CHAPTER THREE

MODEL FRAMEWORK

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> *'In the beginner's mind there are many possibilities; in the expert's mind there are few'.*
>
> Shunryu Suzuki, Zen philosopher (De Necker 1997:157).

3.1 MODELS USED IN THIS STUDY

3.1.1 General

This project is classified as *theory-based empirical research.* More specifically, the research is termed *theory- or model building research,* where new theory is proposed and presented in the form of a *model.* The model is a manner of representing reality. According to Buys (2004) the model has certain limitations and can at best be representative approximately 70% of reality. This research project utilised retroductive reasoning instead of deductive reasoning to derive at the final research findings. The steps in the retroductive reasoning process are the following:

3.1.1.1 Statement of the research problem (Chapter 1);
3.1.1.2 Review of past research and current theories and models (Chapter 2);
3.1.1.3 Statement of the 'theory gap' (Chapter 2);
3.1.1.4 Description of current theory and model framework (Chapter 3);
3.1.1.5 Data gathering and analysis (Chapters 4 & 5);
3.1.1.6 Inference of new hypotheses (Chapter 5);
3.1.1.7 Induction of new theory and model (Chapter 6).

The first step in this Chapter is to describe the current theory and models which is followed by formulating propositions to describe the proposed model framework.

The empirical research endeavours to prove the interdependence and quantify the relationships between the elements of the model. The method followed to prove this is discussed in Chapter 4. This Chapter explores the existing models that are relevant to the study subject, as well as those models that form the body of knowledge of the study subject. The three models in particular which are explored and used throughout the study, are the following:

- The model of Bolton & Thompson (2000) which describes the *entrepreneur* (person);
- The model of *entrepreneurial environment* by Gnyawali & Fogel (1994); and
- The model of Roberts (1991), which describes the *technological entrepreneur development* process.

Other models that contain elements of relevance are also briefly discussed. This Chapter explains the theory-base of the research, which is derived from the research and theory survey conducted in Chapter 2.

3.1.2 Entrepreneur

It is common belief that entrepreneurs create and build the future and that they are found in every walk of life. The belief is also extended to postulate *'…that every community group, every public organization and every private corporation has within it an entrepreneurial potential waiting to be released*' (Bolton et al 2000:1). Many entrepreneurial talents lie unrecognised, unused and undeveloped. It is these people and their talent that are needed to challenge and change the business world of the day to ensure optimum benefits for mankind.

It is also recognised in theory that entrepreneurial talent, like any talent, has to be discovered before it can be developed (Bolton et al 2000:4). Inherently modern societies however, tend to inhibit rather than promote the development of entrepreneurial talent through embedded constraints such as cultural and educational systems. This phenomenon is illustrated by the recorded research results that 10-15% of engineering students at Cambridge University in the 1980's

were potential entrepreneurs, while the real number of entrepreneurs was estimated to be only 1% (Bolton 1986:15). Other studies in the USA have quoted the number of potential entrepreneurs as more than 40% (Bygrave 1998:61). The large difference between the potential and real entrepreneurs raises the question as to why the potential entrepreneurial talent is not nourished by modern society to its full capacity. This discrepancy forms the basis for the model proposed by Bolton & Thompson in their publication 'Entrepreneurs: Talent, Temperament, Technique' (2000). See Figure 3.1.

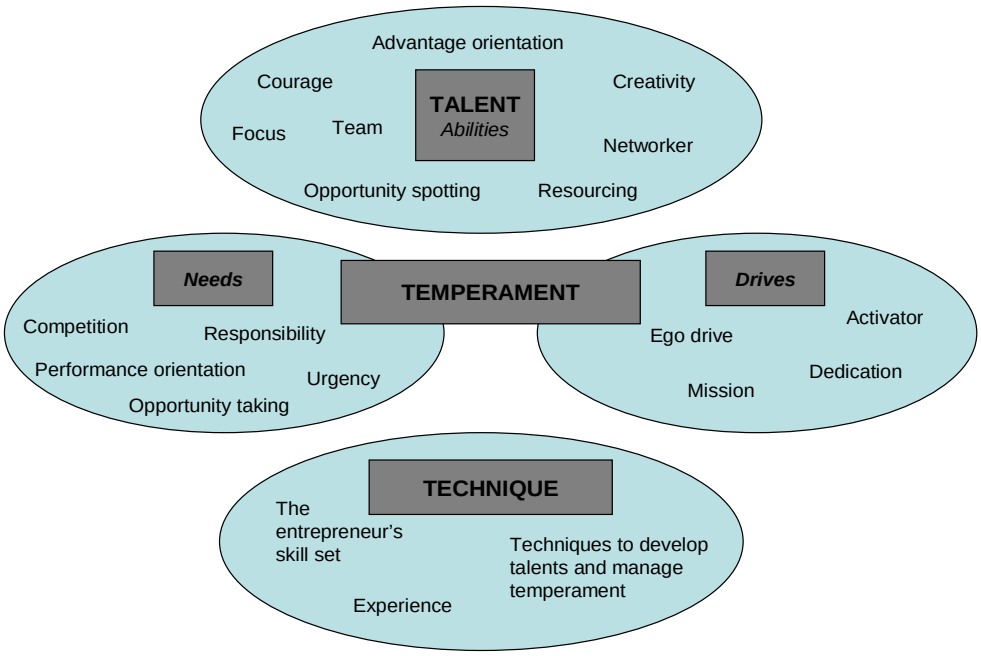

Figure 3.1 The Entrepreneur: Talent, Temperament and Technique

Source: Bolton & Thompson (2000).

3.1.3 Entrepreneurial environment

The model of Gnyawali & Fogel (1994) presents a suitable framework to describe the environment of technological entrepreneurs. The model has the following key role players:

- Government policies and procedures;
- Socio-economic conditions;
- Entrepreneurial and business skills;
- Financial assistance; and
- Non-financial assistance.

The model also identifies the following key elements:

- Opportunity;
- Propensity to enterprise;
- Ability to enterprise.

The model describes the relationships that link the elements and the effect of each related element on the other. This model is presented in Figure 3.2.

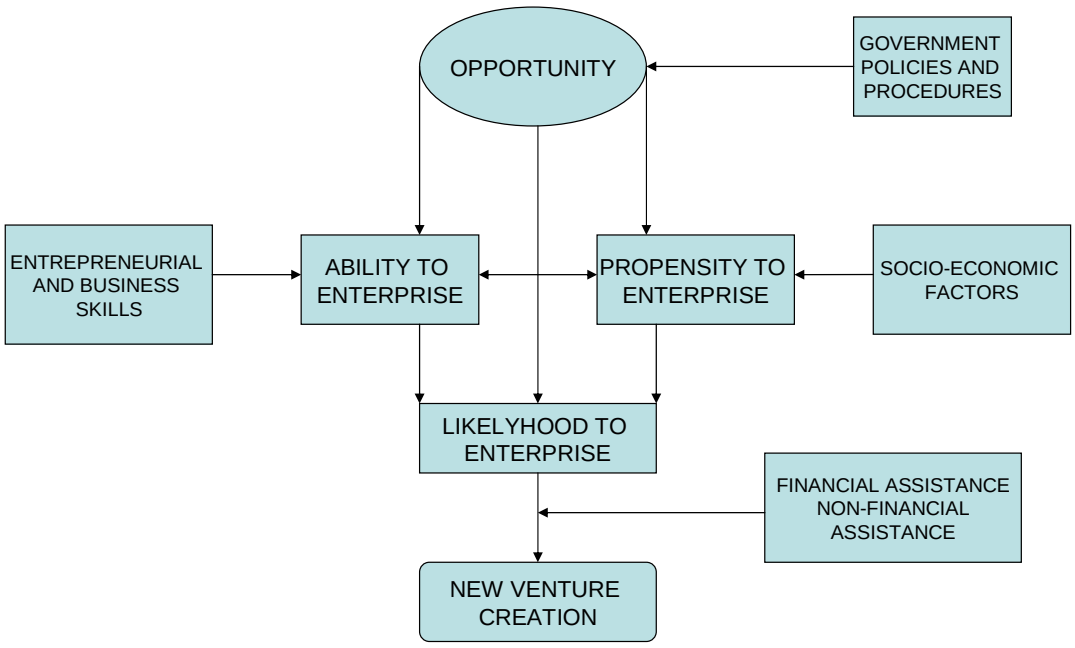

Figure 3.2 An Integrative Model of Entrepreneurial Environments

Source: Gnyawali & Fogel (1994).

3.1.4 Entrepreneur development

Roberts developed a four-factor model of the technical entrepreneur in his work (1991:52). He identified the following influences on technical entrepreneurship:

- Family background;
- Personal development, including goal orientation, personality and motivation;
- 'Growing up', including educational attainment and age; and
- Work experience.

Again, as with the other models, the links between the elements form relationships with individual characteristics. The reaction of elements depends on the variables and the specific configuration in which these elements are captured. Roberts documented the results of his studies on technological entrepreneurs in a typical profile format, which will be used as a control for the results obtained in this study. The four-factor model is presented in Figure 3.3.

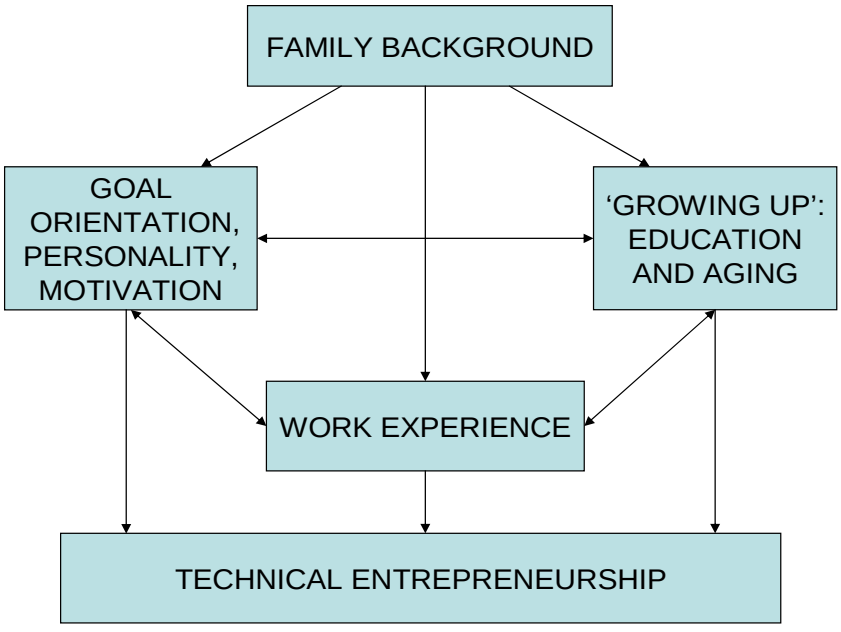

Figure 3.3 A Model of Entrepreneur Development

Source: Roberts (1991).

3.1.5 Other models

Other models that contribute to the understanding of entrepreneurship in the context of this study are the following:

3.1.5.1 Model of economic development

The Technology and Development Institute of the East-West Center in Honolulu, Hawaii (1973) developed the following model that consists of four concepts of economic development:

- *Goal:* The promotion of economic development through the increase of employment level, as well as those levels of domestic output and exports;
- *Means:* The promotion of economic growth involving technology adapted to local conditions, given a particular stage of socio-economic development;
- *Agents of change: entrepreneurs:* The critical link in the process of technology adaptation and employment creation; and

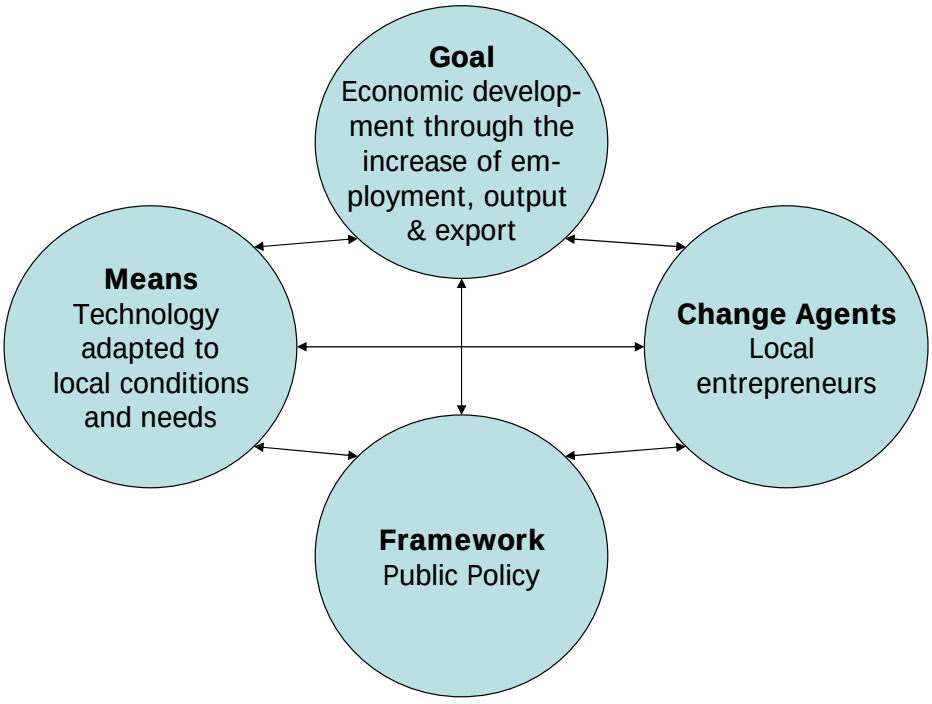

Figure 3.4 Model of Economic Development

Source: Entrepreneurship Workshop II (1973) as cited by Tran (1975).

- *Framework: public policy:* The institutional framework used to accelerate the flow of entrepreneurial talent to use technology and to expand exports.

The interrelationships between the four concepts of economic development are given in Figure 3.4 (Entrepreneurship Workshop II 1973:25 as cited by Tran 1975).

3.1.5.2 General theory framework of entrepreneurship education

Klandt et al (1993) developed a general framework for entrepreneurship research, which was represented by Schubert (Klandt et al 1993:162) in the paper on educational requirements of entrepreneurship. The model is given in Figure 3.5.

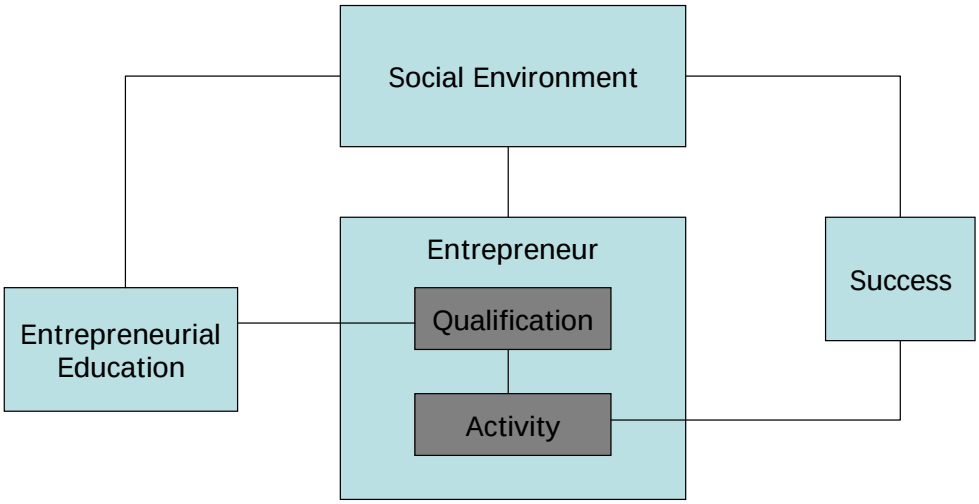

Figure 3.5 Theoretical model for studying training objectives (Schubert)

Source: Klandt et al (1993).

Here the entrepreneur and his/her social environment are pointed out as independent elements that determine business activities and business success. The model of Schubert (Klandt et al 1993:162) has certain similarities with the five categories proposed by Bull et al (1995) for the theoretical framework for

entrepreneurship research. These similarities include the identification of entities such as the entrepreneur and the social environment as key elements in the entrepreneurial process, which eventually lead to business success. The additional element introduced in the Schubert model is entrepreneurial training as a key ingredient in the development of the entrepreneur and his/her qualifications. Schubert (Klandt et al 1993) uses this model to derive training objectives for entrepreneurship education and training programs.

3.1.5.3 Entrepreneurial training model at The University of Tulsa (Oklahoma, USA)

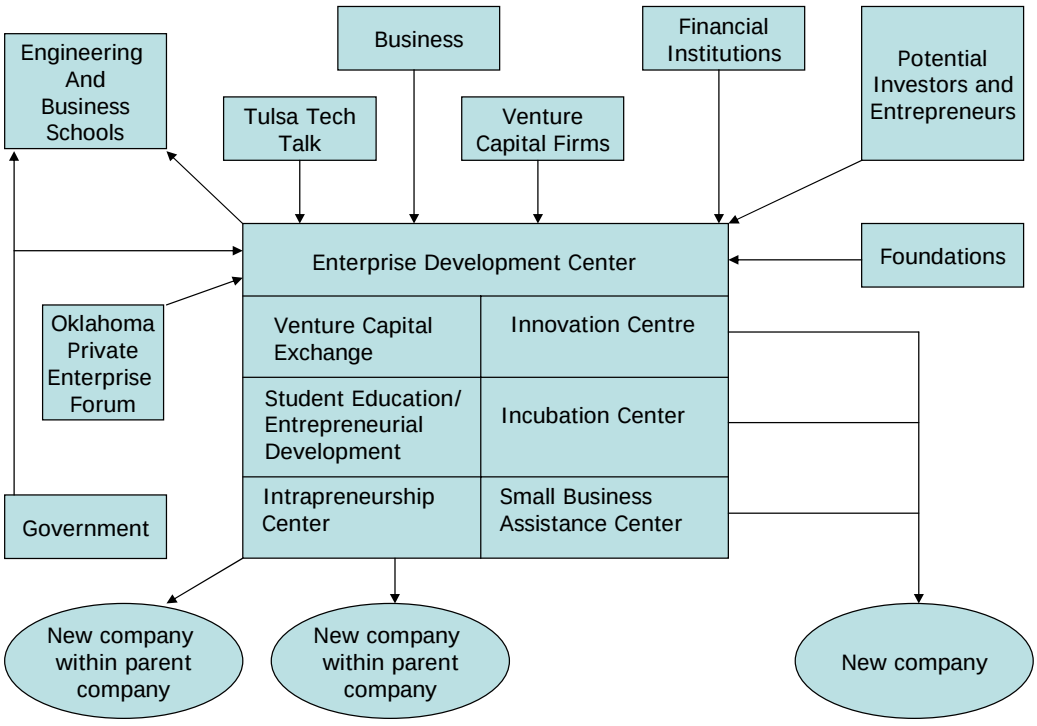

Figure 3.6 Model of practical aspects of entrepreneurial education at The University of Tulsa (USA)

Source: Klandt et al (1993).

One model which has particular relevance in the creation of a national framework for entrepreneurship education and training, is the Enterprise Development Centre model used by the University of Tulsa in the USA in the early 1990's (Klandt et al

1993:32). The model focuses in particular on the practical aspects of entrepreneurship education at a tertiary educational institute and brings together the public sector (federal, state, and city governments), the university sector (engineering and business schools), the private sector (businesses, venture capital firms, financial institutions, potential investors, and entrepreneurs), and foundations. The model is illustrated in Figure 3.6.

3.1.5.4 Structures of industrial development and government roles

The proposed model of Liu (1998), which analyses the structural development and industrial adaptation in Taiwan, is based on the following elements:

- Product market demands;
- Factor market supplies;
- Competitive strategy;
- Government leadership; and

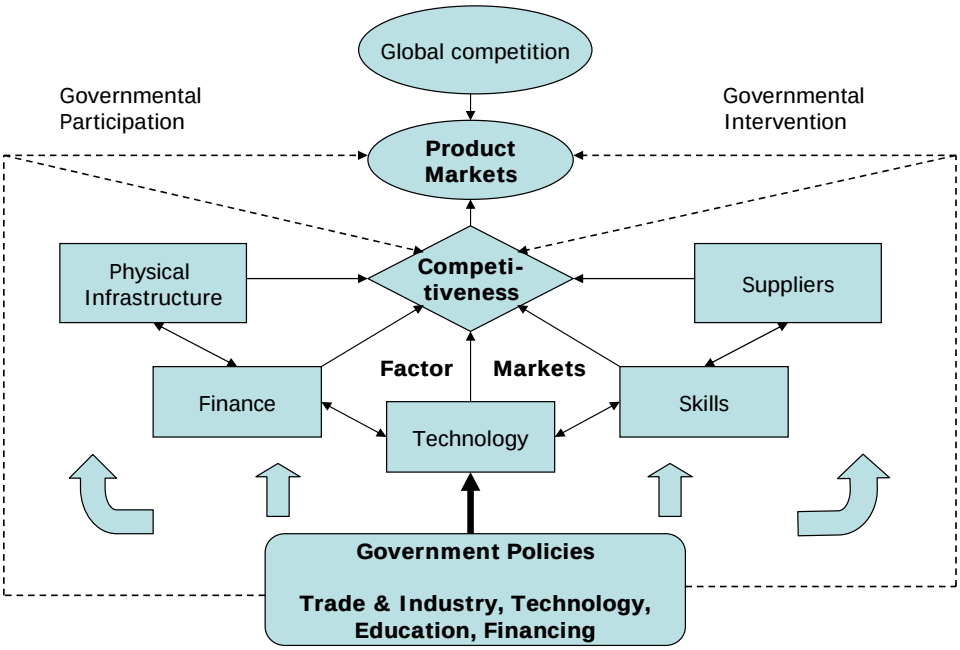

Figure 3.7 Structures of industrial development and government roles

Source: Liu (1998).

- Dynamic contingency of industrial systems.

The model is presented schematically in Figure 3.7. Although the model is of significance in its totality, it is the influences of governmental policies and their inter-relationships with the other elements that have significance to this research. The notion that distinction is made between governmental intervention and governmental participation can be incorporated into the proposed model of this research where the government's role as a key role player in the entrepreneurial environment is formulated.

3.1.6 Existing model overview

No suitable model could be found in the existing literature that is applicable to the study domain of technological entrepreneurship in the emerging landscape. The closest model identified is that of Roberts (1991), which focuses on the person and the influences on his or her development. The model of Roberts has four entities only and does not address the prominent environmental drivers. It also excludes elements of the new venture creation process such as assistance during start-up, opportunity recognition and other socio-economic influences on the process. The model of Bolton et al (2000) addresses some of the same issues more in detail, but is generic by nature and not specific to the technological domain. Another aspect not addressed in any of the models is the further growth from inception to maturity.

Subsequent literature to Roberts' research indicates that elements of his model variables serve as useful predictors of performance. These include (with specific variables in brackets):

- Jones-Evans (1995) and his work on typology of technology-based entrepreneurs and their occupational background in the UK (work experience);
- Whittaker (2001) on the engineers, their education and inclination and the commercialization of technology in Canada (technical training);
- Capaldo and Fontes (2001) with their study of graduate entrepreneurs in new technology-based firms of southern Europe. They provide empirical research on the strengths and weaknesses that are associated with their age, limited credibility, particular set of competencies and skills, the resources that they have

access to and the relationships that they are able to establish. Of particular relevance is the 'formal' assistance rendered by dedicated institutions and the 'informal' support provided by the network of interpersonal relationships (educational level, background and assistance during start-up);

- Politis (2005) on the process of entrepreneurial learning through career experience, transformation and entrepreneurial knowledge (experience and education); and
- Cooper and Folta (2000) with their views on the importance of geography on the new business formation and subsequent performance when they explore entrepreneurship and high-technology clusters (location and technology).

The model of Gnyawali et al (1994) is the best fit of the available models that address the environmental influences on the new venture creation process. Its focus is away from the entrepreneur. When combined with the model of Roberts, a broad frame that is fit-for-purpose can be created for the research parameters. The environmental influences expected to be present in the proposed model framework for this project are: 1) government policies and procedures; 2) socio-economic environment (especially the cultural aspect); and 3) financial and non-financial assistance during start-up. The fourth influence of the Gnyawali model i.e. entrepreneurship and business skill set overlaps that of Roberts.

Kropp et al (2005) also support the importance of government policies as a variable in determining venture performance in both developed countries (USA, Sweden and Australia) and developing countries (Malaysia) through Small Business and Innovation Programs (SBIP). Other models discussed enhance the formation of the model framework with variables such as entrepreneurship training, access to venture capital, small business and innovation centre assistance, as well as the influence of local conditions and needs.

In conclusion, the existing theory gap could not be satisfied with available model comparisons, insofar as both elements (the representative profile of the technological entrepreneur in an emerging environment, as well as a suitable model demonstrating the new venture creation process) are concerned. Although the model of Roberts (1991) was found to be the most appropriate template, it has to be

supplemented with several elements borrowed from other models such as that of Gnyawali et al (1994). In an effort to contain the extent of the research framework, certain potential entities in the proposed model had to be omitted. The process of technological innovation, the nature and availability of venture capital and opportunity recognition are examples of these omissions.

3.2 THE PROPOSED MODEL

3.2.1 General model theory

A model can be described as a 'snapshot of reality'. Buys (2004:4) describes the model as *'a method to simulate or present reality … a tool that can be applied in practice'*. Buys also describes it as: *'A graphical, mathematical or schematic representation of a system of postulates (theory), data, and inferences'.*

3.2.2 Model framework

The model framework consists of the four key elements mentioned earlier which are inter-connected through certain relationships. These four elements or entities are:

- The *technological entrepreneur;*
- The *new venture creation process;*
- The *mature enterprise;* and
- The *environmental influences* on the three entities above*.*

Each of the elements used was 'borrowed' from one of the most appropriate models found in the relevant theory.

3.2.2.1 The technological entrepreneur

The entrepreneur (person) is one of the three main elements of entrepreneurship as defined in literature. The technological entrepreneur is therefore placed in the centre of the model and he/she is the conductor of the whole process. Bolton & Thompson

(2000) also place the entrepreneur in the centre of their proposed model with the entrepreneur as the spotter and activator of opportunities.

3.2.2.2 The new venture creation process

The new venture creation process, or start-up as it is often referred to in the literature, is the core activity of the entrepreneurial process. This is the last of the three main elements of entrepreneurship i.e. the entrepreneurial process. Models suggested by Roberts (1996), Bolton & Thompson (2000) and Gnyawali & Fogel (1994) all include start-up activity as the centre of the process, with the other elements in supportive and influential capacities. It is therefore appropriate to follow this trend in the composition of the proposed model.

3.2.2.3 The mature enterprise

One of the elements often neglected in the entrepreneurial process, is the final product established by the venture creation activity i.e. the mature or successful business. Researchers such as Schöllhammer & Kuriloff (1979), Drucker (2001), Block & MacMillan (1985) and Scott & Bruce (1987) all acknowledged the development stages of the newly formed enterprise, from incubation to full maturity. The small business management discipline is also well-documented. Although this section of the literature does not feature directly in the critical study field of this research, it was however added to the model and included in the research scope. It was deemed necessary, firstly for the sake of completeness of the entrepreneurial process and secondly, the success rate after start-up is becoming more critical in emerging countries with a high ratio of necessity entrepreneurship (GEM report 2003:10).

3.2.2.4 Environmental influences

Environmental influences, as is the case with the other two main elements of the study subject, should be seen as a group of non-homogenous role-players from a wide range of angles. The following elements are classified as environmental influences from their relative position to the person (entrepreneur), the process (start-up) and the mature business:

- Government institutions;
- Policies and legislation;
- Private sector initiatives;
- Financial institutions;
- Educational and training institutions;
- Employers;
- Society in general;
- Cultural heritage;
- Family background;
- Economic conditions;
- Political dispensation; and
- Religion.

These are the main categories and can be refined further to represent the full domain of the external environment that has an effect on the person and process. The model framework is represented schematically in Figure 3.8.

3.2.3 Three-part model

The objective was set to derive a three part model from the research framework. The proposed model consists of the three main entities (entrepreneur, new venture creation process and mature enterprise) and the relationship(s) between each of the three with any of the other entities, including the environment.

3.2.4 Verification of proposed model

The design of the field research was done to verify the nature and weight of the six identifiable inter-relationships between the four elements. This aspect is addressed in Chapters 4 and 5.

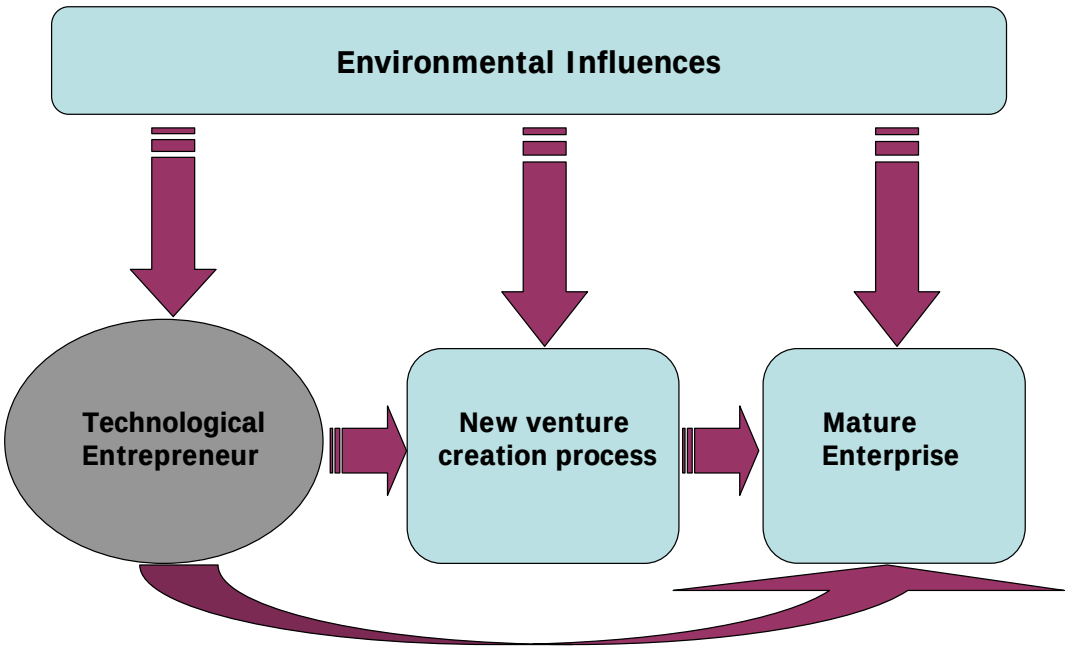

Figure 3.8 Model Framework

3.2.5 Future expansion of the model

The model can be expanded through further research to include three additional elements that are crucial to the entrepreneurial process in the technological domain. These three elements are: *Opportunities, Technological Innovation* and *Venture Capital.*

3.2.5.1 Opportunities

Most models that describe the entrepreneurial process acknowledge the core position of the opportunity in the hierarchy of events. Stevenson & Gumpert, as stated by Bolton et al (2000:50), argue that entrepreneurs are opportunity driven and that they constantly seek answers to a series of questions such as:

- Where are the opportunities?
- How do I capitalize on them?
- What resources do I need?
- How do I gain control over them?
- What structure is best?

Opportunity is recognised by both the models of Bolton et al (2000) and Gnyawali & Vogel (1994) and should be included in future model expansion projects.

3.2.5.2 Technological innovation

The question whether technological innovation should be a prerequisite for new venture creation to be classified as technological entrepreneurship, is irrelevant if a compromise is reached between the two schools of thought on the level of innovation. If it is accepted that different levels and intensities of innovation is possible and in fact occurs during the majority of new venture creations, the rigid go or no-go approach towards this qualifier is avoided. This view opens the door for new technology-based ventures to be studied even if their technological innovation component is marginal. It is within this context that the element of technological innovation is proposed for future inclusion in the model.

3.2.5.3 Venture capital

A significant gap exists in early-stage seed capital for technology-based new ventures in the United States (Carayannis, Kassicieh & Radosevich 1997). This was also reported for South Africa by Koekemoer & Kachieng'a (2002), for China by Burke, Boylan & Walsh (1998) and for Taiwan by Liu (1998). It is therefore essential to include venture capital as a key element in the entrepreneurial process for future

models due to its crucial role in the venture formation process, which is also supported by Roberts (1990 and 1991).

The GEM reports of 2002, 2003 and 2004 also highlight the important role of access to early seed capital as one of the major key success factors in the venture formation process.

3.3 PROPOSITIONS

3.3.1 Formulation of propositions

In order to develop a basis from which to predict the outcome of certain variables, it is necessary to formulate a set of propositions. Buys (2004:24) defines a proposition as *'Something offered for consideration or acceptance usually stated in sentence form near the outset'.* Three propositions were developed to form a basis from which further statistical analysis of this research project is conducted.

3.3.2 Proposition 1: Three-part model for technological entrepreneurship domain

The technological entrepreneurship domain in emerging economic regions can be presented by a three part model consisting of three primary entities which are each inter-correlated with each other, as well as environmental influences. The three primary entities are:

- *The entrepreneur (person);*
- *The new venture creation process; and*
- *The mature business.*

3.3.3 Proposition 2: Technological entrepreneurship profile comparison

The profile of technological entrepreneurs in emerging economic regions is different to that of their counterparts in developed regions, but there are also distinct similarities.

3.3.4 Proposition 3: Formal entrepreneurship training

The extent of formal entrepreneurship training in primary, secondary and tertiary educational programs in South Africa is inadequate in relation to its importance in the development process of technological entrepreneurs.

3.4 SUMMARY

Chapter 1 presents the introduction to this research project, while Chapter 2 contains the theory and research survey. In this chapter, the current theories are summarised in the different categories and the theory gap is identified. In Chapter 3 several existing models from the literature are explored from which key entities are 'borrowed' to develop a unique research framework for this study. The framework is presented in schematic format and consists of four elements:

- The *technological entrepreneur* (person);
- The *venture creation process;*
- The *mature enterprise; and*
- *Environmental influences* on the three elements above.

A three-part model is proposed from the research framework.

Three propositions are also formulated and presented as a basis to predict the outcome of certain variables Chapter 4 addresses the research design and methodology, including the research strategy and instruments.

CHAPTER FOUR

RESEARCH DESIGN AND METHODOLOGY

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RESEARCH DESIGN AND METHODOLOGY

'Madame, enclosed please find the novel you commissioned. It is in two volumes. If I had more time I could have written it in one'.

Voltaire (Timmons 1994:375).

4.1 RESEARCH STRATEGY

4.1.1General

This research project has previously been described as *theory building research,* or more specifically *model building research.* While the tendency in human sciences research projects is to use *qualitative* research methods*,* the natural sciences lend themselves to *quantitative* research techniques due to their very nature. The trend in management sciences is to focus on qualitative research rather than qualitative methods. In order to test the propositions formulated for the study, the suggested model and new theory was tested in the real life situation by quantitative data gathering and analysis in a format compatible with the model framework.

4.1.2The study population

The study object of this research project is the technological entrepreneur and his or her founded business. A sample of the study population was defined in order to understand:

- The environment in which the study object functions;
- The influences on his or her behaviour; and
- The circumstances under which he or she operates.

To study a representative group of entrepreneurs, the primary characteristics of this particular group are defined first to ensure sufficient focus of the research efforts. This is addressed later in this Chapter when the sample frame is discussed in detail.

4.1.3 The choice of data gathering techniques

If a quantitative method is appropriate for verification of the propositions, a crucial question to be answered is what technique will be used in the data gathering process. Buys (2004:36) suggests that there are four primary techniques that can be used to collect data:

- Perusal;
- Observation;
- Questioning (consultation);
- Measurement.

The third option i.e. questioning was selected as the most appropriate technique for this type of research project.

According to De Necker (1997:139), there are four data collection methods that were originally proposed by Manzini (1998:199). These are:

- *Structured interviews,* where a prescribed sense of questions is followed, which was developed by the interviewer. Alternatively, questions provided by a diagnostic model can be used;
- *Unstructured interviews***,** where non-leading questions aimed at generating the respondent's own definition of relevant problems and issues are asked;

- *Questionnaires,* where pen and paper instruments are developed by the diagnostic team in conjunction with management, or commercial products;
- *Survey-research methods***,** involving data collection by consultants and subsequent feedback of data to management.

4.1.4Validity of the data gathering techniques

The next step in the design of the research plan was to assess whether the data gathering techniques have the desirable attributes. The following control questions were asked (Buys 2004:36):

4.1.4.1 How reliable is the data gathered through the proposed techniques?
4.1.4.2 How valid is the data?
4.1.4.3 Is the data sensitive to the issues at hand?
4.1.4.4 Is the data appropriate to solve the research problem?
4.1.4.5 How objective is the data?
4.1.4.6 Are the techniques feasible to execute?
4.1.4.7 Are the techniques ethically acceptable?

4.2 RESEARCH METHODOLOGY

4.2.1The quantitative research approach

In order to obtain a clear understanding of research domain in the various disciplines, it is appropriate to explore some theoretical perspectives by various authors.

Mouton & Marais (1990:8) define research domain in the human science as follows: *'Human science is a communal human activity, by means of which a particular phenomenon is studied objectively in reality in order to present a valid understanding of the phenomenon'.*

According to De Necker (1997:137), Mouton et al (1990) explain five dimensions of research as follows:

- The *sociological dimension,* which emphasises scientific research as a joint or collaborate activity;
- The *ontological dimension,* which states that research should be directed at an aspect or aspects of social reality;
- The *teleological dimension,* which maintains that research is intentional and goal-directed with its main aim being the understanding of phenomena;
- The *epistemological dimension,* which says that the aim of research is not merely to understand phenomena but also to provide a valid and reliable understanding of reality;
- The *methodological dimension,* which emphasises research as objective by virtue of its critical, balanced, unbiased, systematic and controllable nature.

Leedy (1989:5) argues that true research has the following characteristics:

- Research originates with a *question*;
- Research demands a clear articulation of a *goal*;
- Research requires a specific *plan* or procedure;
- Research usually divides the *principle problem* into more manageable sub-problems;
- Research is tentatively guided by constructs called *hypotheses*;
- Research will countenance only hard, *measurable data* in attempting to resolve the problem that initiated the research; and
- Research is, by nature, *circular*; or, more exactly, helical.

4.2.2Survey methods

The main research designs and methods for organisational research according to Bryman (1989:29) consist of the elements as presented in Table 4.1.

The design of this research project consisted of a D2 (survey) and the method by which data was gathered was M1 (Self-administered questionnaires).

Table 4.1: Survey designs and methods	
DESIGNS	**METHODS**
D1 – Experiment (major distinctions: laboratory and field experiments: experiments and quasi-experiments)	**M1** – Self-administered questionnaire **M2** – Structured interview
D2 – Survey (including longitudinal survey design)	**M3** – Participant observation
D3 – Qualitative research	**M4** – Unstructured interviewing
D4 – Case study	**M5** – Structured observation
D5 – Action research	**M6** – Simulation **M7** – Archival sources of data

Source: De Necker (1997:158).

4.2.3Data collection and analysis

The process of theory building research (retroductive reasoning) is categorised into the following main elements (Buys 2004:61):

- Data collection;
- Data analysis;
- Inference of new hypotheses.

The first of the processes i.e. data collection, is described in more detail in this chapter, while the analysis of the data is dealt with in the next chapter.

4.2.4Sampling

Levin and Rubin (1991:260) define a sample as *'…a portion of elements in a population chosen for direct examination or measurement'.*

Population sampling can be divided into two broad categories:

- *Random* or probability sampling, and
- *Non-random* or non-probability sampling (sometimes called judgement sampling).

Mason & Lind (1996:296) define probability sampling as follows: *'A sample selected in such a way that each item or person in the population being studied has a known (non-zero) likelihood of being included in the sample'.*

The chances with random sampling are real that an element of the population will or will not be included in the chosen sample. The way to deal with this inherent weakness is to describe the objectivity of the estimates in a mathematical manner. At least, unlike non-random sampling, each member of the population in random sampling has an equal probability of being selected. This aspect is dealt with in Chapter 5.

According to Mason et al (1996:296), four methods of random sampling exist:

- *Simple* or singular (individual) random sampling, where each item or person in the population has the same chance of being included;
- *Systematic* random sampling, where the items or individuals of the population are arranged in some way and selected in accordance with a predetermined pattern;
- *Stratified* random sampling, where a population is first divided into subgroups, called strata, and a sample is selected from each stratum, and
- *Cluster* or batch sampling, where large population groups are divided into smaller units, of which a few are selected randomly to investigate.

4.2.5Research field

After reviewing the theoretical research domain, the next step in the research design process was to develop a research framework. A research field was defined first to act as a framework for the research model. The research field is illustrated in Figure 4.1.

The research field model clearly defines the entrepreneurship process (with all its role-players) within the two main domains i.e:

4.2.5.1 Technology based enterprises; and

4.2.5.2 Emerging regions.

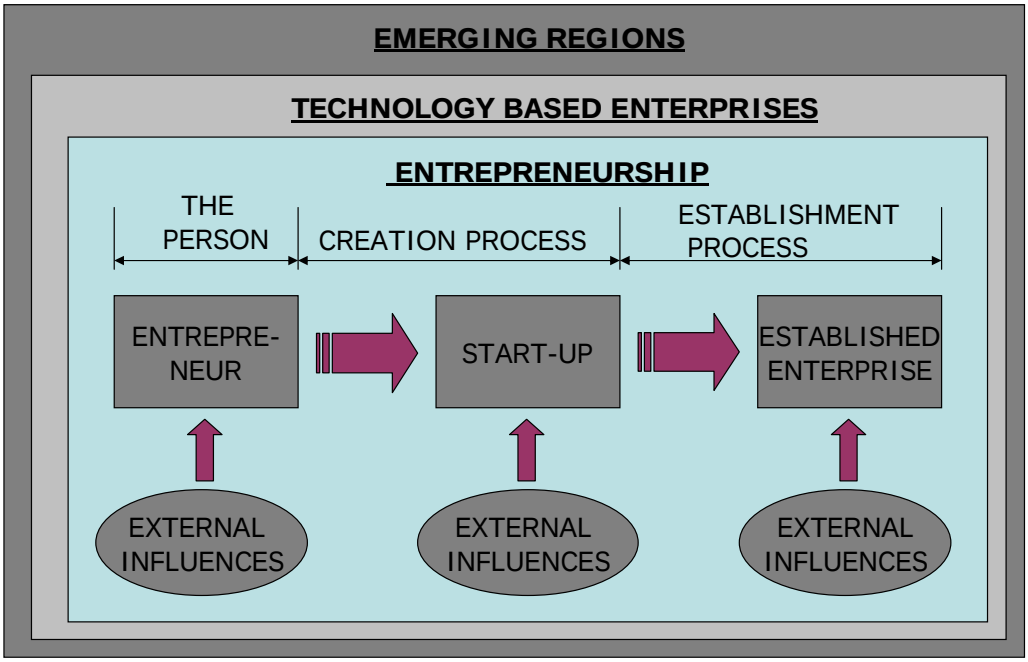

Figure 4.1 Research field

4.2.6Research framework

The research design focuses mainly around the four key entities and their inter-relationships defined in the proposed model framework as it is presented in Chapter 3. A model framework was developed to group the necessary data categories. This framework consists of four main elements with the required data grouped as follows:

4.2.6.1 The enterprise detail;

4.2.6.2 The entrepreneur;

4.2.6.3 Formation of new enterprise; and

4.2.6.4 Mature enterprise.

The research framework was used for the design of the questionnaire to entrepreneurs. The block diagram in Figure 4.2 illustrates the research framework.

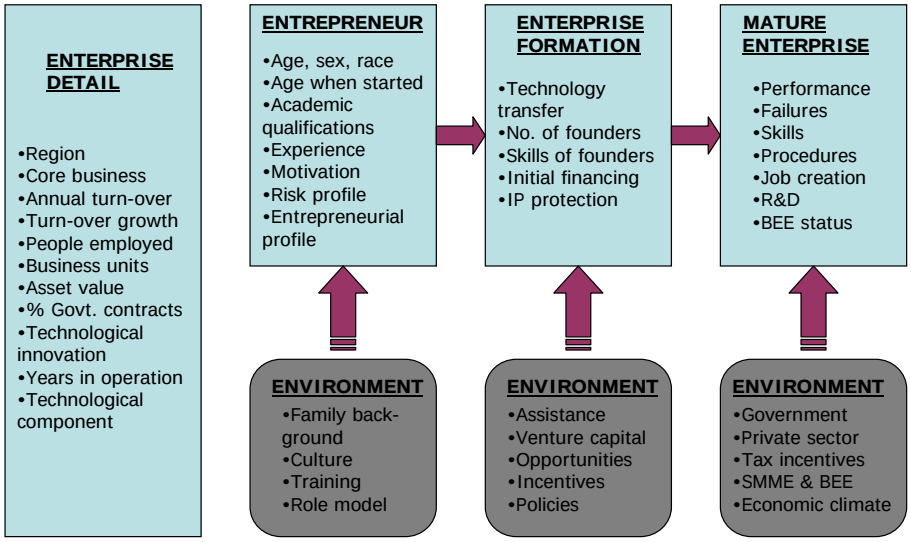

Figure 4.2 Research framework

4.2.7The sample frame

With the theoretical background reviewed, the research method chosen and the research model developed, the next step in the design process was to identify the sample frame to be studied. To retain research focus, the following definition was developed: *The study population group consists of entrepreneurs, who have founded and successfully operated a business, with a significant technological component in its final product or service, in an emerging economic region.*

The following population was excluded from the sample frame:

- Entrepreneurs in the sales, commercial or general business sectors;
- Technological entrepreneurs in developed or industrialised countries;
- Technological entrepreneurs who were not operating a business at the time of the data collection process.

4.2.8Population size

Although the research topic has narrowed the research population group down to a significantly smaller and more manageable group i.e. technological (versus all) entrepreneurs in emerging (versus all) countries, the total population is still by far too large within the constraints of the research project. The choice of sampling method and the sample frame was a critical decision, which has a significant effect on the success of the research and the validity of the results obtained (and the conclusions drawn). The population size of all technological entrepreneurs in all the developing countries could not be established in the available literature, and can at best be estimated. In any event, the figure is of academic value only, as it is not practical from a research point of view to include the total population group in the data collection process.

The choice of sampling method was another critical decision in the research design. The most appropriate and practically feasible method is that of *cluster random sampling.* The sampling method is applied to the research population group as follows:

- The Republic of South Africa is classified as an emerging country using the criteria as discussed in Chapters 1 and 2;
- The Republic of South Africa is divided into nine geographical provinces of which a typical province was selected as representative of an emerging economic region.

The province that was selected is the Province of KwaZulu-Natal as described in Chapter 1.

4.2.9Database

The most comprehensive electronic database of registered companies and their activities in KwaZulu-Natal is a commercial business telephone directory that

operates on an annual subscription basis. According to the Braby's directory (2002), there are approximately 500,000 registered businesses on their database in Southern Africa comprising South Africa, Lesotho, Swaziland, Namibia, Botswana, Mozambique, Zimbabwe, Angola, Madagascar, Seychelles, Mauritius and Zambia. It contains a comprehensive database of each company, including contact details, e-mail addresses, major activities and location of premises. The number of companies in South Africa alone totals well over 119,000.

4.2.10 Sample selection

The sample was selected from the Braby's data base to include companies with a technological service or product only. Utilising the search engine of the Braby's database for technological categories within the province of KwaZulu-Natal, South Africa, the following four categories were identified:

4.2.10.1 Manufacturers
4.2.10.2 Chemical, Industrial and Mining
4.2.10.3 Technical services
4.2.10.4 Technical general

Any duplicated firms and branches were electronically deleted and a stratified sample was selected from each of the four categories to obtain a database of multiples of 100 companies to assist research administrators.

The detail questionnaire administration process, as well as sample sizes is discussed in Chapter 5.

4.3 RESEARCH INSTRUMENTS

4.3.1 Data collection

The process of data collection was selected as follows:

4.3.1.1 Using the database of technological entrepreneurs in KwaZulu-Natal which was compiled as described earlier, Questionnaire A was forwarded to the selected entrepreneurial companies by e-mail, facsimile, personal delivery with the help of research administrators.

4.3.1.2 A follow-up exercise to ensure receipt of completed questionnaires was also done by research administrators.

4.3.1.3 A total number of 210 questionnaires were collected in this manner.

4.3.1.4 Similarly, Questionnaire B was given to 183 post-graduate students at the University of Pretoria to complete.

4.3.2The questionnaire to technological entrepreneurs

As previously stated, the *sample frame is entrepreneurs who have successfully founded and still operate a business with a technological base in the province of KwaZulu-Natal*. It is necessary to discuss the contents of the questionnaire in order to establish the appropriateness of the information that is to be collected to achieve the research project goals. Main Questionnaire A was developed with the propositions in mind and designed to address the research questions in the most effective manner possible. The questionnaire consisted of the following main categories of information:

4.3.2.1 Part A contained personal and background information about the *entrepreneur* such as age, religion, gender, position in the family, home language, training, level of education, as well as the development of their entrepreneurial capabilities.

4.3.2.2 Part B contained the *enterprise details*, such as geographical representation, annual turnover and growth figures, asset value, government contracts as well as a quantification of the technological component of the product or service.

4.3.2.3 Part C addressed the *new venture formation process* and the circumstances under which the new business was founded. Issues such as the degree of technology transfer, details of the initial founders, contribution by founders to the initial financing, assistance obtained and major problems experienced during the initial phases were addressed.

4.3.2.4 Part D contained questions about the enterprise growth process after formation and the *new business success*. Issues such as management skills, use of formal procedures, outside consultants and factors affecting the business' success are addressed here. The respondents were also asked in this part to assess the factors that to their opinion influenced the development of technological entrepreneurship in emerging regions.

The questionnaire was developed in conjunction with the personnel who assisted with the statistical analysis of the data and contains 55 questions, 132 data figures spread over 10 pages. It took approximately 20 minutes for a respondent to complete the questionnaire. The questionnaire is attached as Appendix A.

The questionnaire was structured to assess the four key elements identified in the proposed three part model of Chapter 3 and their inter-relationships in the manner described in Table 4.2.

Table 4.2: Assessment of four key elements in proposed model and their inter-relationships

ITEM	KEY ELEMENT	SUBJECT	QUES-TION No.	ENVIRON-MENTAL INFLUENCE
1	Technological Entrepreneur (TE)	❑ Position in family	8	TE
2	❑ Family back-ground	❑ Level of income @ 18 yrs	9	TE
3		❑ Employment of parents @ 18 yrs	10	TE
4	TE	❑ Language	5	TE
5	❑ Cultural	❑ Religion	6	TE
6		❑ Race	7	TE
7		❑ Attitude of culture towards entrepreneurship	21	TE
8	TE	❑ Academic qualifications	11	TE
9	❑ Education	❑ Primary field of training	12	TE
10		❑ Formal training in entrepre-neurship	13	TE
11		❑ Years experience	14	TE
12		❑ Age when introduced to entrepreneurship	20	TE
13	TE	❑ Age	2	-
14	❑ Personal profile	❑ Gender	4	-
15	TE	❑ Risk profile	18	-
16	❑ General	❑ Entrepreneurial abilities	19	-
17	New venture creation process (NVCP)	❑ Age when starting new business	3	NVCP
18		❑ Size of previous firm	15	TE
19		❑ Factors that motivated entrepreneur	16	TE

20		❑ Role models	17	TE
21		❑ Period between idea and start-up date	33	NVCP
22		❑ No of founders	35	NVCP
23		❑ Remaining founders still owners	36	ME
24		❑ Skills of founders	37	NVCP, ME
25		❑ Assistance from institutions	40	NVCP
26		❑ Degree of intellectual property (IP) protection	41	NVCP
27		❑ Financing by founders	38	NVCP
28		❑ External financing	39	NVCP
29		❑ Availability of and access to venture capital (VC)	53 (part)	NVCP
30	Mature Enterprise (ME)	❑ Geographical area of operation	22	-
31	❑ Details	❑ Core business	23	-
32		❑ Annual turn-over	24	-
33		❑ Turn-over growth	25	-
34		❑ Number of people employed	26	-
35		❑ Number of business units/branches	27	-
36		❑ Value of assets	28	-
37		❑ Extent of government contracts	29	NVCP, ME
38		❑ Age of enterprise	31	-
39	ME	❑ Performance vs expectations	42	-
40	❑ Success	❑ Previous failures	43	-
41		❑ Imported managerial skills	44	-
42		❑ Own people management skills	45	-
43		❑ Marketing function	46	-
44		❑ Use of procedures	47	-
45		❑ Job creation	48	-
46		❑ External factors in first three years	50	NVCP, ME
47		❑ Reasons for failures	53, 54	NVCP, ME
48	ME	❑ Extent of innovation	30	NVCP, ME
49	❑ Technological Innovation	❑ Technological component	32	NVCP, ME
50		❑ Technology transfer	34	NVCP, ME
51		❑ R & D department	49	NVCP, ME
52		❑ Causes for lack of technological innovation	51	NVCP, ME
53	Environmental Influences	❑ Improvement areas for technological entrepreneurship	55, 56	TE, NVCP, ME
54		❑ Black empowerment and affirmative action	52	TE, NVCP, ME

The number of data points is a further analysis of the questionnaire and is indicated in Table 4.3.

Table 4.3: Analysis of data points in main questionnaire to the entrepreneur			
QUESTION NUMBER	**QUESTION SUBJECT**	**NO OF DATA POINTS**	**PROPO-SITION**
1	Respondent's number	1	-
2	**Part A: Entrepreneur** Age	1	P1, P2
3	Age when starting new business	1	P1, P2
4	Gender	1	P1, P2
5	Home language	1	P1, P2
6	Religion	1	P1, P2
7	Race group	1	P1, P2
8	Position in family	1	P1, P2
9	Family income	1	P1, P2
10	Employment status of parents	4	P1, P2
11	Qualifications	10	P1, P2, P3
12	Field of training	1	P1, P2
13	Training in entrepreneurship	1	P1, P2, P3
14	Working experience	5	P1, P2
15	Previous firm	1	P1, P2
16	Motivation to start own business	1	P1, P2
17	Role model	1	P1, P2
18	Risk profile	1	P1, P2
19	Entrepreneurial characteristics	10	P1, P2, P3
20	Age when introduced to entrepreneurship	1	P1, P2
21	Attitude of culture towards entrepreneurship	1	P1, P2
-	**Subtotal A**	45	-
22	**Part B: Enterprise details** Geographical areas	1	P1
23	Core business	1	P1
24	Annual turnover	1	P1
25	Annual turnover growth	1	P1
26	Number of employees	1	P1
27	Business units or branches	1	P1
28	Value of assets	1	P1
29	Percentage of government contracts	2	P1
30	Technological innovation	1	P1
31	Years in operation	1	P1
32	Technological component	1	P1
-	**Subtotal B**	12	-
33	**Part C: Formation of new enterprise** Time between idea and start-up	1	P1
34	Degree of technology transfer	1	P1
35	Number of initial founders	1	P1
36	Original founders still owners	1	P1
37	Compliment of founder's skills	1	P1
38	Ratio of initial financing	1	P1
39	Institutions assisting with initial financing	8	P1
40	Institutions assisting with initial start-up	7	P1
41	Intellectual property protection	1	P1
-	**Subtotal C**	22	-
42	**Part D: New enterprise success** Enterprise performance against expectations	3	P1
43	Previous business failures	3	P1
44	Managerial skills	1	P1
45	Personnel management skills	1	P1

46	Marketing function	1	P1
47	Written procedures	1	P1
48	Job creation	1	P1
49	Research and development	1	P1
50	External influences on success	10	P1
51	Causes for lack of technological innovation	5	P1
52	Black owned status	1	P1
53	Causes for new technological business failures	10	P1, P2
54	Other causes for failures	5	P1
55	Measures to improve technological entrepreneurship	5	P1, P2
56	Other measures to improve TE	5	P1
-	**Subtotal D**	53	-
-	**Total**	133	-

List of abbreviations used:

a. P1 - P3 = Proposition 1 to 3
b. TI = Technological Innovation
c. TE = Technological Entrepreneur
d. ME = Mature Enterprise
e. VC = Venture Capital
f. NVCP = New Venture Creation Process.

4.3.3 The Questionnaire to MOT/MEM/MPM students at the University of Pretoria

One of the research goals is to assess the importance of training and formal education in entrepreneurship in the entrepreneur's development. This issue was addressed in the main questionnaire, but as a data controlling mechanism, a second sample frame was identified for this purpose. A second Questionnaire B that specifically addresses this issue was developed and given to post graduate students in Engineering and Technology Management courses at the University of Pretoria (Yearbook 2004). These students were all enrolled for one of the following degrees:

- Masters degree in Maintenance Management (MEM);
- Masters degree in Project Management (MPM);
- Honours or masters degree in Technology Management (MOT).

The significance of this sample frame and the data acquired in this way is the following:

- All the students attended the subject 'New ventures and Entrepreneurship' as part of their honours or masters degree program;
- The subject was an elective subject, which implies that the primary reason for attending the course was the need to learn more about entrepreneurship and new venture formation;
- Although the students were not all entrepreneurs at the time of completing the questionnaires, the improvement to their entrepreneurial knowledge and affinity for entrepreneurship was assessed in the questionnaire;
- The sample frame was fairly homogenous as potential entrepreneurs and the accuracy and reliability of the data is regarded as relatively high.

The questionnaire addressed the following main issues:

- Limited personal and background information;
- Training and educational profile, especially in the subject of entrepreneurship;
- The respondent's assessment of the importance of training and education in entrepreneurship.

The questionnaire contained 14 questions, 16 data figures over 2 pages and takes less than five minutes to complete. The questionnaire was submitted to groups of postgraduate students in 2002 and 2003 and a 93% response or 170 of the total student population of 183 was achieved.

The questionnaire is attached as Appendix B.

The questionnaire was structured mainly to evaluate Proposition 3. The analysis of the questionnaire is given in Table 4.4.

Table 4.4: Analysis of data points of questionnaire to students			
QUESTION NUMBER	**QUESTION DESCRIPTION**	**NO OF DATA POINTS**	**PROPOSITION**
1	Respondent number	1	-
2	Age	1	-
3	Entrepreneurial history	1	-
4	Entrepreneurial history	1	-
5	Race	1	-
6	Secondary education	1	P3
7	Tertiary education	1	P3
8	Tertiary education	1	P3
9	Tertiary education	1	P3
10	Formal entrepreneurial training	3	P3
11	Formal entrepreneurial education	1	P3
12	Entrepreneurial future	1	-
13	Formal entrepreneurial training	1	P3
14	Gender	1	-
-	**Total**	**16**	**-**

4.3.4Correlation of the data with the propositions

4.3.4.1 Proposition 1

The technological entrepreneurship domain in emerging economic regions can be presented by a three part model consisting of three primary entities which are each inter-correlated with each other, as well as environmental influences. The three primary entities are:

- *The entrepreneur (person);*
- *The new venture creation process; and*
- *The mature business.*

Proposition 1 was addressed by the main research questionnaire to entrepreneurs (Questionnaire A) as the questionnaire collects 132 data points through 55 questions. It was further supported by Questionnaire B to the master's degree students by 15 data points through 13 questions.

4.3.4.2 Proposition 2

The profile of technological entrepreneurs in emerging regions is different to that of their counterparts in developed regions, but there are also distinct similarities.

Proposition 2 was addressed by main Questionnaire A with 44 data points through 20 questions and by Questionnaire B to students with 15 data points through 13 questions.

4.3.4.3 Proposition 3

The extent of formal entrepreneurship training in primary, secondary and tertiary educational programs in South Africa is inadequate in relation to its importance in the development process of technological entrepreneurs.

Proposition 3 was addressed by main questionnaire A with 36 data points through 5 questions and by Questionnaire B to students with 9 data points through 7 questions.

The analysis summary of the data points versus proposition testing is given in Table 4.5.

Table 4.5: Summary analysis of data points versus proposition testing

ITEM	PROPOSITION	NO OF QUESTIONS	NO OF DATA POINTS
1	P1 Questionnaire to entrepreneurs	55	132
2	P1 Questionnaire to students (control)	13	15
3	P2 Questionnaire to entrepreneurs	20	44
4	P2 Questionnaire to students (control)	13	15
5	P3 Questionnaire to entrepreneurs	5	36
6	P3 Questionnaire to students	7	9
7	**Total**	**113**	**251**

4.3.4.4 The validation of the proposed model.

The four elements and five inter-relationships of the proposed three part model were verified with all the data in the main Questionnaire A to entrepreneurs i.e. 132 data points and 55 questions.

4.3.5Administration of the questionnaires

The questionnaires were submitted to and collected from the respondents by research administrators in one of the following ways:

4.3.5.1 By hand or through personal contact;

4.3.5.2 By e-mail; or

4.3.5.3 By facsimile.

After collection, the questionnaires were handed to the statistical personnel for the detail analyses, which are explored in detail in Chapter 5. This applies to both sets of questionnaires.

4.3.6Quantitative analyses

Statistics are defined by Mason & Lind (1996:3) as follows: *'The science of collecting, organising, presenting, analysing, and interpreting numerical data for the purpose of assisting in making a more effective decision'.*

The statistical analyses of the quantitative data are described in more detail in the next Chapter. Statistical analysis is the core of any quantitative research project and forms the primary interpretation mechanism of the research findings.

4.3.7Controlling of the data

Apart from the normal quality control of statistical data, which forms part of the statistical analysis process, it provides greater significance and status to the results

of any research project if the results are tested against known benchmarks or against comparable previous research results. In order to obtain the maximum benefit from this approach, it is important to keep these benchmarks in mind during the research design. Two such data controlling mechanisms were included in this research design:

4.3.7.1 The control of one of the primary research goals i.e. to asses the effect of training and formal education in the development of entrepreneurship, through a second questionnaire, sample frame and subsequent results;

4.3.7.2 The control of the results with previous comparable research results obtained from technological entrepreneurs in developed regions. The work of Roberts (1991) on technological entrepreneurs in the Boston area, Massachusetts, United States of America, is of particular significance in testing the validity of the research. The main questionnaire and data composition in particular, were designed to reveal the same data structure for this purpose.

4.4 SUMMARY

After the introduction and general research background in Chapter 1, the theory and research review followed in Chapter 2, where the existing knowledge and theory on the research subject was given. In Chapter 3 three propositions and a new model to enhance the theory were proposed. This Chapter addresses the methodology through which the proposed model will be tested in practice through the field research. Aspects such as the research strategy, where the question of qualitative versus quantitative research is addressed, are covered. This is followed by a discussion of the complete research design and more specifically, the research methodology. Various methods and data collection techniques are discussed, as well as the selection of the most appropriate methods and techniques for this project. The concept of sampling and various sampling types are briefly reviewed, but the core of the Chapter is devoted to the identification and discussion of the specific study population and the selection of an appropriate sample frame.

The actual data collection through self-administered questionnaires is presented in detail, as well as the specific two questionnaires that were developed for this research project. Their main focus areas are highlighted to present the necessary aspects for proposition verification. Controlling of the research data with other comparable research results is also discussed.

The analysis of the statistical data as part of the interpretation process is briefly mentioned, which is addressed in more detail in Chapter 5.