Chapter 1 Introduction

"You cannot step twice into the same river, for fresh waters are ever flowing in upon you".

Heraclitus

This research sets out to explore the following question:

> **What are we learning about technology and educational innovation?   A case study of the virtual campus at the University of Pretoria.**

> Key words: virtual campus, learning, technology innovation, knowledge creation, knowledge management, organisational learning, instructional design, change management, customer relationship management (CRM).

In today's business environment there is no executive task more vital and demanding than that of sustained management of innovation and change…to compete in this ever-changing environment, companies must create new products, services and processes; to dominate they must adopt innovation as a way of life.

Tushman and Nadler (1986:74)

Quality in a service or product is not what you put into it. It is what the client or customer gets out of it.

Drucker (cited in Crego and Schiffrin, 1995:42)

This thesis investigates *process*, *product* and *service* innovation at a higher education institution. The virtual campus of the University of Pretoria was chosen as the case, because it is regarded as an example of educational innovation. As project leader of the virtual campus, the researcher managed the innovations in the case. As a result primary experience informs this study.

Technology innovation is an established field of research, but innovation in higher education (educational innovation) is an unexplored research area. The field of technology innovation is not adequate to describe and investigate all aspects of educational innovation. Therefore both learning and management theories are drawn upon to better understand the virtual campus as an educational innovation. An interdisciplinary framework is developed by exploring *knowledge*, *learning and design theory*, *organisational learning*, *knowledge creation*, *knowledge management*, *change management*, *technology innovation* and *customer relationship management*; and using it to identify critical success factors involved in educational innovation.

In the field of technology innovation a useful distinction is made between *process, product*, and *service* innovation as different types of innovation. Product or service innovation is associated with new product development. In a service organisation the product is supplying a service to the client Process or procedure innovation relates to improving current procedures and processes used in the production of products. (Utterback and Abernathy, 1975). This distinction is relevant to this study because an analysis of the virtual campus as an educational innovation proves that it can be collapsed into three distinctive components: *process, product,* and *service* innovation. Process innovation is required to create and sustain new products and services. This cycle is illustrated in Figure 1.1.
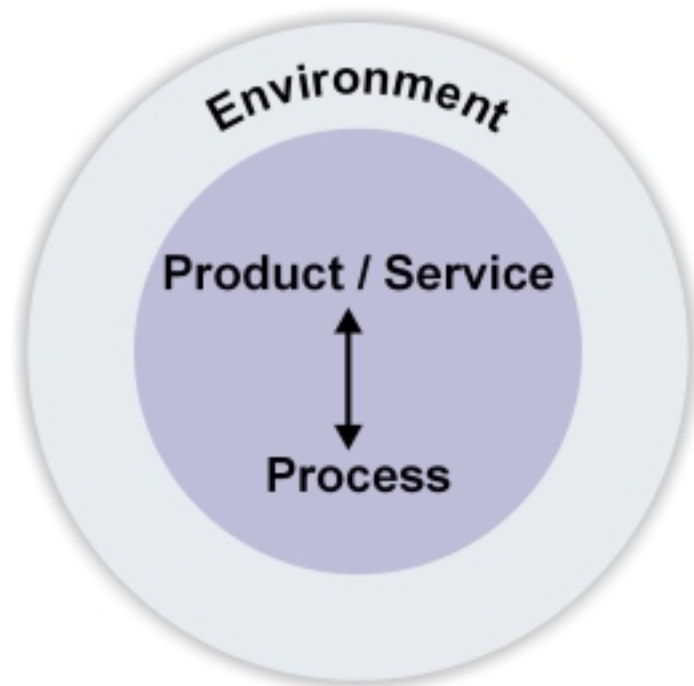

Figure 1.1 Innovation cycle

The focus on *Process innovation* refers to the implementation of structures, procedures and infrastructure to create and support the virtual campus.
The focus on *Product innovation* in this study refers to web-supported courses and the online yearbook and degree audit. The focus on *Service innovation* refers to web-based administrative facilities that were created for students and faculty.

Table 1.1 indicates the products and services of the virtual campus.

Product	Service
Online courses	Student Online Services
Online yearbook and degree audit	Online Application
	Online Payment
	Lecturers Online
	Online Registration

Table 1.1 Products and services of the virtual campus

The web-supported courses and web-based yearbook are regarded as new products and therefore as examples of *product* innovation. The various web-based administrative services are regarded as new services and therefore are regarded as examples of *service* innovation. The new structures, infrastructure and processes that were used on the one hand to create the new products and services of the virtual campus and which have been embedded in the institution to support and sustain the virtual campus on the other hand are considered to be examples of *process* innovation.

Figure 1.2 illustrates how the different theories are used to describe and interpret *process, product* and *service* innovation of the virtual campus. Disciplines drawn upon to develop the framework were identified during the research process and are particularly suited to higher education. Theory is applied to the case to reveal how it manifested in its various components of *process*, *product* and *service* innovation. Concomitantly, the innovation components are interpreted to enquire how the case informs theory.
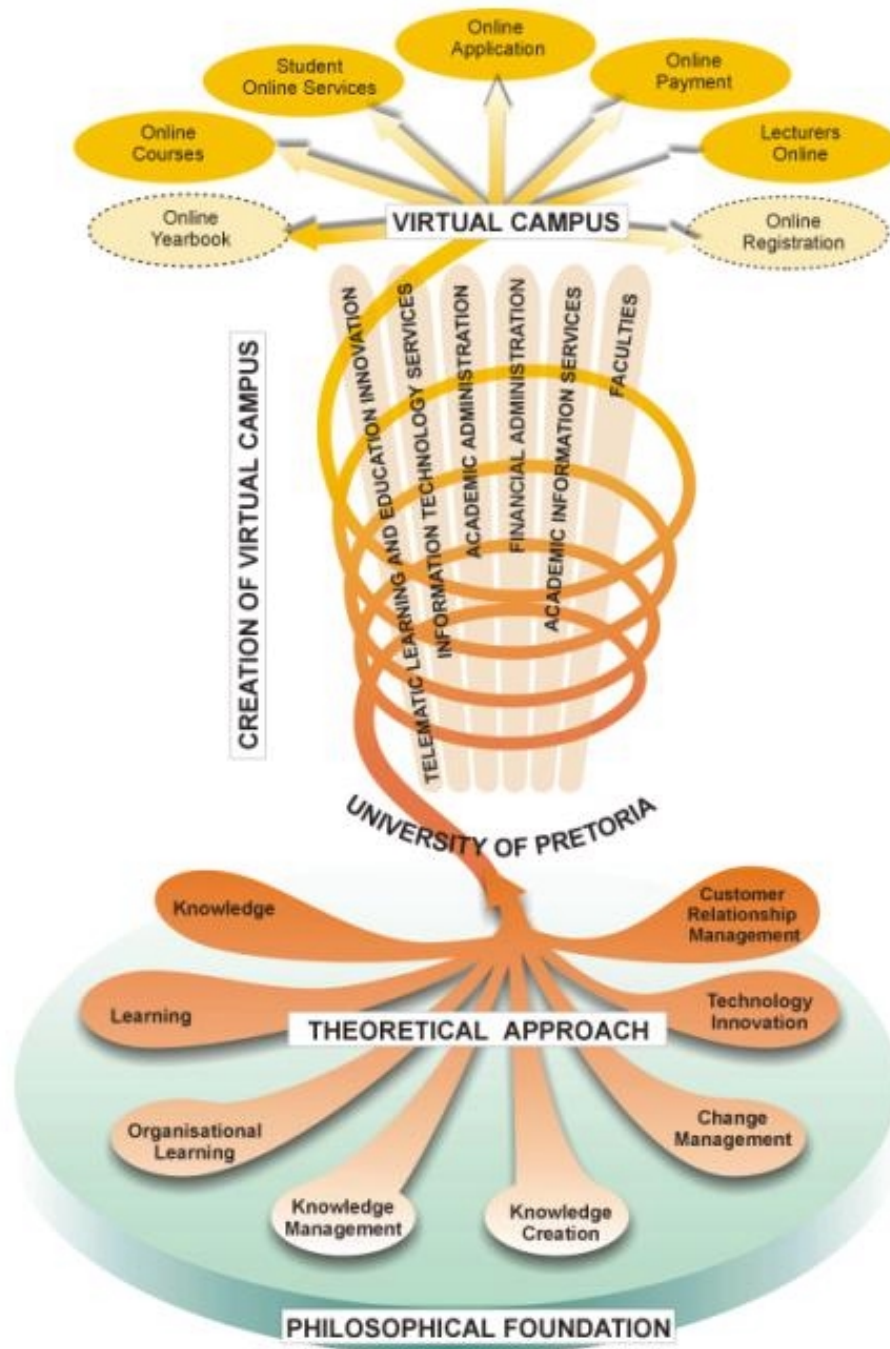
Figure 1.2 Theoretical fields used to describe and interpret the virtual campus

A decision was made to adopt a qualitative approach to explore educational innovation because innovation is too complex to reduce to only quantifiable measures. Statistical data is used as a descriptive measure. Hence a mixed method of research is used.

The structure of the thesis is illustrated in Figure 1.3. Chapter One describes the research problem and research methodology.   It gives an overview of the study and explains terminology. Chapter Two is a comprehensive literature review of Learning and Management theories that are applied to the case. Technology innovation is also discussed to explore innovation theory. Chapter Three shows how these different theories manifest in the current higher education landscape. The impact of technology on higher education institutions is emphasised in light of an important focus of this thesis: technology innovation. It explains forces that are shaping the higher education landscape and touches on *process*, *product* and *service* innovation within an educational context. Both international and national perspectives are given. The purpose of Chapter Three is to provide the correct context for the virtual campus as a case. Chapter Four is a case study and describes and interprets the virtual campus from multiple perspectives: learning, management and innovation involved in *process*, *product* and *service* innovation. Chapter Five is the conclusion and makes recommendations for further research.
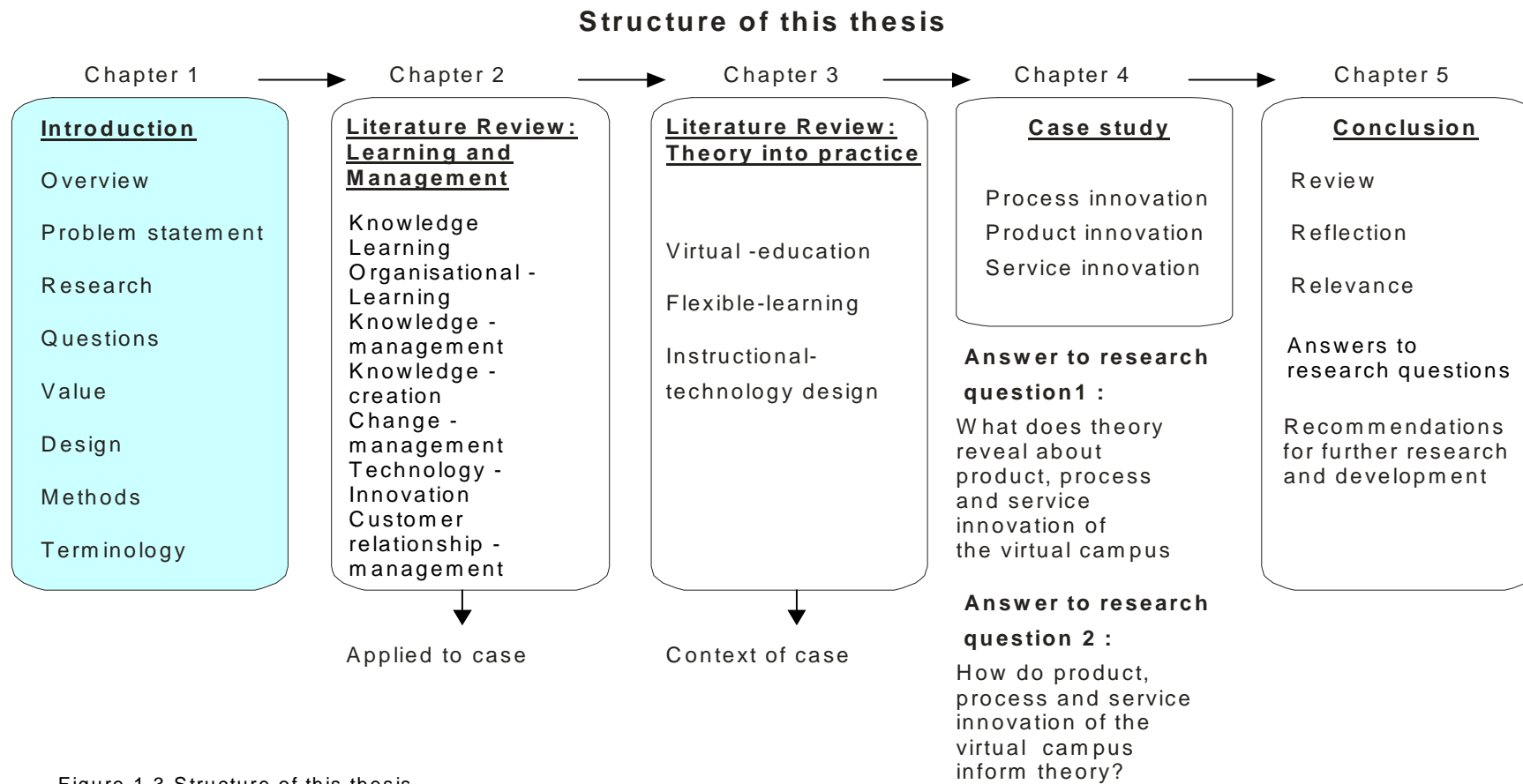
Structure of this thesis

Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5

Introduction

Overview

Problem statement

Research

Questions

Value

Design

Methods

Terminology

**Literature Review:
Learning and
Management**

Knowledge
Learning
Organisational -
Learning
Knowledge -
management
Knowledge -
creation
Change -
management
Technology -
Innovation
Customer
relationship -
management

**Literature Review:
Theory into practice**

Virtual -education

Flexible-learning

Instructional-
technology design

Case study

Process innovation
Product innovation
Service innovation

**Answer to research
question1 :**
What does theory
reveal about
product, process
and service
innovation of
the virtual campus

**Answer to research
question 2 :**
How do product,
process and service
innovation of the
virtual campus
inform theory?

Conclusion

Review

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Relevance

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Applied to case

Context of case

Figure 1.3 Structure of this thesis

The structure of the thesis is explained in Section 1.1.

1.1 Overview

The thesis consists of five chapters, references, annexures and a glossary.

Chapter One (Introduction) is an introduction of this study and explains the research methodology that is used.   The reliability of the outcome of the study depends largely on the methods used to reach those conclusions. It should be noted that subjectivity could be considered a threat to valid inferences in qualitative research because the researcher is the key instrument. Although this could confound the validity of the study, it is lessened by empirical components that are used. The research questions, approach, design, data collection methods, sampling and reliability and validity considerations are discussed. The value of the research is highlighted as well as the reasons for the selection of specific theories.

Chapter Two (Literature review: Learning and Management) explores different theories related to Learning and Management. The fields of *knowledge*, *learning and design theory*, *organisational learning*, *knowledge creation*, *knowledge management*, *change management*, *technology innovation* and *customer relationship management* are discussed. These theories are explored to illustrate the complex nature of educational innovation and the factors inherent in educational innovation. They are applied to the virtual campus as a case of educational innovation in Chapter Four in order to describe and interpret the various components of the virtual campus.

Chapter Three (Literature review: Theory into practice) Global innovation trends in higher education are highlighted to create the appropriate context of the study and particularly of the case of the virtual campus. Best practice is delineated and the concepts of *virtual education*, *flexible learning* and *instructional technology design* are explored as a literature review of theory into practice. Certain aspects of theory in practice are applied to the case in Chapter Four.

Chapter Four (Evaluation) is a case on the creation and evolution of the virtual campus of the University of Pretoria. It explores the various innovation processes that were used to create new products and services and the way these were managed over a four-year period. *Product* and *service* innovation are both

investigated. New processes that support and sustain the new products and services are described. Theory in Chapter Two is applied to *process*, *product* and *service* innovation to reveal what manifested in the case. In turn, these innovations are interpreted as to how they inform theory.

Chapter Five (Conclusion) is a review of the thesis and is a reflection on what the case study reveals about theory and practice. It highlights limitations and benefits of the study. The relevance of the study is discussed and recommendations for further research are made.

The addendum contains documentation, questionnaires, samples of web courses and a glossary.

Section 1.2 presents the problem statement of this study.

1.2 Introduction to research questions

Innovation in higher education is an unexplored field. Increased understanding of innovation should, in turn, lead to competitiveness. There is, therefore, a need for a framework that can be used as a tool to guide innovation management in terms of new *products*, *processes* and *services* in higher education. Organisations are increasingly turning to innovative practices in order to remain competitive. According to Porter *et al.* (1991:5) there is synergy between innovation and competitiveness. This thesis focuses on a case at the University of Pretoria in an attempt to contribute to knowledge about innovation in higher education. Although the findings of this study cannot be generalised to other higher education institutions, the study contributes to knowledge about educational innovation within a higher education context. It also contributes to knowledge about virtual education.

Information and communication technologies (ICT) and the knowledge economy require higher education institutions to change. In order to adapt, many residential higher education institutions have positioned themselves to offer flexible, technology-enhanced education that includes the use of technology in their product and service offering. The creation and evolution of the virtual campus is regarded in this study as an educational innovation and is therefore investigated from both a learning and management perspective, i.e. how were the *process*, *product* and *service* aspects managed; which theoretical constructs manifested and how do these innovations

inform theory. Theory about learning is relevant from a product perspective i.e. how must the new product be designed to foster individual learning in teams and from an organisational perspective, i.e. how do people learn during innovation.

Technology innovation is an established field of study, but limited literature is available on innovation in a higher education context. This prompted the researcher to select relevant theories that are appropriate to address the broader context of educational innovation.

Amidst significant changes and challenges, knowledge of institutional processes and structures required to support virtual education is topical and relevant to higher education institutions globally.

The magnitude of administrative, teaching and learning components present in the virtual campus, makes it a complex and encompassing project. As a result this study covers all aspects of the virtual campus in order to provide a comprehensive and holistic analysis. As stated previously, during the research process it became apparent that technology innovation as a field is not adequate to explain *process, product*, and *service* innovation involved in the creation and evolution of the virtual campus. Subsequently there is a range of theories that sheds light on the various aspects of the virtual campus. Thus, a multiple faceted approach is adopted to explore *process, product and service innovation* in the creation and evolution of the virtual campus.

The selected theories are disciplines in their own right. To the researcher's knowledge these theoretical fields have never been combined to augment technology innovation as a field of study to better inform educational innovation.

Section 1.3 explains the research questions of this study.

1.3 Research questions

The following main research question guided the inquiry:

What are we learning about technology and educational innovation at the University of Pretoria?

This question can be sub-divided into two research questions:

1.3.1   What does theory reveal about process, product and service innovation of the virtual campus? (Addressed in Chapter Four)

1.3.2   How do process, product and service innovation of the virtual campus inform theory? (Addressed in Chapter Four)

The purpose of these questions is to elicit information regarding the connection between various theories and educational innovation.

Each of these questions can be expanded into further sub questions:

1.3.1.1 Having selected theoretical and practical elements to comprise the literature survey in Chapter Two and Chapter Three, in what ways, and to what extent, are they found to be implemented and manifested in the creation and evolution of the virtual campus in terms of *process, product*, and *service* innovation and the management thereof?

Specific research questions regarding product innovation

- What is the prevalent educational model that is followed in web-supported courses?
- Do behaviourist or constructivist instructional design principles manifest in the web-supported courses?
- Is the diffusion of *WebCT* as the solution to support web-supported courses successful?
- Does effective learning take place in web-supported courses?

- How does the use of the web in teaching and learning impact the role of the lecturer?

Specific research questions regarding process innovation

- Which processes were used to create new products and services and in what way do the theories of knowledge creation, knowledge management, organisational learning, change management, technology innovation and customer relationship management manifest in these processes?
- Which new processes sustain the new products and services?

Specific research question regarding service innovation

- Is the diffusion of web-based services successful?

General research question regarding the virtual campus

- Do the new products and services of the virtual campus make the University of Pretoria more competitive?

1.3.2.1 How do the findings about *process, product and service innovation* of the virtual campus inform knowledge about the theories discussed in Chapter Two?

Specific research questions regarding product innovation

- How does the prevalent educational model used for web-supported courses inform behaviourist and constructivist instructional design approaches?
- How do the perceptions of learners and lecturers inform the role of the lecturer in a web-supported environment?
- How does the diffusion of the new web-supported courses inform technology innovation theory?

Specific research questions regarding process innovation

- How do the processes that were used to create new products and services inform the theories of *knowledge creation*, *change management* and *technology innovation*?
- How do the processes that have been embedded to support and sustain new products and processes inform virtual education?

Specific research questions regarding service innovation

- How does the diffusion of the new web-based services inform technology innovation theory?

General research question regarding the virtual campus

- Which critical success factors are important to consider in educational innovation?

The value of the research is highlighted in Section 1.4.

1.4 Value of the research

This study will contribute to our understanding of the following aspects:

1.4.1   Technology innovation at a (South African) higher education institution.

1.4.2   Knowledge creation, knowledge management, organizational learning, change management and customer relationship management at a (South African) higher education institution.

1.4.3   Web-supported learning at a (South African) higher education institution.

1.4.4   Instructional design and project management involved in web-supported education at a (South African) higher education institution.

1.4.5   Technology architecture required to support a virtual campus.

1.4.6   Educational innovation at a (South African) higher education institution.

Section 1.5 provides an overview of the research methodology used in this study.

1.5 Research plan

Research methodology is explained in terms of the following components:

- Approach
- Design
- Data collection instruments and methods
- Reliability and validity

As indicated in Table 1.2, a qualitative research approach is used in this thesis. A descriptive and interpretive case study is used as the design of the research, with the virtual campus as the case. The reason for selecting this particular design in explained in Section 1.5.4. Data collection methods to answer the research questions include technical and non-technical literature, a sample of three web-supported programmes, interviews and questionnaires.

Approach:	Qualitative
Design:	Descriptive and interpretive case study
Data collection:	Literature review (Technical literature) Non-technical literature (institutional reports & statistics)
	Sample of web-supported programmes
	Interviews
	Questionnaires

Table 1.2 Research plan

Because of the interdisciplinary nature of this study, a systems perspective on research is given in Section 1.5.1.

1.5.1 Research from a systems perspective

According to a systems perspective, objective reality does not exist in the sense that research is a way of finding out about the world through objective and systematic information gathering (Johns, 1996). Rather, research is a way of holistically describing patterns among phenomena of interest that are continually changing (Hanson, 1995).

As mentioned in Section 1.5, the research design is a descriptive and interpretive case study. The case study focuses on the creation and evolution of the virtual campus, and consists of multiple innovations, i.e. *process, product* and *service* innovation. It is important to select appropriate research methods to analyse the various innovations that, due to their nature, require different research methods. Yet it should be emphasized that because the context of the study is dynamic and ever changing, the purpose of research, as defined in this study, is not to reveal truth or an absolute reality, but to explore different realities in which the researcher is a participant in the interaction process within the system that is being investigated (Moore, 1997).

In systems thinking no research method is protected from being influenced by the subjectivity and bias of the researcher. This should not be viewed as a constraint. The researcher brings tacit knowledge constructs and insight to the study. Both add value to the research findings. Yet in order to retain credibility it is required of the researcher to make subjectivity in the research process as visible as possible.

From a research design perspective this study interfaces with development research design and excludes program evaluation. The reasons for this exclusion are given in Section 1.5.4.1. Section 1.5.2 describes this research from a time perspective.

1.5.2 Research as a process in time

Hanson (1995) describes research as a process in continuous time where certain patterns emerge as time transpires. Research could also add a dimension of freezing time by taking a snap shot of events at a given time. This study is a combination of a longitudinal analysis over several years and a snapshot of the present.

Table 1.3 establishes the relevance of the selected theories, and explains why they are used as the base from which the case is explored.

Theoretical field	Definition	Motivation
Knowledge (epistemology)	Epistemology is the theory of the method and nature of knowledge. **Knowledge Management** addresses the issues of organisational adaptation, survival and competence in face of increasingly discontinuous environmental change. It embodies organisational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of people (Malholtra, 2000).	Knowledge forms the foundation of learning and feeds into innovation. One cannot innovate without knowledge. Moreover, knowledge is the core competence of a higher education institution and is therefore the appropriate springboard for this study.
Individual learning	**Learning theory** deals with the way in which people learn. Learning is generally regarded as the acquiring of knowledge or skill (Brown & Duguid, 2000). There is a close relationship between individual learning and organisational learning (Argyris, 1977).	How a person learns, is important to understand if your innovation *product, process* or *service* involves learning. Various learning theories are explored, and later applied to the case.

Theoretical field	Definition	Motivation
Organizational learning	**Organisational learning** refers to the way in which people in organisations create and share new skills and knowledge that lead to an increased capacity for effective coordinated action (Kim, 1998:41). Nadler and Tushman (1999:96) mention that the most important business development in the twentieth century "is the pursuit of competitive advantage in an uncertain world through new approaches to organisational design".	How people learn in teams is important to understand in the innovation process. Change impacts on people and innovation often occurs in a team – especially on an enterprise level. Thus, an organization is an epistemological system containing mental models that have to change in an innovation process.
Knowledge creation	**Knowledge creation** arose because of a perceived lack in knowledge management. It involves the ability to deal with situations, events, information and contexts (Von Krogh *et al.* (2000:19).	How knowledge is created in an organization is important if one wants to better understand the innovation process, because everyone involved continually builds on the knowledge that exists. Knowledge is tacit and explicit and especially tacit knowledge is important in innovation. Different models of knowledge creation are explored within a context of innovation.

Theoretical field	Definition	Motivation
Change management	**Change management** is self-explanatory, because it refers to the management of change. Change is a continuous process, which has to be managed. Change management is part of leadership and the learning organisation. According to Nickols (2002) change management refers to the following: • systematic and planned management of internal, controlled changes within an organisation, or • responses to changes that lie outside the control of the organisation Hence one type of change management is proactive and the other is reactive.	The magnitude of change involved in an enterprise wide and crosscutting innovation process makes it important to understand the dynamics of change management. Different change management strategies are briefly explored.

Theoretical field	Definition	Motivation
Technology innovation	**Innovation** is defined by Schumpeter (cited in Janszen, 2000:3) as the commercialisation of all new combinations based upon the application of: • new materials and components • the introduction of new processes • the opening of new markets • the introduction of new organisational forms. Hence, innovation is the commercialisation of a new technology or combination of technologies introduced to meet a user or market need (Utterback, 1994). Innovation only takes place when market adoption occurs.	The case of the virtual campus consists of product and service innovation that are both examples of technology innovation. Process innovation relates to the structures, procedures and infrastructure that were created to support the virtual campus and that were used to create new products and processes.
Customer Relationship Management (CRM)	**CRM** is a business strategy whose outcomes optimise profitability, revenue and customer satisfaction (Gartner, 2001:7)	Innovation requires adoption by the market, or put differently, diffusion. An understanding of CRM can assist diffusion.

Theoretical field	Definition	Motivation
Instructional design and technology	**Instructional technology design** refers to the design of a learning environment when technology is involved. When learning is designed in a technology-enhanced environment, it firstly requires familiarity and understanding of the underlying models of the specific technology application (Reigeluth, 1999).	How a person learns in a technology-enhanced environment is important to understand if your innovation product is web-supported courses. It is also important to understand best practice on how to design web-based learning environments.

Table 1.3 Description of, and motivation for, selected theories

Driscoll & Dick (1999) point out that educational technology research demands alternative research methodologies.

The following section explains the research methodology used in this study.

1.5.3 Research approach

As mentioned in Section 1.1, the research approach of this study is qualitative.

The characteristics of qualitative research (Bogdan & Biklen, 1992:29-33) are as follows:

- Qualitative research is descriptive.
- Qualitative researchers are concerned with process rather than simply with outcomes and products.
- Qualitative researchers tend to analyse their data inductively.
- "Meaning" is of essential concern to the qualitative approach.
- Qualitative research has the natural setting as the direct source of data and the researcher is the key instrument.

Merriam (1998:6-8, 202) adds the following characteristics of qualitative research:

- Qualitative research can reveal how all the parts work together to form a whole.
- It assumes that reality is holistic, multidimensional, and ever-changing.

1.5.4 Research design

According to Mouton (1996:175) the research design serves to "plan, structure and execute" the research to maximise the "validity of the findings". The specific research design chosen for this study is that of a descriptive and interpretive case study. An interpretive case study can be categorised as qualitative research.

Various definitions for a case study exist. A case is something that is intrinsically bounded (Merriam, 1998:27). Lancy (1993:140) describes it as "the method of

choice for studying interventions or innovations". Thus it fits the educational innovation of creating a virtual campus at the University of Pretoria. Merriam (1988, cited in Bogdan & Biklen, 1992:62), defines a case study as "a detailed examination of one setting, or a single subject, a single depository of documents, or one particular event". This particular case study of the virtual campus of the University of Pretoria therefore falls within the category of a "detailed examination of one setting", although the single setting comprises various sub-components. These sub-components consist of *process, product* and *service* innovation.

Yin (1994:13) describes a case study in terms of the research process:

"A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context …"

Merriam (1998) lists the case study as one type of qualitative research design that is particularly appropriate in the following instances:

- When one wants to advance a field's knowledge base.
- In applied fields such as education, in which the findings can improve upon existing practice.
- In studying educational innovations.

1.5.4.1 Research design in this thesis

The research design is a descriptive and interpretive case study that is analysed through a combination of exploratory, qualitative methods and quantitative methods.

In a descriptive and interpretive case study, the researcher analyses, interprets and theorises about the phenomenon against the backdrop of a theoretical framework. Although the research process in qualitative research is inductive, Merriam (1998:49) notes that most qualitative research inherently moulds or changes existing theory in that:

- Data are analysed and interpreted in light of the concepts of a particular theoretical orientation (Research question 1).

- Findings are usually discussed in relation to existing knowledge (some of which is theory) with the aim of demonstrating how the present study has contributed to expanding the knowledge base (Research question 2).

Qualitative and quantitative data analyses are combined in an attempt to interpret the various innovations in this case.

Figure 1.4 illustrates the research approach and design used in this study.

Qualitative research type: Descriptive and interpretive case study

Theoretical framework

↓

Sample: University of Pretoria virtual campus

↓

Data collection

Inductive

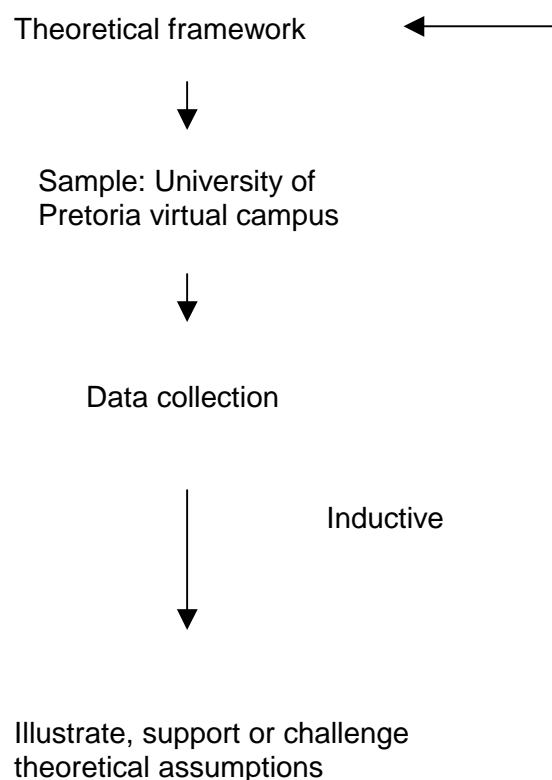Illustrate, support or challenge theoretical assumptions

Figure 1.4: Research approach and design

Merriam (1998:11,19) states that qualitative case studies in education are often framed with concepts, models and theories. An inductive method is then used to support or challenge theoretical assumptions.

Section 1.5.5 covers data collection methods used to address the research questions of this thesis. It is imperative that appropriate research methods are selected, which in this instance, are suitable for a case study.

According to Strauss and Corbin (1990:48), technical and non-technical literature is used in tandem with data in qualitative research methodology. They provide the following definitions of technical and non-technical literature respectively:

- "Technical literature: Reports of research studies and theoretical or philosophical papers characteristic of professional and disciplinary writing. These can be used as background materials against which one compares findings from actual data gathered in grounded theory studies" (Strauss & Corbin, 1990:48).

- "Non-technical literature: Biographies, diaries, documents, manuscripts, records, reports, catalogues and other materials that can be used as primary data or to supplement interviews and field observations in grounded theory studies" (Strauss & Corbin, 1990:48).

This study is similar to development research design as articulated by Van den Akker (1999). A significant characteristic of development research, identified by Van den Akker is "complex, innovative tasks for which only very few validated principles are available to structure and support design and development activities" (1999:7). Development research design is appropriate when an intervention or product is implemented to address a need. Theory and hypotheses are then extrapolated in the course of design and development of the product/intervention. It is particularly suitable for research on a micro level, i.e. to, for example, understand the characteristics of the role of a web lecturer. This study does not attempt to identify characteristics and conditions of a single product or intervention, but rather describes and interprets *process, product* and *service* innovation in light of various theoretical constructs on a macro level. The study excludes program evaluation design in which certain outcomes and performance goals are evaluated (McNamara, 1998). *Process, product* and *service* innovations are interpreted against the backdrop of theory and practice.

Section 1.5.5 explains the data collection methods.

1.5.5 Data collection

The research questions below are addressed through the literature reviews, institutional reports, statistics, questionnaires, interviews and an overview of a sample of web-based courses. Table 1.4 exemplifies how the research questions are addressed through appropriate data collection methods.

Research question 1 (Chapter Four)	
What does theory reveal about process, product and service innovation of the virtual campus?	
Method	
Investigation of the creation and evolution of the virtual campus in terms of theory.	
Goal	*Data collection methods*
Action *(Using theory and practice to investigate the manifestation of its elements in the case study)*	*Qualitative methods:* • Application of theory, interpretation of interviews, questionnaires, document analysis of non-technical literature and overview of courses.
	Quantitative methods: Collection of quantitative survey data and descriptive statistical analysis. • Adoption rate of services. • Adoption rate of products. • Aspects of web-supported courses.
Research question 2 (Chapter Four)	
How do process, product, and service innovation of the virtual campus inform theory?	
Method	
Building more knowledge about innovation management and theories discussed in Chapter Two.	

Goal	Data collection methods
Development and interpretive	*Inductive methods and qualitative methods:* Examination of theories and practice being applied in practice, and induction of ways to implement them. Qualitative inquiry into how the theoretical elements function in different aspects of innovation. Qualitative inquiry of how the findings of the case study contribute to knowledge about innovation in higher education. Motivation: The interpretive design is characterised by subjectivity and the study of individual experience. In this study the theoretical approach is further informed by practice, tending to become grounded theory.

Table 1.4 Research questions and related data collection methods of this thesis

Section 1.5.6 describes the types of sampling used in the case.

1.5.6 Sampling and selection

The virtual campus at the University of Pretoria was selected as the case study. In the study, purposeful sampling is used. Purposeful sampling takes place when the researcher selects a sample from which the most can be learned (Merriam, 1998:31). Section 1.5.7 describes the instruments used in the study.

1.5.7 Instruments

The sources of information or instruments are the following:

- Literature reviews (Technical data)
- Institutional reports and statistics (Non-technical data)
- Web-supported programmes (*WebCT*)
- Individual interviews
- Focus group interview
- Questionnaires (Lecturers and students)

Table 1.5 is a detailed matrix that illustrates which sources are used to explore answers to the research questions about *process, product* and *service* innovation.

Product innovation			
Product	**Instrument**	**Sample**	**Type of sampling**
Web-supported courses	Questionnaire (Open ended and rating questions) Focus group interview	Lecturers who have used *WebCT* frequently for one year and longer	Purposeful
Masters in Engineering Management (MEM), Masters in Project Management (MPM) and Masters in Business Administration (MBA)	Questionnaire (4-point Likert scale and rating questions) Overview of courses in MEM, MPM,MBA	First and second year students: MEM & MPM. First year MBA (modular)	Purposeful
Adoption rate of web-based courses	Virtual Campus server and *WebCT* Database	All courses – measured over a period of 4 years	Purposeful
Process innovation			
Virtual campus creation: process, infrastructure, services	Interview Non-technical literature (document analysts)	Virtual campus project team.	Purposeful
Instructional design and development model/project management	Non-technical literature	Telematic Learning and Education Innovation	Purposeful
Service innovation			
Adoption rate of services	Virtual Campus server	Student Online Services Online Application Online Payment Lecturers Online	Purposeful

Table 1.5 Overview of research methods used in this study

Section 1.5.8 investigates the reliability and validity of the research.

1.5.8 Reliability and validity

Subjectivity can be considered a threat to valid inferences in qualitative research. Mouton (1996:176) argues "especially in theoretical research this problem emerges as a problem of objectivity". In this regard, Bogdan & Biklen (1992:46) note "the worth of a study is the degree to which it generates theory, description or understanding". Thus a good qualitative researcher does not pass judgement, but attempts to add to knowledge. Yet Merriam (1998:199) mentions that a debate is raging because the constructs of reliability and validity are quantitative and positivist and not necessarily that applicable to qualitative research. Although the researcher takes cognisance of this debate, reliability and validity issues are addressed because both quantitative and qualitative research methods are used in the research.

Internal validity deals with the question of how research findings match reality, yet according to the philosophy underlying qualitative research, reality is relative to meaning that people construct within social contexts. Merriam (1998:204) provides the following six strategies to enhance internal validity in qualitative research:

1. Triangulation – using multiple sources of data or methods to confirm emerging findings.
2. Member checks – taking data and tentative interpretations back to the people from whom they were derived and asking them if the results are plausible.
3. Long-term observation.
4. Peer examination.
5. Participatory or collaborative modes of research.
6. Clarifying the researcher's biases, assumptions, worldview and theoretical orientation at the outset of the study.

The researcher used member checks, long-term observation and clarification of biases as strategies to enhance the internal validity of the findings of this study.

To clarify possible bias it is necessary to mention that the researcher was the project leader of the virtual campus.

Reliability refers to the extent to which research findings can be replicated (Merriam, 1998:205). Reliability is problematic because the culture and context of the creation

and evolution of the virtual campus at the University of Pretoria are unique to this study. Secondly, behaviour is not static, but changes continuously. Hence because there is no single reality, a similar study would most probably not yield the same results. Yet certain principles and patterns could prove to be reliable and some aspects could be replicated. Another factor is that of the researcher, who is conducting the research based on a personal construction of meaning through individual experience. Merriam (1998:206) explains it as follows:

"Because what is being studied in education is assumed to be in flux, multifaceted, and highly contextual, because information gathered is a function of who gives it and how skilled the researcher is at getting it, and because the emergent design of qualitative case study precludes a priori controls, achieving reliability in the traditional sense is not only fanciful but impossible".

She rather suggests that reliability in this instance should be determined by whether the results are consistent with the data collected. The following techniques are provided to achieve this (Merriam, 1998:206-207):

- Explain the assumptions and theory behind the study.

- Use multiple methods of data collection and analysis (triangulation).

- Explain in detail how data was collected to allow for an audit trail if necessary.

Section 1.6 presents the limitations and delimitations of this study.

1.6 Limitations and delimitations of the study

In light of the reliability techniques set out in Section 1.5.8 it is necessary to set out the researcher's assumptions and various limitations of the study. The Literature reviews in Chapter Two and Chapter Three consist of theories that were generated in other countries. The fact that these theories are applied to a South African context could be considered a limitation of this study. It is important to state that this study is

not an attempt to answer one specific aspect of educational innovation in detail. Rather, it is a broad study and strives to contribute to knowledge about various aspects of educational innovation. Therefore the case of the virtual campus informs about both learning and management aspects of educational innovation. The scope of the study does not allow the researcher to investigate both learning and management aspects in - depth. The findings should be considered as research findings on a macro, and more strategic level. One example of this is that samples of 40 lecturers and 174 students respectively (who participate in web-supported courses) are used. If this study focused on the virtual campus in terms of only product innovation within the context of learning theory, these samples would not have been adequate. It is however, adequate for this study because it is purposeful sampling of three flagship programmes. A possible limitation is that the perceptions of students are recorded in the questionnaire. Their perceptions are not necessarily a representation of reality, but as stated before, a qualitative research approach does not attempt to represent an absolute reality.

The following concepts are addressed to clarify the researcher's assumptions, namely:

- The view in this study of educational innovation.
- The domain of the study and its literature resources.
- An overview of the research perspective.
- The view of technology.

1.6.1 View of educational innovation

Educational innovation in this study uses the field of technology innovation as its base, but also looks to learning and management theories to inform the broader field of educational innovation.

Management of technology innovation refers to the way in which the invention of new technology and its implementation and introduction to the market is managed (Betz, 1998). Innovation in this study deals with *process, product,* and *service* innovation*.*

Girifalco (1991) defines innovation as "the process by which the invention is first brought into use. It involves the improvement or refinement of the invention, the initial design and production of prototypes, pilot plant testing and construction of

production facilities … diffusion is the process of the spread of the innovation into general use as it is adopted by more and more users".

According to Pistorius (2000:2-7) "Innovation is the process through which technology can be leveraged to attain the goal of competitiveness". Further that "innovation is a process that culminates in the implementation and adoption of the idea or innovation" (2000:3-5). Therefore it can be seen as the "creation of new products, processes, services, techniques and their acceptance in the market". (2000:3-4). Also that "Innovation is a core process concerned with renewing what the organization offers (products and services) and the ways in which it generates and delivers these (processes)" (2000:3-7).

Innovation is as diverse as strategic decision-making and organisational culture. A synthesis of the work of Betz (1998), Utterback (1994), Pistorius (2000) and Tidd *et al.* (1997) indicates that innovation cannot be analysed without considering the market, people involved, strategy and leadership (Chapter Two).

In light of the above the virtual campus is considered to be an example of *process, product* and *service* innovation:

- *Process innovation* occurred by successfully implementing institution-wide procedures, structures and infrastructure to support and sustain the virtual campus.
- *Product innovation* occurred by successfully implementing web-supported courses on a significant scale at a residential university and changing to a flexible learning model.
- *Service innovation* occurred by successfully implementing administrative self-services via the web for all students of the university.

Section 1.6.2 explains the domain of the study.

1.6.2 Domain of the study and its literature resources

As explained, this study cannot be generalised to other institutions. Being a case study, certain variables such as the organisational culture, individuals, conditions, resources and market are unique to this case.

An extensive body of literature and practice was consulted in the thesis. Nevertheless, the limitation of this study does not make provision for a complete literature survey, in the sense that important and relevant theories and practice could have been omitted.

An additional limitation is that it does not explore one specific research question in-depth, but rather covers a broad spectrum of research questions on a macro level in order to reach a holistic understanding of the various components of the virtual campus.

Even though the study aims to integrate various theories as a means to better understand educational innovation, its richness in terms of a multiple faceted focus on learning, management and innovation could give an impression of fragmentation and lack of focus.

1.6.3 Research perspective of the study

Research generated in this study does not pretend to be absolute. This pertains to findings of the analysis of the case. It should rather be viewed as a contribution to the fields of educational innovation and particularly virtual education.

1.6.4 Technology in this study

Technology in this study is very prominent because product and service innovation in this study are examples of technology innovation.

1.7 Relevance and significance of the study

This study is particularly relevant to South African higher education institutions. It is also useful for higher education institutions globally that are moving towards flexible, technology-enhanced products and services. Many residential institutions are moving towards becoming hybrid institutions with increasingly prominent traits of a virtual organisation.

The theories that are used to explore the creation of the virtual campus at the University of Pretoria cover a broad range. The range includes learning, management and innovation theory that are interwoven in Chapter Three (Theory into practice). Similarities and differences between literature and the actual experience are explored, and where possible, explained. Significant patterns and possible critical success factors are indicated to provide guidelines to higher education institutions that have embarked on similar routes.

A multiple faceted perspective lends itself to a systemic approach. O'Conner & McDermot (1997) point out that the parts of a system are interconnected and interdependent, with a mutual influence among the parts.

Some systems principles are listed below:

- The focus is on emergent, relational wholes.
- Systems vary in complexity.
- Systems can be open or closed.
- Interaction patterns exist between systems, rather than cause-effect relationships.
- Identification of phenomena is only an attempt to understand relational patterns and interaction between systems.
- There is no predictability of outcomes.
- Processes are dynamic.

(Hanson, 1995; O'Conner & McDermot, 1997)

An organisation such as the University of Pretoria is an open system, i.e. a system in which transformation occurs due to influences from its internal and/or external environment.

Inherent in systems epistemology is the notion of multiple realities, i.e. people construct their own truths based on their frame of reference. In this sense reality is continuously constructed through a creative process. Especially in qualitative research, reality is subjective. In this type of descriptive and interpretive study, patterns can be identified and compared to literature, and observations can be made.

South African research focused on this area, listed below, correlate with some aspects of this study. The estimated correlation is low because these studies

address mostly one aspect of this case. The other possible reason is probably because this type of innovation has only recently been attempted at other South African higher education institutions and most responding studies are in progress. As a result, not many similar studies have been completed.

The following NEXUS and SABINET searches verify the significance of this study:

Table 1.6 shows that the study is (i) relevant, because some of its components concur with some of the listed research studies in terms of the general thrusts of technology in education, innovation and organisational learning and (ii) that it is unique, because it is interdisciplinary and combines the fields of innovation, knowledge management/creation and organisational learning, learning theory and instructional design to better understand *process, product and service innovation*. It is also unique in being a case study of the virtual campus of the University of Pretoria from an *educational innovation* perspective.

Yet absolute truth, reminiscent of positivist research, remains elusive - including inferences made from statistics.

Researcher	Year	Title
Lazenby K	1998	Constructivism and the creation of virtual campuses in higher education.
Van der Merwe, AJ	2000	Modelling strategies to construct virtual distance environments.
Pullen, G	1999	The development of a model to effectively utilize computer mediated communication to support assessment in a virtual learning environment.
Campbell, HM	1999	The impact of asynchronous groupware as knowledge management strategy.
Naidoo, SG	1997	The role of knowledge management in developing competitive advantage.
Kloppers, M	1996	Characteristics of the digital information service.
Marais, NJ	1996	Analysis of the effectiveness of a process of change, with special reference to the establishment of a new set of value in a high-technology organisation.
Vercueil, A	2001	The impact of information technology on the work life of the individual: University of Pretoria
Lehr, RH	2000	Web-based distance learning for power system engineering.
De Villiers, GJ	2000	Evaluation of the web-based information resources to support learning: an exploration
Alberts, P	2001	Instructional design insight and skills required by university lecturers in Advanced Accounting and Finance in order to facilitate Web-based learning
Pistorius, CWI	1996	World competitiveness and the technology
Williams, CB	1998	The evaluation process for technological innovation
Pelser, TG	2001	A strategic management taxonomy of technology and innovation
Van der Merwe, H.J	2001	The use of the Internet as a facet of a multimode educational approach at Technikon Pretoria.
De Villiers, MR	2002	The dynamics of theory and practice in instructional systems design
Steyn, A.B.	2001	eVelopment: Creating a learning organisation, using the advantages of information technology.

Table 1.6 Related studies in South Africa