Credit Scoring Model: Incorporating Entrepreneurial Characteristics

By

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DECLARATION

I, JIF Henning, hereby declare that this Doctoral Degree research thesis that I herewith submit for the degree of Philosophiae Doctor in the Faculty of Natural and Agricultural Sciences, Department of Agricultural Economics at the University of the Free State, is my own independent work, and that I have not previously submitted it for a qualification at another institution of higher education.

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Janus Henning

List of acronyms and abbreviations

ANN	Artificial neural network
ATO	Asset turnover ratio
CR	Current ratio
DTA	Debt to asset ratio
DTE	Debt to equity ratio
MLP	Multi-layer perceptron
MSA	Measure of sampling adequacy
Netfarmratio	Net farm income ratio
NN	Neural Network
NNs	Neural Networks
PCA	Principal component analysis
Prodcost	Production cost ratio
ROA	Return on Assets
ROE	Return on Equity
SME	Small and Medium Enterprises
WCTGR	Working capital to Gross revenue ratio

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ABSTRACT

The main objective of the research was to develop a theoretical credit model that incorporates entrepreneurial competencies of farmers as variables in order to determine the repayment ability of the farmer. The research was conducted by using a financial organisation as case to test the application of a statistical credit-scoring model that incorporates entrepreneurial competencies. Entrepreneurial competencies have been found to have an influence on the competitiveness, and, by extension the financial performance of a business. Farms are no different from other businesses, where the aim of the farming business is to ensure profits, and decisions are made accordingly. Individuals that possess higher levels of entrepreneurial competencies are therefore expected to perform better in terms of management and coordination in the business environment, which improves financial performance and repayment ability. The theoretical credit model includes a neural network identified from literature and applied to accurately predict the high-risk loans which are liable to be rejected.

The variables and characteristics used in the credit process were investigated from the credit provider's viewpoint. Most research on credit tends to report on the variables and characteristics from the borrower's side, which can result in variables that are important when the lender considers the loan applicant's ability to repay being omitted. Results indicated that many of the variables used in the decision-making process are based on subjective measures, especially the variables that are associated with managerial and entrepreneurial abilities. The use of human judgement in the credit process is associated with several disadvantages that can influence the decision-making process, specifically consistency in the decision-making. Recommendations are therefore to investigate extending credit models by including entrepreneurial competencies that are measured with the use of an instrument that can provide a consistent reporting method for different applications. Further research is also needed to

investigate the implementation of an objective, statistical credit-scoring model in determining the repayment ability of farmers.

The entrepreneurial competencies of the farmers were measured and examined to gain a better understanding and insight into the specific competencies of farmers in South Africa. The entrepreneurial competencies of farmers can be measured with the use of an objective instrument that provides a score for each competency. The entrepreneurial competencies included the following: opportunity; relationship; conceptual; organising; strategic; commitment; learning; and personal strength competencies. Farmers were found to have higher scores in the commitment and relationship competencies, while opportunity competencies had the lowest score for the farmers included in the research. The scores determined for the farmers also provide a consistent measuring instrument that can be used to measure the entrepreneurial and managerial competencies as variables for inclusion in credit-granting decisions.

The entrepreneurial scores were included with other decision-making variables in a statistical credit-scoring model. A back propagation neural network was trained with the use of known input–output combinations, tested and then applied to agricultural credit applications. The entrepreneurial competencies were found to contribute in the decision-making of the network, where the generalised weights compared with age and experience and other scale variables also included in the network. Entrepreneurial competencies can, therefore, also be included in determining the repayment abilities of credit applicants. The use of the studied neural networks in agricultural credit applications require further research, as neural networks are known for exhibiting difficulty in interpreting the results, indicating that providing reasons for a decision can be difficult. The method can, however, be used as a supplementary tool for current methods that may assist in assuring consistency in decision-making, as the neural networks are unable to accommodate additional variables that were not part of the training process.

The main conclusion drawn from the research is that entrepreneurial competencies of farmers can be included with the use of a measuring instrument

in a neural network credit model. The model can provide consistency in the decision-making procedure for agricultural loan applications; however, further research is necessary to provide a method that can accommodate the dynamic nature of the agricultural sector where conditions may necessitate the inclusion of additional variables in the decision-making process.

Chapter 1
Introduction

1.1.   Background and motivation

Agricultural sectors the world over have seen many changes over the years. As with many other industries, the agricultural sector has also been affected by globalisation. Farmers have to compete, not only against their own national competitors, but also against international farmers, all over the world. Lans, Seuneke and Klerkx (2013) mention that the agricultural sector is traditionally seen as a low-tech industry, with limited dynamics. However, the situation has seen dramatic changes due to economic liberalisation, unprotected agricultural markets, consumer-related changes, enhanced environmental requirements and product quality. Family firms, mostly small businesses, dominate the sector where the focus is on doing habitual things better, rather than on innovation. The changes have opened the agricultural sector to new entrants, innovation and portfolio entrepreneurship (Lans *et al.,* 2013).

The nature of the agricultural sector makes it difficult and costly for lenders to finance activities in the sector. To assist the agricultural sector, the South African government, and governments worldwide, have adopted several measures to support farmers' access to financial services (Vink and van Rooyen, 2009). Vink and van Rooyen (2009) conclude that, with regard to agricultural finance, all the policy changes in South Africa have had little effect, as commercial farmers have had to make the shift to commercial banks. The commercial banks do not provide capital in terms of mortgage financing at the same levels that were provided by the Land Bank in the past. Smallholder farmers have not received any appreciable, sustainable access to agricultural financing. Existing credit-scoring models judge smallholder farmers to be high-risk clients for repayment of loans. These farmers do not have the necessary collateral or strong financial position that is necessary for obtaining credit from financial organisations.

The need for tailor-made credit products, especially with regard to granting smallholder farmers access to credit, is emphasised by Chisasa and Makina (2012). Such custom-made products may, for example, consider the ability of the farmer to make strategic decisions and hence exhibit entrepreneurial skills, and

may thus be considered for both smallholder and commercial farmers. It is important to consider these decision-making options since a producer or applicant makes daily decisions that have an influence on profitability, and by implication the financial performance, of a farm (Henning, 2011). Running farming enterprises in a dynamic setting, such as the agricultural environment, requires tangible resources. There is also however, a need for intangible resources embedded in the farming enterprise, such as entrepreneurial capital (McElwee, 2005).

In recent times, it is recognised that farmers are increasingly required to demonstrate entrepreneurship or entrepreneurial competence, instead of merely being able to practise sound management and craftsmanship, to ensure sustainable production for the future (Pyysiäinen, Anderson, McElwee & Vesala, 2006; McElwee, 2008; Lans *et al.*, 2013). Researchers have found that agricultural entrepreneurship is not only a way of thinking, but also has an influence on a farm's business growth and survival (Lans, Verstegen & Mulder, 2011; Verhees, Kuiper & Klopcic, 2011). The conclusion that can be drawn is that the entrepreneur has an influential role in the performance of small firms (Covin & Slevin, 1991; Bird, 1995; Cooper *et al.*, 1994; Lerner & Almor, 2002; Man, Lau and Chan, 2002).

Entrepreneurial competencies may be viewed as comprising the essential personal traits, skills, knowledge and motives of a person that may lead to superior managerial performance (Mitchelmore & Rowley, 2010). Mitchelmore & Rowley (2010) mentions that there is also a distinction in research between entrepreneurial and managerial competencies (Chandler & Hanks, 1994a, 1994b; Lerner & Almor, 2002). Researchers have found that entrepreneurial competencies are needed to start a business, while managerial competencies are used to grow the business (Mitchelmore & Rowley, 2010).

1.2. Problem statement

While both the problem and importance of decision-making and entrepreneurship has been identified, the field of entrepreneurship, and the measuring thereof, has no clear exposition and has not been given much emphasis in the field of agricultural economics (Knudson, Wysocki, Champagne & Peterson, 2004). Scientific literature increasingly acknowledges the rich setting that the agricultural sector provides for researching entrepreneurial competencies (Pyysiäinen *et al.*, 2006). Research studies have been conducted in countries including (Lans, 2009) (with additional studies added): the United Kingdom (Carter, 2001; McElwee, 2008; Phelan, 2014), the United States of America (Hinrichs, Gillespie & Feenstra, 2004), Nordic countries (Levander, 1998; Alsos & Carter, 2006; Grande, Madsen & Borch, 2007), Southern Europe (Skuras, Meccheri, Moreira, Rosell & Stathopoulou, 2005), Australia and New Zealand (Nuthall, 2006; Pritchard, Burch & Lawrence, 2007) and the Netherlands (Bergevoet, 2005; De Lauwere, 2005; Lans, 2009). The concept of entrepreneurial competencies, however, is still an unfamiliar aspect in the South African agricultural sector.

The field of entrepreneurial farmer competencies in relation to credit applications and decisions has not received much attention, not only in South Africa but worldwide. This is despite research that has found that entrepreneurial competencies do have an influence on business performance (Man *et al.*, 2002). The positive influence of higher entrepreneurial competencies levels on performance is important, as improved performance does have an influence on the repayment ability of a business or individual. The problem is that there is currently no scientific evidence available of the influence of such skills on the ability to repay loans. Thus, there are grounds to justify greater attention being given to the extension of the existing credit scoring models. These should be extended to include soft skills, such as entrepreneurial competencies of farmers, to predict, more accurately, the repayment abilities of agricultural credit applicants.

The decision-making involved in, and the classification of, credit applications are important aspects of the credit process. It is thus important to assess the potential contribution that the inclusion of the entrepreneurial competencies in credit scoring models can make towards improving the reliability and accuracy of current credit-granting decision-making.

1.3.   Objectives

The main objective of the research is to develop a theoretical credit model that extends current credit scoring models by incorporating evaluations of the entrepreneurial competencies of farmers. Entrepreneurial competencies have been proved effective in increasing a firm's performance, and can thereby provide important indications of the abilities of farmers to ensure the growth and survival of their businesses, which in effect will enhance and ensure their ability to repay loans. The objective of the research will be reached by making use of a case which includes a South African financial organisation.

The main objective will be achieved through the following sub-objectives:

Objective 1: To explore the current credit assessment process to understand the factors and characteristics that are used to assess credit applications and to identify other factors and characteristics that could improve the degree of accuracy with which repayment ability is predicted.

A Delphi study was conducted to explore factors which indicates loan repayment ability, and financial sustainability of farming enterprises in South Africa. The objective was not only to identify factors that are currently considered, but also to identify other personal attributes that may improve the accuracy in predicting the repayment ability of potential borrowers. The Delphi method was applied to a panel consisting of nine credit analysts and credit managers from the commercial credit provider in South Africa.

Objective 2: To measure the entrepreneurial competencies of farmers that can be included in credit applications. The entrepreneurial profile includes factors that are associated with entrepreneurial competencies that enhance the performance of a firm.

The measuring of entrepreneurial abilities and characteristics has developed over the years, and in recent years the measuring of entrepreneurial competencies has emerged. Competence is an indication of the ability to apply knowledge, skills and attitudes within a specific position (Mulder, Gulikers, Biemans & Wesselink, 2009). Entrepreneurial competencies are, therefore, a broad-spectrum concept that embraces several aspects of an individual's behaviour. The concept does not only concentrate on certain attributes.

There is a definite gap in the limited research on measuring the entrepreneurial competencies of farmers in the agricultural sector, especially the South African sector, with only Jordaan (2012), Xaba (2014) and Nieuwoudt, Henning and Jordaan (2015) providing research on measuring the entrepreneurial ability or competencies of South African farmers. There is a need for more research to be done on entrepreneurial competencies in the South African agricultural sector. This research would, therefore, make a twofold contribution to the current knowledge; firstly, by researching the entrepreneurial competencies of South African farmers, whose competencies may differ from farmers in European countries, as farmers everywhere have to negotiate different environmental, institutional and political structures. Secondly, by including entrepreneurial competencies of farmers in credit-scoring models that are based on an objective instrument for measuring their entrepreneurial competencies. To include the entrepreneurial competencies of farmers in a credit-scoring model, a specific profile or scoring system is necessary. Man (2001) and Man *et al.* (2002) provided an available instrument which was adopted to determine the entrepreneurial competencies of farmers. The entrepreneurial competencies can be used to provide a farmer's entrepreneurial competencies profile, or entrepreneurial competencies score, that can be used, as exemplified in the following objective.

Objective 3: To incorporate the entrepreneurial competencies profile of a farmer into a credit-scoring model that minimises the acceptance of high-risk finance applications in the South African agricultural sector.

Literature has identified Neural Networks as a statistical tool that performs well in identifying high-risk loans as good loans (Glorfeld and Hardgrave, 1996). As the current system used to determine the repayment ability of applications is still based on human judgement, the implementation of the Neural Network credit-scoring model can contribute to obtaining more consistent and reliable results that are not influenced by human perspectives. The literature also mentions that additional contribution to the credit-scoring systems will be found in the variables that contribute to decision-making. Accordingly, this research identified certain entrepreneurial competencies that are measured using a proven instrument. The entrepreneurial competencies do have an influence on the financial performance of businesses, and can contribute to credit-scoring models when included as decision-making variables. The research will therefore contribute to current knowledge by introducing a theoretical credit-scoring model which includes objectively measured entrepreneurial competencies of farmers.

1.4.   Organisation of the thesis

The thesis consists of six chapters which include an introduction (**Chapter 1**) and a summary, conclusion and recommendation in **Chapter 6**.

A review of research that was conducted on credit and entrepreneurship is provided in **Chapter 2.** The review consists of two sections; the first section provides relevant information that is associated with the credit process. Focus is especially placed on the methods and variables used for determining repayment ability and the process used in the agricultural sector. The second section reviews research on entrepreneurship, especially that which focuses on farmers as entrepreneurs. Different methods used to determine the characteristics of an

entrepreneur are discussed, and the section concludes with the identification of a measuring instrument that can be used to explore the entrepreneurial competencies of farmers according to their observed behaviour.

The aim of **Chapter 3** is to explore the current credit process used in the agricultural sector with an emphasis on the variables used to determine the repayment ability. The chapter considers the credit process from the providers' perspective, which is different from what is normally found in the literature. Credit analysts and managers participated in a Delphi study to identify the factors that are currently considered in the applications. The study also identifies variables that are problematic and/or based on subjective measuring methods. The results of the Delphi identified several variables that are considered in the credit process, and importantly identified that the entrepreneurial abilities of farmers are indeed significant factors to consider in determining repayment ability.

Results from Chapter 3 indicated that entrepreneurial abilities of farmers are important factors that need to be considered in terms of their credit repayment ability. The aim of **Chapter 4** is to explore the entrepreneurial competencies of farmers as observed through their behaviour in the context of their farming business. An instrument developed by Man (2001) is used to explore the entrepreneurial competencies of farmers, and the competencies that were identified were scored using the Likert scale scores, providing a score for each of the competencies that can be included in a credit-scoring method.

Chapter 5 provides a methodology that can be used as an objective credit scoring method as identified from the literature. The Neural Network method used has the ability to accurately predict rejection-worthy, high-risk loans which are associated with the highest costs for financial organisations. The entrepreneurial competencies, as identified in Chapter 4 are also included as decision-making variables along with other identified variables in the credit model to achieve the main objective of the research.

The final chapter of the thesis, **Chapter 6**, includes the summary of the results and the conclusion that include the entrepreneurial competencies of farmers should be included in a theoretical credit-scoring model. The chapter provides recommendations for the practical implementation of the findings of the research in the credit and agricultural sector, and also identifies key areas of future research that will contribute towards improving the agricultural credit sector and also a deeper understanding and measuring of the farmer as an entrepreneur.

Chapter 2

Literature review

2.1.   Introduction

The objective of Chapter 2 is to discuss important aspects that contribute to meeting the objectives of this research. The chapter is divided into two main sections. The first section provides information on credit. Applications for credit and the process of credit scoring are discussed, including the variables and methods used in credit scoring, aimed at ultimately identifying a credit-scoring method that is best suited for predicting high-risk applications. The second section provides information on entrepreneurship in a broader spectrum, specific to the agricultural sector and within the available frameworks for measuring entrepreneurial competencies.

2.2.   Credit

2.2.1.   Defining credit

The phenomenon of borrowing and lending has long been associated with human behaviour (Thomas, Edelman & Crook, 2002). Different methods can be used to determine the viability of lending funds. The main purpose of the transaction is for the lender to receive his money back, with interest. The first credit form probably originated in ancient Babylon, where farmers borrowed at planting time and repaid after the crop had been harvested (Lewis, 1992). Consumer credit is defined as "any of the many forms of commerce under which an individual obtains money or goods or services on condition of a promise to repay the money or to pay for the good or services along with an additional fee at specific date or dates in the future" (Lewis: 1992: 1). Hand and Henley (1997) refer to credit as "an amount of money that is loaned to a consumer by a financial institution and must be repaid, with interest, in regular interval instalments". Credit in the context of agricultural production is explained by Winn, Miller and Gegenbauer (2009) as "the advance of funds to enterprises to finance inputs, production and accompanying support operations, using certain types of security that are not normally accepted by banks or investors and which are more dependent on the structure and performance of the transaction, rather than the characteristics of the borrower."

Since the earliest reference to credit, several changes have occurred in the credit industry as we know it today. Combined effects of financial stress, deregulation of interest rates in financial markets, and improved information system for lenders have brought significant changes in the evaluations of credit, risk assessments and pricing policies in agriculture lending (Barry & Ellinger, 1989). Access to credit is regarded as an important requirement for economic growth and raising of living standards (Petrick, 2005). As capital is such an important and necessary factor to improve living standards, one would presume that capital should be an easily accessible resource.

2.2.2. Role of credit

The continuation of production activities worldwide depends on the presence of natural resources and the human power that can take advantage of the resources (Kizilaslan & Adiguzel, 2007). Hou (2006) argues that the ability to raise financial capital is one of the most important factors for the survival and growth of a business. Credit is part of financial capital, and can provide assistance to farmers to benefit from financial resources beyond their own abilities and therefore take advantage of potentially profitable business opportunities (Zellar & Sharma, 1998). In the agricultural sector, the farmers also depend on financial capital as the value of total capital assets for South African commercial farms increased from R 331 619.9 million in 2013 to 359 058.7 million in 2014. During the same period the farming debt levels increased from R 102 507.5 million to R 116 575.6 million. Since 2010 there has been an increase of 66.6% in farming debt levels compared to an increase of 40.19% in the value of total capital assets on commercial farms (DAFF, 2015). The ability to raise financial capital is an important factor that is needed in the production of farm products. Without access to credit, many farmers will not be able to reap maximum returns from the natural resources available to them. However, despite the importance of credit, credit is not available or accessible to everyone.

Most credit grantors do not provide credit to all the applicants because there is always the potential for a high level of losses, especially from clients who have a

high probability of default (Banasik, Crook & Thomas, 2003). The result is that a number of individuals and businesses face a credit constraint. Credit constraint means that certain individuals obtain loans, while other individuals, willing to borrow at the same standards and rates, do not obtain loans (Reyes, Lensink, Kuyvenhoven & Moll, 2012).

To supply credit to borrowers, there are certain rules and regulations that have to be met, no matter what the status of the individual or business may be. Several laws and regulations regulate the applications and these are implemented nationally, while certain regulations are implemented internationally. The regulations and governing rules that affect the manner in which financial organisations provide credit are discussed in the following section.

2.2.3.   Regulations and governing of access to credit

Borrowers and lenders in the credit market require protection for two broad reasons. The first reason is the protection of consumers (borrowers) from being exploited by better-informed financial institutions. The other reason is systematic risk, where banks are often viewed to be sources of systematic risk. Banks are viewed in this way for their central role in the payment system and allocation of financial resources in combination with the fragile financial structures of banks (Jacobsohn, 2005).

The protection of borrowers and lenders has been recognised and a committee has been established. The Basel Committee on Banking Supervision (BCBS) was established in 1975 by the central bank Governors of ten countries[1] (Basel Committee on Banking Supervision, 2004). The Basel Committee does not have any formal authority or legal power (Jacobsohn, 2005) and the directive of the committee is to improve the regulation, supervision and practices of banks all over the world, with the goal of enhancing financial stability (Jacobsohn, 2005). Other individual authorities, including financial organisations, are then encouraged to implement these standards with detailed arrangements, which

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1 These countries include: Belgium, Canada, France, Germany, Italy, Japan, Luxembourg, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom and the United States of America.

are best suited to each country's national systems (Insurance Advisory Board, 2002). There was a clear recognition in the committee for the need of a multinational accord that strengthens the international banking system's stability, and also removes sources of competitive inequality that arise from differences in national capital requirements.

In 1988, the Basel Capital Accord (Basel I) was drafted, which set out minimum standards for banks that are internationally active. According to Basel I, banks were required to divide their exposures into broad, different "classes" that reflect similar types of borrowers. All exposure to the same kinds of corporate borrowers, therefore, are subjected to the same capital requirements, regardless of differences in creditworthiness and risk exposure of each individual borrower (Jacobsohn, 2005). With the lapse of time, a need for further adjustments was identified and a new framework was developed.

The objective of the new Basel II framework is to strengthen the soundness and stability of the international banking system. Basel II aims to maintain consistency to ensure that capital adequacy regulation will not be a source of competitive inequality among international operating banks. Basel II aims to improve the risk management of banks in the financial systems. To achieve the goals of Basel II, three pillars have been introduced that reinforce each other and create incentives for banks to improve the quality of their control processes. The three pillars, as described by the Bank of International Settlements (Basel Committee on Banking Supervision, 2015), are the following:

- "Minimum capital requirements, which sought to develop and expand the standardized rules set out in the 1988 Accord,

- Supervisory review of an institution's capital adequacy and internal assessment process, and

- Effective use of disclosure as a lever to strengthen market discipline and encourage sound banking practices. "

The framework design is aimed at improving the regulatory capital requirements that reflect underlying risks and at better addressing the financial innovations

that had occurred over the years (Basel Committee on Banking Supervision, 2004).

The probability that an applicant will default has to be determined with the use of information about the applicant, which is provided at the time of the application and that serves as a basis to make the decision to accept or reject the application (Hand & Henley, 1997). Rules, regulations and laws make the use of a formal method in credit scoring a necessity to ensure that decision-making is fair and true to all applicants. The accuracy of this process is to the benefit of the creditor, insofar as it affects profit levels, and to the applicant, to avoid over-commitment. Credit scoring is the name given to describe the process of determining how likely applicants are to default on their loan repayments. Since the implementation of Basel II, it has almost become a necessity for banks to incorporate advanced methods – credit-scoring models – that enhance the efficiency with which capital allocations are made (Marqués, García & Sánchez, 2013).

2.2.4. Approaches for granting credit

Access to credit is obtained through an application process whereby credit providers assess the risk of granting credit to an applicant. The process that is used to assist in the decision-making concerning the acceptance or rejection of an application has evolved over the years. Evolution in credit grant decision-making is important, especially if there is to be an improvement in accuracy. The increase in credit-scoring accuracy is a significant improvement, even if it is just a fraction of a percentage (West, 2000). The evolution of the process is discussed briefly in the following sections.

2.2.4.1.   Judgemental procedures

Before an objective application method was introduced in the banking industry, credit decisions were made on a judgmental basis, where the manager would assess the creditworthiness of the applicant based on personal knowledge of the applicant. The personal judgment method has several shortcomings including its unreliability, the fact that its results are not replicable, it is difficult, both to teach,

and share knowledge, it is unable to handle large quantities of applications, and the method is subjective (Bolton, 2009). Marqués *et al.* (2013) mention that the judgmental method suffers from high training costs, and frequent incorrect and inconsistent decision-making by different experts for the same application. With the use of judgemental risk evaluation, each applicant and the information of the application are evaluated individually by an employee of the credit-granting organisation (Abdou & Pointon, 2011).

These shortcomings, together with economic pressure, increased demand for credit, and the emergence of new computer technology, have led to the development of new, more sophisticated statistical models which are incorporated in credit granting decisions. In an effort to improve social outreach and financial stability, more sophisticated credit scoring techniques were introduced in the micro-finance industry. Credit scoring is a method that analyses the historical data of the applicant to predict the repayment behaviour of the applicant, based on the characteristics of the loan, lender and borrower (Van Gool, Baesens, Sercu & Verbeke, 2009). In the following sub-section, credit scoring will be discussed in more detail.

2.2.4.2.   *Credit scoring*

Credit scoring is a quantitative evaluation system that credit suppliers employ to assess the creditworthiness of an individual or firm that has applied for a loan (Casu, Girardone & Molyneux, 2006). Abdou (2009) mentions that credit scoring can also be defined as the set of decision-making models and their underlying techniques that aid lenders in the granting of credit to customers. The techniques that are used assist in deciding who gets credit, how much credit will be provided, and what operational strategies might enhance the profitability of borrowers for the respective lenders (Thomas *et al.,* 2002).

Compared with the judgemental method, credit scoring has several advantages such as the reduction of costs of the evaluation process and the reduction in the expected risk of an application turning into a bad loan. Credit scoring also means savings in time and effort, and the making of consistent recommendations based

on objective information. Human-bias decisions are thus eliminated with credit scoring. Policy and economic changes can be incorporated into the credit scoring models, allowing for constant improvement of the models over time. Thus, the performance of the models can be monitored, tracked and adjusted over time (Marqués *et al.,* 2013).

2.2.5.   Rationale of credit scoring models

The aim of credit scoring is to predict whether a client, when granted a loan, will repay the loan in a timely manner[2] (Banasik *et al.*, 2003). Credit scoring is used by several financial institutions when evaluating loan applications (Mester, 1997) by assessing the risk of lending to differing consumers (Bellotti & Crook, 2009). Prediction and assessment are needed to determine which of the applicants, normally from a large number of applicants, has the ability to repay the loan and might thus be granted a loan (Banasik *et al.*, 2003). The scoring problems are thus related to classification analysis (Lee, Chiu, Lu & Chen*,* 2002; Anderson, 2003). Scorecards are a widely used method in the banking industry that provide quantitative information that guides operations from the initial accept-or-reject decision, to monitoring and choosing specific actions for existing credit consumers (Hand, Sohn & Kim, 2005). Credit scoring models not only assist in loan approvals, but also in the pricing and monitoring of loans. Potential borrowers are classified according to their probability to default on the relevant loan according to the data used in the credit application and the individual or business's credit reference (Bellotti & Crook, 2009). The amount of credit, management of credit, and credit portfolio risks can be identified with the use of credit scoring (Turvey & Brown, 1990).

Credit-scoring models have the potential to reduce the variability in credit decisions and to add efficiencies in credit risk assessments (Limsombunchai, Gan & Lee, 2005). The method of credit scoring is to use a numerical model where decisions are made on the applicant's final score that can be compared with a threshold that assists in decision-making (Hand *et al.*, 2005). Credit scoring can be thought of as a classification or prediction problem. The classification

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2 Payments are made when due and the loan is repaid within the specific timeframe.

problem is presented where an input sample must be categorised into one or more predetermined classes that are based on a number of observed variables that are associated with the sample (Marqués *et al.,* 2013).

To explain the process of credit scoring more practically, a data set with *n* customers will be used.

$$S = \{(x_1 y_1), \ldots \ldots, (x_n y_n)\}$$ <div align="right">**Equation 2.1**</div>

Where each customer $x_i = (x_{i1} x_{i2}, \ldots \ldots, x_{iD})$ is characterised by *D* variables that are defined on an input space X^D, and $y_i \in \{approved, rejected\}$ denoting the type of customer. The credit-scoring model, which is the classifier, can be seen as a mapping function $f: x^D \dashrightarrow \{approved, rejected\}$ that predicates a value (y) for a new credit applicant (x) that can be defined as $f(x) = $ y (Marqués *et al.,* 2013).

Variable or characteristics selection in credit scoring is the process through which the best subset for a given set of variables in a data set is found (Dash & Liu, 1997). Variable selection is a very important process in the designing of classification systems and for ensuring that the most relevant variables are chosen to have a limited amount of inputs for a more predictive, less computationally intensive model (Marqués *et al.,* 2013).

2.2.5.1.   *Variable selection in credit scoring*

Distinguishing between good and bad loans is very important and this is the objective of credit-scoring models (Lee *et al.,* 2002). An appropriate classification technique is therefore necessary to assist in determining the categorisation of a new applicant. The input that is used in the classification consists of a collection of information that describes the socio-demographic characteristics and economic conditions of the applicant (Marqués *et al.,* 2013). Wide varieties of variables can and have been used to classify applicants in credit-scoring processes. Variables that are used for categorising an application as being either a good or a bad loan include (Abdou & Pointon, 2011): age, income and marital status (Chen & Huang, 2003); dependents; having a telephone; education level, occupation, and time at present address; having a credit card; time at present

job; loan amount and duration; house owner; monthly income, bank accounts, ownership of a car and mortgage; purpose of loan; guarantees (Orgler, 1970; Greene, 1998; Lee *et al.*, 2002; Banasik *et al.*, 2003; Crook & Banasik, 2004; Ong, Huang & Tzeng, 2005; Lee & Chen, 2005; Hand *et al.*, 2005; Andreeva, 2006; Banasik & Crook, 2007; Bellotti & Crook, 2009; Šušteršič, Mramor & Zupan, 2009; Martin, 2013;). Hand, Sohn and Kim (2005) used credit amount, credit history, duration in months, other debtors and guarantors, other instalment plans, present employment, present residence, property, purpose, savings account and bonds, and status of existing checking (current) account as characteristics variables.

Research focused on factors that determine farmers' access to credit which include: age, gender, education, experience, farm size, household size, income, group membership and source of credit (Hananu, Abdul-Hanan & Zakaria, 2015); distance between lender and borrower, perception of loan repayment, perception of lending proceedings, and value of assets (Chauke, Motlhatlhana, Pfumayaramba & Anim, 2013); marital status and lack of guarantor (Ololade & Olagunju, 2013). Akudugu (2012) and Dzadze (2012) mention that crop grown; farm size and savings are rural banks' main determinants of credit supply. Several studies (i.e. Chauke *et al.,* 2013; Ololade & Olagunju, 2013; Hananu *et al.,* 2015) considered credit repayment ability, and the effects of factors that influence the repayment ability, as indicators of future repayment abilities. Researchers often do not include all the factors that are considered in actual credit applications for determining repayment ability. This might be because the information is not obtainable from commercial or agricultural banks.

Variables that are included for business applications include (Abdou & Pointon, 2011): the main activity of the business, age of the business, location, credit amount and financial ratios that represent financial performance (Emel, Oral, Reisman & Yolalan, 2003; Liang 2003; Zekic-Susac, Sarlija & Bensic 2004; Cramér, 2004; Lensberg, Eilifsen & McKee, 2006; Min & Lee, 2008; Min & Jeong, 2009). Evidence suggests that financial ratios provide information on a borrower's credit risk, and can assist in making the decision for granting access

to credit (Demerjian, 2007). These financial ratios can be divided into five categories, as described by the Farm Financial Standards Council (FFSC) in the United States of America (USA).

The five categories are Liquidity, Solvency, Profitability, Repayment Ability and Financial Efficiency, each of which has several measurement ratios that provide information on the financial situation. Credit providers tend to rely more on repayment ability, solvency and the loan security than on profitability and financial efficiency (Featherstone, Roessler & Barry, 2006). Despite the fact that the use of ratios is widespread, the use of the ratios varies and there is little evidence on how the financial ratios are selected for inclusion (Demerjian, 2007). Barney, Graves and Johnson (1999) used ratios in the prediction of failure of debt repayment. Financial ratios are useful in the identification of trends (Ferris & Malcolm, 1999) and can be used by investors and credit providers that are interested in the success of a business (Martikainen, Perttunen, Yli-Olli and Gunasekaran, 1995).

These characteristics are used to categorise new credit applicants as being accepted (good loans) or rejected (bad loans) (Marqués *et al.,* 2013). The determining characteristics can vary between countries, industries and environments. There is no specific indication on established characteristic variables that have to be chosen, since "It is believed that there is no optimal number of variables that should be included in building credit-scoring models" (Abdou, 2009). The selection of variables that are used for building credit-scoring models depends on the data that are provided and the availability of data (Abdou, 2009).

The selection of variables is an important part of credit scoring. Variables selection influence the credit-scoring model by improving the performance of predictors, providing faster and more cost efficient predictors, and providing an opportunity to gain a better understanding of the underlying process that generated the data (Marqués *et al.,* 2013). As these characteristics are used to determine the outcome of a credit application, it is important for financial

organisations to apply the most appropriate technique(s) in building credit-scoring models (Abdou, 2009).

2.2.6. Credit scorecards techniques

Several credit-scoring techniques have been developed over the years (Hoffman, Baesens, Martens, Put & Vanthienen, 2002), and they can be used by credit analysts, researchers, lenders and computer developers and providers (Abdou, 2009). Techniques range from classical techniques that employ statistical methods (discriminant analysis, linear and logistic regression, multivariate adaptive regression splines, classification and regression trees, nonparametric smoothing, and survival analysis) or operations models (linear programming, quadratic programming, integer programming, multiple criteria programming, and dynamic programming) (Marqués *et al.*, 2013). More sophisticated techniques have also been used that are more related to computational intelligence, such as neural networks, support vector machines fuzzy systems, rough sets, artificial immune systems and evolutionary algorithms (Marqués *et al.*, 2013).

The objective with credit scoring is to correctly classify credit applications into accepted or rejected classification groups, and therefore the identification of the model that has the highest percentage of correctly classified applicants needs to be ascertained. Accepting a high-risk loan can be very costly to a lender and have an impact on the profitability of the lending organisation (Nayak & Turvey, 1997). The losses incurred in granting a loan to a high-risk borrower include the principal payments and interest payable on the principal for the specific loan period, which are directly related to the loan. Other indirect costs include administration costs, legal fees, insurance costs and property taxes (Nayak & Turvey, 1997). This clearly illustrates that the costs of granting credit to a high-risk application is much higher than rejecting a low-risk client (Nayak & Turvey, 1997; West, 2000). When considering the prediction ability of the different methods, it can be to the advantage of the financial organisation to ensure that it correctly classifies high-risk loans as being in the rejection category.

Several different credit-scoring models have been applied and researched. When focusing on the classification problem of credit scoring, Marqués *et al.* (2013) conclude that there is no best algorithm. One technique might be best fitted to one particular data set, while another method might be best fitted to a completely different data set. Differences in predictability of the models can be influenced by several factors (Ellinger, Splett & Barry, 1992). These factors include the different purposes for the use of the model and differences in risk attitudes between lenders, with lenders catering for different types of borrowers and in effect having regard to differences in the type of information at their disposal. These factors contribute to the fact that there is no perfect or best credit-scoring model, but suitable models are available for the lender that wants to minimise the problem of mistakenly accepting a wrongly classified application, especially accepting high-risk loans.

Several researchers have investigated the prediction ability of the different available methods. Yobas, Crook and Ross (2000) found that linear discriminant analysis (LDA) and neural networks (NNs) had almost identical prediction abilities in identifying slow payers. Desai, Crook and Overstreet (1996) found that NNs have good performance in predicting bad loans, compared with LDA and Linear Regression (LR). Glorfeld and Hardgrave (1996) confirm that NNs are successful at predicting bankruptcy as the NNs learn from examples drawn from very noisy, distorted or incomplete data how to adjust the data dynamically, where other methods fail (Salame, 2011). Refaat (2007: 25) also states that a NN generally outperform other methods because a NN has complex structures and insensitivity to outliers. For this reason, the NN has been identified as having the best classification record in the classification of an applicant that has a high-risk probability of default.

2.2.6.1.   *Neural networks*

Neural networks is a widely used method in various areas of predictability and classification. Much of the research on neural networks has focused on problems in the accounting and finance industries (Paliwal & Kumar, 2009). In these industries, the prediction of bankruptcy, credit evaluations, insolvency

prediction and other aspects were in the forefront of problems solved in terms of classification and prediction. In the early 1980s, artificial intelligence techniques were applied successfully in the prediction of bankruptcy. These techniques included machine-learning techniques such as artificial neural networks (ANN), also known as Neural Networks (NN) (Salame, 2011). NN is a method that attempts to mimic the human brain (Paliwal & Kumar, 2009) with the use of an assortment of computational elements in an interrelated system.

An input layer, one or more hidden layers, and the output layer constitute a NN. When the network has more than one hidden layer, it is referred to as a multi-layer neural network. Every layer is interrelated, as each layer receives information from the previous layer. The hidden units in the hidden layers perform calculations to combine the inputs by applying mathematical transformations (Salame, 2011). A NN consists of several inputs (variables), which are each multiplied by a weight that is similar to a dendrite that spreads impulses between cells. The products are then summed and transformed in the next step, known as a "neuron". The result then becomes an input for the next neuron in multi-layer networks (Thomas *et al.*, 2002). A single-layer network consists only of an input layer, comprising the variables, neuron and output value or values. The output value is therefore the value of importance as it is used to predict whether a case is accepted or rejected (Thomas *et al.*, 2002) when credit applications are considered.

Information between the neurons is weighed to present a result from each neuron that is sized in relation to the connection between the neurons (Pacelli & Azzollini, 2011). Every neuron in the network has a predetermined transition and threshold value that must be reached to activate the neuron (Pacelli & Azzollini, 2011). A NN that consists of an input layer, a middle layer (three neurons) and an output layer is shown in Figure 2.1 below. The neurons in the middle layer perform a summation of the inputs presented, consisting of the product of the output neurons of the first layer and the weights of the connections (Pacelli & Azzollini, 2011). Results from the interactions are summed on the basis of the specified transfer function of the neurons and then

forwarded to the following neuron, where it is again multiplied by the weight between the neurons (Pacelli & Azzollini, 2011).
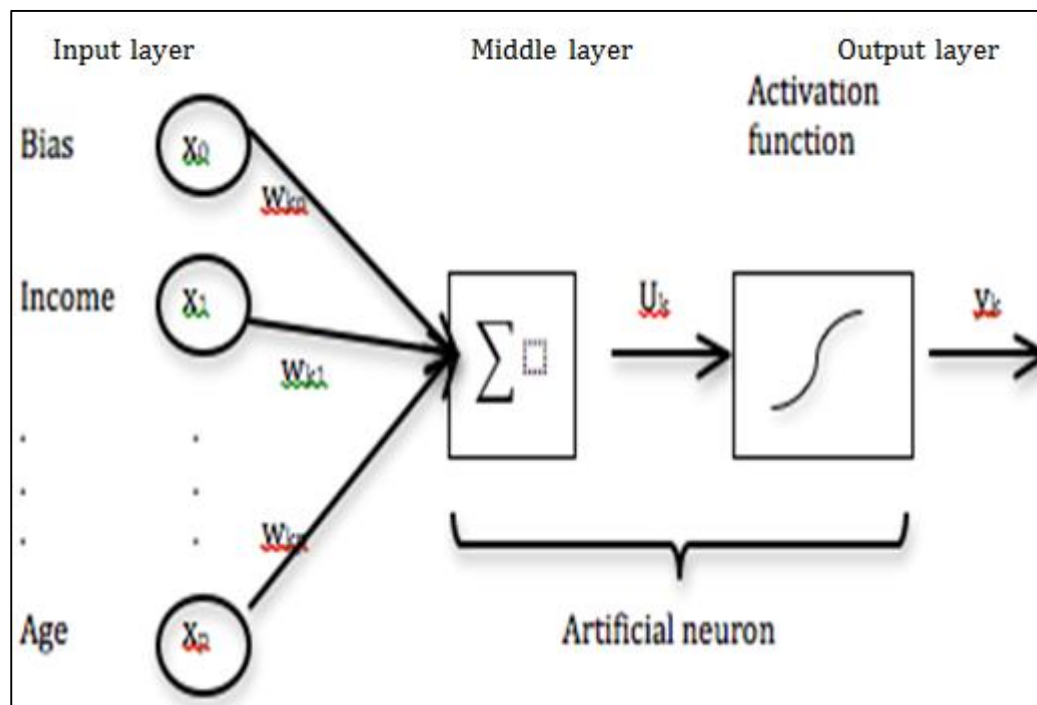
Figure 2.1: Illustration of a neural network consisting of an input layer, middle layer and an output layer
Source: Thomas *et al.* (2002)

The adjustment of the weights in the network is specifically altered, which is accomplished by a specific learning algorithm. Learning algorithms are used to train the network and constantly vary the weights to ensure that a specific condition is met (Pacelli & Azzollini, 2011). The conditions are mostly specified as a minimum threshold error between the expected and determined output.

Different methods of learning mechanisms are used to determine when the training can stop and these are called the learning algorithm (Pacelli & Azzollini, 2011). Learning algorithms stop the network when the discrepancy error, between the known output and determined output as calculated by the network, falls within a determined threshold (Pacelli & Azzollini, 2011). Three different methods of learning mechanisms are available for training NNs: supervised; unsupervised; and reinforced learning (Angelini, Tollo & Roli, 2008). Supervised learning is typically applied in classification, which makes supervised learning

applicable in the research for classifying credit applications. The learning consists of a training set of data, which is used to train the network. Input combinations and the desired outputs for the combinations are used in the training that will be used in the application of the network. The inputs for the research consist of the variables and characteristics that are used to determine the repayment ability of the specific application. The output is the outcome as found by the financial organisation as being either accepted or rejected. The network used in the research is therefore a supervised, back propagation algorithm (Angelini *et al.*, 2008).

Apart from predicting ability, several regulations and laws also have an influence on the outcome of an application, which are intended to protect the financial organisations and also to ensure fairness in granting credit between clients. Limited research is available on the specific methods and processes that are used in the granting of credit in agricultural credit applications. The following provides more information on the process of granting credit in the agricultural sector of South Africa.

2.2.7. South African agricultural credit process

The agricultural credit process has received little attention from researchers in South Africa. For an applicant to gain access to credit, the application has to go through a certain process. The process used by a financial organisation in South Africa, as shown in Figure 2.2 below, starts with where the applicant or customer applies for credit by completing a credit application form with assistance from his personal banker (representative executive).
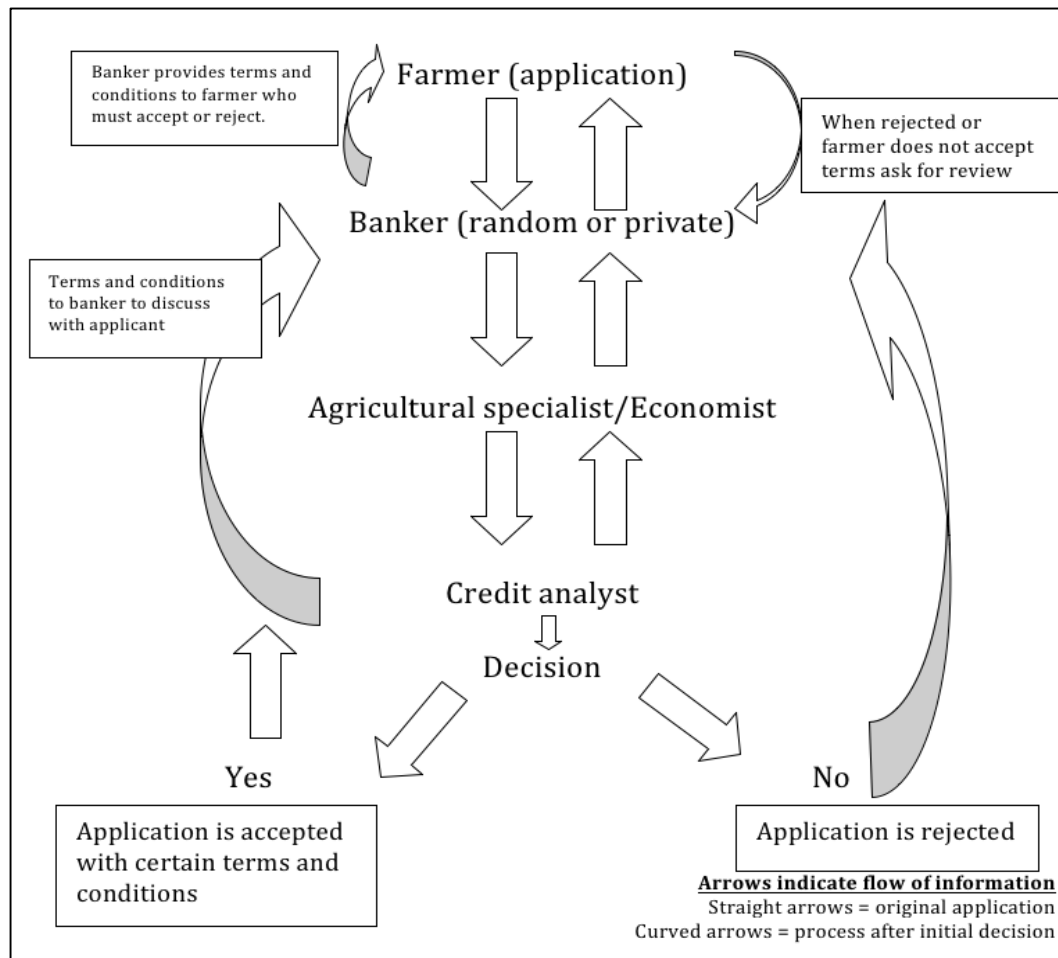
Figure 2.2: An illustration of a South African agricultural credit application process used by a financial organisation

Source: Own compilation via Anonymous 1, (2014); Anonymous 2, (2015)

Next, the application is submitted for assessment, which is done by a credit analyst (Anonymous 1, 2014). Other sources of information are also available to the credit analyst as required, such as an economic situation report, enterprise specific report and so on. From all of these sources, the analyst makes a recommendation according to strict guidelines as set out by the specific financial institution. Certain instances exist when the credit analyst requests more information about the applicant (a farmer, in this case) and his business activities (farming activities). In cases like these, the information is provided in a report from the representative executive or an agricultural economist (agricultural expert) in the specific region (Anonymous 1, 2014; Anonymous 2, 2015).

The report provides all the detail that is necessary to determine the repayment ability in terms of the farming business, relevant enterprise and the abilities of the farmer. The abilities of the farmer are reported from the viewpoint of the agricultural economist's experiences with the specific farmer. More specifically, the report considers facts like the structure and management structure of the farm, and the financial position of the farm (past and present) that is experienced under normal operating performance. Any once-off transactions and activities are thus excluded. The report would include an overview of the person's farming knowledge, experience, abilities and skills, and these would also be considered in the credit application.

In essence, some of the information can only be based on physical information, including financial information in terms of past and current financial performance, projected performance of the farm, enterprise or both, and the specific industry. However, information that is relevant to the management and decision-making abilities of the farmer is not easily reported. An important contribution can, therefore, be to determine the factors that are properly considered in the credit process.

Lastly, and importantly, the management and other abilities of the farmer are based on subjective measures in the credit process. Objective measures can be used in the credit application that are more reliable and which are specifically related to enhanced firm or farm performance. As reported, there are different ways to analyse information to determine the repayment ability in credit applications.

The review of characteristics or variables used in credit applications found that the five 'C's of credit are used in credit applications. However, the characteristics associated with the individual, whether the owner or manager, mostly concentrate on factors related to human capital, thus ignoring the managerial and entrepreneurial abilities of an individual. Bolton (2009) mentions that significant improvement in credit decisions are more likely to come from including new and/or more predictive characteristics.

The performance of a business is related to the entrepreneurial competencies of an individual, which provides a reason for including these aspects of an individual in credit applications. The following section will, therefore, discuss entrepreneurship and the ways in which it can be included in credit applications.

## 2.3.	Entrepreneurship

Decisions that are made by farmers on farms are not informed by only economic factors, such as high profits, but also by additional factors, such as socio-economic and psychological characteristics (Gow & Stayner, 1995; Willock, Deary, Edward-Jones, Gibson, McGregor, Sutherland, Dent, Morgan & Grieve, 1999; Ondersteijn, Giesen & Huirne, 2003). A farm, in many cases, represents a family business where lifestyle and personal considerations have an influence on the management decisions (Austin, Willock, Deary, Gibson, Dent, Edwards-Jones, Morgan, Grieve & Sutherland, 1998a,b). A farm is in many cases a family business, where the farmer is not only the manager, but also the entrepreneur and main labour force, all at the same time (Ondersteijn *et al.*, 2003).

The meaning of entrepreneurship has been a point of discussion for many years, starting from the explanation of Cantillon (1755) that an entrepreneur is the bearer of uncertainty who purchases a product at a certain price in the present to sell the product at an unknown price in the future. Entrepreneurial definitions have seen changes from the explanation of Cantillon, with several scholars providing their view. One of the regularly mentioned definitions is that of Schumpeter (1934): "an entrepreneur is a person who carries out new combinations, causing discontinuity. The carrying out of new combinations can include a new good, quality of good, a new method of production, opening a market, conquest of a new raw materials or the reorganisation of any industry" (cited by Phelan, 2014). From Schumpeter's (1934) definition, it is clear that entrepreneurship does not have to include the starting-up of a new business. Gartner (1985) contrasts with Schumpeter (1934), stating that entrepreneurship is the creation of a new organisation. This illustrates that entrepreneurship is not a straightforward concept, with several different schools of thought existing on

what an entrepreneur is exactly. The following discussion will further explore the different viewpoints of entrepreneurship.

Entrepreneurship is not a precise concept, carrying a precise theoretical paradigm (McElwee, 2005). When all the core elements of the definitions are integrated, Stevenson and Jarrillo-Mossi (1986) capture the essence of entrepreneurship as "the process of creating value by bringing together a unique combination of resources to exploit an opportunity". The definition provides four key elements of entrepreneurship; firstly, entrepreneurship is a process. Being a process indicates that entrepreneurship is manageable, and can be broken down into steps or stages that are ongoing. Secondly, entrepreneurs create value within businesses and in the market place. Entrepreneurs make use of scarce resources, in unique ways and combinations of money, people, procedures, technologies, materials, facilities, packaging, distribution channels and other resources that can be used to create value and differentiate their efforts. The last element considers the fact that entrepreneurs have opportunity-driven behaviour, without considering current resources at hand (Stevenson, Roberts, Sahlman and Hammermesh, 2006 cited by Morris, Kuratko and Covin, 2010; 9).

The skill to recognise new opportunities, and evaluate and prioritise opportunities that can be transformed into feasible business ideas is at the centre of the entrepreneurial process (Groenewald, 2010). Dollinger (2003; 2008) adds that entrepreneurship is the creation of an innovative economic organisation that aims to gain or grow in conditions that are characterised by risk and uncertainty. To be an operator of a firm or a business does not necessarily make a person an entrepreneur, as the skills and abilities needed to run and operate a business are not the same as those for being an entrepreneur (Corman & Lussier, 1996). Entrepreneurship does not only refer to the start-up of a new small business; the entrepreneurial process also includes a new venture that is created (Groenewald, 2010) by an entrepreneur in his or her actions by bringing together resources to pursue an opportunity (Nieman, Hough & Nieuwenhuizen, 2003: 20). The new venture can include taking new products into existing markets, introducing existing products into new markets, and/or

creating a whole new business (Hisrich, Peters & Shepherd, 2008: 9). An entrepreneur is not the only factor that determines the success of a firm; the environment in which the firm is operated also has an important role in the structures of the firm (Bosma, van Praag & de Wit, 2000).

From the variety of definitions that are provided in the literature, Phelan (2014) refers to Hébert and Link's (1982) who suggests that there are 'four dynamic theory types' that reflect the developing definition of entrepreneurs. Each of these theories can be characterised by the burden that is placed on the entrepreneur (Phelan, 2014). These burdens include the following: pure uncertainty, pure innovation, uncertainty bearing and either ability or innovation, and lastly, the perception of adjustment to uncertainties (Phelan, 2014). Klein (1979), cited by Hébert and Link (1989), mentions that the U.S. economy was, at the time, experiencing changes from a dynamic to a static situation. In a situation like this, the economy loses the capacity to produce new practical and organisational alternatives to what is then currently available, which would be needed to prevent a static economic situation. To respond to the weakening productivity reduced growth and increasing global competition, academia and policymakers called for the revival of entrepreneurship (Klein, 1979, cited by Hébert and Link, 1989). Against this background, it is important to gain an understanding of what themes may be associated with entrepreneurs in a static and a dynamic economy.

Hébert and Link (1989), in a later study on entrepreneurship, found twelve distinct themes that are related to entrepreneurship (Phelan, 2014), as indicated in Table 2.1 below. The entrepreneur's role in a static state can only be presented by statements 2, 6, 8 and 9 in Table 2.1, as the role of the entrepreneur is passive. In a static state, the actions of the entrepreneur comprise only repetitions of past procedures and techniques that are known (Hébert & Link, 1989). In a dynamic economy, the entrepreneur is represented by statements 1, 3, 4, 5, 7, 10, 11, and 12 (Hébert & Link, 1989), which illustrate that risk, uncertainty, innovation, and decision-making, among others, have important roles in the theory of entrepreneurship.

Table 2.1: Themes of entrepreneurship

Entrepreneur is someone who:	
1	Assumes the risk associated with uncertainty
2	Who supplies the capital
3	Acts as an innovator
4	Acts as the decision maker
5	Is an industrial leader
6	Is a manager or superintendent
7	Acts as the organiser and coordinator of economic resources
8	Is the owner of the enterprise
9	Is an employer of factor of production
10	Acts as a contractor
11	Is an arbitrageur
12	Is an allocator of resources among alternative uses

Source: Hébert and Link (1989)

There is some confusion concerning the theory of entrepreneurship, especially regarding the definition of what an entrepreneur is. Bull and Willard (1993) suggest that the continuous pursuit of defining entrepreneurship contributes to the lack of development of entrepreneurship theory (Phelan, 2014). Stearns and Hills (1996) support their view and further suggest that the definitional debate should not be the centre of attention. Phelan (2014) concludes that it is evident that challenges remain in attempts to define entrepreneurship.

An entrepreneur can, therefore, be seen as an individual that has the ability to identify opportunities and has a high level of self-belief to take advantage of an opportunity by implementing innovative ideas in the allocation of resources to ensure the success of a venture. The following section will place emphasis on the farmer as an entrepreneur.

2.3.1. Farmers and entrepreneurship

Farmers are individuals that have a wide range of skills, to manage their farming businesses (Mcelwee, 2008). Viewing farming from the perspective of

entrepreneurship has not always been very popular in the field of agricultural economics (Knudson *et al.*, 2004), although Wilcox (1932) identified two means by which a farmer affects the success of the farming business. The first is the way a farmer discharges his or her entrepreneurial role and secondly, the skills with which the farmer perform his farming activities, these are very important factors associated with the individual in farm management. Wilcox (1932) mentions that studying the human factor in farm management is centred on the entrepreneurial function. Since the entrepreneurial side of farmers had been identified in the early to mid-1900s, it might be expected that farmers are now widely acknowledged as entrepreneurs (Phelan, 2014). Phelan (2014) mentions that this is in fact not the case, as there is still a lack of information on the factors that push farmers into the development of entrepreneurial activities (Agnete Alsos, Ljunggren & toril Petteren*.,* 2003 cited by Phelan, 2014).

The problems discussed in the previous section about the difficulties of defining an entrepreneur have also contributed difficulty in the conceptualisation of farmers as entrepreneurs (Phelan, 2014). There are, however, research reports that argue that the same concepts used to analyse business entrepreneurs can be applied in the agricultural sector (McElwee, 2008). However, McElwee (2008) also states that the situation in the agricultural sector is much more complex. The complexity associated with the agricultural sector arises because a farmer can be an owner, a tenant, a manager, a subcontractor or any combination of these attributes (McElwee, 2008). Farmers are defined as individuals that are engaged in a variety of activities that is primarily based on the farm in the agricultural sector. These activities include cultivation of soil, growing crops and raising livestock, which forms the main source of income (McElwee, 2004 cited in McElwee, 2008). McElwee (2008), as mentioned by Phelan (2014), continues with another factor that can also influence the categorisation of a farmer as an entrepreneur. Many farms are family businesses, where profit maximisation and separation of ownership and management are not necessarily the norm.

McElwee (2008) classify farmers in two different sections, which may overlap, in terms of their economic activity: farmer can be considered as entrepreneurial

active individuals or as managers of the farming business. Farmers as manager can also be entrepreneurial in different aspects in the farming business. McElwee (2008) proposed separating the identity of a farmer from the farm (Phelan, 2014). The farmer can be seen as the initiator or person in charge, whereas the farm is the place or mechanism through which the farmer applies his or her trade. By splitting the identity of the farm and the farmer, McElwee (2008) identifies four types of farmers. According to McElwee (2008) a farmer can be classified as: (1) Farmer as a farmer – farmer who is involved in limited diversification, thus placing limited awareness on new market opportunities; (2) the farmer as entrepreneur, this category farmer has or can develop a required skill set that will enable the farmer to engage in entrepreneurial activities; (3) the farmer as contractor, where the farmer can possibly be an individual that earns a salary for providing a service such as being a "technical or specialist" farm manager. This type of farmer does not necessarily own a farm but may own assets, and the farmers apply their skills in the agricultural sector. This type of farming include different business models (contract farming, share farming and whole farm contracting); and (4) the rural entrepreneur who stopped farming to concentrate on their alternative enterprises which are not based on food production (agricultural sector).

There are still several questions which arise regarding farm entrepreneurship. However, farmers do need to develop and acquire new skills, while enhancing their existing skills, to remain competitive in the national and international agricultural sectors (McElwee, 2008). To have a better understanding of the overall theory of entrepreneurship, the following sections will review the literature on approaches that have been used to gain a better understanding of entrepreneurship.

2.3.2. Approaches to understanding entrepreneurship

Several approaches for understanding entrepreneurship are found in literature. Phelan (2014) discusses various available approaches to understand entrepreneurship in different sectors. The following section is based on the discussion by Phelan (2014) which includes: the traits approach; behavioural

approach; the opportunity identification approach and entrepreneurial human capital, skills and competencies (Phelan, 2014).

2.3.2.1. The traits approach

This approach relies heavily on psychology, with reference to the theory of personality, focusing on the individual as the catalyst of entrepreneurship (Phelan, 2014). Individuals can be distinguished from one another by the identification of certain personality traits that can be observed (Low & MacMillan, 1988; Gartner, 1989; Kobia & Sikalieh, 2010 cited by Phelan, 2014). Phelan (2014) mentions that the traits approach takes one aspect for granted; there is some internal structure to personality and those specific traits of an individual that can be recognised and measured. The recognised and measured traits can then be used in predicting the behaviour of an individual (Rauch & Frese, 2007; Kolvereid & Isaksen, 2012 cited by Phelan, 2014).

- "The big three" traits of entrepreneurship

The traits literature is dominated by the discussion of three entrepreneurial traits: need for achievement, locus of control and risk-taking propensity (Phelan, 2014).

Need for achievement (NAch)

Entrepreneurs are people that are driven, have ambition and are goal orientated (Singh, 2013). Goals set by entrepreneurs form part of their motivation to reach a higher potential in their lives (Darroch & Clover, 2005). The need for achievement entails the expectancy of doing something better and faster than anyone else does or better than before (Hansemark, 2003). Motivation also has an important role in the description of an entrepreneur. A desire for the need for achievement will ultimately lead to a behaviour that is characterised by persistence. The people that have a need for achievement also tend to believe that they have control over the outcomes of their behaviour and reliable feedback about their progress towards their specific goals (Locke and Latham, 1994). A highly motivated person will be able to continue with his or her innovative plans, even through difficult times. Wu, Matthews and Dagher (2007)

found that inner drives motivate entrepreneurs in their pursuit of identified opportunities when they are faced with difficulties in the process. Drives and motivations, therefore, have an important influence on the achievement of goals.

Wu *et al.* (2007) confirm that persistence and the need for achievement are positively related, and that the need for achievement is an important factor for entrepreneurs. Need for achievement is believed to influence the desire to improve performance; consistently perform at a high level; strive for success; and to take responsibility for the knowledge and learning that is required for achieving success (Loon & Casimir, 2008). Entrepreneurs are people that motivate themselves to achieve the best possible results (Wu *et al.*, 2007). The need for achievement will be a contributing factor for a person to be innovative. Entrepreneurs are associated with introducing changes in their environment and/or the introduction of new ideas. De Lauwere (2005) mentions, by using several research sources, that entrepreneurs can be seen as "movers of the market", "innovators" and/or "discovers of profit opportunities (Hébert & Link, 1988; van Praag, 1999).

Entrepreneurial activities are planned behaviour and reflect the processing of thinking (Krueger, Reilly & Carsrud, 2000). Bergevoet (2005) found that a farmer's goals, objectives and attitudes comprise a determinant of strategic and entrepreneurial behaviour for Dutch dairy farmers. Luthans, Avolio, Avey & Norman, (2007) explains hope in terms of psychological capital can be thought of as having the will to accomplish the desired effect (Snyder, Sympson, Ybasco, Borders, Babyak & Higgins, 1996; Snyder, 2002). Hope consists of three conceptual foundations, namely agency, pathway and goals (Luthans *et al.*, 2007). Agency, according to Luthans *et al.*, (2007), can be thought of the individual having the will to accomplish the intended or desired effect (Snyder *et al.*, 1996; Snyder, 2002). Hope can also be seen as the motivational energy to pursue a goal (Luthans *et al.*, 2007). Part of hope consists of the pathways that are included in identifying goals and sub-goals, and also alternative ways to reach each of the specific goals. Hope comprises the will to succeed and the ability of the individual to identify, clarify and pursue the way to success (Luthans *et al.*, 2007).

Locus of control

Locus of control is also an important personality trait originating from the work of Rotter (1966). Individuals observe the outcome of an event as either within their own control or not. Locus of control does refer to the expectancy that rewards, reinforcements or outcomes in life are either influenced by one's own actions or by other forces (Rotter, 1966; Bergevoet, 2005). Locus of control can be divided into two categories that explain the ability to control outcomes. The first is internal locus of control, where one believes the outcome can be controlled through personal ability, effort or skills. The alternative, external locus of control, is where the belief is that there is no control on the outcome and the outcome is fully determined by forces outside the control of the individual (Rotter, 1966). To have an internal locus of control is an important factor when considering the characteristics of an entrepreneur, as an internal locus of control orientation increases the probability that an entrepreneur will take action and implement the plans to take advantage of an opportunity (Mueller & Thomas, 2001). Internal persons do appear to take more initiative and responsibility in performance situations. These persons have the tendency to seek and utilise information more efficiently and are more in touch with external realities (Fagbohungbe & Jayeoba, 2012).

Rotter (1966) hypothesised that an individual with an internal locus of control is more likely to pursue an entrepreneurial career because of the belief of being in control of his or her own destiny. A person with internal locus of control would also have a sense of need for achievement, and research has attempted to link these two aspects.

Risk attitude

Many of the entrepreneurship definitions highlight the role of risk taker or risk bearer in the individual. Phelan (2014) refer to Hull, Bosley and Udell (1980) and Timmons (1994) who suggests that entrepreneurs are greater risk takers, but on the other hand, as these entrepreneurs do depend on the outcome of their activity, they can also be expected to take calculated risks, as stated by Stearns

and Hills (1996). Stearns and Hills (1996) state that successful entrepreneurs may be individuals that are more effective in managing their risks, rather than 'wild-eyed' risk takers (Phelan, 2014). These facts do show that entrepreneurs may be expected to take on risky activities where the possibility for rewards are apparent, but this process is a measured, and not an inherent character trait (Phelan, 2014).

Agricultural activities are characterised by a certain level of risk, as the environment is very unpredictable, and agricultural entrepreneurs might or might not be keen to take risks that are created by their awareness of opportunities in the unpredictable environment. Where attitudes to risk are normally categorised as risk averse, risk seeking or risk neutral, entrepreneurs provide an additional category by taking calculated risks as mentioned by Knudson *et al.* (2004).

Risk attitudes of decision makers determine the type of decisions that are made. Entrepreneurs are people that have a combination of optimism and self-confidence, and are often characterised as being risk takers (Brandstätter, 1997; Ripsas, 1998; Elfring, 1999, Knudson *et al.,* 2004). These two characteristics of an entrepreneur reflect different aspects of personality towards risk aversion. The perception of risk by a person is subjective. An entrepreneur who is confident may see an opportunity as a low risk, where others see it as a considerable- or high-risk opportunity. The entrepreneur will therefore invest to take advantage of the opportunity, while others will withdraw because of the perceived high risk. A possible reason for the involvement of entrepreneurs in riskier events is that entrepreneurs evaluate opportunities in a more positive or optimistic mind-set than others (Palich & Bagby, 1995 cited in Bergevoet 2005), and are therefore willing to take calculated risks. Assumptions are made that an entrepreneur takes calculated economic risks, but may maximise profit by bearing the risk and uncertainty, notwithstanding the possibility that the venture may fail (Vesala, 1996 from McElwee, 2005). These entrepreneurs, in their business activities, tend to discount risk and see themselves as being in control of their business ventures (Mueller & Thomas, 2001; Bergevoet 2005). The fact

that entrepreneurs see themselves as being in control of their ventures is also related to their preference for risk taking (Jonassen & Grabowski, 1993).

The concept of the "big three" has been further developed and is presented by five new components. These components, "the big five", comprise neuroticism, extraversion, openness, agreeableness and conscientiousness (Zhao & Seibert, 2006). Zhao and Seibert (2006) used an analytical review and suggested that there is difference between entrepreneurs other individuals when their personalities are considered (Phelan, 2014). With the use of a meta-analysis, additional traits were identified, including generalised self-efficacy, proactive personality, innovativeness and achievement motives. These traits are strongly related to entrepreneurial behaviour (Rauch & Frese, 2007).

- The "big five" or new personality traits associated with entrepreneurship

Zhao and Seibert (2006) have suggested that differences exist between entrepreneurs and other individuals who are in managerial positions when considering four of the five fundamental dimensions of personality. The five factors, as noted above, are neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. Each personality element defines a broad field of psychological functioning that is composed from a set of more specific and narrow traits and. The five-factor model (FFM) combines over 40 years of research on the emotional, interpersonal, experiential, attitudinal, and motivational style of an individual (Zhao & Seibert, 2006). The discussion by Zhao & Seibert (2006) is used as a basis for a short discussion of the five dimensions.

Neuroticism

Neuroticism is an indication of how individuals differ in their adjustment and emotional stability. Individuals with high levels of neuroticism tend to experience emotions that are more negative (Zhao & Seibert, 2006). The negative emotions include anxiety, hostility, depression, self-consciousness, impulsiveness, and vulnerability (Costa & McCrae, 1992 cited by Zhao & Seibert, 2006). Individuals that have lower levels of neuroticism tend to be more positive

in their appearance and exhibit emotions such as self-confidence, calmness, even-temperedness, and relaxed attitudes. These factors can also be used to distinguish between managers and entrepreneurs, in their expectations within their respective roles in the business environment.

The difference between managers and entrepreneurs is that managers, by definition, are associated with employment within an established business. Established organisations consist of work processes supported by established procedures and practices. Entrepreneurs work in a rather unstructured environment, where they are responsible for all aspects of the venture (Zhao & Seibert, 2006). Entrepreneurs do not work according to fixed hours and also often lack a level of separation between the work and life spheres typical of managerial work (Dyer, 1994 via Zhao & Seibert, 2006). One of the significant differences between managers and entrepreneurs is that entrepreneurs typically have a personal stake, including a personal financial stake, in the business or venture (Zhao & Seibert, 2006). Entrepreneurs do not have the added advantage of security benefits that are typically provided to middle- and upper-level managers (Zhao & Seibert, 2006). These advantages are normally associated with permanent employment, and include severance packages and independently funded retirement programmes.

The starting of a new business can be associated with additional stress that has an impact on an entrepreneur. However, other aspects such as the 'work environment, workload, work–family conflict, and financial risk of starting and running a new business venture', can produce physical and psychological stresses beyond those of typical of managerial work (Zhao & Seibert, 2006). Entrepreneurs have been labelled as highly self-confident individuals (Crant, 1996; Chen, Greene & Crick, 1998; Zhao & Seibert, 2006) with a strong belief in their ability which enables them to control outcomes in their working environment (Simon, Houghton & Aquino, 1999) (Zhao & Seibert, 2006). Self-confidence and resilience can be described as very important traits associated with entrepreneurs. These traits, i.e. self-confidence and resilience, can be

associated with lower levels of neuroticism. Entrepreneurs can be expected to have higher levels of self-confidence than do managers (Zhao & Seibert, 2006).

Extraversion

Extraversion describes individuals in terms of how assertive, dominant, energetic, active, talkative, and enthusiastic they are (Costa & McCrae, 1992). Individuals with high levels of extraversion tend to be more cheerful, to like people and large groups, and to seek excitement and stimulation, as opposed to individuals with lower levels of extraversion. The latter individuals prefer to spend time alone and are characterised as reserved, quiet, and independent (Zhao & Seibert, 2006).

Costa and McCrae (1992) described salespersons as typical outgoing persons or extraverts. Extravert personalities are positively related to interest in innovative professions (Costa, McCrae & Holland, 1984). While extraversion may be a valuable trait for individuals that are managers, entrepreneurs can be expected to have a greater reliance on extraversion. Entrepreneurs must interact with a diverse range of individuals who are in different positions, such as venture capitalists, partners, employees, and customers (Zhao & Seibert, 2006). As the appropriate structures will still need to be developed for new ventures, and the development of relationships will be lacking, it is expected that entrepreneurs in new ventures could spend considerable time in direct interpersonal interaction with their partners and employees (Zhao & Seibert, 2006).

Openness to Experience

Openness to experience characterises individuals that are open to exploring new ideas or opportunities. These individuals are intellectually curious and tend to seek new experiences and explore novel ideas (Zhao & Seibert, 2006). The propensity to explore new ideas is an indication that individuals are able to think for themselves by considering different aspects that can be known or need to be explored. Creativity, innovativeness, imaginativeness, reflectiveness and being untraditional are all traits used to describe individuals that are open to experience, while individuals that are low in openness can be characterised as

conventional, having limited interests, and being un-analytical in their behavioural appearance. Openness has been found to be positively related to intelligence levels, especially when intelligence is considered in connection with creative activities, such as "out of the box" thinking (McCrae & Costa, 1987). Entrepreneurs can therefore be linked to higher levels of openness, as the invention of new ventures or business does require the entrepreneur to explore new, creative and innovative ideas.

Agreeableness

Agreeableness assesses the relational orientation of an individual. Individuals that exhibit high levels of agreeableness can be characterised as trusting, forgiving, caring, and altruistic, as well as sometimes being gullible (Zhao & Seibert, 2006). Higher levels of agreeableness represent an individual that has accommodating values and a preference for positive interpersonal relationships, while individuals with lower levels of agreeableness can be manipulative, self-centred, suspicious, and ruthless (Costa & McCrae, 1992; Digman, 1990 cited by Zhao & Seibert, 2006).

As individuals with high levels of agreeableness are accommodating and have a tendency to preserve relationships, this may restrain the individual's willingness to drive hard bargains, look after self-interest, and influence or manipulate others for his own advantage. This can lead to situations in the work place where the individual may lose opportunities due to his or her nature to accommodate others. Zhao and Seibert (2006) expect the negative effects to be even more unfavourable for entrepreneurial individuals. Managers are often found in working environments where they have the necessary access resources that can be used for their own protection, while entrepreneurs often operate in environments where they have less legal protection, with a limited margin for error due to limited resources (Zhao & Seibert, 2006). Entrepreneurs are therefore more likely to have to exhibit higher levels of agreeableness than managers do, as entrepreneurs have to look after their self-interests.

Conscientiousness

In the work place there must be a tendency to do things right, thoroughly and vigilantly. Conscientiousness is an indication of organisation, persistence, hard work, and motivation in the pursuit of accomplishing predetermined goals (Zhao and Seibert, 2006). All these traits indicates possibility of hard work (Barrick & Mount, 1991 cited by Zhao & Seibert, 2006) in ensuring that work is done correctly in ways that that will lead to accomplishing goals. Conscientiousness has been one of the most consistent personality predictors of job performance across several industries (Barrick, Mount & Judge, 2001 cited by Zhao & Seibert, 2006). In the traits that are used to illustrate conscientiousness, two primary facets are recognisable: achievement motivation and dependability (Zhao & Seibert, 2006). Achievement motivation has been widely studied in the context of entrepreneurship (Shaver, 1995 cited by Zhao & Seibert, 2006), and has already been discussed.

Dependability reflects the extent to which an individual is organised, deliberate, and methodical in his or her approaches. The reliability of the person to fulfil his or her duties and responsibilities is also linked to dependability. The reliability of individuals is very important, especially where individuals need to exercise self-discipline. Managers working within an established organisation, where other individuals are also involved in many of the processes, are likely to have more structured responsibilities, goals, and work performance (Zhao & Seibert, 2006). On the other hand, entrepreneurs operate in a more flexible and self-directed environment, that is, "weak" situations in which individual traits are likely to have a more important role (Snyder & Ickes, 1985 cited by Zhao & Seibert, 2006).

Research has thus far not been able to identify any definite combination of traits that is able to explain entrepreneurial personality (Brockhaus & Horwitz, 1986; Phelan, 2014). Phelan (2014) mentions that criticism of the traits approach is that many of the traits that were identified are not only relevant to entrepreneurs, but also to non-entrepreneurs or individuals (Low & MacMillan, 1988; Gartner, 1989). A factor that contributes to the problems mentioned in the

traits approach is the lack of consensus on the definition of the entrepreneur. The definitions are inconsistent (Gartner, 1989), and this contributes to the problems of distinguishing entrepreneurs from other individuals (Phelan, 2014). Low and MacMillan (1988) concluded that there is no typical entrepreneur and attempts to profile an individual are unsuccessful. As there are still problems experienced with the traits approach, and there is no consensus on what the specific traits are for identifying entrepreneurs, another method that has been used is the behavioural approach. Following the statement by Low and MacMillan (1988), research has moved away from traits-based measurements of entrepreneurship to more practical measures of entrepreneurship (Low, 2009).

2.3.2.2. *Behavioural approach*

Personality characteristics of an entrepreneurial individual are ancillary to the behaviour of the individual (Gartner, 1989). The behavioural approach to entrepreneurship is concerned with the undertakings and procedures associated with the establishment of a new venture. Focus is therefore placed on what the entrepreneur does, rather than who the entrepreneur is (Gartner, 1989, Phelan, 2014). By emphasising the process rather than the person, the behavioural approach highlights the creation of a venture, thus placing the main analysis on the organisation (Timmons, 1994 cited by Phelan, 2014). The behavioural approach includes the venture creation and the cognitive approaches.

- Venture creation

The theory of entrepreneurship as venture creation, described by Gartner (1988, 1989), argues that entrepreneurs are distinguished from non-entrepreneurs by the creation of an organisation. To have an understanding of entrepreneurship Gartner (1989) mentions that entrepreneurship is about behaviour rather than characteristics, the entrepreneur is within a process and a new venture is created within the process. There are similarities or parallels between the study of entrepreneurship and the research on traits and personality characteristics of leaders (Gartner, 1989). There is no finite number of characteristics of leadership and that these characteristics distinguish between successful and unsuccessful leaders (Gartner, 1989). Leadership theories shifted to a

behavioural focus of leadership, focusing on what the leaders do instead of who they are (Gartner, 1989). For the field of entrepreneurship to mature or progress, the same shift is needed (Phelan, 2014). Even though the behavioural approach focuses on venture creation, the influence of the individual is not forgotten. The individual's behaviour is an important part of creating an undertaking (Phelan, 2014). Individual decision-making and activities are an important part in any new undertaking. With the behavioural approach, the organisation is the main focus, while the individual or entrepreneur is analysed by considering the actions undertaken to enable the business or venture to materialise (Kobia & Sikalieh, 2010).

- Cognitive approach

An important idea that entrepreneurs are part of a special group of individuals exists (Phelan, 2014). Phelan (2014) explains that this has led several scholars (Mitchell, Busenitz, Lant, McDougal, Morse & Smith, 2002; Baron, 2004; Grégoire, Corbett & McMullen, 2011; Sánchez, Carballo & Gutiérrez, 2011) in the entrepreneurship field to turn to psychology to explain the way entrepreneurs think and behave. There are two broad categories of factors that influence the probability that certain individuals will be able to identify particular opportunities; the first is the possession of information that is needed to identify an opportunity, and the second is the cognitive properties to take advantage of the identified opportunity (Shane & Venkataraman, 2000). The interaction with people and the environment and the process that occurs within individuals can be explained by cognition and cognitive psychology. The interaction can be defined as "all processes by which sensory input is transformed, reduced, elaborated, stored, recovered and used" (Phelan, 2014; 73). Entrepreneurial cognitions are the knowledge structures that are used by individuals in their assessment procedures (Phelan, 2014). In their assessment procedures, entrepreneurs need to make judgements or decisions involving opportunity evaluation, venture creation and growth (Phelan, 2014).

Phelan (2014) make use of several cognitive elements to explain the entrepreneurial behaviour of individuals. These elements include: self-efficacy,

scripts, cognitive bias, and opportunity recognition (Phelan, 2014). **Self-efficacy** is the belief in one's abilities to implement the necessary resources, skills and competencies to achieve a level of achievement for a given venture (Shane, 2003b; Phelan, 2014). **Confidence or self-efficacy**, as defined by Stajkovic and Luthans (1998), represents the "individual's convictions about his or her own abilities to mobilise the motivation, cognitive resources, and course of action needed to successfully execute a specific task with a given context". Phelan (2014) explains that self-efficacy is seen as an important aspect in distinguishing between entrepreneurs and non-entrepreneurs (Chen *et al.*, 1998), and can also be used to explain why some individuals choose not to become entrepreneurs; as this is not always the result of a lack of ability, but rather a lack in the self-efficacy, or belief in own ability, of the individual (Markman, Balkin and Baron, 2002; Markman, Baron & Balkin, 2003; Luthans *et al.*, 2007; Sánchez *et al.*, 2011).

The knowledge and abilities of an individual are very important for assessing an opportunity, whether it be for starting or growing a venture (Sánchez *et al.*, 2011). Within the concept of entrepreneurship the knowledge structures that are used by entrepreneurs for assessments, judgement or decisions when determining the feasibility of opportunities, venture creation and business growth are referred to as **Scripts** (Sánchez *et al.*, 2011). Scripts, in an entrepreneurial research context, refer to simplified mental models that are used by entrepreneurs to connect new information to develop new products or services, and to identify the resources for the specific venture creation (Sánchez *et al.*, 2011). Entrepreneurs have different thought processes, compared with non-entrepreneurs (Sánchez *et al.*, 2011), as the entrepreneurs have refined their mental models. The entrepreneurs are able to perform better in certain environments as they follow the development and growth of early businesses, or have knowledge in the particular area (Sánchez *et al.*, 2011).

Several studies showed that knowledge structures could be used to distinguish entrepreneurs from non-entrepreneurs (Mitchell, *et al.*, 2002). The reason for the ability to distinguish between entrepreneurs and non-entrepreneurs is that entrepreneurs have shared the same experiences about the conceptualisation

and development of the business, from early development and through the growth stages. These experiences allow the entrepreneurs to develop similar and advanced mental models that are not developed by non-experts, as the non-experts have less experience in the domain (Phelan, 2014).

Innovation, growth and realignment of strategies is important aspects that assist in the identification and pursuit of new business opportunities (Sharma & Chrisman, 1999)'. A significant part of entrepreneurial research focuses on the role of opportunity identification. The cognitive model assumes that, through previous experiences by the individual, prototypes of opportunities will form as conceptual thoughts (Phelan, 2014). The process of opportunity recognition can then include the process of comparing the new ideas of products or services with existing or past prototype opportunities (Baron, 2004 as cited by Phelan, 2014). To be able to take advantage and identify these new opportunities, small business and entrepreneurship literature suggests that the process is enabled by entrepreneurial ability (Chandler & Jansen, 1992; Man *et al.*, 2002; Ucbasaran, Westhead & Wright, 2008 cited by Lans *et al.,* 2010). Shane and Venkataraman (2000) observe that, to exercise entrepreneurship, an individual must first have entrepreneurial opportunities.

The behavioural approach, specifically venture creation, only implies that an individual is entrepreneurial in the context of venture or firm creation, and therefore the method remains controversial (Phelan, 2014). Knudson *et al.,* (2014) also mentions that entrepreneurs exist on three levels: starting your own business, those who work for other businesses that are owned and run by other entrepreneurs, and lastly the entrepreneurs that are able to find a way to perform an entrepreneurial function within a larger business organisation. The identification of opportunities is also a factor that is mentioned when explaining entrepreneurship, and this can also be used as an approach to entrepreneurship.

2.3.2.3.   *Opportunity identification approach*

Phelan (2014) mentions that opportunity is a frequently mentioned aspect in entrepreneur and entrepreneurship research (citing Kirzner, 1985; Stevenson, Roberts & Grousbeck, 1989; Bygrave & Hofer, 1991; Kaish & Gilad, 1991, Mitchell *et al.*, 2002; Sánchez *et al.*, 2011). Phelan (2014) refers to the two entrepreneurial theorists who are frequently cited in terms of entrepreneurial opportunities; Schumpeter (1928; 1934; 1954) and Kirzner (1978; 1983; 1985). These two theorists differ in describing the way in which opportunities arise.

- Schumpeterian and Kirznerian opportunities

The Schumpeterian (1934) theory suggest that opportunities arise through the introduction of new combinations of existing resources, while the Kirznerian (1978) theory proposes that opportunities arise through identifying gaps in the market and using existing market information to take advantage of the gaps (Phelan, 2014). The main difference between the two theorists is whether entrepreneurial opportunities involve new information in the identification of opportunities. Schumpeter (1934) argued that new information is very important and that changes in the areas of technology, politics, regulation, social trends and macro-economic factors provide new information that can be used by entrepreneurs to combine resources and create new value (Phelan, 2014). This may certainly apply in the agricultural sector, which is known for being an ever-changing environment where the farmers have to make constant adjustments to remain efficient in their production activities, which consist of the utilisation of natural and other resources. Kirzner's (1983) theory of opportunity focuses on optimising and making the existing market more effective (Phelan, 2014), which can also be applied in the agricultural sector. Farmers have the tendency to produce as much as possible from their limited resources.

- Human Capital and opportunity identification in entrepreneurship

The opportunity identification approach of entrepreneurship focuses on the individual's ability to exploit opportunities (Phelan, 2014). Identification and pursuit is an important process that needs to be considered in agriculture. This

process enables the farmer to effectively respond to changes in the policy environment, markets, competition, technology, social demand and sustainability (Lans, van Galen, Verstegen, Biemans & Mulder, 2014). A range of individual characteristics, psychological and non-psychological, influences the ability of an entrepreneur (Phelan, 2014). Many of the non-psychological factors are related to human capital, where the idea is that an experienced entrepreneur will do a better job than an inexperienced or less experienced entrepreneur (Shane, 2003a cited by Phelan, 2014). The general belief is that experience emerges from the information and skills of the individual and the individual's level of education (Phelan, 2014). Phelan (2014) further mentions (citing Schultz, 1980; Hébert & Link, 1989; Audretsch, 2003; Shane, 2003a) that education level is generally seen to increase the likelihood of the individual exploiting an identified opportunity.

The literature indicates concerns about what the desirable psychological factors for entrepreneurship are. Traits and personality have been linked and discussed in terms of entrepreneurship, but both of these aspects, especially the traits approach, have received criticism regarding the explanation of entrepreneurial behaviour and performance (Shane, 2003a cited by Phelan, 2014). Entrepreneurship is an important factor, and there is a need to understand the role of entrepreneurship in developing human and intellectual capital (Zahra & Dess, 2001).

Human capital includes individual characteristics such as education, economic education, experience, skill and other qualities of management. These characteristics do have a positive influence on the performance of an organisation (Han & Lin, 2008). Individuals who have higher qualities of human capital have the ability to better recognise profitable opportunities in the economy (Davidsson & Honig, 2003). Several researchers have found a positive relationship between human capital characteristics of an entrepreneur and firm performance (e.g. Skuras *et al.*, 2005; Colombo & Grillo, 2005; Ucbasaran *et al.*, 2008; Lans, 2009; Onphanhdala & Suruga, 2010; Unger, Rauch, Frese & Rosenbusch, 2011; Kungwansupaphan & Siengthai, 2014).

Cooper and Gascon (1992), as mentioned by Man .*et al.*, (2002), found that there are inconsistencies in the literature on the relationship between an entrepreneur's age and performance. Man *et al.,* (2002) explains that an entrepreneur can become more competent (Brockhaus & Horwitz, 1986; Cooper, Dunkelber & Woo, 1988), but become less entrepreneurial, at an older age (Begley & Boyd, 1985; Cragg & King, 1988). An older operator may have the advantage of experience over younger operators, but the older operator might also be more hesitant to adopt new innovative management practices (Haden & Johnson, 1989). The age of a farmer, however, is not necessarily a constraint that determines the success of the agricultural entrepreneur. Older, uneducated farmers can still be as successful agricultural entrepreneurs as any other farmer, as long as they are well informed about their farming activities (Singh, 2013).

One of the criticisms of the entrepreneurial human-capital approach is raised by Lans, van Galen, Verstegen, Biemans and Mulder (2010), noting the fact that human capital is normally operationalised in terms of the number of years of experience and type of education (see also Lans *et al.*, 2014). With this approach, entrepreneurial behaviour and activities are only superficially addressed, and provide little detail about the complex relationship and synergy between human capital and performance (Baum, Locke & Smith, 2001; Rauch, Frese & Utsch, 2005; Lans, 2009). The human factor is supported by Stoner (1987), in that the key distinctive competence of small firms is constituted by the experience, knowledge and skills of the owners and workers (Man *et al.,* 2002). The concept of competence, mentioned by Lans (2009) can be seen as a third conceptual strand for researching the entrepreneurial human capital in small firms (Man *et al.,* 2002). The competency approach objective is to identify long-lasting individual characteristics that lead to success or performance in a job or organisation (Thomas & Herrisier, 1991 cited by Man, 2001). Characteristics that lead to competence of an individual include motive, traits, self-image, skill and a body of knowledge (Boyatzis, 1982). Entrepreneurial competencies are discussed in the following section.

2.3.2.4.   *Skills and competencies frameworks for measuring entrepreneurship*

There are a variety of skills that are required to ensure business success, whether that business be in the start-up, growing or declining phase. Competencies can be observed through the behaviour of an entrepreneurial individual (Bird, 1995), and therefore, when observing and measuring an entrepreneur exhibiting a certain kind of behaviour, it can be claimed that the individual possesses certain competencies (Man & Lau, 2005). The following section explores the skills and competencies that are associated with entrepreneurship and how these differ from managerial skills and competencies in certain cases.

- Entrepreneurial competencies

The competencies approach has developed over recent years into an increasingly popular method (Man *et al.*, 2002) for measuring entrepreneurial characteristics. Entrepreneurial competencies have been identified as constituting an important factor that can influence business growth and success (Mitchelmore & Rowley, 2010). Competencies are the characteristics of individuals that include the motives, traits, aspects of self-image or social roles, skills or a body of knowledge that lead to effective and/or superior job performance (Man, 2001). Competencies can assist with the 'central question in entrepreneurship' as to why certain entrepreneurs are more successful than others (Omrane and Fayolle 2011 cited by (Phelan, 2014). The competencies approach focuses on the individual level changes that aim at organisational-level outcomes (Man, 2001). Entrepreneurial competencies literature can be observed in two separate strands, according to Lans *et al.* (2010). The first strand seeks to identify the specific entrepreneurial competencies that are required, and the second is more concerned with how entrepreneurs assess their own competencies and the influence of the competencies on performance (Phelan, 2014).

Competence is the ability of an individual to apply knowledge, skills and attitudes within a specific context (Mulder *et al.,* 2009). Lans (2009) explains that entrepreneurial competence in agriculture refers to exploring new

pathways to be innovative, grow and diversify the business. Competence also refers to the ability of the farm owners or managers to identify and take advantage of these opportunities. The competency approach was proposed by the research of Boyatzis (1982), where competencies are defined as the underlying characteristics that are related to the effective and/or superior performance of an individual in a job (Man, 2001).

One question that has persisted in the relevant literature is the competencies of entrepreneurship and several authors provide explanations of what entrepreneurial competencies are and consist of. Man *et al.* (2002) explain entrepreneurial competencies as: "a higher-level characteristic encompassing personality traits, skills and knowledge, and therefore can be seen as the total ability of the entrepreneur to perform a job role successfully". Lans, Biemans, Mulder & Verstegen (2010) explain that "entrepreneurial competence refers to new pathways of achieving innovation-related business targets on the one hand and the set of knowledge, skills and attitudes of the owner-manager to identify and pursue these opportunities on the other hand". According to Lans *et al.* (2014), entrepreneurial competence therefore refers to the activities of identifying customers' needs, scanning the environment, formulating strategies, bringing together networks, taking initiatives, introducing diversity and collaboration (Chandler & Jansen, 1992; Bird, 1995; Man *et al.,* 2002; Gibb, 2002; Sadler-Smith, Hampson, Chaston & Badger, 2003; Dyer, Gregersen & Christensen, 2008).

Entrepreneurial competencies can also be understood in terms of traits, skills and knowledge (Lau, Chan & Man, 1999). Interest in how these skills are applied in different contexts has grown (Mitchelmore & Rowley, 2010), as most researchers recognise the differences in entrepreneurial competencies. Research therefore endeavours to differentiate the entrepreneurial competencies that are needed to start a new venture from the competencies necessary to manage the growth of a business (Chandler & Jansen, 1992; Chandler & Hanks, 1994a, 1994b; Man *et al.*, 2002 cited by Mitchelmore & Rowley, 2010). A relationship exists between entrepreneurial competencies and firm performance, where

research has found that competencies are correlated to venture performance (Mitchelmore & Rowley, 2010). Venture growth has also been identified in research as an indicator of the success of the venture (Low & MacMillan, 1988). Research indicates that the skills of an entrepreneur are a contributing factor to performance and growth (Bird, 1995; Cooper, *et al.,* 1994; Lerner & Almor, 2002) and competencies can also be considered as important in all the life stages of a venture (Churchill & Lewis, 1983) (Mitchelmore & Rowley, 2010). Entrepreneurial competencies do have an influence on performance, and consequently, an instrument is needed to measure these entrepreneurial competencies.

- Measuring entrepreneurial competencies

Man (2001) mentions that measures that were used to measure entrepreneurial competencies at that time were limited and that more research was necessary to develop a unifying set of instruments that could be used to measure entrepreneurial competencies from a behavioural perspective. In further research, Man (2001) developed an instrument to measure entrepreneurial competencies that is based on the behaviour of an entrepreneur. The instrument was developed by modifying existing instruments which were used to measure entrepreneurial and managerial competencies. The instrument can be seen as a multipurpose tool, as it can be used to determine entrepreneurial competencies in relation to firm performance, and to identify the strength of different entrepreneurial competencies in distinctive dimensions for current and potential entrepreneurs. As these competencies can be improved, identifying the strength of certain entrepreneurial competencies is an important aspect for further development of the entrepreneur. The following section provides a background to the framework, the competencies and the further development of the framework.

Man (2001) and Man, Lau and Chan (2002) entrepreneurial competencies framework

The framework of Man *et al.* (2002) was developed to provide a solution to the problem that existed when measuring the relationship between entrepreneurial

characteristics and the performance of a business. The framework was developed as a theoretical framework that made use of the concept of competitiveness of SME and the entrepreneurial competency approach where the focus is on the role of the entrepreneur in determining the performance of the firm (Man, Lau & Snape, 2008). Competitiveness should be considered as a multidimensional concept. It is important to note that Man *et al.* (2002) conceptualise competitiveness in three dimensions, as suggested by Buckley, Pass and Prescott (1988), namely potential, process and performance. The study distinguishes between three aspects: internal firm aspects, external environment and the influence of the entrepreneur, which all have an influence on the competitiveness of SMEs. Competitiveness is only a means to an end, which is the performance of the firm (Man *et al.,* 2002).

A certain relationship exists between these characteristics and the dimensions of competitiveness. By using the competencies approach, the influence of the entrepreneur addresses the process dimension of the Man *et al.* (2002) competitiveness framework. One of the advantages is that the approach, according to Man *et al.* (2002), provides a method to investigate the entrepreneurial characteristics that have an influence on organisational performance. The conceptual model of Man *et al.* (2002) is shown in Figure 2.3 below. Figure 2.3 shows how the different dimensions (entrepreneurial competencies, competitive scope, organisational capabilities and firm performance) have an influence on the competitiveness and, ultimately, the performance of the firm.
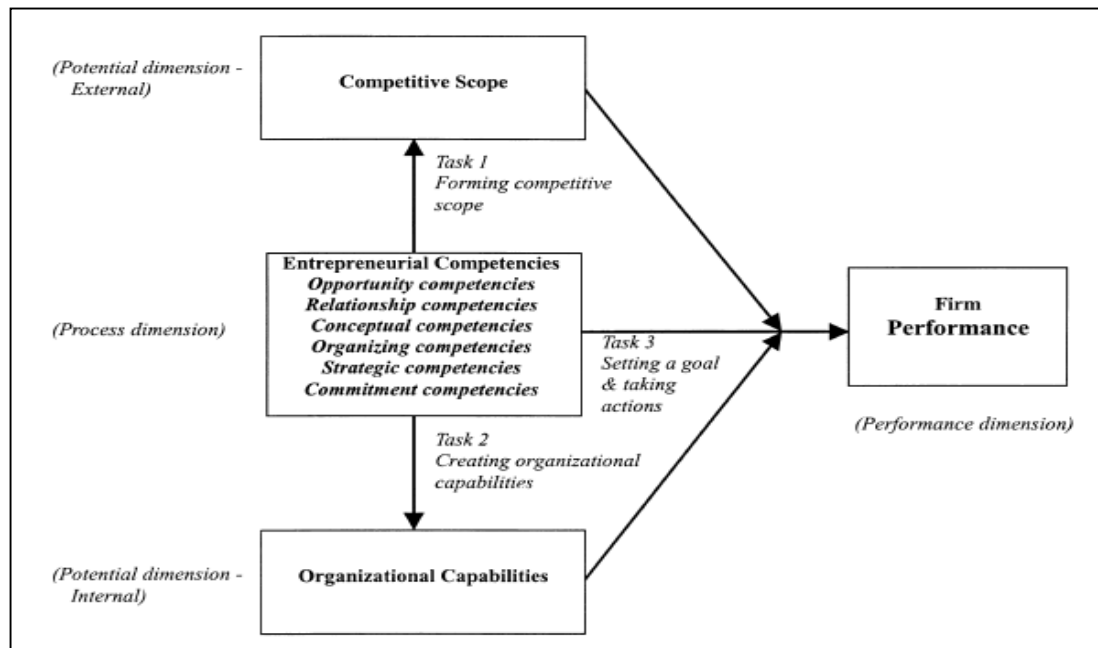
Figure 2.3: Model of SME competitiveness representing the dimensions of SME competitiveness
Source: Man (2001); Man *et al.*(2002)

The framework emphasises the central role of the entrepreneur in terms of the entrepreneurial competencies in entrepreneurial tasks that influence the financial performance of the business (Man *et al.,* 2002). As shown in Figure 2.3, the entrepreneur must have certain competencies in order to manage and take actions in the external and internal environments to ensure the success and performance of the firm. Man (2001) and Man *et al.* (2002) identified ten areas of entrepreneurial competencies that have direct or indirect impacts on the performance of SME (Mitchelmore & Rowley, 2010). These competencies are: opportunity-; relationship-; analytical-; innovative-; operational-; human-; strategic-; commitment-; learning-; and personal strength competencies. The original competencies and their descriptions are discussed and summarised by Man (2001), Man *et al.* (2002) and Lans (2009) and include: Opportunity-; Relationship-; Conceptual-; Organising-; Strategic-; and Commitment competencies.

Opportunity competencies

Opportunity competencies are related to the development and identification of opportunities (Shane & Venkataraman, 2000; Man *et al.,* 2002). Lans (2009) explains that a real entrepreneurial opportunity can manifest itself in many

forms, such as an ill-defined market need, a technology or innovation for an undefined market, or an idea or service (Ardichvili, Cardozo & Ray, 2003). Chandler and Jansen (1992) mention the individual's ability to search and assess opportunity strategies, or entrepreneurial alertness. Lans *et al.* (2014) see opportunity competence as more than just opportunity recognition. The competency involves the process where solutions are developed to solve specific problems. Man (2001) also presented a more passive form of opportunity competence by referring to entrepreneurial alertness. Entrepreneurial alertness is the ability of the individual to notice without searching (Gaglio & Katz, 2001). The opportunity competencies consist of entrepreneurial activities such as identifying opportunities, actively looking for new opportunities, and developing opportunities (Man, 2001).

Conceptual competencies

The domain is linked to abilities of the individual to solve problems by separating facts from opinions and being able to see the big picture (Man *et al.,* 2002). Lans, Verstegen and Mulder (2011) mention that conceptual competencies have a strong link with the opportunity domain. The competencies category includes the ability of cognitive and critical thinking, learning, decision-making and problem solving, sustaining temporal tension, innovating and coping with risk and uncertainty (McClelland, 1987; Mitton, 1989; Baum, 1994; Bird, 1995; Man, 2001). The reason for the link is that the focus is on the systematic development of adequate solutions to problems as Lans *et al.* (2011) explain that it emphasises a more structured view of opportunities, whereby observation, interpretation and conceptualising is at the centre of opportunity identification. Different underlying competencies that can be associated include the ability to identify and analyse a problem, connect and arrange ideas, and match the new ideas with the existing knowledge and capabilities (Mitchell, Smith, Seawright & Morse*,* 2000; Detienne & Chandler, 2004; Baron & Ensley, 2006 see Lans, 2009).

Relationship competencies

Relationship competencies refer to the social interactions with other persons (Man *et al.,* 2002; Baron & Markman, 2003; Baron & Tang, 2009; Lans *et al.,*

2011). The interactions can occur between individuals, individuals and groups, and even between groups. Networks have an important role in the development of new ideas when identifying and exploiting opportunities (Elfring & Hulsink, 2003). Research has shown that some personal characteristics of entrepreneurs do have an influence on the success of the entrepreneurs. These characteristics include self-efficacy, as found by Chen *et al.* (1998), and also the overall proclivity for entrepreneurship (Stewart, Watson, Carland & Carland, 1999).

Organising competencies

When new products, services and processes are introduced in the market, several different internal, external, human, physical, financial and technological resources have to be managed and organised (Lans *et al.,* 2011). This involves several lower-level functional tasks and sub-tasks that are very close to those involved in managing a small firm, in terms of managerial tasks and primary and secondary activities. Man (2001) views this domain at the more general level that surrounds operational competencies, which include planning and organising non-human resources (Lans, 2009). Not only do non-human resources have to be managed, but also human resources. Leadership and delegation skills are therefore also very important, as confirmed by Chandler and Jansen (1992) and

Strategic competencies

The entrepreneur as owner or manager of a firm has to set the direction for the business (Man, 2001). This indicates that the entrepreneur is required to have a vision for the business (Mitton, 1989; Durkan, Harrison, Lindsay & Thompson, 1993; Snell & Lau, 1994). The vision will include factors such as the goals that must be achieved (Snell & Lau, 1994) and the formulation and implementation of strategies. The long-term feasibility of a firm is very important, and the strategic competencies are related to securing the long-term performance of the firm. One important part of strategic competencies is planning for short- and long-term activities (Nuthall, 2006). All competencies that are related to the setting, evaluation and implementation of strategies are thus associated in the category.

Commitment competencies

Lans *et al.* (2014) refer to entrepreneurial self-efficacy, while Man *et al.* (2002) refer to commitment competencies; but the explanations are quite similar. The element is a broad domain of meta-level competencies (Lans *et al.,* 2014). Lans *et al.,* (2014) explain that on an individual level, these influence other competencies positively (Le Deist & Winterton, 2005) rather than being a mere element of the other competencies (Markman, 2007). Successful entrepreneurs can be characterised as people with a restless attitude in their working environment, which is an indication of proactive commitment, determination and dedication in their duties and responsibilities (Man, 2001). In the opinion of Lans *et al.* (2011), commitment has a volition connotation as well as a moral connotation. The volition connotation is linked to motivational aspects including self-perseverance and self-efficacy. Self-efficacy is a very strong indicator for entrepreneurial success (Rauch & Frese, 2007) as it is an expression of belief in an individual's own competence.

Man (2001) followed certain criteria in selecting and developing suitable instruments. The first was that more concise instruments are preferred over specific ones; secondly, instruments with higher reliability or wider commercial applications are preferred over ones that are not; and lastly, ones that required the least amount of modification are preferred over ones that required greater modification. The instruments must also focus on behavioural aspects.

The instrument that is used to measure the competencies of the framework developed by Man (2001) consists of a total of 53 statements in the form of a survey instrument. Man (2001) developed the survey instrument by combining existing instruments from Chandler and Jansen (1992); Roemer (1996); Evers and Rush (1996); Quinn, Faerman, Thompson and McGrath (1990); and from own qualitative analysis. The competencies are measured with the use of a 7-point Likert scale in terms of how the individual agrees with each statement in terms of his or her abilities as owner of the farming business.

2.4.   Conclusion

Research has proved that statistical methods can be used to effectively determine the repayment ability of applications, and also to ensure that the regulations and laws, and even the aspect of consistency, are adhered to. The process in the South African agricultural sector does rely on the human judgement technique, which is known for high training costs and inconsistency, the inconsistency factor especially can have an influence on the agricultural credit process because of the dynamic nature of the sector. The consequent errors do have certain cost implications for financial organisations. Higher costs can be associated with accepting high-risk loans, which can be higher than those incurred in rejecting low-risk loans. It is, therefore, to the advantage of financial organisations to ensure that high-risk loans are correctly classified, which can in turn assist in minimising the risk exposure of the organisations. The concept of Neural Networks was found by several researchers to have the best ability to predict the classification of high-risk loans as bad or rejectable loans, and therefore the method will be used for the purpose of this research.

Indications are that improvement in credit decisions is more likely to come from including new and/or more predictive characteristics/variables. Several characteristics or variables are used to determine the repayment ability of a specific applicant. However, the entrepreneurial ability or competencies of a farmer have thus far been ignored in credit applications, even though research has proved that entrepreneurial competencies do have an influence on the financial performance of SMEs. As entrepreneurial competencies influence the financial performance of business, especially small and medium enterprises, it can be expected that farmers with higher or better entrepreneurial competencies will have improved abilities to ensure the repayment of their loans. Improved financial performance can be linked with better loan repayment ability, as the financial resources are available.

Entrepreneurship is not a precise concept, although the definition of Stevenson and Jarrillo-Mossi (1986) captures the core of entrepreneurship as being the

"process of creating value by combining resources in a unique manner to exploit opportunities". Farmers have to become more entrepreneurial in their farming business to ensure the sustainability of their farm businesses. The farmers are responsible for most, or even all, of the activities in their farming businesses and this requires that the farmers possess several entrepreneurial competencies. Entrepreneurial competencies are considered as being high-level characteristics of an individual, including traits, skills and knowledge that are needed to ensure that a task is successfully completed (Man *et al.*, 2002).

Entrepreneurial competencies in the South African agricultural sector have not received much attention, and the competencies of farmers in South Africa are still unknown. Entrepreneurial competencies have thus far featured in credit models, where these competencies can provide valuable information on the abilities of the applicants. Methods are available to measure entrepreneurial competencies. One of the methods that are available is an instrument developed by Man (2001), which provides tools to measure the entrepreneurial and managerial competencies of individuals. The instrument can therefore be used to explore the competencies of farmers, and provide a method that can be used to determine a basis of comparison between farmers.

Chapter 3
Determinants of farm repayment ability

Henning, J.I.F. and Jordaan, H. (2015). Investigating factors considered in agricultural credit applications, what are currently considered by commercial bank? In *Proceedings I, Healthy Agriculture for a Healthy World.* 20th International Farm Management Congress, Quebec City, Canada. 12 – 17 July, 2015; H. Watson, M. Lipari, S. Gendron, M-C, Bouchard, S, Couture, N. Nadeau.

Henning, J.I.F.and Jordaan, H. (2016). Determinants of Financial Sustainability for Farm Credit Applications—A Delphi Study. *Sustainability* 8, 1: 77.

3.1. Introduction

The aim of Chapter 3 is to explore current credit assessment processes to understand the factors and characteristics that are used to assess credit applications, and to identify other factors and characteristics that could improve the degree of accuracy with which repayment ability is predicted. In Chapter 2 literature indicated that improvements in credit decisions are likely to come from including new and/or more predictive characteristics/variables. The chapter comprises of methods and data used, results, conclusions and recommendations.

3.2. Method and data used

3.2.1. Method

The Delphi technique, developed by Dakey and Helmer (1963) is a widely used technique for achieving convergence on real world opinions from experts within specific topic areas (Hsu and Sandford, 2007). Delphi technique is distinguished from other group decision-making processes by four features; anonymity; iteration with controlled feedback; statistical group responses; and expert input (Goodman, 1987). The technique can be used to obtain the opinions of different experts without the necessity of bringing the experts together, requiring less of their valuable time to participate in the research (Wilson, Averis & Walsh, 2003).

The Delphi technique was used to determine the level of consensus among individuals, from different regions of South Africa, involved in determining the repayment ability of loan applicants. Delbecq, van de Ven and Gustafson (1975) indicate that the Delphi technique can explore or expose the underlying assumptions or information leading to differences in judgement, or can seek out information that may generate consensus among individuals in a respondent group. The Delphi technique (Dalkey & Helmer, 1963) is widely used for purposes of achieving convergence on real world opinions from experts within specific topic areas (Hsu & Sandford, 2007), through a series of questionnaires used to collect data from a selected panel in view of achieving consensus (Dalkey

& Helmer, 1963; Dalkey, 1969; Linstone & Turoff, 1975; Lindeman, 1981; Martino, 1983; Young & Jamieson, 2001). The Delphi technique does not make use of a representative random sample of a target population, but rather makes use of a panel of experts; an expert being an individual who is considered to be an expert in the relevant research area (Keeney, Hasson & McKenna, 2001). The Delphi process starts with an initial questionnaire that acts as an idea-generating strategy to uncover the issues related to the specific topic or to identify several broad aspects that are related to the specific topic in question. The relevant question for the research is to identify the factors considered and new factors that need to be considered in credit applications. Responses from the initial questionnaire must provide as many relevant issues as possible, as these issues are the foundation for the continuation of the process (Keeney *et al.,* 2001), where the identified aspects are used for further refinement that could lead to consensus on what the important factors are, and which need to be considered. The complete process can thus extend into several iterations, where the previous iteration forms the foundation for the next. Iterations are important in the process to reach consensus between the respondents on what the factors are and which should be used to determine the repayment ability of applicants.

These multiple iterations develop into a consensus on the different opinions concerning the topic in question (Hsu & Sandford, 2007). Every feedback process provides an opportunity for each of the participants to reassess his or her initial opinion in relation to the responses of the other respondents (Hsu & Sandford, 2007), who remain anonymous during the entire process (Dalkey, 1972; Ludlow, 1975; Douglas, 1983). The feedback process consists of a summary of the previous iteration's answers and forms part of a new questionnaire. The number of rounds depends on, amongst other things, the time available and whether only a single broad question needs to be answered, or whether several questions require responses (Keeney *et al.*, 2001). In some instances where the Delphi technique has been used, two or three rounds have proven to be sufficient to reach consensus (Beech, 1997; Gibson, 1998; Green, Jones, Hughes & Williams, 1999).

3.2.1.1.   Level of consensus

The level of consensus reached after each round determines the need for another round in the research process. Different methods exist to determine the level of consensus amongst different opinions, as well as the level of agreement among respondents, the coefficient of variations, the interquartile range and standard deviation. Loughlin and Moore (1979) found that consensus could be achieved with 51 % agreement amongst respondents, while Seagle and Iverson (2002) found consensus at 60 % for a specific score on a five-point Likert scale. Putman, Spiegel and Bruininks (1995) found consensus reached with 80 % agreement falling within two measures of a five-point Likert scale.

The coefficient of variation is a method used to measure the spread of opinions. Coefficient of variation has been used in several Delphi studies to measure consensus, as it allows for the direct comparison of succeeding rounds. An indication of consensus is that the coefficient of variation decreases from one round to the next (Buck, Gross, Hakim & Weinblatt, 1993; von der Gracht, 2012). A coefficient of variation of less than 0.5 indicates a reasonable internal agreement (Zinn, Zalokowski & Hunter, 2001). The level of consensus as determined by the coefficient of variation is shown Table 3.1.

Table 3.1: Coefficient of variation cut-off points and decision rules

Coefficient of variation	Decision rule
$0 \leq V \leq 0.5$	Good degree of consensus, no additional round
$0.5 < V \leq 0.8$	Less than satisfactory consensus, possible need for another round
$0.8 \leq V$	Poor degree of consensus, need for additional round

Source: English and Kernan (1976)

The interquartile range (IQR) is a measure of dispersion for the median, consisting of the middle 50 % of observations (Sekaran, 2003). IQR is a method that is frequently used in Delphi studies, as it is an objective and rigorous means

of determining consensus among respondents (von der Gracht, 2012). The rule of thumb is that for a five-point Likert scale, an IQR of one or less is a suitable indication of consensus.

Standard deviation (SD) is a measurement used to assess the variation in a population. In a normal distribution, 68 % of scores will fall within one SD above and below the mean (Grobbelaar, 2006). Standard deviation is an indication of stability on consensus and convergence on the agreement between the rounds (Wilson *et al.*, 2003). The lower the Standard deviation, the higher the level of agreement between the respondents (Wilson *et al.*, 2003), which are the purpose of the exercise. For purposes of this exercise, the level of consensus indicated by Grobbelaar (2006) was used as a guideline on which to base decisions of consensus in terms of SD, as shown in Table 3.2.

Table 3.2: Decision criteria used in determining level of consensus achieved according to standard deviation

Standard deviation	Level of consensus achieved
$0 \leq x \leq 1$	High level
$1.01 \leq x \leq 1.49$	Reasonable/fair level
$1.5 \leq x \leq 2$	Low level
$2 \leq x$	No consensus

Source: Grobbelaar (2006)

3.2.2.   Data used

The data used to explore the characteristics was obtained through a formal agreement with a commercial financial organisation of South Africa, who was willing to participate and share information and other resources. The Delphi was conducted between November 2014 and April 2015, with the participants being nine credit analysts and managers from a commercial financial organisation in South Africa. The respondents, who were identified by a representative of the financial organisation, were all involved in the decision-making process relating to the granting of credit in the agricultural sector, including applications by farmers. The questionnaires were sent to the aforementioned financial

organisation's representatives by electronic mail and subsequently distributed to the respondents. The resulting feedback was sent to either the representative or the main researcher.

Information was also obtained by reviewing actual credit application documents, which provided a more detailed description of the factors mentioned in the Delphi. This also served to identify additional factors not mentioned in the answers from round one of the Delphi study. The additional characteristics mentioned by respondents were compared with the literature and were included in round two.

3.3. Application of the Delphi study

3.3.1. Round one

To ensure that the questions did not elicit biased responses from the experts (Linstone & Turoff, 1975), two open-ended questions were used in the questionnaire, as shown in Appendix A. The first question determined which factors and characteristics in an application were used to judge the applicant's repayment ability:

> Question 1: *What are the personal characteristics and aspects of a farmer that is considered as important for assisting in credit applications? Which capabilities of a farmer are considered when writing the credit report that forms part of the credit application process?*

The second question identified factors or characteristics that were not currently considered in credit applications, as well as any other areas of the credit application process that could be improved.

> Question 2: *In your opinion, are there any additional characteristics or factors, which influence repayment ability that are not considered?*

An important note is that, while some of the characteristics are included in the application, they are not based on objective measurements, but rather on personal experience and knowledge of the applicant by his or her personal banker (Anonymous 1, 2014).

3.3.1.1. *Factors that were currently considered (Question 1)*

Prominent factors mentioned by at least three of the respondents included management capability (100 %); sustainability of the enterprise (86 %); past and current financial performance (86 %); account standings and credit record (86 %); experience (57 %); reputation (57 %); collateral (43 %); client success factor compared with competitors (43 %); education/qualifications (43 %); willingness to repay (43 %); and farm ownership (30 %). Less important factors included succession planning, bounce-back ability, labour force, strategic position of business, business-model type of farming enterprise, external market and market projections, and the business environment.

In most cases, these factors rely on the abilities of one person, as most farms are traditional family farms and the personal characteristics and abilities of the farmer are also considered in the application. This is reflected in a response by Respondent 2, "*most of the farming businesses are family owned with the father playing an important role and is normally the main decision maker*". With regard to the individual and management capabilities of the applicant, the following were mentioned: reputation (57 %); integrity (43 %); abilities (43 %); honesty (30 %); and reliability (30 %). Other factors that are also mentioned by fewer than three respondents were: innovation, risk behaviour; leadership; entrepreneurship; open mindedness; perseverance and business awareness. Abilities were mentioned as one factor and were also divided into more specific categories. These categories included: financial (71 %), technical (43 %), marketing (43 %), general business and human relations abilities. These factors indicate that the financial performance of the business is very important. Apart from the performance of the farm, several personal aspects of the farmer are also considered. Farms are in most cases family businesses, where one person is in charge of the operations, management and other day-to-day activities of the farm.

These abilities are also considered in the review process of the application, but as mentioned earlier, are reported on through the application of subjective measures and reporting.

Additional information obtained from reviewing applications included age and experience of operator, the importance of the debt ratio and profitability of the business, market projections and information, and the influence of the client's financial position compared with the risk taken on by the lender. Characteristics such as age and experience are inherent aspects and are beyond the control of the farmer. Farmers are expected to learn more in their early lifecycle periods of farming and to become more efficient as they age (Tauer & Lordkipanidze, 2000). As expected, experience comes with age, where age is a non-psychological factor that influences the decisions to exploit opportunities (Phelan, 2014). The age of the farmer has an influence on decision-making, and can be one of the reasons why it is included in the application. Decisions are made with different goals in mind and at different levels of farmers' respective lifecycles, and these decisions influence the ultimate farm performance. Factors such as experience are, however, not something that can be taught, learned or adjusted in a short period of time, and this implies that younger, inexperienced farmers are at a disadvantage.

The respondents emphasised the management capabilities of the farmer. Management capabilities of the farmer are also related to financial performance of the farm, because decisions influence the daily activities and sustainable financial performance of the farming business. Importantly, some of the characteristics reported in the application are not based on any objective measurements. The personal banker bases judgement on personal experience and knowledge of the applicant.

Thus, similar to the findings in the literature (Gustafson, 1989; Wilson, Featherstone, Kastens & Jones, 2006; Featherstone, Wilson, Kastens & Jones 2007), credit evaluations in South Africa prove to relate to the 5 Cs (capacity, capital, collateral, conditions, and character) of credit. The results thus confirm

the importance of the 5 Cs of credit, and stress that these are also applicable to the agricultural sector in South Africa.

3.3.1.2. Additional factors indicated by respondents (Question 2)

Most of the responses to factors that are not measured or are problematic were related to financial aspects such as cash flow problems. For example, Respondent 1 mentioned: "*Stress testing of income, expenditures, yields and prices*" and "*To what extent is farmer able to absorb any deviations or losses*". With regard to the absorption of deviations, Respondent 4 mentioned "*Comparing projected performance with historically achieved performance, i.e. can the projections be believed?*" where the accuracy of historical and projected cash flow is questioned. As agriculture is an unpredictable industry with several external factors playing an important role in daily activities (i.e., the weather), turnaround strategies are also considered to be very important and thereby connected to the implementation of the turnaround strategy after a disaster. Other factors considered as being important are related to market and economic conditions. Respondent 4 mentioned "*Severe interest rate hikes, severe adverse movement in energy cost* (considered in a sensitivity analysis, which can also be related to cash flow).

Given the importance of the management capabilities of the farmer, Respondent 3 mentioned the following: "*Management Capability: The farmer's reputation, ability and willingness to repay the debt are assessed. This includes his/her integrity, honesty and reliability. His background is assessed, his qualifications or experience, as well as his track record as a farmer. This aspect is considered the most imperative, but yet the most difficult to assess".* Respondent 5 mentioned similar factors, but importantly also mentioned factors that are not measured in the current system. The respondent's response (translated from Afrikaans):

"*Additional skills that are not currently really being measured, but will have a great influence on the ability to pay back:*

- *Honesty – in business transactions and general behaviour,*

- *To what extent does the farmer accept responsibility for his actions,*

- *How adaptable is the farmer. How easily can the farmer make a different plan when the first plan does not work?*

- *How does the farmer respond to difficult situations? Is the farmer the kind that will work and work on new plans, or just give in and fade away?*

- *Is this farmer optimistic by nature? Does the farmer have a positive outlook on life? An optimistic person will make use of opportunities that come his way."*

Interestingly, these factors relate to psychological capital (Luthans *et al.*, 2007) and entrepreneurial skills when the key concepts defining entrepreneurship are considered. Psychological capital relates to: (1) having confidence (self-efficacy) to take on and put in the necessary effort to succeed at challenging tasks; (2) making a positive attribution (optimism) about succeeding now and in the future; (3) persevering towards goals and, when necessary, redirecting paths to achieve goals in order to succeed (hope); and (4) when beset by problems and adversity, sustaining, bouncing back and even beyond to attain success (resilience). Entrepreneurial skills include seeing changes as opportunities, which can be related to opportunity seeking. Entrepreneurs are also able to see the big picture, as they know what they want to achieve and how to realise aims and objectives. When the first plan does not work, does the farmer have the ability to persist in overcoming the hurdles and obstacles? When faced with a difficult situation, pushing through is very important and a high level of self-determination or internal locus of control is needed and this is where the entrepreneurial farmers will respond with alternative ideas to ensure success. A high level of self-efficacy will also assist a person through difficult times, as the person will have a belief in his or her own abilities to perform tasks (Lambing and Kuehl, 2003: 29). As mentioned by Respondent 3, "*management capabilities of the farmer is most imperative, but difficult to assess".* An objective method for measuring these characteristics, skills and attributes is lacking and may be considered as a shortcoming in the current credit application assessment.

Additional characteristics identified by respondents and compared with the literature are illustrated in Table 3.3 below. Lambing and Kuehl (2003: 26) and

Baron and Shane (2005: 292) also emphasise the skills or associated factors listed in Table 3.3 as being important for a successful business.

Table 3.3: Characteristics and associated factors identified by respondents in Round One and from literature included in Round Two

Additional characteristics identified from Question two and literature	Associated factor
Ability to build a team and giving responsibility and credit when due	Leadership and human relations
Applying new ideas, for example, adjusting or refining an existing product; identifying new opportunities with a solution	Creativity and innovation
Believe that others or chance control destiny	External Locus of control
Believe to be in control of own destiny	Internal Locus of control
Belief in his or her own abilities	Self confidence
Belief in his or her own capability to perform tasks so as to be successful	Self-efficacy
Belief in the business, despite setbacks	Persistence
Deal with problems as they occur rather than anticipating before hand	Planning
Enjoy what he or she is doing in all activities	Passion
Good personal interactions and trust in people and giving recognition when deserved	Leadership
Having the ability to adjust to an ever-changing environment and to use the change to their advantage	Opportunity seeking
Having the ability to handle conflict between various stakeholders of the business	Managing conflict
Having the ability to take on calculated risk opportunities	Risk management
In control of situations, with good delegation skills	Locus of control
Internally driven by strong desires to compete and excel against self-imposed standards in order to pursue and attain goals	Need for achievement
Observing more opportunities than threats	Positivity
Observing more strengths than weaknesses	Positive attitude
Overcoming hurdles and obstacles	Tenacity
Planning ahead for possible problems that may be encountered	Planning
Pursuing business with a "go get it" attitude	Passion
Willingness to commit personal resources to the business	Commitment and Confidence

Many of these factors are skills that are and can be associated with entrepreneurial and managerial competencies. Research has shown that entrepreneurial and managerial competencies have an influence on the

competitiveness and financial performance of small and medium enterprise businesses. In the entrepreneurship context, competencies are related to the birth, survival and/or the growth of a venture (Bird, 1995; Baum *et al.*, 2001; Colombo & Grilli, 2005; Mitchelmore & Rowley, 2010). The skills of an entrepreneur are a contributing factor to performance and growth (Bird, 1995; Lerner & Almor, 2002). Furthermore, Chandler and Jansen (1992) mention that the development of entrepreneurial skills contributes to the profitability and growth of a firm. There are several factors that have been associated as being influential in the performance of firms, which include the entrepreneur's demographic, psychological and behavioural characteristics, and the individual's skills and technical know-how (Mitchelmore & Rowley, 2010). The skills that are illustrated in Table 3.3 above, are essential for running and managing of a successful business. The factors that are considered in determining the repayment ability of agricultural credit applicants have now been identified, and the next step was to determine the importance of the individual factors when considered in the applications.

3.3.2.   Round two

A second questionnaire (Appendix B) was developed, based on the first round responses. The second round tested the degree to which the respondents agreed on the findings of the first round, while reviewing the additional information and factors identified from the literature. The option to add additional information was also available to respondents if they felt information had been omitted. The questionnaire consisted of statements to which the respondents again answered according to a Likert scale of 1 – 5, in terms of how important the statements were in their credit process. A score of five indicated that the factor was very important, while a score of one indicated that it was of little importance. An important purpose of the second round was to determine the degree of consensus among the respondents' answers.

The results of the second round are shown in Table 3.4 below. There were high levels of consensus (SD ≤ 1) among the financial factors, including account standing, credit record, past and current performance, sustainability of the

enterprise, and willingness to repay. There were still, however, factors that did not reflect a high level of consensus. Of the factors that are currently considered in credit applications, only 2 of 15 had a reasonable level of consensus (1.01 ≤ SD ≤ 1.49). All the other factors had a high level of consensus.

The mode and medians of the factors with a high level of consensus are equal, suggesting that there is little or no room for improvement. There are, however, other factors that have a high level of consensus with mode and medians that are not equal. The difference between the mode and the median suggests that there is still room to improve the level of consensus among the respondents.

Table 3.4: Summary of results for the Delphi second round, illustrating the average, standard deviation, mode, median and consensus level for factors as mentioned by respondents

Measurement	Average	SD	Mode	Median	Consensus level
Question 1					
Account standing	4.25	0.71	4.0	4.0	High
Age	2.25	0.71	2.0	2.0	High
Client success factor compared to competitors	4.50	0.76	5.0	5.0	High
Collateral	3.75	0.89	4.0	4.0	High
Credit record	4.50	0.76	5.0	5.0	High
Education/qualifications	3.38	1.06	4.0	3.5	Reasonable
Experience	4.63	0.52	5.0	5.0	High
Farm ownership	3.88	0.83	4.0	4.0	High
Market information	4.00	0.93	3.0	4.0	High
Past and current financial performance	4.75	0.46	5.0	5.0	High
Product market projections	3.75	0.89	3.0	3.5	High
Reputation	4.13	0.83	4.0	4.0	High
Sustainability of the enterprise	4.63	0.74	5.0	5.0	High
Type of farming enterprise	3.25	1.16	3.0	3.0	Reasonable
Willingness to repay	5.00	0.00	5.0	5.0	High
Question 2					
Leadership and human relations	3.38	0.74	4.0	3.5	High

Creativity and innovation	4.13	0.83	5.0	4.0	High
External locus of control	2.50	1.31	2.0	2.5	Reasonable
Internal locus of control	3.88	1.13	5.0	4.0	Reasonable
Self-confidence	4.13	0.83	5.0	4.0	High
Self-efficacy	3.75	1.04	4.0	4.0	Reasonable
Persistence	3.88	1.25	4.0	4.0	Reasonable
Planning	2.75	0.46	3.0	3.0	High
Passion	3.63	0.74	4.0	4.0	High
Leadership	3.50	0.53	4.0	3.5	High
Opportunity seeking	4.25	0.71	4.0	4.0	High
Conflict management	3.88	0.99	4.0	4.0	High
Risk management	3.63	0.92	4.0	4.0	High
Locus of control	3.63	0.74	3.0	3.5	High
Need for achievement	4.13	0.83	4.0	4.0	High
Positivity	3.88	0.99	4.0	4.0	High
Positive attitude	3.57	0.79	4.0	4.0	High
Tenacity	3.63	0.74	4.0	4.0	High
Planning	4.13	1.13	5.0	4.5	Reasonable
Passion	3.63	1.41	5.0	4.0	Reasonable
Commitment and confidence	4.75	0.46	5.0	5.0	High

Source: Own calculations

Interestingly, certain factors that were not currently being measured fell within the reasonable consensus level (1.01 ≤ SD ≤ 1.49). Two of the statements related to the opposite ends of locus of control (external and internal), namely belief that others or chance control destiny, and belief in autonomous control of one's destiny, both of which fell within the reasonable consensus level (SD of 1.31 and 1.13, respectively). The second factor is related to self-efficacy (belief in one's own ability to perform tasks and to be successful) with an SD of 1.04. Belief in the business despite setbacks (persistence) is an important factor (average 3.88), with a reasonable consensus level (SD 1.25).

The consensus levels reported in Table 3.4 above suggest scope for improvement regarding the factors that can be used to predict farmers' repayment ability and to assess credit applications. To obtain a higher level of consensus, a third round

was used. The respondents in the second round provided no additional factors, and therefore the third round included the same factors as the second round.

3.3.3.   Round three (final round)

With the third round, the respondents received feedback in the questionnaire (Appendix C) from the second round, and had the opportunity to determine whether they still agreed with, or would like to adjust, their original answers. The feedback was given by means of the average scores and the mode for each of the factors and statements of questions one and two. The midpoint of the responses was categorised using the median score. It is normally expected that in each succeeding round, the range of responses from the panellists will decrease and the median will be closer to the score of the final answer [35]. Results for the third round are shown in Table 3.5 below.

Table 3.5: Summary of results for the Delphi third round, illustrating the average, standard deviation, mode, median and consensus level for factors as mentioned by respondents

Measurement	Average	SD	Mode	Median	Consensus level
Question 1					
Account standing	4.44	0.53	4.00	4.00	High
Age	2.22	0.44	2.00	2.00	High
Client success factor compared to competitors	4.00	0.71	4.00	4.00	High
Collateral	3.44	0.53	3.00	3.00	High
Credit record	4.67	0.71	5.00	5.00	High
Education/qualifications	3.44	0.73	4.00	4.00	High
Experience	4.56	0.73	5.00	5.00	High
Farm ownership	3.67	0.87	4.00	4.00	High
Market information	3.89	0.60	4.00	4.00	High
Past and current financial performance	5.00	0.00	5.00	5.00	High
Product market projections	4.00	0.71	4.00	4.00	High
Reputation	3.67	1.00	4.00	4.00	High

Sustainability of the enterprise	5.00	0.00	5.00	5.00	High
Type of farming enterprise	3.22	0.97	3.00	3.00	High
Willingness to repay	5.00	0.00	5.00	5.00	High
Question 2					
Leadership and human relations	3.22	0.83	4.00	3.00	High
Creativity and innovation	3.78	0.83	4.00	4.00	High
External locus of control	2.56	0.73	3.00	3.00	High
Internal locus of control	3.33	1.12	3.00	3.00	Reasonable
Self-confidence	3.78	0.67	4.00	4.00	High
Self-efficacy	3.67	0.50	4.00	4.00	High
Persistence	3.78	0.67	4.00	4.00	High
Planning	2.89	0.78	3.00	3.00	High
Passion	3.56	0.53	4.00	4.00	High
Leadership	3.44	0.53	3.00	3.00	High
Opportunity seeking	4.11	0.60	4.00	4.00	High
Conflict management	3.67	0.50	4.00	4.00	High
Risk management	3.78	0.67	4.00	4.00	High
Locus of control	3.44	0.53	3.00	3.00	High
Need for achievement	3.67	0.50	4.00	4.00	High
Positivity	3.56	0.53	4.00	4.00	High
Positive attitude	3.56	0.53	4.00	4.00	High
Tenacity	3.67	0.50	4.00	4.00	High
Planning	4.00	1.00	3.00	4.00	High
Passion	3.78	0.67	4.00	4.00	High
Commitment and confidence	4.44	0.73	5.00	5.00	High

Source: Own calculations

All the factors which were deemed reasonable in the second round, with the exception of internal locus of control, were changed to a high consensus level in the third round. Thus, the factors of question one all achieved a high level of consensus in the third round, indicating that the respondents agreed with the factors determining the repayment ability of farmers.

Table 3.5 above also shows that the reasonable consensus levels of external locus of control, self-efficacy, persistence, planning and passion, changed to high consensus levels. This means that only one factor still remained at a reasonable

level of consensus. An advantage is that as external locus of control is the opposite of internal locus of control, and with high consensus levels, the results are not difficult to interpret. The results in Table 3.5 therefore provide evidence that acceptable levels of consensus were reached after the completion of the third round.

The consensus of respondents indicates the factors which are to be considered as important, and do not provide difficulty in determining farmers' repayment ability in credit applications. The factor that was identified as the most important, with an average score of 4.44 and equal mode and median of 5, was commitment and confidence. From the original statement, this is a clear indication that a farmer must be willing to commit and have confidence in himself or herself and the opportune venture. The farmer must be willing to commit his or her own resources and time, to favourable predispose the financial organisation to provide finance.

Anticipation was also very important, as the ability of the farmer to plan ahead was indicated with an average score of 4. Further confirmation was that the inability to plan ahead and only to deal with problems as they occur, rather than anticipating beforehand, was found to be unimportant. It can therefore be concluded that the financial organisation would be more willing to provide finance to a farmer that anticipates problems beforehand and plans accordingly than to farmers who only deal with problems as they arise. The practice of only considering problems as they arise places farmers at a disadvantage, compared with a situation where problems are anticipated by the farmer and possible solutions are already in place or can be implemented in a short time frame.

Self-confidence, self-efficacy and internal locus of control were found to be important, with average scores of 3.78, 3.67 and 3.33, respectively. The modes and medians for these factors were all equal, with a score of 4. Farmers must, according to these scores, believe in their abilities, believe that they have the ability to perform tasks in the business, and also believe that their behaviour will have an influence on the destiny or ultimate performance of the business. These

factors ensure that the farmer will continue with the business, despite setbacks (average score of 3.78; equal mode and median of 4) and take advantage of opportunities that have been identified. Opportunity seeking, with an average score of 4.11, is also an indication of the ability of farmers to adjust to an ever-changing environment and to use the change to their advantage. The identification of opportunity can also be related to the positive attitude of the farmer. A more positive farmer will identify more opportunities than threats and will also concentrate on his or her business strengths instead of weaknesses. The positivity factor had an average score of 3.56 and an equal mode and median of 4. Applying new ideas, adjusting or refining an existing product, and identifying new market opportunities are related to creativity and innovation, which are also considered when determining the repayment ability of farmers. Creativity and innovation achieved an average score of 3.78 and equal mode and median of 4.

Taking advantage of opportunity involves strategic thinking, especially with regards to the consideration of risk that is associated with opportunity. Results from the third round indicated that the ability of the farmer to take calculated risks (average score of 3.78) is an important factor in determining the repayment ability in credit applications. Even though risk taking is associated with higher returns, not all risky ventures will lead to greater returns. As one of the objectives of financial organisations is to minimise their risk, the investment in high-risk ventures can have a negative influence on credit applications.

A business requires the owner and/or manager to take a leading role to ensure that the required processes are in place. Whether the farming business is a family business that only involves family members in their daily activities, or when permanent or casual labour is used, the relation between the farmer and the other members is very important. Leadership and human relations were found to be an important aspect, but as can be expected, conflict also exists in teamwork. Teamwork involves having trust in the abilities of others, the ability to divide work confidently and give the necessary recognition. The ability to handle conflict is therefore also very important. These aspects are related to

networking. It is not always necessary to build a team, as vital information can also be obtained by communicating with others. The management of conflict had an average score of 3.67, and equal mode and median of 4. Leadership and human relations had an average score of 3.22, but the difference in the mode and the median indicate differences of opinions from the respondents.

The results indicated that the entrepreneurial and management abilities of a farmer are very important and need to be considered by means of an objective and consistent method in credit applications. Man *et al*. (2002) identified six areas of entrepreneurial competencies from literature for small and medium enterprises, and also for businesses managed by an individual. The six competencies are opportunity, relationship, conceptual, organising, strategy and commitment. Each one of the competencies has underlying skills or competencies which can be related to the behaviour of a farmer in terms of behaviour in leadership and human relations, creativity and innovation, internal locus of control, self-confidence (self-efficacy), persistence, planning, passion, leadership, opportunity seeking, conflict management, risk management, need for achievement, positivity, tenacity, commitment and confidence.

Opportunity competencies relate to recognising and developing market opportunities (Man *et al*., 2002). Networking and human relations can be related to person-to-person or person-to-group based interactions, included in the relationship competencies of Man *et al.* (2002). According to Man *et al.* (2002), conceptual competencies are related to the conceptual abilities of the individual. These abilities are reflected in behaviour involving decision-making skills, absorbing and understanding complex situations, problem analysis, vision and judgment. The organisation and management of internal and external human, physical, financial and other resources are all skills or competencies that are associated with organising competencies (Man *et al*., 2002). Strategic competencies are related to the setting, evaluation and implementation of strategies in the business. Underlying competencies are related to learning from past behaviour and results orientation. There needs to be a drive that ensures the anticipated results of the venture, which is also an important factor for

determining the repayment ability. The last competency factor, i.e. commitment, is related to the forward-moving drive of the individual. Factors such as self-confidence, self-efficacy and persistence can be associated with the factors that ensure the continuation of venture. All the factors identified by the respondents in Question Two can be associated with certain competencies, as proposed by Man *et al.* (2002). This is an indication that the framework proposed by Man *et al.* (2002) can be used to provide valuable and additional information on aspects that are related to the entrepreneurial and management abilities of farmers in determining their repayment ability in credit scoring.

The respondents were also asked to indicate whether the approach used to measure each of the factors was objective or subjective. Three of the respondents did not answer the question, but there was agreement between the respondents who answered. The respondents agreed that the additional factors related to Question Two, which was associated with manager and entrepreneurial skills, were all based on subjective measurements. While factors such as financial performance, age, experience, education, ownership, collateral, market and product situation and projections, and the type of farming operations were mostly based on objective measures, it was also further indicated by several respondents that the final decision on repayment ability is based on human judgement, which is a subjective conclusion.

Not only is human judgement very subjective in decision making, but research has found several shortcomings that are associated with personal judgement procedures. These shortcomings include aspects such as unreliability, results not being replicable, and potential problems with the handling of large quantities (Bolton, 2009). Apart from decision-making problems, the judgement methods suffer from high training costs, and frequent incorrect and inconsistent decision making by different experts when considering the same application (Marqués *et al.*, 2013). Human judgement does provide challenges when used in the credit process, especially when considering consistency between applications, or even between credit analysis and managers. Challenges arise, irrespective of whether

human judgement is included in the final decision-making process or when used to analyse aspects within the process, as consistency cannot be guaranteed.

3.4.   Conclusions and Recommendations

The main objective of this research was to explore the current agricultural credit assessment process, to understand the factors and characteristics used to assess credit applications, and to identify any other factors and characteristics that could improve the degree of accuracy with which repayment ability is predicted. Although several researchers have previously investigated the credit process and the factors influencing access to credit, the data used in their analyses was mostly gathered through questionnaires or sourced from farmers, and since the information did not originate from a financial institution, it could easily omit several important aspects used in determining the repayment ability of applicants. This situation has resulted in a gap in the knowledge which is necessary to ensure a proper understanding of the characteristics and variables that are actually considered by existing credit providers and financial organisations today.

A Delphi study was conducted to determine the characteristics and variables considered as important by a financial organisation in determining the repayment ability of farmers in South Africa. In total, 15 different factors were identified as being important when evaluating a credit application. The factors that were deemed as important in the credit process are: Account standing, Age, Client's success factor compared with competitors, Collateral, Credit record, Education/qualifications, Experience, Farm ownership, Market information, Past and current financial performance, Product market projections, Reputation, Sustainability of the enterprise, Type of farming enterprise, and Willingness to repay. As expected, the most important factors included the financial performance, sustainability and security of the applicant. Age, experience and education, which are often cited in the literature as factors that influence access to credit, are also considered in the application process, but are considered to be less important than the other above-mentioned factors.

The respondents identified a number of additional personal characteristics and abilities of a farmer that should be considered in the credit application process, including certain managerial and entrepreneurial characteristics such as the ability to manage different aspects of the farm business (financial, technical, production, marketing, natural resources and human resources). The research has identified several entrepreneurial and management capabilities that are considered to be important aspects of any credit evaluation instrument. These factors include: Leadership and human relations, Creativity and innovation, Internal locus of control, Self-confidence (Self-efficacy), Persistence, Planning, Passion, Leadership, Opportunity seeking, Conflict management, Risk management, Need for achievement, Positivity, Tenacity, Commitment and confidence. The aspects of the individual related to the characteristics used to describe the entrepreneurial competencies explained in literature, and by Man *et al.*, (2002), consist of opportunity, relationship, conceptual, organising, strategy and commitment competencies. The entrepreneurial abilities of the farmer indicate a degree of promise in the application, with a higher level of entrepreneurial competencies having been found to have a positive influence on farm performance, thus pointing to better repayment ability. The influence of entrepreneurial competencies on performance therefore justifies the possible inclusion thereof in the credit application process, and this factor should be investigated further in future research studies.

The results show that there is consensus on the factors that are considered in determining the repayment ability of farmers. Such consensus is a good indication that there may be a high level of consistency in the classification of applications. However, further investigation revealed that the decisions in terms of classification are based on human judgement. The use of human judgement does have certain disadvantages, such as high training costs, as well as frequent incorrect and inconsistent decision-making by different experts about the same application. When the respondents were asked to indicate whether the use of objective credit-scoring models would assist in improving the consistency of the classifications, most indicated that the use of statistical methods could improve

consistency in credit-granting decisions, but some limitations were also mentioned.

It is therefore recommended that further research be conducted to investigate the implementation of objective statistical methods to determine repayment ability within the South African agricultural sector where these identified factors can be implemented to extend or contribute to the current decision-making variables in credit instruments. Research would include identifying measurement instruments which are in turn used to identify and/or measure these characteristic factors in such a way that the factors can be included in the credit instruments. Such research would not only be to the advantage of the South African agricultural sector, but might also be successfully applied to other developed and developing countries.

Chapter 4

Measuring entrepreneurial competencies

4.1. Introduction

Entrepreneurship in agriculture is not a new phenomenon, although the entrepreneurial characteristics of farmers only started receiving attention during the last few years. The bulk of the research on entrepreneurial attributes or characteristics of farmers is found in European countries, the United Kingdom, Australia and New Zealand, with some limited research in the South African agricultural sector. Only research undertaken by Jordaan (2013), Xaba (2014) and Nieuwoudt *et al.* (2015) relates to the entrepreneurial characteristics or competencies of farmers. Therefore, little is known about the entrepreneurial competencies of South African farmers, which verifies the need for further investigation and research on the subject. The objective of this chapter is to measure the entrepreneurial competencies of farmers.

4.2. Data used to explore the entrepreneurial competencies of farmers

The data used to explore the entrepreneurial competencies of farmers were received with the assistance of the financial organisation in question, where the representatives of clients completed the questionnaires. The questionnaires were sent to the Head: Sales Enablement – Agribusiness of the financial organisation, who distributed the questionnaires to the relevant agricultural managers throughout South Africa. The agricultural managers further distributed the questionnaires to the specific relationship executives or agricultural economists who assisted with the respective client credit applications. These individuals would henceforth be referred to as 'representatives'. The representatives completed the questionnaire on the abilities of their clients, viz. the farmers applying for credit. Although the information concerning the farmers in this study was obtained from representatives of the financial organisation, the farmers will be referred to as 'respondents' for ease of reference, where appropriate. The questionnaires were completed between September and November 2015, and a total of 125 completed questionnaires were received.

4.3.   Procedure to determine entrepreneurial competencies of farmers

4.3.1.   Measuring instrument

The instrument used to measure the entrepreneurial competencies was developed by Man (2001). The instrument was developed by combining several existing measuring instruments of entrepreneurial and managerial competencies. The different instruments used include those of Quinn, Faerman, Thompson and McGrath (1990); Chandler and Jansen (1992); the *learning skills profile* (1993); Roemer (1996); Williams (1996), and lastly, the *Leadership Competency Inventory* (1996). These were used to develop a framework to measure eight entrepreneurial competencies: opportunity; relationship; conceptual; organising; strategic; commitment; learning; and personal strength competencies.

The instrument provides a high level of reliability in the variables used for measuring entrepreneurial competency from a behavioural perspective (Man, 2001). The entrepreneurial competency survey instrument consists of 53 items and the distributions of the items are shown in Table 4.1 below. To measure the entrepreneurial score for each farmer, representatives of clients at the financial organisation were asked to rate the degree to which each statement reflects their clients' actual behaviour on a 7-point anchored Likert scale. The Likert scale indicated one as 'strongly disagree' and seven as 'strongly agree' with the relevant statement.

Table 4.1: Survey items of the entrepreneurial competencies instrument

		Strongly disagree						Strongly agree
VAR1	Identify goods or services the agricultural market needs	1	2	3	4	5	6	7
VAR2	Perceive unmet consumer needs	1	2	3	4	5	6	7
VAR3	Actively look for products or services that provide real benefit to customers and the agricultural market	1	2	3	4	5	6	7
VAR4	Seize high-quality business opportunities	1	2	3	4	5	6	7
VAR5	Develop long-term trusting relationships with others	1	2	3	4	5	6	7
VAR6	Negotiate with others	1	2	3	4	5	6	7
VAR7	Interact with others	1	2	3	4	5	6	7
VAR8	Maintain a personal network of work contacts	1	2	3	4	5	6	7
VAR9	Understand what others mean by their words and actions	1	2	3	4	5	6	7
VAR10	Communicate with others effectively	1	2	3	4	5	6	7
VAR11	Apply ideas, issues, and observations to alternative contexts	1	2	3	4	5	6	7
VAR12	Integrate ideas, issues, and observations into more general contexts	1	2	3	4	5	6	7
VAR13	Take reasonable job-related risks	1	2	3	4	5	6	7

VAR14	Monitor progress toward objectives in risky actions	1	2	3	4	5	6	7
VAR15	Look at old problems in new ways	1	2	3	4	5	6	7
VAR16	Explore new ideas	1	2	3	4	5	6	7
VAR17	Treat new problems as opportunities	1	2	3	4	5	6	7
VAR18	Plan the operations of the business	1	2	3	4	5	6	7
VAR19	Plan the organisation of different resources	1	2	3	4	5	6	7
VAR20	Keep the farming organisation running smoothly	1	2	3	4	5	6	7
VAR21	Organise resources	1	2	3	4	5	6	7
VAR22	Coordinate tasks	1	2	3	4	5	6	7
VAR23	Supervise Lower ranking employees	1	2	3	4	5	6	7
VAR24	Lead employees	1	2	3	4	5	6	7
VAR25	Organise people	1	2	3	4	5	6	7
VAR26	Motivate people	1	2	3	4	5	6	7
VAR27	Delegate effectively	1	2	3	4	5	6	7
VAR28	Determine long-term issues, problems, or opportunities	1	2	3	4	5	6	7
VAR29	Aware of the projected directions of the industry and how changes might impact the firm	1	2	3	4	5	6	7
VAR30	Prioritise work in alignment with business goals	1	2	3	4	5	6	7

VAR31	Redesign the department and/or organisation to better meet long-term objectives and changes	1	2	3	4	5	6	7
VAR32	Align current actions with strategic goals	1	2	3	4	5	6	7
VAR33	Assess and link short-term, day-to-day tasks in the context of long-term direction	1	2	3	4	5	6	7
VAR34	Monitor progress toward strategic goals	1	2	3	4	5	6	7
VAR35	Evaluate results against strategic goals	1	2	3	4	5	6	7
VAR36	Determine strategic actions by weighing costs and benefits	1	2	3	4	5	6	7
VAR37	Dedicated to make the venture work whenever possible	1	2	3	4	5	6	7
VAR38	Refuse to let the venture fail whenever appropriate	1	2	3	4	5	6	7
VAR39	Possess an extremely strong internal drive	1	2	3	4	5	6	7
VAR40	Commit to long-term business goals	1	2	3	4	5	6	7
VAR41	Learn from a variety of means	1	2	3	4	5	6	7
VAR42	Learn proactively	1	2	3	4	5	6	7
VAR43	Learn as much as I can in my field	1	2	3	4	5	6	7
VAR44	Keep up to date in my field	1	2	3	4	5	6	7
VAR45	Apply learned skills and knowledge into actual practices	1	2	3	4	5	6	7

VAR46	Maintain a high energy level	1	2	3	4	5	6	7
VAR47	Motivate self to function at optimum level of performance	1	2	3	4	5	6	7
VAR48	Respond to constructive criticism	1	2	3	4	5	6	7
VAR49	Maintain a positive attitude	1	2	3	4	5	6	7
VAR50	Prioritise tasks to manage my time	1	2	3	4	5	6	7
VAR51	Identify my own strengths and weaknesses and match them with opportunities and threats	1	2	3	4	5	6	7
VAR52	Manage my own career development	1	2	3	4	5	6	7
VAR53	Recognise and work on my own shortcomings	1	2	3	4	5	6	7

Source: adopted from Man (2001)

A short discussion of the items used to measure each of the competencies follows according to the predetermined sets of competencies sub-constructs by Man, (2001).

- *Opportunity seeking competencies*

Recognising and developing market opportunities comprise an important part of entrepreneurial behaviour (Bergevoet, 2005). It is therefore necessary to identify whether the farmers' behaviour illustrates that they are actively looking for new market opportunities which could provide a benefit to their customers. Farmers can provide more than just commodities in the agricultural sector, by providing alternative services, such as contract work for neighbouring farmers or hiring out of farming equipment. A four-item scale for measuring the ability to recognise opportunities was used to measure opportunity competencies (Man, 2001). Items included in the measuring instrument were "Identify goods or services the agricultural market needs"; "Perceive unmet consumer needs"; "Actively look for products or services that provide a real benefit to customers and the agricultural market"; and "Seize high quality business opportunities". The respondents who scored high on these four items are deemed to exhibit higher competencies in the identification of opportunities.

- *Relationship competencies*

The building and maintenance of networks in the business environment can provide a great source of information. Networking involves the interaction and building of trusting relationships between individuals and also organisations. These networks can be a great source of information for farmers, and thus assist in their business activities. The relationship competencies construct consists of items related to interpersonal skills: "Develop long-term trusting relationships with others"; "Negotiate with others", "Interact with others"; "Maintain a personal network of work contacts and communications skills"; "Understand what others mean by their words and actions"; and "Communicate with others effectively". Maintaining a personal network can assist in obtaining new information, and an individual who scores higher on these items is expected to exhibit behaviour consistent with identifying and maintaining personal networks.

- *Conceptual competencies*

Farmers are required to make use of information in different ways. First, farmers have to identify problems, seek solutions for the problem, and then identify and implement the best solution. This process requires the farmer to conceptualise problems, through which they can form ideas which can be transformed into solutions and/or opportunities, and individuals that have higher scores in the conceptual competencies tend to indicate abilities to conceptualise and work on ideas. Their ability to conceptualise and willingness to incorporate the ideas into their business was measured by items included in the measuring instrument: "Apply ideas, issues and observations to alternative contexts"; "Integrate ideas, issues and observations into a more general context"; "Take reasonable job-related risks"; "Monitor progress toward objectives in risky actions"; "Look at old problems in new ways"; "Explore new ideas"; and "Treat new problems as opportunities" (Man, 2001).

- *Organising competencies*

The management of resources in the agricultural sector is very important, and needs be considered as an ability of the farmer to ensure effective organisation in the business environment. Organisational competencies have also been found in literature to be closely related to managerial competencies (Boyatzis, 1982; Woodruffe, 1992; Cockerill, Hunt & Schroder, 1995; Evers & Rush, 1996), which includes the management of farm resources such as financial, human and natural resources. The instrument consists of the following items utilised to measure the organisational competencies of individuals: "Plan the operations of the business"; "Plan the organisation of different resources"; "Keep the farming organisation running smoothly"; "Organise resources"; "Coordinate tasks"; "Supervise Lower ranking employees"; "Lead employees"; "Organise people"; "Motivate people"; and "Delegate effectively" (Man, 2001).

- *Strategic competencies*

Goals and objectives are used to guide the behaviour and decision-making in businesses. The decisions are made to ensure that the goals can be reached within the abilities of individuals. Bergevoet (2005) found that goals, objectives and attitudes are aspects that need to be considered in the strategic and

entrepreneurial behaviour of dairy farmers. The farmers are responsible for making strategic decisions in their farming business which assists in the achievement of their predetermined goals and objectives. To measure strategic competencies, the instrument includes items "Determine long-term issues, problems, or opportunities"; "Aware of the projected directions of the industry and how changes might impact the firm"; "Prioritise work in alignment with business goals"; "Redesign the department and/or organisation to better meet long-term objectives and changes"; "Align current actions with strategic goals"; "Assess and link short-term, day-to-day tasks in the context of long-term direction"; "Monitor progress toward strategic goals"; "Evaluate results against strategic goals"; and "Determine strategic actions by weighing costs and benefits" (Man, 2001).

- ***Commitment competencies***

Entrepreneurs differ in their commitment levels from those of hired employees (Bergevoet, 2005). This means that the farmers, the owners, put in extra effort to ensure the success of their farming business or the given venture. One of the abilities of an entrepreneur is to ensure that the venture or commitment is adhered to, until the required result is achieved. Therefore, commitment is a very important aspect. The measurement items consists of "Dedicate to make the venture work whenever possible"; "Refuse to let the venture fail whenever appropriate"; "Possess an extremely strong internal drive"; and lastly, "Commit to long-term business goals" (Man, 2001).

- ***Learning competencies***

Changes in the agricultural sector attributable to globalised trade, free market systems and a dynamic social society force farmers to be adaptive to their environment. The environment is also not only influenced by economic factors, but also by environmental factors, which are unpredictable. To enable farmers to continue their business functions in the environment, they must demonstrate a willingness to learn and acquire new knowledge. To measure the ability and behaviour associated with learning, the following items were used in the instrument: "Learn from a variety of means"; "Learn proactively"; "Learn as much as I can in my field"; "Keep up to date in my field"; and "Apply learned

skills and knowledge in actual practices" (Man, 2001). It is important for farmers not only to remain up to date in their business environment, but also to apply the acquired knowledge in their business, and the farmers that score higher in these competencies exhibit willingness to enhance their own abilities.

- ***Personal strength competencies***

Several aspects of cognitive abilities are considered to be important in terms of entrepreneurial competencies. An individual's self-belief in being able to implement the necessary resources, skills and competencies (self-efficacy) and his or her motivation levels can have an influence on the successful implementation of ventures and even on the overall business. Energy levels, self-belief and self-efficacy are therefore important aspects that need to be determined. The items used to measure these aspects were: "Maintain a high energy level"; "Motivate self to function at optimum level of performance"; "Respond to constructive criticism"; "Maintain a positive attitude"; "Prioritise tasks to manage my time"; "Identify my own strengths and weaknesses and match them with opportunities and threats"; "Manage my own career development"; and "Recognise and work on my own shortcomings" (Man, 2001).

4.3.2. Methods used to determine entrepreneurial competencies

The data were analysed through a factor analysis to gain insights into the underlying dimensions between the measured items and latent constructs (Williams, Brown & Onsman, 2010). Factor analysis is used, among other instruments, to examine the structure or relationship between variables (Williams *et al.*, 2010).

When making use of a factor analysis, the number of cases per item must preferably be at least five, with a preferred minimum of at least ten cases per item (Tinsley & Tinsley, 1987). There are, however, different opinions on the minimum number of cases per item and the preferred number of cases, but indications are to maximise the number of cases per item. Following Man (2001),

three separate factor analyses were conducted. The first factor analysis included items VAR1 to VAR17, followed by VAR18 to VAR40, and lastly VAR41 to VAR53.

The factor analysis was performed with the use of a varimax rotation (Li, 2009; Mitchelmore and Rowley, 2013), with Kaizer normalisation and principal component analysis. Problematic or redundant items were removed according to the following criteria: (1) a measures of sampling adequacy of less than 0.5 and; (2) communalities of less than 0.5. The number of factors was determined by the loading patterns for each of the survey items. Different minimum factor loadings can be used, with Hair, Black, Babin and Anderson (2010) suggesting a minimum loading of 0.300. Loué and Baronet (2012) used a more stringent minimum loading of 0.500 and factors that loaded on one factor. The higher factor loading is for more practical significance (Hair *et al.*, 2010), and was therefore used in this research. The Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity were determined to estimate the sampling adequacy. Components are extracted according to the Kaiser-Gutman Rule where all components are included with Eigen values greater than one.

To determine the internal consistency or reliability of the items extracted within each of the entrepreneurial competencies factors, Cronbach's Alpha was calculated. Acceptable values for Cronbach's Alpha according to Nunnally (1978) are 0.7 and larger. The calculated Cronbach's Alphas for each of the extracted competencies factors, and the overall number of items included, therefore need to be larger than 0.7, to be used in the determining of entrepreneurial competencies score for the individuals.

4.4. Results and discussion

4.4.1. Entrepreneurial competencies of farmers

- **Interaction and exploring**

The factor analysis for items VAR1 to VAR17 extracted three components, with the exclusion of four items (VAR4, VAR5, VAR9 and VAR13) due to communality ratings which were less than 0.5. These items were therefore removed, and the

factor analysis was repeated and concluded with a satisfactory result. The Kaiser-Meyer-Olkin measure of sampling adequacy for the set of items is larger than the required 0.5, while the Bartlett test of sphericity is statistically significant, as shown in Table 4.2 below.

Table 4.2: Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test for VAR01 to 17

	1-17
KMO Measure of Sampling Adequacy	0.892
Bartlett's Test of Sphericity (Approx. Chi-Square)	914.548
df	78
Sig.	0.000

Three components were extracted where the factor loadings of each item was larger than 0.5. The three components provided a satisfactory solution by explaining 68.47 % of the total variance. As indicated in Table 4.3 below, the first component (Eigenvalue of 6.616) consists of items that loaded high on items that are related to the abilities of the farmers to identify problems, explore new ideas and integrate ideas into the necessary context.

Table 4.3: Rotated component matrix, Eigenvalues and percentage of variance for VAR01 to 17

	Component		
	Conceptual	**Relationship**	**Opportunity**
VAR11	**0.816**	0.142	0.165
VAR15	**0.766**	0.096	0.384
VAR14	**0.734**	0.294	0.104
VAR16	**0.69**	0.326	0.342
VAR17	**0.675**	0.399	0.216
VAR12	**0.644**	0.353	0.318
VAR07	0.247	**0.839**	0.063
VAR08	0.26	**0.784**	0.138
VAR06	0.169	**0.698**	0.371
VAR10	0.465	**0.532**	0.233
VAR02	0.205	0.179	**0.868**
VAR03	0.28	0.08	**0.766**
VAR01	0.251	0.308	**0.689**
Eigenvalues	**6.616**	**1.226**	**1.061**
% of variance	**50.889**	**9.428**	**8.159**
Cronbach's Alpha	**0.894**	**0.814**	**0.797**

These items include: "apply ideas, issues and observations to alternative contexts" (VAR15); "Look at old problems in new ways" (VAR11); "Monitor progress toward objectives in risky actions" (VAR14); "Explore new ideas" (VAR16); "Treat new problems as opportunities" (VAR17) and; "Integrate ideas, issues and observations into a more general context" (VAR12). These aspects are all related to the identification, exploration and implementation of ideas which can be used in the daily activities of a farming business. As the focus of the items in the component refers to the conceptualisation ability of the individual, the first component was called "Conceptual competencies".

The items with the high loadings in component two were: "Interact with others" (VAR7); "maintain a personal network of work contacts and communications skills" (VAR8); "negotiate with others" (VAR6); and "communicate with other effectively" (VAR10). The second component, with an Eigenvalue 1.226, consisted of items with high loadings on aspects that are related to the interaction and communication with other individuals and was subsequently called "Relationship competencies".

The third component consists of high loadings for the items: "Perceive unmet consumer needs" (VAR2); "Actively look for products or services that provide a real benefit to customers and the agricultural market" (VAR3); and "Identify goods or services the agricultural market needs" (VAR1). The loadings indicate that individuals that identify the needs of consumers are actively looking for products and services that are needed in the market and also by their clients. The items with high loadings relate to seeking and observing opportunities in the product and service market, which can be of great advantage to their farming business. These opportunities do not simply present themselves, as the farmers need to actively seek new opportunities in the very dynamic agricultural environment. The high loading items in the component relate to seeking of new opportunities, and were therefore named "opportunity seeking competencies".

The Cronbach alphas for the items loaded in each of the components were calculated and indicated a strong internal consistency with all being larger than the necessary 0.7. These items in each of the factors can therefore be used to measure the identified factors.

- **Business management**

The factor analysis for items VAR18 to VAR40 extracted three components. All of the items have MSA values greater than 0.5, which do not require any elimination of items. However, two items (VAR30 and VAR20) were found to have high cross loadings in two components and were removed, after which the process was repeated. For the second repetition, item VAR21 was found with high cross loadings in two components, while item VAR29 factor loadings were less than 0.5 in each of the three components. The two items were therefore removed, and the factor analysis was repeated. After the third repetition, all cross loadings were removed and the Kaiser-Meyer-Olkin measure of sampling adequacy for the set of items was larger than the required 0.5, while the Bartlett test of sphericity was statistically significant, as shown in Table 4.4 below. The three components that were extracted explained 68 % of the total variance.

Table 4.4: Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test for items VAR18 to 40

		18-40
KMO Measure of Sampling Adequacy		0.898
Bartlett's Test of Sphericity (Approx. Chi-Square)		1795.666
	df	171
	Sig.	0.000

The first component consists of the following items with loadings larger than 0.5: "determine strategic actions by weighing costs and benefits" (VAR36) ; "Monitor progress toward strategic goals" (VAR34); "Align current actions with strategic goals" (VAR32); "Commit to long term business goals" (VAR40); "Evaluate results against strategic goals" (VAR35); "Determine long-term issues, problems, or opportunities" (VAR28); "Redesign the department and/or organisation to better meet long-term objectives and changes" (VAR31) and; "Assess and link short-term, day-to-day tasks in the context of long-term direction" (VAR33). These factor loadings are shown in Table 4.5 below. The items with higher loadings in factor one compare with the original strategic competencies of Man (2001), with the exception of VAR40 which relates to committing to long-term goals, which are an essential part of strategic planning. Factor loadings of the items indicate that individuals who are working towards long-term goals will also determine their strategic actions by considering costs and benefits and make the necessary adjustments to achieve the long-term goals. Committing to long-term goals ensures the necessary effort and commitment to implement the determined strategies. The component was therefore called "Strategic competencies".

Table 4.5: Rotated component matrix, Eigenvalues and percentage of variance for items VAR18 to 40

	Component		
	Strategic	**Organising**	**Commitment**
VAR36	**0.774**	0.245	0.213
VAR34	**0.753**	0.363	0.172
VAR32	**0.742**	0.327	0.252
VAR40	**0.709**	0.1	0.453
VAR35	**0.704**	0.379	0.246
VAR28	**0.691**	0.409	-0.017
VAR31	**0.668**	0.398	0.275
VAR33	**0.589**	0.426	0.195
VAR24	0.326	**0.811**	0.066
VAR23	0.124	**0.766**	0.31
VAR27	0.389	**0.661**	0.286
VAR25	0.351	**0.639**	0.35
VAR26	0.414	**0.632**	0.147
VAR19	0.405	**0.601**	0.32
VAR22	0.43	**0.587**	0.326
VAR18	0.386	**0.562**	0.359
VAR38	0.146	0.291	**0.811**
VAR37	0.17	0.319	**0.796**
VAR39	0.457	0.148	**0.661**
Eigenvalues	**10.516**	**1.271**	**1.108**
% of variance	**55.349**	**6.69**	**5.83**
Cronbach's Alpha	**0.926**	**0.918**	**0.810**

Items that load high in the second component included "Lead employees" (VAR24); "Supervise Lower ranking employees" (VAR23); "Delegate effectively" (VAR27); "Organise people" (VAR25); "Motivate people" (VAR26); "Plan the organisation of different resources" (VAR19); "Coordinate tasks" (VAR22); and lastly, "Plan the operations of the business" (VAR18), with an Eigenvalue of 1.271. The loadings in the component consider that individuals that lead employees, are supervisors, and would delegate effectively, which includes organising and managing the available resources. These aspects also need effective planning in business operations. Management in a farming business is very important, as the farm operator has to manage natural, human and financial resources, among others, all at the same time. The items in the component indicate that the above-mentioned aspects are normally related to one another, which is a good

indication that the individual who works effectively with people and resources will also plan the operations within the business. The component is called "Organising competencies".

"Refuse to let the venture fail whenever appropriate" (VAR38); "Dedicate to make the venture work whenever possible" (VAR37) and; "Possess an extremely strong internal drive" (VAR39) comprise the factor with high loadings in the third component, with an Eigenvalue of 1.108. According to the loadings, the component indicates that individuals with a strong internal drive are dedicated to making a venture work and, will also, within their own abilities, prevent ventures from failing. The aspects in the component relate to the commitment of an individual to ensuring the success of any venture, and therefore the component was named "Commitment competencies".

The items that loaded high in the three factors, strategic, organising and commitment competencies, indicated a strong internal consistency in measuring the competencies factor, as indicated by Cronbach alphas of 0.926, 0.918 and 0.810, respectively; which are all larger than 0.7.

- **Personal improvement**

The last factor analysis consisted of VAR41 to VAR53, and originally comprised learning and personal-strength competencies. All of the items have MSA values greater than 0.5, which do not require any elimination of items. The Kaiser-Meyer-Olkin measure of sampling adequacy for the set of items is larger than the required 0.5, while the Bartlett test of sphericity is statistically significant, as shown in Table 4.6 below.

Table 4.6: Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test for VAR41 to 53

	41-53
KMO Measure of Sampling Adequacy	0.913
Bartlett's Test of Sphericity (Approx. Chi-Square)	1067.299
df	78
Sig.	0.000

Two components were extracted with items that had factor loadings of greater than 0.5, and a cumulative variance of 65 %. The first component consists of items "Learn from a variety of means" (VAR41); "Keep up to date in my field" (VAR44); "Learn as much as I can in my field" (VAR43); "Learn proactively" (VAR42); and "Identify my own strengths and weaknesses and match them with opportunities and threats" (VAR51). The agricultural sector has seen many changes over the years, and is constantly changing. These changes in the sector force farmers to be adaptive to their environment (Lans *et al.*, 2013), and to be adaptive, farmers need to be open to learning and to adjust accordingly to ensure the competitiveness of their farming businesses. The component was called "Learning competencies".

Table 4.7: Rotated component matrix, Eigenvalues and percentage of variance for VAR41 to 53

	Component	
	Personal strength	**Learning**
VAR46	**0.821**	0.247
VAR50	**0.817**	0.217
VAR49	**0.719**	0.32
VAR53	**0.654**	0.423
VAR48	**0.651**	0.301
VAR47	**0.637**	0.462
VAR45	**0.614**	0.467
VAR52	**0.573**	0.454
VAR41	0.207	**0.846**
VAR44	0.334	**0.807**
VAR43	0.362	**0.769**
VAR42	0.399	**0.734**
VAR51	0.403	**0.686**
Eigenvalues	**7.475**	**1.036**
% of variance	**57.502**	**7.966**
Cronbach Alpha	**0.903**	**0.898**

The items with high loadings in the second component included "Maintain a high energy level" (VAR46); "Prioritise tasks to manage my time" (VAR50); "Maintain a positive attitude" (VAR49); "Recognise and work on my own shortcomings" (VAR53); "Respond to constructive criticism" (VAR48); "Motivate self to function at optimum level of performance" (VAR47); "Apply learned skills and knowledge into actual practices" (VAR45); and "Manage my own career development" (VAR52). The items with high loadings in the component indicate that individuals that maintain high energy will manage their time, have a positive attitude, recognise their own shortcomings, and respond in a positive manner to criticism. These individuals also apply the knowledge obtained into actual practice. Belief in one's own abilities and the ability to identify and work on shortcomings are important aspects that are associated with entrepreneurial individuals and, accordingly, the competencies were named "Personal strength".

Internal reliability between the items in the two components factors was also found to be larger than 0.7, which is an indication that there is internal

consistency between the items to measure each of the two component factors. The Cronbach's Alpha for all the items used to determine the entrepreneurial scores was 0.976, which indicates that internal consistency exists between the items used to determine the different factor competencies as a proxy of an overall entrepreneurial competencies score. The eight competencies factors that were used for further analysis in determining the entrepreneurial score of the individuals are the following: opportunity seeking; relationship; conceptual; organising; strategic; commitment; personal strength and learning. As the different competencies have now been identified, the next step is to score each individual according to the competencies factors as observed by their representatives. The representative-assessment score is an illustration of the behaviour of the client, as observed by the representative from the financial organisation.

4.4.2.   Determining entrepreneurial competencies score

To determine the entrepreneurial score for each individual farmer, the representative scores according to each of the entrepreneurial competencies was calculated as the average for the items in each of the component factors. The farmers are scored in terms of their opportunity seeking; relationship; conceptual; organising; strategic; commitment; learning; and personal strength competencies. Representatives of the financial organisation do not necessarily have the training to assess the entrepreneurial competencies of the farmers and therefore the questionnaire provides financial organisations with an assessment tool that measures the entrepreneurial competencies of the farmers.   The average scores for all the respondents are shown in Figure 4.1 below. The farmers scored high in most of the competencies factors. There is, however, a range between the smallest and highest scores for each of the competencies factors. The competencies factors that were found to have one of the highest scores for the farmers, and also the smallest range between the highest and smallest scores, are related to self-management and learning competencies factors of the farmers. This is an indication of the farmers' willingness to enhance their own abilities by being active in learning and obtaining new knowledge that can assist them in applying this knowledge to their practices.
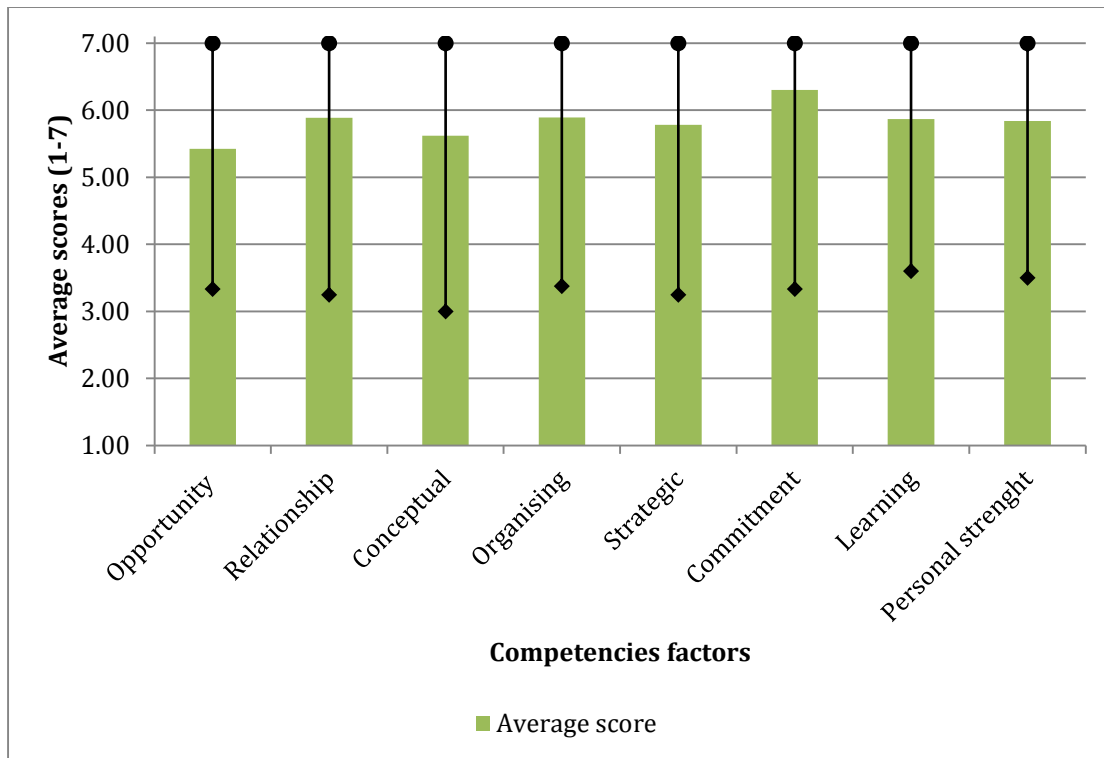
Figure 4.1: Average scores and range of each individual entrepreneurial competencies factor

This can be expected, when the sector of operation is considered. It has been mentioned in literature that the agricultural sector is known for many unpredictable factors that have an influence on daily activities and therefore it can be expected that the behaviour of the farmers will be to make use of information to remain up to date on developments, and to apply newly obtained knowledge in their daily operations. Not only is it important for the farmers to keep up to speed with the latest developments, but they must also be able to interpret, understand and react to the developments by incorporating the knowledge in their strategies to ensure that their long-term goals can be achieved. High ratings in learning and personal strength emphasise personal success, which can be achieved through hard work and achievement motivation (Siu & Martin, 1992; Tam & Redding, 1993; Man, 2001). These abilities, however, need to be combined with other abilities which are indicated by different competencies factors.

Commitment competencies were found to have the highest average score for the farmers, but also had a larger range between the smallest and largest scores for

individual farmers. The commitment competencies factor is an indication of the farmers' behaviour to make ventures, which are undertaken, work. The individual's behaviour indicates dedication to make ventures work and to keep on working within own abilities to ensure success. A strong internal drive is also an important aspect in the motivation to continue, when difficulties arise. This clearly indicates that the farmers are dedicated to ensure the success of the business. Literature also indicates that individuals with an internal locus of control believe that their own actions have an influence on the outcome; they have been found to have an increased probability to take advantage of given opportunities (Mueller and Thomas, 2001), and are also associated high achievements (Kobia & Sikalieh, 2010). Individuals with internal locus of control take more initiative and responsibility in performance and tend also to seek and make use of information (Fagbohungbe & Jayeoba, 2012). However, only gaining access to information is not sufficient and farmers must be able and willing to make use of the information and conceptualise an idea which can be implemented, to the advantage of the farming business.

The higher score of the organisational competencies factor of the farmers illustrates the point that the farmers are taking a leading role in their farming business where they have to lead and supervise their employees. Farmers have been identified in literature as being the entrepreneur, manager and main labour source (Ondersteijn *et al.*, 2003). This is also shown in the responses found in the organisational competencies factor. The farmer is the person who is the manager of the activities of the farm, which include the coordination of the activities, leading, delegating and providing supervision and motivation for the workforce. The management of people is an important part of the organisational activities in any business, and according to Man (2001) these individuals need to be competent in the leading, delegating, coaching and training of employees (Martin & Staines, 1994). The organisational competencies have also been found in literature to be closely related to managerial competencies (Cockerill *et al.*, 1995; Evers & Rush, 1996; Man, 2001; Lans, 2009), which is clearly visible in the items used to measure the organisational competencies factor.

Conceptual competencies, consisting of exploring new ideas that could be implemented in alternative contexts, was found to rank lower compared with the other competencies factors. In a sector that is known for its ever-changing environment, where the use of information is very important in observing and implementing ideas in alternative contexts, the expectation would be that these aspects would be of greatest importance. Farmers need to make use of information and develop their own ideas and the implementation of plans which can be used in their farming businesses. Not only is the implementation of ideas an important aspect, but finding solutions for problems can also be a challenge. Problems can be overcome, and one way is to look at older problems in new ways, and to consider new problems as opportunities. The results indicated that individuals who view old problems in new ways, explore new ideas and treat new problems as opportunities are all included in the opportunity seeking competencies factor; this indicates that there may be a tendency for the farmers to be less active in seeking new opportunities in relation to the other competencies.

Consequently, the opportunity seeking competencies factor was found to have the lowest average scores, when compared with the other competencies factors. The lower score is not an indication that the farmers' behaviour is not aligned to seeking new opportunities. The lower scores can possibly be explained by the sector in which the farmers operate. The farmers mostly produce commodities, and as stated by Bergevoet (2005), it can be more difficult to identify and develop opportunities in the commodity market. When compared with the other identified competencies factors, these lower scores can be an indication that the farmers' behaviour is less orientated towards the identification of opportunities in the agricultural market, and rather more to the needs of the final consumer. The production of commodities does, however, provide diversification opportunities in vertical and horizontal integration options in the value chains, where value adding can be used to produce products that are specifically aimed at identified needs.

The eight competencies factors do provide a method by which farmers can be scored and compared with one another, in terms of the individual competencies factors or, if necessary, by adding the individual competencies factors to determine an overall entrepreneurial competencies score. The overall entrepreneurial competencies score would be a representation of the abilities illustrated by the farmers in terms of the eight competencies factors. The use of individual behaviour in the competencies approach also provides the advantage that shortcomings are identified, which provides the farmers with the opportunity to improve on these shortcomings. This is an indication that the farmers are presented with the opportunity to identify shortcomings and by their own willingness to learn, improve or adjust their behaviour to their own and the farming business's advantage.

4.5.   Conclusion

The research made use of representatives to complete questionnaires to rate their clients' abilities in their farming businesses. The rating method is similar to what has already been used in previous research, but the use of only representatives to rate their clients' behaviour is not consistently found to be an independent method. The use of representatives is a method that serves as an option to eliminate the possibility of respondents who subjectively overstate their own abilities. The farmers are therefore rated in terms of their actual behaviour as observed by the individuals that are not normally part of their farming business. The results of the factor analysis identified eight entrepreneurial competencies factors that indicated internal consistency between the measuring items. The competencies factors are mostly similar to the competencies factors identified by other researchers in the agricultural and other sectors.

The behaviour of the farmers illustrates their competencies in terms of their commitment to their farming business and also by investing in themselves. The investment in themselves is related to their willingness to improve their own abilities by being open to learning and obtaining knowledge through a variety of

means. This has also been emphasised in literature as becoming more important in the agricultural sector because of the increasing international competitiveness of the agricultural industry. Farmers' behaviour also illustrates the fact that they are capable of managing, leading and supervising their employees, which is an important aspect in the coordination and planning of resource usages. Resources have to be managed efficiently, considering that land and other resources that are used in the sector are either limited and/or very expensive.

Farmers in South Africa, as in other countries, mostly produce commodities. As the final product is a commodity, the farmers may consequently be less attracted to the identification and development of opportunities. This is also found in the results, where the opportunity seeking factor was found to be the lowest scored, compared with the other competencies factors. The lower ranking in the opportunity seeking competencies factor illustrates a possible area for improvement, as commodities are produced. There are options available for vertical and horizontal integration and diversification in the different value chains. By adding value to their commodities, farmers have the potential to exploit new opportunities.

The results of the research indicate that farmers exhibit entrepreneurial behaviour according to the observed competencies factors. The scoring of each of the competencies factors provides an indication of the behaviour and ability of the farmers. Not only is this behaviour an important part in their business, it can also assist financial organisations and other role players in determining a client's behaviour in comparison with other clients.

The competencies scores provide a method that can be used to report the entrepreneurial competencies of the farmers in credit applications. The measuring instrument provides a consistent basis which can be used by the representatives to report on entrepreneurial competencies, thereby eliminating a situation where different aspects are reported on by different representatives. In the next chapter, the entrepreneurial competencies scores of the farmers are included in a credit model to explore whether or not the inclusion of the

entrepreneurial competencies in a credit-scoring model can contribute towards modelling and predicting the repayment ability of prospective borrowers.

Chapter 5
Incorporating entrepreneurial competencies into a credit model

5.1. Introduction

The aim of chapter 5 is to extend current credit-scoring models by successfully incorporating the entrepreneurial competencies of farmers. The content of the chapter consists of a Neural Network credit-scoring model, as identified in Chapter 2, to correctly classify high-risk loans as rejectable. The Neural Network credit model is used as a method to incorporate the relevant variables identified in Chapter 3 and the entrepreneurial competencies of farmers identified and measured in Chapter 4.

5.2. Procedure

A multi-layer perceptron consists of an input layer that consists of p number of input variables (x) and an output layer consisting of a single output neuron. The perceptron can be calculated by the function shown in Equation 5.1 below:

$$u_k = w_{k0}x_0 + w_{k1}x_1 + w_{k2}x_2 + \ldots + w_{kp}x_p = \sum_{q=1}^{p} w_{kq}x_q \qquad \text{Equation 5.1}$$

The input layer consists of several variables, characteristics used in credit applications, x_q, ($q = 1,\ldots\ldots,p$) that is known as a signal. The variables used in the research consists of farmer characteristics, farm business performance and account conduct information. Weights or synaptic weights (w) are used in the training of the network, indicated by the subscripts (k,p) where k indicates the neuron, and the specific weight, and p the variable. The weights can be either positive (excitory) or negative (inhibitory). A positive value increases the value of positive u_k^1, while a negative will decrease the value (Thomas *et al.,* 2002). The value of x_0 is ascribed to positive one (+1), meaning that the value of $w_{k0}x_0$, known as the bias or intercept of the specific layer, is w_{k0} and increases or decreases the u_k^1 by a constant value (Thomas *et al.,* 2002). The output value (u_k^1) is transformed with the use of an activation function that can be set by the user according to the specific problem at hand. The output y_k of the neural is equal to the result of the neuron, as shown in Equation 5.2 below.

$$y_k = F(u_k)$$

<div align="right">Equation 5.2</div>

A multi-layer perceptron that consists of more than one neuron is mathematically presented by Equation 5.3 below, where F indicates the layer and the subscript the exact number of the associated layer.

$$y_k = F_1\left(\sum_{q=0}^{p} w_{kq}x_q\right)$$

<div align="right">Equation 5.3</div>

The result (y_k) is the input for the second layer and is presented by Equation 5.4 below:

$$z_v = F_2\left(\sum_{k=1}^{r} k_{vk}y_k = F_2\left(F_1\left(\sum_{q=0}^{p} w_{kq}x_q\right)\right)\right)$$

<div align="right">Equation 5.4</div>

The output of neuron is illustrated by z_v, F_2 is the specific activation function in the output layer. K_{vk} is the weight used to in the layer y_k that connects neuron k and neuron v of the output layer (Thomas *et al.*, 2002). An activation function that provides values between zero and one are applicable in the research, and logistic activation function (Equation 5.5 below) is used when the output of the neuron needs to be mapped to the interval (0,1) (Günther & Fritsch, 2010).

$$F_{(u)} = \frac{1}{1 + e^{-u}}$$

<div align="right">Equation 5.5</div>

The training in the network is done through calculations of the weight vectors, and back propagation is one of the most frequently used methods (Thomas *et al.*, 2002). The training process starts with equal weights that are randomly selected (Günther & Fritsch, 2010), while a training pair is selected and the input variables (x_q) are used to determine z_v (Equation 5.4 above). The difference between the z_v values and the known outputs (training outputs)(o_v) are calculated and the process is known as a forward pass (Thomas *et al.*, 2002). The back propagation algorithm differs in the fact that the error is distributed back through the network in proportion to the contribution made by each weight and

adjusting the weights to reduce the portion of the error. The process is repeated for all existing cases and only stops when a certain criterion is met, normally the minimum error. For binary approaches, the cross entropy error function is shown in Equation 5.6 below:

$$E = -\sum_{l=1}^{L}\sum_{h=1}^{H}(y_{lh}\log(o_{lh}) + (1 - y_{lh})(\log 1 - (o_{lh}))$$

Equation 5.6

The cross entropy measures the difference between the predicted output by the model and the observed output provided. *l = 1, …..,L,* indexes the observations of the input output combinations and *h* = 1, …..,*H* illustrates the output nodes (Günther & Fritsch, 2010).

5.2.1. Training, testing and application of the neural network model

The training, testing and application of a neural network was applied by using R-studio version 3.2.1 (2015-06-18). The neural net package (Fritsch & Günther, 2008) was used and contains a flexible function that can be used to train back propagation networks. A back propagation algorithm in the software provides the choice of which activation function and error function are to be implemented (Günther & Fritsch, 2010). A random number of input variables and responses (outputs) can be included (Günther & Fritsch, 2010), which makes the use of the software applicable to the research as a large number of input variables are used in credit applications.

The neural net function is used to train the neural network and provides an opportunity to define the number of hidden layers and neurons (Günther & Fritsch, 2010). The complexity of the network increases with the number of hidden layers, and therefore the network that provides the best accuracy rate of prediction will determine the number of hidden layers. The function used in the software consists of several arguments (Günther & Fritsch, 2010) that are specified in the script used (Appendix D) for incorporating the entrepreneurial competencies of farmers in determining their repayment ability:

- Formula – *description of the model that will be fitted.*

- Data – *data file that consists of the variables which will be used in the neural network, data used in the network was named "**train**".*

- Hidden – *vector that specifies the number of hidden layers and hidden neurons. The vector can be specified as (3,2,1), which is an indication of three hidden layers consisting of three, two and one hidden neurons. The default function is 1, if not specified. The number of layers to be used in the neural network was determined by the network that had the lowest misclassification error. The number of layers was therefore varied to determine the best fitted network.*

- Threshold – *is an integer that specifies the threshold for the derivates of the error function. The error function is used as the criterion for stopping the network. The aim is to minimise the error function, and the **default is 0.01** if no other number is specified.*

- Algorithm – *is a string that contains the algorithm type that can be specified in the network. The algorithm that was used in the research is the back propagation network and was therefore specified as **"backprop".***

- Err.fct – *the error function that was used to determine the stopping point of the network can be specified between two functions. As the response of the data is binary, **cross entropy ("ce")** was used as error function.*

- Act.fct – *the output values of the network were expected between 0 and 1, where 1 indicated an application that was accepted and 0 one that was rejected. The default setting of the network, **"logistic"** was thus acceptable, and has no need to be specified.*

- Linear.output – *as the output or the determination of repayment ability is illustrated by the acceptance or rejection of the application, the output should be stated by an activation function that maps the output between 0 and 1. The default setting is stated otherwise in the neuralnet package, and therefore the linear output was stated as "**FALSE**".*

These aspects were used in the training, testing and application of the back propagation neural network. In the following section, the data used as determinants of repayment ability are discussed.

5.2.2.   Data used

The data used in the research consist of information set out in a total of 130 credit applications from different regions of South Africa. The applications include instances where more than one application was made by the same individual or farming business. The information included several characteristics and variables, as identified in Chapter 3, that are used to determine the repayment ability of the applicant. Information for the research was obtained between July and November 2015. Several different categories are used to determine the repayment ability of a prospective client. These categories are used as input variables in credit-scoring models. These variables can be categorical or scale variables; the categorical variables are compared with a base for the category. The base category for each categorical variable is indicated in bold in the distribution table of the variable. The decision-making variables include: loan purpose; application period; loan size; date of first business; account conduct; credit history; collateral; financial performance; application risk; product diversification; age; experience; education; and lastly, the addition of the entrepreneurial competencies. The entrepreneurial competencies were calculated and reported in Chapter 4 above.

5.2.2.1.   Loan purposes and loan application period

Loans are required for different purposes in the agricultural sector, which can be separated into several different categories. These categories range from short-term production loans and overdrafts, to medium-term loans for vehicles, equipment and breeding livestock, to longer-term loans for the purchase of new farms (agricultural land). To provide a sufficient number of observations in each purpose category, three categories were identified: short-, medium- and long-term. Using these categories will ensure that there are sufficient observations in each category for modelling purposes.

Short-term loans consist mostly of loan applications that are between 1 to 12 months' duration and include loans for working capital, production loans and increases in overdrafts. Loan applications for farm machinery and vehicles, farm

development, livestock and diversification activities are categorised as medium-term applications. This medium-term category consists of applications with repayment periods between 12 to 120 months, with the exclusion of farm purchases. Long-term loans, for periods longer than 120 months, consist mostly of cover for farm and property purchases. The distribution of the loans are shown in Table 5.1 below, which clearly shows that most of the loan applications were for medium-term loans, followed by short-term loans.

Table 5.1: Distribution of loan applications according to short-, medium- and long-term categories

Loan applications	Number of Respondents n = 130
Short-term	43
Medium-term	67
Long-term	20
Longest period	180 months
Shortest period	2 months
Average period	82 months

The repayment periods can be divided into three different time frames; short, medium and long term. The longest loan period is 180 months, the shortest 2 months, and the average repayment period for the 130 loan applications was 82 months. Loan purpose variable will be used as an ordinal variable for further analysis, while loan application period will be a scale variable.

5.2.2.2. Loan size

The size of a loan does not necessarily cause a loan to default (Roessler, 2003; Jouault & Featherstone, 2006). Agriculture is a dynamic industry, and it is difficult to differentiate between sizes (in currency terms) of loan in terms of repayment period. This can be seen in Table 5.2 below, where it is shown that the average short-term loan application was actually for a larger amount than the average medium-term loan application. This situation places emphasis on how dependent the farmers are on short-term loans, or production loans, in their production activities. Besides the dependency on the short-term loans, the

second factor that can also be realised is the high costs that are associated with the inputs used in the production process.

Table 5.2: Distribution of the largest, smallest and average loan sizes for the short-, medium- and long-term categories

	Average	Largest	Smallest
Short term	R4 017 730	R32 000 000	R150 000
Medium term	R3 099 175	R10 000 000	R –
Long term	R9 856 248	R52 000 000	R1 400 000

These short-term loans, comprising production, working capital and overdraft loans, make up a very important part of the finance necessary for the continuation of food production. Short-term loans are normally repaid at the end of the production season from the revenue obtained for the product produced from the original financing. The medium-term category consisted mostly of loans for development, expansion, and vehicle and machinery finance. Finance in this category is normally between 60 and 120 months. The long-term category consists predominantly of farm purchase loans, where the repayment period is between 120 and 180 months. The loan size variable will be used as a scale variable for analysis.

5.2.2.3. Date of First business, account conduct and credit history

The standing of the current business is an important consideration in credit applications. A good relationship with the financial organisation does provide additional advantages when loan applications are considered. Good relations can be illustrated in loyalty to the organisation. A client that is satisfied with the nature of the business of the financial organisation will prefer to continue doing business with the financial organisation. To illustrate this loyalty, the number of years with which the client has been with the financial organisation is determined as shown in Table 5.3 below. The categories used in Table 5.3 are only used for illustration purposes, as the variable is used as a scale variable in the NN.

Table 5.3: The number of years an account was held with the financial organisation

Years	Number of Respondents n = 130
0	21
1-15	51
16-30	41
31-45	12
46-60	5
Longest period	60 years
Shortest period	1 year
Average period	15.18 years
New applicants	21

Several of the applicants were also potential clients for other financial organisations; these clients (21) have no history with the organisations and are captured in the 0 category. The largest numbers of applicants have been with the financial organisation for between 1 to 15 years. About 4 % of the total number of applicants had held accounts with the financial organisation for more than 46 years, with the longest being 60 years.

The history of a client's business with the financial organisation also needs to be considered in determining the repayment ability. As seen in Table 5.3 above, the largest proportion of applicants are current clients of the financial organisation, which indicates that the clients will have a history of conduct with the organisation. The conduct of the current account is categorised into two categories: the first is Good conduct; which include the farmers that have a good record in servicing their loans and other accounts, and are also the base category. The second category comprises all other account conduct options that include average, bad and undetermined. These clients have most probably created difficulties for the financial organisation in terms of their accounts conduct and credit servicing, which places these clients in a possibly riskier situation than the clients in the base category. Those also considered in the category are the undetermined clients, mostly new clients, who have no records with the financial

organisation and still have to prove that they are able to obtain good conduct status. It is important for the clients to ensure that their accounts are in good order to prevent a situation where they will be handed over to the legal department for not complying with loan terms and conditions.

The distribution of the account conduct categories, as an ordinal variable, is shown in Table 5.4 below. Table 5.4 indicates that the largest portion of the accounts are in good standing. This includes the applicants that are possibly new clients. In some instances, the possible new client's account standing is unknown and therefore the client still has to prove his or her ability to maintain a good standing with his or her financial account. These clients are also considered in the other category.

Table 5.4: Distribution of account conduct by clients' accounts

Account conduct	Number of Respondents n = 130
Good	**117**
Other	13

The standing of the clients' accounts with the financial organisation is not the only aspect that is considered in terms of past behaviour. If the situation arises that the client is not able to repay a loan, the financial organisation requires collateral to ensure that the resources supplied to the client are not lost. Accordingly, collateral or security is also considered in agricultural credit applications.

5.2.2.4. Collateral (security provided)

Collateral is also an important factor when considering credit applications. The most used collateral in the agricultural sector is agricultural land. Providing collateral is seen as a security measure for the financial organisation when the applicant is unable to repay the loan, which gives the organisation the right to sell the land, subject to due process, to gather all unpaid funds due in terms of the loan agreement. The categories used to indicate the collateral status of the

loan applications were divided into two, as shown in Table 5.5 below. The first is where sufficient collateral is supplied for the associated loans (base). The financial organisation would also consider additional loans, as the collateral may also be used for other loans, and there must be clarity on whether the value is great enough to cover all these loans. The second category is an indication of the farmers that do not provide sufficient collateral and are therefore required to provide additional collateral.

Table 5.5: Indication whether the existing collateral of the client is sufficient for the credit status

Security status	Number of Respondents n = 130
Secured	**119**
Other	11

When the existing collateral is not sufficient for the purpose of the new application, additional collateral needs to be supplied. The distribution for new collateral is shown in Table 5.6 below, which illustrates that most of the collateral supplied is sufficient, at 98 %.

Table 5.6: Indication of whether the additional collateral supplied by the client is sufficient for the credit status

Additional security status	Number of Respondents n = 130
Secured	128
Other	2

5.2.2.5. *Financial performance indicators*

The financial information provided in the application is contained in the income statement, balance sheet and current and projected cash flow statements of the applicant. Financial information is very important, as the financial organisation has to determine whether the farming business will have the capacity to repay according to the stipulated repayment terms and conditions. Making use of the

values to compare the performance of the farms places the smaller farms at a disadvantage, compared with larger or higher revenue farms. To avoid this problem, the financial performances are illustrated in terms of financial ratios. Financial ratios can be divided into five categories that illustrate different aspects of the financial situation of the business; these categories are shown in brackets for the ratios used as variables. The ratios used are: Debt to assets (DTA); Debt to equity (DTE) (Solvability); Current ratio (CR); Working capital to gross revenue (WCTGR) (liquidity); Asset turnover ratio (ATO); Return on assets (ROA); Return on equity (ROE); net farm income ratio (Netfarmratio) (profitability); Production cost ratio (Prodcost); interest cost ratio (interest); and the cash flow ratio (cashflow) (efficiency). The information supplied in Table 5.7 below provides several of the key aspects of the farming business.

Table 5.7: Farm financial information summarised from actual financial statements as illustrated by financial ratios

Financial ratio	LARGEST	SMALLEST	AVERAGE
DTA	1.8	0.0029323	0.3
DTE	10.9	0.0000000	0.4
CR	9800000.0	0.0000001	243739.0
WCTGR	6.4	-0.7434548	0.3
ATO	2.0	0.0000000	0.1
ROA	1.8	0.0000000	0.1
ROE	4.2	0.0000000	0.1
NETFARMRATIO	2.9	0.0000000	0.4
PRODCOST	6.8	0.0066743	0.7
INTEREST	1.4	0.0008387	0.1
CASHFLOW	2.4	0.0700000	1.1

5.2.2.6. *Associated risk of application and product diversification*

Demography and other factors have a significant influence on the agricultural sector as a whole, and can therefore also influence individual farmers. As there are a variety of commodities, enterprises and products which farmers produce,

all with different associated risks, it is important to consider the future risk for the specific application. The associated risks were divided into three categories, high-, medium-, and low-risk, and were allocated to each loan application according to the financial organisation's prescriptions. It is important to note that the risk category considers more than just the relevant enterprise, but also the location, future expectations and the overall economic situation, among other things. The largest proportion of loan applications for the research were categorised as medium risk, at 61 %, as illustrated in Table 5.8 below.

Table 5.8: Risk level for each loan applications expressed in three categories

Risk level	Number of Respondents n = 130
High	29
Medium	79
Low	**22**

Product diversification is a strategy that can be used to reduce the risk of a farming business by spreading the cost and income opportunities across several different enterprises. As already mentioned, the agricultural sector has a rather wide variety of diversification options. The diversification categories were divided into three options, according to the above mentioned number of enterprises of the farm as shown in Table 5.9 below.

Table 5.9: Product diversification of the respected farms

Diversification	Number of Respondents n = 130
Divers1	**40**
Divers2	56
Divers3 and more	34

5.2.2.7.   Age, experience and education

The age of the farmer does have an influence on the decisions that are made on the farm, and the results from Chapter 3 indicated that the age of the respondent is considered in credit applications. Age of the applicant is, however, less important in relation to the other factors, but is still included in the decision-making process. The age distributions of the respondents are illustrated in Table 5.10 below. The largest proportions of respondents were in the age groups between 41 and 50 (35) and 51 and 60 (36).

Table 5.10: The age distribution of the respondents

Age	Number of Respondents n = 130
21-30	3
31-40	31
41-50	35
51-60	36
61-70	19
71-80	6
Average age in years	51
Youngest respondent	28
Oldest respondent	81

The large distribution of farmers between 41 and 60 is an indication that the individuals involved in farming are of the older generation, and, as shown in literature, this can have an influence on the way decisions are made. Older operators may have the advantage of more experience, in certain cases, over younger operators, but older operators may be more hesitant to adopt new, innovative management practices (Haden & Johnson, 1989).

The average age of the farmers in the data set was 51 years of age, with the oldest being 81 and the youngest at 28 years of age. Farmers of different ages are represented in the dataset, and are at different stages of their lifecycles, for

example: younger farmers who are perhaps in the first years of their farming careers, the farmers who have been farming for a number of years and are starting to consider retiring; and lastly, farmers who are at the end of their farming careers. Each of these lifecycle stages does have an influence on decision making. The age of the farmer or operator, however, does not necessarily need to be a constraint in determining the success of the entrepreneur or farming business. The older and/or uneducated farmers can still be very successful in their agricultural activities by staying informed about the developments and advances in the sector (Singh, 2013). Farm experience and education levels of the respondents are discussed below to provide more information about the respondents. The older respondents reflect a greater amount of experience. The experience of the respondents in years is shown in Table 5.11 below. Most of the farmers (35 %) have between 11 and 20 years of experience.

Table 5.11: Distribution of the farm experience of respondents in years

Experience	Number of Respondents n = 130
<10	22
11-20	46
21-30	34
31-40	19
41-50	8
51-60	1
Average years of experience	23
Minimum years of experience	5
Maximum years of experience	60

The average number of years of experience is 23. Older operators will have an advantage over younger operators in terms of experience, and this is also illustrated in the number of years' experience in relation to age.

Education and work experience contribute by enabling individuals to discover entrepreneurial opportunities that are presented by changes that have occurred

(Shane, 2000). Education is an important aspect that can influence the decision-making behaviour of an individual to the extent that, as stated by Gasson (1998), better-educated farmers are known to make use of information, advice and training. The level of education is also an important factor which can explain changes in the strategic behaviour of farmers (Ondersteijn *et al.*, 2003). The education levels of the respondents are therefore important and are shown in Table 5.12 below. From the total number of respondents, 30 % have no tertiary education, while the largest proportion, 56 %, have at least one form of tertiary education qualification. Tertiary education includes individuals that have a degree or diploma from any tertiary institution.

Table 5.12: Distribution of respondents' education levels

Education level	Number of Respondents n = 130
No education	2
Matric	**34**
Graduate	76
Postgrad	14
No Indication	4

5.2.2.8. *Entrepreneurial competencies*

The entrepreneurial competencies of the farmers were calculated in Chapter 4. These competencies are now included as variables in determining the repayment ability of a client. Entrepreneurial competencies of the individuals are included in terms of each of the measured competencies: opportunity seeking; relational; conceptual; organising; strategic; commitment; learning; and personal strength competencies. These competencies are the average score for the items in each of the competencies, considering the scores provided by the representative assessment. The competencies scores were determined as the average of all items included in the determined factor and the number of respondents in each scoring category, as indicated in Table 5.13 below.

Table 5.13: Distribution of the number of respondents in score categories for each entrepreneurial competencies factor

Category Competencies	Rating scores of the applicants as determined by the representatives			
	3 – 3.99	**4 – 4.99**	**5 – 5.99**	**6 – 7**
Opportunity seeking	6	32	46	46
Relationship	2	5	55	68
Conceptual	3	19	65	43
Organising	2	13	48	67
Strategic	2	12	62	54
Commitment	1	5	19	105
Learning	1	12	54	63
Personal Strength	1	11	58	60

All the input variables are used to categorise the applications as acceptable or rejectable for the final decision. As the supervised, back propagation algorithm uses input–output combinations for training purposes, the final decisions for the applications are indicated next.

5.2.2.9.   *Final decision*

The final decision is the dependent variable in the model. The applications can be either accepted or rejected, and this takes the value of an ordinal variable. Loans that were accepted are attributed a value of one, and those that were rejected a value of zero. The financial organisation has a very high approval rate of between 90 and 97 % (Anonymous 3, 2015). The high approval rate is also reflected in the amount of approved applications (88 %) in the dataset, which is reflected in Table 5.14 below. Only five per cent of the applications were declined, while the other applications were approved by the organisation. These output variables were used in the training of the NN.

Table 5.14: Final decision in determining the repayment ability of loan applicants

Category	Number of Respondents n = 130	Cumulative percentage (%)
Approved	114	88
Pending	9	95
Rejected	7	100

The applications that are indicated as pending are used in the application of the neural network, where the trained network was applied to determine the outcome for the nine credit applications. These applications are therefore classified in a category by the NN according to the training process.

5.3. Results

5.3.1. Training of the back propagation neural network

The results (output) of the neural network are between zero and one due to the logistic activation function and linear output. Following Angelini *et al.* (2008), applications scoring less than 0.5 were converted to zero (rejected) and larger than 0.5 to one (approved).

The numbers of hidden layers and neurons in the model were determined by trial and error by implementing different layers and comparing the misclassification error of each model run. The back propagation network, however, performed satisfactorily with three layers (input, one hidden and output) consisting of two neurons. The misclassification error of 0 % illustrates that the network was able to correctly train and predict all of the applications according to the original classification by the financial organisation. The classification and conversion of the outputs (classification categories) can be found in Appendix E, where the specific calculated output for each application is shown, together with the converted output value (zero or one); trained or original classification used by the network to learn (zero and one); application status; and lastly, an indication whether the classification from the model is correct.

Basic information regarding the training process for the neural network was calculated in one repetition and reached a minimum error of 0.025. A small minimum error indicates that the network is a good model fit. A total of 20 533 steps were needed for the absolute partial derivatives of the error function to reach a minimum threshold of 0.009999985, which is less than 0.01 stipulated in the formula. A plot of the determined network is shown in Figure 5.1 below, which shows the single hidden layer consisting of two hidden neurons, synaptic weights and the intercept values.
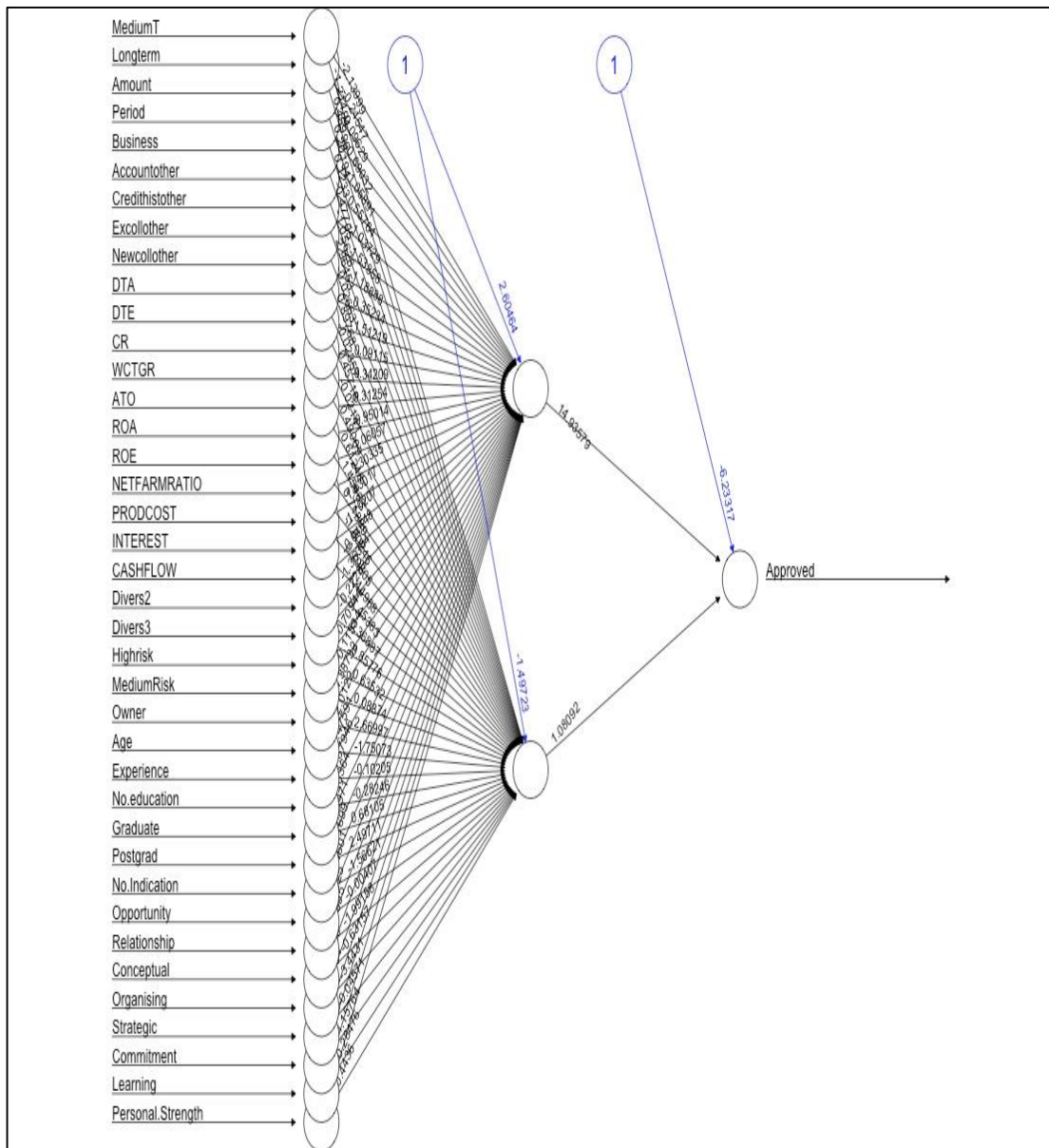
Figure 5.1: A graphical illustration of the trained neural network, indicating the trained synaptic weights of the train process

The synaptic weights between each of the inputs and the hidden neurons are not clearly identifiable in Figure 5.1, hence are shown in Table 5.15 below. The weights are a representation of the information that is used in the network to perform the task of predicting the class of each application by increasing or decreasing the output of the specific neuron. The weights used in the neural network can be excitory or inhibitory. Weights are used to connect each individual input from the input layer with the neurons and finally to the output. The weights are used in the training of the network to reach the specified threshold, and the weights were adjusted until the threshold was below 0.01. When the threshold was reached, the network was also able to correctly predict all the outputs with the determined weights. When the training of the network is finished, by reaching the minimum threshold, the network can be applied to other data observations. The weights contribute to minimising the error function by increasing or decreasing their values and the product of the weights and the associated inputs. The outputs from the sum product of the weights and inputs are then transformed to output values between zero and one due to the logistic activation function. The weights indicate the direction and effect of the inputs in the network, and more specifically at each of the three neurons. The weights of the variables and intercepts are shown in Table 5.15 below with respect to each neuron.

Table 5.15: The weights determined by the neural network to classify credit applications for each of the neurons included in the network

	Neuron 1	Neuron 2	Accept
Intercept	2.604639698	-1.497230922	-6.233166844
MediumT	-2.139986986	-1.21493544	
Longterm	-0.245467585	0.459955698	
Amount	0.096287889	0.201938822	
Period	-0.690315301	0.12330327	
Business	-1.058913127	-0.47705494	
Accountother	0.55764252	-1.056276427	

Credithistother	-1.037286919	2.964529763	
Excollother	1.538575954	-0.026627234	
Newcollother	1.188879814	0.897678952	
DTA	0.352343965	-0.023569954	
DTE	1.512189985	0.45717894	
CR	0.091149849	-0.021412424	
WCTGR	0.342091415	0.490092273	
ATO	0.312541277	0.612477607	
ROA	-0.950136174	1.456630664	
ROE	-1.06056535	0.718989366	
NETFARMRATIO	-1.303351747	-1.602464024	
PRODCOST	1.430172402	0.798052865	
INTEREST	-1.702070735	-1.449675542	
CASHFLOW	-0.046482558	-1.45383473	
Divers2	-1.36383606	0.368873351	
Divers3	-0.222832442	0.857762007	
Highrisk	0.709437948	0.635320458	
MediumRisk	-0.115336351	0.088735477	
Owner	4.387319733	2.669974958	
Age	-2.012200093	-1.750728663	
Experience	2.47590992	-0.10205119	
No.education	-1.679464778	-0.282455197	
Graduate	0.483637801	0.681047474	
Postgrad	1.669713651	2.497114691	
No.Indication	-1.716991687	-1.566209359	

Opportunity	*-1.246013494*	*-0.004074801*	
Relationship	*-2.152501161*	*-1.99158306*	
Conceptual	*-0.483954954*	*-0.631572929*	
Organising	*0.643297072*	*-3.443102196*	
Strategic	*0.313940943*	*-0.045710701*	
Commitment	*0.098707967*	*1.157642951*	
Learning	*2.079524394*	*-0.284760889*	
Personal.Strength	*1.595703542*	*-0.443598672*	
Neuron 1			14.93578736
Neuron 2			1.080917097

An important aspect to consider is that the output from each neuron is not only transferred to the next neuron. The output is first transformed to a value according to the logistic activation function. This implies that a value is determined with the use of the weight coefficients, inputs and the intercept for each neuron, and the output is transformed by the activation function and then transferred to the following neuron. If it were to be the final neuron, the output would be the result of the network. The coefficient weights, inputs and intercept therefore influence the output value that is transformed by the logistic activation function. Positive values are transformed to values closer to zero by the logistic function, while negative values are closer to one.

Table 5.15 above shows that the weight with the largest influence, with relation to the first neuron, is the ownership of the farm, followed by experience. Both weights are positive and would increase the positive values, while decreasing negative variables. Weights with the smallest negative values were relationship competencies and medium term loans, and the opposite effect can be expected on variables. The values closest to zero that will have the smallest effect in determining the output value for the neuron included amount and current ratio, both positive, and cash flow ratio and medium risk sector (both negative). As the

weights associated with these values are smaller compared with the other variables, a smaller change would be observed in the product. Added to the sum product of the weights and variables is the intercept for the neuron, **2.60**. The number of weights that was distributed between 1 and -1 is 18, of which 11 are positive weights and 7 are negative. The positive intercept implies that, before any of the weighs or inputs are considered, the output will be closer to zero (rejected). To achieve an output value closer to one (approved), the sum product of the weights and variables needs to be larger than the **2.60**.

The second neuron has a spread of between 2.96 and -3.44, with more negative than positive weights. Credit history and ownership were the largest weights, while two entrepreneurial competencies factors, organising and relationship, indicated the lowest weights. The intercept for the second neuron is -1.49, which would have to be added to the sum product of the weights and inputs from neuron two. As explained for the intercept of neuron one, the intercept for neuron two is negative, indicating that before considering the sum product of the weights and inputs, the output transformation will be closer to one. The weights that have the smallest effect, smaller than one, total 25. Of these 25, 14 are positive and 11 negative. The outputs from neuron one and two are then multiplied by the weights that connect the neurons with the final output neuron. The weight is **14.94** for the first neuron and **1.08** for the second. The intercept for calculating the output that needs to activate the last neuron is **-6.23**. The sum product of the transformed outputs from the first and section neurons and the weights (14.94 and 1.08) needs to be larger than the intercept for rejected applications. The sum product of approved application weights and inputs can be less than or equal to 6.23, while rejected applications will have values greater than 6.23. The values have been calculated and converted by the logistic function and the final category of the application is revealed by a value between zero and one.

The network provides weights to each individual variable in the training process that was used in the prediction for each applicant. Generalised weights indicate the contribution of each of the inputs in the network to determine the output

value. These weights are calculated in relation to the total number of inputs used in the network. The focus in the results is concentrated on the entrepreneurial competencies inputs, as the main objective of this chapter is to include the entrepreneurial competencies in the credit models. The results of the other input factor will be compared in relation to the competencies factors.

The distribution of the generalised weights provides an indication of whether each input has an overall effect in the weight determination of the variable, and whether the effect is linear or non-linear. A small variation suggests that there is a linear effect, while a larger variation suggests a nonlinear effect (Intrator & Intrator, 2001 cited in Günther and Fritsch, 2010). The distribution of the generalised weights of the entrepreneurial competencies is shown for opportunity seeking (Figure 5.2); relationship (Figure 5.3); conceptual (Figure 5.4); organising (Figure 5.5); strategic (Figure 5.6); commitment (Figure 5.9); learning (Figure 5.8); and personal strength (Figure 5.9) to determine whether the distribution of the weights are not all equal to zero.
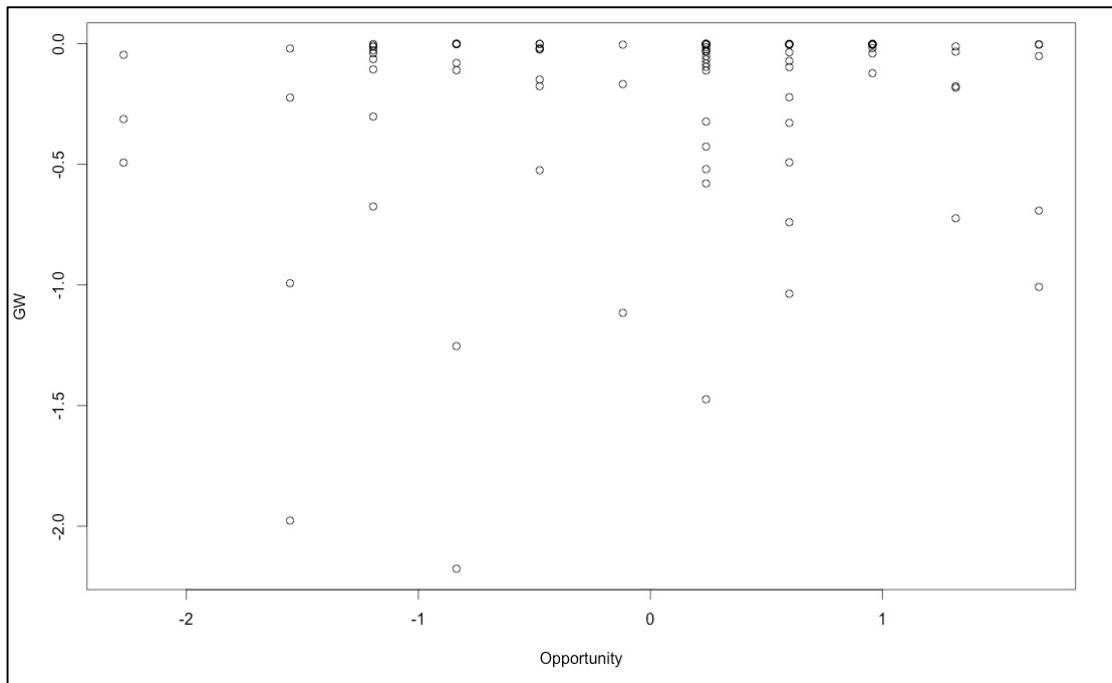
Figure 5.2: Generalised weight distribution for opportunity seeking competencies
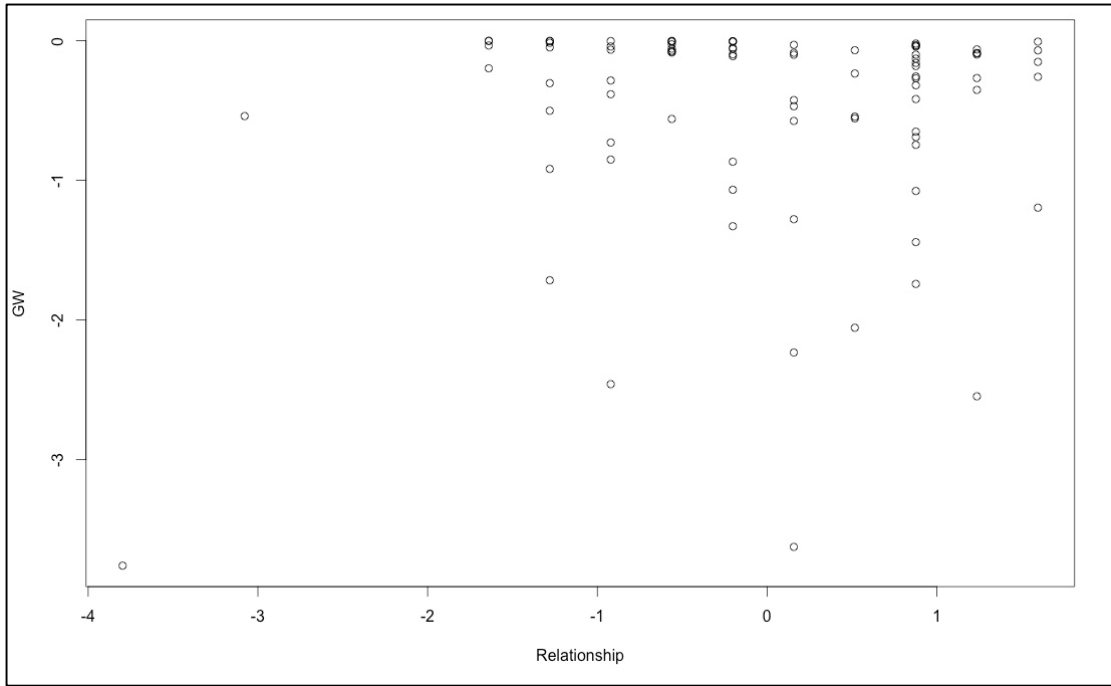
Figure 5.3: Generalised weight distribution for relationship competencies
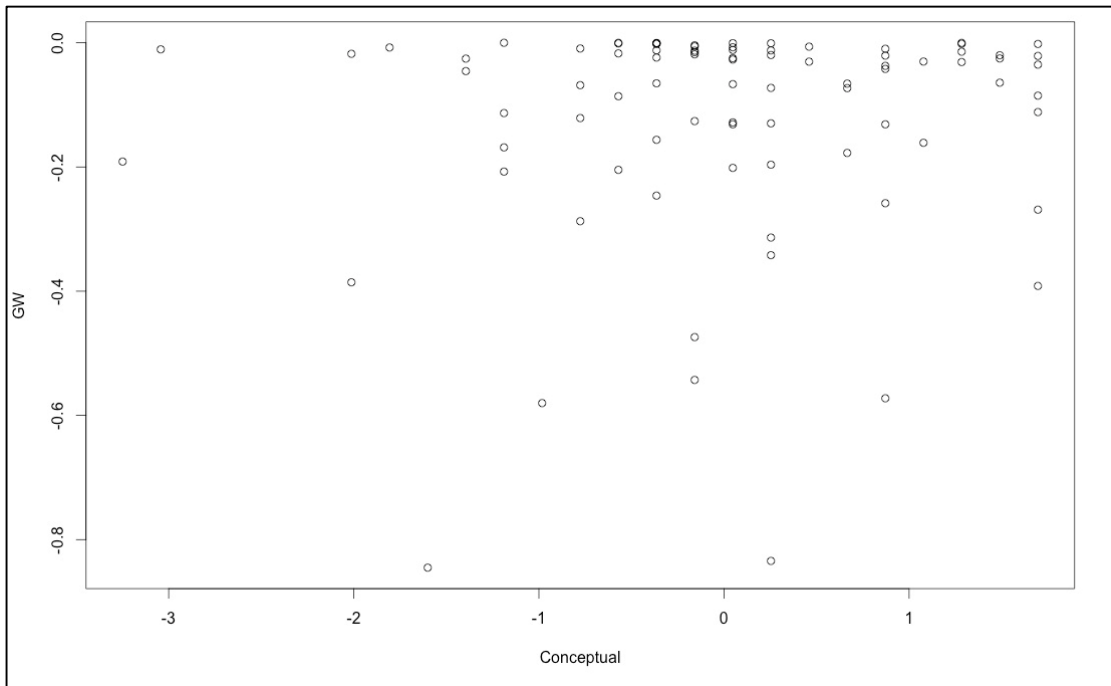
Figure 5.4: Generalised weight distribution for conceptual competencies

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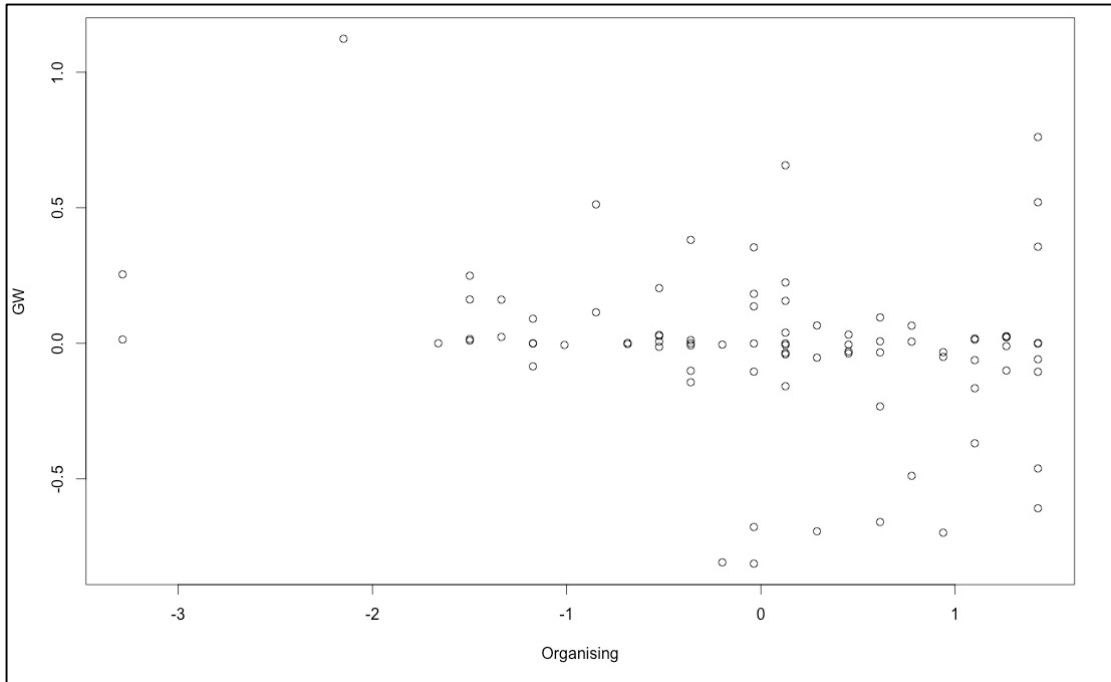
Figure 5.5: Generalised weight distribution for organising competencies
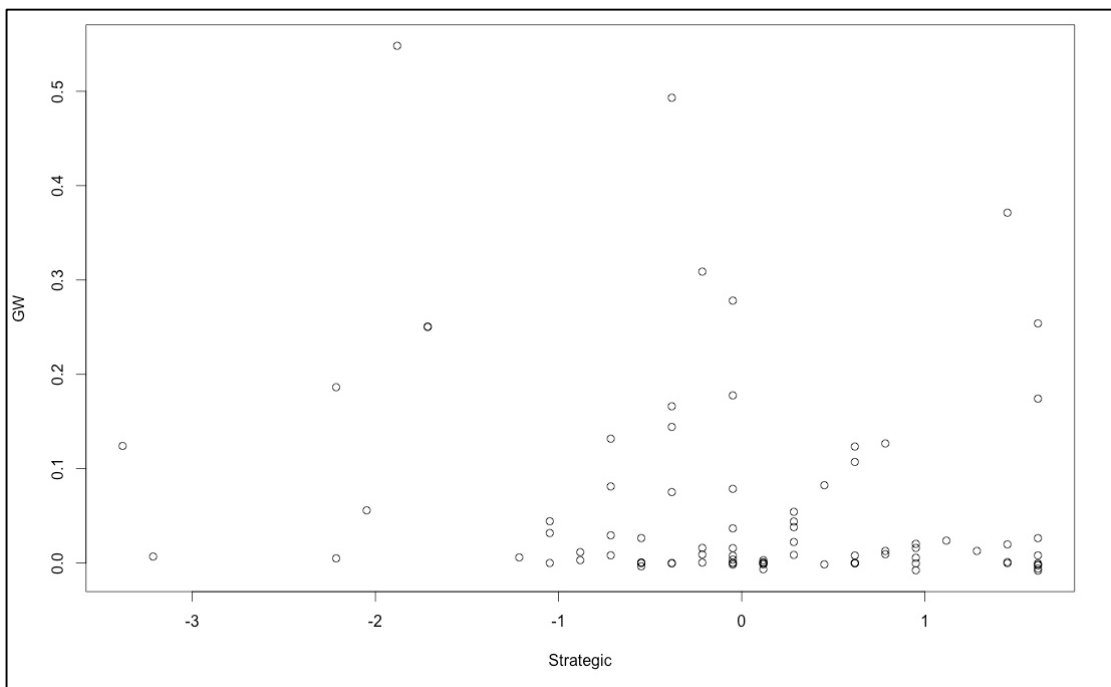
Figure 5.6: Generalised weight distribution for strategic competencies
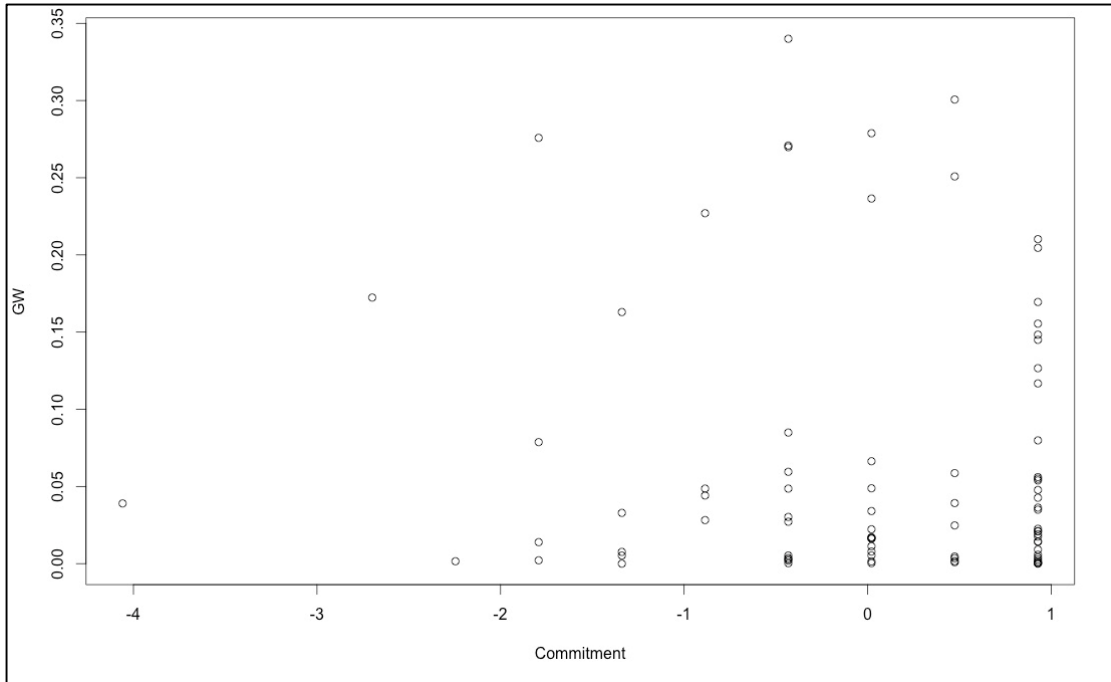
Figure 5.7: Generalised weight distribution for commitment competencies
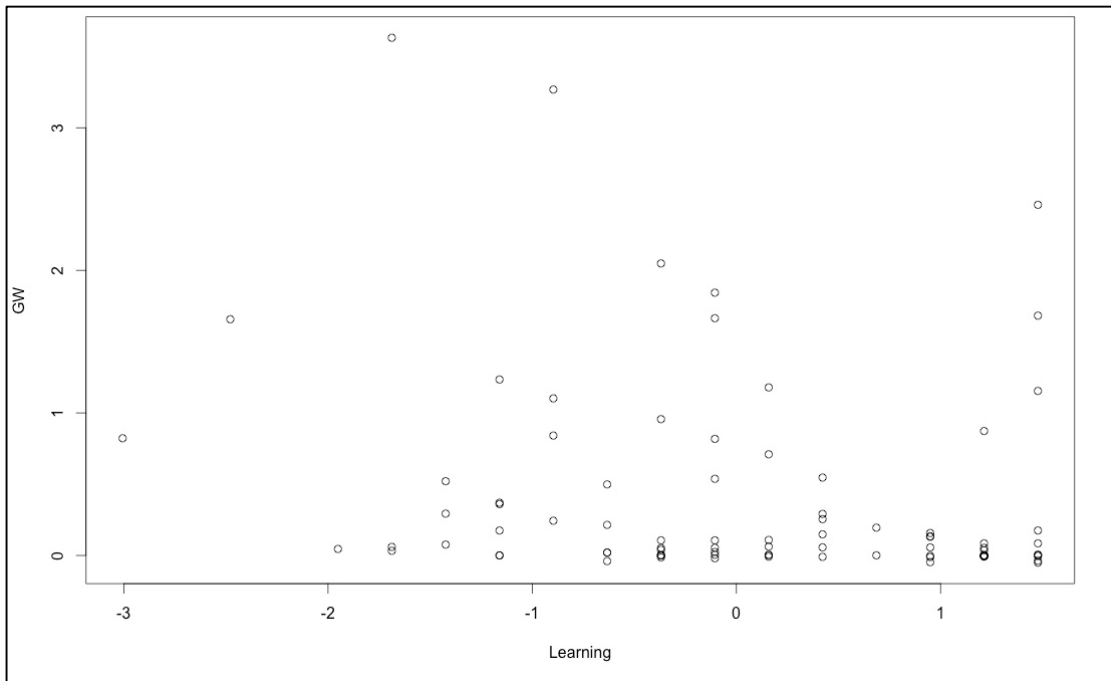
Figure 5.8: Generalised weight distribution for learning competencies
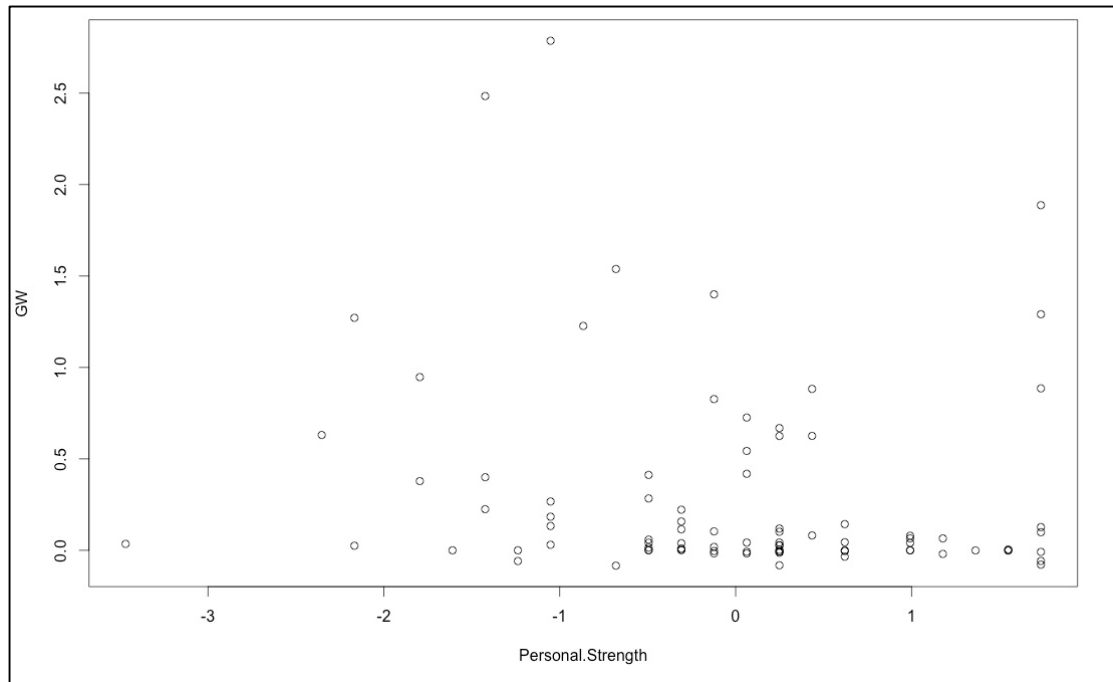
Figure 5.9: Generalised weight distribution for personal strength competencies

Each of the competencies' generalised weights distribution indicates that there is an effect on the weights determined that are used in the decision making to approve the loans. The distribution is found to have a non-linear effect, as the variations of the weights are not all equal to zero. Opportunity seeking competencies' generalised weight distribution[3] was between 0 and -2.18; relationship between -0.0001 and -3.76; conceptual between -0.00002 and -0.85; organisational between 1.12 and -0.81; strategic between 0.55 and -0.01; commitment between 0.34 and 0; learning between 3.63 and -0.05; and lastly, personal strength between 2.79 and -0.08. The two competencies with the lowest variations in their generalised weights were commitment and organising, while relationship and learning competencies factors indicate the largest distribution in generalised weights.

When the distributions of the entrepreneurial competencies are compared with the other scale variables included, the distribution of the general weights do in fact compare well with the other scale variables (age; experience; amount; period; business; DTA; DTE; CR; WCTGR; ATO; ROA; ROE; NETFARM; Prodcost;

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3 The value of zero indicates a value that is very close to zero and is for ease shown as zero.

interest; and cashflow) used in the neural network, also shown in Appendix F. The entrepreneurial competencies have now been successfully included in the neural network credit model, and further testing is required for determining that the network is a good fit.

The number of neurons in the hidden layer can influence the validity of the results from the network. An incorrect number of neurons can result in the network being unable to model complex data, which results in a poor fit model (Pacelli & Azzollini, 2011). Too many neurons in the hidden layer can result in prolonged training time and over fit the data. Over fitting of the data can result in the model beginning to model noise in the data, which results in the neural network predicting the training data very well, but working poorly when used with new data (Pacelli & Azzollini, 2011). To ensure that there is no over fitting of the data, 30 % of the data was randomly extracted by the software and used as testing data. The result is interpreted with the use of a confusion matrix, indicating the number of correctly and incorrectly predicted applications. Paliwal and Kumar (2009) indicate that the confusion matrix is the most frequently used method to evaluate error measures. The confusion matrix shown in Table 5.16 below indicates the classification of the credit applications of the testing data.

Table 5.16: Confusion matrix of the results for the testing of the neural network

	Model testing		
	Approved	Rejected	Total
Approved	32	1	33
Rejected	1	2	3
Total			36

The classification matrix indicates that only 2 of the 36 applications were categorised in a different category, compared with those of the financial organisation, thus presenting a misclassification rate of only 5.6 %. The results of the testing indicated that there was no over fitting, with the model predicting 94.4 % of the applications correctly, indicating that the network can be used for

application purposes. The network can thus be used in the application of the network to categorise the pending applications.

The following section demonstrates the application of the trained neural network incorporating the entrepreneurial competencies in categorising nine pending credit applications.

5.3.2.   Application of the trained back propagation neural network

The neural network was trained with the known input and output combinations, where the network learned the relationship between the inputs and the decisions that were made for each application. The knowledge, weights (Table 5.15 above) and thresholds, which are obtained during the learning process and tested, are applied to predict the decisions for the pending applications. The inputs for the applications were processed with the trained back propagation neural network to determine whether the applications should be approved or rejected. The results are shown in Table 5.17 below.

Table 5.17: Result indication for the pending credit applications according to the trained back propagation neural network

Application number	Output	Output conversion	Result
3	0.999815258	1	Approved
107	0.999935832	1	Approved
112	0.999894763	1	Approved
113	0.999857639	1	Approved
114	0.999548795	1	Approved
116	0.999842669	1	Approved
117	0.001975713	0	Reject
118	0.999943598	1	Approved
126	0.999834381	1	Approved

Table 5.17 shows that only one of the nine applications was classified as being appropriate to be rejected (application 117). The remaining applications were all classified as approved. Importantly, the classification of these applications

indicates that the neural network, with the inclusion of the entrepreneurial competencies, can be used in the classification of credit applications.

It is noted that when new applications are used in the network, the input variables must correspond with the input variables used in the training and testing processes. The introduction of new variables would require a new training process where the neural network first has to learn the relation between the new input variables and the outputs (outcome). This also influences the credit decision-making process insofar as no additional factors can be considered in the process, other than those that are required and trained originally. This provides a reliability aspect to the decision-making process, as the same variables are consistently considered between all applications.

The neural network methodology does, however, provide some difficulty in providing reasons for why a certain decision was reached for an application. This is also stated as one of the main weaknesses of neural networks by Salame (2011): "the structure of the relationship is not so transparent and neural networks have been known for being black boxes", and this can be a very important factor that influences the adoptability of neural networks for agricultural credit applications. Reasons for rejecting an application are to be expected, but reasons cannot be supplied for applicant 117 as to why the credit application was classified as rejectable only on the basis of considering the neural network results. This does not, however, prohibit a financial organisation from making use of neural networks as supplementary tools in its credit evaluation processes, where the NNs can be applied in certain situation such as disputes and borderline applications. The network can be used in a borderline situation, as the network will be able to compare the current applications to similar situations in the trained data set and provide a category accordingly.

5.4.   Summary and Conclusion

The objective of Chapter 5 was to incorporate the previously defined entrepreneurial competencies in determining credit repayment ability models. A supervised, back propagation neural network was used as a methodology for

incorporating the variables. Neural networks were identified in literature to be the best predictor in classifying high-risk loan applicants, or in other words, for accurately predicting bad loans as rejection appropriate. As the objective of credit scoring models is to correctly classify applications, it was decided that the model composition that yielded the lowest misclassification rate would be chosen.

The neural network was successfully trained, with a 100 % classification rate. All of the applications were correctly predicted in the training stage of the network that consisted of three layers (input, middle and output) and two neurons, and using an error of 0.025 and threshold of 0.00999985, it took a total of 20 533 steps to converse. The trained model was also tested on an unseen dataset to ensure that there was no over fitting of the model and that it would be able to predict the applications. A confusion matrix was used to interpret the results of the testing data, and indicated that the model was very accurate in correctly predicting 94.6 % of the applications, indicating that the model is able to predict new data accurately.

The inclusion of the entrepreneurial competencies factors was of interest for achieving the aim of the exercise, and the generalised weights of the eight competencies factors were plotted to estimate the contribution of the factors. The generalised weights indicated that the competencies factors do indeed contribute at different levels in determining the output category as either approved or rejected. The competencies variables generalised weight distributions were found to be similar to variables, such as age and experience, that are constantly found in credit literature which are directly related to the individual. The trained network was used to categorise nine credit applications that were still being processed at the financial organisation. Of the nine applications, one was classified as appropriate to be rejected by the trained network. The reasons for the rejection of this application are, however, difficult to provide, due to the nature of the neural networks. One of the advantages of using the neural network is that there is reliability in the decision-making process, as the variables used to reach a certain decision are consistently similar

between all the applications. Neural networks are not able to consider new or additional variables for individual cases when using the application of the trained network on new applications. When new variables or additional variables need to be considered, a new training procedure is needed, where the neural network is trained for the inclusion of the new variables. This is a very important aspect, as organisations need to ensure that the decision-making is consistently similar between the applications to ensure that no single application has a certain advantage compared with others.

The chapter describes the inclusion of the entrepreneurial competencies of farmers in the credit-scoring model. The competencies contributed as decision-making variables in predicting the repayment ability of the applications. The results indicate that the competencies of farmers that are measured with an objective instrument, where scores are provided for each or even overall, do provide a decision-making variable or variables that can be included in credit applications in the agricultural sector. As the procedure only included one financial organisation, the exercise serves as a test case for the application of the statistical procedures and inclusion of the entrepreneurial competencies in agricultural credit modelling. Further research is, however, needed to interpret the results provided by the neural network on the classification of the specific application. The shortcoming shown by the difficulty in interpreting the reasons behind the results of the network, which is also mentioned in previous research, provides some indication as to why the implementation of neural networks might still need further development for agricultural credit applications.

Chapter 6
Summary, Conclusion and Recommendations

6.1. Introduction

6.1.1. Background and motivation

Changes in the agricultural sector over the years have forced farmers to become more adaptive to their environment (Lans *et al.*, 2013). Farmers are required to exhibit entrepreneurship or entrepreneurial competencies to ensure the continuation of their farming businesses (Pyysiäinen *et al.*, 2006; McElwee, 2008; Lans *et al.*, 2013). One of the aspects that is associated with business growth and performance comprises entrepreneurial competencies (Mitchelmore & Rowley, 2010). Competencies can be seen as the essential personal traits, skills, knowledge and motives of a person that lead to superior managerial performance (Mitchelmore & Rowley, 2010).

Competencies in entrepreneurship comprises a combination of both entrepreneurial and managerial competencies. In the entrepreneurship context, the competencies are related to the birth, survival and/or growth of a venture (Bird, 1995; Baum *et al.*, 2001; Colombo & Grilli, 2005; Mitchelmore & Rowley, 2010). The skills of the entrepreneur play an important part in the venture's performance and growth (Bird, 1995; Cooper *et al.*, 1994; Lerner & Almor, 2002) furthermore, Mitchelmore & Rowley (2010) mentions the development of entrepreneurial skills contributes to profitability and growth (Chandler & Jansen, 1992).

6.1.2. Problem statement and objective

Literature increasingly acknowledges the rich setting that the agricultural sector provides for researching entrepreneurial competencies (Pyysiäinen *et al.*, 2006). Lans (2009) refers to several research studies that have been carried out in countries (with additional studies added) including the United Kingdom (Carter, 2001; McElwee, 2008; Phelan, 2014), the United States of America (Hinrichs *et al.*, 2004), Nordic Countries (Levander, 1998; Alsos & Carter, 2006; Grande *et al.*, 2007), Southern Europe (Skuras *et al.*, 2005), Australia and New Zealand (Nuthall, 2006; Pritchard *et al.*, 2007) and the Netherlands (Bergevoet, 2005; De Lauwere, 2005; Lans 2009). The concept of entrepreneurial competencies is,

however, an unfamiliar aspect in the South African agricultural sector, with limited research on the concept.

The fields of entrepreneurial competencies or farmer entrepreneurship have not received much attention, especially in relation to credit applications. However, research has shown that entrepreneurial competencies of the entrepreneur do have an influence on business performance. The positive influence of higher entrepreneurial competencies levels on performance provides an important link, as improved performance does exert an influence on the repayment ability of a business or individual. There is thus justification for giving attention to entrepreneurship in agriculture by extending existing credit scoring models to include soft skills, such as entrepreneurial competencies of farmers, to increase their potential for gaining access to credit or affordable credit.

The problem is that currently there is no information available on the influence of such skills on the ability to repay loans, and, as Singh (2013) explains, "in any country or region, strategies for improving agricultural productivity or income of farmers, it is necessary to develop an entrepreneurial culture among farmers". Bergevoet (2005) also mentions that insight into the entrepreneurial role of farmers is relevant for inclusion among the factors for the evaluating of risk related to external financing. Both the decision-making involved in, and the classification of, credit applications are important aspects of the credit provision process.

6.1.2.1. Objectives

The main objective of this research is to develop a theoretical credit model that extends current credit models by incorporating the entrepreneurial competencies of farmers. Entrepreneurial competencies have proved to increase a firm's performance, and can thus provide important indications of the abilities of farmers to ensure the growth and survival of their businesses, which in effect will enhance and ensure their ability to repay loans. The objective of the research will be reached by making use of a case which includes a South African financial organisation.

The main objective will be achieved through the following objectives:

Objective 1: To explore the current credit assessment process in order to understand the factors and characteristics that are used to assess credit applications and to identify other factors and characteristics that could improve the degree of accuracy with which repayment ability is predicted.

Objective 2: To measure the entrepreneurial competencies of farmers that can be included in credit applications. The entrepreneurial profile includes factors that are associated with entrepreneurial competencies that enhance the performance of a firm.

Objective 3: To incorporate the entrepreneurial competencies profile of a farmer into a credit-scoring model that minimises the acceptance of high-risk applications in the South African agricultural sector.

6.2. Literature review

A literature review was undertaken to gain a better understanding of the credit process and especially the credit process in the South African agricultural sector. Variables that are considered in the credit applications of a farmer comprise aspects such as age, gender, marital status, education, experience, farm and household size, income, group membership, source of credit, distance between lender and borrower, perception of loan repayment, perception of lending proceedings, guarantor, farm enterprises and value of assets (financial performance). The variables mentioned that can be associated with the character of an individual are age, gender, education and experience. Managerial and entrepreneurial abilities of the individual farmers are thus ignored in credit applications, and research has found that entrepreneurial competencies do have an influence on the financial performance of a business. Farmers with better entrepreneurial competencies abilities are therefore expected to perform better in their businesses, a factor which can be related to improved or better repayment ability.

The process used by a commercial financial organisation operating in the South African agricultural sector was found to rely on several steps, which include completing the credit application with assistance from a representative executive from the financial organisation, reporting by agricultural experts on the current economic and sector situations, and lastly, a decision made by a credit analyst with the use of available information and internal systems. During this process, reports are also submitted on the abilities of the farmer by the executive representative or agricultural expert. These reports are based on the personal knowledge of the individual writing the report of the client, and are therefore based on human judgement. The shortcomings of human judgement, as mentioned, provide opportunities for improvements in the credit process by introducing methods that can provide reliable and consistent reports on the managerial and entrepreneurial abilities of farmers.

As the entrepreneurial side of the farmers is currently ignored in the credit process, literature related to entrepreneurship, entrepreneurship in agriculture, and characteristics associated with being entrepreneurial were reviewed. The review highlighted the fact that the aspect of farmers, as entrepreneurs, has only recently attracted more attention, even though farmers were noted to be entrepreneurs a long time ago (Wilcox, 1932). A farmer is seen as the individual in charge of the business, while the farm is the business in which the farmer applies his or her trade. Farmers need to develop new skills and improve their existing skills to remain competitive (McElwee, 2008).

Several approaches exist in the literature to gain a better understanding of entrepreneurship, including the traits approach; the behavioural approach; the opportunity identification approach and the approach involving entrepreneurial human capital, skills and competencies (Phelan, 2014). The competencies approach has been an increasingly popular method used to measure the entrepreneurial characteristics of individuals. Competencies can be observed through the behaviour of an individual (Bird, 1995), and when the behaviour is observed, one can claim that the individual possesses the relevant competencies (Man & Lau, 2005). Competencies involve characteristics of an individual that

include motives, traits, aspect of self-image (social roles), and skills or knowledge that lead to effective and/or superior job performance (Man, 2001). Entrepreneurial competencies were found to have a positive influence on the competitiveness of SMEs, and when a business is mostly managed by a single individual. Competitiveness can be seen as a means to attain increased financial performance, which in turn leads to improving the repayment ability of the business. Man (2001) developed an instrument to measure the entrepreneurial competencies of owners and managers from a behavioural perspective.

Research which has explored entrepreneurial competencies in agriculture is limited, especially in the South African agricultural sector. The entrepreneurial abilities of South African farmers are relatively unknown and should be researched to assist the farmers and other role players in the sector to learn, adapt and apply new skills and knowledge.

6.3.   Determinants of farm repayment ability

The main objective of Chapter 3 was to explore the current agricultural credit assessment process, specifically to understand the factors and characteristics that are used to assess credit applications. Attention was also given to identifying other factors and characteristics of a farmer that might improve the degree of accuracy with which repayment ability is predicted.

The chapter presented an alternative view of the indicators used in the agricultural credit process by considering the process from the credit provider's perspective, and not from that of the borrower. Credit research tends to view the process from the borrower's perspective. Characteristics and factors that are considered by the credit providers were identified in the Delphi procedure, but the research was expanded to identify additional factors which are currently escape consideration or are problematic in the process.

In total, 15 different factors were identified as being important when evaluating a credit application. Factors that were found to be important in the credit process included: Account standing, Age, Client success factor compared with

competitors, Collateral, Credit record, Education/qualifications, Experience, Farm ownership, Market information, Past and current financial performance, Product market projections, Reputation, Sustainability of the enterprise, Type of farming enterprise, and Willingness to repay. As expected, the most important factors included the financial performance, sustainability and security of the applicant. Age, experience and education, which are often cited in the literature as factors that influence access to credit, are also considered in the application process, but are considered to be less important than the other above-mentioned factors.

The representatives of the financial organisation identified a number of additional personal characteristics and abilities of a farmer that should be considered in the credit application process, including certain managerial and entrepreneurial characteristics such as the ability to manage different aspects of the farm business (financial, technical, production, marketing, natural resources and human resources). The research has identified several entrepreneurial and management capabilities that are considered to be important in a credit evaluation instrument. These factors include: Leadership and human relations, Creativity and innovation, Internal locus of control, Self-confidence (Self-efficacy), Persistence, Planning, Passion, Leadership, Opportunity seeking, Conflict management, Risk management, Need for achievement, Positivity, Tenacity, Commitment and confidence. The aspects of the individual related to the characteristics used to describe the entrepreneurial competencies are explained in the literature and by Man (2001) as consisting of opportunity, relationship, and conceptual, organising, strategy and commitment competencies. The entrepreneurial abilities of a farmer indicate a degree of promise in the application, with a higher level of entrepreneurial competencies having been found to have a positive influence on farm performance, thus pointing to better repayment ability. The influence of entrepreneurial competencies on performance therefore justifies the inclusion thereof in the credit application process, and this factor should be investigated further in future research studies.

The results show that there is consensus on the factors that are considered in determining the repayment ability of farmers. Such consensus is a good indication that there may be a high level of consistency in the classification of applications. However, further investigation revealed that the decisions in terms of classification are based on human judgement. The use of human judgement does have certain disadvantages, such as high training costs, as well as frequent incorrect and inconsistent decision-making by different experts on the same application. When the respondents were asked to indicate whether the use of objective credit-scoring models would assist in improving the consistency of the classifications, most indicated that the use of statistical methods could improve consistency in credit-granting decisions, but some limitations were also mentioned.

Further research needs to be conducted to investigate the implementation of objective statistical methods to determine repayment ability within the South African agricultural sector where these identified factors can be implemented to extend or contribute to the current decision-making variables in credit instruments. Research would include identifying measurement instruments to identify and/or measure the entrepreneurial competencies factors in such a way that the factors can be included in the credit instruments. Such research would not only be to the advantage of the South African agricultural sector, but could also be successfully applied to other developed and developing countries.

6.4.   Measuring entrepreneurial competencies of farmers

The aim of Chapter 4 was to explore the entrepreneurial competencies of farmers and to provide a method through which these competencies could be included in a credit-scoring methodology. Entrepreneurial competencies of South African farmers are still unknown, with limited research on the subject. This research contributes to current literature by investigating the entrepreneurial competencies of South African farmers from a behavioural perspective.   The research found that farmers illustrate entrepreneurial competencies through their observed behaviour.   Eight entrepreneurial

competencies were identified: opportunity seeking; relationship; conceptual; organising; strategic; commitment; learning; and personal strength.

Farms are seen as businesses where the farmer is the owner, manager and craftsman. This illustrates the fact that the farmer is responsible for most, if not all the business activities. This contributes to the fact that farmers need to be competent to ensure the success of their farming business, including the ability to recognise opportunities, allocation and use of scarce resources in ordinary and/or unique ways, management of relationships (employees, family members and other work contacts); and also to look after himself by ensuring that he/she keep abreast with occurrences in the sector.

Farmers' behaviour places a strong emphasis on commitment, relationships and organising competencies. A certain type of behaviour is expected when considering that farms are in most cases family businesses where the farmers are responsible for various roles in the business structures. Farmers have to be committed to their business to ensure the success and sustainability of the farming business, which is also influenced by the relationships and organisation between the farmers, family and the labour force. The many roles of the farmer can also have a negative effect on the farming business, as the farmer has to divide his/her time and attention to a variety of events or activities. Relationships and organisation play an important role, as the farmer must be able to delegate the different activities to employees.

The behaviour of the farmers illustrated that they are less active in the opportunity-seeking competencies compared to the other identified competencies. Farmers produce commodities and the commodity market does create difficulty in identifying and developing new opportunities. There are however options available for farmers by making use of horizontal and vertical integration and adding value to their commodities in order to develop and take advantage of opportunities. It is important to include these aspects in their strategies for developing and ensuring the sustainability of their farming business. Farmers must be able to explore and identify, process and develop

new ideas (conceptualise) that can be used to take advantage of opportunities in the commodity and product value chains. The development of opportunity identification for farmers is thus a very important aspect in their own personal development, ensuring that the farmers have the ability to identify opportunities outside their direct commodity market.

Farmers are willing to learn and enhance their own abilities, as illustrated by their learning and personal-strength competencies. Learning and adapting competencies are important as these are used to enhance other competencies (Man, 2001). As the farmer is expected to perform several roles in the farming business, the farmer must attempt to improve his abilities and possess a strong internal drive towards specified strategic goals. A farmer's willingness to improve his own abilities to ensure the successful implementation of resources and strategies is very important. Farmers' behaviour was found to illustrate their willingness to enhance their own abilities to ensure the optimal performance of the farming business, including high energy levels, positive attitude and having the necessary skills and knowledge to identify and take advantage of opportunities that are available.

The identification of the entrepreneurial competencies provides important information on the behaviour of farmers which is included in the research. Competencies can be improved and it is therefore important to identify the competencies in which an individual is strong and the ones that are in need of improvement. The risk behaviour and risk attitude of farmers needs further research to identify the decisions and behaviour of farmers in different risk situations. Importantly, the entrepreneurial competencies of the farmers explored in the chapter, provided a method by which each of the eight competencies can be illustrated as a score to indicate the differences between the individual farmers. The scores can further be used as a decision-making variable to represent each of the competencies in determining the repayment ability associated with a credit application.

6.5.   Incorporating the entrepreneurial competencies of farmers in a credit scoring model for the agricultural sector

Entrepreneurial competencies have not been included as decision-making variables in credit-scoring methods, thus the influence of differences in entrepreneurial competencies between farmers, as decision-making variables to determine repayment ability, is unknown. The aim of the research is to include the entrepreneurial competencies of farmers in a theoretical credit scoring methodology, to determine whether the differences in entrepreneurial competencies between farmers contributes to determining the repayment ability of the specific loan applications. Neural networks were identified from the literature as a credit scoring method that has the ability to best predict high risk loans as rejected. A supervised, back propagation neural network was therefore used as methodology to include the entrepreneurial competencies of farmers as decision making variables, and also to improve the consistency in categorisation of credit applications.

The eight entrepreneurial competencies' scores as determined in Chapter 4 were included for each farmer along with several other decision making variables including: loan purpose; application period; loan size; date of first business; account conduct; credit history; collateral; financial performance; application risk; product diversification; age; experience; education. The distribution of the generalised weights determined for the entrepreneurial competencies suggested a larger variation, which can be interpreted as a non-linear effect indicating that the difference between the scores for the different farmers does contribute in determining the repayment ability of the applications.   The differences of entrepreneurial competencies as illustrated and measured by the behaviour of farmers can therefore be included in credit-scoring models, as the differences contribute to the categorising of an application as either accepted or rejected.

Results from Chapter 3 indicated that the use of a statistical methodology can assist the credit analyst in his/her decision-making ability, especially in relation to the consistency with which decisions are made. The use of neural networks

does show promise for use in the South African agricultural sector, especially when considering that neural networks are unable to consider any other factors in the classification process that were not originally included in the training of the network. This eliminates the possibility of different factors being considered from one client to another.

However, further research is necessary to determine the effectiveness of neural networks in the agricultural sector before the method can implemented in any situation by financial organisations. This would include, for example the investigation by other financial organisations of the methodology in conjunction with current decision-making methods to ensure that the results between the methods are consistent and the performance of the proposed neural networks is sufficient and reliable according to the organisation's standards. Advantages from the implementation of the neural networks can include among others: consistency between applications in terms of categorisation and variables used in decision making, increase in the number of application that are reviewed in a time period (providing quicker responses to clients), and the neural network can be used as a supplementary tool to current systems where a client has for instance appealed a decision, or a specific application is on border line and can then be analysed by a trained network from similar applications. The results would therefore be comparable to previous results without considering any other factors in the decision making process. The shortcomings of neural networks do have an influence on their implementation in the agricultural credit sector. These include: the networks are known as "black boxes" where the results are difficult to interpret creating difficulty for the organisation to provide reasons for the decision reached. The dynamic nature of the sector can influence the use of the networks as changes do occur that need to be considered in determining repayment ability. The network therefore needs to be trained again to include the new variables. Neural network may be unable to include these variables, as there is no training sample available that can be used for training purposes.

6.6.   Recommendations

The findings of this research give rise to several recommendations that can be implemented, or suggested for further research, in the credit and entrepreneurial context. The recommendations are presented in two sections. The first section provides recommendations that can assist the credit application and review process. The second section concentrates on recommendations for future research in the fields of credit and entrepreneurship in the agricultural sector.

6.6.1.   Recommendations for practical implementation

- The use of human judgement in reporting the abilities of a farmer can lead to inconsistencies being reported between individuals and their respective applications. Inconsistent reporting can lead to irrelevant factors being reported, or to factors being omitted, which are required, in the reports. The use of a proven framework provides a measuring tool that can be used to report on the entrepreneurial and managerial behaviour of the farmers, while ensuring that the factors that are considered remain consistently similar between applications. Policies that stipulate the method used to report on the abilities of farmers in their credit applications are therefore required. Although the abilities are reported in the application process it is currently considered on a subjective basis rather than a proven framework that considers entrepreneurial and management competencies that may have an influence on financial performance.

- One of the findings of the research was that the use of statistical methods could increase the consistency in predicting repayment ability in the agricultural sector. A neural network, especially a back propagation algorithm network, is a promosing method that can be used in the agricultural sector. The methodology has the ability to learn from past application decisions and to then apply the knowledge in the prediction of new applications. Caution must, however, be taken to consider the

dynamic nature of the sector, which can create obstacles for the statistical methods, as the inclusion of new and/or additional variables would require that the model be retrained to include these variables. This can prove to be difficult, as situations may arise where no cases where the variable has already been included exist, thus providing no training opportunities for the network. Suggestions would be to use the methodology as a supplementary tool in making credit-granting decisions, as the tool could also assist in ensuring consistency in the granting of loans. Future research is still needed with regard to statistical credit-scoring models for the agricultural sector.

- Jordaan (2012) has stated that tailor-made financing products should be developed for emerging farmers, and entrepreneurial and managerial competencies measurements can provide important information on the ability of emerging farmers to ensure that the required competencies are shown in their behaviour in managing their farming businesses successfully. These measures can therefore be used to illustrate the business behaviour of the emerging farmers who do not always have the necessary financial background, when compared with commercial farmers. The use of the statistical method, which incorporates the entrepreneurial competencies, can therefore assist by providing an automated evaluation system in the assessment of small-scale farmers and land reform beneficiaries in South Africa.

- The measuring of entrepreneurial competencies provides a consistent method for including the abilities of farmers, as the competencies can also be used by the financial organisation to provide assistance to their clients by providing opportunities to enhance their abilities in each of the identified competencies. Farmers can receive information on their measured competencies that can then be used to assess their own shortcomings, in comparison with other farmers. Methods can be employed to assist these farmers to improve their abilities, which will be to the advantage of both the farmer and the credit-providing financial organisation. Policies are required to motivate the improvement of

entrepreneurial competencies of farmers. By improving their entrepreneurial competencies, farmers enhance their ability to improve their business through various processes. Entrepreneurial competencies have been found to have an influence on the competitiveness of a business (Man, 2001). Furthermore, the identification of the competencies can provide a basis which can be used to develop training courses and other incentives in the agricultural sector.

6.6.2.   Recommendation for future research

- The results from this research serve as a test case for the application of statistical credit modelling with the inclusion of entrepreneurial competencies of farmers. Further research can therefore follow the procedure to identify and enhance credit assessment procedures at financial organisations.

- Literature has indicated that future improvement in the accuracy of granting credit to prospective lenders will most likely be achieved by additions or improvements in the accuracy of the variables used in the decision-making process. Several variables were identified with the use of the Delphi procedure. These variables need to be researched in future and include the following:

  o Sensitivity testing of income, which is related to price and yields, expenditures, and how the farmer would be able to absorb deviations in the market;

  o Unpredictability in the agricultural industry, along with several external factors influencing daily activities;

  o Turnaround strategies or adjusting strategies which are also considered to be highly important.

- This research has provided additional variables that can be used to assist in the decision-making process, together with a method which is suggested for the purpose of measuring the entrepreneurial competencies of farmers. The measure does, however, still rely on a questionnaire,

which still means that there is a subjective element in the measurements. Future research should consider eliminating the subjective elements in measuring the entrepreneurial competencies of farmers.

- Given the different statistical methods that are available in literature, the prediction abilities of the different methods can be researched to identify the method that has the best prediction ability specific to the South African agricultural sector. That research would also have to consider the dynamic nature of the sector, which does make the application of the statistical methods more difficult.

- Given the impact of entrepreneurial competencies on the performance of a business, further research is necessary to determine the exact impact of these competencies on the financial performance of farming businesses.

References

Abdou, H.A. (2009). Genetic programming for credit scoring: The case of Egyptian public sector banks. *Expert systems with Applications 36 (2009) 11402-11417.*

Abdou, H.A. and Pointon, J. (2011). Credit Scoring, Statistical Techniques and Evaluation Criteria: A Review of the Literature. *Intelligent Systems in Accounting, Finance and Management, 18 (2-3), 59-88*.

Agnete Alsos, G., Ljunggren, E. and Toril Pettersen, L. (2003). Farm-based entrepreneurs: what triggers the start-up of new business activities?. *Journal of Small Business and Enterprise Development*, *10*(4), 435-443.

Akudugu, M (2012). Estimation of the determinants of credit demand by farmers and supply by rural banks in Ghana's upper east region. *Asian Journal of Agriculture and Rural Development*, *2*, 189-200.

Alsos, G.A. and Carter, S., (2006). Multiple business ownership in the Norwegian farm sector: Resource transfer and performance consequences. *Journal of Rural Studies*, *22*(3), 313-322.

Anderson, T.W. (2003). An Introduction to Multivariate Statistical Analysis. New York: Wiley-Interscience.

Andreeva, G. (2006). European genetic scoring models using survival analysis. *Journal of the Operational Research Society 57(10): 1180-1187*.

Angelini, E., di Tollo, G. and Roli, A. (2008). A neural network approach for credit risk evaluation. *The quarterly review of economics and finance*, *48*(4), 733-755.

Anonymous 1. (2014). Personal communication with Agricultural specialist at a South African financial organisation (bank). 2014

Anonymous 2. (2015). Personal communication with Agricultural specialist at a South African financial organisation (bank). 2015

Anonymous 3. (2015). Personal communication with Agricultural specialist at a South African financial organisation (bank). 2015

Ardichvili, A., Cardozo, R., and Ray, S. (2003). A theory of entrepreneurial opportunity identification and development. *Journal of Business Venturing, 18,* 105-123.

Audretsch, D.B. (2003). *Entrepreneurship: A Survey of the Literature.* Centre for Economic Policy Research, A report to the European Union, London.

Austin, E.J., Willock, J., Deary, I.J., Gibson, G.J., Dent, J.B., Edwards-Jones, G., Morgan, O., Grieve, R. and Sutherland, A. (1998a). Empirical Models and Farmer Behaviour Using Psychological, Social and Economical Variables. Part I: Linear Modelling. *Agricultural Systems, 58 (2), 203 – 224*.

Austin, E.J., Willock, J., Deary, I.J., Gibson, G.J., Dent, J.B., Edwards-Jones, G., Morgan, O., Grieve, R. and Sutherland, A. (1998b). Empirical Models and Farmer Behaviour Using Psychological, Social and Economical Variables. Part II: Nonlinear and expert Modeling. *Agricultural Systems, 58, 225 – 241*.

Banasik J. and Crook J. (2007). Reject inference, augmentation, and sample selection. *European Journal of Operational Research 183 (3): 1582-1594.*

Banasik, J., Crook, J., and Thomas, L. (2003). Sample Selection Bias in Credit Scoring Models. *Journal of the Operational Research Society 54 (8): 822-832*.

Barney, D.K., Graves, O.F. and Johnson, J.D., (1999). The farmers home administration and farm debt failure prediction. *Journal of accounting and public policy*, *18*(2), 99-139.

Baron, R. A., and Markman, G.D. (2003). Beyond social capital: the role of entrepreneurs' social competence in their financial success. *Journal of Business Venturing, 18*, 41-60.

Baron, R.A. (2004) The Cognitive Perspective: A Valuable Tool for Answering Entrepreneurships Basic "Why" Questions, *Journal of Business venturing,* 19, 2, 221-239.

Baron, R.A. and Ensley, M.D. (2006). Opportunity recognition as the detection of meaningful patterns: Evidence from comparisons of novice and experienced entrepreneurs. *Management science*, *52*(9), 1331-1344.

Baron, R.A. and Shane, S.A (2005). *Entrepreneurship: A process perspective;* South-Western, Thomson; Ohio, United States of America; 292.

Baron, R.A. and Tang, J. (2009). Entrepreneurs' social skills and new venture performance: mediating mechanisms and cultural generality. *Journal of Management, 35,* 282-306.

Barrick, M.R., and Mount, M.K. (1991). The Big Five personality dimensions and job performance: A meta-analysis. *Personnel Psychology*, 44, 1–26.

Barrick, M.R., Mount, M.K., and Judge, T.A. (2001). Personality and performance at the beginning of the new millennium: What do we know and where do we go next? *International Journal of Selection and Assessment*, 9, 9 –30

Barry, P.J. and Ellinger, P.N. (1989). Credit Scoring. Loan pricing and farm business performance. *Western Journal of Agricultural Economics 14 (1). 45-55.*

Basel Committee on Banking Supervision. (2004). Basel II: International Convergence of Capital Measurement and Capital Standards: a Revised Framework. Online available: <http://www.bis.org/publ/bcbs107.htm>. (accessed on 5 February 2014).

Basel Committee on Banking Supervision. (2015). A brief history of the Basel Committee. Online available: http://www.bis.org/bcbs/history.pdf (accessed on 5 February 2016).

Baum, J. R. (1994) The Relationship of Traits, Competencies, Motivation, Strategy and Structure to Venture Growth, Ph.D. Thesis, University of Maryland, United States of America.

Baum, J.R., Locke, E.A. and Smith, K.G. (2001). A multidimensional model of venture growth. *Academy of management journal*, *44*(2), 292-303.

Beech, B (1997). Studying the future: A delphi survey of how multi-disciplinary clinical staff view the likely development of two community mental health centres over the course of the next two years. *Journal of Advanced Nursing., 25*, 331-338.

Begley, T.M. and Boyd, D.P. (1985). Company and chief executive officer characteristics related to financial performance in smaller business. *Frontiers of entrepreneurship research*, 146-165.

Bellotti, T. and Crook, J. (2009). Support vector machines for credit scoring and discovery of significant features. *Expert Systems with Applications 36 (2/2):* 3302-3308.

Bergevoet, R.H.M. (2005). Entrepreneurship of Dutch Dairy Farmers, PhD Thesis, Department of Social Sciences, Wageningen University, Wageningen, Netherlands.

Bird, B. (1995). Towards a Theory of Entrepreneurial Competency, Advances in Entrepreneurship, Firm Emergence and growth, 2, 51-72.

Bolton, C. (2009). Logistic regression and its application in credit scoring, MSc dissertation, University of Pretoria, Pretoria.

Bosma, N., Van Praag, M. and De Wit, G. (2000). Determinants of successful entrepreneurship. Online available: http://www.ondernemerschap.nl/pdf-ez/H200002.pdf. (accessed on 25 July 2014).

Boyatzis, R.E. (1982). *The competent manager.* New York: John Wiley & Sons.

Brandstätter, H. (1997). Becoming an entrepreneur—a question of personality structure? *Journal of economic psychology*, *18*(2), 157-177.

Brockhaus, R.H., and Horwitz, P.S. (1986). The psychology of the entrepreneur. In D. Sexton & R. Smilor (Eds.), The art and science of entrepreneurship, 25 – 48. Cambridge, MA: Ballinger.

Buck, A.J., Gross, M., Hakim, S. and Weinblatt, J (1993). Using the delphi process to analyse social policy implementation: A post hoc case from vocational rehabilitation. *Policy Sciences.*, *26*, 271-288.

Buckley, P.J., Pass, C.L. and Prescott, K. (1988). Measures of international competitiveness: A critical survey. *Journal of marketing management,4*(2), 175-200.

Bull, I and Willard, G.E. (1993). Toward a theory of Entrepreneurship. *Journal of Business Venturing, 8,* 183 – 195.

Bygrave, W.D. and Hofer, C.W. (1991). Theorizing About Entrepreneurship, *Entrepreneurship Theory and Practice,* **16**, 2, 13-22.

Cantillon, R. (1755). Essay on the Nature of Trade in General. *Eng. trans. by H. Higgs, New York: AM Kelley*.

Carter, S. (2001). Multiple Business Ownership in the Farm Sector – Differentiating Mono Active, Diversified and Portfolio Enterprises, *International Journal of Entrepreneurial Behaviour & Research,* 7, 2, 43-59.

Casu, B., Girardone, C., and Molyneux, P. (2006). Introduction to Banking. London:

Chandler, G.N. and Hanks S.H. (1994a) Founder Competence, the Environment, and Venture Performance, *Entrepreneurship: Theory & Practice,* 18, 3, 77-89.

Chandler, G.N. and Hanks, S.H. (1994b). Market attractiveness, resource-based capabilities, venture strategies, and venture performance. *Journal of business venturing*, *9*(4), 331-349.

Chandler, G.N. and Jansen, E. (1992). The Founders Self-Assessed Competence and Venture Performance, *Journal of Business Venturing*, **7**, 3, 223-236.

Chauke, P.K., Motlhatlhana, M.L., Pfumayaramba, T.K. and Anim, F.D.K., (2013). Factors influencing access to credit: A case study of smallholder farmers in the Capricorn district of South Africa. *African Journal of Agricultural Research*, *8*(7), 582-585.

Chen M-C and Huang S-H (2003). Credit scoring and rejected instances reassigning through evolutionary computation techniques. *Expert Systems with Applications 24(4): 433–441.*

Chen, C.C., P.G. Greene and Crick, A. (1998). Does Entrepreneurial Self-Efficacy Distinguish Entrepreneurs from Managers?, *Journal of Business Venturing,* 13, 4, 295-316.

Chisasa, J. and Makina, D. (2012). Trends in credit to smallholder farmers in South Africa, *International Business and Economic Research Journal*, 11 (7), 771-784.

Churchill, N.C. and Lewis, V.L. (1983). The five stages of small business growth. Harvard Business Review 61(3): 1-12.

Cockerill, T., Hunt, J. and Schroder, H. (1995). Managerial competencies: Fact or fiction? *Business Strategy Review* 6(2): 1-12.

Colombo, M.G., and Grilli, L. (2005). Founders human capital and the growth of new technology-based firms: A competence-based view. *Research Policy, 34*(6), 795-816.

Cooper, A.C. and Gascon, F.J.G. (1992). Entrepreneurs, processes of founding, and new-frim performance, in D.L. Secton and Kasarda, J.D. (Eds.), *The State of Art of Entrepreneurship:* 301-340. Boston, PLOS-KENT Publishing Company.

Cooper, A.C., Dunkelber, W.C. and Woo, C.Y. (1988). Survival and failure: a longitudinal studies. *Frontiers of Entrepreneurship Research:* 1988: 255-267

Cooper, A.C., Gimeno-Gascon, F.J. and Woo, C.Y., (1994). Initial human and financial capital as predictors of new venture performance. *Journal of business venturing*, *9*(5), 371-395.

Corman, J., and Lussier, R.N. (1996). '*Small Business Management, a planning approach'.* Irwin/McGraw-Hill, United States of America.

Costa, P. T., Jr. and McCrae, R. R. (1992). Revised NEO Personality Inventory (NEO-PI-R) and NEO Five Factor Inventory (NEO-FFI) professional manual. Odessa, FL: PAR.

Costa, P.T., Jr., McCrae, R.R., and Holland, J.L. (1984). Personality and vocational interest in an adult sample. *Journal of Applied Psychology*, 69, 390 – 400.

Covin, G.V. and Slevin, D.P. (1991). A conceptual model of entrepreneurship as frim behaviour. *Entrepreneurship theory and practice*, *16*(1), 7-25.

Cragg, P.B. and King, M. (1988). Organizational characteristics and small firms' performance revisited. *Entrepreneurship theory and practice*, *13*(2), 49-64.

Cramér, H. (2004). *Random variables and probability distributions* (Vol. 36). Cambridge University Press.

Crant, J.M. (1996). The proactive personality scale as a predictor of entrepreneurial intentions. Journal of Small Business Management, 34, 42– 49

Crook, J. and Banasik, J. (2004). Does reject inference really improve the performance of application scoring models?. *Journal of Banking & Finance*, *28*(4), 857-874.

DAFF. (2015). Abstract of Agricultural Statistics 2015. Department of Agriculture, Forestry and Fisheries.

Dalkey, N.C (1972). The Delphi method: An experimental study of group opinion. <u>In</u>: N.C. Dalkey, D.L. Rourke, R. Lewis & D. Snyder (Eds.). *Studies in the quality of life: Delphi and decision-making.* Lexington, MA: Lexington Books, 13-54.

Dalkey, N.C. (1969). An experimental study of group opinion. *Futures, 1 (5), 408-426.*

Dalkey, N.C. and Helmer, O. (1963). An experimental application of the Delphi method to the use of experts. *Management Science, 9(3), 458-467.*

Darroch, M.A. and Clover, T.A. (2005). The effects of entrepreneurial quality on the success of small, medium and micro agribusinesses in KwaZulu-Natal, South Africa. *Agrekon*, *44*(3), 321-343.

Dash, M. and Liu, H., (1997). Feature selection for classification. *Intelligent data analysis*, *1*(1), 131-156.

Davidsson, P. and Honig, B. (2003). The role of social and human capital among nascent entrepreneurs. *Journal of business venturing*, *18*(3), 301-331.

De Lauwere, C.C., (2005). The role of agricultural entrepreneurship in Dutch agriculture today. *Agricultural Economics 33(2005) 229 – 238*.

Delbecq, A.L., Van de Ven, A.H. and Gustafson, D.H. (1975). *Group techniques for program planning: A guide to nominal group and Delphi processes.* Glenview, IL: Scott, Foresman & Co.

Demerjian, P.R., (2007). Financial Ratios and Credit Risk: The Selection of Financial Ratio Covenants in Debt Contracts., Stephen M. Ross School of Business, University of Michigan, AAA 2007 Financial Accounting & Reporting Section (FARS) Meeting Paper.

Desai, V.S., Crook, J.N. and Overstreet, G.A. (1996). A comparison of neural networks and linear scoring models in the credit union environment. *European Journal of Operational Research*, *95*(1), 24-37.

Detienne, D.R., and Chandler, G.N. (2004). Opportunity identification and its role in the entrepreneurial classroom: A pedagogical approach and empirical Test. *Academy of Management Learning and Education, 3*(3), 242-257.

Digman, J.M. (1990). Personality structure: Emergence of the five-factor model. *Annual Review of Psychology*, 41, 417– 440.

Dollinger, M.J. (2003). '*Entrepreneurship – strategies and resources*'. Pearson International Edition, New Jersey.

Dollinger, M.J. (2008). '*Entrepreneurship – strategies and resources*'. 4th edition. Marsh Publications, Lombard, Illinois.

Douglas, D.C. (**1983).** A comparative study of the effectiveness of decision-making processes which utilize the Delphi and leaderless group methodologies. PhD thesis. The Ohio State University, Columbus.

Durkan, P., Harrison, R., Lindsay, P. and Thompson, E. (1993). Competence and executive education and development in an SME environment. *Irish Business and Administrative Research*, *14*(1), 65-80.

Dyer, J.H., Gregersen, H.B., and Christensen, C. (2008). Entrepreneur behaviors, opportunity recognition, and the origins of innovative ventures. *Strategic Entrepreneurship Journal, 2*(4), 317-338.

Dyer, W.G., Jr. (1994). Toward a theory of entrepreneurial careers. Entrepreneurship Theory and Practice, 18(3), 7–21.

Dzadze, P.; Osei, M.J.; Aidoo, R.; Nurah, G. K. (**2012).** Factors determining access to formal credit in Ghana: A case study of smallholder farmers in the Abura-Asebu Kwamankese district of central region of Ghana. *Journal of Development and Agricultural Economics. 4*, 416-423.

Elfring, T., (1999). Reviving entrepreneurship (in Dutch) Oplevend ondernemerschap. Wageningen Universiteit, Wageningen, Netherlands.

Elfring, T., and Hulsink, W. (2003). Networks in entrepreneurship. *Small Business Economics, 21,* 409-422.

Ellinger, P.N., Splett, N.S. and Barry, P.J. (1992). Consistency of credit evaluations at agricultural banks. *Agribusiness*, *8*(6), 517-536.

Emel, A.B., Oral, M., Reisman, A. and Yolalan, R. (2003). A credit scoring approach for the commercial banking sector. *Socio-Economic Planning Sciences*, *37*(2), 103-123.

English, J.M. and Kernan, G.L. (**1976).** The prediction of air travel and aircraft technology to the year 2000 using the delphi method. *Transportation Research*, *10*, 1-8.

Evers, F.T., and Rush, J. C. (1996). The Bases of Competence Skill Development During the Transition from University to Work. *Management Learning*, *27*(3), 275-299.

Faerman, S.R., Thompson, M.P., and McGrath, M.R. (1990). *Becoming a master manager: A competency framework*. New York, NY: Wiley.

Fagbohungbe, O.B. and Jayeoba, F.I. (2012). Locus of control, gender and entrepreneurial ability. *British Journal of Arts & Social Sciences*, *11*(1).

Featherstone, A.M., Roessler, L.M. and Barry, P.J. (2006). Determining the Probability of Default and Risk Rating Class for Loans in the Seventh Farm Credit District Portfolio. *Review of Agricultural Economics, 28(Spring):4-23.*

Featherstone, A.M.; Wilson, C.A.; Kastens, T.L.; Jones, J.D (2007). Factors affecting the agricultural loan decision-making process. *Agricultural Finance Review. 67*, 13-33.

Ferris, A. and Malcolm, B., (1999). January. Sense and nonsense in dairy farm management economic analysis. In *43rd Annual Australian Agricultural and Resource Economics Society Conference and 6th Annual New Zealand Agricultural Economics Society Conference, Christchurch, New Zealand.*

Gaglio, C. M., and Katz, J. A. (2001). The psychological basis of opportunity identification: Entrepreneurial alertness. *Small Business Economics, 16,* 95-111.

Gartner, W.B. (1985). A conceptual framework for describing the phenomenon of new venture creation. *Academy of management review*, *10*(4), 696-706

Gartner, W.B. (1988) Who Is the Entrepreneur? Is the Wrong Question, *American Journal of Small Business,* **12**, 4, 11- 32.

Gartner, W.B. (1989). "Who Is an Entrepreneur?" Is the Wrong Question, *Entrepreneurship Theory & Practice,* **13**, 4, 47-68.

Gasson, R. (1998). Educational qualifications of UK farmers: A review. *Journal of Rural Studies, 14(4), 487-498.*

Gibb, A.A. (2002). Creating conducive environments for learning and entrepreneurship: Living with, dealing with, creating and enjoying uncertainty and complexity. *Industry and Higher Education, 16*(3), 135-48.

Gibson, J.M (1998). Using the Delphi technique to identify the content and context of nurses' continuing professional development needs. *Journal of Clinical Nursing. 7*, 451-459.

Glorfeld, L.W. and Hardgrave, B.C. (1996). An improved method for developing neural networks: The case of evaluating commercial loan creditworthiness. *Computers & operations research*, *23*(10), 933-944.

Goodman, C. M. (1987). The Delphi technique: a critique*. Journal of advanced nursing*, 12(6), 729-734.

Gow, J. and Stayner, R. (1995). The process of farm adjustment: a critical review. *Review of marketing and Agricultural Economics*, *63*(02).

Grande, J., Madsen, E.L., and Borch, O.J. (2007). The relationship between resources, entrepreneurial orientation and performance in farm-based ventures in Norway. Paper presented at the RENT XXI – Research in Entrepreneurship and Small Business.

Green, B.; Jones, M.; Hughes, D.; Williams (1999). A. Applying the delphi technique in a study of gps' information requirements. *Health & social care in the community. 7*, 198-205.

Greene, W. (1998). Sample Selection in Credit-Scoring Models. *Japan and the World Economy 10 (3): 299-316.*

Grégoire, D.A., Corbett, A.C. and McMullen, J.S. (2011). The cognitive perspective in entrepreneurship: an agenda for future research. *Journal of Management Studies*, *48*(6), 1443-1477.

Grobbelaar, S.S. (2006). R&D in the national system of innovation: A system dynamics model. Ph.D. Thesis. University of Pretoria, Pretoria, South Africa.

Groenewald, D. (2010). *Assessment of corporate entrepreneurship and the levels of innovation in the South African short-term insurance industry.* Ph.D. thesis, University of Pretoria, Pretoria, South Africa.

Günther, F. and Fritsch, S. (2010). Neuralnet: Training of neural networks. *The R Journal*, *2*(1), 30-38.

Gustafson, C.R. (1989). Credit evaluation: Monitoring the financial health of agriculture. *American Journal of Agricultural Economics*. 1145-1151.

Haden, K.L. and Johnson, L.A. (1989). Factors which contribute to the financial performance of selected Tennessee dairies. *Southern Journal of Agriculture Economics, July 1989.*

Hair, J.F. Jr., Black, W.C., Babin, B.J. and Anderson, R.E. (2010). *Multivariate Data Analysis*, 7th ed., Prentice Hall, Upper Saddle River, NJ.

Han, T-S, and Lin, C.Y. (2008). Developing human capital indicators: a three-way approach. *International Journal of Learning and Intellectual Capital*, 5(3/4): 387-403

Hananu, B., Abdul-Hanan, A. and Zakaria, H., (2015). Factors influencing agricultural credit demand in Northern Ghana. *African Journal of Agricultural Research*, *10*(7), 645-652.

Hand, D.J. and Henley, W.E., (1997). Statistical classification methods in consumer credit scoring: a review. *Journal of the Royal Statistical Society. Series A (Statistics in Society)*, 523-541.

Hand, D.J., Sohn, S.Y., Kim, Y. (2005). Optimal bipartite scorecards. *Expert Systems with Applications 29(3): 684-690*.

Hansemark, O.C. (2003). Need for achievement, locus of control and the prediction of business start-ups: A longitudinal study. *Journal of economic Psychology*, *24*(3), 301-319.

Hébert, R.F. and Link, A.N. (1989). In search of the meaning of entrepreneurship*. Small Business Economics, 1(1), 39-49.*

Hébert, R.F. and Link. A.N. (1982). *The Entrepreneur: Mainstream Views and Radical Critiques.* Praeger, New York.

Henning, J.I.F. (2011). *Financial Benchmarking Analysis: Northern Cape Farmers*. Master's dissertation, University of the Free State, Bloemfontein, South Africa.

Hinrichs, C.C., Gillespie, G.W. and Feenstra, G.W. (2004). Social Learning and Innovation at Retail Farmers' Markets. *Rural Sociology* 69(1): 31-58.

Hisrich, R.D., Peters, M.P. and Shepherd, D.A. (2008). Entrepreneurship. 7th ed. New York: McGraw-Hill.

Hoffmann F, Baesens B, Martens J, Put F and Vanthienen J (2002). Comparing a genetic fuzzy and a neurofuzzy classifier for credit scoring. *International Journal of Intelligent Systems 17(11): 1067–1083.*

Hou, J. (2006). A measurement of the small business credit gap and the use of credit scoring by small financial institutions. PhD Thesis, University of Kentucky, United Kingdom,

Hsu, C-C and Sandford, B.A. (2007). The Delphi technique: Making sense of consensus. *Practical Assessment Research & Evaluation*, 12, 1-8*.*

Hull, D.L., Bosley, J.J. and Udell, G.G. (1980). Renewing the hunt for the heffalump: identifying potential entrepreneurs by personality characteristics. *Journal of Small Business Management (pre-1986)*, *18*(000001), p.11.

Insurance Advisory Board. (2002). The new Basel Accord.

Intrator, O. and Intrator, N. (2001). Interpreting neural-network results: a simulation study. *Computational statistics & data analysis*, *37*(3), 373-393.

Jacobsohn, O. (2005). Impact of Basel II on the South African banking system. Masters dissertation, Rand Afrikaans University, Johannesburg, South Africa.

Jonassen, D.H. and Grabowski, B. (1993). Individual differences and instruction. *New York: Allen & Bacon*.

Jordaan, H. (2012). *New institutional economic analysis of emerging irrigation farmers' food value chains.* Ph.D. thesis, University of the Free State, Bloemfontein, South Africa.

Jouault, A. and Featherstone, A.M. (2006). Determining the Probability of Default of Agricultural Loans in a French Bank. In *American Agricultural Economics Association Annual Meeting, Long Beach, California*.

Kaish, S. and B. Gilad. (1991). Characteristics of Opportunities Search of Entrepreneurs Versus Executives: Sources, Interests, General Alertness, *Journal of Business venturing,* **6**, 1, 45-61.

Keeney, S.; Hasson, F.; McKenna, H.P. A critical review of the delphi technique as a research methodology for nursing. *International journal of nursing studies.* **2001**, *38*, 195-200.

Kirzner, I.M. (1978). *Competition and Entrepreneurship.* University of Chicago Press, London.

Kirzner, I.M. (1983). *Perception, Opportunity, and Profit: Studies in the Theory of Entrepreneurship.* The University of Chicago Press, London.

Kirzner, I.M. (1985). *Discovery and the Capitalist Process.* University of Chicago Press, Chicago, IL.

Kizilaslan, H. and Adiguzel, O. (2007). Factors affecting credit use in Agricultural business concerns in Turkey. *Research Journal of Agriculture and Biological Sciences, 3(5): 409-417*.

Klein, B.H. (1979). 'The Slowdown in Productivity Advances: A Dynamic Explanation', in C. T. Hill and J. M. Utterback (eds.), *Technological Innovation for a Dynamic Economy*, New York: Pergamon Press.

Knudson, W., Wysocki, A., Champagne, J., and Peterson, H.C. (2004). Entrepreneurship and innovation in the agri-food system. *The American Journal of Agricultural Economics*, 86(5), 1330-1336

Kobia, M. and D. Sikalieh. (2010). Towards a Search for the Meaning of Entrepreneurship, *Journal of European Industrial Training,* 34, 2, 110-127.

Kolvereid, L. and E. J. Isaksen (2012). The Psychology of the Entrepreneur. In: K. Mole and M. Ram (eds.), *Perspectives in Entrepreneurship: A Critical Approach.* 27-39. Palgrave Macmillan, Basingstoke.

Krueger, N.F., Reilly, M.D. and Carsrud, A.L. (2000). Competing models of entrepreneurial intentions. *Journal of business venturing*, *15*(5), 411-432.

Kungwansupaphan, C. and Siengthai, S. (2014). Exploring Entrepreneurs Human Capital Components and Effects on Learning Orientation in Early Internationalizing Firms, *International Entrepreneurship and Management Journal*. September 2014,10,(3), 561-587.

Lambing, P.A. and Kuehl, C.R. (2003). *Entrepreneurship.* 3rd Edition. Pearson Education; New Jersey, United States of America; 26**.**

Lans, T. (2009). *Entrepreneurial competence in agriculture: characterization, identification, development and the role of the work environment.* Ph.D. thesis. Wageningen Universiteit, Netherland.

Lans, T., Bergevoet, R.H.M., Mulder, M. and van Woerkum, C. (2005). Identification and Measurement of Competences of Entrepreneurs in Agribusiness, In: M. Batterink, R. Cijsouw, M. Ehrenhard, H. Moonen and P. Terlouw (eds.), Proceedings of the Selected papers from the 8th PhD Conference on Business Economics, Management and Organization Science Conference, 81-95, Enschede, Netherlands.

Lans, T., H. Biemans, M. Mulder and J. Verstegen (2010). Self-Awareness of Mastery and Improvability in Small Business in the Agrifood Sector, *Human Resource Development Quarterly,* **21**, 2, 147-168.

Lans, T., Seuneke, P. and Klerkx, L. (2013). Agricultural Entrepreneurship. In *Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship,* 44-49. Springer New York.

Lans, T., van Galen, M., Verstegen, J., Biemans, H. and Mulder, M. (2010). Searching for Entrepreneurs among Small Business Owner-Managers, In: L. Dietmer, S. M.L. and S. Manning (eds.), Proceedings of the ECER2010, Education and Cultural Change Conference, Helsinki, 27th August.

Lans, T., van Galen, M.A., Verstegen, J.A.A.M., Biemans, H.J.A. and Mulder, M.

(2014). Searching for entrepreneurs among small business ownermanagers in agriculture. *NJAS-Wageningen Journal of Life Sciences*, *68*, 41-51.

Lans, T., Verstegen, J and Mulder, M. (2011). Analysing, Pursuing and Networking: Towards a Validated Three-Factor Framework for Entrepreneurial Competence from a Small Firm Perspective, *International Small Business Journal,* **29**, 6, 695-713.

Lau, T., Chan K.F. and Man, T.W.Y. (1999). Entrepreneurial and Managerial Competencies: Small Business Owner-Managers in Hong Kong. In: P. Fosh, A. W. Chan, W. W. S. Chow, E. Snape and R. Westwood (eds.), *Hong Kong Management and Labour: Change and Continuity.* 220-236. Routledge, London.

Le Deist, F.D. and Winterton, J. (2005). What is competence?. *Human resource development international*, *8*(1), 27-46.

Lee, T., Chen, I. (2005). A Two-Stage Hybrid Credit Scoring Model Using Artificial Neural Networks and Multivariate Adaptive Regression Splines. *Expert Systems with Applications 28 (4): 743-752*.

Lee, T., Chiu, C. Lu, C., Chen, I. (2002). Credit Scoring Using the Hybrid Neural Discriminant Technique. *Expert Systems with Applications 23 (3): 245-254*.

Lensberg, T. Eilifsen, A. and McKee, T. (2006). 'Bankruptcy theory development and classification via genetic programming'. *European Journal of Operational*

Lerner, M. and Almor, T. (2002), "Relationships among strategic capabilities and the performance of women-owned small ventures", *Journal of Small Business Management*, 40 (2), 109-25.

Levander, L.M. (1998). *From green fingers to green eyes: exploring the conception of knowledge and knowledge construction of horticultural entrepreneurs.* PhD-thesis, Helsinki: University of Helsinki.

Lewis, E.M. (1992). An Introduction to Credit Scoring. California: Fair, Isaac & Co., Inc.

Li, X. (2009). Entrepreneurial competencies as an entrepreneurial distinctive: An examination of the competency approach in defining entrepreneurs. Master's dissertation, Singapore Management University, Singapore.

Liang, Q. (2003). Corporate Financial Distress Diagnosis in China: Empirical Analysis Using Credit Scoring Models, *Hitotsubashi Journal of Commerce and Management* 38 (1), 13-28.

Limsombunchai, Gan and Lee. (2005). An analysis of credit scoring for agricultural loans in Thailand. *American Journal of Applied Sciences* 2 (8): 1198-1205.

Lindeman, C.A. (1981). Priorities within the health care system: A Delphi survey. Kansas City, MO: American Nurses Association.

Linstone, H.A., and Turoff, M. (1975). Introduction. In H. A. Linstone, & M. Turoff (Eds.). The Delphi method: Techniques and applications, 3-12. Reading, MA: Addison-Wesley Publishing Company.

Locke, E.A. and Latham, G.P. (2004). What should we do about motivation theory? Six recommendations for the twenty-first century, *Academy of Management Review*, (29), 388-403.

Loon, M. and Casimir, G. (2008). Job-demand for learning and job-related learning: the moderating effect of need for achievement. *Journal of Managerial Psychology*, *23*(1), 89-102.

Loué, C., and Baronet, J. (2012). Toward a new entrepreneurial skills and competencies framework: a qualitative and quantitative study. *International Journal of Entrepreneurship and Small Business*, *17*(4), 455-477.

Loughlin, K.G.; Moore, L.F. **(1979).** Using delphi to achieve congruent objectives and activities in a pediatrics department. *Academic Medicine*. *54*, 101-106.

Low, M.B. and MacMillan, I.C. (1988). Entrepreneurship: Past Research and Future Challenges, *Journal of Management,* **14**, 2, 139-161.

Low, S.A. (2009). Defining and measuring entrepreneurship for regional research: a new approach. *Ph.D. in Agricultural and Consumer Economics, Graduate College of the University of Illinois.* Urbana, Illinois.

Ludlow, J. **(1975).** Delphi inquiries and knowledge utilization. In: H.A. Linstone & M. Turoff (Eds.). *The Delphi method: Techniques and applications*. Reading, MA: Addison-Wesley Publishing Company, 102-123.

Luthans, F., Avolio, B.J., Avey, J.B. and Norman, S.M. (2007). Positive psychological capital: Measurement and relationship with performance and

satisfaction. *Personnel psychology*, *60*(3), 541-572.

Luthans, F.; Youssef, C.M.; Avolio, B.J. **(2007).** *Psychological capital*: New York: Oxford University Press, 3.

Man, T.W., and Lau, T. (2005). The context of entrepreneurship in Hong Kong: An investigation through the patterns of entrepreneurial competencies in contrasting industrial environments. *Journal of Small Business and Enterprise Development, 12*(4), 464-481.

Man, T.W., Lau, T., and Snape, E. (2008). Entrepreneurial competencies and the performance of small and medium enterprises: An investigation through a framework of competitiveness. *Journal of Small Business & Entrepreneurship,21*(3), 257-276.

Man, T.W.Y. (2001). *Entrepreneurial competencies and the performance of small and medium enterprises in the Hong Kong services sector*. PhD-thesis, Hong Kong: Hong Kong Polytechnic University.

Man, T.W.Y., Lau, T. and Chan, K.F. (2002). The Competitiveness of Small and Medium Enterprises a Conceptualization with Focus on Entrepreneurial Competencies, *Journal of Business venturing,* 17, 2, 123-142.

Markman, G.D. (2007). Entrepreneurs' competencies. In J.R. Baum, M. Frese & R. Baron (Eds.). *The psychology of entrepreneurship, SIOP organisational frontier series,* 67-92. New Jersey: Lawrence Erlbaum.

Markman, G.D., D.B. Balkin and R.A. Baron. (2002). Inventors and New Venture Formation: The Effects of General Self-Efficacy and Regretful Thinking, *Entrepreneurship Theory and Practice,* **27**, 2, 149-165.

Markman, G.D., R.A. Baron and D.B. Balkin. (2003). The Role of Regretful Thinking, Perseverance, and Self-Efficacy in Venture Formation. In: J. A. Katz and D. A. Shepherd (eds.), *Cognitive Approaches to Entrepreneurship Research (Volume 6, Advances in Entrepreneurship, Firm Emergence and Growth),* 73-104. Emerald, Bingley.

Marqués, A.I., García, V. and Sánchez, J.S. (2013). A literature review on the application of evolutionary computing to credit scoring. *Journal of the Operational Research Society (2013) 64, 1384-1399*.

Martikainen, T., Perttunen, J., Yli-Olli, P. and Gunasekaran, A., (1995). Financial ratio distribution irregularities: implications for ratio classification. *European Journal of Operational Research*, *80*(1), 34-44.

Martin, G., and Staines, H. (1994). Managerial competences in small firms. *Journal of Management Development*, *13*(7), 23-34.

Martin, N. (2013). Assessing scorecard performance: A literature review and classification. *Expert Systems with Applications 40 (2013)* 6340-6350*.

Martino, J.P. (1983). Technological forecasting for decision-making. New York: North-Holland.

McClelland, D.C. (1987). Characteristics of Successful Entrepreneurs, *The journal of creative behavior,* 21, 3, 219-233.

McCrae, R.R., and Costa, P.T. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of personality and social psychology*, *52*(1), 81.

McElwee, G. (2004). A segmentation framework for the farm sector, 3rd Rural Entrepreneurship**,** Conference, University of Paisley.

McElwee, G. (2005). *A Literature Review of Entrepreneurship in Agriculture.* Research Institute of Organic Agriculture FiBL, Frick, Switzerland.

McElwee, G. (2008). A taxonomy of entrepreneurial farmers. *International Journal of Entrepreneurship and Small Business*, *6*(3), 465-478.

Mester, L.J., (1997). What's the point of credit scoring? Business Review, Federal Reserve Bank of Philadelphia, September/October.

Min, J.H. and Jeong, C. (2009). A binary classification method for bankruptcy prediction, *Expert Systems with Applications*, 36(3), 5256-5263.

Min, J.H. and Lee, Y. (2008). A practical approach to credit scoring. *Expert Systems with Applications 35(2008), 1762-1770.*

Mitchell, R.K., L. Busenitz, T. Lant, P.P. McDougall, E.A. Morse and J.B. Smith (2002). Toward a Theory of Entrepreneurial Cognition: Rethinking the People Side of Entrepreneurship Research, *Entrepreneurship Theory and Practice,* 27(2) 93-104.

Mitchell, R.K., Smith, B., Seawright, K.W., and Morse, E.A. (2000). Cross-cultural cognitions and the venture creation decision. *The Academy of Management Journal, 43*(5), 974-993.

Mitchelmore, S. and Rowley, J. (2013) Entrepreneurial Competencies of Women Entrepreneurs Pursuing Business Growth, *Journal of Small Business and Enterprise Development,* **20**, 1, 125-142.

Mitchelmore, S. and Rowley, J. (2010). Entrepreneurial Competencies: A Literature Review and Development Agenda, *International Journal of Entrepreneurial Behaviour and Research,* 16(2) 92-111.

Mitton, D.G., (1989). The complete entrepreneur. *Entrepreneurship Theory and Practice, 13*(3), 9-19.

Mueller, S.L. and Thomas, A.S. (2001). Culture and entrepreneurial potential: A nine country study of locus of control and innovativeness. *Journal of business venturing, 16*(1), 51-75.

Morris, M.H., Kuratko, D.F. and Covin, J.G. (2010) Corporate Entrepreneurship and Innovation: Entrepreneurial Development within Organizations, 3rd Edition. South Western cengage learnig.

Mulder, M., Gulikers, J., Biemans, H. and Wesselink, R. (2009). The New Competence Concept in Higher Education: Error or Enrichment? *Journal of European Industrial Training,* 33 (8/9), 755-770.

Nayak, G.N., and C.G. Turvey (1997). Credit Risk Assessment and the Opportunity Costs of Loan Misclassification. *Canadian Journal of Agricultural Economics 45 (1997): 285-299.*

Nieman, G., Hough, J. and Nieuwenhuizen, C. (2003). Entrepreneurship: a South African perception. *Pretoria: Van Schaik*

Nieuwoudt, S., Henning, J.I.F.; Jordaan, H (2015). Exploring entrepreneurial competencies of smallholder producers: the case of Eksteenskuil raisin producers. In *Proceedings I, Healthy Agriculture for a Healthy World.* 20th International Farm Management Congress, Quebec City, Canada. 12 – 17 July, 2015; H. Watson, M. Lipari, S. Gendron, M-C, Bouchard, S, Couture, N. Nadeau.

Nunnally, J.C. (1978). *Psychometric Theory.* New York: McGraw Hill. 2nd Edition.

Nuthall, P.L. (2006). Determining the Important Management Skill Competencies: The Case of Family Farm Business in New Zealand, *Agricultural Systems,* 88(2-3), 429-450.

Ololade, R.A. and Olagunju, F.I. (2013). Determinants of access to credit among rural farmers in Oyo State, Nigeria. *Global Journal of Science Frontier Research*, *13*(2). 17-22

Omrane, A. and A. Fayolle. (2011) Entrepreneurial Competencies and Entrepreneurial Process: A Dynamic Approach, *International Journal of Business and Globalisation,* 6(2), 136-153.

Ondersteijn, C.J.M., Giesen, G.W.J. and Huirne, R.B.M. (2003). Identification of farmer characteristics and farm strategies explaining changes in environmental management and environmental and economic performance of dairy farms. *Agricultural Systems 78 (2003) 31-55.*

Ong, C., Huang, J., Tzeng, G. (2005). Building Credit Scoring Models Using Genetic Programming. Expert Systems with Applications 29 (1), 41-47.

Onphanhdala, P. and T. Suruga. (2010). Entrepreneurial Human Capital and Micro and Small Business in Lao Pdr. *The Developing Economies,* 48 (2), 181-202.

Orgler, Y.E. (1970). *A Credit Scoring Model for Commercial loans. Journal of Money, Credit and Banking 2(4), 435-445.*

Pacelli, V., Azzollini, M., (2011). An Artificial Neural Network Approach for Credit Risk Management. Journal of Intelligent Learning Systems and Applications 3, 103-112

Palich, L.E. and Bagby, D.R. (1995). Using cognitive theory to explain entrepreneurial risk-taking: Challenging conventional wisdom. *Journal of business venturing*, *10*(6), 425-438.

Paliwal, M. and Kumar, U.A. (2009). Neural networks and statistical techniques: A review of applications, *Expert Systems with Applications*. 36(1), 2-17.

Petrick, M. (2005). Empirical measurement of credit rationing in agriculture: a methodological survey. *Agricultural Economics 33(2005) 191 – 203.*

Phelan, C. (2014). Understanding the farmer: An analysis of the entrepreneurial competencies required for diversification to farm tourism. Ph.D. Thesis, University of Central Lancashire, Preston, Lancashire, England, 2014.

Pritchard, B., Burch, D., and Lawrence, G. (2007). Neither `family nor `corporate farming: Australian tomato growers as farm family entrepreneurs. *Journal of Rural Studies, 23*(1), 75-87.

Putnam, J.W.; Spiegel, A.N.; Bruininks, R.H (1995). Future directions in education and inclusion of students with disabilities: A delphi investigation. *Exceptional Children. 61*, 553.

Pyysiäinen, J., A.R. Anderson, G. McElwee and K. Vesala (2006) Developing the Entrepreneurial Skills of Farmers: Some Myths Explored, *International Journal of Entrepreneurial Behaviour & Research,* **12**, 21-39.

Quinn, R.E., Faerman, S.R., Thompson, M.P., McGrath, M.R., and Wiley, J. (2000). Becoming a master manager: A competency framework. New York: Wiley

Rauch, A. and M. Frese. (2007). Let's Put the Person Back into Entrepreneurship Research: A Meta-Analysis on the Relationship between Business Owners Personality Traits, Business Creation, and Success, *European Journal of Work & Organizational Psychology,* 16(4), 353-385.

Rauch, A., Frese, M., and Utsch, A. (2005). Effects of human capital and long-term human resources development and utilization on employment growth of small-scale businesses: A causal analysis. *Entrepreneurship Theory and Practice, 29*, 681-698.

Refaat, M. (2007). Data Preparation for Data Mining Using SAS. Morgan Kaufmann Publishers, San Francisco.

Reyes, A., Lensink, R., Kuyvenhoven, A. and Moll, H. (2012). Impact of Access to Credit on Farm Productivity of fruit and Vegetable Growers in Chile. Poster Presented at the International Association of Agricultural Economist Triennial Conference, Foz do Iguaçu, Brazil, 18 – 24 August 2012.

Ripsas, S. (1998). Towards an interdisciplinary theory of entrepreneurship. *Small Business Economics*, *10*(2), 103-115.

Roemer, L., (1996). Hospital middle managers' perceptions of their work and competence. *Journal of Healthcare management*, *41*(2), p.210.

Roessler, L. M. (2003). Determining the Probability of Default of Loans in the Seventh Farm Credit District. Unpublished MAB thesis, Kansas State University. United States of America.

Rotter, J.B. 1966. *Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs: General and Applied 80, Whole No 609.*

Fritsch, S. and Günther. F. (2008). neuralnet: Training of Neural Networks . R Foundation for Statistical Computing, 2008. R package version 1.2.

Sadler-Smith, E., Hampson, Y. Chaston, I., and Badger, B. (2003). Managerial behaviour, entrepreneurial style, and small firm performance. *Journal of Small Business Management* 41: 47-67.

Salame, E. (2011). Applying data mining techniques to evaluate applications for agricultural loans. University of Nebraska-Lincoln,

Sánchez, J.C., T. Carballo and A. Gutiérrez (2011). The Entrepreneur from a Cognitive Approach, *Psicothema,* **23**, 3, 433-438.

Schultz, T.W. (1980). Investment in Entrepreneurial Ability, *The Scandinavian Journal of Economics,* 82(4), 437-448.

Schumpeter, J. A. (1928) 'The Instability of Capitalism', *The Economic Journal,* **38**, 151, 361-386.

Schumpeter, J.A. (1934) *Capitalism, Socialism, and Democracy.* Harper and Row, New York.

Schumpeter, J.A. (1954) *History of Economic Analysis.* E. B. Schumpeter (ed), Oxford University Press, New York.

Seagle, E. and Iverson, M. (2002). Characteristics of the turfgrass industry in 2020: a Delphi study with implications for agricultural education programs. *Journal of Southern Agricultural Research*, *52*(1), pp.1-13.

Sekaran, U. **(2003).** *Research methods for business: A skill building approach*, 4th Edition; John Wiley & Sons: New York, United States of America.

Shane, S. (2000). Prior knowledge and the discovery of entrepreneurial opportunities. *Organization science*, 11(4), 448-469.

Shane, S. (2003a) *A General Theory of Entrepreneurship: The Individual-Opportunity Nexus.* Edward Elgar, Cheltenham.

Shane, S. (2003b). Entrepreneurial Motivation, *Human Resource Management Review,* **13**, 257-279.

Shane, S. and Venkataraman, S. (2000). The Promise of Entrepreneurship as a Field of Research, *Academy of Management Review,* 25(1), 217-226.

Sharma, P. and Chrisman. J.J. (1999). Toward a Reconciliation of the Definitional Issues in the Field of Corporate Entrepreneurship, *Entrepreneurship: Theory & Practice,* 23(3), 11-27.

Shaver, K.G. (1995). The entrepreneurial myth. *Business & Economic Review*, 41(3), 20 –23

Simon, M., Houghton, S.M., and Aquino, K. (1999). Cognitive biases, risk perception, and venture formation: How individuals decide to start companies. *Journal of Business Venturing*, 15, 113–134.

Singh, A. P. (2013). Factors Influencing Entrepreneurship among Farming Community in Uttar Pradesh. *Researchers World*, *4*(3), 114.

Siu, W.S. and Martin, R.G. (1992). Successful entrepreneurship in Hong Kong. *Long Range Planning,* 25(6): 87-93.

Skuras, D., N. Meccheri, M.B. Moreira, J. Rosell and S. Stathopoulou. (2005). Entrepreneurial Human Capital Accumulation and the Growth of Rural Businesses: A Four-Country Survey in Mountainous and Lagging Areas of the European Union, *Journal of Rural Studies,* 21(1), 67-79.

Smith, J.B., Mitchell, J.R. and Mitchell, R.K. (2009). Entrepreneurial scripts and the new transaction commitment mindset: Extending the expert information processing theory approach to entrepreneurial cognition research. *Entrepreneurship Theory & Practice*, 33(4), 815-844.

Snell, R. and Lau, A. (1994). Exploring local competences salient for expanding small businesses. *Journal of Management Development*, *13*(4), 4-15.

Snyder CR, Sympson S, Ybasco F, Borders T, Babyak M, Higgins R. (1996). Development and validation of the state hope scale. Journal of Personality and Social Psychology, 70, 321–335.

Snyder CR. (2002). Hope theory: Rainbows in the mind. Psychological Inquiry, 13(4), 249–276

Snyder, M., and Ickes, W. (1985). Personality and social behavior. In G. Lindzey & E. Aronson (Eds.), Handbook of social psychology 3rd ed., Vol. 2, 883–947. New York: Random House.

Stajkovic, A.D. and Luthans, F. (1998). Self-efficacy and work-related performance: A meta-analysis. *Psychological bulletin*, *124*(2), p.240.

Stearns, T.M. and Hills, G.E. (1996). Entrepreneurship and New Firm Development: A Definitional Introduction, *Journal of Business Research,* 36, 1-4.

Stevenson, H., Roberts, M.and Grousbeck. H. (1989). *New Business Ventures and the Entrepreneur.* Irwin, Boston, MA.

Stevenson, H. H., Roberts, M. J., Sahlman, W. and Hammermesh, R. (2006). New Business Ventures and the Entrepreneur. Homewood, IL: McGraw-Hill Irwin Publishing.

Stevenson, H.H. and Carlos Jarrillo-Mossi, J., (1986). Preserving entrepreneurship as companies grow. *Journal of Business Strategy*, *7*(1), 10-23.

Stewart, W.H., Watson, W.E., Carland, J.C. and Carland, J.W. (1999). A proclivity for entrepreneurship: A comparison of entrepreneurs, small business owners, and corporate managers. *Journal of Business venturing*, *14*(2), 189-214.

Stoner, C.R. (1987). Distinctive competence and competitive advantage. *Journal of Small Business Management 25*(2), 33-39.

Šušteršič, M., Mramor, D. and Zupan, J. (2009). Consumer credit scoring models with limited data. *Expert Systems with Applications*, *36*(3), 4736-4744.

Tam, S. and Redding, S.G. (1993). The impact of colonialism on the information of an entrepreneurial society in Hong Kong, in S. Birley and I.C. MacMillan (Eds.), *Entrepreneurship Research: Global Perspective.* Elsevier Science.

Tauer, L.W., and Lordkipanidze, N. (2000). Farmer efficiency and technology use with age. *Agricultural and Resource Economics Review*, *29*(1), 24-31.

Thomas, I. and Herrisier, R.L. (1991). Managerial competencies for effective performance at senior levels in government.

Thomas, L.C., Edelman, D.B. and Crook, J.N., (2002). *Credit scoring and its applications*. Siam.

Timmons, J.A. (1994). *New Venture Creation: Entrepreneurship for the 21st Century.* Irwin, Boston.

Tinsley, H. E. and Tinsley, D. J. (1987). Uses of factor analysis in counseling psychology research. *Journal of counseling psychology*, 34(4), 414.

Turvey, C.G. and Brown, R., (1990). Credit scoring for a federal lending institution: the case of Canada's Farm Credit Corporation. *Agricultural Finance Review*, *50*, 47-57.

Ucbasaran, D., Westhead, P. and Wright, M. (2008). Opportunity identification and pursuit: does an entrepreneur's human capital matter? *Small Business Economics*, *30*(2), 153-173.

Unger, J.M., Rauch, A., Frese, M. and N. Rosenbusch. (2011). Human Capital and Entrepreneurial Success: A Meta-Analytical Review, *Journal of Business venturing,* 26(3), 341-358.

Van Gool, J., Baesens, B., Sercu, P. and Verbeke, W., (2009). An analysis of the applicability of credit scoring for microfinance. *Katholieke Universiteit Leuven Leuven, Belgium. University of Southampton, Southampton, United Kingdom*.

Van Praag, C.M. (1999). Some classic views on entrepreneurship. *De economist*, *147*(3), 311-335.

Verhees, F.J., Kuipers, A. and Klopcic, M. (2011). Entrepreneurial proclivity and farm performance: the cases of Dutch and Slovenian farmers. *The International Journal of Entrepreneurship and Innovation*, *12*(3), 169-177.

Vesala, K.M., 1996. *Yrittäjyys ja individualismi: relationistinen linjaus*. Helsinki: University of Helsinki, Department of Social Psychology.

Vink, N. and Van Rooyen, J. (2009). The economic performance of agriculture in South Africa since 1994: Implications for food security. Development Planning Division Working Paper Series No.17, DBSA: Midrand.

von der Gracht, H.A. **(2012)** Consensus measurement in delphi studies: Review and implications for future quality assurance. *Technological Forecasting and Social Change.* 2012, *79*, 1525-1536.

West, D., (2000). Neural network credit scoring models. *Computers & Operations Research*, *27*(11), 1131-1152.

Wilcox, W.W. (1932). The Human Factor from the Viewpoint of Farm Management, *Journal of Farm Economics,* 14, 119-127.

Williams, B., Brown, T., and Onsman, A. (2010). Exploratory factor analysis: A five-step guide for novices. Australasian Journal of Paramedicine, 8(3). Available online: http://ro.ecu.edu.au/jephc/vol8/iss3/1. (accessed on13 October 2015).

Williams, C. (1996). Management competence and the management education needs of science graduates. *Management learning*, *27*(3), 301-322.

Willock, J., Deary, I.J., Edward-Jones, G., Gibson, G.J., McGregor, M.J., Sutherland, A., Dent, J.B., Morgan, O. and Grieve, R. (1999). The role of attitudes and objectives in farmer decision-making: Business and Environmentally-orientated behavior in Scotland. *Journal of Agricultural Economics 50 (2), 286 – 303.*

Wilson, A., Averis, A. and Walsh, K. (2003). The influences on and experiences of becoming nurse entrepreneurs: A Delphi study. *International journal of nursing practice*, *9*(4), 236-245.

Wilson, C.A., Featherstone, A.M., Kastens, T.L., and Jones, J.D. (2006). Determining what's really important to lenders: Factors affecting the agricultural loan decision-making process Dept. of Agricultural Economics Purdue University. 2006. Available online: http://ageconsearch.umn.edu/bitstream/28678/1/sp060007.pdf. (accessed on 20 April 2015).

Winn, M., Miller, C., and Gegenbauer, I. (2009). The Use of Structured Finance Instruments in Agriculture in Eastern Europe and Central Asia. Agricultural Management, Marketing and Finance Services (AGSF) Rural Infrastructure and Agro-Industries Division. Food and Agriculture Organization of the United Nations, Rome, Italy.

Woodruffe, C. (1992). What is meant by a competency? In R. Boam and P. Sparrow (Eds.), *Designing and Achieving Competency.* New York: McGraw-Hill.

Wu, S., Matthews and Dagher, G.K. (2007). Need for achievement, business goals, and entrepreneurial persistence. *Management Research News*, *30*(12), 928-941.

Xaba, G.G. (2014). *Identifying entrepreneurial skills required by South African black farmers–An entrepreneurial model*. Ph.D. thesis, University of the Witwatersrand, Johannesburg, South Africa.

Yobas M.B., Crook J.N. and Ross P. (2000). Credit scoring using neural and evolutionary techniques. *IMA Journal of Mathematics Applied in Business and Industry 11(4): 111–125.*

Young, S. J., and Jamieson, L. M. (2001). Delivery methodology of the Delphi: A comparison of two approaches. *Journal of Park and Recreation Administration, 19 (1), 42-58.*

Zahra, S. and Dess, G.G. (2001). Entrepreneurship as a field of research: Encouraging dialogue and debate. *Academy of Management Review*, *26*(1), 8-10.

Zekic-Susac, M., Sarlija, N. and Bensic, M. (2004). Small business Credit Scoring: A comparison of Logistic Regression, Neural Network and Decision Tree Models. *26th International Conference on Information Technology Interfaces, Croatia*. Available online: http://bib.irb.hr/datoteka/182478.zekic-sarlija-bensicITI2004_revised.pdf. (accessed on 22 October 2013).

Zellar, M. and Sharma, M. (1998). Rural finance and poverty alleviation*. Food policy report, International Food Policy Research institute. June, Washington, D.C.*

Zhao, H. and Seibert, S.E. (2006). The big five personality dimensions and entrepreneurial status: a meta-analytical review. *Journal of Applied Psychology*, *91*(2), 259-271.

Zinn, J., Zalokowski, A. and Hunter, L. (2001). Identifying indicators of laboratory management performance: A multiple constituency approach. *Health Care Management Review. 26*, 40-53.

Appendices

Round 1
Holistic credit scoring model: Incorporation entrepreneurial characteristics

Introduction

The questionnaire forms part of a Ph.D. in Agricultural Economics at the University of the Free State. The topic of the thesis is HOLISTIC CREDIT SCORING MODEL: INCORPORATING ENTREPRENEURIAL CHARACTERISTICS where the idea is to extend the current credit evaluation models to also consider the applicant's personal characteristics, decision making and entrepreneurial abilities and capabilities in the credit evaluation process. The aim is to improve the accuracy of the evaluation tool that is used to decide whether or not to grant credit to the prospective clients based on his/her expected ability to repay the loan. The abilities and capabilities will be measured using a recognised scientific measuring instrument, instead of relying only on experience and personal knowledge of the applicant.

Questionnaire

1.1 Wat is die persoonlikheids eienskappe en aspekte van 'n boer wat in ag geneem word om bydraes te lewer by 'n kredietaansoek? Waarna word verwys in terme van die vermoëns van die boer in die kredietverslag?

What is the personal characteristics and aspects of a farmer that is considered as important for assisting in credit applications? Which capabilities of a farmer are considered when writing the credit report that forms part of the credit application process?

1.2 Volgens u opinie, is daar enige addisionele eienskappe of faktore wat terugbetalings vermoë beïnvloed wat tans nie in ag geneem word nie?

In your opinion, are there any additional characteristics or factors which influence repayment ability that is not considered?

| |
| |
| |
| |

Round two Delphi Questionnaire

Round 2
Holistic credit scoring model: Incorporation entrepreneurial characteristics

Please respond by 25 February 2015

I would like to thank you for participating in the first round of the study and have the honour to invite you now to participate in the second round. The second round provides feedback from the first round 1 in Question 1, where the mentioned factors and attributes are listed.

Question 2 of Round 2 includes the factors and attributes identified in Question 2 from round 1 that are important but are not currently considered, especially specific factors and attributes are to be ranked in terms of importance to be included in credit evaluations. Question 2 also introduces several factors and attributes from literature that is associated with personality factors and attributes.

Feedback and results from round 2 will be provided in Round 3, where the responses to each statement would be presented. Respondents would then have opportunity to verify or adjust their responses and if necessary provide additional information.

Questions applicable to round 2.

Question 1:
What is the relevant importance of each of the following factors and attributes, specific to the individual, when considering a credit application in determining repayment ability?

Question 2:
If the factor or attribute is not currently considered please indicate the importance of including the specific factor or attribute.

Space is also available where other or additional factors could be added for consideration.

I appreciate your willingness to participate in this research

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Answering the questionnaire:
Please indicate the level of importance of the specific factors in question as a determinant of repayment ability by a potential client to evaluate a credit application. Importance is shown with the likert scale where 0 is not important and 5 is very important.

Answers can either be provided in the answer column or crossed in the scale.

Example	Answer	Not important					Very important
Ability to build a team and giving responsibility and credit when due	4	0	1	2	3	☒ 4	5

The factors and attributes are not in any specific order.

		Relative importance in consideration					
		Not important					Very important
Question 1: Round 1 Summary feedback							
Account standings		0	1	2	3	4	5
Age		0	1	2	3	4	5
Client success factor compared to competitors		0	1	2	3	4	5
Collateral		0	1	2	3	4	5
Credit record		0	1	2	3	4	5
Education/qualifications		0	1	2	3	4	5
Experience		0	1	2	3	4	5
Farm ownership		0	1	2	3	4	5
Market information		0	1	2	3	4	5
Past and current financial performance		0	1	2	3	4	5
Product market projections		0	1	2	3	4	5
Reputation		0	1	2	3	4	5
Sustainability of the enterprise		0	1	2	3	4	5
Type of farming enterprise		0	1	2	3	4	5
Willingness to repay		0	1	2	3	4	5
Question 2: Identified additional factors and characteristics from round 1 and literature							
Ability to build a team and giving responsibility and credit when due		0	1	2	3	4	5

Applying new ideas for example adjusting or refining an existing product; identifying new opportunities with a solution.		0	1	2	3	4	5
Belief other or chance control destiny		0	1	2	3	4	5
Belief to be in control of own destiny		0	1	2	3	4	5
Believe in his own abilities		0	1	2	3	4	5
Believe in his own capability to perform tasks to be successful		0	1	2	3	4	5
Believe in the business despite setbacks		0	1	2	3	4	5
Deal with problems as they occur rather than anticipating before hand		0	1	2	3	4	5
Enjoy what the person is doing in all activities		0	1	2	3	4	5
Good personal interactions and to trust people and give recognition when deserved		0	1	2	3	4	5
Have the ability to adjust to an ever changing environment and to use the change to their advantage		0	1	2	3	4	5
Have the ability to handle conflict between various stakeholders of the business		0	1	2	3	4	5
Have the ability to take on calculated risk opportunities		0	1	2	3	4	5
In control of situations with good delegation skills		0	1	2	3	4	5
Internally driven by strong desires to compete and excel against self-imposed standards to pursue and attain goals		0	1	2	3	4	5
Observing more opportunities than threats		0	1	2	3	4	5
Observing more strengths than weaknesses		0	1	2	3	4	5
Overcoming hurdles and obstacles		0	1	2	3	4	5
Planning ahead for possible problems that may be encountered							
Pursue business with a "go get it" attitude		0	1	2	3	4	5
Willingness to commit personal resources to the business		0	1	2	3	4	5
Additional:							

Round three Delphi Questionnaire

**Round 3
Holistic credit scoring model: Incorporation entrepreneurial
characteristics**

Please respond by 17 March 2015

I would like to thank you for participating in the first and second round of the study
and have the honour to invite you now to participate in the third round. The third
round provides feedback and summarized responses from the second round.
Question 1 and 2 includes the factors and attributes identified in the first two rounds
with the results in terms of the average response and the most repeated response
for each factor or statement.

Each respondent now have the opportunity to verify or adjust the original response
from the previous rounds in relations to the overall responses as provided.

Questions applicable to round 3;

**Question 1 and 2: This is the main question that is applicable to the original rounds
with the answers.**
Question 1:
What is the relevant importance of each of the following factors and attributes,
specific to the individual, when considering a credit application in determining
repayment ability?

Question 2:
If the factor or attribute is not currently considered please indicate the importance
of including the specific factor or attribute.

**Question 3: is a new question to determine the method used to analyse the
applications from which a decision is made. This question is answered by indicating
whether the factor is considered objectively or subjectively, where is subjectively
based on human judgement and objectively is based on empirical results or
information.**

Space is also available where other or additional factors could be added for consideration.

I appreciate your willingness to participate in this research

Janus Henning
henningjif@ufs.ac.za
051 401 9713

Answering the questionnaire:
Please indicate the level of importance of the specific factors in question as a determinant of repayment ability by a potential client to evaluate a credit application. Importance is shown with the likert scale where 0 is not important and 5 is very important. A factor that is observed subjectively (human judgement) can be indicated by (Sub), and when observed objectively (measured empirically) can be indicated by (obj).

Answers can either be provided in the answer column or crossed in the scale.

Example	Answer	Subjective / objective	Not important				Very important
Ability to build a team and giving responsibility and credit when due	4	Sub	0	1	2	3	⊠4	5

The factors and attributes are not in any specific order.

	Average	Most repeated answer	Answer	Subjective / objective	Not important					Very important
Question 1: Round 1 and 2 Summary feedback										
Account standings	4.25	4			0	1	2	3	4	5
Age	2.25	2			0	1	2	3	4	5
Client success factor compared to competitors	4.50	5			0	1	2	3	4	5
Collateral	3.75	4			0	1	2	3	4	5
Credit record	4.50	5			0	1	2	3	4	5
Education/qualifications	3.38	4			0	1	2	3	4	5

Experience	4.63	5			0	1	2	3	4	5
Farm ownership	3.88	4			0	1	2	3	4	5
Market information	4.00	4			0	1	2	3	4	5
Past and current financial performance	4.75	5			0	1	2	3	4	5
Product market projections	3.75	4			0	1	2	3	4	5
Reputation	4.13	4			0	1	2	3	4	5
Sustainability of the enterprise	4.63	5			0	1	2	3	4	5
Type of farming enterprise	3.25	3			0	1	2	3	4	5
Willingness to repay	5.00	5			0	1	2	3	4	5
Final decision for accepting or rejecting application is based on			**1. Human judgement**				**2. Statistical tool**		

Question 2: Identified additional factors and characteristics from round 1 and literature

Ability to build a team and giving responsibility and credit when due	3.38	4			0	1	2	3	4	5
Applying new ideas for example adjusting or refining an existing product; identifying new opportunities with a solution.	4.13	4			0	1	2	3	4	5
Belief other or chance control destiny	2.50	3			0	1	2	3	4	5
Belief to be in control of own destiny	3.88	4			0	1	2	3	4	5
Believe in his own abilities	4.13	4			0	1	2	3	4	5
Believe in his own capability to perform tasks to be successful	3.75	4			0	1	2	3	4	5

Believe in the business despite setbacks	3.88	4			0	1	2	3	4	5
Deal with problems as they occur rather than anticipating before hand	2.75	3			0	1	2	3	4	5
Enjoy what the person is doing in all activities	3.63	4			0	1	2	3	4	5
Good personal interactions and to trust people and give recognition when deserved	3.50	4			0	1	2	3	4	5
Have the ability to adjust to an ever changing environment and to use the change to their advantage	4.25	4			0	1	2	3	4	5
Have the ability to handle conflict between various stakeholders of the business	3.88	4			0	1	2	3	4	5
Have the ability to take on calculated risk opportunities	3.63	4			0	1	2	3	4	5
In control of situations with good delegation skills	3.63	4			0	1	2	3	4	5
Internally driven by strong desires to compete and excel against self imposed standards to pursue and attain goals	4.13	4			0	1	2	3	4	5
Observing more opportunities than threats	3.88	4			0	1	2	3	4	5
Observing more strengths than weaknesses	3.57	4			0	1	2	3	4	5
Overcoming hurdles and obstacles	3.63	4			0	1	2	3	4	5
Planning ahead for possible problems that may be encountered	4.13	5			0	1	2	3	4	5

Pursue business with a "go get it" attitude	3.63	4			0	1	2	3	4	5
Willingness to commit personal resources to the business	4.75	5			0	1	2	3	4	5
Additional:					0	1	2	3	4	5
					0	1	2	3	4	5
					0	1	2	3	4	5
					0	1	2	3	4	5
					0	1	2	3	4	5
					0	1	2	3	4	5

Question 3

In your opinion would the use of a statistical tool improve the consistency in credit granting decisions?

Yes		No	

Script used for determining the back propagation neural network

```
#############################################################################
                                 R script
#############################################################################

train<-read.csv(file.choose(), header = T)
attach(train)
library(neuralnet)
library(nnet)
#############################################################################
#data split for testing
testsplit = sort(sample(nrow(train),nrow(train)*0.3))
testsplit


#############################################################################
                        backpropogation neural net
#############################################################################

nn.backprop = neuralnet(Approved~MediumT+ Longterm+ Amount+ Period+
Business+ Accountother+Credithistother+ Excollother+ Newcollother+ DTA+
DTE+ CR+ WCTGR+ ATO+ ROA+ ROE+ NETFARMRATIO+ PRODCOST+
INTEREST+CASHFLOW+ Divers2+ Divers3+ Highrisk+ MediumRisk+ Owner+
Age+ Experience+ No.education+ Graduate+ Postgrad+ No.Indication+
Opportunity+ Relationship+ Conceptual+ Organising+ Strategic+ Commitment+
Learning+ Personal.Strength, data = train, hidden = 2, learningrate =
0.01,algorithm = "backprop",err.fct = "ce", linear.output = FALSE)
nn.backprop
##summary of the main results
##recall the neuralnet
nn.backprop
nn.backprop$net.result
nn.backprop$weights   #weights
##summary of the main results
nn.backprop$result.matrix
##generalized weights – list containing the generalised weights of the neuralnet
for each replication
nn.backprop$generalized.weights
```

nn.backprop$covariate

##datasplit if greater than 0.5 = accepted; less than 0.5 rejected

nn.backprop1 = ifelse(nn.backprop$net.result[[1]]>0.5,1,0)

nn.backprop1

##determining the misclassification error

misclasserrorbackprop= mean(Approved!=nn.backprop1)

misclasserrorbackprop

percentagebackprop = misclasserrorbackprop*100

percentagebackprop

##view data approved vs predictions

outvspredictionbackprop = cbind(Approved,nn.backprop1)

outvspredictionbackprop

###
Testing the network
###

testing= compute(nn.backprop,covariate=matrix(c(0, 0, -0.171867008, -
1.195957304, 0.061839266, 0, 0, 0, 0, 0.359965873, 0.049803422, -
0.192274049, -0.304072133, -0.295541819, -0.375627949, -0.082704721, -
0.39080536, 0.086722195, 0.329959, -0.548777414, 0, 1, 1, 0, 1, 2.695380469,
3.03654717, 0, 0, 0, 0, 0.240031694, 0.157637455, 0.665625493, 0.776303739, -
0.215271254, 0.474248934, 0.421909661, 0.434583789,
1, 0, -0.198082006, 0.616632119, -1.065138018, 0, 0, 0, 0, 0.015262386, -
0.039199994, -0.192274799, -0.633969474, 0.159065571, 0.338317064,
0.033785561, 0.276135653, -0.237182534, -0.199334398, 0.226244039, 0, 1, 1,
0, 1, 0.749208255, -1.224831046, 0, 1, 0, 0, 1.316035839, 0.876685494,
0.047544678, 0.61379249, 0.784202427, 0.927575122, 0.158216123,
0.806267293,
0, 0, -0.722381959, -1.310264745, 2.466057472, 1, 1, 0, 0, 0.60279627,
0.134430313, -0.192274578, -1.031769359, -0.290556978, -0.402867456, -
0.084902968, -0.084217882, -0.053995411, 1.020338573, -1.075792003, 1, 0, 1,
0, 1, 1.810756735, -1.880427695, 0, 0, 0, 0, -1.911976596, -0.561410585, -
1.806697767, -1.986387507, -1.714481777, -2.699034377, -2.478719258, -
1.981358987,
0, 1, 6.06730243, 1.596410185, 0.888289275, 0, 0, 0, 0, 0.56744901,
0.120621703, -0.19227217, 0.072251613, 0.138875044, -0.168004465, -
0.03293559, 0.042204366, -0.118262653, -0.659179702, 0.133241465, 1, 0, 1, 0,
1, 0.837670628, -0.897032722, 0, 1, 0, 0, -1.1946405, 0.876685494,
0.871652431, 0.938814989, 0.950781374, 0.020922747, 0.949296737,
0.248742037,

1, 0, -0.748596956, -1.1469684, 0.061839266, 0, 0, 0, 0, 0.434221865, 0.073321902, -0.192273765, -0.120837055, -0.305674696, -0.173262996, -0.039616638, -0.472641154, 0.276412811, -0.359333832, -3.524859796, 0, 1, 1, 0, 1, 0.129971641, 0.496110156, 0, 0, 1, 0, -1.1946405, 0.876685494, 0.871652431, 0.938814989, 0.950781374, 0.020922747, 0.949296737, 0.248742037,

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0, 1, 2.266127772, 0.616632119, 0.888289275, 0, 0, 1, 0, 0.801160709, 0.224146038, -0.192274658, -0.448903147, -0.183119386, -0.731425658, -0.166496277, -0.595759312, 0.206048666, -0.60957527, -0.083764542, 1, 0, 0, 1, 1, -1.46235108, -1.224831046, 0, 0, 1, 0, -0.118636354, -0.201886565, -0.364509199, 0.776303739, 0.284465586, 0.927575122, -0.105477415, 0.248742037,

0, 0, -0.460231982, -1.1469684, -0.539215285, 0, 0, 0, 0, -0.142636531, -0.07152153, -0.192274009, -0.282105316, -0.106576871, -0.193297323, -0.05964336, -0.180274771, -0.005164518, -0.147766078, 0.04023889, 1, 0, 0, 1, 1, 0.837670628, 0.578059737, 0, 1, 0, 0, 0.240031694, -1.639982644, -0.364509199, -1.173831258, -0.048692308, 0.020922747, 0.685603199, -0.494624971,

0, 0, -0.643736966, -1.1469684, 0.362366542, 0, 0, 0, 0, -0.652449103, -0.152139688, -0.192272433, 1.547636654, -0.345745654, -0.220226456, -0.071994752, 0.502830667, -0.352423826, 0.154897788, -0.1147654, 0, 0, 0, 0, 1, -1.108501586, -0.651183979, 0, 1, 0, 0, 0.957367791, -0.201886565, 0.459598555, 0.12625874, 0.451044533, 0.927575122, 0.158216123, -0.122941467,

0, 0, -0.578199472, -1.1469684, -1.140269836, 0, 0, 0, 0, -0.68100081, -0.155834525, -0.192271419, 0.212831708, 0.033303423, -0.41601514, -0.097693348, 0.052146657, -0.123316855, -0.56238685, -0.238768833, 1, 0, 0, 1, 1, 0.306896388, 0.578059737, 0, 1, 0, 0, 0.598699742, 0.517161475, 0.253571616, 0.61379249, 0.451044533, 0.927575122, 0.158216123, 1.177950797,

0, 0, -0.093222015, -1.1469684, -1.140269836, 0, 0, 0, 0, -0.031466813, -0.049224839, -0.192274123, -0.333627425, -0.10819335, 0.768114479, 0.102076365, -0.58234511, 0.028750456, -0.620302242, 0.133241465, 1, 0, 0, 1, 1, 0.660745881, 0.168311832, 0, 1, 0, 0, -0.835972451, -0.920934604, -0.982590014, -0.361275009, -0.215271254, 0.474248934, -1.687638644, -1.237991979,

0, 1, 0.562152926, 1.596410185, -1.140269836, 0, 0, 0, 0, -0.081504987, -0.059520205, 0.202152764, -0.228539238, -0.019160221, -0.155763256, -0.052241647, -0.257721415, 0.034205786, -0.297679441, -0.176767117, 1, 0, 0, 1, 1, -0.754652093, -1.060931884, 0, 1, 0, 0, 0.598699742, 0.157637455, 0.047544678, -0.361275009, -0.381850201, -0.43240344, -0.105477415, -1.237991979,

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0, 1, -0.15875951, 0.028765279, -0.464083466, 0, 0, 0, 0, -0.377758079, -0.112540713, -0.192274799, -0.575718987, -0.14601287, -0.105933757, -0.051548481, -0.040911182, -0.076010541, 0.057754174, 0.350247472, 1, 0, 0, 1, 1, -0.489264973, -0.077536911, 0, 0, 0, 0, -1.553308548, 0.517161475, 0.665625493, -0.198763759, -0.548429148, 0.020922747, -0.369170953, 0.248742037,

0, 0, -0.624075718, -0.363145947, 0.061839266, 0, 0, 0, 0, -0.446427728, -0.123187278, -0.192274702, -0.617945862, 0.171098506, 0.328582166, 0.008009131, 0.403973594, -0.302169449, -0.065399599, 0.38124833, 1, 0, 0, 1, 1, 0.395358761, 0.168311832, 0, 0, 0, 0, 0.240031694, 0.157637455, 0.253571616, -0.198763759, -0.215271254, -0.885729628, -0.369170953, -0.122941467,

0, 0, -0.683059462, -1.1469684, -0.388951647, 0, 0, 0, 0, -0.177000378, -0.078005922, -0.192274799, -0.32827593, 0.13378887, 0.304104965, 0.017175002, -0.030566102, -0.1024816, -0.336971834, 0.505251762, 1, 0, 1, 0, 1, 0.483821134, 0.332210994, 0, 0, 1, 0, -0.118636354, -0.920934604, 0.665625493, -0.03625251, 1.117360321, -0.43240344, -0.896558029, 0.806267293,

0, 0, -0.224297004, -1.1469684, 0.362366542, 0, 0, 0, 0, -0.408301117, -0.117343205, -0.192274641, -0.722001054, -0.170639318, -0.003042216, -0.037558578, -0.184479218, -0.003027171, -0.53554054, 0.38124833, 0, 1, 0, 1, 1, 1.545369615, 1.397555548, 0, 0, 1, 0, 0.240031694, -0.920934604, -1.188616952, -0.848808759, -1.214744936, -0.43240344, -0.369170953, 0.248742037,
0, 0, -0.682067008, -1.1469684, 2.090398377, 0, 1, 0, 0, 0.117517689, -0.015753705, -0.19227344, -0.229440799, -0.001474505, 0.012483269, -0.017095233, -0.143910895, -0.327823719, -0.062829125, 0.102240607, 1, 0, 1, 0, 1, 1.191520121, 1.643404291, 0, 1, 0, 0, 1.674703887, 1.595733534, 1.695760185, 1.426348739, 1.617097162, 0.927575122, 1.476683813, 1.735476053,
0, 1, -0.342264493, 0.616632119, -0.388951647, 0, 0, 1, 0, 0.203087131, 0.005638625, -0.192274799, -0.40469519, -0.164924168, -0.102713962, -0.034488981, 0.757423034, -0.481846848, 0.747118102, 3.884345299, 0, 0, 0, 1, 1, 1.191520121, -1.060931884, 0, 0, 1, 0, -1.1946405, -0.201886565, 0.047544678, 0.45128124, -0.215271254, 0.020922747, -0.105477415, 0.434583789,
0, 0, -0.70927446, -1.244946207, -0.539215285, 0, 0, 0, 0, -0.465467385, -0.126044984, -0.192274799, -0.361675549, -0.654151217, -0.515049042, -0.11050457, -1.018306683, 0.443201619, 0.125415991, -0.331771407, 0, 0, 1, 0, 1, 1.103057748, -1.224831046, 0, 0, 1, 0, -1.911976596, -1.280458624, -1.39464389, -0.686297509, -1.381323883, 0.020922747, -0.369170953, -0.308783219),
byrow=TRUE, ncol=39))
testing$net.result
testing1 = ifelse(testing$net.result[[1]]>0.5,1,0)
testing1

##summary of main results backprop
##
                      plotting of neuralnet
##
plot(nn.backprop)
##
##
                  Application of backprop neuralnet
              Application of neuralnet to pending applicants
##
netappoutback= compute(nn.backprop,covariate=matrix(c(0, 0, -0.506108228, -0.363145947, 0.587761999, 0, 0, 0, 0, 0.45830496, 0.319728893, -0.192274759, -1.0879562, -0.725141231, -0.864536443, -0.187281928, -1.211469447, -1.211469447, 0.644144673, 0.644144673, 0, 1, 1, 0, 1, -0.754652093, -

1.060931884, 0, 0, 0, 1, -0.118636354, 0.157637455, 0.253571616, -0.03625251, 0.117886639, -1.339055815, 0.158216123, 0.434583789,

1, 0, -0.420909486, -0.363145947, 0.061839266, 0, 0, 0, 0, 0.384396352, 0.270450928, -0.192274793, -0.339275479, 1.25134568, -0.498655002, -0.065789424, -0.189049803, -0.189049803, -0.539850031, -0.539850031, 0, 0, 0, 0, 1, -0.93157684, -0.651183979, 0, 1, 0, 0, 0.598699742, 0.517161475, 0.459598555, -0.03625251, 0.61762348, 0.020922747, -0.105477415, -0.308783219,

1, 0, -0.093222015, 0.616632119, -0.16355619, 0, 0, 0, 0, 0.835060712, 0.646457413, -0.192274788, -2.055361681, 1.093225995, 1.374854469, 0.712694006, 0.264826114, 0.264826114, -0.227882829, -0.227882829, 0, 1, 1, 0, 1, -0.843114466, -0.651183979, 0, 0, 0, 0, 1.316035839, 0.517161475, 0.253571616, 0.45128124, 0.451044533, -0.43240344, -0.105477415, 0.992109045,

0, 1, 0.168927961, 0.616632119, 0.963421093, 0, 0, 0, 0, -0.231351193, -0.029720404, -0.192274793, -0.526356072, -0.192012723, -0.102622359, 0.030360483, -0.410833739, -0.410833739, -0.271782016, -0.271782016, 1, 0, 1, 0, 1, 1.014595375, 1.397555548, 0, 0, 0, 0, -0.477304403, -0.201886565, -0.15848226, -0.523786259, -0.215271254, 0.927575122, -1.951332182, -0.122941467,

1, 0, 0.103390467, -0.363145947, -0.313819828, 0, 0, 0, 0, -0.407048223, -0.090639543, -0.192274793, -0.328644478, 0.44860848, 0.76868335, 0.222175412, 1.34158299, 1.34158299, -0.131792738, -0.131792738, 0, 0, 0, 1, 1, -1.108501586, -0.897032722, 0, 1, 0, 0, 0.240031694, -0.561410585, -0.570536137, -1.661365008, -0.548429148, 0.927575122, -1.160251567, -0.494624971,

0, 1, 0.037852973, 0.616632119, 0.362366542, 0, 0, 0, 0, -0.231584688, -0.029806901, -0.192269977, -0.184500562, 2.327158522, -0.054758156, 0.041971278, 1.390189346, 1.390189346, -0.063676481, -0.063676481, 0, 0, 1, 0, 1, -1.373888707, -0.897032722, 0, 1, 0, 0, 0.957367791, 1.236209514, 1.695760185, 1.426348739, 1.617097162, 0.927575122, 1.476683813, 1.735476053,

0, 1, 2.921502713, 1.596410185, 0.212102904, 0, 0, 0, 0, 0.091770047, 0.107240028, 7.358252049, 2.409025464, -0.264410948, -0.230150857, 0.008793284, 7.249634557, 7.249634557, 8.912112146, 8.912112146, 0, 1, 0, 1, 1, 0.483821134, 0.987807643, 0, 0, 0, 0, 0.598699742, 0.157637455, 0.253571616, -0.523786259, -0.881587042, -0.885729628, 0.158216123, 0.062900285,

 0, 1, 2.331665266, 0.616632119, -0.16355619, 0, 0, 0, 0, -0.323339953, -0.062620275, -0.192225558, 2.277524686, 0.375308436, -0.345836052, -0.029972014, 1.390189346, 1.390189346, -0.063676481, -0.063676481, 0, 0, 1, 0, 1, -1.373888707, -0.897032722, 0, 0, 0, 0, 0.240031694, -0.920934604, -

```
1.188616952, -0.848808759, -1.214744936, -0.43240344, -0.369170953,
0.248742037,
1, 0, 0.300002949, 0.616632119, 0.437498361, 0, 0, 0, 0, -1.197114416, -
0.289653221, -0.192274568, -0.399901043, -0.649433346, -0.498655002, -
0.065789424, -0.061199201, -0.061199201, -0.55875943, -0.55875943, 0, 0, 0, 0,
1, -1.285426333, -0.897032722, 0, 0, 1, 0, 1.674703887, 1.595733534,
1.695760185, 1.426348739, 1.617097162, 0.927575122, 1.476683813,
1.735476053),
byrow=TRUE, ncol=39))
netappoutback$net.result
outputconback = ifelse(netappoutback$net.result[[1]]>0.7,1,0)
outputconback
############################################################################
                            Variable visialisation
############################################################################
##backpropagation
##par(mfrow=c(3,3))
##gwplot(nn.backprop,selected.covariate = "Shortterm"")
gwplot(nn.backprop,selected.covariate = "MediumT"")
gwplot(nn.backprop,selected.covariate = "Longterm"")
gwplot(nn.backprop,selected.covariate = "Amount"")
gwplot(nn.backprop,selected.covariate = "Period"")
gwplot(nn.backprop,selected.covariate = "Business"")
##gwplot(nn.backprop,selected.covariate = "AccountGood"")
gwplot(nn.backprop,selected.covariate = "Accountother"")
##gwplot(nn.backprop,selected.covariate = "Credithistgood"")
gwplot(nn.backprop,selected.covariate = "Credithistother"")
##gwplot(nn.backprop,selected.covariate = "Excollgood")
gwplot(nn.backprop,selected.covariate = "Excollother")
##gwplot(nn.backprop,selected.covariate = "Newcollgood")
gwplot(nn.backprop,selected.covariate = "Newcollother")
gwplot(nn.backprop,selected.covariate = "DTA")
gwplot(nn.backprop,selected.covariate = "DTE")
gwplot(nn.backprop,selected.covariate = "CR")
gwplot(nn.backprop,selected.covariate = "WCTGR")
gwplot(nn.backprop,selected.covariate = "ATO")
gwplot(nn.backprop,selected.covariate = "ROA")
gwplot(nn.backprop,selected.covariate = "ROE")
gwplot(nn.backprop,selected.covariate = "NETFARMRATIO")
gwplot(nn.backprop,selected.covariate = "PRODCOST")
gwplot(nn.backprop,selected.covariate = "INTEREST")
gwplot(nn.backprop,selected.covariate = "CASHFLOW")
##gwplot(nn.backprop,selected.covariate = "Divers1"")
```

```
gwplot(nn.backprop,selected.covariate = "Divers2"")
gwplot(nn.backprop,selected.covariate = "Divers3"")
gwplot(nn.backprop,selected.covariate = "Highrisk"")
gwplot(nn.backprop,selected.covariate = "MediumRisk"")
##gwplot(nn.backprop,selected.covariate = "Lowrisk"")
gwplot(nn.backprop,selected.covariate = "Owner")
gwplot(nn.backprop,selected.covariate = "Age")
gwplot(nn.backprop,selected.covariate = "Experience")
gwplot(nn.backprop,selected.covariate = "No.education")
##gwplot(nn.backprop,selected.covariate = "Matric")
gwplot(nn.backprop,selected.covariate = "Graduate")
gwplot(nn.backprop,selected.covariate = "Postgrad")
gwplot(nn.backprop,selected.covariate = "No.Indication")
gwplot(nn.backprop,selected.covariate = "Opportunity")
gwplot(nn.backprop,selected.covariate = "Relationship")
gwplot(nn.backprop,selected.covariate = "Conceptual")
gwplot(nn.backprop,selected.covariate = "Organising")
gwplot(nn.backprop,selected.covariate = "Strategic")
gwplot(nn.backprop,selected.covariate = "Commitment")
gwplot(nn.backprop,selected.covariate = "Learning")
gwplot(nn.backprop,selected.covariate = "Personal.Strength")


############################################################################
```

Classification results of the neural network compared to training

output

Table E.1: **Classification results of the Neural network compared to the training outputs used in training**

	Output value	Converted value [0,1]	Original output	Application status	Accuracy of prediction
1	0.999943456	1	1	Approved	Correct
2	0.999919618	1	1	Approved	Correct
3	0.999941234	1	1	Approved	Correct
5	0.999393701	1	1	Approved	Correct
6	0.005880193	0	0	Rejected	Correct
7	0.999575532	1	1	Approved	Correct
8	0.999608181	1	1	Approved	Correct
9	0.002961639	0	0	Rejected	Correct
13	0.999836201	1	1	Approved	Correct
14	0.999943535	1	1	Approved	Correct
15	0.999821963	1	1	Approved	Correct
16	0.999943451	1	1	Approved	Correct
17	0.999925572	1	1	Approved	Correct
19	0.999823992	1	1	Approved	Correct
21	0.999941695	1	1	Approved	Correct
23	0.999835464	1	1	Approved	Correct
25	0.999614617	1	1	Approved	Correct
26	0.999822011	1	1	Approved	Correct
28	0.999912533	1	1	Approved	Correct
30	0.999935003	1	1	Approved	Correct
31	0.999809857	1	1	Approved	Correct
34	0.999843983	1	1	Approved	Correct
38	0.999942126	1	1	Approved	Correct
39	0.999926537	1	1	Approved	Correct
40	0.999829932	1	1	Approved	Correct
41	0.999827011	1	1	Approved	Correct
42	0.999943629	1	1	Approved	Correct
44	0.999941911	1	1	Approved	Correct
45	0.999943446	1	1	Approved	Correct
46	0.999833933	1	1	Approved	Correct
47	0.999704183	1	1	Approved	Correct
48	0.999857899	1	1	Approved	Correct
50	0.999943554	1	1	Approved	Correct
52	0.999868832	1	1	Approved	Correct
53	0.999838296	1	1	Approved	Correct

54	0.999836857	1	1	Approved	Correct
55	0.999813375	1	1	Approved	Correct
56	0.999895288	1	1	Approved	Correct
57	0.999932513	1	1	Approved	Correct
58	0.99994246	1	1	Approved	Correct
59	0.999911941	1	1	Approved	Correct
60	0.999885092	1	1	Approved	Correct
61	0.999831132	1	1	Approved	Correct
63	0.999943546	1	1	Approved	Correct
64	0.999942957	1	1	Approved	Correct
66	0.999943537	1	1	Approved	Correct
67	0.999915372	1	1	Approved	Correct
68	0.999942734	1	1	Approved	Correct
69	0.999942845	1	1	Approved	Correct
71	0.999920346	1	1	Approved	Correct
72	0.999783616	1	1	Approved	Correct
74	0.999826354	1	1	Approved	Correct
75	0.999841923	1	1	Approved	Correct
77	0.999891848	1	1	Approved	Correct
78	0.003274166	0	0	Rejected	Correct
79	0.999596522	1	1	Approved	Correct
80	0.999938155	1	1	Approved	Correct
81	0.999940855	1	1	Approved	Correct
82	0.99990445	1	1	Approved	Correct
83	0.999943585	1	1	Approved	Correct
85	0.999809412	1	1	Approved	Correct
86	0.999851798	1	1	Approved	Correct
88	0.999940689	1	1	Approved	Correct
89	0.999941518	1	1	Approved	Correct
93	0.999943575	1	1	Approved	Correct
94	0.999942543	1	1	Approved	Correct
95	0.999935517	1	1	Approved	Correct
96	0.999941053	1	1	Approved	Correct
97	0.999942273	1	1	Approved	Correct
98	0.999941894	1	1	Approved	Correct
99	0.999868963	1	1	Approved	Correct
100	0.99988151	1	1	Approved	Correct
102	0.002549793	0	0	Rejected	Correct
104	0.999908111	1	1	Approved	Correct
106	0.999801028	1	1	Approved	Correct
107	0.999943224	1	1	Approved	Correct
108	0.999936148	1	1	Approved	Correct
110	0.999826933	1	1	Approved	Correct
111	0.999927265	1	1	Approved	Correct
112	0.999867014	1	1	Approved	Correct
113	0.999943612	1	1	Approved	Correct

115	0.999838598	1	1	Approved	Correct
116	0.999824547	1	1	Approved	Correct
118	0.999824076	1	1	Approved	Correct
120	0.999825183	1	1	Approved	Correct

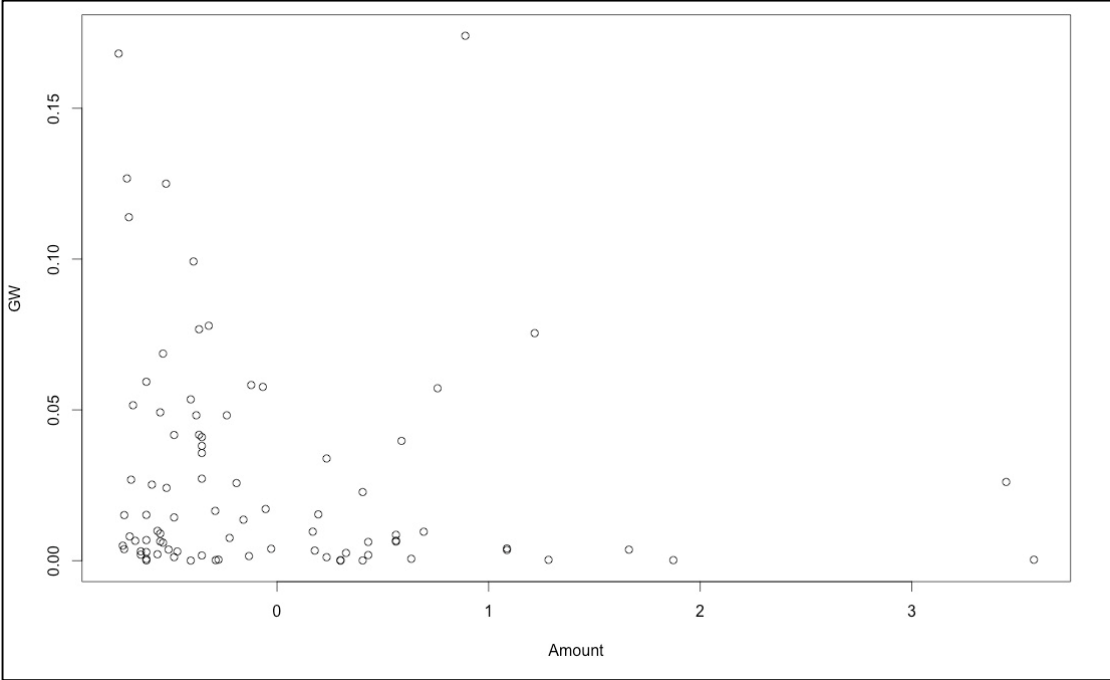General weight distribution of the scale variables used in the neural

network

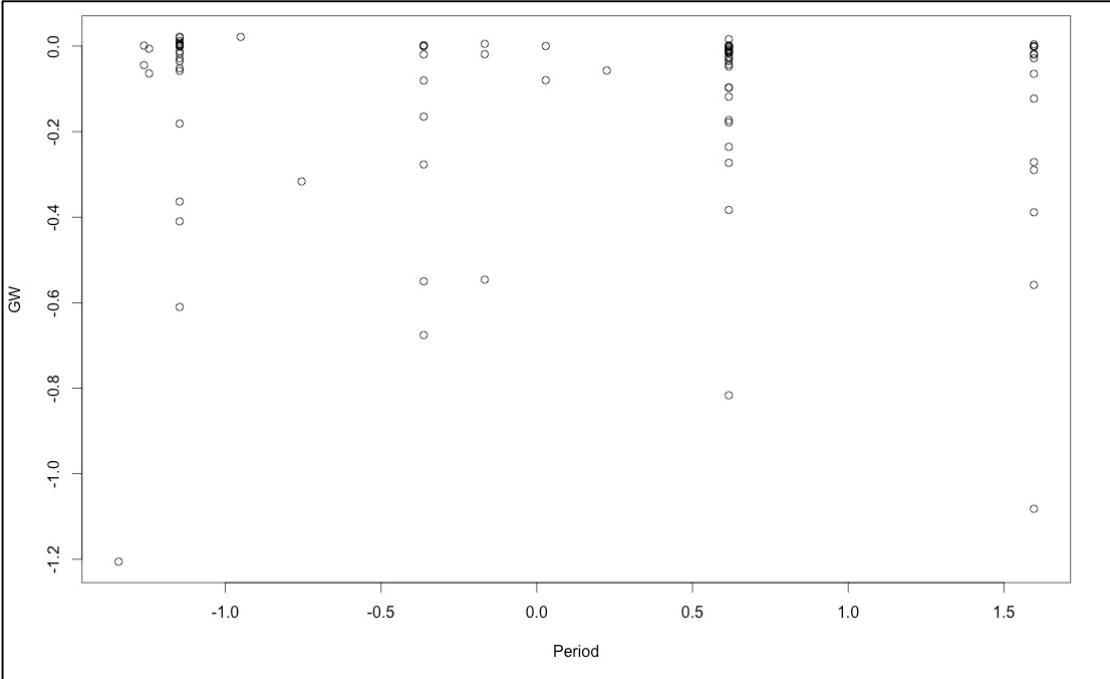**Figure F.1: General weight distribution of the variable amount**
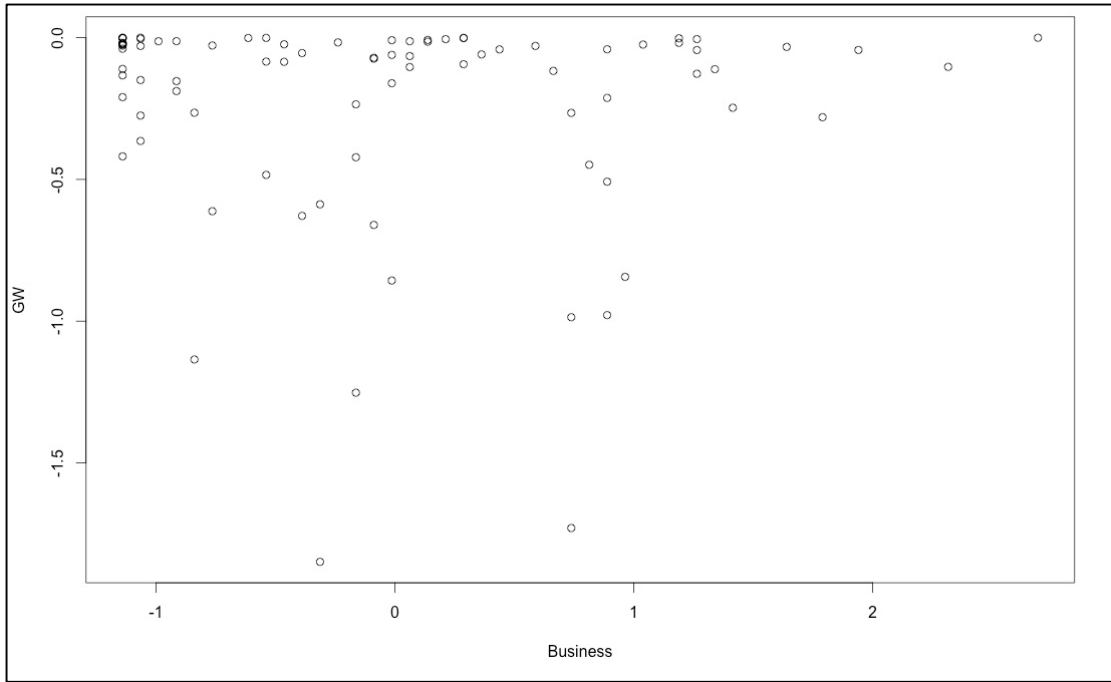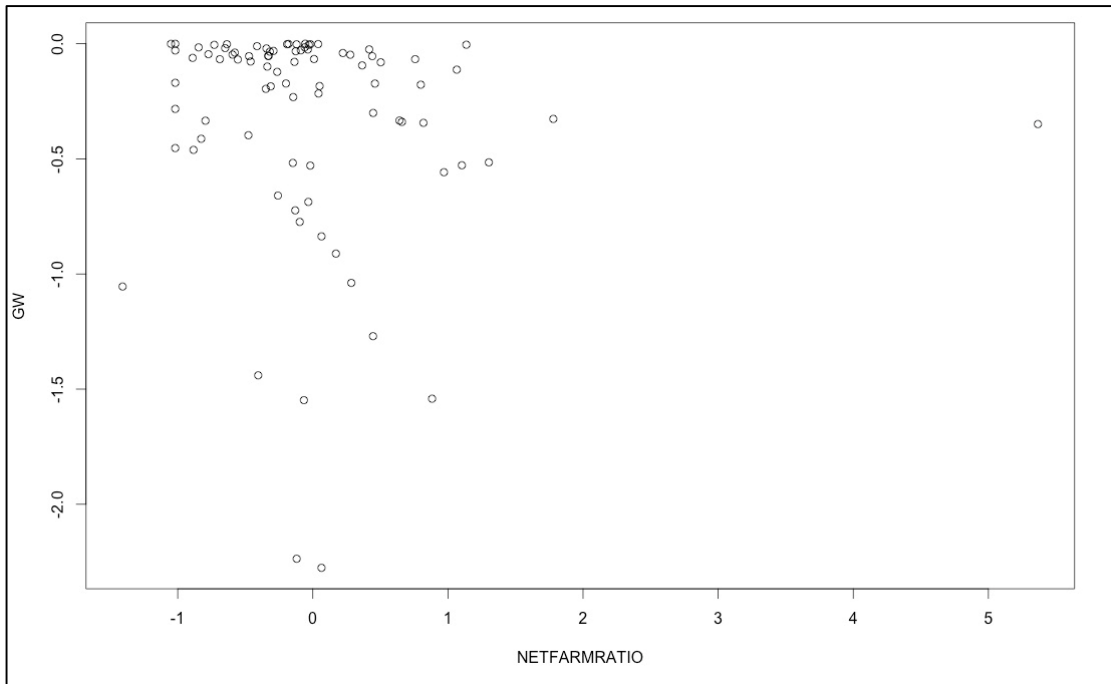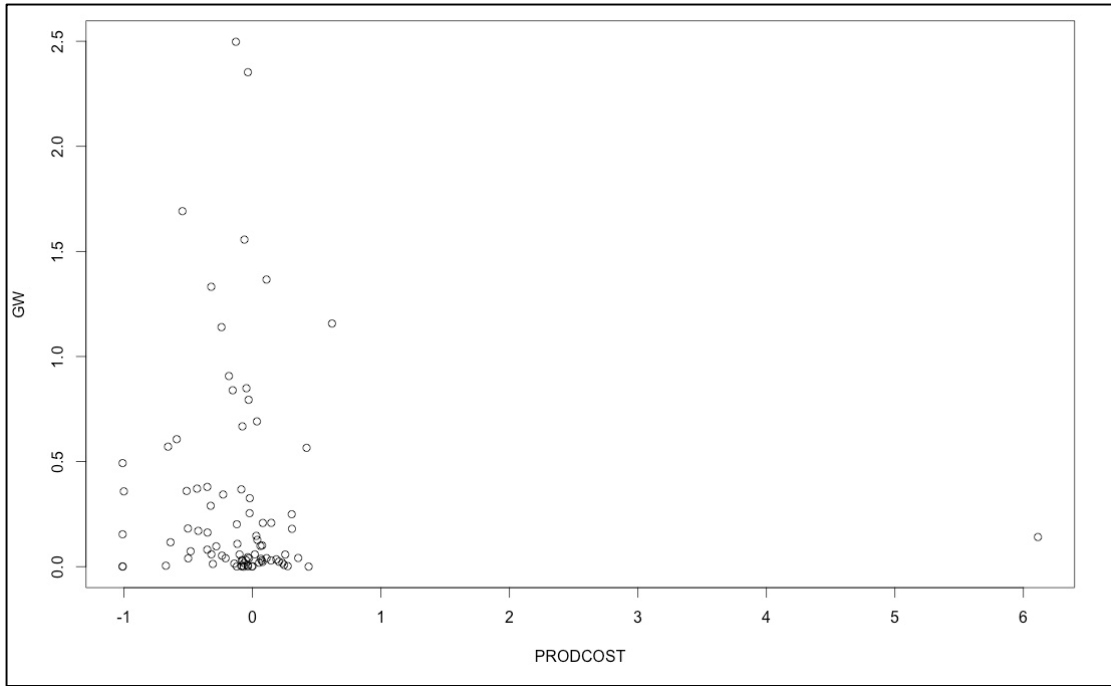

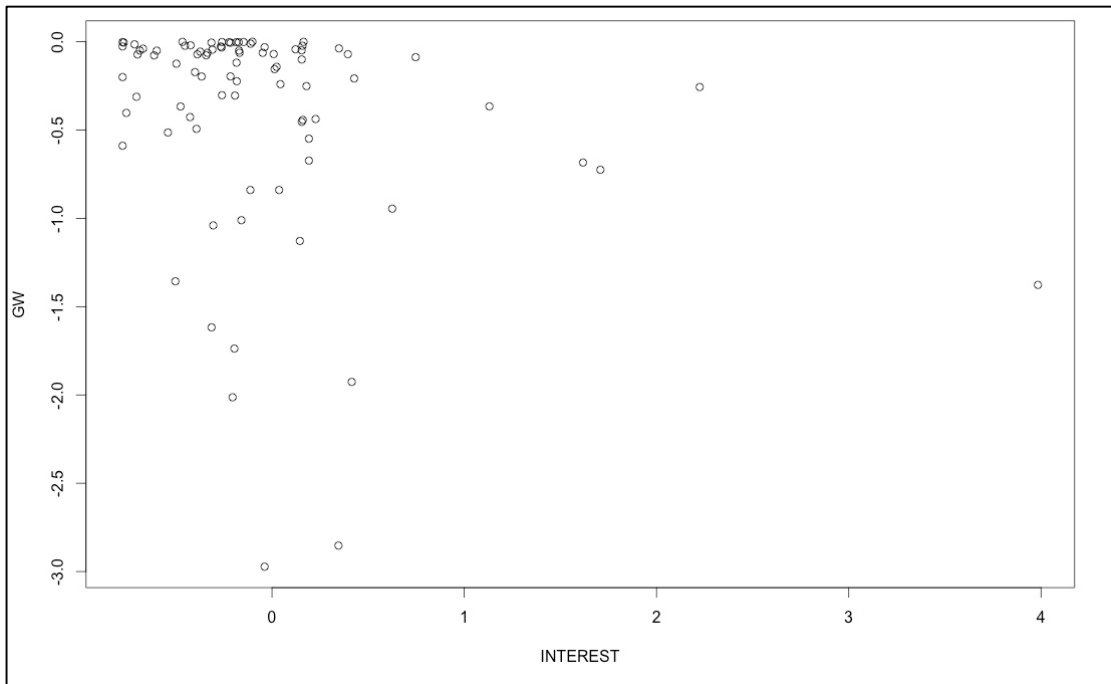**Figure F.2: General weight distribution of the variable period**

Figure F.3: General weight distribution of the variable business with the organisation
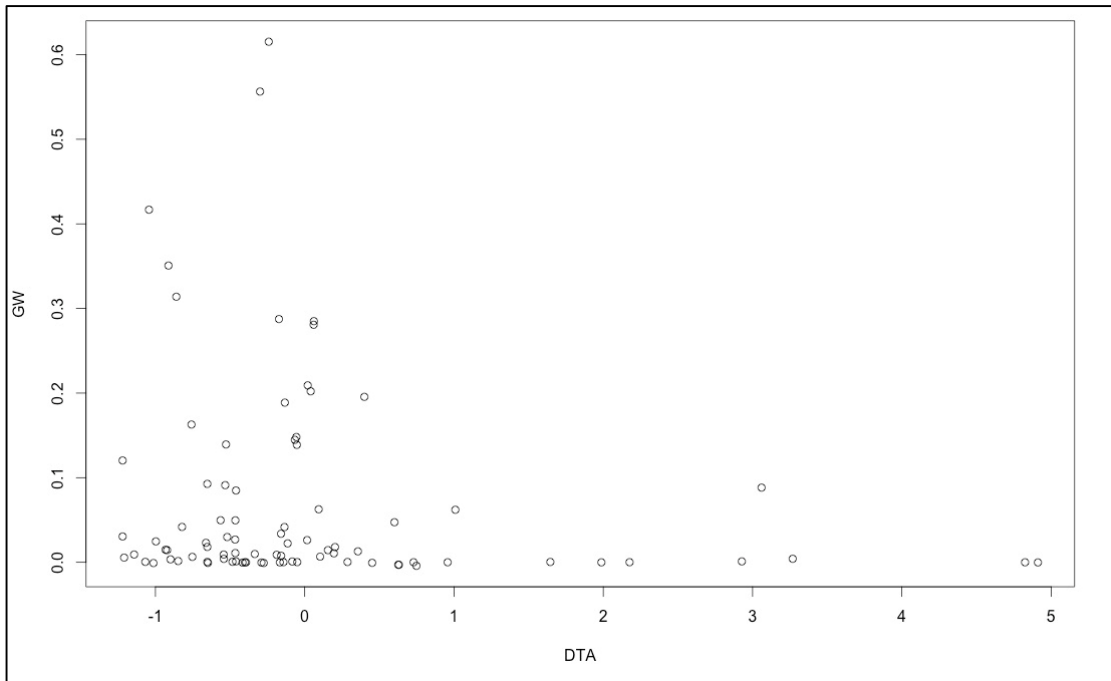
Figure F.4: General weight distribution of the variable debt to asset ratio
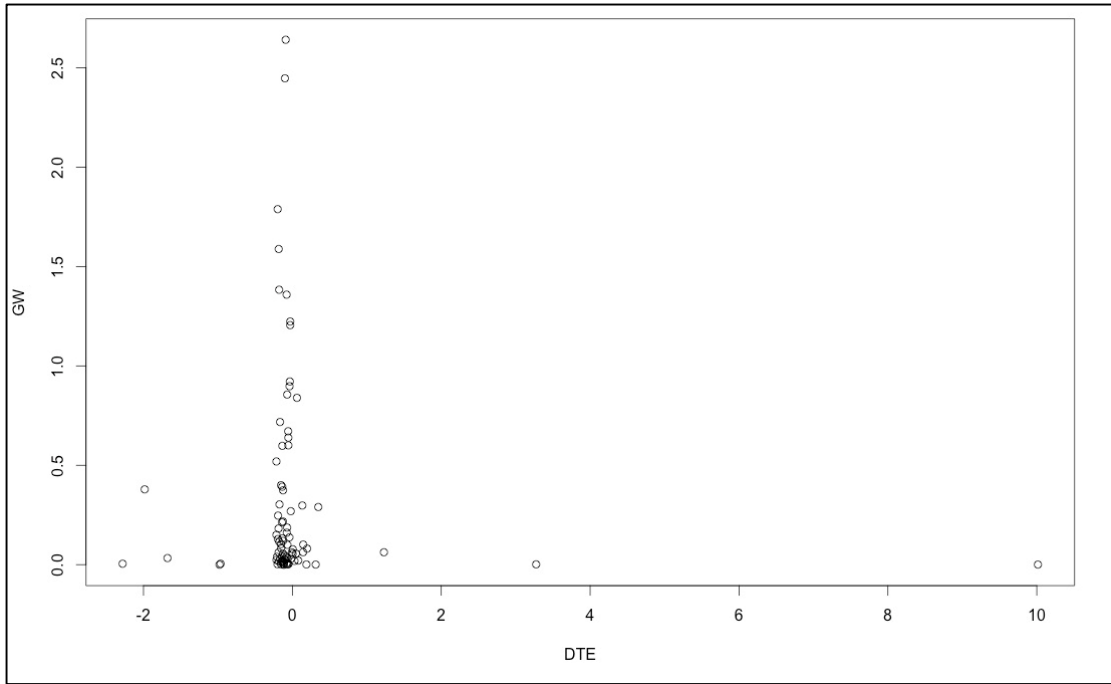
Figure F.5: General weight distribution of the variable debt to equity
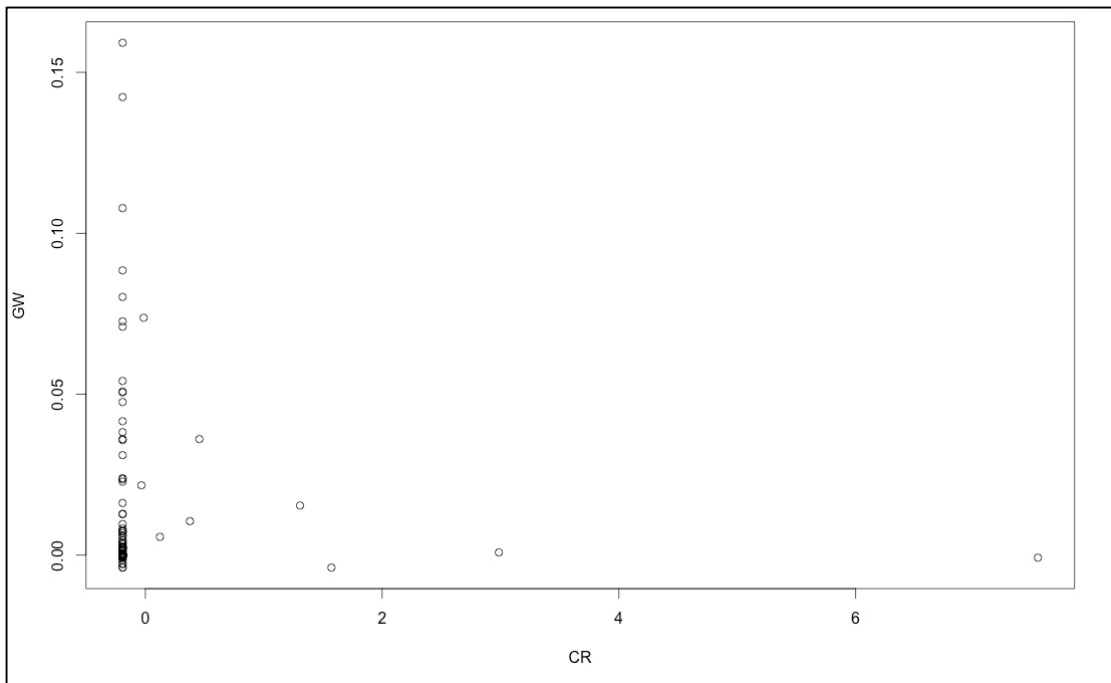
Figure F.6: General weight distribution of the variable current ratio
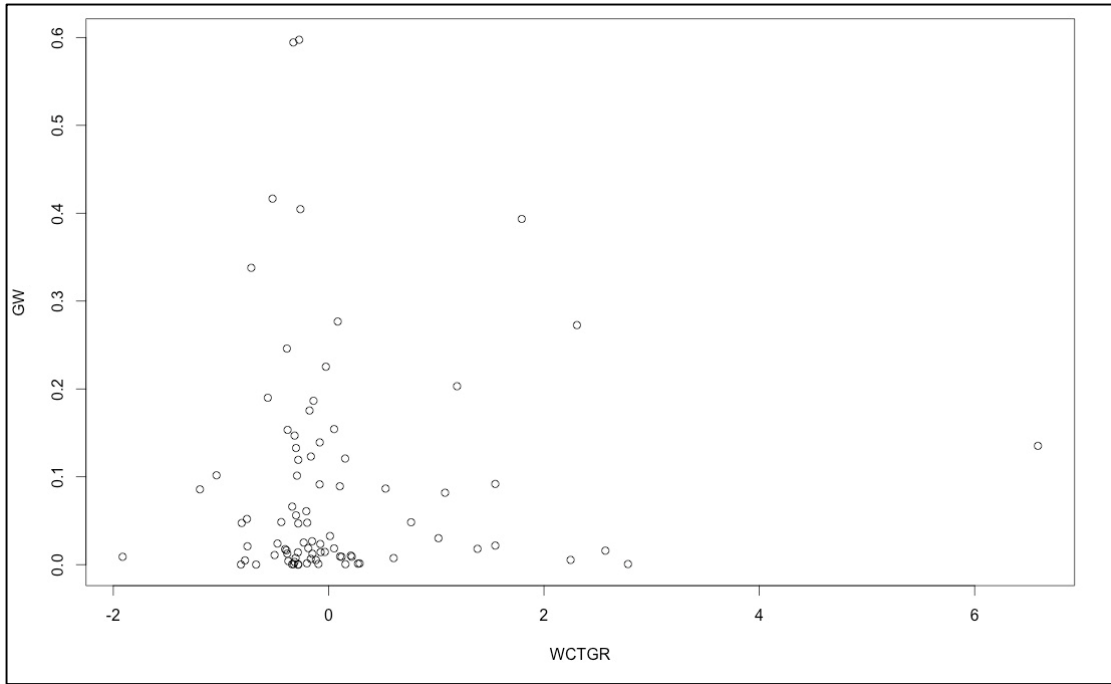
Figure F.7: General weight distribution of the variable working capital to gross revenue
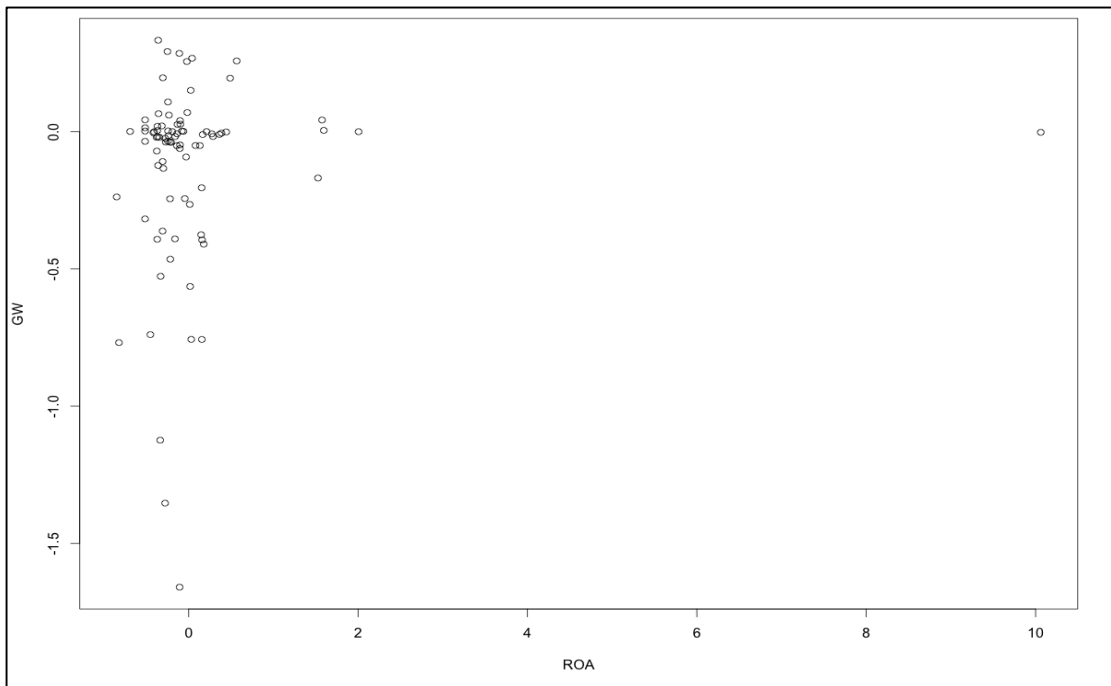
Figure F.8: General weight distribution of the variable return on assets
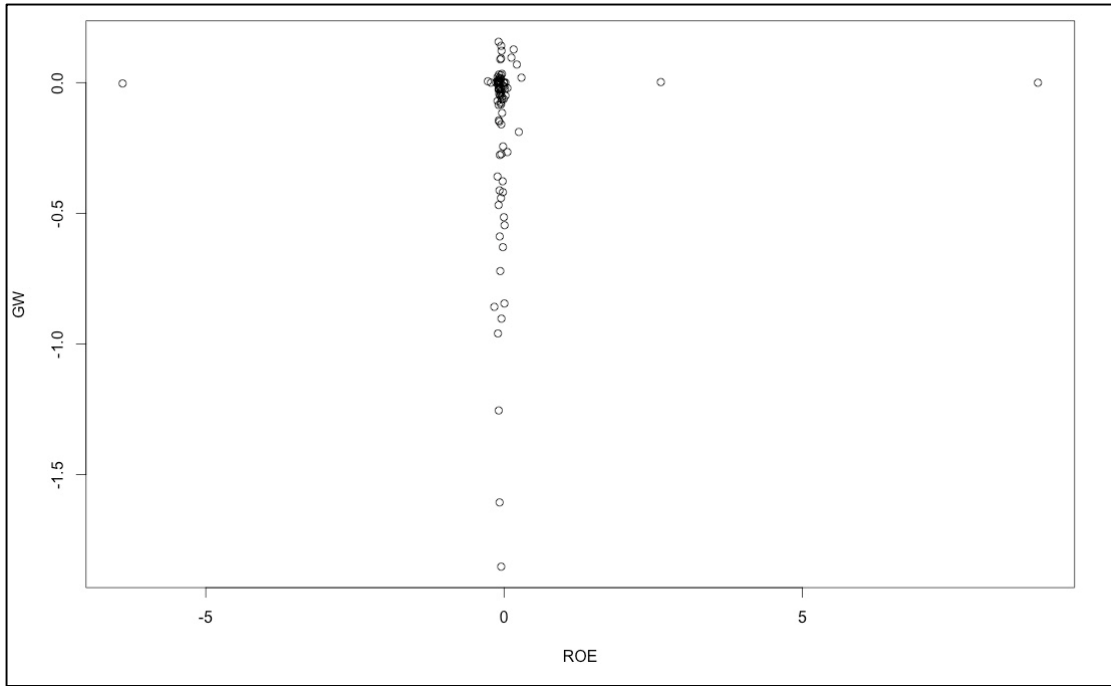
Figure F.9: General weight distribution of the variable return on equity

Figure F.10: General weight distribution of the variable net-farm-income ratio

Figure F.11: General weight distribution of the variable production-cost ratio

Figure F.12: General weight distribution of the variable interest-expense ratio
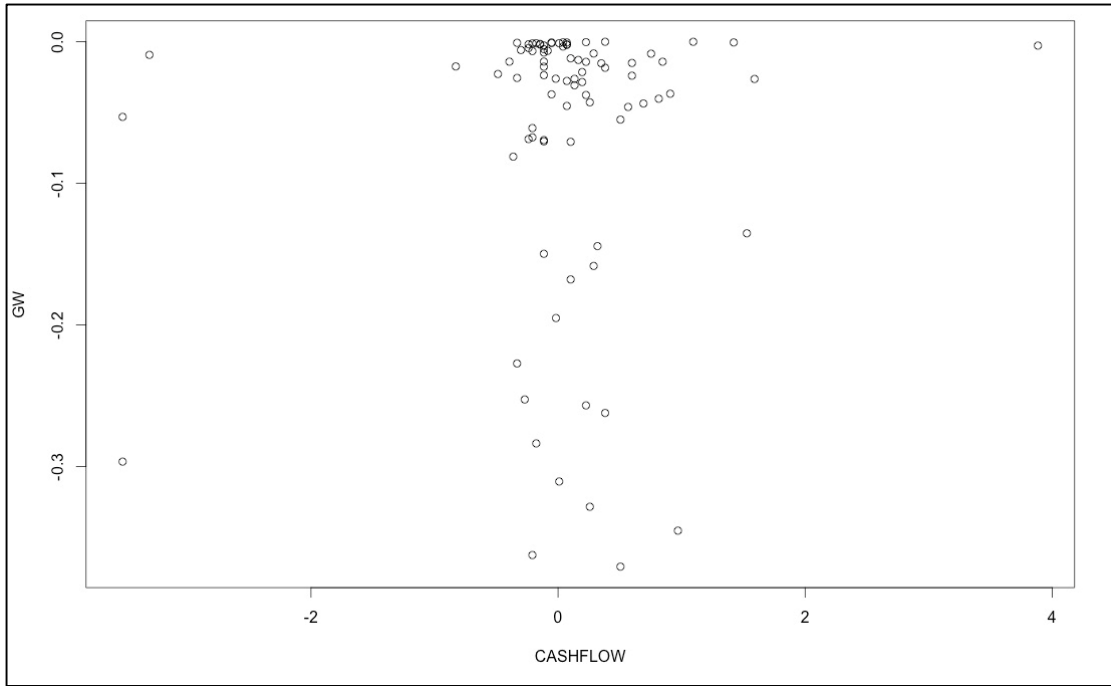
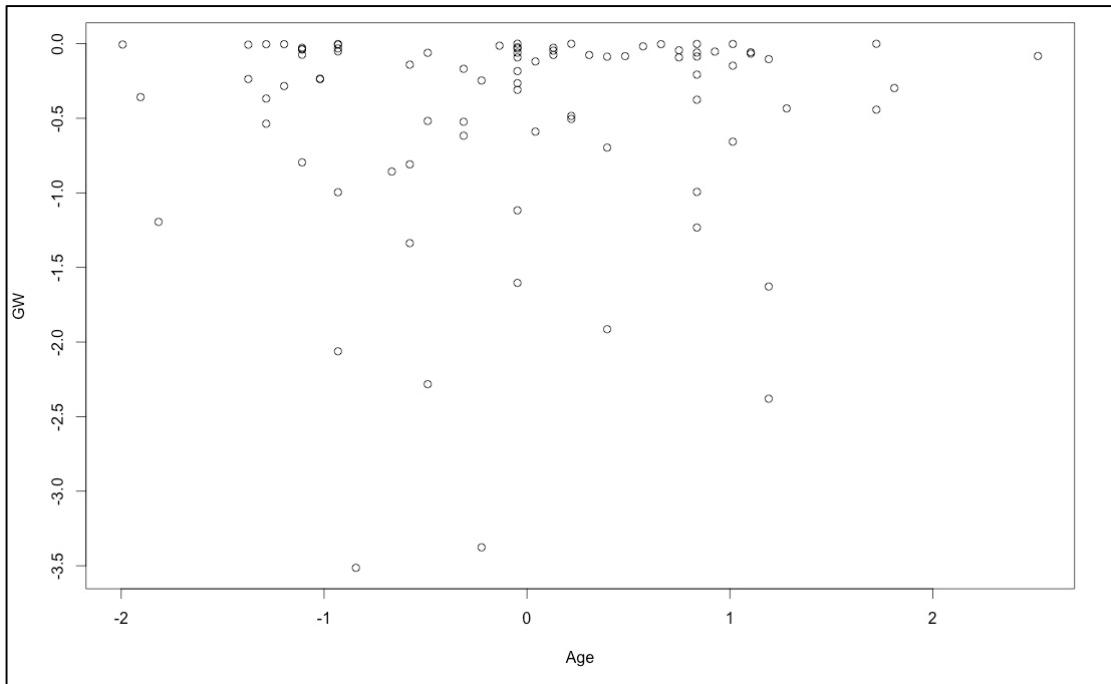**Figure F.13: General weight distribution of the variable cash-flow ratio**

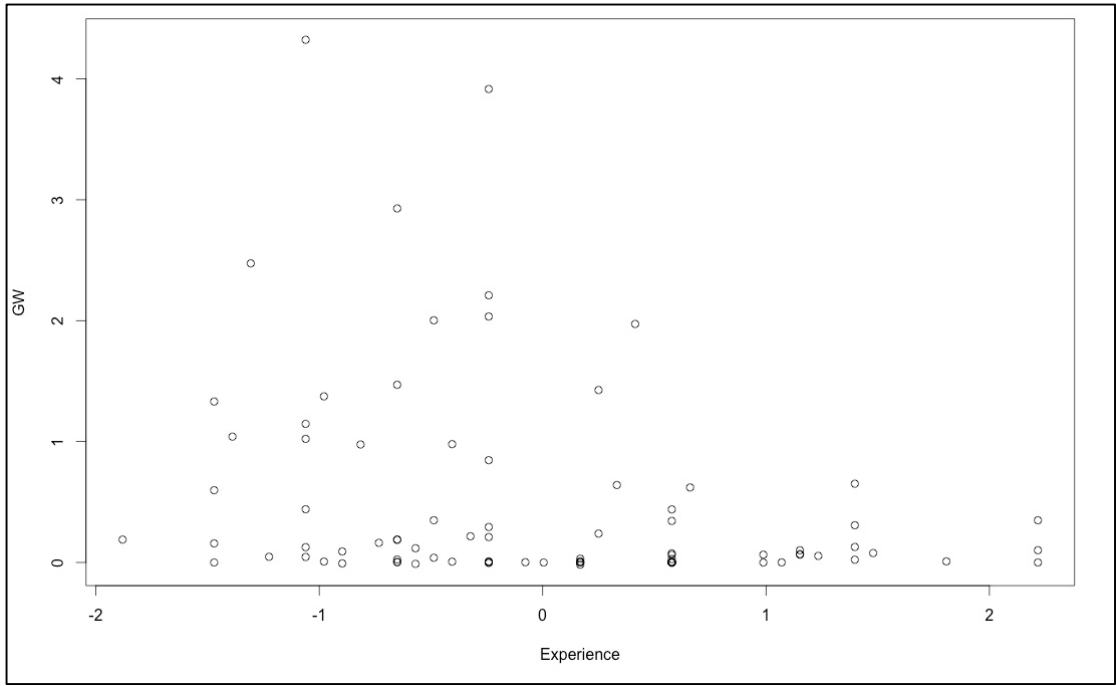**Figure F.14: General weight distribution of the variable age**

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Figure F.15: General weight distribution of the variable experience