (staff and students). Therefore, their business and customer requirements are not sufficiently addressed;
- There is an imbalance with the number of devices in the network and the capacity of the network. The current growth rate may present difficulties at a later stage;
- There is a gap created between the management of personal devices and NMMU-owned devices;
- There is no formal review process set for the review of the Internet resources;
- The controls implemented to monitor the users' usage as well as bandwidth utilisations are lacking; and
- There is a skills or educational gap between the student and staff support systems.

Chapter 6 will present the proposed Internet Management Model for NMMU derived from the findings. The chapter will conclude by providing the limitations of the study as well as future research. Therefore, the research objective of this chapter is focused on RO_M, which is to present the components of the Internet Management Model at an HEI. This will be achieved by asking RQ_M, which questions "*What are the components of an Internet Management Model that will ensure effective management of Internet usage at an Higher Education Institution?*".

6. RECOMMENDATIONS AND CONCLUSIONS

6.1. Introduction

Chapter 5 focused on the compiling, distribution, collection, analysis and presentation of the findings of the NMMUIUS. The NMMUIUS was created by means of reviewing current literature studies which were aligned with the overall research question and research objective. The NMMUIUS was then distributed to all NMMU Internet users. The empirical results were collected, analysed and presented in a logical and clear manner.

This chapter will address RQ_M which states "*What are the components of an Internet Management Model that will ensure effective management of Internet usage at an Higher Education Institution?*". The objective of the chapter is to develop an Internet Management Model for the effective management of the Internet usage at an Higher Education Institution. To be able to achieve this objective, the following had to be scrutinised. Firstly, the national and international governance structures that influence the management of the Internet had to be identified. Secondly, the research methodology applied in this research study had to be recognised. Thirdly, the national best practices adopted for Internet management at Higher Education Institutions had to be answered. And lastly, an empirical evaluation of Internet usage at NMMU by staff and students had to be conducted. See Figure 6.1 for an overview of the research question and research objective of this chapter.

Chapter 6 will summarise the research process followed in this research study. Thereafter, a list of recommendations and considerations will be presented according to the empirical data. The proposed Model for Internet Management at an Higher Education Institute will then be presented and discussed. Chapter 6 will then conclude by identifying the limitations of the research study and possible future research that can stem from this treatise. See Figure 6.2 for a Structural overview of Chapter 6.

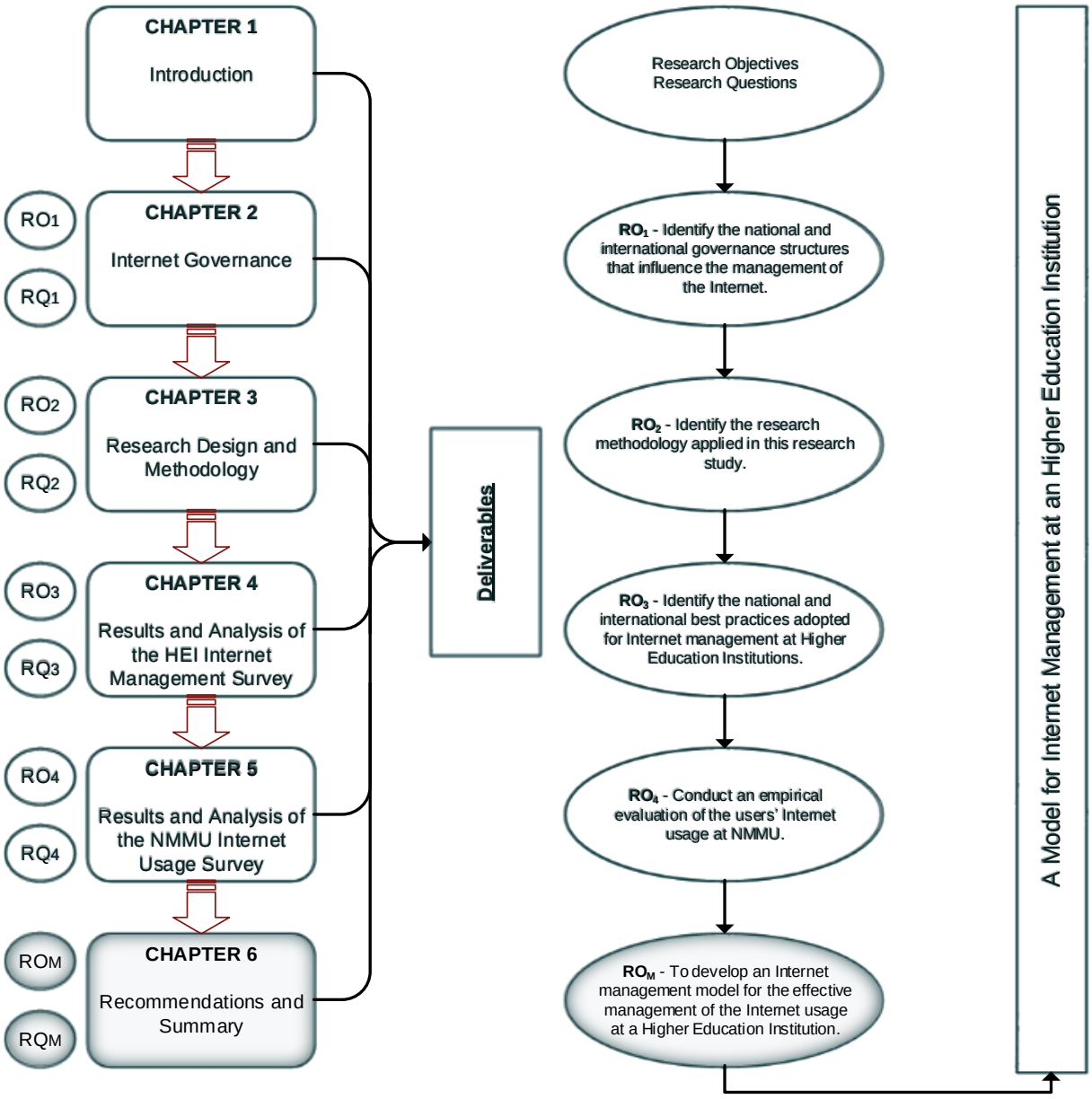

Figure 6.1: Chapter 6 Research Question and Research Objective.

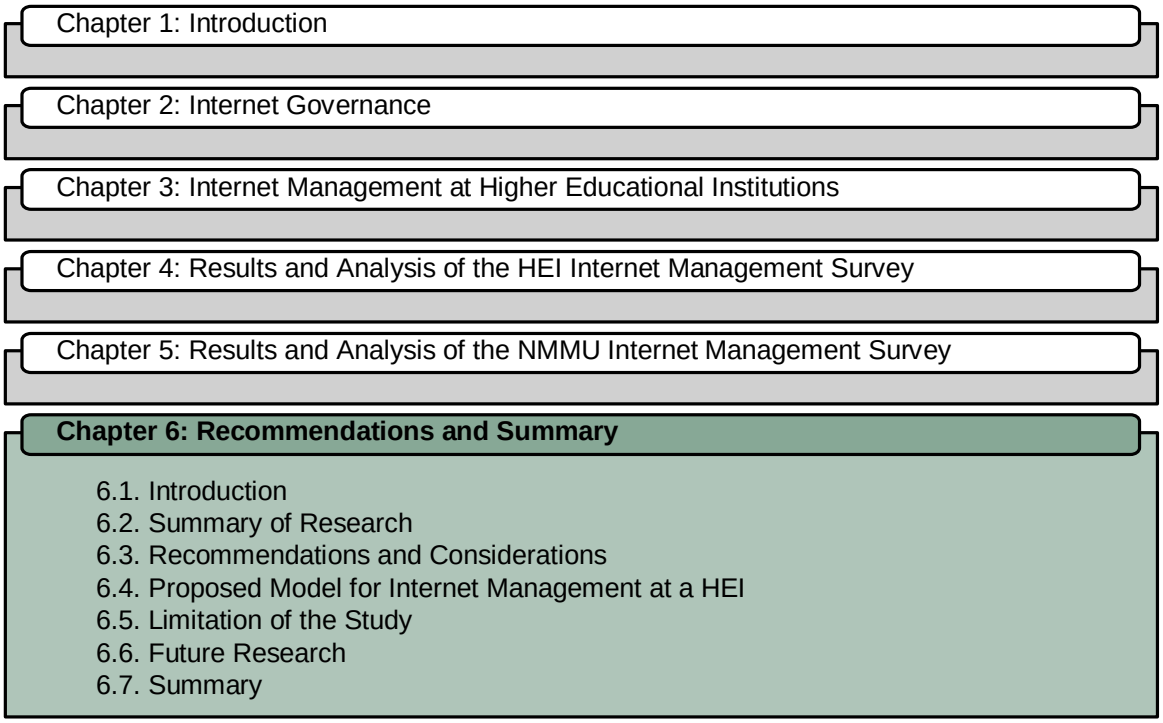

Figure 6.2: Structural overview of Chapter 6.

6.2. Summary of the Research

The research study constituted various research questions that were identified and analysed in order to address the main research question. The following sub-section discuss these research questions.

6.2.1. Main Research Question (RQ_M) and Research Objective (RO_M)

The Main Research Question of the research study was stated as "*What are the components of an Internet Management Model that will ensure effective management of Internet usage at an Higher Education Institution?".* In order to analyse the main research problem effectively, the following four research questions (**RQ_1** to **RQ_4**) based on the secondary research objectives, had to be answered first:

RQ_1 - *What national and international governance structures are available that influence Internet management?*

RQ_2 - *What research methodology can be utilised for this study?*

RQ_3 - *What are the national best practices for Internet management at Higher Education Institutions?*

RQ_4 - *How is the Internet utilised at NMMU by staff and students?*

6.2.2. Research Question RQ_1 and Research Objective RO_1

The first research question (RQ_1) states "*What national and international governance structures are available that influence Internet management?*". The objective of the question was to identify the national and international governance structures that influence the management of the Internet. Current literature studies were reviewed to find a suitable answer to the identified research question.

The literature reviews identified the five available IG models as defined by Solum, (2008) with support from Collins (2007),that can be used to govern the Internet. It was clear from the discussion that each model cannot address the immense responsibilities and requirements of IG. This led to an investigation into ascertaining what the current, implemented national and international IG structures entail. A Multi-Stakeholder model was therefore investigated, which asked the various stakeholders involved with IG and the respective committees and groups they created to address specific IG issues. The discussion concluded by highlighting the recently implemented IG ecosystem which is a framework used to address any new IG issues experienced.

The review of the current, employed model led to the realisation that it is a combination of the five IG models, therefore making it a hybrid model. The Multi-Stakeholder model incorporates the benefits of each model whilst trying to exclude their respective drawbacks. Note should be taken that IG is sophisticated by its very nature and therefore requires complex regulatory mechanisms to ensure that it is properly managed. The most respected IG model therefore requires an optimal mix of transnational institutions, international organisations, national governments, and market regulations which encompasses the Internet's congruent technical and policy environment. The chapter concluded that the Multi-Stakeholder model satisfies this need.

6.2.3. Research Question (RQ_2) and Research Objective (RO_2)

The second research question (RQ_2) states "*What research methodology can be utilised?*". The objective of the question was to identify the research methodology applied in this research study. Current research methodology practices were reviewed and suitable research methodologies applicable to this research study were extracted and presented.

The research onion as defined by Saunders, et al., (2012) was used as a guide to ensure all elements of the research process were covered. The processes of 'peeling back' the layer of the onion ensured that the research philosophy, research approaches, research strategies, time horizons and techniques and procedures were all defined and discussed. The chapter concluded by summarising the followed research methodology for this treatise.

6.2.4. Research Question (RQ_3) and Research Objective (RO_3)

The third research question (RQ_3) states "*What are the national best practices for Internet management at Higher Education Institutions?".* The objective of the chapter was to identify the national best practices adopted for Internet management at Higher Education Institutions.

Current literature studies were reviewed to find a suitable answer to the identified research question according to the resources groupings found in all organisations. These resources are Human Resources, Financial Resources, Physical Resources and Organisational Resources. From these findings, the HEIIMS was compiled and distributed to all 23 South African universities. The HEIIMS focused on determining what they currently use to manage their Internet resources. The best practices for each resource found in the collected HEIIMS data was analysed and presented in Chapter 4. The combined findings will constitute HEI Internet management best practices.

6.2.5. Research Question (RQ_4) and Research Objective (RO_4)

This fourth research question (RQ_4) states "*How is the Internet utilised at NMMU by staff and students?*". The objective of the chapter was to conduct an empirical evaluation of the users' Internet usage at NMMU. Current literature studies were reviewed to find a suitable answer to the identified research question. From these findings, an NMMUIUS was compiled and distributed to all NMMU staff and students. The NMMUIUS focused on determining what they currently use the NMMU's Internet for. The combined findings were analysed and presented in Chapter 5. The combined findings will constitute a proposed Model for Internet Management at an Higher Education Institute.

6.3. Recommendations and Considerations

Based on the empirical study conducted, it is apparent that there are gaps in the current NMMU Internet resource model that must be addressed. This will assist NMMU to achieve its goals and deliver value through the effective and efficient governance and management of its Internet resources. The researcher proposes the following recommendations and considerations for successful re-alignment:

- There are two different age groups. These age groupings are students aged 18 - 29 and staff aged 30 – 60;
- Respective importance must be set for each group (% ratio assigned to each) according to their purpose and requirements;
- Technical and operational policies must be aligned (importance and message) to meet business needs as well as the customer needs;
- The marketing and awareness strategy must be aligned with the interests of each respective user group. Therefore, the message must speak to the audience and must reach them in their preferred channel of communication;
- The controls implemented for each group must match the scope of their work and personal requirements as well as their Internet requirements for the specific period of day or week. Business requirements must receive priority over all. This will ensure the optimal use of the Internet resources;
- There should be an Internet profile for each main group: administrative staff, academic staff, undergraduate students and postgraduate students;
- NMMU must maintain a balance between the number of devices as introduced by BYOD and IoT and the NMMU network or Internet growth strategy. At the current device growth rate the Internet resources will not be able to handle the load in a few years' time. Alternatively, emphasis should be placed on adding additional restrictions to control unwanted Internet usage and only focus on business and research Internet usage;
- The controls used to manage personal and NMMU-owned devices must be present and aligned with the operational requirements;
- There should be a formal Internet resources review process and this should be completed on an annual or biennial basis;
- Controls must be installed to monitor users' usage as well as bandwidth utilisations. Outliers must be identified and users must be notified accordingly; and
- Internet and network support for staff and students should be of equal value.

6.4. Proposed Model for Internet Management at an HEI

Figure 6.3 presents the proposed Internet Management Model for NMMU. The model is based on the findings presented in chapter 5 and described in Section 6.3. The model adapts a multi-layered model approach that starts at the centre being, corporate vision and strategy and expands, layer by layer, until it reaches the outer layer, being trends in ICT and Higher Education (HE) landscape. All layers of the model are connected and are directly influenced by any form of change made to the Internet resources. It is therefore apartment that no element in the model can be viewed in isolation.

At the heart of the proposed Internet Management Model for NMMU is the corporate vision and strategy. All Internet resource alignment within NMMU must start at this layer. The second layer is the business and customer requirements layer. This layer assists by incorporating the Internet community's needs. The third layer is the resource layer. The resource layer comprises of financial-, organisational-, human-, and physical resource. This comprises the operational and technical requirements of the Internet resources. The awareness strategy forms the foundation of the proposed Internet Management Model for NMMU. All major changes that affect the Internet community directly must be communicated to them in their preferred communication medium. Lastly, the global economy and trends in the ICT and HE landscape encapsulate all layers of the model as these layers are directly affected by changes in the macro environment.

The following sub-sections discuss each layer of the proposed Internet Management Model for NMMU in more detail:

- Corporate vision and strategy

  At the heart of the model is the corporate vision and strategy. The corporate vision and strategy helps to communicate the purpose of the organisation to all stakeholders, inform strategy development, and identifies the measurable goals and objectives of the organisation's strategy. Top Management's commitment to the Internet resources are therefore incorporated in this layer.

  All activities within this model need to be aligned with the overall corporate vision and strategy. Therefore, all Internet resources must be aligned with the NMMU Vision 2020 strategy (Strategic Priority 2 - Goal 2, 3 and 5, Strategic Priority 6 - Goal 3 and Strategic Priority 7 - Goal 1, 2 and 4), NMMU Institutional Support strategy, Academic Infrastructure, Financial Growth and Development plan, Human Resource Management plan and lastly, the ICT Strategic plan. These strategies and plans must form the foundation and therefore guide all decisions made towards the re-alignment of the Internet resources.

Figure 6.3: Proposed Internet Management Model for NMMU.

- Business and Customer Requirements

  The second layer of the proposed Internet Management Model for NMMU is the business and customer requirements layer. All Internet resources must 'speak' to the business and customers' 'hearts', 'minds' and 'pockets'. The Internet forms the foundation of most activities (work-related and personal-related) at NMMU and should therefore be aligned according to their changing needs. It is therefore imperative that the business and customer requirements be reviewed annually or biennially, and re-

aligned accordingly. This will ensure that the Internet resources are effectively and efficiently used at all times.

According to the NMMUIUS findings, the two main user age groups in the NMMU environment are students at age 18 – 29 and staff at age 30 – 60. The generation gap will present different norms, values, motivations, ethical considerations, workplace ethics, technological understandings etc. Therefore, to optimally align the Internet resources with these groups' requirements, all operational and technical Internet resources must be synchronised with their overall business needs, and thereafter customer needs.

An additional consideration would be to create an Internet profile for each main Internet user group: administrative staff, academic staff, undergraduate students and postgraduate students. The 'Importance of Internet at HEI' findings in Chapter 4 clearly supports this argument. Currently, there are only two profiles created, these are students and staff. The environments that each profile group works in are vastly different and will consequently have a different business focus. An expansion of the profile groups as recommended will ensure that the Internet resources are optimally aligned to each profile's work and personal requirements. If all requirements are met, the corporate vision and strategy should be achieved quite easily.

- Financial Resources

  Part 1 of the third layer of the proposed Internet Management Model for NMMU is the Financial Resource layer. Financial resources, such as annual Internet budget, ISP costs, hardware and software costs, staff budget, third stream income etc. form part of this resource. In addition, the interest rates, exchange rates, budget guidelines, annual increases etc. should all be taken in consideration. All financial resources must be able to support the products and services comprising the Internet's resources. Without sufficient funding, the Internet resources will be inadequate to support the requirements. On the other hand, a waste of financial resources means that they could have been better used in other parts of the University.

- Organisational Resources

  Part 2 of the third layer of the proposed Internet Management Model for NMMU is the Organisational Resource layer. Organisational resources such as policies, procedures, guidelines, incident and change reporting structures, technological controls etc. form

part of this resource. It is vital for NMMU to invest in the governance, monitoring and technological structures to support the Internet resources. Consequently, technical and operational policies must be aligned to meet business needs as well as the customer needs. The monitoring controls must be installed to monitor users' usage as well as bandwidth utilisations. Any outliers captured by the monitoring systems must be identified, and the users and/or administrators must be notified accordingly. Lastly, all implemented technical controls must be aligned to the business and customer requirements, and ultimately the corporate vision and strategy. As indicated before, business requirements should be the driving factor in this regard. The governance resources will emphasise what may and may not be done while the technical resources will support these rules on a technical level. As presented in the findings, the technical controls used to manage personal and NMMU-owned devices must be present and aligned with the operational requirements.

- Human Resources

  Part 3 of the third layer of the proposed Internet Management Model for NMMU is the Human Resource layer. Human resources such as staffing requirements, training, talent management, Peromnes levels, KPIs, mentoring, coaching etc. form part of this resource. The human resources must have sufficient knowledge and skills to support this massive Internet infrastructure at NMMU. Investment into this resource must ensure that all student and staffing support and contact centres have adequately trained personnel to support the user's Internet requirements. The findings indicated that there is a lack of support for students in this regard.

- Physical Resources

  Part 4 of the third layer of the proposed Internet Management Model for NMMU is the Physical Resource layer. Physical resources such as hardware, local and international bandwidth, bandwidth allocation to groups, device connections management, backbone connections, intercampus connections etc. form part of this resource. The correct combination of physical resource will provide for a reliable Internet service foundation as it is at this layer that the Internet traffic is processed and routed. Therefore, it is important to have the correct balance of bandwidth allocated to each group. The size of the group, its importance to NMMU and requirements must be taken into consideration. According to the findings, this area needs to be re-aligned.

In addition, NMMU must maintain a balance between the number of devices as brought about by current trends (BYOD and IoT) and the NMMU network or Internet growth strategy. At the current device growth rate the Internet resources will not have the capacity to be able to handle the demand in a few years' time. Alternatively, emphasis should be placed on adding additional restricting to control unwanted Internet usage and only focus on business and research Internet usage.

- Awareness Strategy

  The awareness strategy forms the foundation of the proposed Internet Management Model for NMMU. The goal of the awareness strategy is to communicate the products and services related to the Internet resources to the user community. This will assist users to know what their roles and responsibilities are related to the Internet resources. In addition, this action will increase the users' understanding of the Internet resource environment and therefore, boost their overall Internet service experience and morale. A successful change management implementation and acceptance is fundamentally dependent on proper communication with all stakeholders.

  The awareness strategy must be aligned with each respective user group. Therefore, the message must speak to the audience and must reach them in their preferred channel of communication. Furthermore, continuous, timeously communication must be completed when major changes are made to the Internet resources affecting the users directly. These changes could be in the form of policy updates, control changes, new physical resources being installed etc.

- Global Economy and Trends in Information and Communication Technology and Higher Education Landscape

  NMMU, like all other organisation operate in the global economy. The economy directly affects how business is conducted and therefore, factors such as currency value, technology, restrictions of trade, war, natural disasters, labour costs, political changes etc. should all be taken into account whilst going business. These factors will directly and indirectly affect NMMU and consequently its Internet resources.

  The ICT and HE landscape is a fast-changing environment. If an organisation does not stay up-to-date with the latest trends affecting its environment, the organisation may fall behind and lose market shares, its reputation, brand name, profits, investments etc. It is therefore vital for NMMU to identify the changes in the environment and adopt the

ones that will positively influence NMMU. Examples of current changes in the environment for ICT include Mobile Internet, IoT, Cloud technology, BYOD. Examples of current changes in the environment for HE include changes in new Legislative and Regulatory mandates, National Development Plan 2030, ASAUDIT plans, Higher Education South Africa plans.

Changes identified and adopted will force a revision of the proposed Internet Management Model for NMMU, meaning that one will start at the center, and incorporate the new adopted ICT and/or HE trend into the layers. Alternatively, it would be recommended to do a thorough environmental analysis and consequently review and re-align the Internet resources on an annual or biennial basis.

6.5. Limitations of the Study

Limitations are shortcomings, conditions or influences that are outside the control of the researcher that may place restrictions on the research study. The following are limitations that have been identified in this research study:

- The NMMUIUS lacked open-ended questions, the Likert Scale failed to measure some of the respondents' true attitudes.
- The NMMUIUS contained various categories of possible Internet content. Due to the amount of content in different forms found on a single webpage, the staff and students may be unaware of some content whilst only focusing on the main page information. Therefore, although more content was visited, the respondents were only aware of what they were looking at or focusing on.
- Due to the sensitivity of some of the questions in both surveys, some respondents may have selected the more appropriate answer and not the true answer.
- In both surveys the response rate was adequate, however, a higher response rate would have been more favourable.
- The cross-sectional study only includes the current state of affairs at the time of the set timeframe. Anything before and after the snapshot is excluded.
- Due to time constraints, some areas may not have received the researcher's full and undivided attention as was intended.
- The study is only focused on the NMMU Internet usage. Some users may be using their mobile data, thinking they are using the NMMU's Internet bandwidth.

6.6. Future Research

During the course of this research study a number of future research possibilities have been identified that will assist future researcher to strengthen the findings as presented. These opportunities are:

- Analysis of the NMMU Firewall logs and cross-reference these findings with the NMMUIUS findings;
- Extend the HEIIMS to include all sizes and variations of HEI within SA;
- Add brief descriptive fields next to each Internet usage category to ensure that all users understand what is captured in the respective Internet category; and
- Split the different Internet user groups (undergraduate students, postgraduate students, academic staff and administrative staff) within the HEI and determine the usage patterns and requirements for each.

6.7. Summary

The main objective of this research study was to identify a proposed Internet Management Model for an Higher Education Institute. The deliverables set to achieve the main objective included:

- Identify the national and international governance structures that influence the management of the Internet.
- Identify the research methodology applied in this research study.
- Identify the national best practices adopted for Internet management at Higher Education Institutions.
- Conduct an empirical evaluation of the users' Internet usage at NMMU.
- Identify the elements that will constitute a proposed Internet Management Model for NMMU.

The research study concluded with the identification of a list of recommendations and considerations that stem from the NMMUIS findings. In addition, a proposed Model for Internet Management at an Higher Education Institute was presented. The purpose of the Model for Internet Management is to provide a high level understanding of each topic or area within the Internet resource landscape and provide a basic relationship which joins the topics or areas together. Therefore, the proposed Model for Internet Management at NMMU provides a holistic view of the NMMU Internet resource landscape. The proposed Model for Internet Management will assist NMMU to re-align the Internet resources to ensure they meet both the business' needs as well as our customers' requirements whilst receiving optimal value from the instilled Internet resources on a continuous basis.

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Appendix A – RESEARCH ALIGNMENT PLAN

Title: A Model for Internet Management at a Higher Education Institution.				
Research Problem: Higher Education Institutions have limited ICT Internet resources (funds, hardware, software and support staff) available to implement and management Internet connectivity in the work environment. Users generally misuse their privileges by using the Internet for non-work related matters.				
Thesis Statement: To provide an Internet management model that will ensure effective management and usage of all ICT Internet resources at an Higher Education Institution.				
Main Research Objective: To develop an Internet Management Model for the effective management of the Internet usage at an Higher Education Institution.				
Main Research Question (RQ_M): What are the components of an Internet Management Model that will ensure effective management of Internet usage at an Higher Education Institution?				
Secondary Research Questions		**Research Objectives**	**Chapters**	**Deliverables**
RQ_1	What national and international governance structures are available that influence Internet management?	Identify the national and international governance structures that influence the management of the Internet.	Chapter 2 - **INTERNET GOVERNANCE** (Literature Study)	**Identified Governance Structures**
RQ_2	What research methodology can be utilised for this study?	Identify the research methodology applied in this research study.	Chapter 3 - **RESEARCH DESIGN AND METHODOLOGY** (Literature Study)	**Identified research methodology**
RQ_3	What are the national best practices for Internet management at Higher Education Institutions?	Identify the national best practices adopted for Internet management at Higher Education Institutions.	Chapter 4 - **RESULTS AND ANALYSIS OF THE HEI INTERNET MANAGEMENT SURVEY** (Empirical Study)	**Best Practice**
RQ_4	How is the Internet utilised at NMMU by staff and students?	Conduct an empirical evaluation of the users' Internet usage at NMMU.	Chapter 5 - **RESULTS AND ANALYSIS OF THE NMMU USAGE SURVEY** (Empirical Study)	**Comprehensive analysis of the collected empirical data.**

RQ_M	What are the components of an Internet Management Model that will ensure effective management of Internet usage at an Higher Education Institution?	RQ_M	Chapter 6 - **FINDINGS, RECOMMENDATIONS AND CONCLUSIONS**	**Results**

Appendix B – ETHICAL CLEARANCE FORM E WITH RESOLUTION NUMBER

• PO Box 77000 • Nelson Mandela Metropolitan University
• Port Elizabeth • 6031 • South Africa • www.nmmu.ac.za

Nelson Mandela Metropolitan University
for tomorrow

Chairperson: Research Ethics Committee (Human)
Tel: +27 (0)41 504-2235

Ref: [H15-SCI-CSS-005 /Approval]

Contact person: Mrs U Spies

14 May 2015

Prof A Calitz
Faculty: Science
Department: Computing Sciences
South Campus

Dear Prof Calitz

A MODEL FOR INTERNET MANAGEMENT AT A HIGHER EDUCATION INSTITUTION

PRP: Prof A Calitz
PI: Mr R Boshoff

Your above-entitled application for ethics approval served at Research Ethics Committee (Human).

We take pleasure in informing you that the application was approved by the Committee.

The ethics clearance reference number is **H15-SCI-CSS-005** and is valid for three years. Please inform the REC-H, via your faculty representative, if any changes (particularly in the methodology) occur during this time. An annual affirmation to the effect that the protocols in use are still those for which approval was granted, will be required from you. You will be reminded timeously of this responsibility, and will receive the necessary documentation well in advance of any deadline.

We wish you well with the project. Please inform your co-investigators of the outcome, and convey our best wishes.

Yours sincerely

CB Cilliers

Prof C Cilliers
Chairperson: Research Ethics Committee (Human)

cc: Department of Research Capacity Development
Faculty Officer: Science

Appendix C – HEIIMS

Higher Education Institute (HEI) Internet Management Survey

Thank you for taking the time out of your busy schedule to complete this survey. Your input will greatly assist the researcher in determining what is considered as best practice when managing South African Universities' Internet resources. The expected time to complete the survey is 30 minutes.

The Section 1: Biographical Information will be kept confidential and will not be shared with any other party. The information will only be used for authentication purposes and to communicate with you if needed e.g. you request a copy of the final results. The completion and submission of the survey constitute consent for the data (excluding Section 1: Biographical Information) to be used in the study as well as made available to other Universities who request access to the findings.

Once completed, please return the survey to Mr Ryno Boshoff via email at ryno.boshoff@nmmu.ac.za.

REC-H Reference Number: H15-SCI-CSS-005.

Thanking you in advance!

		Section 1: Biographical Information
1.1	Title	☐ Mr ☐ Ms ☐ Mrs ☐ Miss ☐ Dr ☐ Prof
1.2	Name and Surname	Type Name and Surname here
1.3	Email Address	Type Email Address here
1.4	Job Title	Type Job Title here
1.4	Faculty/Department	Type Faculty/Department here
1.6	Duration in this position?	Type Duration in this position here
		Section 2: General University Details
2.1	Name of University	Type Name of University here
2.2	Number of Registered Students	Type Number of Students here number of registered students
2.3	Number of Academic Staff	Type Number Academic Staff here number of academic staff
2.4	Number of Administrative Staff	Type Number of Admin Staff here number of admin staff
2.4	Do you give consent for the information to be shared with other participants (excluding Section 1: Biographical Information)?	☐ Yes | ☐ No
2.6	Would you like to receive feedback on the findings of the survey?	☐ Yes | ☐ No

2.7	Would you like to receive feedback on the findings of the study titled 'A Model for Internet Management at an Higher Education Institution?	☐ Yes | ☐ No
		Section 3: Human Resources
3.1	Please provide a rating on how important the Internet is as a service for the entire University.	Little Importance ↔ Great Importance
	Internet:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
3.2	Please rate how important high speed reliable Internet services are to these customers	Little Importance ↔ Great Importance
	Academic Staff:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
	Administrative Staff:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
	Students:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
	Contractors:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
	Visitors:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
	Residence:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
	Other:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
3.3	Is there a dedicated person(s) whose job description includes Internet Management at your University?	☐ Yes | ☐ No
	If no, skip to question 3.8.	
3.4	If yes, on what Peromnes level is the post?	☐ 10 ☐ 9 ☐ 8 ☐ 7 ☐ 6 ☐ 5 ☐ 4
3.5	Does this post receive a scarce skills allowance?	☐ Yes | ☐ No
3.6.1	Is Internet Management this person's only task to be performed?	☐ Yes | ☐ No
3.6.2	What percentage of his/her time is dedicated/spent on Internet Management?	☐ Below 10% ☐ 10% - 19% ☐ 20% - 29% ☐ 30% - 39% ☐ 40% - 49% ☐ 50% - 59% ☐ 60% - 69% ☐ 70% - 79%

		☐ 80% - 89% ☐ Above 90%
3.8	Do you have an ICT Data Engineer (or position with similar KPIs) at your university?	☐ Yes | ☐ No
3.10	Are there any noticeable shortcomings in the way the Internet is managed with regards to Human Resources? In other words, are there any concerns that you would like to raise regards to your ICT Internet human resource capacity?	Type Comments here
		Section 4: Financial Resources
4.1	Please indicate the total annual Internet cost?	☐ ≤ R1m ☐ ≤ R2m ☐ ≤ R3m ☐ ≤ R4m ☐ ≤ R5m ☐ ≤ R6m ☐ ≤ R7m ☐ ≤ R8m ☐ ≤ R9m ☐ > R9m
4.2	What percentage of your overall annual ICT allocated budget is dedicated to your annual Internet cost?	☐ Below 10% ☐ 10% - 19% ☐ 20% - 29% ☐ 30% - 39% ☐ 40% - 49% ☐ 50% - 59% ☐ 60% - 69% ☐ 70% - 79% ☐ 80% - 89% ☐ Above 90%
4.3	Do you feel that the allocated Departmental Internet budget is enough to provide a reliable and effective Internet experience to your University? Allocated Departmental Internet budget:	Strongly Disagree ↔ Strongly Agree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
4.4	Do you source third stream income to add to your bandwidth budget? E.g. receive from student fees	☐ Yes | ☐ No

	If no, please skip to question 4.6.	
4.5	If yes, from whom do you source? (Select all relevant options)	☐ Academic Staff ☐ Administrative Staff ☐ Students ☐ Contractors ☐ Visitors ☐ Residence ☐ Other, please specify Type Other here
4.6	Are there any noticeable shortcomings in the way the Internet is managed with regards to Financial Resources? In other words, are there any concerns that you would like to raise regards to your ICT Internet financial resource capacity?	Type Comments here
		Section 5: Physical Resources
5.1	Are you aware of all devices that connect to your University's Internet connection?	☐ Yes | ☐ No
5.2	Do you cater for all devices that connect to your University's Internet connection?	☐ Yes | ☐ No
5.3	If no for 5.1 or 5.2, how do you manage them?	Type Management Comments here
5.4	Does a device need to authenticate before being granted access to the Internet?	☐ Yes | ☐ No
5.5	Do you have an active Mobile Device Management (MDM) system in your University to manage connected mobile devices?	☐ Yes | ☐ No
5.6	What is the speed of your local (South African) Internet traffic?	Type Local Speed here MB
5.7	What is the speed of your International Internet traffic?	Type International Speed here MB
5.8	What percentage of your Internet bandwidth is allocated to staff?	☐ Below 10% ☐ 10% - 19% ☐ 20% - 29% ☐ 30% - 39% ☐ 40% - 49% ☐ 50% - 59% ☐ 60% - 69% ☐ 70% - 79%

		☐ 80% - 89% ☐ Above 90%
5.9	What percentage of your Internet bandwidth is allocated to students?	☐ Below 10% ☐ 10% - 19% ☐ 20% - 29% ☐ 30% - 39% ☐ 40% - 49% ☐ 50% - 59% ☐ 60% - 69% ☐ 70% - 79% ☐ 80% - 89% ☐ Above 90%
5.10	Does your University have a Campus Internet backbone?	☐ Yes | ☐ No
	If no, please skip to question 5.13	
5.11	If yes, please indicate the type of WAN Technology used in your University environment to connect campuses together in the space provided below.	Options under Technology tab includes Fiber Optic, Diginet, ISDN, Wireless, Other

Site Name (Type Site Names in space provided)	**Technology** (Select Technology from dropdown list)	**Speed** (Type Speed in space provided)
Example: Main site to 2nd Ave	Example: Wireless	Example: 100 MB
Site Name to Site Name	Choose Technology used at this Site	Speed MB
Site Name to Site Name	Choose Technology used at this Site	Speed MB
Site Name to Site Name	Choose Technology used at this Site	Speed MB
Site Name to Site Name	Choose Technology used at this Site	Speed MB
Site Name to Site Name	Choose Technology used at this Site	Speed MB
Site Name to Site Name	Choose Technology used at this Site	Speed MB
Site Name to Site Name	Choose Technology used at this Site	Speed MB
Site Name to Site Name	Choose Technology used at this Site	Speed MB
Site Name to Site Name	Choose Technology used at this Site	Speed MB

5.12	Please indicate the type of Backbone Connection used between your University and your Service Provider. (Select all relevant options)	☐ Fiber Optic ☐ Diginet ☐ Wireless ☐ Other
5.13	Are there any noticeable shortcomings in the way the Internet is managed with regards to Physical Resources? In other words, are there any concerns that you would like to raise regards to your ICT Internet physical resource capacity?	Type Comments here
		Section 6: Organisational Resources
		Governance
6.1	Does your University have any of the following policies in place that addresses Internet Management issues?	☐ ICT Policy ☐ Acceptable Use Policy ☐ Privacy Policy ☐ ICT Information Security Policy ☐ Bandwidth/Network Policy ☐ Other
6.2	Are changes made to the Internet management resources approved by Official University Committees before implementation?	☐ Yes | ☐ No
6.3	Are Internet performance reports sent to an Official University Committee on a regular basis?	☐ Yes | ☐ No
	If no, please skip to question 6.6	
6.4	If yes, to whom?	Type To Whom here
6.5	How frequently?	☐ When Requested ☐ Real-Time ☐ Daily ☐ Weekly ☐ Monthly ☐ Quarterly ☐ Bi-Annually ☐ Annually ☐ Never
6.6	How often do you review your Internet management resources to ensure its effectiveness and relevancy?	☐ When Requested ☐ Real-Time ☐ Daily ☐ Weekly

		☐ Monthly ☐ Quarterly ☐ Bi-Annually ☐ Annually ☐ Never
		Technology
6.7	What is the main tool (technology/software package) that you use to manage your Internet? E.g. Firewall, Proxy.	Type Main Tool here
6.8	Do you monitor you Internet bandwidth?	☐ Yes | ☐ No
6.9	If yes, what tools/systems do you use?	Type Name of Tools/Systems here
6.10	Do you have a bandwidth management solution in place?	☐ Yes | ☐ No
6.11	If yes, what tools/systems do you use?	Type Name of Tools/Systems here
6.12	Do you monitor your campus network/backbone?	☐ Yes | ☐ No
6.13	If yes, what tools/systems do you use?	Type Name of Tools/Systems here
6.14	Do you have a web caching solution in place?	☐ Yes | ☐ No
6.15	If yes, what tools/systems do you use?	Type Name of Tools/Systems here
6.16	Do you implement per profile limits?	☐ Yes | ☐ No
6.17	If yes, please elaborate briefly on how this is implemented.	Type Brief Implementation here
6.18	Do you implement per machine limits?	☐ Yes | ☐ No
6.19	If yes, please elaborate briefly on how this is implemented.	Type Brief Implementation here
6.20	Do you have site restriction/limitations in place?	☐ Yes | ☐ No
6.21	If yes, please elaborate briefly on how this is implemented.	Type Brief Implementation here
6.22	What do you do with the unknown Internet traffic that you capture?	☐ Drop the traffic ☐ Place it in isolated category ☐ Combine it with other category ☐ Other, please specify Type Other here
6.23	Do you implement hard cap?	☐ Yes | ☐ No

6.24	If yes, please elaborate briefly on how this is implemented.	Type Brief Implementation here
6.25	Do you implement soft cap?	☐ Yes | ☐ No
6.26	If yes, please elaborate briefly on how this is implemented.	Type Brief Implementation here
6.27	Do you implement shaping?	☐ Yes | ☐ No
6.28	If yes, please elaborate briefly on how this is implemented.	Type Brief Implementation here
6.29	Do you implement throttling?	☐ Yes | ☐ No
6.30	If yes, please elaborate briefly on how this is implemented.	Type Brief Implementation here
6.31	Do you implement distinctions between business hours and non-business hours regarding these controls?	☐ Yes | ☐ No
6.32	If yes, please elaborate briefly on how this is implemented.	Type Brief Implementation here
		Monitoring
6.33	Do you process and store Internet logs?	☐ Yes | ☐ No
	If no, please continue to question 6.37	
6.34	If yes, which log analyser do you use?	Type Log Analyser here
6.35	How often are these logs reviewed?	☐ When Requested ☐ Real-Time ☐ Daily ☐ Weekly ☐ Monthly ☐ Quarterly ☐ Bi-Annually ☐ Annually ☐ Never
6.36	What do you do with the findings?	Type Action here
6.37	What do you do with students that abuse their Internet privileges?	☐ Handle enquiry internally ☐ Receive verbal/written/final written warning ☐ Follow University Disciplinary policy and procedure ☐ Other, please specify Type Other here

6.38	How many reported student Internet abuse cases have you had in the past year?	Type Number of students per year (approximately) here number of students per year
6.39	What do you do with staff that abuse their Internet privileges?	☐ Handle enquiry internally ☐ Receive verbal/written/final written warning ☐ Follow University Disciplinary policy and procedure ☐ Other, please specify Type Other here
6.40	How many reported staff Internet abuse cases have you had in the past year?	Type Number of staff per year (approximately) here number of staff per year
6.41	Are there any noticeable shortcomings in the way the Internet is managed with regards to Organisational Resources? In other words, are there any areas that you would improve with regards to this resource?	Type Comments here

Please return the completed survey to Mr Ryno Boshoff via email at ryno.boshoff@nmmu.ac.za.

Thank you for participating in this survey!

Appendix D – HEIIMS DISTRIBUTION EMAIL

From: Maryna van Rooyen [mailto:mvanrooyen@asaudit.ac.za]
Sent: 20 May 2015 02:18 PM
Cc: Boshoff, Ryno (Mr) (Summestrand Campus North)
Subject: ASAUDIT: Higher Education Institute (HEI) Internet Management Survey for distribution amongst all Directors: ICT within the South African Universities who forms part of the ASAUDIT group

Dear Colleague,

Below is a request for a survey from NMMU.

Thanks,

Maryna

Dear ASAUDIT Colleague

I would like to request your permission as gatekeeper to distribution of my research questionnaire titled 'Higher Education Institute (HEI) Internet Management Survey' amongst the Directors: ICT within the South African Universities on my behalf.

My treatise investigates the management of the Internet at the Nelson Mandela Metropolitan University. This investigation will be conducted at the internet usage level and from two angles: firstly, what the users indicate they use the Internet for and secondly, what the captured Internet activities on the firewall logs indicate it is used for. The two results will then be compared and the difference interpreted. From these findings an Internet management model will be created that will assist NMMU with their Internet management obligations.

Before I can commence with the creation of the HEI Internet management model, I need to know what is considered best practice regarding the management of the Internet at South African Universities. The survey attached will therefore cover all aspects of HEI organisational resources linked to Internet management and will give me a proper understanding of how the ICT Internet resources are utilised at South African Universities.

I therefore request your permission to distribute my questionnaire titled 'Higher Education Institute (HEI) Internet Management Survey' to all Directors: ICT who form part of the ASAUDIT group in an attempt to gain insight into their Internet management practices. The findings will give me insight into their Internet management resources and will allow me to create a foundation of Internet management best practices within South African Universities. These findings will also be available to the participants if requested. This will give them insight into what other Universities are doing regarding their Internet

Management practices. The final Internet management model will also be made available to them if requested.

Please find attached the survey titled 'Higher Education Institute (HEI) Internet Management Survey'.

Additional attachments include 'Background, Objective and Methodology for the study' which is a brief motivation for my study and the REC-H approval letter titled 'H15-SCI-CSS-005 Prof A Calitz-Mr R Boshoff.14May2015', both for your review.

REC-H Reference: H15-SCI-CSS-005

Yours Sincerely
Die Uwe

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Information has no value, unless it is available immediately.
Knowledge has no value, unless it is turned into a skill.

Appendix E – NMMUIUS

NMMU Internet Usage Survey

Thank you for taking the time out of your busy schedule to complete the survey. Your input will greatly assist the researcher to determine what NMMU's Internet resources are being utilised for. This information will also assist the ICT Management Team to review their current Internet resources and align them accordingly. The expected time to complete this survey is 20 minutes. No personal identifiable information will be captured and used in this survey. Completion and submission of the survey constitute consent for the data to be used in the study. If you have any question regarding the survey, please feel free to contact me via email at ryno.boshoff@nmmu.ac.za. REC-H Reference Number: H15-SCI-CSS-005.

Section 1: Demographic Information

1.1 *	Gender	○ Female ○ Male
1.2 *	Age	○ Below 20 ○ 21 - 29 ○ 30 - 39 ○ 40 - 49 ○ 50 - 59 ○ 60 +
1.3 *	On what Campus are you mainly situated?	○ South Campus ○ North Campus ○ 2nd Ave Campus ○ Birdstreet Campus ○ Missionvale Campus ○ George Campus ○ NMMU Business School
1.4 *	Are you administrative staff, academic staff or a student?	○ Academic Staff ○ Administrative Staff ○ Student
1.5 *	Do you have an active Internet connection at home?	○ Yes ○ No

Section 2: Governance

2.1 *	Are you aware of the NMMU General ICT Policy?	Yes No
2.2 *	Have you read and understood it?	Yes No Not Applicable
2.4 *	Do you agree with it?	Yes No Not Applicable
2.5 *	Are you aware of the Acceptable Use Policy?	Yes No
2.6 *	Have you read and understood it?	Yes No Not Applicable
2.7 *	Do you agree with it?	Yes No Not Applicable
2.8 *	How many devices to you use to connect to NMMU's Internet?	1 2 3 4 5 or more
2.9 *	What type of device do you mainly use to connect to NMMU's Internet?	Desktop Computer Laptop Tablet Smartphone Other

Section 3: Usage and Access Duration

Access to NMMU's Internet can be done when inside the NMMU environment (on Campus) and via VPN connection from off Campus.

How many hours per day on average do you use NMMU's Internet for:

3.1 *	GENERAL PURPOSES DURING OFFICE HOURS ON WEEKDAYS?	None Less than 1 hour 1 - 3 hours 4 - 5 hours More than 5 hours
3.2 *	GENERAL PURPOSES AFTER HOURS ON WEEKDAYS?	None Less than 1 hour 1 - 3 hours 4 - 5 hours More than 5 hours

3.3 *	GENERAL PURPOSES OVER WEEKENDS?	None Less than 1 hour 1 - 3 hours 4 - 5 hours More than 5 hours
3.5 *	WORK/ACADEMIC PURPOSES DURING OFFICE HOURS ON WEEKDAYS?	None Less than 1 hour 1 - 3 hours 4 - 5 hours More than 5 hours
3.6 *	WORK/ACADEMIC PURPOSES AFTER HOURS ON WEEKDAYS?	None Less than 1 hour 1 - 3 hours 4 - 5 hours More than 5 hours
3.7 *	WORK/ACADEMIC PURPOSES OVER WEEKENDS?	None Less than 1 hour 1 - 3 hours 4 - 5 hours More than 5 hours
3.8 *	NON-WORK/NON-ACADEMIC PURPOSES DURING OFFICE HOURS ON WEEKDAYS?	None Less than 1 hour 1 - 3 hours 4 - 5 hours More than 5 hours
3.9 *	NON-WORK/NON-ACADEMIC PURPOSES AFTER HOURS ON WEEKDAYS?	None Less than 1 hour 1 - 3 hours 4 - 5 hours More than 5 hours
3.10 *	NON-WORK/NON-ACADEMIC PURPOSES OVER WEEKENDS?	None Less than 1 hour 1 - 3 hours 4 - 5 hours More than 5 hours

Section 4: Content

Please take note that these are websites with contains information related to the topic/area or generate internet traffic related to the topic/area.

How often do you use the NMMU's Internet to access the following categories of websites?

4.1 *	BUSINESS	Daily Weekly Monthly Less Often Never
4.2 *	FINANCE AND BANKING	Daily Weekly Monthly Less Often Never
4.3	INFORMATION TECHNOLOGY	Daily Weekly Monthly Less Often Never

4.4 *	INFORMATION AND COMPUTER SECURITY	Daily	Weekly	Monthly	Less Often	Never
4.5 *	SEARCH ENGINES AND PORTALS	Daily	Weekly	Monthly	Less Often	Never
4.6 *	SECURE WEBSITES	Daily	Weekly	Monthly	Less Often	Never
4.7 *	WEB-BASED APPLICATIONS	Daily	Weekly	Monthly	Less Often	Never
4.8 *	BUSINESS EMAILS	Daily	Weekly	Monthly	Less Often	Never
4.9 *	RESEARCH	Daily	Weekly	Monthly	Less Often	Never
4.10 *	WEBSITES RELATED TO BUSINESS CONTENT WHICH MAY INCLUDE ARMED FORCES, GENERAL ORGANISATIONS, GOVERNMENT AND LEGAL ORGANISATIONS, WEB HOSTING	Daily	Weekly	Monthly	Less Often	Never
4.11 *	EDUCATION	Daily	Weekly	Monthly	Less Often	Never
4.12 *	ENTERTAINMENT	Daily	Weekly	Monthly	Less Often	Never
4.13 *	GAMES	Daily	Weekly	Monthly	Less Often	Never
4.14 *	INSTANT MESSAGING	Daily	Weekly	Monthly	Less Often	Never
4.15 *	SOCIAL NETWORKING	Daily	Weekly	Monthly	Less Often	Never
4.16 *	PERSONAL EMAILS	Daily	Weekly	Monthly	Less Often	Never
4.17 *	CONTENT SERVERS	Daily	Weekly	Monthly	Less Often	Never
4.18 *	SHOPPING AND AUCTION	Daily	Weekly	Monthly	Less Often	Never

4.19 *	SPORTS	Daily	Weekly	Monthly	Less Often	Never
4.20 *	JOB SEARCH	Daily	Weekly	Monthly	Less Often	Never
4.21 *	NEWS AND MEDIA	Daily	Weekly	Monthly	Less Often	Never
4.22 *	WEBSITES RELATED TO PERSONAL/PRIVATE CONTENT WHICH MAY INCLUDE ARTS AND CULTURE, BROKERAGE AND TRADING, CHILD EDUCATION, DYNAMIC CONTENT, FOLKLORE, GLOBAL RELIGION, HEALTH AND WELLNESS, MEDICINE, PERSONAL PRIVACY, REAL ESTATE, RESTAURANT AND DINING, TRAVEL	Daily	Weekly	Monthly	Less Often	Never
4.23 *	FILE SHARING AND STORAGE	Daily	Weekly	Monthly	Less Often	Never
4.24 *	FREEWARE AND SOFTWARE DOWNLOADS	Daily	Weekly	Monthly	Less Often	Never
4.25 *	INTERNET RADIO AND TV	Daily	Weekly	Monthly	Less Often	Never
4.26 *	INTERNET TELEPHONY (VOIP)	Daily	Weekly	Monthly	Less Often	Never
4.27 *	PEER-TO-PEER FILE SHARING	Daily	Weekly	Monthly	Less Often	Never
4.28 *	STREAMING MEDIA AND DOWNLOAD	Daily	Weekly	Monthly	Less Often	Never
4.29 *	MALICIOUS WEBSITES	Daily	Weekly	Monthly	Less Often	Never
4.30 *	PHISHING	Daily	Weekly	Monthly	Less Often	Never
4.31 *	SPAM URLS (LINKS TO SPAM WEBSITES)	Daily	Weekly	Monthly	Less Often	Never

4.32 *	CHILD ABUSE	Daily	Weekly	Monthly	Less Often	Never
4.33 *	DRUG ABUSE	Daily	Weekly	Monthly	Less Often	Never
4.34 *	ILLEGAL OR UNETHICAL	Daily	Weekly	Monthly	Less Often	Never
4.35 *	PLAGIARISM	Daily	Weekly	Monthly	Less Often	Never
4.36 *	WEBSITES RELATED TO POTENTIALLY LIABLE CONTENT WHICH MAY INCLUDE EXPLICIT VIOLENCE, EXTREMIST GROUPS, HACKING, DISCRIMINATION, PROXY AVOIDANCE	Daily	Weekly	Monthly	Less Often	Never
4.37 *	ALCOHOL	Daily	Weekly	Monthly	Less Often	Never
4.38 *	ALTERNATIVE BELIEFS	Daily	Weekly	Monthly	Less Often	Never
4.39 *	DATING	Daily	Weekly	Monthly	Less Often	Never
4.40 *	GAMBLING	Daily	Weekly	Monthly	Less Often	Never
4.41 *	PORNOGRAPHY	Daily	Weekly	Monthly	Less Often	Never
4.42 *	SPORTS HUNTING AND WAR GAMES	Daily	Weekly	Monthly	Less Often	Never
4.43 *	TOBACCO AND WEAPONS (SALES)	Daily	Weekly	Monthly	Less Often	Never
4.44 *	WEBSITES RELATED TO ADULT/MATURE CONTENT WHICH MAY INCLUDE ABORTION, ADVOCACY ORGANISATIONS, LINGERIE AND SWIMSUIT, MARIJUANA, NUDITY AND RISQUE, OTHER ADULT MATERIALS, SEX EDUCATION	Daily	Weekly	Monthly	Less Often	Never

4.45 * WEBSITES THAT DOES NOT FORM PART OF THE CATEGORIES AS LISTED ABOVE

Daily Weekly Monthly Less Often Never

Section 5: Primary Purpose

What are your TOP 3 PRIMARY uses for NMMU's Internet:

5.1 * DURING OFFICE HOURS ON WEEKDAY?

- Blogs
- Chat rooms
- File Storage and Sharing
- Gaming
- Instant Messenger (e.g. MSN, Yahoo, WhatsApp, WeChat, Facebook Massager)
- Video Communication (e.g. Lync, Skype)
- Internet TV (e.g. DSTV)
- Music (e.g. iTunes, Radio)
- News and Sports
- Research
- Shopping and Auctions
- Social Networking (e.g. Facebook, Twitter, LinkedIn)
- Web browsing
- Work
- Other

5.2 * AFTER HOURS ON WEEKDAYS?

- Blogs
- Chat rooms
- File Storage and Sharing
- Gaming
- Instant Messenger (e.g. MSN, Yahoo, WhatsApp, WeChat, Facebook Massager)
- Video Communication (e.g. Lync, Skype)
- Internet TV (e.g. DSTV)
- Music (e.g. iTunes, Radio)
- News and Sport

- [ ] Research
- [ ] Shopping and Auctions
- [ ] Social Networking (e.g. Facebook, Twitter, LinkedIn)
- [ ] Web browsing
- [ ] Work
- [ ] Other

5.3 * OVER WEEKENDS?

- [ ] Blogs
- [ ] Chat rooms
- [ ] File Storage and Sharing
- [ ] Gaming
- [ ] Instant Messenger (e.g. MSN, Yahoo, WhatsApp, WeChat, Facebook Massager)
- [ ] Video Communication (e.g. Lync, Skype)
- [ ] Internet TV (e.g. DSTV)
- [ ] Music (e.g. iTunes, Radio)
- [ ] News and Sport
- [ ] Research
- [ ] Shopping and Auctions
- [ ] Social Networking (e.g. Facebook, Twitter, LinkedIn)
- [ ] Web browsing
- [ ] Work
- [ ] Other

Section 6: Management

Please rate the following aspects of NMMU's Internet service:

6.1 * The Internet speed designated to me for work use is

Very Poor ○ ○ ○ ○ ○ Excellent

6.2 * The Internet speed designated to me for personal use is

Very Poor ○ ○ ○ ○ ○ Excellent

6.3 *	The availability of the Internet (coverage areas) in the NMMU environment is	Very Poor	Excellent
6.4 *	The support I receive from ICT Services staff regarding the Internet services is	Very Poor	Excellent
6.5 *	The security controls in place to protect me when using the Internet is	Very Poor	Excellent
6.6 *	My overall perception/feeling of the Internet at NMMU is	Very Poor	Excellent

Appendix F – NMMUIUS DISTRIBUTION EMAIL

From: NMMU-Communique
Sent: 20 May 2015 08:57 AM
To: #SURVEYS; * ALL NMMU STUDENTS
Subject: #SURVEYS - NMMU Internet Usage Survey

Dear NMMU Internet user

You are invited to participate in a research study relating to Staff and Student Internet usage and requirements at NMMU. The study will require you to complete the questionnaire related to your Internet usage and requirements in the NMMU environment. This data will assist NMMU ICT Services to provide the required Internet infrastructure to staff and students. The survey is done on a voluntary basis. None of your personal information will be used or published. Participation in this study will not result in any additional cost to you.

The investigators are researching the staff and student Internet usage and requirements to gain a better understanding of the current NMMU Internet landscape. The data collected will assist the researcher to create **a Model for Internet Management at a Higher Education Institute** which will allow for the effective management of ICT Internet resources at NMMU.

You, as the participant, will be required to answer a series of questions related to the NMMU's Internet. These questions relates to your Internet usage. Your participation will assist in providing suggestions for improved Internet services.

Please click on the link below to access the survey:

http://forms.nmmu.ac.za/websurvey/q.asp?sid=1417&k=uteqyqzxwy

Ethics clearance has been obtained: REC-H Reference Number: H15-SCI-CSS-005.

Ryno Boshoff
Systems Engineer: Security
ICT Services: Operation and Development

Appendix G – NMMUIUS'S DEMOGRAPHIC INFORMATION

1.1 Gender						
Answer	**Staff**		**Students**		**TOTAL**	
Female	82	62%	230	46%	312	49%
Male	50	38%	270	54%	320	51%
TOTAL	**132**	**100%**	**500**	**100%**	**632**	**100%**
Chi^2(d.f. = 1, n = 632) = 10.86; p = .001; V = 0.13 Small						

1.2 Age						
Answer	**Staff**		**Students**		**TOTAL**	
Below 20	0	0%	149	30%	149	24%
21 - 29	14	11%	286	57%	300	47%
30 - 39	37	28%	46	9%	83	13%
40 - 49	34	26%	16	3%	50	8%
50 - 59	30	23%	3	1%	33	5%
60 +	17	13%	0	0%	17	3%
TOTAL	**132**	**100%**	**500**	**100%**	**632**	**100%**
Chi^2(d.f. = 5, n = 632) = 344.78; p < .0005; V = 0.74 Large						

1.3 On what Campus are you mainly situated?						
Answer	**Staff**		**Students**		**TOTAL**	
2nd Ave Campus	9	7%	51	10%	60	9%
Birdstreet Campus	1	1%	0	0%	1	0%
George Campus	6	5%	42	8%	48	8%
Missionvale Campus	2	2%	19	4%	21	3%
NMMU Business School	4	3%	35	7%	39	6%
North Campus	36	27%	107	21%	143	23%
South Campus	74	56%	246	49%	320	51%
TOTAL	**132**	**100%**	**500**	**100%**	**632**	**100%**
Chi^2(d.f. = 6, n = 632) = 13.96; p = .030; V = 0.15 Small						

1.5 Do you have an active Internet connection at home?						
Answer	**Staff**		**Students**		**TOTAL**	
Yes	101	77%	304	61%	405	64%
No	31	23%	196	39%	227	36%
TOTAL	**132**	**100%**	**500**	**100%**	**632**	**100%**
Chi^2(d.f. = 1, n = 632) = 11.21; p = .001; V = 0.13 Small						

Appendix H – NMMUIUS'S CONTENT

STAFF					
	Never	**Less Often**	**Monthly**	**Weekly**	**Daily**
Business	23%	29%	11%	12%	26%
Finance and banking	20%	21%	27%	27%	5%
Information Technology	19%	31%	10%	20%	20%
Information and computer security	27%	41%	10%	11%	11%
Search engines and portals	3%	9%	5%	17%	66%
Secure websites	17%	11%	11%	19%	43%
Web-based applications	26%	23%	8%	16%	27%
Business emails	15%	17%	3%	2%	62%
Research	9%	14%	16%	27%	34%
Websites related to business content	36%	29%	11%	16%	8%
Education	8%	25%	17%	27%	23%
Entertainment	26%	33%	6%	25%	10%
Games	75%	16%	1%	5%	4%
Instant messaging	53%	15%	5%	7%	20%
Social networking	26%	28%	3%	14%	30%
Personal emails	15%	27%	2%	17%	40%
Content servers	46%	25%	8%	7%	14%
Shopping and auction	46%	33%	12%	7%	2%
Sports	55%	27%	5%	12%	2%
Job search	55%	37%	2%	5%	0%
News and media	7%	31%	9%	18%	35%

	Never	Less Often	Monthly	Weekly	Daily
Websites related to personal/private content	16%	36%	19%	19%	10%
File sharing and storage	29%	33%	10%	11%	18%
Freeware and software downloads	33%	43%	16%	8%	1%
Internet radio and TV	56%	27%	6%	5%	7%
Internet telephony (VOIP)	80%	12%	2%	2%	4%
Peer-to-peer file sharing	67%	21%	2%	5%	5%
Streaming media and download	47%	23%	10%	13%	7%
Malicious websites	95%	5%	0%	1%	0%
Phishing	96%	3%	0%	1%	0%
Spam URLs (links to spam websites)?	95%	4%	0%	1%	0%
Child abuse	98%	2%	0%	0%	0%
Drug abuse	94%	5%	2%	0%	0%
Illegal or unethical	95%	4%	0%	1%	0%
Plagiarism	83%	14%	3%	0%	0%
Websites related to potentially liable content	95%	4%	2%	0%	0%
Alcohol	93%	6%	1%	0%	0%
Alternative beliefs	85%	13%	2%	0%	0%
Dating	97%	2%	1%	1%	0%
Gambling	100%	0%	0%	0%	0%
Pornography	97%	3%	0%	0%	0%
Sports hunting and war games	98%	1%	1%	0%	0%
Tobacco and weapons (sales)	99%	0%	0%	1%	0%
Websites related to adult/mature content	89%	10%	1%	1%	0%
Websites that does not form part of the categories as listed above?	77%	19%	2%	1%	2%

STUDENTS					
	Never	**Less Often**	**Monthly**	**Weekly**	**Daily**
Business	45%	28%	6%	12%	9%
Finance and banking	53%	26%	7%	10%	4%
Information Technology	35%	25%	8%	13%	19%
Information and computer security	40%	27%	10%	11%	12%
Search engines and portals	6%	8%	5%	18%	64%
Secure websites	16%	17%	7%	17%	42%
Web-based applications	22%	24%	7%	18%	29%
Business emails	32%	22%	6%	13%	27%
Research	4%	13%	15%	30%	37%
Websites related to business content	47%	29%	9%	9%	7%
Education	10%	14%	9%	22%	44%
Entertainment	16%	19%	8%	22%	35%
Games	52%	24%	5%	10%	9%
Instant messaging	30%	16%	6%	9%	38%
Social networking	18%	15%	5%	15%	47%
Personal emails	12%	14%	6%	15%	53%
Content servers	41%	26%	9%	11%	13%
Shopping and auction	66%	17%	8%	6%	3%
Sports	51%	21%	7%	12%	9%
Job search	40%	26%	11%	12%	11%
News and media	16%	16%	10%	24%	34%
Websites related to personal/private content	30%	29%	13%	15%	13%
File sharing and storage	26%	26%	12%	19%	18%

	Never	Less Often	Monthly	Weekly	Daily
Freeware and software downloads	37%	29%	14%	12%	8%
Internet radio and TV	55%	19%	6%	10%	10%
Internet telephony (VOIP)	73%	14%	5%	5%	2%
Peer-to-peer file sharing	54%	22%	5%	11%	8%
Streaming media and download	35%	23%	10%	16%	16%
Malicious websites	80%	15%	2%	2%	2%
Phishing	90%	8%	1%	1%	0%
Spam URLs (links to spam websites)	90%	8%	1%	1%	0%
Child abuse	94%	5%	0%	0%	0%
Drug abuse	94%	6%	1%	0%	0%
Illegal or unethical	90%	7%	1%	1%	0%
Plagiarism	83%	13%	3%	2%	0%
Websites related to potentially liable content	87%	9%	2%	1%	1%
Alcohol	91%	7%	1%	1%	0%
Alternative beliefs	85%	11%	1%	2%	1%
Dating	89%	7%	1%	2%	0%
Gambling	96%	3%	1%	0%	0%
Pornography	90%	5%	3%	2%	1%
Sports hunting and war games	90%	6%	2%	1%	1%
Tobacco and weapons (sales)	96%	2%	1%	0%	0%
Websites related to adult/mature content	81%	12%	5%	1%	1%
Websites that does not form part of the categories as listed above?	74%	20%	2%	2%	2%