Resilience attributes of New Zealand dairy farmers

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Abstract

New Zealand dairy farmers are now in an era characterised by uncertainty in the farm business environment. Thus, managing risk is a major challenge for farmers if they want to keep ahead in the business. This means that farmers must develop resilience. Resilience involves having the ability to mitigate threats and adapt to the opportunities offered by change when this is required. However, little is known about what is required to become resilient, or whether someone with a highly resilient personality has different perceptions of risks and risk management behaviours compared to others.

To determine what the attributes of a resilient dairy farmer were likely to be, what the most relevant sources of risk in the farm business environment were, and what the most relevant strategies for managing risk were, an extensive literature review was undertaken. This review was also used to develop a survey which was conducted with a random sample of 1559 dairy farmers. Principal component analysis and cluster analysis were used to determine the most relevant resilience and risk profile attributes from the survey data and to differentiate farmer types based on these attributes. Furthermore, differences between resilient farmer types with respect their perceptions of change, volatility and opportunities in the risk sources in the farm business environment, risk management behaviour, and other individual and farm business characteristics were tested by a range of statistical tests.

Results concluded that five resilience attributes (general self-efficacy, willingness to change, locus of control, social sense-making, and strategic thinking) were useful in distinguishing two resilient farmer types: high and low resilient farmers. Few differences were found between resilient farmer types regarding their perceptions of risk in the different sources of risk in the farm business environment, although high resilient farmers did see more opportunities than threats in the farm business environment. However, they were also more risk averse which may indicate that they carefully plan and implement the strategies they choose for managing risks. Indeed, high resilient farmers made more use of, and gave more importance to, strategies that were associated with visualising and positioning their business in the future, and with strategies associated with the prevention, mitigation, flexibility and diversity to risks compared to low resilient farmers, which was consistent with resilience theory. The resilience profile and management strategies used by resilient farmers identified in this research can be used by those in the industry to support farmers in building resilience and encourage the use of management strategies associated with resilience.

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Chapter one

1. Introduction

1.1. The New Zealand dairy industry.

In 2012, New Zealand produced 18.9 million tonnes of milk, a little over the 2% of the globally produced milk (IFCN, 2013). New Zealand is the 9th largest milk producing country in the world, far behind from India (121 million tonnes) and the United States of America (89 million tonnes), which ranked first and second top milk producers in the world, respectively (IFCN, 2013). Despite the fact that New Zealand's milk production is relatively low compared to countries such as India or the U.S., New Zealand's dairy industry accounts for about one-third of cross-border trade of dairy products (Coriolis, 2014). This is because almost 95% of the milk produced in the country is exported, making New Zealand an important player in the dairy global market (Coriolis, 2014). Moreover, dairy exports account for nearly 30% of the value of all merchandise exports in New Zealand (highest export earning industry), making this industry an important contributor to the economy of the country (Coriolis, 2014).

The contribution of the dairy industry to the prosperity of New Zealand has been increasing since the mid 1980's when the country liberalised its agricultural sector trade (Howard, 2011). Today, the dairy industry remains competitive, despite being heavily influenced by the external forces that shape the global markets and that threaten its sustainability (Conforte, Garnevska, Kilgour, Locke, & Scrimgeour, 2008). A widely regarded source of competitive advantage of New Zealand's dairy industry is its low cost pasture based farming systems (Conforte et al., 2008; Coriolis, 2014; Proudfoot, 2010; Shadbolt, 2012). New Zealand dairy farmers play a key role in sustaining the competitiveness of these farming systems (Morrison, 2013).

1.2. The farm business environment and the quest of resilience.

Over the last few years, there has been increasing concern about the instability of the business environment in which dairy farmers operate (Gray, Dooley, & Shadbolt, 2008; Shadbolt, Rusito, Gray, & Olubode-Awasola, 2011). A number of factors, such as the increased variability in milk and input prices, international trade policies, global policies on bio-fuels, increasing consumer awareness of sustainable food systems, government regulations on animal welfare and the environment, and the consolidation of the dairy industry, have been blamed for the instability in the business environment (Conforte et al., 2008; Gray et al., 2008). This instability has brought

about increased variability in the financial performance of dairy farm businesses, posing significant risk to the survival of these businesses (Gray et al., 2008).

Perhaps one of the most illustrative descriptors of the degree of change, and therefore turbulence, in the dairy business environment is the variation observed in the prices of dairy commodities in market over the last 30 years. Figure 1.2 shows the dairy commodity price index, an indicator of dairy commodity prices, from 1990 to 2014.

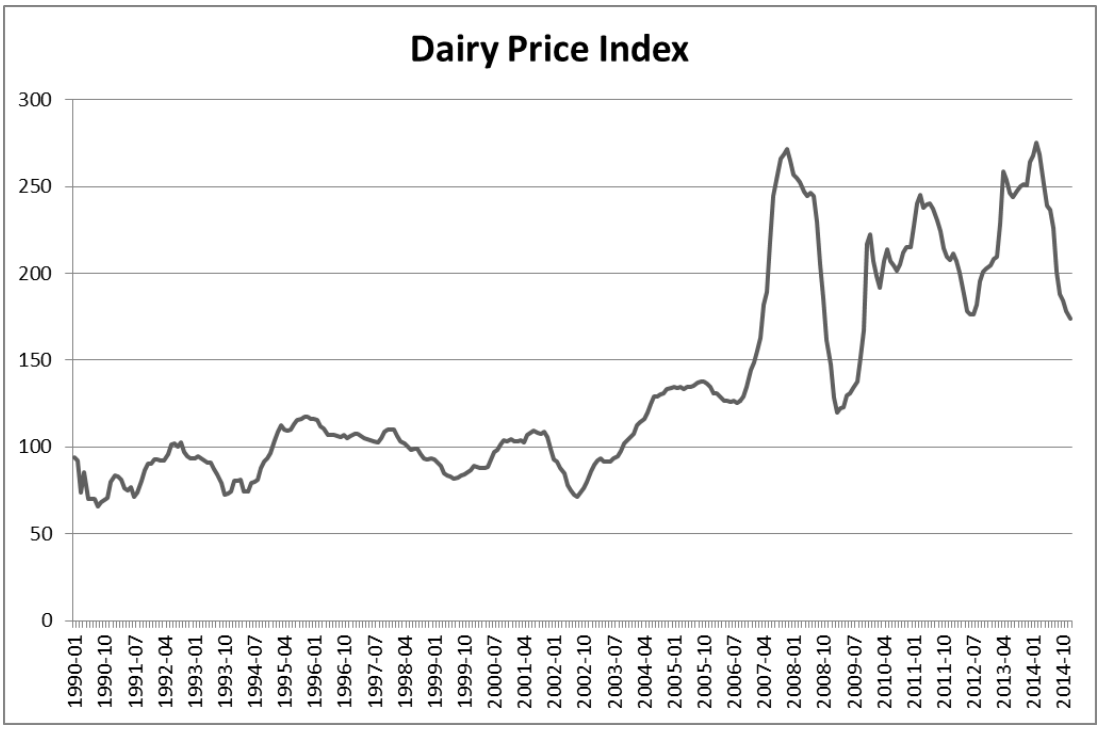


Figure 1.1. Dairy commodity index (commodities include butter, whole milk powder, skim milk powder, cheese and casein). Source: FAO (2015)

As shown in Figure 1.1, from 1990 to 2007, the prices of dairy commodities were relatively stable, but from 2007 onwards dairy commodity prices have increased but have also been more volatile. In a purely descriptive sense, volatility usually refers to variations of economic variables over time (Tangermann, 2011). The degree to which market price exhibits volatility is typically expressed by one of a family of statistical indicators (e.g. standard deviations) that measures changes over a period of time. In contrast, price change is measured by the change in the mean price between two periods (Tangermann, 2011). The dairy commodity price index mean value and the standard deviation for the period 1990 to 2006 were 100 and 18.2 points, respectively, whereas the price index mean and standard deviation for the period 2007 to 2014 were significantly higher at 211 and 40 points, respectively (FAO, 2015).

Gray et al. (2008) suggest that New Zealand dairy farmers are entering a new era in relation to risk, which is characterised by increased uncertainty in the farm business environment. Gray et al. (2008) also suggest that the future business environment that farmers will face fits the description of the "turbulent" type of business environment theorised by Emery and Trist (1965) nearly five decades ago. Back in the mid-sixties, Emery and Trist (1965) hypothesised that in the future, the greater competition between systems and their interdependence would provoke changes that would result in a highly uncertain business environment. Emery and Trist (1965) described this type of environment as "turbulent" (p. 26). Many farm management scholars (Boehlje, Akridge, & Downey, 1995; Boehlje, Gray, & Detre, 2005; Boehlje & Roucan-Kane, 2009; Gray et al., 2008; Parsonson-Ensor & Saunders, 2011) discussed the increase of risk in the farm business environment and recognised that coping with risk will be a major challenge for farmers in the years to come. Gray et al. (2008) also noted that this poses an important question: how best can New Zealand dairy farmers manage the increased risk?

Resilience is an important attribute of systems facing uncertainty because it allows them to be prepared to cope with uncertain shocks and changes in the environment (Darnhofer, Fairweather, & Moller, 2010b; Darnhofer, Moller, & Fairweather, 2008b; Folke, Stephen, Brian, Marten, Terry, & Johan, 2010; Milestad & Darnhofer, 2003). In the context of farming, resilience would allow farm businesses to minimise the threats that arise from uncertain disturbances in the environment and cope with change so that the businesses persist in their purpose (Milestad, 2003; Shadbolt et al., 2011). It is important to note that resilience is not just about robustness, it is also about seizing the opportunities in their favour (Shadbolt et al., 2011). However, little is known about resilience and how it is developed.

Some farm management scholars (Conway, 1993; Crawford et al., 2007; Darnhofer, 2014; Darnhofer et al., 2010b; Darnhofer et al., 2008b; Shadbolt et al., 2011) support the idea that resilient farming systems have three types of resilience (buffer capacity, adaptive capacity and transformability) which are used in response to different degrees of change in the environment (Figure 1.2).

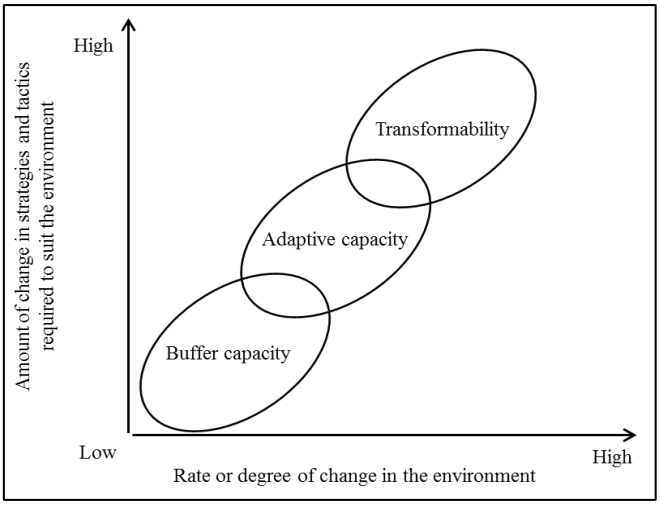


Figure 1.2. An illustration of the continuum of change in strategies and tactics between buffer capacity, adaptive capacity, and transformability. Source: Shadbolt et al. (2011)

Farmers use buffer capacity to achieve stability in the face of normal variation within a relatively stable environment (Conway, 1993; Darnhofer, 2014). When the change in the environment increases, farmers need to make significantly greater changes in the strategies and tactics they use in order to adapt the system to the changes in the environment (Crawford et al., 2007; Darnhofer, 2014). Finally, if the changes in the environment are such that creating a fundamentally different farm system is required (e.g. shifting from dairy farming to kiwifruit farming), then resilience is dependent on its transformative capability (i.e. transformability) (Darnhofer, 2014). The successful management of dairy farms in the context of a turbulent business environment requires the development of resilient farming businesses with the ability to display buffer capacity, adaptive capacity and transformability in order to manage different degrees of change in the environment.

General resilience theory provides a framework on how to achieve sustainability in the context of change (Milestad, 2003). This framework uses a different approach compared to the traditional farm management approach to sustainability that is based on the assumption that the environment is predictable and stable (Darnhofer et al., 2008b; Love, Sharma, Boxelaar, & Paine, 2008). Darnhofer et al. (2010b) suggest farmers coping in a turbulent environment will face periods of unforeseeable rapid change and periods of slow gradual change which will be able to foreseen to certain degree. Many farm management scholars (Darnhofer, 2014; Darnhofer, Gibbon, & Dedieu, 2012; Love et al., 2008; Miller, Dobbins, Pritchett, Boehlje, & Ehmke, 2004) have suggested that farm management research has primarily focused on efficiency and optimizing system's performance during short-term periods of stability, rather than focusing on the development of long-term adaptive capacity. As such, the discipline struggles to provide

practical theory that helps farmers cope effectively with a turbulent operating environment (Darnhofer, 2014; Darnhofer, Bellon, Dedieu, & Milestad, 2008a).

Since resilience is recognised as an emergent property of farming systems a major limitation for its operationalisation is its measurement (Crawford et al., 2007; Darnhofer et al., 2012; Shadbolt et al., 2011). Despite the fact that measuring resilience as a whole is probably an impossible task, measurement of resilience can be approached by measuring its elements individually. Recently, Shadbolt et al. (2011) identified resilient dairy farms in New Zealand through the indirect measurement of their buffer capacity. In order to gain more knowledge about how resilience works, further research is required to develop a measurement, or indicator, for adaptive capacity.

Adaptive capacity is mostly associated to be an individual's attribute. Walker, Holling, Carpenter, and Kinzig (2004) describe adaptive capacity as "the ability of actors in a system to influence resilience" (p. 5). Therefore, to understanding adaptive capacity of farm businesses is about knowing how a farmer deliberately adapts their business in response to changes in the environment, so that the business is well positioned to capture opportunity without relegating the mitigation of threats also present in the environment. Several authors (Crawford, McCall, Mason, & Paine, 2007; Darnhofer, 2014; Darnhofer, Bellon, Dedieu, & Milestad, 2010a; Gray et al., 2008; Shadbolt et al., 2011) suggest that, in order to cope with a turbulent environment, farmers must develop resilience. Little is known about the adaptive capacity of dairy farmers in New Zealand. More importantly, little is known about how farmers with different degrees of resilience, and therefore adaptive capacity, can be identified, and whether different resilient farmer types differ in their perception of risks in the farm business environment and their risk management behaviour. Identifying, farmers based on the attributes that confer resilience, with a focus in their adaptive capacity would provide a milestone in the quest to build resilience in dairy farm businesses.

1.3. Problem statement.

The challenge for New Zealand dairy farmers to remain competitive and to respond to the turbulent environment in which they operate is to build resilient farm businesses. However, little is known about how to build this resilience. A key element of resilience is adaptive capacity which is mainly related to individuals' characteristics. No study has approached farm resilience from the perspective of studying the individuals. Since farmers have a key role in farm businesses, a milestone in the quest to build resilience is to identify farmers based on the attributes that would confer them with resilience. In addition, little is known about whether their

attributes is reflected in differences in their perceptions of risk in the farm management environment and their risk management behaviour.

1.4. Research questions.

Given the lack of information on farmer resilience, two research questions were asked:

Question 1: What are the attributes that define a resilient farmer?

Question 2: Do different resilient farmer types differ in their perceptions of the farm business environment and their risk management behaviour?

1.5. Research objectives.

This study set out to define the resilience attributes that differentiate farmers. Furthermore, this research aimed to identify different farmer types based on the resilience attributes previously defined. Finally, this research sought to investigate any differences between resilient farmer types regarding their use of, and importance given to, strategies for managing risks in their farm businesses and to explore their perceptions of sources of risks in the farm business environment.

Chapter two

2. Literature Review

2.1. Resilience.

2.1.1. Resilience research across disciplines.

The concept of resilience was first introduced in ecology by Holling (1973) who studied the persistence of organisms in ecosystems exposed to external disturbances. Since then, the concept has evolved and been applied to other disciplines such as psychology, organisational management, and farm management, among others.

In psychology, resilience has been used to explain the endurance of individuals when faced with major life difficulties (Luthar, 2003; Reich, Zautra, & Hall, 2010). In organisational management, resilience theory has been used to study how businesses are organised in order to effectively absorb, respond to, and potentially capitalise on disruptive surprises and changes that arise in the environment (Klein, Nicholls, & Thomalla, 2003; Lengnick-Hall & Beck, 2009; McCann, 2004; McCann, Selsky, & Lee, 2009). At the community organisational level, resilience theory was used to understand how communities respond to unexpected shocks, such as natural hazards or acts of terrorism (McManus, Walmsley, Argent, Baum, Bourke, Martin, Pritchard, & Sorensen, 2012; McManus, 2008; Riolli & Savicki, 2003). Resilience theory has also been applied in the small and medium enterprises management discipline, where research has been undertaken to understand how small and medium sized businesses respond to disturbances and changes in the environment (Kamen & Behrer, 2012; Sullivan-Taylor & Branicki, 2011).

Research on resilience in the farm management literature has drawn upon the concepts developed in ecology in order to address the issue of how farm systems and farm businesses effectively cope with disturbances and changes in the environment (Crawford et al., 2007; Darnhofer et al., 2010a; Kaine & Tozer, 2005; Kamen & Behrer, 2012; Love et al., 2008; Shadbolt et al., 2011). Much of the resilience research found in the farm management literature approached resilience from a participatory perspective, where resilience is understood and built though collective interaction among farmers, researchers, extensionists, and society members (Darnhofer, 2006, 2010; Kenny, 2011; Roling & Wagemakers, 2000). Much of the participatory resilience research on dairy farm businesses in New Zealand and Australia has been undertaken

to address the issue of climate change (Kalaugher, Bornman, Clark, & Beukes, 2013; Nottage, 2010) and droughts (Kenny, 2011; Love et al., 2008).

Limited empirical research has been done on resilience at the farm level (Crawford et al., 2007; Darnhofer et al., 2010a; Darnhofer et al., 2012; Shadbolt et al., 2011). Darnhofer et al. (2012) argue that the reason for the lack of resilience research within the farm management discipline is because the discipline has traditionally adopted a reductionist approach, focusing on the development of technologies and management practices designed to increase production within stable environments; these ideas collide with the concept of resilience.

Crawford et al. (2007) and Boehlje and Roucan-Kane (2009) describe the frequency of research on farm management practice that does not consider the effects of long term risk and uncertainty on farm sustainability. Risk and uncertainty are concepts intimately linked to resilience. Crawford et al. (2007) suggest that in order to build farm resilience, a farm manager must be able to manage the risks and uncertainties to which their business is exposed. Nevertheless, not much is known about the abilities necessary for farmers to manage risk successfully and bring a degree of "resiliency", or if these abilities would be reflected in their farm businesses through the risk management strategies they use.

2.1.2. Definitions of resilience.

There are a number of different definitions of resilience depending not only on the discipline in which it is being considered but also the level of analysis to which these definitions apply (landscape level, farm level or individual level) (e.g.:Shadbolt et al., 2011; Walker et al., 2004; Zautra, Hall, & Murray, 2010). However, despite the variety of definitions used for the study of resilience across disciplines, all of them draw upon the definitions and concepts developed in ecology and social-ecological systems (SESs) (Darnhofer, 2010; Rodriguez, deVoil, Power, Cox, Crimp, & Meinke, 2011; Shadbolt et al., 2011). Resilience-Alliance (2013), a research community that study resilience in SESs, currently acknowledges the Walker et al. (2004) definition as a common starting point for research on SESs' resilience. Walker et al. (2004) defined resilience as "the capacity of a system to absorb disturbance and re-organize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks" (p. 2).

In the farm management literature, cropping farm business resilience was defined by Rodriguez et al. (2011) as "the ability of a farm business to absorb disturbances while remaining productive and profitable" (p. 158). Another farm management study on dairy farm business resilience

defined the resilience of a dairy farm business as "the capacity of a farming system to not only adapt to change in the environment, but also take advantage of opportunities created by a disturbance while maintaining productive capacity in the face of variability in production, financial and market related factors" (Shadbolt et al., 2011, p. 8).

In the field of psychology, Zautra et al. (2010) defined individual resilience as "the amount of stress that a person can endure without a fundamental change in capacity to pursue aims that give life meaning" (p. 6). Or, in the words of Walsh (2006), individual resilience was defined as "a person's ability not only to cope with, survive and bounce back from difficult and traumatic experiences and situations but also to grow and develop psychologically and emotionally" (p. 14). Both of these definitions recognise resilience as an individual attribute, or ability, which helps people to thrive during stressful situations so that they can give meaning to their lives, grow and develop emotionally. However, some small differences arise when contrasting the definitions found in the psychology literature. Although the Zautra *et al.* (2010) definition highlights the idea of resilience as a measure of a person's resistance to change, Walsh (2006) acknowledges that change is also a fundamental part of resilience when they suggest that resilience is not just the ability to bounce back from difficulty but also to grow and develop psychologically and emotionally. Another definition of resilience, from the rural psychology literature, describes farmer resilience as a process instead of an attribute (Greenhill, King, Lane, & MacDougall, 2009). Greenhill et al. (2009) defined the individual resilience of farmers as "a process wherein an individual (e.g. a farmer) displays positive adjustment such as psychological wellbeing or the absence of psychological distress despite experiencing adversity like severe droughts" (p. 318). Greenhill et al. (2009) argue that defining resilience as a process rather than a personal attribute is important for developing tools to promote resilience across rural communities, therefore, reducing the effect of stress on the mental health of farmers.

All of the resilience definitions cited above exhibit some similarities and differences. A mutual characteristic is that these definitions describe resilience as having a purpose and doing whatever is required to fulfil that purpose under the premise of the occurrence of external events (Rodriguez et al., 2011; Shadbolt et al., 2011; Walker et al., 2004; Walsh, 2006; Zautra et al., 2010). Nevertheless, some differences among the definitions arise when the nature of the external events are described. In this respect, Zautra et al. (2010) and Rodriguez et al. (2011) emphasise that resilience is about mitigating the negative effects that result from changes and/or disruptions in the environment, while other definitions (Greenhill et al., 2009; Shadbolt et al.,

2011; Walker et al., 2004; Walsh, 2006) acknowledge that resilience is not just about responding to threats but also about responding to the opportunities which might arise in the environment.

2.1.3. Buffer capacity, adaptive capacity and transformability.

The definitions described in section 2.1.2 suggest that resilient systems exhibit three main elements: buffer capacity; adaptive capacity; and transformability. These elements represent a system's ability to respond to different degrees of change in their underlying environments (Folke et al., 2010). Buffer capacity is described as a critical element of resilient systems (Carpenter, Walker, Anderies, & Abel, 2001; Crawford et al., 2007; Darnhofer et al., 2008b; Folke, 2006; Folke et al., 2010; Walker et al., 2004). A common understanding of a buffer is that it reduces disturbances, decreases variation and resists change, or in simple terms, the buffer capacity is "the ability to cushion change" (Speranza, 2013, p. 523). Carpenter et al. (2001) defined the buffer capacity of an ecosystem as the magnitude of shock that a system can absorb and remain within a given state. Farm management scholar Conway (1993) provided a useful definition of buffer capacity for application in the study of farming systems. Conway described buffer capacity as "the constancy of productivity in the face of small disturbing forces arising from fluctuations and cycles in the surrounding environment" (p. 50). According to Conway , buffer capacity is used to cope with disturbing forces that are relatively small and predictable in an environment that is relatively stable.

Many farm management scholars (Crawford et al., 2007; Darnhofer et al., 2008a, 2010a; Darnhofer et al., 2008b; Shadbolt et al., 2011) agree that adaptive capacity is another key attribute of resilient farming systems. Crawford et al. (2007) described adaptive capacity as the degree to which the farm system is capable of responding to change. According to Conway (1993), adaptive capacity is used to cope with major disturbances which are rare and less expected being due to major changes in the underlying environment of farming systems. Accordingly, the premise on which adaptive capacity is based is that the key to coping with rapid and unforeseeable change is to strengthen the ability to adequately respond to change to sustain long-term survival (Darnhofer et al., 2010a). According to Cowan, Kaine, and Wright (2013), adaptive capacity requires changes in the structure of the farm system, so that it adapts to the change imposed by the environment without altering the function for what the system was created.

Transformability is the third element of resilience (Folke, Carpenter, Elmqvist, Gunderson, Holling, & Walker, 2002; Folke et al., 2010). Walker et al. (2004) defined the transformability of ecosystems as "the capacity to create fundamentally new systems when ecological, economic or

social conditions make the current existing system untenable" (p. 3). Farm management scholar Darnhofer et al. (2010b) described transformability as the ability of farm managers to find new ways of arranging resources when changes in the environment are extreme enough to make the current system untenable. Transformability implies the change of the purpose of a system. Examples for transformability are the conversion of sheep and beef farms to dairy that has occurred in the South Island of New Zealand over the last 10 years (Copeland & Stevens, 2012).

2.2. Farm management.

Management has multiple perspectives. The first perspective understands management in relation to three different levels of management (strategic, tactical, and operational). These three levels refer to a hierarchy within which goals and plans are set to achieve different purposes. At the top level of this hierarchy is strategy. According to Shadbolt and Bywater (2005), the strategy of a farm business aims to pursue the ultimate purpose of how value will be created for the shareholder. Strategic decisions, therefore, relate to the actions and resource use relating to how the farm business is going to be organised to produce a farm's outputs (Wright, 1985). These types of decisions involve making assumptions about the future, and, therefore, are more greatly linked to the unknown rather than the known (Shadbolt, 2008; Shadbolt & Bywater, 2005). Gray (2001) suggests that strategic decisions involve planning horizons of 5 to 10 years. An important aspect to the description of strategic decisions is that they are made infrequently, involve heavy investment and have long lasting effects (Shadbolt & Bywater, 2005). Moreover, because strategic decisions have a large impact on farm businesses, they influence the other two levels of management also (Shadbolt & Bywater, 2005). The tactical level of management forms the link between strategy and the day-to-day operations of a farm (Gray, Parker, & Kemp, 2009). This type of management is concerned with implementing the planned strategy efficiently and is, therefore, concerned with efficient acquisition and allocation of resources (Gray et al., 2009; Shadbolt & Bywater, 2005). The planning horizon for making tactical decisions is lesser than the one estimated for strategic decisions; Gray (2001) suggests that in dairy farm businesses, tactical decisions involve planning for a season. Trafford and Gray (2012) describe that because of the seasonal nature of tactical management, tactical decisions are made more frequently than strategic ones, and that because of their repeatability, decision problems and their solutions can often be more accurately defined. The final level of management is the operational level. This type of management is concerned with the efficiency with which day-to-day operations are implemented and controlled (Shadbolt & Bywater, 2005). Operational management planning

horizons are shorter than the ones required for the other two levels of management (Shadbolt & Bywater, 2005).

A second perspective sees management as a process consisting of three main actions: planning; implementation; and control (Shadbolt & Bywater, 2005). Planning refers to the process of developing a plan for the planning horizon (Gray, 2005). After planning, a plan is implemented and managers monitor performance in comparison with the standards specified in the plan. If the actual performance deviates from the one specified and expected, a manager must decide between carrying on with the plan and implementing a control response. If the actual performance is what expected, then the manager will implement the next activity on the plan (Gray, 2005). During this process, farm managers should make decisions relating to the areas of planning, implementation, and control.

The third perspective of management is to consider that farm management decisions should relate to the four fields of management (Shadbolt & Bywater, 2005). Shadbolt and Bywater (2005) describe the main fields related to farm management decisions as finance, production, human resources and marketing. Finally, a fourth perspective of management is to describe decisions along a continuum of "structuredness" which addresses different management decisions according to the nature of the problem they aim to solve and the complexity of the management process involved in the decision. In this regard, two types of decisions can be differentiated: structured and unstructured decisions. On one hand, structured decisions are those made routinely by managers and, therefore, tend to involve well known procedures and are made almost sub-consciously because of their frequency (Gray et al., 2009). According to Gray (2001), most tactical and operational decisions fall into this category. In contrast, unstructured decisions are novel or unique decisions that have not been previously made by the manager, meaning the management process is not routine and may, therefore, involve search, screening, analyses, diagnostic and design sub-routines (Gray et al., 2009). According to Gray (2001), strategic management decisions are unstructured by nature.

The third perspective of farm management acknowledges that decision-making is influenced by the life cycle of the farm-family. In this regard, the life cycle involves a period of time in which farm decisions are greatly influenced by different goals and objectives that are derived from the stage in which the family-farm is situated (Boehlje & Eidman, 1984). Boehlje and Eidman (1984) described three stages in the life cycle of a farm: the entry; the growth; and the exit stage. At the entry stage, a farm manager must make decisions with the objective of establishing a satisfactory

lifestyle. Thus, it is important farmers take studied decisions about what to produce, how to produce and how much to produce. At this stage, the entry farmer develops the skills that will determine their ability to manage the farm. The growth stage refers to a period of time in which the farm manager has gained some experience and confidence and thus could decide to grow their farm or improve their life style by implementing new technology or farm practices. At this stage, decision-making is heavily influenced by the practices of neighbours and friends. The final stage, the exit stage, is characterised by a farmer preparing to pass the farm on to the next generation or retiring. Therefore, farmers transiting this stage are less likely to take on new debt, adopt new technology or implement new farm practices.

2.3. Strategic management.

2.3.1. Definitions of introducing strategic management.

The vast majority of strategic management literature in the area of farm management has been adapted from the original concepts introduced and developed in the bodies of knowledge related to business and organisational management. French (2009a) suggests that a proper introduction to strategic management should begin with a discussion around the multiple definitions of strategy that exist in the organisational literature.

The work of Mintzberg (1987) described five definitions of strategy (plans, ploys, patterns, positions, and perspectives) that contribute to generate a complete understanding of the meaning of the term. Firstly, Mintzberg (1987) indicated that strategy can be defined as a plan. As such, this definition assumes that strategy is a consciously intended course of action that offers guidance for dealing with a situation. The second definition of strategy considers strategy planned as a ploy. Both these definitions define strategy as consciously intended plans, but the difference between the two is the ones that are defined as ploy strategies focus on deliberate actions undertaken with the intention to outwit a competitor.

Both of the previous definitions indicate that strategies are intended (as general plans or specific ploys) for the achievement of a purpose. However, some non-intended strategies can also be realised for the achievement of the same purpose. Accordingly, Mintzberg (1987) proposed that strategies can be thought of as a "pattern in a stream of action" (p. 12). According to this definition, strategies are not limited to intended plans and ploys but rather seen as a behavioural pattern. This behavioural pattern is shown in Figure 2.3.1, and describes the interplay among four different types of strategies: intended; deliberate; realised; and emergent (Mintzberg, 1987).

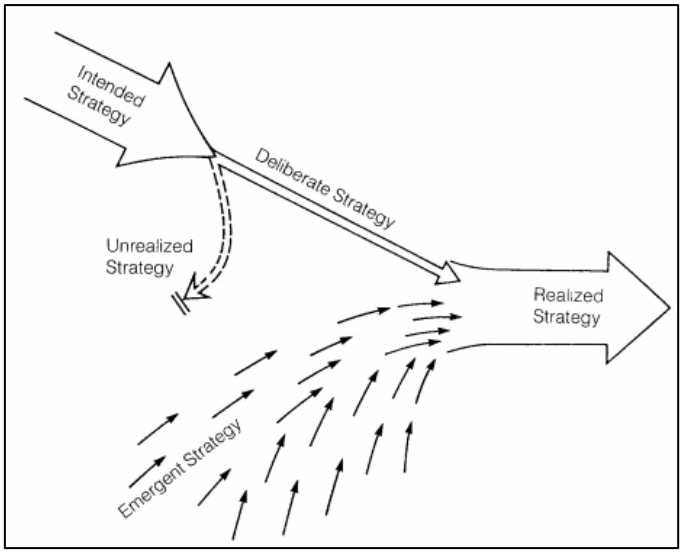


Figure 2.3.1. Strategy as a pattern in a stream of action. Source: Mintzberg (1987)

Mintzberg (1987) defines an intended strategy as one "conceived by the top management team" (p. 13). In this respect, Mintzberg (1987) describes that intended strategies take the form of plans or ploys, but that sometimes managers may decide not to implement them. He differentiates deliberate strategies, intended realised strategies, from unrealised strategies that are intended strategies that were discarded prior to implementation. An emergent strategy can take the place of an intended strategy as a result of the complex processes by which individual managers interpret intended strategies and adapt their thinking to changing external circumstances. The discharged intended strategy then becomes an "unrealised strategy". The interplay between deliberate strategies and emergent strategies is key in the understanding of the concept of strategy as a pattern of behaviour (Mintzberg, 1987).

The fourth definition of strategy refers to strategy as a means to position an organisation in relation to its environment (Mintzberg, 1987). In this sense, the strategy is considered the mediating force between the organisation's internal and external environments. In economic terms, a positioning strategy is represented by locating an organisation in a situation that it generates "rent" (Mintzberg, 1987, p. 15). This definition is attuned with the previous definitions; indeed a position can be reached by an intended plan, or an intended ploy, or it can be achieved by a behavioural strategy as the result of a pattern of behaviour (Mintzberg, 1987).

Lastly, Mintzberg (1987) defined strategy as a perspective. This definition asserts that strategy is not just about seeking to position an organisation with respect to its external environment, but it is also about positioning the organisation inside of the heads of the collective strategists. In this

respect, strategy is seen as an ingrained way of perceiving the world, and, therefore, defining the character of the organisation (Mintzberg, 1987). What is of key importance in this concept is that strategy is a perspective shared by members of an organisation, through their intentions and/or by their actions. In this sense, the strategy of an organisation can be linked to its active behaviour towards the creation of new technologies or exploiting new markets (Mintzberg, 1987).

Mintzberg (1987) asserted that his five definitions of strategy hold equal importance in the understanding of the term as the five complement each other by addressing different perspectives, therefore offering a complete picture of its meaning. This is because, as suggested by Mintzberg (1987), not all plans become patterns, not all patterns are the result of intended plans; and in the same way, some ploys are less than a position strategy, and other strategies are more than positions, yet less than perspective strategies.

2.3.2. Theoretical perspectives on strategic management.

French (2009b) acknowledged that the meanings of strategy gave room for different theoretical perspectives on strategic management. Mintzberg, Ahlstrand, and Lampel (1998) and later French (2009c) classified strategic management theoretical perspectives into a different number of schools of thoughts (Table 2.3.2.1).

Table 2.3.2.1. Schools of thought of strategic management

Source	Category	School of thought
Mintzberg et al. (1998)	Prescriptive (i.e. classical) schools	Design school Planning school Positioning school
	Descriptive school	Environmental school Cognitive school Entrepreneurial school Power school Cultural school Learning (i.e. emergent)school
	Configuration school	Configuration school
French (2009c)	The classical schools	Design school Planning school Positioning school
	The neo-classical schools	Contingency view school Resource-based view school
	The post-classical schools	Learning school Emergence school

Mintzberg et al. (1998) organised the ideas in the literature of strategic management in 10 schools of thoughts (Table 2.3.2.1.) According to him, each of the ten schools has a complementary view on what strategic management is about. The contribution of each of the schools is related to the approach and assumptions about the management process, as well as the content and the context of strategy formulation (Elfring & Volberda, 2001; Mintzberg et al., 1998). Mintzberg et al. (1998) grouped the 10 schools of thought into three main categories: the prescriptive schools; the descriptive schools; and the configuration school. The prescriptive schools (or classical schools) study strategic management from a normative perspective. That is, strategic management scholars theorise about how managers should form strategy for their firms. According to Mintzberg et al. (1998), the prescriptive schools are: the design school; the planning school; and the positioning school. The descriptive schools of thought, which include the environmental, the cognitive school, the entrepreneurial, the power, the cultural school, and the learning (or emergent) school, approaches strategic management by describing how managers form strategy in reality. Finally, the third approach (the configuration school of thought) integrates some of the attributes of the other nine schools of thought and studies the formulation of strategies in the context of the organisation's lifecycle (Mintzberg et al., 1998).

French (2009c) organised the ideas of strategic management considering the change of epistemological and systemic paradigms on which strategic management research is based and proposed three main categories of schools of thought: the classical; the neoclassical; and the post-classical schools of thought. The first category included the same thee schools of thought as described by Mintzberg et al. (1998). According to French (2009c), these schools are characterised by classical and neo-classical economic thinking, which rests upon a body of theory that is characterised by concepts of linearity, equilibrium, and predictability. The second category, the neo-classical schools, included the contingency view and the resource-based view schools. These two schools share characteristics from the linear modernist paradigm of the classical schools in that they see firms as closed linear systems. However, they differ in the sense that these neo-classical schools recognise that firms are unique in relation to resources and it is these that determine how firms are positioned in markets. Thus, when firms possess resources that are valuable, rare, inimitable, and non-substitutable, they can achieve sustainable competitive advantage. Finally, the post-classical schools do not consider firms as linear systems but rather acknowledge them as learning organisations which are able to adapt though complex processes of learning. Thus, for the post-classical schools, strategic management has characteristics in common with processes of emergence in other complex adaptive systems. Despite the differences in the classifications proposed by French (2009c) and Mintzberg et al. (1998), the

work of Mintzberg et al. (1998) is described as the most detailed and organised overview of strategic management theory for business studies (Eden & Ackermann, 2013).

The design school of thought conceives strategy formation as a simple process that seeks the achievement of a satisfactory balance, or fit, between the internal and the external environment of an organisation (Mintzberg et al., 1998). The model of strategy formation proposed by enthusiasts of this school of thought is often characterised as a conscious, informal and controlled process of thought, delivered by a chief executive (Elfring & Volberda, 2001; Mintzberg et al., 1998). The model starts when a chief executive makes an assessment of the internal and external environment of the organisation in the form of the SWOT model. SWOT stands for the strengths (S) and weaknesses (W) of the internal environment of the organisation in terms of its resources, and the opportunities (O) and threats (T) comprehended in the organisation's external environment. The information gathered in the SWOT analysis is then used to explore the strategic options that better exploit the opportunities and strengths and minimise the impact of threats and weaknesses. The design school does not contribute to strategy creation theory; the approach to strategy creation implicit to design school thinkers is that strategy will be crafted by a "think-thank" approach, guided by the direction provided by the chief executive. Strategies should be fully crafted before being evaluated; evaluation and choice decisions among alternative strategies is subject to the social responsibility and managerial values of the chief executive before the preferred strategy is implemented (Elfring & Volberda, 2001; Mintzberg et al., 1998).

Mintzberg (1990) identified seven premises that underpin the design school of thought model: 1) strategy formation should be a controlled, conscious process of thought; 2) responsibility for that control and consciousness must rest with the chief executive officer as that person is THE strategist; 3) the model of strategy formation must be kept simple and informal; 4) strategies should be unique with the best ones resulting from a process of creative design; 5) strategies emerge from this design process fully formulated; 6) these strategies should be explicit and, if possible, articulated, which also favours their being kept simple; and 7) only after these unique, full blown, explicit, and simple strategies are fully formulated can they be implemented.

The second school of thought in the prescriptive group, the planning school of thought, delivers the strategic planning frameworks that are the preferred approach to strategic management found in business and organisational management textbooks (French, 2009c). Similarly, it is the preferred approach undertaken not only by most farm management textbooks, but also

extension programmes to aid farmers for the strategic management of their farms (Nell & Napier, 2005; Olson, 2011; Shadbolt & Martin, 2005). According to French (2009c), the strategic planning process models that are often found in management literature are an adaptation of the functions of management identified by Fayol (1949). These functions were described as: planning, organising, command, coordination, and control (Fayol, 1949). In the farm management literature, the functions of management are widely recognised to be summarised in three basic functions: planning, implementation and control (Gray et al., 2009; Gray, 2005).

The planning school of thought frameworks draw upon the premises detailed by the design school of thought theorists (Mintzberg, 1990; Mintzberg et al., 1998). Under the planning school's perspective, strategy formation consists of a formal complex process which results in the development and implementation of a plan (Elfring & Volberda, 2001; Mintzberg et al., 1998). The main idea is that good strategists go through a formal step-by-step procedure that can be replicated by others who follows the same steps (Mintzberg, 1990; Mintzberg et al., 1998). This process involves the formulation of a vision and mission statements, from which clear and measurable objectives are derived. The process continues with a formal analysis of the external and internal environments and the development of suitable strategies. Moreover, strategies are analysed and evaluated in terms of their contribution to the objectives before one of the strategies is selected for implementation. After the strategy is implemented, the firm is then managed to a state of equilibrium through a mechanism of control, so that corrective actions are undertaken if the strategy deviates from the desired objectives. In this sense, the monitoring of the outcomes of the strategy is an important step in relation to the control function of the process because it indicates where control responses or further redefinition of plans are necessary. If the monitored outcome of the implemented strategy does not fit with the statement of the plan, a contingency plan is implemented so that the desired objectives are still achieved. Thus, according to the planning school of thought perspective, management is seen as a continuous process in which planning and control functions are interrelated (Mintzberg, 1990; Mintzberg et al., 1998).

The frameworks delivered by the prescriptive school of thought theorists were heavily criticised for not matching the realities faced by managers and, therefore, not delivering useful solutions to them, particularly when managers face turbulent, unpredictable environments (French, 2009b; Mintzberg, 1994; Panagiotou, 2008). However, an early study undertaken by Ginter, Rucks, and Duncan (1985) tested the feasibility of a typical academic planning framework related to the delivery of good strategy for managers by asking 4000 managers of different organisations in the

UK questions relating to the formal process of planning, implementation and control and its usefulness in delivery of good management of their organisations. Ginter et al. (1985) found that in the early eighties, the model described in Table 2.3.2.2 had practical implications for most of the managers surveyed. The model used by Ginter et al. (1985)shows some similarities when compared to other models of strategic planning used in farm management textbooks. Table 2.3.2.2 describes three models of the strategic management process developed for farm management (Martin & Shadbolt, 2005; Nell & Napier, 2005; Olson, 2011) and the model used by Ginter et al. (1985) by in their research.

Table 2.3.2.2. Elements of four models of the strategic management process

Ginter et al. (1985)	Olson (2011)	Martin and Shadbolt (2005)	Nell and Napier (2005)
Vision and mission Objective setting External environment scanning Internal environment scanning Strategic alternatives (crafting strategy) Strategy selection	Identify stakeholders Develop vision, mission, objectives Analyse the external environment Craft strategy	Vision, strategic intent, long term (high level) goals Evaluate current situation Gap analysis Generating alternative strategic options Evaluating alternative strategic options Choice of preferred strategy	Mission, vision and culture Analysis of the external environment Analysis of the internal environment Strategic analysis and choice: developing a competitive advantage Long-term goals Main strategy Short-term objectives Functional tactics
Strategy Implementation	Obtain and organise farm resources Direct the resources	Implementation of preferred strategy	Key implementation policies Implementation
Strategic Control	Measure and evaluate farm performance Monitor external events Take corrective actions as needed	Monitoring and evaluation	Strategic control and repositioning

The elements within the four models of the strategic management process extracted from Ginter et al. (1985), Martin and Shadbolt (2005), Nell and Napier (2005), and Olson (2011) exhibit some similarities; for example, the four models describe that management consists of three main phases: planning; implementation; and control. However, the number of steps involved and the order in which these steps appear in each of the processes vary among the models as a result of the slitting or splicing of steps. For example, the model proposed by Olson (2011) indicates that the first step in the planning phase is the identification of stakeholders, while in the others this element is not present. Olson (2011) suggests that there may be a number of shareholders related to a firm who do not necessarily take part in the development of a business strategy, but that must be considered for planning. This element is missing in the remaining three models; nevertheless, it is implicit in the development of a vision, mission and objectives. The following step after the development of a vision, mission and objectives is the evaluation or scanning of the external and internal environments (Ginter et al., 1985; Nell & Napier, 2005; Olson, 2011), or in the terms of Martin and Shadbolt (2005) "the evaluation of the current situation" (p. 101). In either sense, these steps refer to a SWOT analysis, after which, managers should be able to identify the gap that they want to improve. This gap indicates the difference between where the business is standing now and where it ought to be according to the stated goals and objectives (Martin & Shadbolt, 2005). Once the gap is identified, strategy is crafted, alternative strategic options evaluated, and the most adequate strategic option chosen (Ginter et al., 1985; Martin & Shadbolt, 2005; Nell & Napier, 2005; Olson, 2011). Differently from the others, the model proposed by Nell and Napier (2005) indicates the necessity to develop short term objectives and functional tactics during the planning stage of the process. These two elements make implicit the necessity to make adjustments at lower levels of management in accordance to the main strategy selected.

The second phase of the strategic management process is the implementation of the preferred strategy. This is where the resources identified during the planning phase are gathered and organised according to what has been planned (Ginter et al., 1985; Martin & Shadbolt, 2005; Nell & Napier, 2005; Olson, 2011). The third phase is the control phase where monitoring becomes an important component of strategic control. However, only the model described by Martin and Shadbolt (2005) includes this element as a separate part of the process.

The monitoring of the plan is an important step in the process to determine if the objectives stated in the plan can be achieved by the implemented strategy (Ginter et al., 1985; Martin & Shadbolt, 2005; Nell & Napier, 2005; Olson, 2011). Martin and Shadbolt (2005) and Olson

(2011) describe that monitoring is an aid for strategy implementation; in this sense, Shadbolt (2008) suggests that the outcomes of an implemented plan can be monitored through the use of management aid tools such as the balanced score card (BSC). The BSC helps managers to distinguish multiple goals from multiple perspectives that include the customer's perspective, financial performance perspective, innovation and learning perspective, natural resource perspective and family lifestyle and community perspective (Olson, 2011; Shadbolt, 2008). The objectives identified through these perspectives provide managers with guidance towards the accomplishment of the vision and mission of their farming businesses. The BSC provides a framework that allows for the implementation of emergent strategies that correct or change the course of the firm; in this sense, the models described by Martin and Shadbolt (2005) and Olson (2011) identify that the BSC is a connection between monitoring and planning. Related to this, French (2009c) recognises that the BCS is an improvement to the way the planning school of thought approached strategic planning before. French (2009c) describes the BSC giving some flexibility to managers by allowing the implementation of emergent strategies into the strategic management process which was not originally described by classical thinkers of the planning school of thought.

Mintzberg *et al.* (1998) acknowledged that the interdependence between planning, monitoring and control has it foundation in the command and control approaches described in cybernetics theory. For this reason, Mintzberg (1994) has extensively critiqued the planning school of thought by arguing that these command and control approaches are only useful in stable predictable environments which are unlikely to exist in the reality of strategic management, and that the structuredness of these models gives little or no room for learning, flexibility while also discouraging creativity; he identifies all of these as important attributes for coping with rapid and unforessen changes.

The final prescriptive school of thought is the positioning school (Mintzberg *et al.,* 1998). According to French (2009c), the positioning school differs from the planning school in the sense that the former argues that strategy formation is a process guided by management, while the latter suggests that a firm's strategy should be a consequence of existing market conditions. One of the key and first researchers of the positioning school of thought is M. Porter (Porter, 1985, 1996, 2008, 2011). According to Porter (1985), only a few key strategies are required for firms to economically and competitively position themselves in a marketplace. Porter (1985) labelled these key strategies as: differentiation; cost leadership; and focus. He argued that only these three strategies provided firms with competitive advantage and allowed them to defend

themselves against current and potential competitors. Table 2.3.2.3 shows the three generic strategies proposed by Porter (1985), in relation to the source of strategic advantage (uniqueness perceived by the customer or low cost position) and strategic target (industrywide or a particular segment only).

Table 2.3.2.3. Generic strategies. Source: Porter (1985)

		Strategic advantage	
		Uniqueness perceived by the customer	Low cost position
Strategic target	Industrywide	Differentiation	Overall cost-leadership
	Particular segment only	Focus	Focus

Porter (1985) also argues that because strategies are pre-determined, the focus of management should be placed in the identification of the forces that shape the environment of organisations. In this respect, Porter described the five forces responsible for determining this environment as: 1) rivalry among established firms; 2) risk of entry by potential competitors; 3) threat of substitute products or services; 4) bargaining power of buyers; and 5) bargaining power of suppliers. Olson and Boehlje (2010) and Gray, Boehlje, and Akridge (2004) indicate that two additional forces influence competition in farming businesses: 1)changes in technology; and 2) the drivers of technological change. French (2009c) has criticised the five forces model proposed by Porter by arguing that this model does not address the role of externalities and institutional regulatory policies that alter the environment of firms.

The positioning school of thought has been criticised by both French (2009c) and Mintzberg et al. (1998). They argue that according to positioning theorists, strategy creation is a deliberate and deductive process which does not appear to recognise the existence of strategic learning, cognition and strategy emergence; all of these are elements which have been described to contribute to empirical strategy formation in firms. According to the positioning school of thought, strategy formulation is limited to the selection of one of the theoretical positions based on analytical calculation. Thus, planners are replaced by analysts who influence managers to plan and implement (French, 2009c; Mintzberg et al., 1998). The positioning school, as with both the other prescriptive schools, does not have a theory of strategy creation (French, 2009c).

The environmental school of thought, the first of the descriptive group identified by Mintzberg et al. (1998), approaches strategy formation as a response to the challenges imposed by the external environment. This approach is different from the one adopted by the other schools which see the environment as a factor influencing strategy formation. However, according to the environmental school, the environment is the main actor in strategy formation. Therefore, there is no one single way in which an organisation should be structured in order to position itself in the environment; rather, the strategy of an organisation depends on the complexity and dynamics of the environment. In this regard, the strategy of an organisation is to adapt its structure to the changing environment to exit the business (Mintzberg et al., 1998). This concept has its roots in biology and in contingency theory, with the latter suggesting that the most effective organisational structure is dependent on the circumstances in which a firm operates (French, 2009c). Mintzberg et al. (1998) have criticised this school of thought by suggesting that, often, the dimensions that define the environment are unclear and aggregated. In addition, they argue that this creates vagueness for strategy formation and denies real strategic choice for organisations.

The second of the descriptive schools is the cognitive school of thought (Mintzberg et al., 1998). According to Mintzberg et al. (1998), the cognitive school views strategy formation as a process that takes place in the mind of the manager strategist. Thus, the approach undertaken by this school is to analyse how people perceive patterns and process information. Strategy formation then considers that strategies emerge as concepts, maps, schemas and frames of reality. Mintzberg et al. (1998) has criticised the approach undertaken by this school for not delivering a practical approach for strategy formation beyond the conceptual stage. They also believe that this is not a practical approach to conceive great ideas or strategies. In the farm management literature, the cognitive school is present in the models which describe relationships between farmer's perceptions of the world and decision making, which are afterward used for the development of decision support systems for farmer decision making and strategy formation (McCown, 2012; van Winsen, de Mey, Lauwers, Van Passel, Vancauteren, & Wauters, 2013)

The entrepreneurial school of thought sees strategy formation as a visionary process undertaken by the mind of a single visionary leader: "the entrepreneur" (Mintzberg et al., 1998). The process relies on the intuition, judgement, wisdom, experience and insight of the strategy formation leader . In this regard, the most important component of strategy formation is the vision. Mintzberg et al. (1998) defined the vision as "a mental representation of strategy, created or at least expressed in the head of the leader. That vision serves as both an inspiration and a sense of

what needs to be done a guiding idea, if you like." (p. 129). Therefore, the leader will also keep in close contact with the implementation of strategies so that they can be changed when required to ensure that his vision will be achieved. Mintzberg (1973) describes the entrepreneurial mode as strategy making that is dominated by the active search for new opportunities, with the problems being secondary. In addition, entrepreneurs were described to have other attributes that define them such as creativity, persuasiveness, and a free spirit (Mintzberg, 1973). While there are many definitions of entrepreneurial farmers within the farm management literature, Shadbolt, Kataliem, and Conforte (2009) suggest that a common theme in farm management literature related to entrepreneurial behaviour is that farmer entrepreneurs tend to be more growth orientated, risk takers, have more innovativeness and personal control characteristics than conventional farmers.

The power school of thought describes strategy as being formed through the exercise of influence among the parties involved in decision making (Mintzberg et al., 1998). Mintzberg et al. (1998) say that the strategies resulting from a process of negotiation between power holders within an organisation (micro power), and or between the organisation and its external stakeholders (macro power) may take the form of emergent, position or ploy strategies. While micro power focusses on internal actors conflicting with their colleagues, usually due to self-interest encounters, macro power views the organisation standing out due to its own self-interest in conflict or cooperation with other organisations (Mintzberg et al., 1998). Mintzberg et al. (1998) suggest that this school offers a realistic perspective on strategy formation. However, they argue that this does not mean that the strategy resulting from power relations is the best strategy, since conflict may often lead to having no strategy or just engaging in tactical manoeuvring.

The cultural school of thought views strategy formation as a collective and cooperative process involving various groups and departments within the company (Mintzberg et al., 1998). The concept of collaboration in strategy formation contrasts with the core idea delivered by the power school in which strategy formation is motivated by self-interest. According to the cultural school, strategy is formed as a perspective which mirrors the culture of an organisation. Thus, social processes and values and beliefs have an important role in strategy formation and decision making. Because strategy is shaped and influenced by the culture of the organisation, this approach discourages strategic change and encourages continuity of current strategy.

The learning school considers planning and implementation to be intertwined and indistinguishable, due to processes of learning (French, 2009c; Mintzberg et al., 1998). Thus, in

this school of thought, learning is seen as the true source of competitive advantage. Because of the influence of learning, systems are seen as complex and self-adapting. French (2009c) argues that approaching strategic management through the lens of the learning school might lead to understanding how and why some organisations are better at adapting to conditions of turbulence than others.

Finally, the configuration school of thought is a meta-school that synthesises elements from the other schools. According to Mintzberg et al. (1998), the configuration school of thought sees an organisation in terms of some type of stable structure or configuration which matches a particular type of environment; however, when the environment changes, the organisation is able to change its structure in order to adapt to the new conditions and achieve new stability. Thus, the configuration school is concerned with explaining patterns or cycles of organisational behaviour that allow organisations to adapt to periods of relative stability and periods of significant change.

2.3.3. Strategic planning and strategic thinking.

Strategic management is the process of formulating and implementing strategy (Elfring & Volberda, 2001; French, 2009a; Harrison, 2012). The work undertaken by Mintzberg (1994; 1987) describes two typical approaches to operationalising organisational strategic management: the planning approach and the strategic thinking approach. Mintzberg (1994) describes the strategic planning approach as a formal and analytical process of defining the strategy of an organisation and making decisions about resource allocation according to the strategy. Additionally, he suggests that strategic planning also refers to defining the control mechanisms used to implement the strategy once it is determined. On the other hand, strategic thinking involves developing a strategic foresight capacity by exploring all possible organisational futures and challenging conventional thinking to foster decision making. For that reason, the strategic thinking approach considers the development of emergent strategies as an important component of the strategy formation process. Therefore, strategic thinking is described by Graetz (2002) to be a more creative, dynamic, responsive and intuitive process when compared to strategic planning.

Graetz (2002) describes strategic thinking and planning as different but interrelated thought processes that have complementary roles in strategic management. Figure 2.3.3 illustrates strategic management as the convergent point where two different thought processes meet. Graetz (2002)describes strategic thinking as synthetic, divergent, creative, intuitive, and

innovative, whereas strategic planning as logical, systematic, conventional, prescriptive and convergent .According to Graetz (2002) the role of thinking is to seek innovation and to imagine new and various different futures that may lead the organisation to redefine their strategies and core competencies; whereas, the role of planning is to realise and support the strategies developed by the thinking process and integrate them into the business.

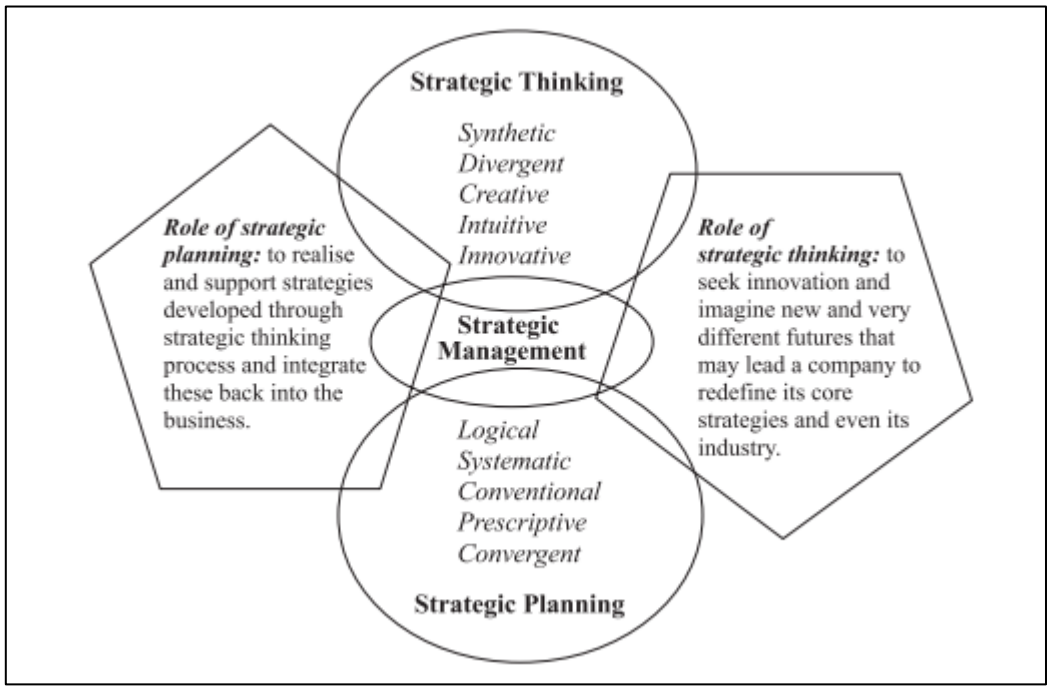


Figure 2.3.3. Strategic thinking and planning. Source: Graetz (2002).

2.3.4. Empirical models of strategic management that combine strategic planning and strategic thinking.

Kajanus (2000) proposed a model of strategy formation that uses both strategic planning and strategic thinking approaches, encouraging innovation during the formulation of a business strategy. The distinctive element in Kajanus's (2000) model, if compared to a formal planning approach model, is that the former involves the use of tools to encourage thinking and communication between the people involved in the planning process. Therefore, if more than one person is involved in the planning, innovative planning is enhanced. Professionals are likely to be very useful in aiding the planning process by helping managers to identify and clarify the environment in which they operate; professionals can also introduce managers to complex tools such as scenario simulation to help them formulate and evaluate hypotheses about alternative strategies in potential future situations (Kajanus, 2000). Creativity is the most important aspect of developing innovative strategies, and it is important to be present in all the stages of strategy

formulation (Graetz, 2002). The model proposed by Kajanus (2000) encourages creativity by three means: firstly, by applying value focused thinking (Keeney, 1992). According to Keeney (1992), focused thinking guides thinking and decision making towards a focused objective. The second approach in Kanjanus' model is creativity which is encouraged by the use of scenario planning tools that help managers to visualise the interaction between different strategy factors (Kajanus, 2000). Finally, creativity is enhanced by the use of the word-random method developed by De Bono (1971); this introduces provocation into the thinking process to develop new alternative strategic ideas.

2.4. Attributes of resilience.

The literature revealed that six attributes are relevant for individual resilience: 1) self-efficacy; 2) locus of control; 3) willingness to accept uncertainty and change; 4) open-mindedness; 5) sense-making; and 6) strategic thinking. Literature on the six attributes is reviewed in the following sections.

2.4.1. Self-efficacy.

Much of the literature on psychological resilience indicates that resilient people have a strong sense of self-efficacy (SE) (Reich et al., 2010; Schwarzer & Warner, 2013). Self-efficacy is defined by Bandura (2000) as "the belief in one's capabilities to organise and execute the courses of action required to produce given levels of attainments" (p. 18). Schwarzer and Warner (2013) and Reich et al. (2010) state that people with strong belief in their capacity to overcome stressful situations are more able to bounce back than people with weak SE beliefs. Likewise, strong SE beliefs about the ability to successfully perform adaptive responses are an indicator of adaptive capacity (Grothmann & Patt, 2005).

There are a number of distinctive characteristics that differentiate people with strong SE beliefs from people with weak SE beliefs (Bandura, 2010). Table 2.4.1 shows a summary of the distinctive characteristics that can distinguish people in the two extremes of SE.

Table 2.4.1. Differences between an individual with strong self-efficacy beliefs and an individual with weak self-efficacy beliefs. Adapted from Bandura (2010).

Strong sense of self-efficacy	Weak sense of self-efficacy
View difficult tasks as challenges to be mastered rather that threats to be avoided	View difficult tasks as personal threats
Fosters intrinsic interest and deep engrossment in activities	Have low aspirations and weak commitment to the goals they choose to pursue
Set strong goals and maintain strong commitment to achieve those goals	When faced with difficult tasks, they dwell on their personal deficiencies, obstacles they will encounter, and adverse outcomes rather than concentrate on how to perform successfully
Increase and sustain their efforts in the face of failure	Relax their efforts and give up quickly in the face of failure
Attribute failure to insufficient effort or insufficient knowledge and skills which are acquirable	Attribute failure to a lack of skills which are not easily acquirable
Approach threatening situations with confidence that they can exercise control over them	Approach threatening situations with little confidence that they can exercise control over the situation
Low vulnerability to depression	High vulnerability to depression

SE theory suggests that SE beliefs influence human behaviour and decision-making (Bandura, 1997, 2000; Krueger & Dickson, 1994; Schwarzer & Warner, 2013). In the context of business management, measures of SE beliefs were important in predicting a number of human behaviours relevant to the understanding of risk management (Krueger & Dickson, 1994). For example, strong SE beliefs are positively correlated with a risk taking attitude. Gist (1987) and Krueger and Dickson (1994) described that the higher the belief that one can manage risk, the greater the appetite is for risk taking. In the farm management literature, Shadbolt and Olubode-Awosola (2013) identified that dairy farmers in NZ who expressed a high risk taking attitude also showed a strong positive belief about their ability to manage those risks.

SE beliefs also affect the way risk is perceived (Bandura, 1997, 2010; Gist, 1987). In relation to this, people with strong SE beliefs are more likely to perceive a source of risk as an opportunity rather than a threat, whereas the opposite happens to people with weak SE beliefs (Bandura, 1997, 2010; Gist, 1987). The relationship between SE beliefs and risk perception is relevant in understanding the influence of SE on opportunity recognition for decision-making (Krueger & Dickson, 1994).

Another way in which SE beliefs influence decision-making is by regulating goal setting (Bandura, 2010; Gist, 1987). SE beliefs regulate the goals to be achieved and the level of achievement reached (Bandura, 2010; Gist, 1987). People with strong SE beliefs are more likely to set more challenging goals than people with weak SE beliefs (Bandura, 2010; Gist, 1987).

SE beliefs also regulate other processes that affect human functioning and are relevant to both management and decision making (Bandura, 1993, 2000, 2010; Gist, 1987). Bandura (2010) explained that SE beliefs regulate human functioning in four major processes:

a) Cognitive processes: SE beliefs influence the setting of goals for the future and the level of commitment to the achievement of those goals;
b) Motivational processes: SE beliefs influence one's own motivation to acomplish pre-established goals and act in anticipation in order to achieve those goals;
c) Emotional processes: SE beliefs play a central role in anxiety arousal which impacts on stress and depression;
d) Selection processes: SE beliefs influence the type of activities and environments people choose to become involved with.

These four processes are closely related (Bandura, 2010). At the cognitive level, much human behaviour is regulated by forethought embodying known goals. Moreover, personal goal setting is influenced by self-appraisal of one own capabilities (i.e. motivational process). Therefore, the stronger the belief about one's own capabilities, the higher the goal challenges people set for themselves and the firmer their commitment to them. Cognitive and motivational processes can also be influenced by stress. People with strong SE beliefs are less likely to suffer from stress. Bandura (2010) explains that people suffering from stress are more erratic in their analytic thinking those suffering less stress. Krueger and Dickson (1994) found a positive relationship between a manager's strong SE beliefs and business performance. They suggested that one of the plausible mechanisms that may explain the strong SE beliefs-business performance relationship was the influence of strong SE beliefs on better analytical thinking.

Bandura (1994) described how people's belief in their efficacy can be developed by four sources of influence: experience; social models; social persuasion; and stress reaction. The first source, experience, relates to the influence of one's own experience in overcoming obstacles and the development of strong SE beliefs. Bandura (1994) suggested that experiencing success through perseverant effort resulted in strong SE beliefs. He argued that, for many people, some situations can have the useful purpose of teaching that success requires sustained effort. The second source, social models, refers to the learning that is gained through the observation of other people's experience. According to Bandura (1994), seeing similar people succeed by sustained effort increases an observer's belief that they can also succeed. Thirdly, people who are persuaded verbally that they possess the capability to master any given situation usually develop

strong SE beliefs, which ultimately result in a greater and more sustained effort to overcome problems. The fouth source, stress reaction, refers to the reduction of stress exposure for the purpose of altering the negative influence of stress over emotions.

2.4.2. Locus of control.

Resilient people have what has been named an "internal locus of control" (Skodol, 2010, p. 114). Locus of control (LoC) theory classifies individuals in one of two categories (internal or external) based on their general expectancy of where control over events and outcomes is located (Rotter, 1966). People with an internal LoC believe that they have considerable control over external events and that, therefore, their behaviour is the only responsible for their situation. In contrast, people with an external LoC usually believe that they have little control over external events, and that, therefore, external factors such as "fate" or "bad luck" are responsible for their situation (Skodol, 2010, p. 114)

An internal LoC is associated with useful skills relevant for coping with uncertain environmental events (Skodol, 2010). People with internal LoC are often more motivated and committed to finding solutions to unexpected problems than people with external LoC (Skodol, 2010). Internal LoC has also been associated with learning success in students (McMillan & Reed, 1994). McMillan and Reed (1994) described students with internal LoC as spending more time in learning activities and showing more intense interest in knowledge pursuit than students with external LoC. In the farm business context, Kaine, Sandall, and Bewsell (2003) described farmers with internal LoC as more likely to participate in extension or benchmarking programmes than farmers with external LoC.

LoC beliefs might also influence relevant aspects of the decision making process such as planning and implementation (Tanewski, Romano, & Smyrnios, 2000; Van Kooten, Schoney, & Hayward, 1986). Van Kooten et al. (1986) and Tanewski et al. (2000) suggested that farmers with a strong internal LoC would place significant importance on planning during decision making. Van Kooten et al. (1986) argued that a farmer's strong belief about their ability to control future events would give them confidence to adopt planning in their decision making. In contrast, farmers with a strong external LoC would be less likely to plan because of their negative belief about their ability to control external events. Internal LoC was positively correlated with farm planning and farm performance of family farm businesses in Australia (Tanewski et al., 2000). Tanewski et al. (2000) suggested that internal LoC was a better predictor of farm performance than a farmer's level of education (another widely used predictor of farm success), because it gave more information about how a farmer used their education to manage their farms. In this

regard, Tanewski *et al.* (2000) described that while level of education and internal LoC were equally good at predicting farm performance, internal LoC was significantly better to predict the sophistication of farmer business planning than level of education.

Van Kooten *et al.* (1986) also believed that internal LoC influenced farmer decisions over what type of risk management strategies farmers were more likely to implement for their businesses. Van Kooten *et al.* (1986) hypothesised that farmers with a internal LoC would be less risk adverse than farmers with external LoC, and that these attributes would be reflected in their choice of strategy. One one hand, internal LoC farmers would rather choose to implement strategies which aimed to increase the profitability of their businesses; while on the other hand, farmers with external LoC would be more likely to implement strategies which aimed for the subsistence of their businesses. These hypotheses were confirmed by Van Kooten *et al.* (1986) who found that farmers with internal LoC were more likely to implement strategies that aimed to increase profit on a yearly basis, whereas farmers with external LoC were more likely to implement strategies which aimed to reduce levels of debt and to avoid low profit and losses. More recently, Hansson and Ferguson (2011) found that LoC influenced dairy farmers' strategic management responses with regard to further developing milk production systems. In fact, Hansson and Ferguson describe farmers with internal LoC as more likely to implement decisions about further developing their milk production systems than farmers who exhibited an external LoC. They suggested that this relationship is due to the fact that a farmer with internal LoC would have a higher expectation of their actions leading to an increase in firm profitability and that this expectation drives implementing decision choices.

The concept of LoC is closely related to the concept of SE (Bandura, 1982; Çelik, Çetin, & Tutkun, 2014; Skodol, 2010). Price and Leviston (2014) suggest that LoC can be thought broadly as a form of self-efficacy. They say the main difference between SE and LoC is that while SE relates to beliefs about one own efficacy in performing tasks, LoC is particularly related to control beliefs. Judge, Erez, Bono, and Thoresen (2002) argued that SE and LoC are part of a same higher order process and that is why general measures of SE and LoC are often correlated. Recently, Judge and Kammeyer-Mueller (2012) reviewed a large amount of empirical organisational behaviour research literature and discussed the use of general or specific measures to assess organisational behaviour. They arrived at a similar conclusion to Judge et al. (2002) and suggested that SE, LoC and self-esteem (the three core self-evaluation traits) might be referring to a measure of the same factor if each of these is expressed as a general measure of the attribute.

2.4.3. Willingness to accept uncertainty and change.

Boxelaar, Sharma, and Paine (2006) suggested that a dairy farmer's degree of resilience is a construct of their ability to face reality, particularly, when confronted with a situation of significant change. Boxelaar *et al.* (2006) argued that in the case of agriculture, where many of the changes are inherently uncertain, a farmer's willingness to face the reality of uncertainty and ambiguity is an attribute that would indicate their level of resilience. On a similar note, Coutu (2002) described resilient people as usually characterised by having a strong acceptance of reality. Coutu (2002) and Feder, Nestler, Westphal, and Charney (2010) argued that, while the common belief is that resilient people are optimistic by nature, many of the most resilient individuals are people who have developed a more "down-to-earth" (Coutu, 2002, p. 1) view of the reality they live in. Coutu (2002) believes that people with this kind of view of reality tend to be more prepared to act quickly in the face of unexpected adverse events than people who have a more optimistic view.

Much research in psychological resilience has studied its relationship with optimism (Cohn, Fredrickson, Brown, Mikels, & Conway, 2009; Ong, Bergeman, Bisconti, & Wallace, 2006; Souri & Hasanirad, 2011; Yu & Zhang, 2007). For example, Souri and Hasanirad (2011) studied the relationship between psychological wellbeing, psychological resilience, and optimism with a sample of medical students. In their study, Souri and Hasanirad (2011) identified that there is a strong positive relationship between optimism and psychological resilience. In another study, Yu and Zhang (2007) explored the factorial structure of the Connor and Davidson's Resilience Scale (CDRS) when applied to a random sample of Chinese people from two Chinese provinces. The CDRS is a widely adopted tool for measuring resilience developed by Connor and Davidson (2003), and was originally used to assess resilience in individuals in the western world (Yu & Zhang, 2007). The objective of their research was to identify whether the factors explaining CDRS variance in Chinese people were different from the factors indicated in the Western resilience literature. Yu and Zhang (2007) found that while for Western people, the number of factors that explained the variability of resilience was 5 (1- personal competence, high standards and tenacity; 2- trust in one's instincts, tolerance of negative affect, and strengthening effects of stress; 3- positive acceptance of change and secure relationships with others; 4- control; and 5- spiritual influences). For the Chinese people, the number of factors was reduced to 3 (tenacity, strength, and optimism). Yu and Zhang (2007) suggest that regardless of a person's cultural background, elements of an optimistic personality reflect a resilient personality.

Boxelaar et al. (2006) suggests that the willingness to accept uncertainty and ambiguity is linked to the ability of a person to learn, and hence, it is related to their adaptive capacity. They argue that recognising that uncertainty and ambiguity are inescapable is a first step to start learning about a situation in order to reduce the level of uncertainty in the environment.

2.4.4. Open-mindedness.

Open-mindedness has been described as a defining attribute of resilient people (Webb, 2013). Darnhofer (2010) suggests that this attribute is relevant for farmers in the process of adapting to changes in the environment. She argues that because farmers with an open-minded personality understand strategy as an unfolding process, they are more likely than farmers with a close-minded personality to implement emergent strategies in relation to changes on their farm if required. Webb (2013) says that open-mindedness refers to being open to accept that sometimes change is a good option and, therefore, having an open-minded personality contrasts with being stubborn. In relation to this theme, Darnhofer argues that that although open mindedness seems to be an evident attribute of most people, it is not usual in the case of farmers since many farmers tend to hold on to traditional farm management practices or social norms of how a farm should be.

Rogers, Luton, Biggs, Biggs, Blignaut, Choles, Palmer, and Tangwe (2013) suggests that there are a number of habits that promote open mindedness (Table 2.4.4), and, therefore, should be expected to be found in a person with an open-minded personality.

Table 2.4.4. Habits that promote open mindedness. Source: Rogers et al. (2013)

• Hold strong opinions lightly and encourage others to do the same.
• Be prepared to identify and accept the intervention of surprise, serendipity, and epiphany.
• Encounter every person with equal respect, listen for their specific needs, knowledge, and ways of knowing.
• Be open to options.
• Do not reject ambiguity or paradox. They are to be expected and their acceptance as legitimate can often avoid dispute.
• Cultivate, honour, and affirm the legitimacy of multiple perspectives and outcomes. Be ready to chart your way through them to learn about multiple legitimate outcomes
• Accept everyone as co-learners, not experts or competitors.
• Encourage cooperation and consensus; the best way to get what you need is to help others get what they need.

Rogers et al. (2013) describes open-minded people as ones who tend to hold their opinions lightly when engaging with others and encourage these others to do the same. This behaviour

allows the interchange of ideas and learning. In the same way, open-minded people are respectful of the opinions of others; are open to any options that can result from discussions; and do not reject ambiguity or paradoxes, since they also consider these opportunities for learning. Open-minded people engage with and internalise different perspectives and even paradigms. Additionally, open-minded people tend to mirror themselves in others and see them as learning partners rather than competitors or experts. They consider this mutual behaviour as beneficial for both parties.

2.4.5. Sense-making.

McCann (2004) and McCann et al. (2009) suggest that organisations that lack of this ability might result in the loss of a business opportunity or over exposure to a threat, which ultimately might lead to the failure of the business. In such circumstances, managers must make sense of the new situation in order to act quickly. McCann (2004) believes that this skill provides businesses with a source of resilience. The ability to make sense is linked to the agility of an organisation in relation to the implementation of strategic decisions in order to adapt to new situations in business environments. Such agility allows businesses to capture opportunities and/or minimise threats. McCann et al. (2009) suggests that sense-making provides businesses with a source of competitive advantage, which ensures the long term survival of the firm. Sense-making provides the theoretical foundations of how individuals are able to put new situations into perspective and "make sense" of them in order to act on new circumstances (McCann et al., 2009).

The relevance of sense-making for decision making is that higher sense-making results in a more complete understanding of a situation. Therefore, sense-making and decision-making are linked through the concept of bounded rationality (Boland, 2008). This means that people's rational decisions are limited by the information they possess; sense-making reduces the gap between the unknown and the known so that people can act more efficiently (Choo, 2002; Klein, Moon, & Hoffman, 2006a; Weick, Sutcliffe, & Obstfeld, 2005). Initially, many of the theories that aimed to link different aspects of decision making and human behaviour were approached from a reductionist and linear perspective (French, 2009b; Mintzberg, 1994; Mintzberg et al., 1998). Weick (1995) suggests that sense-making offers an alternative to traditional rationalistic approaches by suggesting that human behaviour and decision making is often based on plausibility of outcomes rather than the certainty of the accuracy of the decisions

2.4.5.1. Sense-making definitions.

Sense-making has been defined as "a cognitive and behavioural response to ambiguous and uncertain situations that interrupt the ongoing flow of events" (Gioia & Chittipeddi, 1991, p. 442). It is an ongoing process of forming anticipations and assumptions and the subsequent interpretation of experiences that deviate from those anticipations and assumptions (Neill, McKee, & Rose, 2007). Klein et al. (2006a), defines sense-making as "a motivated, continuous effort to understand connections (which can be among people, places, and events) in order to anticipate their trajectories and act effectively" (p. 71). The definitions described above denote that sense-making is about scanning, interpretation, and action in relation to unknown data, and for that reason, Waterman (1993) defined sense-making as "the process of structuring the unknown" (p. 41). This effort of structuring the unknown involves answering questions such as: how something comes to an event; what the event means in the context of a particular situation; or, what the story is here. The answering of these questions will follow with a further question about what should be done next (Weick et al., 2005). The effort taken in trying to answer these questions forces meaning to the situation, resulting in the materialisation of sense-making (Ancona, 2012; Weick et al., 2005).

Sense-making occurs on all of the levels of a social system, ranging from the individual level to the cultural level (Weick, 1995). Moreover, sense-making is described as a multi-dimensional concept that can be approached by different perspectives. The literature on sense-making distinguishes between three perspectives: the psychology perspective; the human computing centred perspective; and the naturalistic decision making perspective (Klein et al., 2006a). These three perspectives are discussed in sections 2.4.5.2, 2.4.5.3, and 2.4.5.4 respectively.

2.4.5.2. The psychological perspective on sense-making.

The perspective psychology takes on sense-making describes it as a psychological human trait based on human behaviour and personality attributes which explain how people make sense of their experiences of the world (Klein et al., 2006a; Weick, 1979). According to Klein et al. (2006a), sense-making is related to factors such as creativity, curiosity, comprehension, mental modelling and situation awareness. They argue that sense-making involves creativity in that people making sense of new experiences and acting in response to those experiences need to generate new solutions to newly arising problems. The second factor linked to sense-making, curiosity, is described as a motivational exploratory behaviour which involves the exploration of the perceived environment in search for different situational states (Mark, 1998). According to

Klein et al. (2006a) sense-making is also about comprehension in the sense that sense-makers have to be able to understand stimuli before acting. Sense-makers are also able to express their comprehension of a situation with some type of mental model which expresses the situation in terms of concepts, principles and knowledge (Klein et al., 2006a). Finally, the last concept linked to sense-making is the idea of situation awareness. Klein et al. (2006a) differentiates sense-making from situation awareness by suggesting that the latter is about the state of knowledge that has been achieved (either knowledge of current data elements, inferences drawn from these data, or predictions that can be made using these inferences). In contrast, sense-making is about the process of achieving these kinds of outcomes, the strategies, and the barriers encountered (Klein et al., 2006a)

2.4.5.3. The individual perspective on sense-making.

The individual perspective on sense-making, also called the human centred computing perspective (HCC), is an interdisciplinary research field focussed on describing sense-making as individual cognitive processes of framing data. The aim of HCC is to improve the usability of, or the development of new, computational technologies based on the understanding of the rationale of human cognition (Klein et al., 2006a; Leedom, 2001; Naumer, Fisher, & Dervin, 2008). The HCC perspective is focused on the analysis of information exchange in the human-machine relationship. For example, computers often provide some kind of synthesised or processed information that is a consequence of complex processes generated by the computer system. As most people are often not aware of the processes that computers undertake in order to generate information, they are subject to trusting the technology to help them solve their problems. However, when a person's objective of using technology is not met, he or she may question technology and try to find the reason behind the unsatisfactory result. HCC focusses on this type of human-machine relationship by understanding how people make sense of information in order to improve technology information systems (Klein et al., 2006a).

At the individual level, sense-making is described as a cognitive process which occurs when a particular event in the environment forces a person to make sense of their current situation; it involves a retrospective rationalisation in search for meaning and sense of a person's actions (Klein, Moon, & Hoffman, 2006b). Sense-making is an ongoing process which involves the development of plausible meanings built on the bracketing of cues from the environment and the interpretation of those cues based on salient frames (Nell & Napier, 2005). In summary, the importance of the HCC perspective on sense-making is that it focusses on the individual process

of data scanning and interpretation which helps to understand how a person makes sense of uncertain events in the environment (Klein et al., 2006b; Weick, 1995). From this perspective, the sense-making process consists of three elements: a frame; a cue; and connections (Klein et al., 2006b; Weick, 1995).

The idea of a "frame" defines the context within which data and information (cues or events) are perceived and processed in order to give a plausible explanation about a particular situation (Klein et al., 2006b). Klein et al. (2006b) suggested that when a person makes sense of a situation, that person begins with some type of perspective, viewpoint, mental model, or framework which helps them explain the situation. Klein et al. (2006b) named this viewpoint a "frame" (p. 88). They argue that people use frames to convert data into information which they use in their decision making. They continue their argument saying even though frames define data, these frames also shape the data a person perceives (for example the introduction of a new regulation over production methods in dairy farms will be perceived differently by farmers, researchers, and individuals from the rest of society). Klein et al. (2006b) also suggest that because of this interaction between data and perception, frames are continuously changing due to learning and the interaction of a person with others.

The terms "cues" and "events" were used by Weick (1995) and Klein et al. (2006b) respectively to define the same concept. Both cues and events (cues from now on) refer to signals for action or stimuli that provide information about what to do. Thus, these cues are perceived data from the environment that trigger sense-making (Shadbolt, 2008; Weick, 1995). The unique characteristic of cues is that they tend to be considered as the factor that captures most of the attention in the environment from which they come from and, therefore, they alone suggest consequences that are more obvious than the environment as a whole (Weick, 1995; Weick et al., 2005). The most salient point relating to cues is that these act as a trigger of the sense-making process. From this point on, the sense-making process can be seen as a continuous delivered effort to make the connections between these cues and the frames (Klein et al., 2006b; Weick, 1995; Weick et al., 2005).

Sense-making is an ongoing and delivered process with a starting point that can be set up at the moment a perceived cue is not explained by an individual's frame and, therefore, the validity of that frame is questioned (Figure 2.4.5.3). Although sense-making is continuous, this cue is used by Klein et al. (2006b) to separate the sense-making process in two phases: the elaboration cycle

(which occurs before the questioning cue); and the reframing cycle (which occurs after the questioning cue).

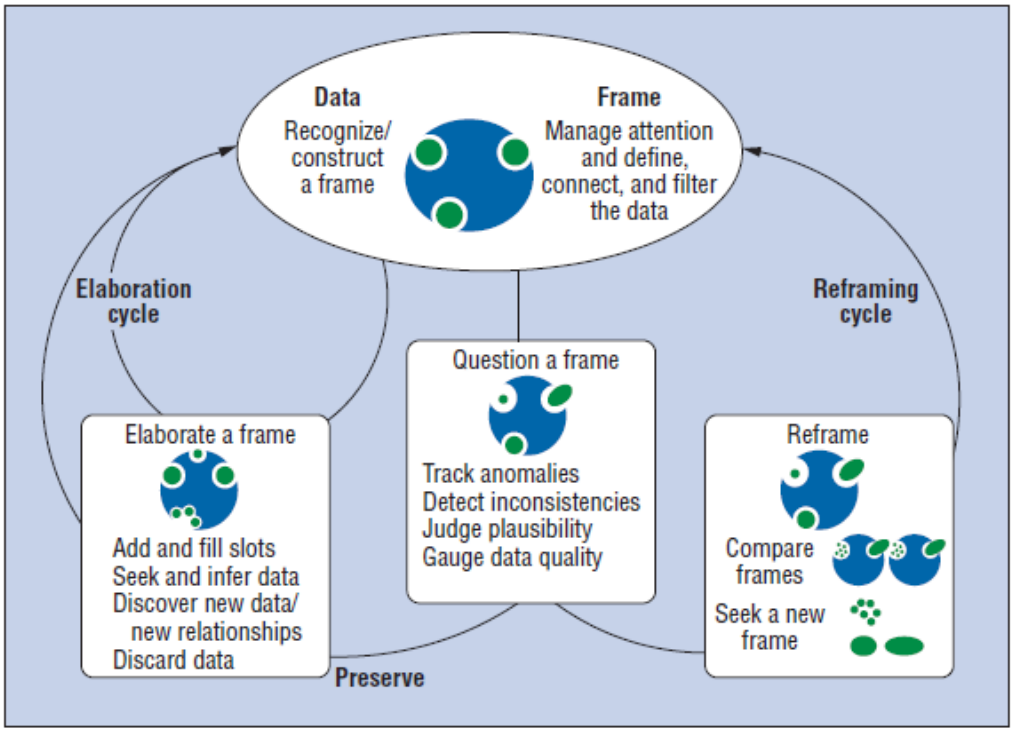


Figure 2.4.5.3. The data/frame theory. Source: Klein et al. (2006b)

The elaboration cycle phase involves the active seeking of and inference of data; the discovery of data; and the discovery of the explanations between the data and the situation at the centre of the sense-making in order to build the frame. In this regard, the frame acts as a hypothesis about the connections among the data. In this phase, data is filtered and useless data is discarded; once the connection among the data makes sense, then the frame is preserved. This first phase corresponds with a closed loop in which a mental model is formed;, in this case, the closed loop is backward looking and explanatory (Klein et al., 2006b). The second phase of the sense-making process is the reframing cycle.

This reframing cycle is triggered by the perception of a cue which leads to the questioning of the current frame and to replace it with a new one which gives a more plausible explanation of the situation. In this regard, the reframing cycle is described as a forward closed loop which involves a mental simulation aiming to anticipate plausible similar events in the future (Klein et al., 2006b). This cycle comprises the comparison of different frames in order to determine which one is the most accurate to explain the cues (Klein et al., 2006b). Once this is determined, the frame that makes more sense is retained (Klein et al., 2006b).

2.4.5.4. The organisational perspective on sense-making.

The organisational perspective on sense-making, also named the naturalistic decision making perspective, approaches sense-making as a social construction; this means that in order to be materialised, sense-making requires collective action in a social setting (Weick, 1995; Weick et al., 2005). This perspective has its foundations in the organisational management literature in which theory has been developed in order to understand : 1) how organisations both adapt to changing environments and contribute to reshaping the environment; 2) the organisational structures and mechanisms that facilitate or inhibit this adaptation; and 3) how these various structures and processes enable the organisation to create a workable level of certainty when dealing with situational ignorance and ambiguity.

The main contributor to the naturalistic decision making perspective is Karl Weick (1979, 1995) who points out that social sense-making has seven properties that describe and distinguish sense-making from other explanatory processes such as understanding, interpretation and attribution. According to Weick (1995), the seven properties of sense-making are: a) identity construction; b) retrospection; c) sense-making is enactive of sensible environments; d) sense-making is social; e) sense-making is on-going; f) sense-making favours plausibility over accuracy; and g) sense-making is focused on and by extracted cues.

a) Identity construction

Sense-making is grounded in identity construction (Weick, 1995). Identity construction is the relationship between a person's view of him/herself, how they see a situation and their perception of how others view them (Sneddon, Soutar, & Mazzarol, 2009). According to Weick et al. (2005, p. 416). "who we think we are (identity) as organisational actors shapes what we enact and how we interpret, which affects what outsiders think we are (image) and how they treat us, which stabilises or destabilises our identity" (p. 416). Weick et al. (2005) describe that identity construction is subject to a continuous redefinition given the interaction among individuals in an organisation. Because of this interaction, a person's perceptions about themselves, about the situation, and about others' perception of them are likely to change over time. The relevance of identity over individual sense-making is that individual perception, which is influenced by a person's social context, will have an effect both on information seeking and on building specific information resources(Weick, 1995).

b) Retrospection

Sense-making is retrospective in the sense that by looking into past events, people review and clarify their frames of thinking (Weick, 1995). Klein et al. (2006a) add that despite clarifying frames of thinking, the retrospective analysis of a frame does not mean that the past will be totally understood.

c) Sense-making is enactive of sensible environments

Sense-makers construct their reality by giving meaning to the environment that they create; this means that the environment is not just a rationale of their own subjective reality, but is also about their actions and efforts to create that environment (Weick, 1995). Weick (1995, p. 30) defined the act of constructing the environment as "enacting". In enacting their environments, sense-makers set apart cues that interrupt the ongoing flow of events that a sense-maker would normally experience. The act of setting apart cues or "bracketing" (Weick, 1995, p. 30) is based on the subjective goals and values of the sense-maker. As an example, a case study on dairy farmers in Australia show that farmers increasing attention on new precision farming technology is pushing them to enact new networks of practice to improve their knowledge about this technology (Thompson, 2009). Moreover, the study suggests these networks are used to co-create decision support systems for farmers to create new knowledge about the use of this new technology (Thompson, 2009).

d) Sense-making is social

According to Weick (1995), social activity enables sense-making as situations, organisations, and environments are "talked" into existence, meaning that stories or narratives enable sense-making. He also suggested that plausible stories about situations are preserved, retained or shared in social activities. Networking and social capital provides people with a source of sense-making, as linkages with peers provide people with sources of knowledge and information which enables understanding of new situations (Weick, 1995).

e) Sense-making is ongoing

Sense-making is a continuous process that has no clear start or ending (Klein et al., 2006b; Weick, 1995). As people act, they make sense of their actions and then act again guided by the sense they have already made (Weick, 1995). At the level of an individual, this means that sense-

making skills are continuously adapting to changes in their environment and, therefore, sense-making can be assessed as an adaptive behaviour in the long term (Weick, 1995; Weick et al., 2005)

f) Sense-making is focused on and by extracted cues

Individuals extract cues from the environment to help them decide what is relevant to them and which explanations are acceptable. Extracted cues from the environment provide people with starting points for further broader meaning of what is going on in the environment (Weick et al., 2005), as Weick (1995) is referring to when he said "extracted cues provide with the seeds from which people develop a larger sense of what may be occurring" (p. 50).

g) Sense-makers favour plausibility over accuracy

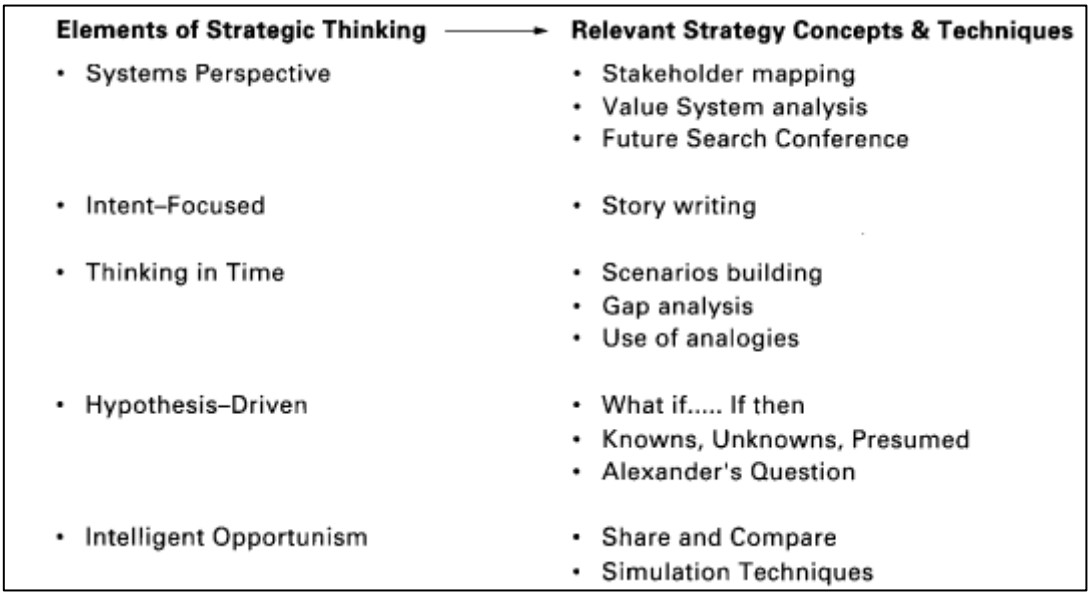
Good sense-makers give importance to cues which are "good enough" to undertake effective action in order to improve the original situation instead of waiting to understand the whole situation before acting Weick (1995). As Klein et al. (2006a) assured, "sense-making isn't the choice of an explanation but a process of deliberating over plausible explanations" (p.72).

2.4.6. Strategic thinking.

Much of the literature on resilience (Carmeli, Friedman, & Tishler, 2013; Darnhofer et al., 2010b; Fazey, 2010; Folke et al., 2010; Walker & Salt, 2006) suggests that, in order to be able to adapt, individuals, communities or organisations must develop holistic thinking and to the ability to develop strategic foresight capacity by exploring all possible futures in order to implement the most appropriate decision in relation to the achievement of their goals. These characteristics are similar to the description of strategic thinking capability (Graetz, 2002) (refer to section for further details 2.3.3). The link between strategic thinking and resilience has been proposed by Sloan (2013) who associated strategic thinking with the adaptive capacity of individuals. Moser and Ekstrom (2010) identified strategic thinking skills as a barrier limiting the development of options in the planning stage of the process of adaptation to climate change in social-ecological systems. Similarly, Sorgenfrei and Wrigley (2005) indicated that strategic thinking was a facilitator of adaptive capacity in organisations facing turbulent environments.

Most of the work describing the attributes of strategic thinking (e.g. Bonn, 2005; Kamangar, Rohani, Salavati, & Karimi, 2013; van der Laan, 2010) is based on the work of Liedtka (1998b), who believes that within organisations, strategic thinking have five main elements: 1) systems

perspective; 2) intent-focused; 3) thinking in time; 4) hypothesis driven; and 5) intelligent opportunism. Bonn (2005) suggested that these five attributes can be reduced to three categories (systems thinking, creativity and vision) which, in essence, integrate the elements described by Liedtka . Moreover, Liedtka (1998b) also believed that each of these elements is informed by the various techniques that can be useful to support strategic thinking. The five attributes of strategic thinking described by Liedtka (1998b) and the supportive aids for each attribute are shown in Figure 2.4.6.



Elements of Strategic Thinking ⟶	Relevant Strategy Concepts & Techniques
• Systems Perspective	• Stakeholder mapping • Value System analysis • Future Search Conference
• Intent–Focused	• Story writing
• Thinking in Time	• Scenarios building • Gap analysis • Use of analogies
• Hypothesis–Driven	• What if..... If then • Knowns, Unknowns, Presumed • Alexander's Question
• Intelligent Opportunism	• Share and Compare • Simulation Techniques

Figure 2.4.6. Elements of strategic thinking and relevant strategy concepts and techniques to aid strategic thinking. Source: (Liedtka, 1998b)

The first element described by Liedtka (1998b) is that strategic thinking requires a "systems perspective" (p. 31). A strategic thinker has a mental model of the complete system of value creation, and understands the interdependencies within it and between the system and the external environment (Liedtka, 1998b). This ability allows strategic thinkers to focus on how to exploit the core competencies of their business, and in how to reduce its weaknesses in order to achieve a better position in the environment. In other words, strategic thinkers see an opportunity or a threat as a part of the whole system (Bonn, 2005; Graetz, 2002; Liedtka, 1998b). Liedtka (1998b) suggests that this "systems perspective" can be promoted via the use of strategy techniques such as stakeholder mapping, value system analysis, and future search conference, which have been proven useful for organisations in the creation of holistic pictures of their businesses and to identify opportunities for the addition of value. According to Garratt (1995), developing systems thinking for strategic purposes requires a person to distance themselves from day-to-day operational problems. This would allow managers to see how different problems

connect and influence each other (Liedtka, 1998b). Moreover, linking the problems would help them to understand what effect one solution in a particular area would have on other areas (Bonn, 2005; Liedtka, 1998b).

The second element, "intent focus" means that strategic thinkers are more determined and less distractible than rivals in the marketplace (Liedtka, 1998b, p. 31). In the experience of Liedtka (1998b), such a focus is achievable when managers force themselves to write down and state their strategic intent.

"Thinking in time" refers to being able to distinguish the gap between the strategic intent and the reality faced today. According to Liedtka (1998b), strategic thinking connects past, present, and future. In this sense, strategic thinkers are able to use their memory to understand a present situation within an historical context and go on to use this information to think about creating their future. Liedtka (1998b) suggests that the use of gap analysis, scenario building, and use of analogies are useful to connect past, present and future.

The fourth Liedtka (1998b) element, is that strategic thinking is hypothesis driven. She believes that in an environment in which information in permanently increasing and where thinking time is always limited, good strategic thinkers should have the ability to develop good hypotheses and to test them efficiently. Liedtka suggests that the scientific method behind hypotheses development mirrors creative and analytical thinking attributes.

Finally, strategic thinking involves intelligent opportunism (Liedtka, 1998b). Intelligent opportunism is about being responsive to good opportunities (Liedtka, 1998b). Liedtka (1998b) describes intelligent opportunism as relating to a business adaptive capacity, since it opens the possibility for emergent strategies instead of blindly relying on intended strategies that may not be the best fit for a changing environment. Liedtka (1998a) suggests that the dilemma of using a well-articulated strategy to channel organisational efforts effectively and efficiently must always be balanced against the risks of losing sight of alternative strategies better suited to a changing environment"(p. 33).

Bonn (2005) identified the challenges of developing strategic thinking at the individual level as the fostering of individual sense-making capability and the fostering of the ability to frame situations and create cognitive maps representing a whole system. Bonn suggested that an organisation benefits from the diversity of individual perspectives on a single situation and their

participation during strategy formation, since it is from multiple diverse perspectives that new ideas for strategy development may arise.

The individual attributes of a person with enhanced strategic thinking and planning skills are often related to the attributes of a leader (Graetz, 2002; Heracleous, 1998). Graetz (2002) described leaders as usually having emotional intelligence, which is reflected in their "whole-brained" approach to thinking and behaving (p. 460). Graetz identified that skills for strategic thinking and strategic planning are located on different hemispheres of the brain and that leaders consistently use both hemispheres, regardless of the circumstances.

Goleman, Welch, and Welch (2012) identified eight attributes of leaders and emotionally intelligent people: 1) strong interpersonal skills; 2) an ease with ambiguity and openness to change; 3) the ability to draw to a vision and take decisive action; 4) "contagious" enthusiasm and commitment; 5) belief in and sensitivity to followers; 6) expertise in managing relationships building networks and creating rapport; 7) high levels of energy, passion, motivation and commitment; and 8) a deep understanding of the business and its operations.

2.5. Measures of resilience, strategic thinking and sense-making.

Measures of individual resilience, strategic thinking and sense-making are explored in depth in sections 2.5.1, 2.5.2 and 2.5.3 respectively.

2.5.1. Measures of psychological resilience.

The Connor-Davidson resilience scale (CD-RISC) is a tool developed to assess psychological resilience (i.e. an individual's ability to cope with stress) (Connor & Davidson, 2003). The CD-RISC contains 25 items (Table 2.5.1). A 5-point range of response assesses each of the items, as follows: 0= not true at all; 1= rarely true; 2= sometimes true; 3= often true; and 4= true nearly all of the time. Responses are subject to how the individual has felt over the past month. Total scoring ranges from 0 to 100, with higher scores reflecting greater resilience.

Table 2.5.1. The Connor-Davidson resilience scale. Source: Connor and Davidson (2003).

Item	Description	Item	Description
1	Able to adapt to change	14	Under pressure, focus and think clearly
2	Close and secure relationships	15	Prefer to take the lead in problem solving
3	Sometimes fate or God can help	16	Not easily discouraged by failure
4	Can deal with whatever comes	17	Think of self as strong person
5	Past success gives confidence for new challenge	18	Make unpopular or difficult decisions
6	See the humorous side of things	19	Can handle unpleasant feelings
7	Coping with stress strengthens	20	Have to act on a hunch
8	Tend to bounce back after illness or hardship	21	Strong sense of purpose
9	Things happen for a reason	22	In control of your life
10	Best effort no matter what	23	I like challenges
11	You can achieve your goals	24	You work to attain your goals
12	When things look hopeless, I don't give up	25	Pride in your achievements
13	Know where to turn for help		

Connor and Davidson (2003) did exploratory factor analysis on a sample of 577 individuals of the general population and identified five factors that summarise the salient features of resilient people. Factor 1 (which comprises items 24, 12, 11, 25, 10, 23, 17, 16) reflects the notion of personal competence, high standards, and tenacity to build in resiliency. Factor 2 (items 20, 18, 15, 6, 7, 19, 14) reflects trust in one's instincts, tolerance of negative affect, and strengthening effects of stress. Factor 3 (items 1, 4, 5, 2, 8) relates to the positive acceptance of change, and secure relationships. Factor 4 (items 22, 13, 21) relates to control. Finally, factor 5 (items 3 and 9) reflect spiritual influences.

In the field of small businesses, the CD-RISC proved to be a valid and reliable tool to measure resilience in entrepreneurial business people in Spain (Manzano-García, Calvo, & Carlos, 2013). Manzano-García et al. (2013) performed a confirmatory factor analysis to assess if the five-factor structure described by Connor and Davidson (2003) is a reflection of resilience when the CD-RISC is applied to entrepreneurial profiles. In their study, the Manzano-García et al. findings did not confirm the five-factor structure as a reflection of resilience in entrepreneurs. Nevertheless, Manzano-García et al. suggest that entrepreneurial resiliency can be summarised with three other factors: hardiness, resourcefulness, and optimism. Hardiness includes nine items (14, 12, 16, 17, 23, 15, 18, 4, and 24) of the CD-RISC. Most of these items are components of the factors relating to personal competence, high standards, and tenacity as indicated by Connor and Davidson. According to Manzano-García et al., hardiness reflects an individual's goal-setting behaviour when faced with situations of uncertainty or frustration. The second factor, resourcefulness, is captured by items 25, 2, 13, 5, 11, 1, and 22, which are components of factors 1, 2 and 4 in the analysis undertaken by Connor and Davidson. Manzano-García et al. suggest

that resourcefulness reflects individual attributes of entrepreneurs enabling them to handle adverse situations; allowing them to feel capable of achieving their goals; and feeling that they have control over their lives. In addition, resourcefulness reflects an individual belief in their own capacity to control events and influence the results of the situations in which they are immersed (Manzano-García et al., 2013). Optimism, the final factor identified by Manzano-García et al., refers to the positive attitude of entrepreneurs when faced with risky events and adverse situations. Items 19, 20, 21, 6, 8, 7, and 10 of the CD-RISC capture optimism. Manzano-García et al. dismiss the relevance of items 3 ("sometimes god can help") and 9 (" things happen for a reason") in relation to addressing resilience attributes for entrepreneurs. They suggest the higher entrepreneur levels of self confidence in skills and resources might be a reason for the low reliability of these two items.

2.5.2. Measures of strategic thinking.

There are a number of different approaches to the measurement of strategic thinking in the literature. Wolters, Grome, and Hinds (2013) identifies four areas in which there have been attemps to assess strategic thinking: typology development, measurement of cognitive processes, identification by experts, and consideration of behaviours.

Daghir and Al Zaydi (2005) suggested a model to assess strategic thinking as a convergent type of thinking. In their model, Daghir and Al Zaydi (2005) suggest that strategic thinking results from the combination of four types of thinking based on Jung's theory of psychological types of thinking (intuitive thinking, logic thinking, sensation thinking, and feeling thinking).

Strategic thinking can also be viewed as a measurement of different cognitive processes (Wolters et al., 2013). For example, Bonn (2005) suggests that strategic thinking can be assessed at multiple levels by addressing its three elements (systems thinking, creativity, and vision). Recently, Moon (2013) has drawn upon the conceptual model developed by Bonn (2005) and added a fourth element (market-oriented thinking) to measure the degree of strategic thinking of top managers of organisations in South Korea. Moon argues that defining a market orientation is a key strategy to attain sustainable competitive advantage for organisations in South Korea, and, therefore, market-oriented thinking should be considered a key element for the measurement of strategic thinking. Moon's method for measuring strategic thinking involved surveying managers to assess their level of agreement in relation to the following statements: 1) overall, my company's decision-making is systemic; 2) overall, my company's decision-making is creative; 3) overall, my company's decision-making is vision-driven; and 3) overall, my company's decision

making is market oriented. Although the aim of this research was not to evaluate startegic thinking per se, the measure of strategic thinking using these questions proved to be reliable (Cronbach alpha coefficient (α)= 0.733) and valid (composite reliability (ϱ)= 0.651 (Moon, 2013).

Another tool used to evaluate strategic thinking, the "Pisapia strategic leadership questionnaire" (PSLQ), developed by Pisapia, Reyes-Guerra, and Coukos-Semmel (2005), consists of a survey questionaire which adresses three fundamental cognitive processes (i.e. skills) of strategic thinking: reflecting; reframing; and systems thinking. The PSLQ questionnaire uses a 1 to 5 Likert scale (5= critically important and 1= non-important) to assess the level of agreement of individuals on a number of statements which refer to each of the processes. Reflecting is captured through 15 questions. According to Pisapia et al. (2005), the the most reliable questions used in the PSLQ questionnaire to capture reflecting are: 1) try to think about what will you do next time in similar circumstances when thinking about what you have done and decisions you have made; 2) acknowledge the limitations of your own perspective; 3) examine the belief values and feelings that you seem to be more sensitive to when thinking about what you have done and decisions you have made. Cronbach alpha coefficients for each of the three questions to capture reflecting were 0.73, 0.66, and 0.62 respectively and the overall subscale coefficient was 0.85. Reframing was captured through the following 10 most reliable questions: 1) judge the problem at its face value and create plans to solve it before looking at other viewpoints (α= 0.38); 2) recognise when a problem is being presented with a predetermined solution (α= 0.38); and 3) ask yourself and others to map out different strategies needed to map out the resolution of a problem (α= 0.34). The overall cronbach alpha coefficients for this scale was 0.72. The final process, systems thinking, was assessed through 13 questions: 1) consider how one thing seems to lead to the next in a non-linear way; 2) search for patterns when confronted with rich information; and 3) consider how different parts of the organisation influence the way things are done. Cronbach alpha coefficients for each of these questiones were 0.60; 0.59; and 0.52 respectivley, and 0.83 for the overall scale for systems thinking. Pisapia et al. (2005) suggests that given the high overall scale reliability (α= 0.91) and the three subscales, the PSLQ instrument could be only measuring one construct instead of three.

Pang and Pisapia (2012) used the PSLQ as a framework to build their own strategic thinking questionnaire (STQ) to capture the level strategic thinking of school leaders in different positions of schools in Hong Kong. Different from the instrument developed by Pisapia et al. (2005) which asks respondents to rank the importance of the use of the three strategic thinking skills, the Pang and Pisapia (2012) instrument asks respondents to rate how often (on a Likert scale

where 1= rarely and 5= frequently or almost always) they use reflecting, reframing, and systems thinking skills when confronted with problems, dilemmas and/or opportunities. The Pang and Pisapia instrument captures systems thinking through the following means: 1) tracks trends by asking everyone "what is new"; 2) sees patterns in ambiguous information; 3) tracks trends by asking those around you what is changing; and 4) look at how things are interconnected to find a specific problem that seems to influence a greater problem. Reframing is addressed by asking how often respondents: 1) do not take into account the real life implications when thinking about decisions and actions they make; 2) find that the external environmental changes do not require internal organisational changes; 3) create a preconceived solution to a problem before it has been clearly defined or understood. Finally, questions to assess reflecting involved asking the frequency in which respondents: 1) accept that their dearest beliefs could be mistaken when thinking about past decisions and actions; 2) acknowledge the limitations of their own perspectives; and 3) engage in discussion with those who hold a different world view.

Pang and Pisapia (2012) found out that in a sample of 531 school leaders (principals, vice-principals, and senior masters), there were no significant differences in the levels of reflecting, reframing, and systems thinking skills in the overall sample. Nevertheless, differences arose when the cognitive skills were analysed across the different hierarchical levels. Pang and Pisapia (2012) described principals exhibiting high levels of systems thinking and reframing skills and low levels of reflecting skills, while vice-principals frequently used more reframing skills that systems thinking skills and reflecting skills. Conversely, senior masters used fewer reframing skills and fewer strategic thinking skills than the other two groups. In addition, senior masters exibited overall fewer strategic thinking skills compared to principals and vice-principals These findings support the idea that different roles require different skills sets. For example, the skills set required for principals, whose main role is to maintain the fit between the external environment and internal organisation's processes to build organisational resilience, relates to their ability see the systems holistically (i.e. systems thinking) and switching across multiple perspectives (i.e. reframing). On the other hand, for vice-principals, whose work mainly focuses on communication, conflict management and developing relationships, reframing is the most important skill. Finally, the work of senior masters does not require high levels of strategic thinking skills because their work is mainly tactical (Pang & Pisapia, 2012).

Graetz (2002) measured the strategic planning and strategic thinking skills of the members of an organisation to assess the distribution of strategic thinking skills across the organisation. To achieve this purpose, a workshop was held in which participants were: 1) asked to complete a

decision styles survey; 2) given training in scenario planning; and 3) asked to participate in a scenario planning exercise. The objective of point (1) was to assess the strategic thinking skills of the participants through a life-time assessment test, which is a measure of individual brain behavioural styles. Points (2) and (3) were delivered to assess participants' planning skills by evaluating the level of creativity, plausibility, and consistency between two planning case scenarios (worst case and best case). Graetz suggests that left-brain thinking reflects the planning side of strategy making (need for logic, analysis, attention to detail, focus on meeting deadlines (Graetz, Macneil, & McWilliams, 1998), while right-brain thinking reflects the thinking component of strategy making (creative, inquisitive, intuitive, entrepreneurial (Graetz et al., 1998). Graetz's findings suggest that the best result for strategy formation comes from the combination of a whole brained approach

2.5.3. Measures of sense-making capability.

Sense-making capability is an emergent phenomenon based on the synthesis of the communicative, interpretive, and analytical dimensions. An empirical study undertaken by Neill et al. (2007) studied the effect of organisational sense-making capability over the development of adaptive strategic market responses to uncertain market conditions. It described sense-making capability as a construct measure of the communicative, interpretive and analytical dimensions. The measures developed by Neill et al. (2007) involved a multi-scale survey questionnaire aiming to address the three dimensions previously mentioned.

Neill *et al.* (2007) captured the communicative dimension of organisational sense-making by measuring the degree of strategic information exchange. Their method involved asking top managers about their degree of agreement or disagreement relating to whether the adequacy of time and resources assigned to discuss strategic issues in relation to good transmission and dissemination of information among key people in the organisation. The level of agreement-disagreement was captured by using a 7 point agree-disagree scale. As an example, questions asked in the questionnaire were: 1) we have regular interdepartmental meetings to discuss market trends and developments; 2) marketing personnel in our business spend time discussing customer's future needs with other functional departments; and 3) data on customer's satisfaction is disseminated across all levels of the organisation on a regular basis.

The interpretive dimension of sense-making capability was seized by analysing the strategic complexity of an organisation (Neill et al., 2007). According to Neill et al. (2007), strategic complexity is a multi-dimensional concept which entails an organisation's cognitive framework.

Strategic complexity comprises a subset of four dimensions on its own (comprise competitor, customer, product and macro-environmental orientations) (Neill et al., 2007). To asses this dimension, Neill et al. (2007)assess agreement-disagreement at management level of the following statements: 1) our strategy includes converting trends outside our industry into business opportunities; 2) we detect changes in the outside environment before most other firms; 3) our organisational objectives are directly influenced by trends outside our industry; 4) we pay close attention to conditions outside our industry.

Neill et al. (2007), measured the analytical dimension of sense-making capability by assessing the organisation's consideration of multiple perspectives during decision-making. Relating to this, the consideration of multiple perspectives on strategy development was assessed by asking top managers their degree of agreement relating to three aspects of decision-making: a) problem identification and definition; b) alternative development; and c) solution selection. The questions asked for in relation to problem identification and definition were: 1) our organisation positions problems within multiple contexts; 2) our organisation gives due consideration to divergent explanations of problems; 3) our organisation reflects on problems from multiple vantage points. The second perspective on decision-making, alternative development of strategy, was captured by the use of the following statements: 1) our organisation seeks solutions by considering a diverse set of perspectives; 2) our organisation relies on diverse information for finding solutions. Finally, solution selection was assessed by the use of two statements: 1) our organisation selects solutions using multiple perspectives; and 2) our organisation views each solution from multiple angles.

2.6. Risk management.

2.6.1. Risk, uncertainty and their management in farm businesses.

Risk and uncertainty are concepts intimately linked to resilience. Crawford et al. (2007) suggest that building resilience in a dairy farm is about being able to successfully manage the risks and uncertainties to which the farm business is exposed. Moreover, the successful management of risks and uncertainties is dependent on the ability of the farm manager to integrate them well into their decisions about the management of the farm business (Chapman, Malcolm, Neal, & Cullen, 2007). In this regard, risks and uncertainties refer to different degrees of knowledge upon which decisions are made.

In decision making theory, a decision may take place under three conditions of knowledge: perfect knowledge; risk; and uncertainty (Bradtke, 2007; Hardaker, 2004). In a perfect knowledge situation, the outcome of any decision to be made is known with certainty and, therefore, there is only one possible outcome attached to a single decision (Bradtke, 2007). The condition of risk refers to a situation in which the outcome of an action is not known with certainty but can be estimated. Risk is often defined as imperfect knowledge of the actual outcome (Hardaker, 2004). The final condition in which decision making may take place is uncertainty. Under this condition, the probable outcome of an action is unknown (Boehlje et al., 2005; Hardaker, 2004). Parker, Dake C, Wright, and Tillman (1994) support the notion that situations of perfect knowledge are rare in agriculture due to the biological aspect of farming. Boehlje et al. (2005) and Gray et al. (2008) argued that most of the decisions in modern farm management involve situations of risk and uncertainty.

The term risk usually denotes a negative consequence for management. For example, Mehr and Hedges (1963) defined the risk of a business enterprise as "the uncertainty of decision makers with regard to future events that is reflected in incomplete knowledge and can result in economic loses or deviations from prior fixed target values" (p. 14). In the farm management literature, risk refers to the variation of some representative measure of farm performance such as the gross farm returns (Hardaker, 2004). Miller et al. (2004) described that risk could be referred to as the probability of an adverse outcome, the potential size of an adverse outcome, or the expected value of a potential loss for farm businesses. Nevertheless, Hardaker (2004) pointed out that risks can result in both gains or losses to farm businesses. In this regard, he described the downside of risk as the probability of attaining worse than normal outcomes, and upside of risk as the probability of attaining better than normal outcomes (Hardaker, 2004). Acknowledging that risk is linked to probability has an important implication for farm management as it allows farmers to make plans based on the predictability of the outcome of an action. On the contrary, uncertainty is about the unknown and, therefore, planning for the unknown is based on no probability. Hardaker (2004) argues that under uncertainty plans are based on a personal judgement for a particular outcome or consequence. Although the terms risk and uncertainty are closely related, they refer to different things. However, Gray et al. (2008) found out that in much of the farm management literature regarding this topic, the terms are used interchangeably.

2.6.2. Types of risk.

There are many classifications of risk in the farm management literature. The traditional approach adopted in farm management research is to classify risk in relation to the factors that place farm businesses into risk. With some small differences, farm management scholars (Boehlje et al., 2005; Hardaker, 2004; Martin, 2005) basically classified the risks experienced by farm businesses into:

a) Production risks: This includes all the factors affecting the level, stability and quality of production. For example: climate (droughts, excessive rainfall, hail, wind), weeds, pests and deceases, and theft.
b) Market risks: This refers to the factors that affect the level and stability of input and output prices. These factors comprise domestic and international markets, consumer demand, trade barriers, exchange rates, and input costs.
c) Casualty and disaster risks: these factors relate to major catastrophic events such as earthquakes or the death of the farmer.
d) Social and legal risks: these are the risks associated with the actions of society, institutions and other business. Examples of these include: institutional risk; regulation risk; compliance risk; and contractual risks that can be linked to land use constraints or uncertainty in relation to future decisions if the land is not owned.
e) Human risks: These risks are associated with the factors that may result in labour not performing as expected. They include illnesses, death of staff or managers, availability and quality of labour force, and family issues. This risk factor is very important in the case of a single owned and operated dairy farm, in which only one person, the farmer, is in charge of the management and daily operation of the business.
f) Technology risks: Changes in technology can result in risks for farm business performance, as the benefits of acquiring new technology may not meet the expected result, or it can be adopted at the wrong time and become obsolete too soon.
g) Financial risks: These risks relate to the impossibility of a farmer to service their debt. Examples of financial risks include: changes in interest rates; finance availability; changes in land prices; and availability of funds.
h) Scale risks: The increasing reliance on economies of scale to sustain competitive advantage in agriculture may result in a risk for the operability of uneconomic small farms.

It is important to acknowledge that there are some small differences in the literature about how these risks can be clustered in a way that are useful to analyse farm management risk. Martin (2005) suggests that, traditionally, the farm management discipline has primarily focused on two risk sources: business risk, which comprises the sum of production and market risks and financial risk. However, Martin (2005) acknowledges that this two sided view of farm risk hides some of the other risks mentioned in the list above. Hardaker (2004) argues that the distinction between business risk and financial risk is important because it highlights the fact that the management of business risks is independent of the way it is financed. However, Kay, Edwards, and Duffy (1994) point out that in most farming businesses, production, market and financial risks and their management are interrelated. Thus, while business risks can be reduced through financing specific assets targeting the reduction of those risks, financial risks may increase as a consequence of an increment in the ratio of debt to equity.

Another way to classify the risks to which a farm business is exposed is to differentiate between tactical (or operational) and strategic risks. This categorisation recognises the importance of time in relation to risk and risk management. On the one hand, the relationship between risk and time is given by the decreasing capacity of making accurate predictions under an increasing time-frame (i.e. planning horizon). Relating to this, management decisions focused on the short-term usually involve less risk than decisions that involve longer time-frames. Tactical risk, therefore, refers to risk management decisions that are relevant to the short-term (e.g. one year) and strategic risk is concerned with decisions that involve the long-term (e.g. 5 to 10 years). On the other hand, both tactical and strategic relate to two different levels of farm management (Shadbolt and Bywater (2005). The difference between tactical and strategic management is well defined in the farm management literature; however, not much is mentioned about either in relation to the management of risk. Tactical management relates to the efficient acquisition and allocation of resources and is, therefore, about planning the production system to meet a defined market (Shadbolt & Bywater, 2005). In contrast, strategic management is more concerned about how value will be created for shareholders (Nell & Napier, 2005; Olson, 2011; Shadbolt & Bywater, 2005). Thus, decisions regarding strategic management are more related to the unknown than the known as it is the future of the farm that is put to the test (Shadbolt & Bywater, 2005). Because strategic decisions have a greater impact on the farm, any change in strategy implies an adjustment in the management decisions that occur at the tactical level (Olson, 2011; Shadbolt & Bywater, 2005). However, strategic decisions are made more infrequently than tactical ones. In this regard, Boehlje et al. (2005) suggest that in a turbulent environment, strategic risk is replacing tactical risk as it has a low probability of occurrence but a large impact on businesses if it occurs.

2.6.3. Risk sources.

The environment in which a farmer operates is usually defined from a source of risk perspective. In systems theory, the degree of control a manager has over a system is a function of the level of uncertainty in the environment and the variety within the system (Ashby, 1957). Therefore, the boundaries that divide a farming system from its environment are subject to farmer traits, such as perception and knowledge of the elements that alter their control over their businesses (Öhlmér, Olson, & Brehmer, 1998). As the world changes, the environment is likely to change as well. Similarly, farmers' perception of these environmental elements might also change as farmer goals and perceptions change over time (Pinochet-Chateau, Shadbolt, Holmes, & Lopez-Villalobos, 2005a; Sutherland, Burton, Ingram, Blackstock, Slee, & Gotts, 2012). Similarly, farmer learning increases the knowledge and, therefore, influences their perception about what they can or cannot control (Öhlmér et al., 1998). For this reason, the extent of the environment in which a farmer operates is knowledge-based. Pinochet-Chateau et al. (2005a) found that the relevant elements that constitute the environment of dairy farming businesses in New Zealand are a reflection of a farmer's perception at a particular moment and that these factors have changed over the last years.

Pinochet-Chateau et al. (2005a) studied the changes in risk perception of dairy farmers in New Zealand (NZ) between 1992 and 2004. In their study, Pinochet-Chateau et al. (2005a) compared the findings of a previous study undertaken by Martin in 1992 (Martin, 1994) to their own findings in 2004. Both of the studies focused on downside risks. Table 2.6.3.1 presents the results of the mean scores for the primary sources of risk perception and their ranking in 1992 and 2004. The findings of Pinochet-Chateau et al. describe market risks as having been ranked among the most important sources of risk for farmers along time. Although product price is consistently the first source of risk for farmers, Pinochet-Chateau et al. point out that dairy farmers in NZ have increased their awareness of the risks that arise from both a complex global situation and the changes in the local economy. Moreover, the mean score for market risk has increased between 1992 and 2004. These findings support the description made by Boehlje et al. (2005) who suggested that the global agricultural sector is and will be increasingly challenged by the increasing turbulence present in their business environment which comes from market sources that are beyond the control of farmers. When looking at production risk, Pinochet-Chateau et al. (2005a)found that the overall score given by farmers to this risk remained unaltered over time. However, Pinochet-Chateau et al. (2005a) point out that there were significant changes in the scores given to the different sources that represented production risk

in 1992 and in 2004. In 1992, farmers perceived that diseases and pests were a relatively important source of risk, but in 2004, the importance given to this source of risk decreased and rainfall shortages became a more important source of risk than it was in 1992.

Table 2.6.3.1. Risk perception of New Zealand dairy farmers in 1992 and in 2004. Source: Pinochet-Chateau et al. (2005a)

	1992		2004	
Source of perceived risk	mean score*	ranking	mean score*	ranking
Market risk	**3.79**		**3.83**	
Product prices	4.03a	1	4.20b	1
World situation	3.78	2	3.8	3
NZ economy	3.58	7	3.7	4
Input costs	3.76a	3	3.60b	5
Financial risk	**3.36**		**3.05**	
Interest rates	3.62a	5	3.40b	8
Land prices	3.09a	14	2.70b	13
Production risk	**3.17**		**3.13**	
Rainfall	3.61a	6	3.90b	2
Other weather	3.02	15	2.9	11
Pests and diseases	3.43a	9	3.20b	10
Disasters	2.63	17	2.5	15
Regulatory risks	**3.4**		**3.23**	
Government laws and policies	3.58a	8	3.40b	8
Local laws and policies	3.41a	10	2.80b	12
Producer board policies	3.20a	11	3.50b	6
Human risk	**3.43**		**3.1**	
Accidents or health	3.71a	4	3.50b	6
Family situation	3.14a	12	2.70b	13
Miscellaneous risk	**2.75**		**2.2**	
Theft	2.83a	16	2.50b	15
Labour and contractors	3.14a	13	2.30b	17
Changes in technology	2.60a	18	2.20b	18
Being unable to meet contracting obligations	2.42	19	1.80b	19

* mean score scale: 1= not important; 5=very important
Different letters indicate statistical difference within risk sources between surveys (t-Test p< 0,05)

A recent study, undertaken by Shadbolt and Olubode-Awasola (2013), indicated that by 2011, dairy farmers perceived that input price and input availability was the major source of long-term negative risk for dairy farm businesses in NZ. Table 2.6.3.2 shows that while input price and availability ranks as the number one source of risk, product prices were listed at number six in a total list of 17. Shadbolt and Olubode-Awasola (2013) also suggested that the regulatory risk have become a significant threat for farmers, as local body laws and regulations ranked second in order of importance. They argue that, nowadays, farmers are more aware that market risk is not just about product price fluctuations but the drivers behind it. As such, the global economic and

political situation (rank three) influencing supply and demand dynamics in global markets are seen as the greater threat.

Table 2.6.3.2. New Zealand dairy farmer's risk perception over sources that create opportunities and threats within the season and in the long-term. Source: Adapted from Shadbolt and Olubode-Awasola (2013).

	Opportunity				Threat			
	Within the season		Long-term		Within the season		Long-term	
Source of risk	Index*	Rank	Index*	Rank	Index*	Rank	Index*	Rank
Climate variation	431	**5**	187	14	348	**5**	256	7
Pasture/crop/animal health	339	7	325	6	151	10	118	11
Interest rates	259	11	221	11	172	8	297	**5**
Land values	129	15	277	7	61.5	14	110	12
Product prices	623	**2**	706	**2**	523	**3**	276	6
Input prices and availability	283	8	187	13	549	**1**	665	**1**
Labour	200	14	154	15	72.4	13	127	10
Skills	607	**3**	582	**4**	32.6	15	60.2	15
Technology	423	6	659	**3**	19.8	16	37.6	16
Business	243	12	238	10	17.6	17	37.3	17
Dairy industry	240	13	268	9	107	11	139	9
Global situation	282	9	274	8	544	**2**	513	**3**
Global supply	1040	**1**	1070	**1**	173	7	92.6	14
Competitors	269	10	214	12	170	9	180	8
Reputation	516	**4**	533	**5**	95.6	12	94.2	13
Government	103	16	135	16	332	6	468	**4**
Local body laws and regulations	76	17	61	17	492	**4**	638	**2**

* Risk importance index: combined measurement of the magnitude of the risk impact and the likelihood of occurrence of the risk source.

Different from the study undertaken by Pinochet-Chateau et al. (2005a), the study by Shadbolt and Olubode-Awasola (2013) also studied dairy farmers' risk perception but in relation to whether a source of risk could provide with an opportunity (i.e. upside risk) or a threat (i.e. downside risk) for dairy farm businesses. Shadbolt and Olubode-Awasola (2013) also addressed farmer's beliefs about the magnitude of the positive or negative impact of opportunities and threats respectively, and the likelihood for them to happen. Moreover, this study analysed two time frames to understand the influence of time on farmer risk perception, since the research assesses opportunity/threat, magnitude of impact, likelihood of the impact to happen within the farming season (i.e. tactical risks) and over the next 5 to 10 years (i.e. strategic risks). To integrate all the dimensions of risk analysed by Shadbolt and Olubode-Awasola (2013), they proposed a Risk Choice Matrix to graphically illustrate the average farmer risk focus (Figure 2.6.3).

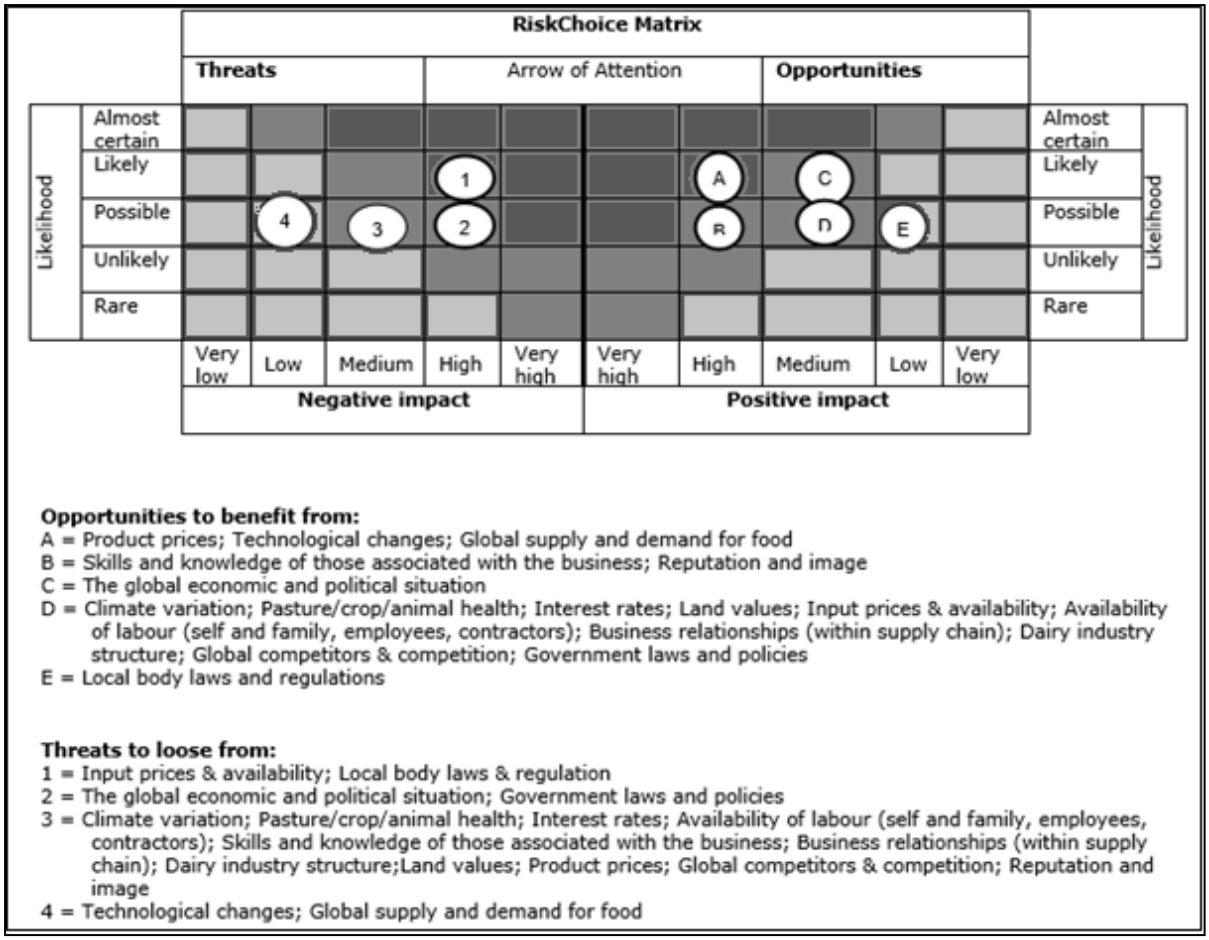


Figure 2.6.3. Risk Choice Matrix of New Zealand dairy farmers considering long-term (over 5 to 10 years). Source: Shadbolt and Olubode-Awasola (2013).

Figure 2.6.3. shows the Risk Choice Matrix for risk sources when considering their impact over the long-term. The "arrow of attention" zone represented by the darker coloured area indicates a zone of extreme riskiness. The risks associated to this zone have high probability to occur and would have a high impact on the farm business if they did. In the Risk Choice Matrix, it can be appreciated that, on average, farmers perceived that technological changes represent a risk from which both threats and opportunities arise. However, farmers consider that the opportunity to benefit from this risk outweighs the threats of a loss. Shadbolt and Olubode-Awasola (2013) also found that farmers perceived more riskiness when considering long-term time frames. Shadbolt and Olubode-Awasola (2013) indicate that while farmers did not perceive sources of risk with high negative impact and likelihood to happen in the short-term, in the long term, they perceived that input prices and availability, and local body laws and regulations were likely to have a high negative impact on farms.

In another study, Pinochet-Chateau et al. (2005b) investigated the relationship between the sources of risks described in a previous study (Pinochet-Chateau et al., 2005a) and the ownership structure of the dairy farms. Pinochet-Chateau et al. (2005b) found that sharemilkers perceive a more risky environment than farmers who owned their businesses. In this regard, sharemilkers weighted overall higher scores for almost all the sources of risk. The only risk source that was more important for owners than for sharemilkers was related to changes of local body laws and regulations. Pinochet-Chateau et al. (2005b) suggest that the difference in the perceived riskiness of the environment might have been attributed to the differences in the nature of sharemilkers and owned businesses. Pinochet-Chateau et al. (2005b) explained that sharemilkers are likely to operate with high levels of debt and that a high proportion of their owned assets are depreciating ones (e.g. machinery and milking plants), with value decreasing rapidly over time. On the other hand, owners not only tend to have smaller levels of debt, but their assets include land which, in contrast with the sharemilker assets, tends to appreciate with time. Pinochet-Chateau et al. (2005b) concluded that these differences might explain why sharemilkers scored high the risks associated with product price and cost volatility. They also suggested that because sharemilking is a considered a first step to land ownership, sharemilker farmers might have placed more importance on land price risk when compared to farmers who owned their businesses.

2.6.4. Resilience management responses.

Given that dairy farmers in New Zealand are being exposed to an increasingly turbulent environment, it has been proposed that it is necessary for farmers to develop resilient farming systems (Boehlje et al., 2005; Crawford et al., 2007; Shadbolt et al., 2011). However, despite the increasing attention given to farm resilience lately, not much is known about the strategies that farmers use to respond to the turbulent environment and which lead to building farm resilience. Drawing on resilience theory, Darnhofer et al. (2008a) proposed four theoretical strategies to build farm resilience. According to Darnhofer et al. (2008a), farmers must employ four overall strategies: exploit; absorb; adapt; and transform.

The first strategy, exploit, refers to farm responses implemented to respond to an environment in which changes are predictable and, therefore, the rate of the perceived change is considered to be slow. Thus, the expected response at the farm level is to persevere with the current system as it is well adapted to the current environment and, therefore allows the farm to take advantage of its successful activities and focus on efficiency. Examples of farm responses include: shifting more resources to current activities (specialisation) and exploiting economies of scale. The

second strategy, absorb, relates to responses which are also maintain the current structure of the system but are implemented in response to unpredictable major changes (i.e. disturbance) in the environment. Thus, the farm system is well adapted to the environment and the sudden changes are absorbed without major alterations being required. An example of a management response of the absorb strategy is to maintain a healthy financial basis to cope with an unusual sudden drop in the price of a farm's main produce. Both the strategies of exploit and absorb refer to the buffer capacity of the farm business.

The two remaining strategies, adapt and transform, require a farmer to restructure the farming system in order to respond to unpredictable major changes that result in both opportunities and threats for the farming business. The restructuring of a system takes place though the exploration of new options, implementing changes in activities traditionally undertaken on the farm, and/or a changing the use of the resources of a farm. Despite this holistic similarity, on a detailed level the adapt and transform strategies involve significantly different responses to be undertaken on farm. On one hand, adapt involves the adaptation of the farming system without changing the purpose of a system (i.e. a dairy farm relying on dairying as the main activity of the farm). Farm management responses include the introduction of new production methods, new crops, direct marketing, etc. These responses reflect the adaptive capacity of the farming system. On the other hand, the transform strategy requires management responses which aim to significantly change the purpose of the farming business. Therefore, these responses reflect the transformative capacity (i.e. transformability) of the farming business. These responses may include changing the focus of the farm into non-traditional activities within farming such as tourism, energy production etc.

Darnhofer et al. (2008a) suggest that the four strategies are time and farm specific as how a specific strategy is implemented relates to: 1) the perception of the farmer of the nature of the change in the environment and whether it was predictable or a sudden change; and 2) the farm's natural, economic, and social capital. Nevertheless, they suggest that these four strategies must not be considered individually since most of the time, farmers will have to implement them simultaneously. Moreover, since the implementation of these strategies requires a combination of limited resources, the farmer will have to evaluate the overall costs and benefits of each strategy and implement the most beneficial mix for the farm business. Other farm management scholars (Shadbolt et al., 2011; Crawford et al., 2007; Boelhje et al., 2005) concur with Darnhofer et al. (2008a), and agree that in order to build resilient farms, farmers must combine a set of strategies with conflicting interests. This is particularly relevant to the strategies implemented to exploit

and absorb current opportunities and threats in the environment and the ones aiming to adapt a farming business. However, there is little evidence in the literature about what the combination of strategies in terms of the on farm responses are or look like, particularly for dairy farm businesses.

Recently, a study on dairy farm resilience in Northland, NZ, sought to identify farmer response after flooding events (White, Moodie, Payne, Wedderburn, & Botha, 2009). The results given by White et al. (2009) do not aim to represent the overall farm management response of dairy farmers, firstly, because their analysis only focused on the production system and, secondly, because the research used a focus group approach, with the sample of farmers perhaps not representing the population of dairy farmers in this region. The aim of this research was to provide qualitative data regarding the strategies that farmers use to improve the resilience of their production systems with respect to adverse climatic events. To this end, they described farmer's farm management responses in terms of: 1) the strategic priorities of farmers to buffer the negative effects of floods (i.e. buffer capacity responses); and 2) their strategic responses aiming to prepare the system to improve its adaptive capacity to cope with flooding events. Farmers identified two strategic priorities aiming to buffer the negative effects of floods. The first one was to maintain feed reserves to ensure the continuity of milking despite the adverse conditions; and the second was to make sure that the milking infrastructure operated properly all the time. The second group of management responses, aiming to improve a farm's adaptive capacity, were separated into two types: strategies implemented permanently on-farm to adapt the systems to the adverse weather conditions; and temporary strategies made despite the adaptations. The most important permanent strategies described by White et al. (2009) were: 1) implementing two wired fences; 2) giving the cows enough supplementary food so that the animals were not stressed; 3) cutting down potentially dangerous trees; and 4) changing fences near waterways. With respect to the temporary strategies, farmers described that the most important ones were: 1) not putting cows on the flats when the farmers "know" that rain is coming; and 2) keeping animals in safe paddocks during the flood periods. A key finding in this research is that most farmers indicated that monitoring the weather patterns was important in the preparation for floods. Therefore, farmers who were aware of deviations of the normal climate could fast implement the temporary strategies to immediately mitigate the adverse consequences of a flood.

In another study, Parsonson-Ensor and Saunders (2011) studied the strategies and management responses implemented by sheep and beef farmers in NZ to increase the resilience of their businesses after two periods of economic crises that affected the agricultural industry. On one

hand, they examined farm management responses and strategies implemented by farmers after the deregulation of the NZ economy, using the results provided by a survey study undertaken by Fairweather (1987) in 1986. They also examined the results of an ARGOS project that collected data on farmer management responses and strategies after the global crises in 2008. The comparison between farmer management responses and implemented strategies in 1986 and in 2008 showed some similarities as well as some differences. The main similarity when comparing the two periods was that most of the farmers implemented a low input policy as a strategy for their business. According to Parsonson-Ensor and Saunders (2011), this was surprising, particularly given the diversity of farming systems (organics, conventional and integrated production systems) that could be found in 2008. In addition, in 2010, 70 per cent of farmers had taken loans and 50 per cent borrowed money for farm development, machinery and building installation, suggesting that farming in New Zealand has become more industrialised and acquiring debt has become a strategy to build more intensified production systems and, therefore, enabled the capacity to adapt businesses. However, Darnhofer (2010) provides a description to contrast this with cropping farmers in Austria; they avoid committing to large investments that might become unviable as the economic and policy environments change which is an important strategy to build adaptive capacity in the face of uncertainty.

Darnhofer (2010) studied the strategic management responses that family crop farmers in Austria used to build the resilience of their farms in the long term. In their study, Darnhofer (2010) identified strategic responses aimed at buffering surprises via exploiting opportunities or absorbing threats in the environment, and the strategic responses that farmers use to increase the adaptive capacity of their farms. However, the explorative nature of the research does not allow for extrapolation of the strategies to the overall population of farmers; rather, the author highlights the fact that farmers are aware of and respond to the increased turbulence in their farming business environment. Table 2.6.3.3 summarises a list of these strategic responses found by Darnhofer (2010). Contrary to the study undertaken by Parsonson-Ensor and Saunders (2011), Darnhofer (2010)identified that a key strategy to enhance the resilience of family farms in Austria was the preference of farmers to rely on their own resources (e.g. own finance resources) rather than borrowing from external sources. Moreover, the exploitation of opportunities to adapt to external conditions was evident in the decisions made by farmers. Such decisions related to investing only in low-risk projects; investing on a small scale to experiment first and then scaling up; cooperating with other farmers and purchasing machinery together. Darnhofer (2010) described the diversification of enterprises as an overall resilience strategy that contributed to enhance both the buffer capacity and adaptive capacity of farms. This is a similar

approach to avoiding the commitment of a large share of resources to one activity so as to give a business a degree of flexibility to face unpredictable and sudden changes in the environment.

Table 2.6.3.3. Strategies used by Austrian crop farmers to build farm resilience. Source: adapted from Darnhofer (2010) and Darnhofer et al. (2008b).

	Adaptive capacity	Buffer capacity	
Theoretical resilience strategies (Darnhofer et al., 2008b).	Adapt	Exploit (opportunity)	Absorb (threat)
Strategic risk management responses (Darnhofer, 2010)	→ Only invest in low-risk projects → Invest on a small scale to experiment first and then scale up → Cooperate with other farmers and purchase machinery together → Diversify crops → Keep farms flexible and avoid committing a large share of resources to one activity	→ Rely as far as possible on own resources → Diversify crops	→ Rely as far as possible on own resources → Keep redundant resources → Keep debt at a reasonable level relative to the assets of the farm → Have farmer and/or family member working off-farm → Create a firm as a separate legal entity to limit the potential threat to each farmer's farm → Diversify crops

2.6.5. Risk management responses.

Crawford et al. (2007) suggest that building resilience in dairy farms is about being able to successfully manage the risks to which the farm businesses are exposed. In this respect, Miller et al. (2004) say that there is a trade-off between risk and farm returns and that selecting the appropriate risk-return trade-off is a critical management decision. Miller et al. (2004) goes on to describe four procedures to manage risk: 1) avoidance; 2) reduction; 3) assumption or retention; and 4) transfer.

Risk avoidance involves the structuring of the business so that certain types of risks are non-existent (Miller et al., 2004). For example, Schaper, Lassen, and Theuvsen (2010) describe a risk avoidance strategy for dairy farmers in Europe is to abandon dairy production, which means that farmers avoid the risk associated with milk production at the cost of the loss of the income opportunity given by the sale of milk. The second procedure to manage risk, risk reduction, consists of measures that reduce potential damage or losses for the farm business (Miller et al., 2004). However, in contrast to risk avoidance which relates to strategic risk management decisions of external forces, risk reduction involves decisions for coping with both internal and external forces. Therefore, some decisions are strategic while others merely tactical or operational. Examples of risk reduction may include enterprise diversification as a strategic management decision to cope with external risks or the compliance with hygiene and quarantine rules as a considered risk reduction decision that works at the operational level (Miller et al.,

2004; Schaper et al., 2010). According to Miller et al. (2004), risk assumption or retention is the process of retaining or accepting risks with the overall objective of maintaining control and/or enhancing the overall profitability of a farming business. According to Schaper et al. (2010), risk assumption is a preferred strategy when the risks have not been identified or where other strategies are technically impossible. The final risk management procedure described by Miller et al. (2004) is to transfer risks. A risk can be transferred to another party often in exchange of a fee (e.g. an insurance contract) or it can also implicate a loss opportunity (the unexpected price rise of using futures and options markets and making forward contracts).

2.6.6. Strategic risk management and operational (i.e. tactical) risk management.

There is little written in the farm management literature about strategic risk management. However, Boehlje et al. (2005) and Boehlje and Roucan-Kane (2009) acknowledge that the management of strategic risks is becoming more and more important for the management of farms given the increasing uncertainty in the farming business environment and the significant negative impacts that these risks have over the future of farming businesses. Miller et al. (2004) argue that management of strategic risk involves using farm planning, decision making, implementation and control processes within the management of farming business. In the farming context, strategic risks are present when a farming business is not responsive to the realities of its business environment and/or a farmer's desires and needs. Therefore, farmers must plan to position their businesses in the desired direction (Miller et al., 2004). Moreover, strategic risk can be managed through reducing the exposure of a business. Finally once a plan is implemented, the processes of monitoring and controlling the risks are important to manage possible deviations from the original plan (Miller et al., 2004) . Miller et al. (2004) suggest that strategic risk can be managed through: positioning the business for flexibility (i.e. long-term flexibility); positioning to avoid risk; positioning to absorb risk; the use of contingency planning for different possible events or business scenarios; tactical flexibility (i.e. short-term flexibility); analysing the risks of the planned decisions before implementing any; implementing any changes on farm gradually if possible; controlling risks though monitoring benchmarks and detecting strategic shortfalls between reality and what has been planned; and finally, farmers willing to cope with strategic risks must identify possible exiting strategies if the risks become impossible to manage. Hardaker (2004) and Boehlje et al. (2005) say the delay of a decision until more information becomes available is another management strategy aimed at the reduction of strategic risk.

The other type of risks, the operational risks, have been relatively better studied in farm management (Hardaker, 2004; Martin, 1994). Accordingly, Gray et al. (2008) point out that there is little differentiation between strategic and operational risk management strategies in the farm management literature in relation to risk management. Usually, operational risk management strategies are described as those responses aiming to manage production risks, marketing risks and financial risks (Hardaker, 2004; Martin, 1994; Patrick, 1998; Pinochet-Chateau et al., 2005a).

2.6.7. Empirical research in risk management responses.

Empirical research into NZ pastoral farmers risk management responses in response to production risks was first undertaken by Martin (1994). Later, Pinochet-Chateau et al. (2005a) used the information from the Martin (1994) study and expanded the knowledge about the risk management strategies of dairy farmers in NZ by comparing how farmer responses have changed in the twenty-two years between 1992 and 2004, examining also the importance given by farmers to these responses in relation to coping with the risks associated with them. Table 2.6.7.1 shows the comparison between the main risk management strategies used by dairy farmers in 1994 and in 2004.

Table 2.6.7.1. A comparison of the risk management strategies used by dairy farmers in 1994 and 2004. Source: Pinochet-Chateau et al. (2005a)

	2004		1992	
Risk management strategy	Mean score	Rank	Mean score	Rank
Production responses	3.2		2.58	
Routine spraying	3.92	1	3.9	1
Maintaining feed reserves	3.9	2	3.8	2
Not producing at full capacity	2.67a	13	2.20b	12
Monitoring pests, crops climate	3.30a	10	2.30b	11
Irrigation	2.23a	17	0.70b	21
Marketing responses	2.46		1.4	
Market information	3.06a	11	2.00b	13
Spreading sales	2.51a	14	1.70b	15
More than one enterprise	2.35a	15	1.70b	15
Forward contracting	2.29a	16	0.90b	19
Futures market	2.10a	19	0.70b	21
Financial responses	3.13		2.47	
Keeping debt low	3.37a	9	3.70b	3
Managed capital spending	3.64	6	3.5	4
Arranging overdraft reserves	3.43a	8	2.70b	10
Debt management	3.81a	3	2.80b	9
Financial reserves	3.37a	9	3.10b	6
Insurance	3.63a	7	2.90b	8
Off-farm investment	2.88a	12	1.60b	17
Main operator working off-farm	1.90a	20	0.90b	19
Family member working off -farm	2.14a	18	1.00b	18
Overall responses	3.7		3.15	
Short-term flexibility	3.75a	4	3.20b	5
Long-term flexibility	3.65a	5	3.10b	6

Pinochet-Chateau et al. (2005a) said that farmers indicated that most of the risk management strategies (production, marketing, and financial and the overall systems responses) were more important to cope with the associated risks in 2004 than in 1992. However, the two most important responses ranked by farmers (routine spraying and drenching and maintaining feed reserves) were ranked number one and two respectively for the two years under analysis. Interestingly, keeping debt low was considered a less important strategy in 2004 than in 1992. This finding is similar to those of Parsonson-Ensor and Saunders (2011) who said that keeping debt low has decreased in its relevancy for sheep and beef farmers in NZ when compared to farmer uptake of that strategy in 1986 and in 2008, suggesting that farmers feel more confident with the banking sector in NZ nowadays than they did before.

In another article, Pinochet-Chateau, Shadbolt, Holmes, and Lopez-Villalobos (2005b) expanded their original analysis by introducing strategic management responses as a set of risk

management strategies and also made the difference between owner operated farms and sharemilkers. The introduction of this set of responses was interesting because they capture the intention of farmers to manage for strategic risks, rather than operational risks or both. The responses introduced in the study were: a) using practical planning steps; b) assessing strengths, weaknesses, opportunities and threats; c) having a written shared mission statement of the farmer's operation; d) having a written shared vision statement of the farmer's operation; and e) using financial ratios for decision making. Sharemilkers ranked more highly and place more importance on these responses than owners. Nevertheless, besides strategic management responses (a) and (b) which were ranked 2 and 7 for sharemilkers, and 4 and 8 for owners respectively, the rest of the strategic management responses were given relatively low importance by farmers.

Recently, Shadbolt and Olubode-Awosola (2013) studied dairy farmer risk management strategies and developed an importance index for weighting these strategies according to the importance that farmers placed on them and which they made most use of (Table 2.6.7.2). Interestingly, the study reports that farmers tended to favour business management strategies related to coping with strategic management issues. This shows the focus was on ensuring the business knows where it is going and why; how it is going to get there; and ensuring it has the flexibility to alter plans should the environment alter on the way. In their study, Shadbolt and Olubode-Awosola (2013) identified that the four most important risk management strategies used by farmers were: managing debt; planning of capital spending; using practical planning steps in business; strategic purpose; followed by maintaining feed reserves in the fifth place. Their findings showed that keeping debt levels low (ranked 15th) was not a very important financial risk management response. This contrasted with Pinochet-Chateau et al. (2005a) who found that in their survey farmers ranked keeping debt low in the top 10 risk management responses. This may have been explained because farmers were actively managing debt servicing capacity (through improving revenues and/or reducing interest and rent costs (Shadbolt & Olubode-Awosola, 2013).

Table 2.6.7.2. Risk management strategies and importance of strategies of dairy farmers in New Zealand. Source: (Shadbolt & Olubode-Awosola, 2013)

Risk management strategy	Importance index	Rank
Having more than one enterprise	72.8	22
Feed reserves	377	5
Not full capacity	104	20
Having short-term flexibility to adjust quickly to weather, price and other factors	375	6
Monitoring programme	360	8
Routine spraying or drenching	305	11
Irrigation	123	18
Spreading sales	118	19
Geographic diversity by having properties in different areas	84.6	21
Futures markets	43.8	24
Forward contracting	143	17
Gathering market information	259	16
Arranging overdraft reserves	284	14
Financial reserves	285	13
Main farm operator or family working off property	58.1	23
Managing debt	421	1
Keeping debt low	272	15
Having long term flexibility	375	7
Planning of capital spending	400	2
Having personal and/or business insurance	344	9
Using practical planning steps in your business	393	3
SWOT	341	10
Strategic purpose	381	4
Using financial ratios for decision making	292	12

2.7. Summary: conceptual framework.

This study sets out to define the resilience attributes that differentiate resilient dairy farmers, and to identify dairy farmers based on these resilience attributes. Figure 2.7 synthetises the conceptual framework proposed for this research in which six resilience attributes are proposed to define and identify resilient dairy farmers.

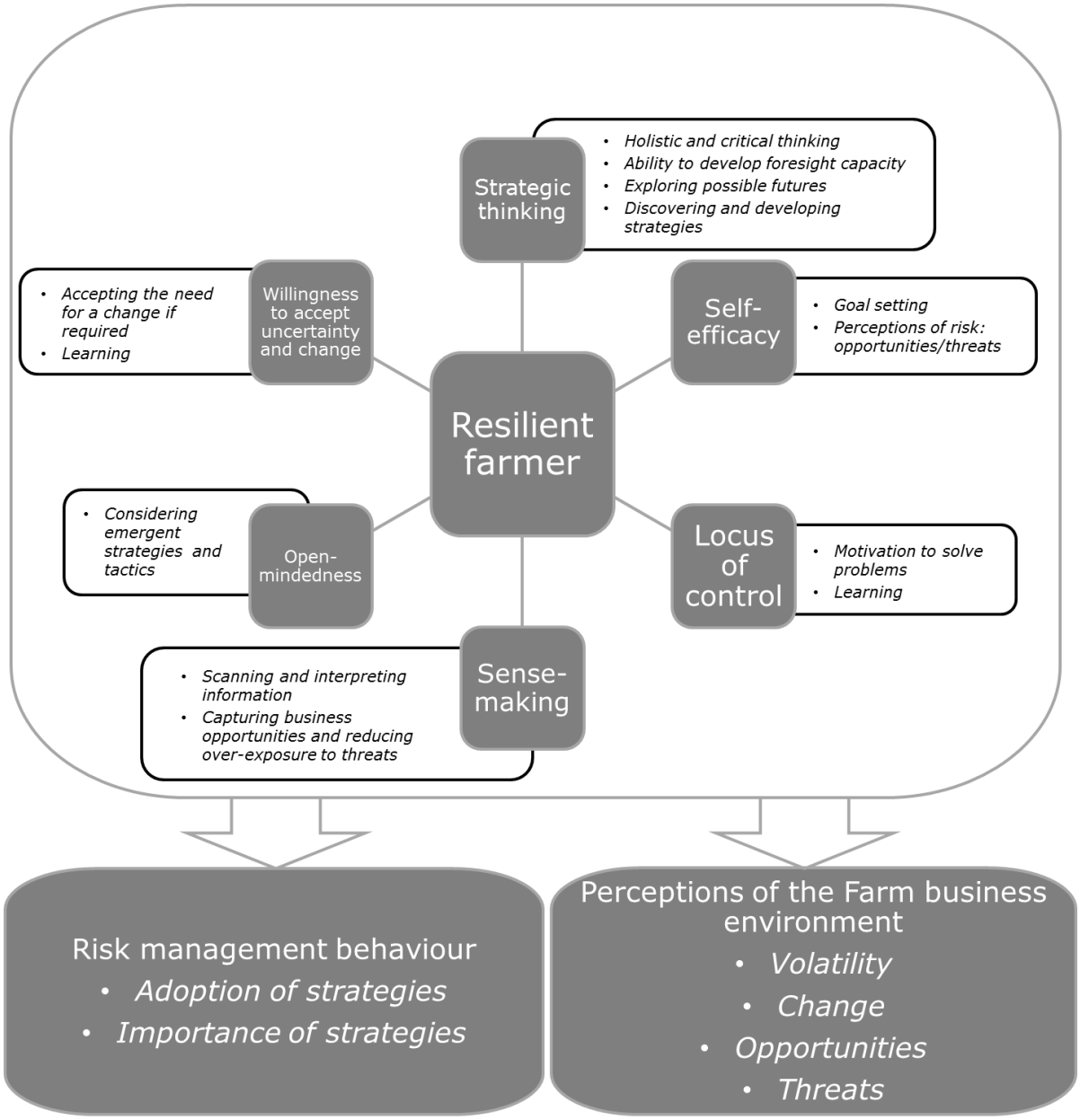


Figure 2.7. Conceptual framework.

The literature review revealed that six resilience attributes related to decision making that could be useful when facing with situations of change and uncertainty (Figure 2.7). Strategic thinking and sense-making are attributes linked to adaptive capacity through their relationship with elements of the strategy formation process such as foresight capacity, ability to develop strategy, and scanning and interpreting information in situations of change. On the other hand, the attributes self-efficacy, locus of control, and open-mindedness, which are not specific to adaptive capacity alone because these can also be related to tactical decision making and therefore buffer capacity, relate to managing risk and uncertainty through their influence on learning, goal setting, problem solving, and perceptions of risk sources as opportunities or threats. Finally, a key

attribute that would define a resilient dairy farmer is their willingness to accept uncertainty and change.

Two other objectives of this research were, first, to investigate if there were any differences between resilient farmer types regarding their risk management behaviour, with the purpose of determining if individual resilience is reflected in the adoption of, and the level of importance given to, specific risk management decisions (Figure 2.7), and second, to explore any differences between resilient farmer types and their perceptions of various sources of risk in the farm business environment that could influence decision-making for managing risks. It is expected that this research will contribute to farm management by providing a clear perspective on how farmers can cope with a turbulent environment in changes are not predictable, and also, to provide the discipline with a set of risk management strategies that can be used for building farm resilience. In order to achieve the research objectives, the following methodology was proposed.

Chapter three

3. Methodology

This research aims to determine what are the attributes of a resilient farmer and to typify New Zealand (NZ) dairy farmers based on their resilience attributes, and to identify their differences in terms of their perceptions of the sources of risk in the farm business environment and their risk management behaviour. An extensive review of psychological, organisational, and farm management literature was undertaken in order to develop a framework to attempt to understand farmer resilience based on a number of resilience attributes. The literature review was then extended in order to identify approaches to study risk and risk management in the farm management literature.

This research is valuable because it provides a new approach for identifying farmers based on resilience theory. Likewise, this study is also valuable for the dairy industry because it creates awareness of the diversity of farmers in the farmer population and allows identification of the most used and important strategies, from a user's perspective, based on their resilience in order to guide industry strategy and policy.

This research also aims to typify farmers according to their risk profile with the objective of making the link between a resilient personality and their risk profile. The final objective of this research is to establish any differences in resilient farmer type perception of the farm business environment over the last 10 years. The following sections outline the different aspects of the methodology used in this study.

3.1. Research design.

A survey study design was proposed to carry out this research. The selection of the research design was based on the criteria described by Yin (2003) and Philliber, Schwab, and Sloss (1980). Yin (2003) explained that the nature of the research question is an important factor to consider when deciding on a study design. The research questions proposed for this study: "what are the attributes that define a resilient farmer?"; and "do different resilient farmer types differ in their perceptions of the farm business environment and their risk management behaviour?" are explorative in nature. "Exploratory" or "what" type of research questions were positively associated by Yin (2003, p. 6) to survey research strategy (i.e. study design). Moreover, Philliber

et al. (1980) suggests that the selection of a study design should be based on the analysis of three important questions:

1) to what extent will it be possible to generalise the findings of the study?;

2) how much control is included, and how close can we come to causal statements with this design?; and

3) what are the appropriate units of analysis for the study, and how could they be sampled?

Firstly, the findings from this research were expected to be generalisable to the NZ dairy farmer population. Philliber et al. (1980) described survey designs as the most appropriate study design for studying how a particular phenomenon is distributed thorough a population. Secondly, given the exploratory nature of this research, no controls were included in this research, either by the inclusion of questions that could be used as control variables or by targeting specific farmers that could be used as a control group. According to Philliber et al., 1980, surveys do not necessarily rule out spuriousness of relationships, rather the strength of the survey thus lies in the generalisability of its findings than on the criteria to ascertain cause. Because this study aimed to generalise findings rather than ascertain cause, a survey design was considered the most appropriate study design (Philliber et al., 1980). However, relationships of causality were also discussed based on the linkages with the literature. Finally, in order to capture the diversity of the NZ dairy farmer population, a random sample of dairy farmers was targeted.

The unit of analysis of this research is the "farmer", who was defined as the person in charge of decision making in the farm business surveyed. Philliber et al. (1980) suggested that survey design is an appropriate study design used in social sciences to gather random data from a large population.

Yin (2003) suggests that the degree of focus on contemporary, as opposed to historical, events is another important factor when considering choosing study designs. In this regard, this research aimed to capture personality attributes of farmers at the time of the survey. However, this research also inquired about farmer perception of the farm business environment from a historical perspective. According to Yin (2003), survey studies are appropriate when the focus of the research is on contemporary events. Because the main focus of the research is to explore farmer attributes and their current use of risk management strategies, and because the period

chosen for the study of the farm business environment is relatively short (10 years), it was considered that a survey study design did also comply with the focus requirement described by Yin (2003). The 10 year period was chosen because over this period, farmers (and their farm businesses) have been exposed to increasing change and volatility in relation to some of the sources of risk present in the farm business environment (e.g. increased volatility in milk price, introduction of government laws and regulations over production methods), yet not much is known about how farmers have perceived these risks.

3.2. Survey design.

Based on the objectives set by this research, an extensive literature review on resilience identified six individual attributes (self-efficacy, locus of control, willingness to accept uncertainty and change, strategic thinking, and sense-making). Furthermore, the literature review provided a set of questions that were used for the assessment of these attributes in this survey. Likewise, a literature review on risk in the farm management literature provided the basis for the questions developed for the study of the sources of risk, risk management strategies and farmer risk profiles (refer to appendix I for a copy of the survey). The questions in the survey questionnaire were organised in four main sections:

Section 1) questions were asked with the objective of capturing demographic information about some individual characteristics of the respondent and their farm business.

Section 2) questions were asked with the objective of capturing respondents' resilience attributes and their risk profile.

Section 3) questions were asked with the objective of capturing respondents' perceptions of sources of risk in the farm business environment.

Section 4) questions were asked with the objective of capturing respondents' risk management behaviour.

The questions asked in sections 1, 2, 3 and 4, and their coding into variables further used for data analysis are presented in the sections 3.2.1, 3.2.2, 3.2.3, and 3.2.4, respectively

3.2.1. Farmer and farm business demographic questions.

The questions in the first section of the survey, which aimed to capture some demographic characteristics of the respondent and their farm business, included questions about age; highest level of formal education achieved; situation of ownership of the farm business; location of the farm business; milking area, cows milked at peak, and milk production in season 2013/14; stage of the farm business in the business cycle; people involved in the farm business (family and non-family); participant role in the farm business; and participant level of influence in the long-term, within the season and day-to-day decision making. These questions were then used as farmer and farm business demographic variables for data analysis and are shown in Tables 3.2.1.1 and 3.2.1.2, respectively.

Table 3.2.1.1. Farmer demographic variables

Variable	Type of variable	Category or Measurement scale
Age	Nominal	20 to 30 years 31 to 40 years 41 to 50 years 60 to 71 years 71 years or more
Level of formal education	Nominal	NCEA level 1 / School Certificate University entrance / bursary / NCEA level 2 or 3 Diploma graduate Degree graduate Postgraduate Other
Current situation	Nominal	A farm manager and/or contract milker and/or variable order sharemilker A herd-owning Sharemilker/Lessee A herd-owning Sharemilker/Lessee with more than one herd A farm owner-operator A farm owner-non-operator A farm owner operator with multiple operations (farms, equity partnerships and/or herd owning sharemilking contracts) An equity partnership managing partner Other
Farmer role in the farm business	Nominal	Sharemilker (variable order) Sharemilker (herd owning) Owner (operator) Owner (non-operator) Equity partner (operator) Equity partner (non-operator) Farm manager Other
Number of years of farming experience	Numerical	years
Influence in long-term decision-decision making	Ordinal	Very little / Little / Some / High / Very high
Influence in within the season decision-decision making	Ordinal	Very little / Little / Some / High / Very high
Influence in day-to-day decision-decision making	Ordinal	Very little / Little / Some / High / Very high

Table 3.2.1.2. Farm business demographic variables

Variable	Type of variable	Category or Measurement scale
Farm business location	Nominal	Northland - Auckland - Waikato - Bay of Plenty - Central Plateau - Western Uplands - East Coast - Hawkes Bay – Taranaki – Manawatu – Wairarapa - Nelson/Marlborough - West Coast - North Canterbury - South Canterbury – Otago - Southland
Farm business stage in the business cycle	Nominal	Entry Growth Consolidation Exit Entry of next generation
Effective milking area	Numerical	ha
Cows milked in 2013/14	Numerical	number
Kilograms of milksolids in 2013/14	Numerical	kgMS
Cow production	Numerical	kgMS/cow
Stocking rate	Numerical	cow/ha
Production per effective hectare*	Numerical	kgMS/ha
Family members in the farm business	Numerical	full time equivalents
Non-family members in the farm business	Numerical	full time equivalents
Labour productivity*	Numerical	kgMS/full time equivalents

* This variable was calculated from other variables.

3.2.2. Resilience attributes and risk profile questions.

The second section of the survey included 25 questions, 20 of which questioned respondents about their resilience attributes and five about their risk profile. Each of these questions was a Likert item type. A Likert item is a statement where the respondent is asked to evaluate by using a scale, which in the case of this survey ranged from "strongly disagree" to "strongly agree". Likert items are useful for the development of overall measurements or scales (Suskie, 1992). Moreover, they have some advantages for data collection and analysis such as: they are easy to respond to; they permit comparisons among answers within the scale; and are a good tool to measure attitudes, such as in the case of most of the items used in this survey (Suskie, 1992). As for the disadvantages, because people are generally more inclined to agree than disagree with a statement, Likert items may yield biased results (Suskie, 1992). The questions used for the measurements of the resilience attributes and risk profiles are outlined in sections 3.2.2.1 and 3.2.2.2, respectively.

3.2.2.1. Resilience attributes questions

Resilience attribute questions included a set of 20 items that were used to develop measurement constructs for the six attributes of individual resilience (Table 3.2.2.1). The content of the items was drawn from different literature sources. These sources varied from psychology, business, and ecology and, therefore, the original items were adapted to the context of farm management.

Table 3.2.2.1. Resilience attributes questions.

Attribute	Item in the survey*	Original item	Original context	Reference
Willingness to accept uncertainty and change	I intend to make time to implement changes required in my farm business. (+)	Intention to make time to implement the change	Organisations	Metselaar (1997)
	I am willing to make changes to my farm business. (+)	Our organisation is open to change	Business	McCann et al. (2009)
	I am willing to face uncertainty in my business. (+)	Derived from the question above	Business	McCann et al. (2009)
Open-mindedness	I value the knowledge of others from inside and outside the farm business. (+)	Encounter every person with equal respect, listen for their specific needs, knowledge, and ways of knowing	Social ecological systems	Rogers et al. (2013)
	I consider everyone in the dairy industry learns from each other. (+)	Accept everyone as co-learners, not experts or competitors	Social ecological systems	Rogers et al. (2013)
Self-efficacy	It is easy for me to stick to my aims and accomplish my goals. (+)	It is easy for me to stick to my aims and accomplish my goals.	Psychology	Schwarzer and Jerusalem (1995)
	No matter how hard I try, I struggle to solve difficult problems. (-)	I can always manage to solve difficult problems if I try hard enough.	Psychology	Schwarzer and Jerusalem (1995)
	I am confident that I can deal efficiently with unexpected events. (+)	I am confident that I could deal efficiently with unexpected events.	Psychology	Schwarzer and Jerusalem (1995)
Locus of control	The success of my farm business is mostly determined by factors outside of my control. (-)	The success of the farm is mostly determined by factors outside of my control	Agricultural systems	Price and Leviston (2014)
	The weather and commodity prices can knock the business around in the short term but in the long term there is still a lot I can do to stay ahead of the game. (+)	The weather and commodity prices can knock you around in the short term, but in the long run there is still a lot you can do to stay	Agricultural systems	Price and Leviston (2014)

* The sign between brackets indicates the sense of the direction between farmer response to an item and their degree of skills in the related attribute. Thus, a (+) indicates that the higher a farmer agrees to the item, the greater their skills in the related attribute. In contrast, a (-) indicates that the higher a farmer agrees to the item, the lesser their skills in the related attribute.

Table 3.2.2.1. (cont.)

Attribute	Item in the survey*	Original item	Original context	Reference
Sense-making	I am not good at making sense of ambiguous and uncertain situations. (-)	Our organisation is good at making sense of ambiguous, uncertain situations	Business	McCann et al. (2009)
	I do not pay close attention to conditions outside the dairy industry. (-)	We pay close attention to conditions outside of our industry	Business	Neill et al. (2007)
	I have regular contact with other farmers where we discuss trends in the industry. (+)	We have regular interdepartmental meetings to discuss market trends and developments.	Business	Neill et al. (2007)
	I have regular contact with other members of the industry to acquire knowledge. (+)	Marketing personnel in our business spend time discussing customers' future needs with other functional departments.	Business	Neill et al. (2007)
	When confronted with a new situation, I revise past experiences to assess the situation. (+)	Consider your own experiences in applying your own knowledge to any problem	Organisations	Pisapia et al. (2005)
Strategic thinking	My decision-making is driven by my vision for my farm business. (+)	Overall, my company's decision-making is vision-driven.	Business	Moon (2013)
	I do not search for patterns when confronted with rich information. (-)	Search for patterns when confronted with rich information	Organisations	Pisapia *et al.* (2005)
	I consider how different parts of the farm system impact on each other. (+)	Consider how different parts of the organization influence the way things are done	Organisations	Pisapia *et al.* (2005)
	When resolving a strategic problem I consider a range of possibilities. (+)	Ask yourself and others to map out different strategies needed to map out the resolution of a problem	Organisations	Pisapia *et al.* (2005)
	No matter what, I always stick to my original plans (+)		Business	Adapted from Graetz (2002)

* The sign between brackets indicates the sense of the direction between farmer response to an item and their degree of skills in the related attribute. Thus, a (+) indicates that the higher a farmer agrees to the item, the greater their skills in the related attribute. In contrast, a (-) indicates that the higher a farmer agrees to the item, the lesser their skills in the related attribute.

The construct developed for measuring willingness to accept uncertainty and change measured the degree to which a farmer was predisposed to accept that uncertainty and making changes in the business change were integrally part of managing a farm business. For this reason, the construct captured a farmer's degree of enthusiasm with respect to making changes and facing uncertainty in their farm business. This construct was adapted from three items used by Metselaar (1997) and McCann et al. (2009).

The construct developed for measuring open-mindedness measured the degree to which a farmer was capable of accepting that there was value in other people's knowledge and their acceptance that those in the dairy industry share their learning. The two items were adapted from Rogers et al. (2013).

The construct developed for measuring self-efficacy measured the degree to which a farmer believed they was able to stick to their aims and accomplish their goals, as well as their ability to solve problems and their confidence in managing unexpected events. The three items were adapted from items developed by Schwarzer and Jerusalem (1995).

The construct developed for measuring locus of control measured the degree to which a farmer believes he/she has control over external events affecting their farm business. The two items used to measure locus of control were adapted from Price and Leviston (2014).

The construct developed for measuring sense-making measured the degree to which a farmer matches the aspects that reflect their sense-making skills. These aspects include: farmer awareness of their own sense-making ability; confirmation of aspects involved in the sense-making process; and farmer use of resources for sense-making. One item, "I am not good at making sense of ambiguous and uncertain situations", reflects a farmer's perception of their sense-making ability skills. This item was adapted from the work of McCann et al. (2009). Two items, "I do not pay close attention to conditions outside the dairy industry" and "when confronted with a new situation, I revise past experiences to assess the situation", capture two aspects of the sense-making process, which are the interpretive and the retrospective aspects. These two items were adapted from original items developed by Neill *et al.* (2007) and Pisapia et al. (2005). Finally, the two items "I have regular contact with other farmers where we discuss trends in the industry" and "I have regular contact with other members of the industry to acquire knowledge" reflect a farmer's use of resources in the form of networking in order to acquire information and knowledge. The two items were drawn from the work of Neill *et al.* (2007).

The construct developed for measuring strategic thinking measured the degree to which a farmer is able to think in a synthetic, analytic and strategic way. Two of the items, "I do not search for patterns when confronted with rich information" and "I consider how different parts of the farm system impact on each other", reflect systems thinking. These two items were drawn from the work of Pisapia et al. (2005).Two items, "when resolving a strategic problem I consider a range of possibilities" and "no matter what, I always stick to my original plans" reflect analytic focus of strategic thinking. The two items were adapted from Graetz (2002) and Pisapia et al.

(2005). The final item, "my decision-making is driven by my vision for my farm business" reflects a farmer's focus on strategy. This item was adapted from the work of Moon (2013).

3.2.2.2. Risk profile questions.

Respondent risk profiles were formed with the use of a set of five items that captured their risk profile in terms of their ability to manage risks in the short and long term, plan for the future, make choices when there are multiple options, and their attitude to risk (Table 3.2.2.2). These items were the same as those used in a prior risk study undertaken by Shadbolt and Olubode-Awosola (2013) for characterising the risk profile of a random sample of dairy farmers in New Zealand.

Table 3.2.2.2. Risk profile variables.

Item in the survey*	Reference
Within a season, I am able to manage almost all uncertainty that occurs. (+)	Shadbolt and Olubode-Awosola (2013)
Over the long term, I am able to manage almost all uncertainty that occurs. (+)	Shadbolt and Olubode-Awosola (2013)
I find planning difficult because the future is so uncertain. (-)	Shadbolt and Olubode-Awosola (2013)
When there are a number of solutions to a problem, I find it difficult to make a choice. (-)	Shadbolt and Olubode-Awosola (2013)
When it comes to business, I like to play it safe. (-)	Shadbolt and Olubode-Awosola (2013)

* The sign between brackets indicates the sense of the direction between farmer response and the meaning of the item used to capture their risk profile. Thus, a (+) indicates that the higher a farmer agrees to the item, the more positive is the association between the item and their risk profile. In contrast, a (-) indicates that the higher a farmer agrees to the item, the more negative is the association between the item and their risk profile.

3.2.3. Farm business environment questions.

In order to characterise farmer perceptions of the sources of risk in the farm business environment, a list of 19 sources of risk was presented in the survey (Table 3.2.3) and farmers were asked to answer three questions with respect to each of the sources of risk in the list:

1) How do you think this source of risk been changing in the last 10 years?
2) How volatile has this source of risk been in the last 10 years?
3) Do you believe this source of risk has presented an opportunity, a threat, or both an opportunity and a threat for your farm business in the last 10 years?

Each question lead to the development of a variable.

The variable "change", defined as the pace at which farmers perceived a source of risk has been changing in the last ten years, was measured by capturing farmer responses to the first question by using a 5-point Likert type scale which ranged from 1= "decreasing rapidly", 2= "decreasing slowly", 3= "constant", 4= "increasing slowly", and 5= "increasing rapidly".

The variable "volatility", defined as the variation perceived in the source of risk in the last ten years, was measured by capturing farmer response to the second question by using a 5 point Likert-type scale which ranged from 1= "very low" to 5= "very high" (it is important to note that volatility was not asked for nine out of the ten sources of risk for which variation was considered not applicable).

Finally, the variable "perception of risk" that captured farmer perceptions on whether a source of risk was considered: 1= an opportunity; 2= a threat or 3= both an opportunity and a threat, for their farm business in the last ten years.

Table 3.2.3. Sources of risk listed in the survey and their classification in six risk categories.

Source of risk in the survey*	Classification of risk
Milk price Input prices and availability Business relationships (within supply chain) Dairy industry structure The global economic and political situation Global supply and demand for food Global competitors & competition Reputation and image of the dairy industry	Market risk
Interest rates Land values Availability of capital	Financial risk
Climate Pasture/crop/animal health	Production risk
Government laws and policies Local body laws and regulations	Regulatory risk
Availability of labour (self and family, employees, contractors) Skills and knowledge of those associated with the business	Human risk
Technological changes	Technology risk

* The list drew upon a number of risk sources used in other studies on risk management for farm business in New Zealand (Martin, 1994; Pinochet-Chateau et al., 2005a; Pinochet-Chateau et al., 2005b; Shadbolt & Olubode-Awosola, 2013).

3.2.4. Risk management questions.

In order to assess farmer risk management behaviour, two questions were asked in relation to a list of 27 risk management strategies commonly used in dairy farm businesses (Table 3.2.4):

1) Have you used this risk management strategy?
2) How important is this strategy for managing risk in your farm business?

Each question led to the development of a variable. On one hand, the variable "use", which measured whether a farmer had used a risk management strategy, had not used it, or if it was applicable for its use in their farm business. On the other hand, the variable "importance", which was measured by capturing farmer responses to the second question using a 5 point Likert-type scale, ranging from "very low" to "very high".

Table 3.2.4. Risk management strategies and the type of risk the strategy aims to manage.

Risk management strategy*	Type of risk the strategy aims to manage
Maintaining feed reserves Monitoring programme for pest and diseases Routine spraying and/or drenching Irrigation Geographic diversity through having properties in different areas	Production risk
Using futures markets Forward contracting Gathering market information Spreading sales (reducing seasonality in milk production)	Market risk
Arranging overdraft reserves Maintaining financial reserves: having cash and easily converted financial assets Main farm operator or family working off property Managing debt Keeping debt low Planning of capital spending	Financial risk
Having personal and/or business insurance	Human risk
Having short term flexibility to adjust quickly to weather, price and other factors Having long term flexibility Having more than one type of animal or other enterprises on your property Using practical planning steps in your business Assessing strengths, weaknesses, threats and opportunities Having a clear and shared vision or strategic purpose for your operation Using financial ratios for decision making Not producing to full capacity so there are reserves in the system	Overall risk
Implementing technological innovation(s)	Technology risk
Adjusting production methods/system to comply with laws and policies	Regulatory risk

* The list of risk management strategies drew upon a number of strategies used in other studies on risk management for farm business in New Zealand (Martin, 1994; Pinochet-Chateau et al., 2005a; Pinochet-Chateau et al., 2005b; Shadbolt & Olubode-Awosola, 2013).

3.3. Pre-test of the survey.

A pilot test of the survey with three farmers was undertaken before the start of data collection. The objective of the pilot study was to query farmers about their understanding of the questions, time of completion, and survey layout. A first draft of the survey was sent out to this group of farmers, who were later contacted by phone in order to get their feedback on the survey.

3.4. Sampling and sample size.

A random sampling procedure was used for this research. Dairy farmers were randomly selected by Asure Quality Limited from a database of dairy farms. Asure Quality Ltd. is a commercial company owned by the NZ government that provides a wide range of services for the agricultural industry all over NZ. Some of these services include: farm audits; animal welfare, hygiene and product quality certificates according to industry standards; organics certificates; soil DDT tests; and milk machine efficiency tests, among other farm related services. The wide diversity of services provided by Asure Quality and the fact that they provide, or have provided, services to a large number of dairy farms across the country signifies that their database should be representative of the dairy farm population.

The farm database included details such as farm address, name of farm manager, name of farm owner, and name of farm decision maker. Because the objective of this research was to associate personality attributes with on-farm decisions, surveys were sent out directly to the decision makers listed in the database for each farm business.

Sample size was estimated based on equation 3.3 and response rates observed in previous survey studies on risk management in New Zealand dairy farms (Martin, 1994; Pinochet-Chateau et al., 2005a; Pinochet-Chateau et al., 2005b; Shadbolt & Olubode-Awosola, 2013).

Equation 3.3:

$$n = \left(\frac{1}{confidence\ level}\right)^2$$

It was estimated that in order to obtain a 5% level of confidence, a size of 400 responses were required. Therefore, considering a conservative response rate of 20%, a total of 2,000 initial contacts needed to made. Initially, a sample of 2000 farm contacts were requested, with a further 800 contacts later. As some farmers in the database had more than one farm business, the number of farmers in the sample of 2800 farms was actually2,465, but was later reduced to 1559 because of out-dated contacts in the database.

3.5. Data collection.

Surveys were sent electronically and by post. A list with email and postal addresses of 2,465 farmers was received from Asure Quality and a unique identification number (ID) was used to identify each of these farmers. From the total contacts list, 752 contacts had email address related errors and another 154 had postal address related errors. From the 1,559 contacts that could have potentially received the survey, 454 responses were received (29.1%), of which 436 were usable responses (27.9%), and 364 had complete answers for the resilience attributes section in the survey.

The survey delivery procedure was undertaken as follows:

Initially, a set of 2000 farms with 1832 farmer contacts was received. The difference between the number of farms and the number of farmers was because some of these farmers in the set accounted for more than one farm. An email with an invitation to participate in the survey was sent to this first group of farmers on 25 July, 2014. The email sent included a cover letter, an information sheet with the terms of reference for the research project (refer to appendix II for a copy of the cover letter and information sheet included in the email) and a link to a web site to access an online version of the survey.

The online version of the survey was developed using Qualtrix®, a web-based surveying tool. To access the online survey, respondents were asked to click on a website link provided in the email or to copy and paste it into a new web browser. Farmers were allowed to start completing the survey at any moment in time. Each online survey was set to close in a period of two weeks from the first time of access. Farmers were allowed to access and modify their responses as many times as they chose to within the two week time frame. After two weeks, the survey was considered closed and responses recorded into the final database. Respondents were given the right to decline to answer any of the questions in the survey. To encourage survey responses, farmers were entered into a draw for a RD1 Gift Card valued at $ 250 and were asked to provide their e-mail address for that purpose only. Email addresses and IP addresses were used to match farmer IDs and avoid any possible duplicates.

After the first email was sent, 537 emails were bounced automatically due to incorrect email addresses or disabled email accounts. Because of the high rate of failed deliveries, an extra set of 800 random farm contacts were asked for order to increase the potential number of survey responses. The new set of contacts provided an extra 633 new farmers. The same email was sent

to this second group of farmers on 29 July, 2014. Similar to what had happened with the earlier email, a large number of the emails sent to the second group bounced back as a consequence of errors in the email addresses. Follow up emails were also sent on to the first group of farmers on the 1 August, 2014.

On 13 August, 2014, a postal survey with a return envelope was sent to all farmers who had not completed the online survey and whose email address was not defective. Refer to appendix II for a copy of the cover letter, information sheet and postal survey sent to farmers via mail. Each of the postal surveys was identified by a unique identification number printed on the return envelope and the printed version of the survey as well. 160 postal surveys were returned due to errors in the addresses.

Finally, a follow up email was sent on 15 August to remind farmers to take part of the survey by choosing to complete it online or by using the printed version posted.

Data collection ended on 10 September, 2014 (47 days after the first online survey was sent).

3.6. Data analysis.

First, exploratory descriptive statistical analysis on all variables was carried out to explore the nature of the data and describe the sample.

Second, principal component analysis (PCA) was carried out for the resilience attribute groups of items and risk profile items in order to identify and understand the underlying factors (i.e. new resilience and risk profile attributes) in the original constructs and to obtain new farmer scores for each of the new factors. This is explained further in section 3.6.1.

The next step was to carry out cluster analysis in order to group and typify farmers according to their resilience attributes and risk profile characteristics. This is explained further in section 3.6.2.

Finally, resilient farmer types were compared for differences in their risk profile type, demographic variables, farm business environment variables, and risk management variables.

3.6.1. Principal component analysis.

In order to perform the principal component analysis (PCA), complete sets of data for resilience attributes and risk profile responses were required. Since respondents had the choice to not answer any or all of the questions in the survey, many questions were left partially or completely

unanswered. This resulted in set of data with missing values. A listwise deletion method was used for handling missing data before performing the PCA; listwise deletion consisted of excluding all registers from analysis if any single value was missing (Meyers, Gamst, & Guarino, 2006).

PCA was used to explain the variance-covariance structure of the set of items for each of the resilience attributes and the risk profile attributes. PCA is often used as a dimensionality-reduction technique which reduces a large number of variables (i.e. items) into a minimum number of uncorrelated linear factors or dimensions called principal components (PCs) (Meyers et al., 2006). These PCs are new non-observed variables that capture the most variance of the data observed in the original items. The PCs resulting from the PCA on the seven groups of items (six for the resilience and one for the risk profile attributes) were used to determine derived resilience and risk profile attributes.

The number of derived resilience and risk profile attributes resulting from the PCA was determined by the eigenvalues of each PC. Eigenvalues indicate the amount of variance captured by each PC and can vary from 0 to any positive value. The greater the eigenvalue, the greater the variance explained by the PC. In contrast, it is assumed that PCs with eigenvalues close to 0 do not explain much of the variance in items responses and, therefore, it is sensible to not use them in further analysis (Meyers et al., 2006). The criterion for selecting the number of PCs to retain for further analysis was of set at the retention of PCs with eigenvalues greater than 1, following the Meyers et al. (2006) recommendation.

Once the number of retained PCs was decided, the interpretation of the underlying structure of each of these PCs was addressed based on the component loadings resulting from the PCA. Component loadings indicate the strength and direction of the relationship between an item and a principal component (Meyers et al., 2006). Thus, the greater the component loading of an item, the more the item contributes to the interpretation of a PC. Following the recommendations of Meyers et al. (2006) and DiStefano, Zhu, and Mindrila (2009), component loadings with an absolute value greater than 0.4 were considered to be determinant for interpreting their related PC. Finally, from the interpretation of each PC, derived resilience and risk profile attributes were proposed.

PC scores for each of the derived resilience and risk profile attributes for each farmer were obtained. These PC scores were expressed in a standardised z-score format, in which a value of 0 corresponded to a score equal to the mean; positive values indicated PC scores greater than the mean and negative values indicated PC scores below the mean score. Because nine of the

attributes derived from the PCA (open-mindedness, locus of control, social sense-making, individual sense-making, strategic thinking, general self-efficacy, willingness to accept uncertainty, willingness to change, and risk management capability) were interpreted as expressing a negative relationship with the trait, the PC scores for these "negative" attributes were converted to positive by multiplying them by -1 so that a score higher than 0 represented a farmer with a greater than average PC score in that attribute, and the derived resilience and risk profile attributes were named in a positive relationship towards the trait.

3.6.2. Cluster analysis.

Two cluster analyses (CA) were performed separately. The first of these CAs was performed using the nine derived resilient attributes as input variables in order to group farmers with similar characteristics on resilience. A second cluster analysis was performed using the two derived risk profile attributes as input variables in order to group farmers with similar characteristics regarding their risk profiles. The units of measurement of these input variables were the PC scores obtained from the PCA. Then, farmers were typified according to the interpretation of the cluster analyses results.

SPSS software was used to perform a Two-step Clustering Component procedure. Two-step Clustering Component procedure is a scalable cluster analysis algorithm present in the version 22 of the SPSS software (SPSS, 2001). The algorithm identifies clusters by running a pre-clustering of selected variables from which it obtains many small sub-clusters. Then, these sub-clusters are re-clustered by using hierarchical methods into a desired number of clusters. If the desired number of clusters is unknown, the SPSS Two-step Cluster Component procedure will find the most appropriate number of clusters automatically. Schwarz's Bayesian Information Criterion method was used as the preferred method for determining the number of clusters. (SPSS, 2001). Moreover, input variables (PC scores) for the models were treated as numerical. Overall, clustering success was measured by the silhouette coefficient, which is a measure of cohesion and separation developed by Kaufman and Rousseeuw (1990). Due to its simplicity, the Two-step Cluster Component procedure was preferred over other clustering methods such as k-means and agglomerative hierarchical techniques (Bacher, Wenzig, & Vogler, 2004; SPSS, 2001). The Two-step Cluster Component procedure was compared against these other two clustering methods and showed consistent results in conditions similar to the one of this research (relatively large number of input cases and use of numerical variables as input variables for the models).

3.6.3. Comparisons between resilient farmer types.

Differences between resilient farmer types regarding demographic variables, their perception of the farm business environment, and risk management strategies were obtained through testing the relationships between resilient farmer types (independent variable) and the a number of different dependent variables. Because the dependent variables were of different types, different tests were used (Table 4.7).

Table 4.7. Statistic tests used for comparing resilient farmer type against different dependent variables.

Dependent variables	Type of variable	Statistical test	Strength of association
Demographic /Farm business environment/Risk management strategy	nominal ordinal numerical	Chi-square/Fisher's exact Mann-Whitney U/Chi-square t-test (independent samples)	Cramer's V r /Cramer's V

In order to find relationships between resilient farmer types and any other nominal variables, Chi-square tests for independence were used. Moreover, for cases in which the assumption of having at least 20% of cells with a minimum expected count of five was not met, Fisher exact tests were also employed (Michael, 2001). The null hypothesis that was tested was that there was no relationship between resilient farmer type and the selected nominal variable. The strength of association of the relationship was assessed by Cramer's V, which ranges from 0 (no association) to 1 (complete association). The drivers of an existing relationship (if any) were identified by assessing the adjusted standard residuals obtained from the difference between observed counts and expected counts in crosstabs between the two variables.

Relationships between resilient farmer types and any other ordinal variables were assessed by Mann-Whitney U test. The null hypothesis tested was that the median scores for a single ordinal variable were the same for the two resilient farmer types. Before running the tests, the shapes of the distribution of the independent variables for both groups of farmers were observed to check for similarity of shape. The strength of association of the relationship was assessed by the r coefficient, which ranges from 0 (no association) to +/- 1 (complete association). The Mann-Whitney U test is the preferred option when comparing populations that are not normally distributed, such as the case of ordinal data (Groves, Fowler Jr, Couper, Lepkowski, Singer, & Tourangeau, 2013). On the other hand, for the case of the ordinal variables, volatility and change for each of the sources of risk, and farmer influence on decision making, Chi-square tests were preferred over the Mann-Whitney U test to identify categories that explained the relationships between resilient farmer type and the selected variable.

Finally, *t*-tests for mean comparison were performed on those independent variables that were numerical and normally distributed.

The significance level for all the tests was set at 5% unless specified.

3.7. Overall farm business environment indices.

The previous tests (Table 4.7) compared resilient farmer type perception of the farm business environment in relation to the three variables (volatility, change, and risk (opportunity/threat) for each of the sources of risk individually. However, an overall measure which combined the set of risk sources was required in order to characterise overall farmer perception of change, volatility and risk (opportunity/threat) in the farm business environment. Thus, five indices were developed:

A. $Overall\ Change\ index_i = \frac{N°\ of\ risk\ sources\ decreasing\ rapidly + N°\ of\ risk\ sources\ increasing\ rapidly_i}{Total\ number\ of\ risk\ sources_i}$

B. $Overall\ volatility\ index_i = \frac{Number\ of\ risk\ sources\ with\ volatility > than\ moderate_i}{Total\ number\ of\ risk\ sources_i}$

C. $Overall\ opportunity\ index_i = \frac{Number\ of\ risk\ sources\ perceived\ as\ an\ opportunity_i}{Total\ number\ of\ risk\ sources_i}$

D. $Overall\ threat\ index_i = \frac{Number\ of\ risk\ sources\ perceived\ as\ a\ threat_i}{Total\ number\ of\ risk\ sources_i}$

E. $Overall\ opportunity/threat\ index_i = \frac{Number\ of\ risk\ sources\ perceived\ as\ an\ opportunity\ and\ a\ threat_i}{Total\ number\ of\ risk\ sources_i}$

Where *i* represented an individual response.

The overall change index (A) represented the proportion of risk sources that a farmer perceived that have been changing either at a decreasing rapidly or increasing rapidly over the total number of risk sources.

The overall volatility index (B) represented the proportion of risk sources that a farmer perceived to have been high or very high volatility over the total number of risk sources.

The overall opportunity index (C) represented the proportion of risk sources that a farmer perceived to have represented an opportunity over the total number of risk sources.

The overall threat index (D) represented the proportion of risk sources that a farmer perceived to have represented a threat over the total number of risk sources.

The overall opportunity/threat index (E) represented the proportion of risk sources that a farmer perceived to have represented both an opportunity and a threat over the total number of risk sources.

Indices ranged from 0 to 1.

In order to compare differences between resilient farmer types regarding these new indices, Mann-Whitney *U* tests were performed as previously described.

3.8. Validity and reliability.

Validity and reliability are indicators of quality research in survey designs (Ghauri & Grønhaug, 2005).

3.9. Validity

Validity relates to obtaining valid knowledge from the research, in other words, a degree of confidence that results are true. Ghauri and Grønhaug (2005) described two forms of validity: construct validity (i.e. internal validity) and external validity.

The first form of validity, construct validity, refers to the extent to which an operationalisation measures the concept that it purports to measure. Construct validity is necessary for obtaining meaningful and interpretable research findings and may be assessed and ensured in various ways (Ghauri & Grønhaug, 2005). According to Netemeyer, Bearden, and Sharma (2003), three steps ensure construct validity: 1) specifying a set of theoretical constructs and their relations; 2) developing methods to measure the theoretical constructs; and 3) empirically testing how well observable variables measure the constructs in the theory and testing hypothesised relationships among the construct of theory as well. In this research, different methods were used to assess and ensure construct validity. First, the development of the constructs was drawn from other research, which used valid empirical tests developed from theory (refer to section 3.5 for variables and their related references). In this respect, it is important to highlight that because

some of the variables used in this survey were taken from other fields of knowledge outside farm management, these were adjusted to the context of the dairy industry and tested with farmers to better fit the understanding of dairy farmers to the variables used in this survey. Second, face validity with experts on the topic was used to assess if whether the resulting constructs seemed to be a reasonable measure for what they purported to measure. Finally, theoretical relationships based on literature findings were tested using the developed constructs for resilience attributes and demographic variables used in this survey.

The second form of validity, external validity, refers to the generalisation of the research findings (Ghauri & Grønhaug, 2005). This is an important form of validity, because it signifies that results from one study can be held to be true for other cases. In this study, external validity was ensured by using a random sample of farmers. In order to assess the randomisation of the sample, descriptive statistics of demographic variables in the sample were compared to the national figures published by DairyNZ (2014b).

3.9.1. Reliability

Reliability refers to answering the question of whether survey respondents have been consistent or stable in their answers. Thus, reliability is a measurement of variability of answers over repeated conceptual trials. A good reliability measurement indicates repeatable research results (Groves et al., 2013). According to Groves et al. (2013), there are two main methods to assess reliability in survey research: 1) repeated interviews with the same respondents; and 2) use of multiple indicators of the same construct. While the first method assesses differences in answers on the same sample in two or more moments in time, the second assesses if there is internal consistency in answers among items in the same scale. The first method was not considered appropriate for assessing reliability in this research due to lack of time and resources required for collecting data two times. Because of the explorative nature of this research, internal consistency of the constructs was not assessed. In this research, resilience and risk profile attributes constructs were developed based on underlying theoretical factors and, therefore, the items captured different aspects of the constructs. In addition, there were not enough items per construct to perform Cronbach's alpha for testing internal consistency. Cortina (1993) suggests that in order to obtain consistent results for Cronbach' alpha measurement, constructs must have more than 6 items. Nevertheless, it was considered that ensuring a good number of representative responses was more important for reliability of data than internal consistency testing.

3.10. Ethical and auditing considerations

This project was judged to be low risk according to Massey University Human Ethics standards. Anonymity and confidentiality were assured by keeping survey responses separate from the contact details database. Unique identification numbers (IDs) were used to identify survey responses so that the names and details from farmers were not associated with survey responses. This was achieved by providing farmers with a return envelope with their ID number and return address printed on. In the case of online survey respondents, farmers were identified by their IP (internet protocol number), and then given a unique ID. IDs were used to identify survey data. In addition, data was analysed collectively so that no person could be identified from the results of this project. Finally, survey responses will be kept in aggregate form and securely stored for five years for audit purposes, as required. After five years, the data collected for this project will be disposed of.

Chapter four

4. Results and Discussion

4.1. Survey response rate.

From the 1559 contacts that could potentially respond to the survey questionnaire, 459 responses (29.4%) were received of which 436 (27.9%) were usable. Despite this, 72 questionnaires were not used for the principal components analyses and final clusters models due to insufficient data, which resulted in a final response rate of 23.3%.

Other surveys in New Zealand agriculture reported similar usable response rates with Bensemann (2012), for example, reporting 29% for a survey undertaken to study marketing strategies of lamb producers in NZ, and Hall, Knight, Coble, Baquet, and Patrick (2003) reporting 30% response rate for a survey on risk management of beef producers. Others reported lower response rates with Nartea and Barry (1994) reporting 20%. However, other surveys of risk in the context of dairying, reported higher response rates than this survey; Pinochet Chateau (2005) and Martin (1994) both reported usable response rates of 42.6% and 43% respectively. Despite the differences observed between the usable response rate obtained in this survey and the ones reported by Pinochet Chateau (2005) and Martin (1994), the final number of responses were similar, since these authors reported 426 and 325 responses respectively. The final number of usable responses obtained in this survey was sufficient to represent a population at a 5% level of confidence.

4.2. Descriptive statistics of the sample.

The following sections outline the descriptive statistics for farmer demographic variables, farm business demographic variables, farmer resilience attributes, farmer risk profile variables, farmer perception of farm business environment variables and farmer risk management strategies. These results are also discussed in relation to existing literature.

4.2.1. Respondent descriptive characteristics

Out of the total number of respondents who reported their age, 67.4% were aged between 41 and 60 years old (Figure 4.2.1.1). Less than 6% of respondents were less than 40 years old, and less than 27% of respondents were aged 61 years old or more.

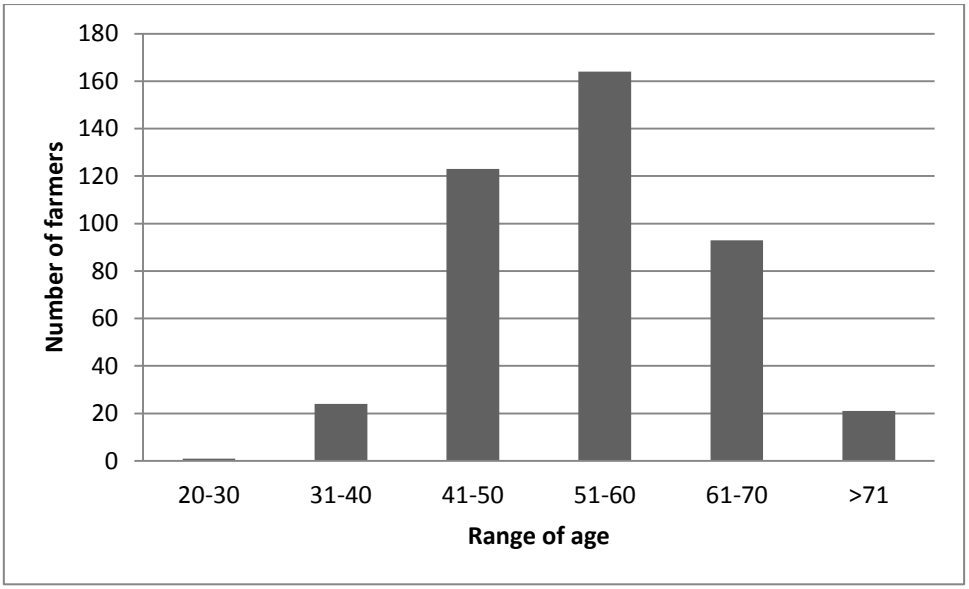


Figure 4.2.1.1. Age of respondents.

Based on information from the 2006 national census, Fairweather and Mulet-Marquis (2009) reported that the average age of dairy farmers and dairy farm workers in NZ was 40 years old. Pinochet Chateau (2005) reported that the average age from a random sample of dairy farmers was 41 years old, and more recently, another survey of random dairy farmers in NZ undertaken by Shadbolt and Olubode-Awosola (2013) reported an average of 52 years of age, with more than 71% of their sample aged between 41 and 60 years old. However, in this survey, age was measured by categories and, therefore, the average age of respondents could not be calculated; the fact than more than 65% of respondents were above 51 years old (Figure 4.2.1.1) indicated that the average age in the sample was higher than the average values reported by Pinochet Chateau (2005) and Fairweather and Mulet-Marquis (2009). However, the age of respondents in this survey was similar to the ages reported by Shadbolt and Olubode-Awosola (2013). This relatively higher age when compared to Pinochet Chateau (2005) and Fairweather and Mulet-Marquis (2009) may have been explained by the fact that surveys were addressed to farm businesses' decision-makers, who may have well been older than the farmers defined in the other studies.

On average, respondents had 32.7 years of farming experience. Figure 4.2.1.2 shows how these years of farming experience were distributed among respondents in ranges of 10 years.

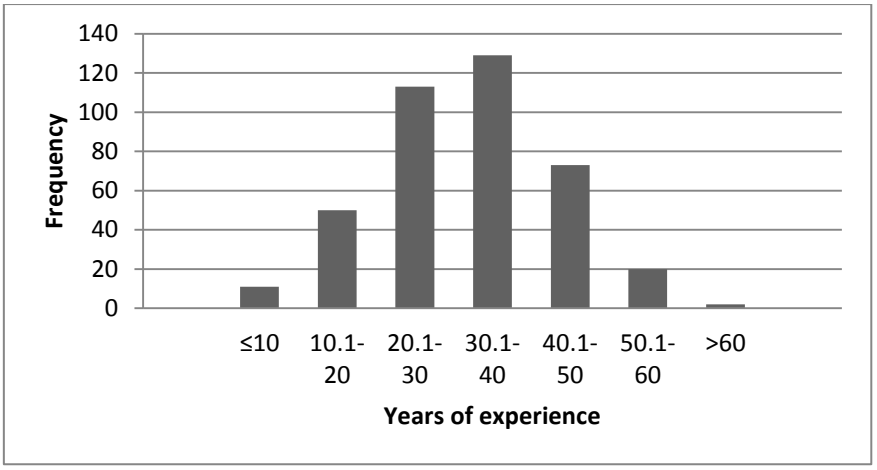


Figure 4.2.1.2. Years of accumulated farming experience of respondents.

Another survey conducted with random dairy farmers in NZ, reported average farming experience to be 29 years (Shadbolt & Olubode-Awosola, 2013). In comparison, respondents in this survey had slightly more farming experience than those reported by Shadbolt and Olubode-Awosola (2013).

The respondents' highest level of formal education achieved is shown in Figure 4.2.1.3.

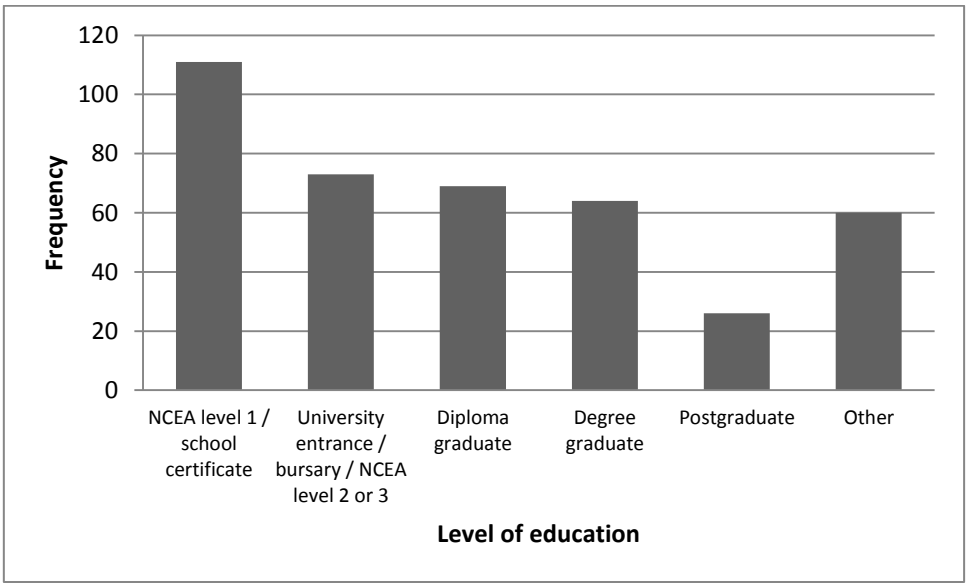


Figure 4.2.1.3. Highest level of formal education achieved by respondents.

The group with the highest percentage of respondents (27.5%) reported they had achieved a NCEA level 1 or School Certificate. The second highest group (18%) reported they had achieved University Entrance, Bursary, or NCEA level 2 or 3. Fewer respondents had a graduate diploma (17%), a graduate degree (16%) or a postgraduate degree (6.5%). Finally, 15% of the respondents

indicated that they had achieved "other" types of formal education that were not listed in the survey. Within this latter category, 5.5% of the respondents stated that they had attended school but did not complete the qualification, 1.4% had a trade certificate in farming or management, 4.3% had other type of trade certificates (mechanics, carpentry or plumbing), and 3.6% had no formal education at all. In a national survey conducted with dairy farmers, Fairweather, Hunt, Cook, Rosin, and Campbell (2007) reported that 25% of farmers surveyed did not have any formal qualification, 24% completed secondary school, 11% had a trade certificate, 7% had an undergraduate diploma or certificate, and 13% had a graduate degree. Although the categories used in this survey were slightly different from those used in by Fairweather *et al.* (2007), a higher proportion of respondents in this survey reported higher levels in secondary school, graduate degree, and graduate diploma when compared to those indicated by Fairweather *et al.* (2007).

The current situation of respondents in the survey and reports from other studies are shown in Table 4.2.1.1.

Table 4.2.1.1. Current situation of respondents in the survey and in other studies.

	Survey (n=426)	Shadbolt and Olubode-Awosola (2013) (n=256)	Pinochet Chateau (2005) (n=423)	DairyNZ, (2014b) (n=National)
Current situation	%	%	%	%
Farm owner-operator	**69.2**	**73**	**77**	**65**
single operation	41.5	57	n/a	n/a
multiple operations	27.7	16	n/a	n/a
Farm owner-non-operator	**19.7**	n/a	n/a	n/a
Equity partner managing partner	**4.2**	**7**	n/a	n/a
Sharemilker	**3.8**	**7**	**20**	**35**
herd-owning /Lessee single herd	2.8	1	n/a	n/a
herd-owning SM/Lessee > 1 herd	0.9	6	n/a	n/a
Farm manager/contract milker/VOSM	**1.6**	n/a	3	n/a
Other	**1.4**	**13**	n/a	n/a
Total	**100**	**100**	**100**	**100**

The majority of respondents in this survey (69%) considered themselves as farm owner-operators (with a single or multiple operations) (Table 4.2.1.1). 19.7% of respondents were farm owners who did not operate their farm. 4.2% indicated that they were best described as equity partners with a managing role. 3.8% of respondents were sharemilkers who owned one or more than one herd. 1.6% of the respondents indicated that the situation that best described them was that of a farm manager, a contract milker, or a variable order sharemilker (VOS). A small number of respondents (0.9%) indicated that they were sharemilkers or lessees with more than one herd. Finally, 1.4% of respondents indicated that their current situation was "other". Under this latter category, two respondents described themselves as sharemilkers with equity partnerships, two

respondents described themselves as CEOs of a farming company, and one was an equity partner with multiple operations. The comparison between the results obtained from respondents in the sample and other studies (Table 4.2.1.1) showed that while the proportion of farm owner-operators was similar to the national statistics provided by DairyNZ (2014b), and lower than that reported by Shadbolt and Olubode-Awosola (2013) and Pinochet Chateau (2005), the proportion of respondents in the sharemilker category was lower than that in any of the other three studies. In contrast to the studies of Pinochet Chateau (2005), Shadbolt and Olubode-Awosola (2013), and DairyNZ (2014b), this survey included the category of farm owner non-operator, and if those in this category were added to the other forms of farm ownership, then the proportion of farm owner would increase to nearly 83% of the total responses.

The respondents' role in the farm business is shown in Figure 4.2.1.4. The vast majority of the respondents (53%) were farm owner operators and farm owners who were not in charge of the operation of their farms (30%). A small proportion of respondents were sharemilkers or farm managers. 3% of respondents indicated other roles. Among this latter group of respondents, six indicated they were CEOs or directors of the company. The responses to the question about respondents' role in the business are very similar to their responses to the question on their current situation. The latter question refers to their personal situation whereas the former question refers to the business situation. Any further discussion in this thesis will refer only to their current situation.

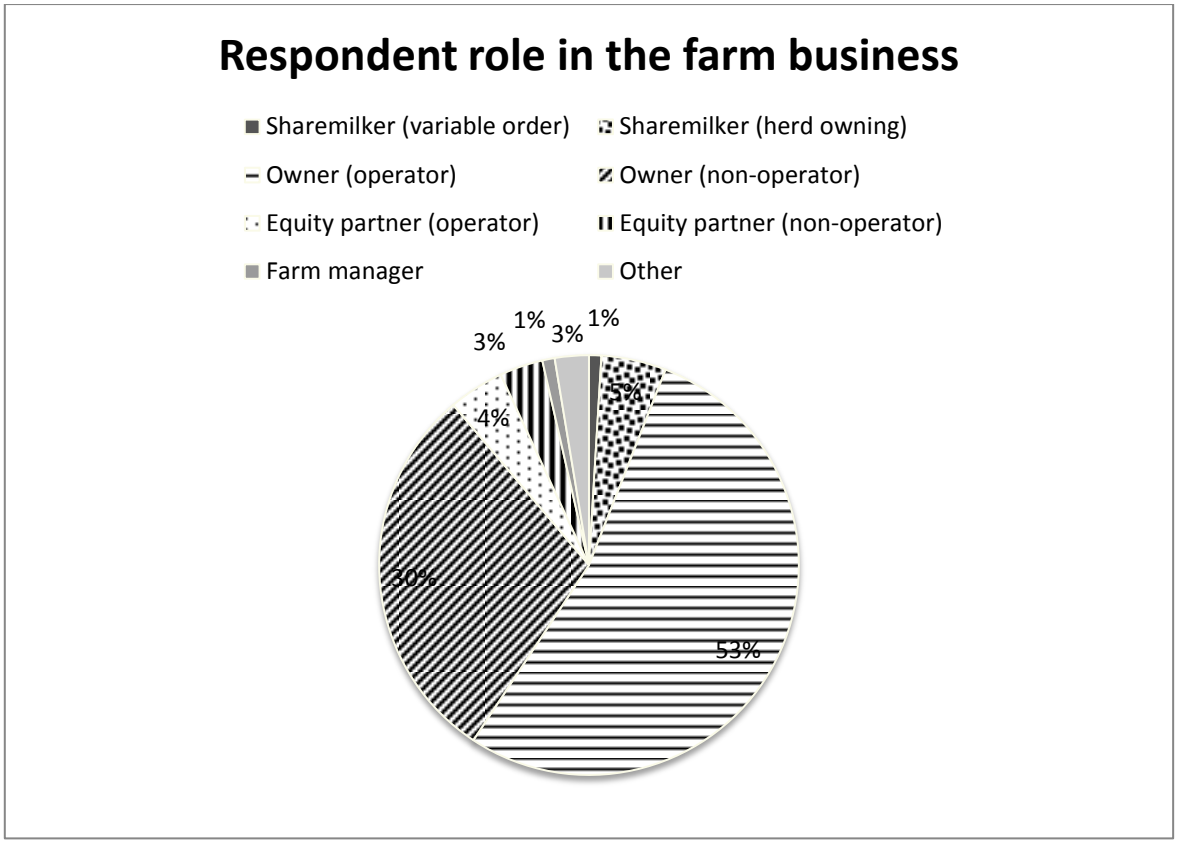


Figure 4.2.1.4. Current role of respondents in their farm business.

The current situation of the farm business is important because it refers to the ownership structure of the farm business, which may influence the type of decisions implemented when managing risks. In this respect, a farm owner operator will have more influence in decisions that are strategic and affect a farm business in the long term; whereas a farm manager is more likely to have more influence in decisions that are tactical or operational and affect the business within the season or on a daily basis (the relationship between current situation and influence in decision making will be further discussed in section 4.4.1).

Respondent profile in relation to their influence in decision making in their farm businesses is shown in Figure 4.2.1.5.

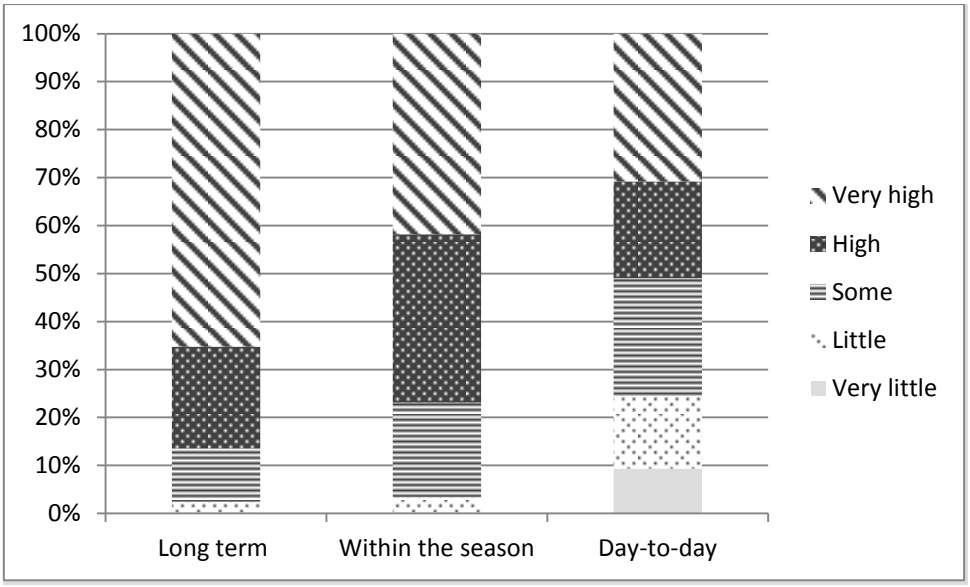


Figure 4.2.1.5. Respondent level of influence on long term, within the season, and day-to-day decision making.

The vast majority of respondents (86%) had very high or high influence on the decisions affecting their farm business in the long term. Likewise, 77% of respondents had very high or high influence on within the season decisions. In contrast, nearly 50% of respondents reported they had very little to some influence of day-to-day decisions. No other studies in the literature were found to contrast with these results. However, these results are important because they indicate that most respondents had a high degree of influence on strategic decisions and thus, strategic risk management strategies implemented on their businesses were very likely to be a consequence of their own decision making and, thus, a reflection of their own personality.

4.2.2. Farm business descriptive characteristics.

The majority of respondents (69%) indicated that the farm business in which they had the most influence was located in the North Island, whereas 31% indicated it was located in the South Island. Table 4.2.2.1 shows the regional distribution of farm businesses and percentage of cows per region obtained from responses in the sample, and national dairy statistics for the location of dairy cows as reported by DairyNZ (2014b).

Table 4.2.2.1. Regional distribution of farm businesses and cows according to the survey and national statistics.

	Survey			National (DairyNZ, 2014b)
Location	Count of farm businesses	% of farm businesses	% of cows	% of cows
Waikato	80	18.9	17.6	23.7
Taranaki	74	17.5	10.3	10
Bay of Plenty	39	9.2	7.1	4
Northland	38	9.0	5.9	5.8
South Canterbury	29	6.8	14.4	4
Southland	28	6.6	8.4	11.2
North Canterbury	27	6.4	9.2	13.4
Otago	21	5.0	4.7	5.4
Manawatu	19	4.5	4.4	4.5
Central Plateau	19	4.5	9.5	5.1
West Coast	14	3.3	2.5	3.1
Wairarapa	12	2.8	1.7	3.4
Nelson/Marlborough	12	2.8	2.0	1.8
Hawkes Bay	8	1.9	1.9	1
Auckland	4	0.9	0.4	2.3
Western Uplands	0	0.0	0	0.9
East Coast	0	0.0	0	0.1
Total	424	100	100	100

The farm businesses located in the North Island and in the South Island accounted for 59% and 41% of total cow numbers, respectively. This distribution was very similar to that observed in the national dairy statistics, at 60.5% and 40.5% for the North Island and the South Island respectively (DairyNZ, 2014b). Moreover, the distribution of the percentage of dairy cows per location in the sample was also similar to the national statistics for most of the locations (Table 4.2.2.1). However, there were some slight differences. While the percentage of cows in the sample for Waikato (17.6%) was lower than the national statistics (23.7%), the percentages of cows observed for Bay of Plenty (7%), Central Plateau (9.5%) and South Canterbury (14%) were greater than the national records at 4%, 5%, and 4%, respectively.

The descriptive statistics for farm business characteristics such as effective milking area, herd size, milk production, stocking rate, per cow production, per hectare production, and people

involved in the farm business are shown in Table 4.2.2.2. In addition, the Table shows results from two survey studies in the literature for comparative purposes. It is important to note that when comparing the results from this survey with the dairy statistics published by DairyNZ (2014b), some of the characteristics cannot be directly compared and therefore were indicated as "n/a". This is because the unit of description used in this section of the survey was different from the unit presented in the dairy statistics. While the results in this section refer to farm businesses, which may consist of one or more farms, dairy statistics figures report results with reference to single herds, and thus variables such as cow number were expected to be relatively higher in the survey when compared to those in the dairy statistics. However, other variables such as stocking rate or production per hectare were perfectly comparable.

Table 4.2.2.2. Descriptive statistics of farm businesses in the survey and from other studies.

	Survey					Shadbolt and Olubode-Awosola (2013)**	DairyNZ (2014b) (National)
Variable	N	Min.	Max.	Mean	Std. Dev.	Mean	Mean
Effective milking area (ha)	403	22	3400	229	335	232	n/a
Number of cows milked at peak	413	50	12000	692	1105	718	n/a
Production per farm business (kg)	405	9000	4150000	274285	421889	n/a	n/a
Stocking rate (cow/ha)	399	1.1	4.6	2.9	0.6	3.1	2.9
Production per cow (kg MS/cow)	405	80	600	389	68	364*	371
Production per hectare(kg MS/ha)	391	257	2100	1153	350	1,013*	1063
Family members involved in farm duties (FTE)	409	0	7	1.9	1.3	1.3	n/a
Non-family staff employed (FTE)	409	0	81	3.9	7.2	3.8	n/a

*reported as estimated
** season 2011/12

The average effective milking area and number of cows milked at peak for the farm businesses in the survey was similar to the averages reported by Shadbolt and Olubode-Awosola (2013) (Table 4.2.2.2). Stocking rates, per cow production, and per hectare production averages were consistent across studies. The number of non-family staff employed by farm businesses in this survey was similar to the one reported by Shadbolt and Olubode-Awosola (2013); however, the average number of family members involved in farm duties was slightly higher.

The farm businesses' profile with respect to their stage in the business cycle is shown in Table 4.2.2.2.

Table 4.2.2.2. Farm business stage in the business cycle.

	Survey (n=417)	Shadbolt and Olubode-Awosola (2013) (n=256)
Business cycle stage	% of farm businesses	% of farm businesses
Entry	1.4	0.4
Growth	19.2	30.9
Consolidation	50.4	52.0
Exit	6.2	2.7
Entry of next generation	22.8	14.1
Total	100	100

The majority of respondents in the survey (50%) stated that their farm business was in the consolidation stage of the business cycle. A similar percentage of dairy farmers (52%) was reported to be at the same stage by Shadbolt and Olubode-Awosola (2013) in their survey. However, fewer farm businesses in our survey were in the growth stage (19%) when compared to those reported in the other study (31%). The relatively low percentage of farm businesses in the growth stage came at the expense of relatively high percentages of farm businesses that were either, in preparation for the entry of the next generation (23%) or near exiting the business (6%) stages. The percentage of farm businesses in both of these two stages(entry of new generation and exit) were higher than those observed in the Shadbolt and Olubode-Awosola (2013) study of Shadbolt and Olubode-Awosola (2013) which were at 14% and 3%, respectively.

4.2.3. Respondent risk profile.

The distributions of respondent answers to the five questions used in this survey for capturing risk profile are shown in Table 4.2.3. In addition, results from the Shadbolt and Olubode-Awosola (2013) study, which used identically worded questions to capture the risk profile of a random sample of dairy farmers in New Zealand, are also reported.

Table 4.2.3. Distribution of respondents by risk profile in the survey and in a study from Shadbolt and Olubode-Awosola (2013).

	Survey		Shadbolt and Olubode-Awosola (2013)	
Items	Count	Count %	Count	Count %
1) Within a season, I am able to manage almost all uncertainty that occurs				
Strongly agree	61	15	29	11
Agree	287	69	163	64
Neutral	48	12	28	11
Disagree	20	5	31	12
Strongly disagree	0	0	4	2
Total	416	100	255	100
2) Over the long term, I am able to manage almost all uncertainty that occurs				
Strongly agree	65	16	26	10
Agree	278	68	155	61
Neutral	53	13	39	15
Disagree	14	3	31	12
Strongly disagree	1	0	3	1
Total	411	100	254	100
3) I find planning difficult because the future is so uncertain				
Strongly agree	11	3	2	1
Agree	54	13	40	16
Neutral	66	16	54	21
Disagree	178	43	125	49
Strongly disagree	108	26	32	13
Total	417	100	253	100
4) When there are a number of solutions to a problem, I find it difficult to make a choice				
Strongly agree	3	1	3	1
Agree	32	8	21	8
Neutral	43	10	37	15
Disagree	213	51	146	57
Strongly disagree	123	30	47	19
Total	414	100	254	100
5) When it comes to business, I like to play it safe				
Strongly agree	28	7	17	7
Agree	196	47	91	36
Neutral	122	30	88	35
Disagree	62	15	55	22
Strongly disagree	5	1	3	1
Total	413	100	254	100

As shown in Table 4.2.3, about 84% of respondents strongly agreed or agreed that they had the ability to manage almost all uncertainties that occur within a season and over the long term.

Nearly 69% of the respondents did not find it difficult to plan despite the future being uncertain. The majority of respondents (81%) indicated they had no difficulty in making a choice where multiple solutions were available. Finally, 54% of respondents strongly agreed or agreed that when it came to business they liked to play it safe. This latter statement indicated that they were more risk adverse than the 29% who stated neutrality with regard to playing it safe and the 16% who strongly disagreed or disagreed, therefore showing a more risk taking attitude.

The results observed from respondents in the survey were slightly different from those in the study by Shadbolt and Olubode-Awosola (2013) (Table 4.2.3.1.). In both the survey and the Shadbolt and Olubode-Awosola (2013) study, all the items had a higher proportion of respondents answering at the same end of the scale. This indicated that the risk profile of respondents in this survey was a fair representation of the dairy farmer population.

4.2.4. Resilience attributes.

The majority of survey respondents agreed or strongly agreed in the relation to the items used to assess a farmer's willingness to accept uncertainty and change (Table 4.2.4.1). In this respect, 84% of respondents intended to make time to implement changes required in their farm business. Nearly all of the respondents (92%) stated they were willing to make changes in their farm businesses. Finally, 70% of respondents were willing to accept uncertainty in their farm businesses.

Table 4.2.4.1. Distribution of respondents by their willingness to accept uncertainty and change profile.

Item	Count	Count %
1) I intend to make time to implement changes required in my farm business.		
Strongly agree	74	18
Agree	272	66
Neutral	61	15
Disagree	4	1
Strongly disagree	2	0
Total	413	100
2) I am willing to make changes to my farm business.		
Strongly agree	95	23
Agree	287	69
Neutral	24	6
Disagree	6	1
Strongly disagree	1	0
Total	413	100
3) I am willing to accept uncertainty in my farm business.		
Strongly agree	31	8
Agree	256	62
Neutral	73	18
Disagree	41	10
Strongly disagree	12	3
Total	413	100

The majority of respondents showed signs of open-mindedness as they agreed or strongly agreed with the two items used to assess open mindedness (Table 4.2.4.2). In this respect, the vast majority of respondents (93%) stated they valued the knowledge of others from inside and outside the farm business, and 78% of respondents considered that everyone in the industry learnt from each other.

Table 4.2.4.2. Distribution of respondents by their open-mindedness profile.

Item	Count	Count %
1) I value the knowledge of others from inside and outside the farm business.		
Strongly agree	129	31
Agree	254	62
Neutral	24	6
Disagree	2	0
Strongly disagree	4	1
Total	413	100
2) I consider everyone in the dairy industry learns from each other.		
Strongly agree	90	22
Agree	232	56
Neutral	62	15
Disagree	29	7
Strongly disagree	1	0
Total	414	100

The majority of respondents showed signs of having a high self-efficacy profile (Table 4.2.4.3). In this respect, 89% of the respondents stated they were confident about their capability to deal efficiently with unexpected events. 88% of respondents affirmed they did not struggle to solve

difficult problems. Finally, 59% of respondents indicated it was easy for them to stick to their aims and accomplish their goals. A smaller group, 29%, stated that it was easy for them or hard to stick to their aims and accomplish their goals.

Table 4.2.4.3. Distribution of respondents by their self-efficacy profile.

Item	Count	Count %
1) I am confident that I can deal efficiently with unexpected events.		
Strongly agree	140	34
Agree	229	55
Neutral	20	5
Disagree	10	2
Strongly disagree	17	4
Total	416	100
2) No matter how hard I try, I struggle to solve difficult problems.		
Strongly agree	2	0
Agree	14	3
Neutral	31	7
Disagree	217	52
Strongly disagree	150	36
Total	414	100
3) It is easy for me to stick to my aims and accomplish my goals.		
Strongly agree	38	9
Agree	209	50
Neutral	123	30
Disagree	41	10
Strongly disagree	5	1
Total	416	100

The majority of respondents showed signs of internal locus of control as indicated by their responses to the questions shown in Table 4.2.4.4. An internal locus of control meant that respondents believed they had control over external events. In this respect, Table 4.2.4.4. shows that 83% of respondents stated that the success of their business was not determined by factors outside their control (item 1), and 91% indicated that while commodity prices and weather can negatively affect the business in the short term, they believed there was a lot they could do to manage and control the business in the long term (item 2). Few respondents indicated neutrality to items 1 and 2, 12% and 8%, respectively. Very few respondents had an external locus of control, as reflected in their responses to items 1 (5% of respondents answered they agreed of strongly agreed in response to item 1) and 2 (1% of respondents disagreed in response to item 2).

Table 4.2.4.4. Distribution of respondents by their locus of control profile.

Item	Count	Count %
1) The success of my farm business is mostly determined by factors outside of my control.		
Strongly agree	5	1
Agree	17	4
Neutral	50	12
Disagree	242	59
Strongly disagree	98	24
Total	412	100
2) The weather and commodity prices can knock the business around in the short term, but in the long term, there is still a lot I can do to stay ahead of the game.		
Strongly agree	121	29
Agree	259	62
Neutral	32	8
Disagree	4	1
Strongly disagree	0	0
Total	416	100

The majority of respondents showed positive signs of sense-making capability (Table 4.2.4.5). In this respect, 78% of the respondents stated that they were good at making sense of ambiguous and uncertain situations, and 81% stated that they paid close attention to conditions outside the dairy industry. Moreover, 63% of respondents had regular contact with other farmers where they discussed trends in the dairy industry and 75% had regular contact with other members in the industry to acquire knowledge. Finally, the vast majority of respondents (91%) indicated they reviewed their experiences to assess a situation that was new to them.

Table 4.2.4.5. Distribution of respondents by their sense-making profile.

Item	Count	Count %
1) I am not good at making sense of ambiguous and uncertain situations.		
Strongly agree	4	1
Agree	29	7
Neutral	59	14
Disagree	202	49
Strongly disagree	121	29
Total	415	100
2) I do not pay close attention to conditions outside the dairy industry.		
Strongly agree	2	0
Agree	33	8
Neutral	43	10
Disagree	231	56
Strongly disagree	105	25
Total	414	100
3) I have regular contact with other farmers where we discuss trends in the industry.		
Strongly agree	48	12
Agree	211	51
Neutral	103	25
Disagree	47	11
Strongly disagree	5	1
Total	414	100
4) I have regular contact with other members of the industry to acquire knowledge.		
Strongly agree	86	21
Agree	224	54
Neutral	80	19
Disagree	18	4
Strongly disagree	4	1
Total	412	100
5) When confronted with a new situation, I review past experiences to assess the situation.		
Strongly agree	118	28
Agree	260	62
Neutral	30	7
Disagree	6	1
Strongly disagree	3	1
Total	417	100

The majority of respondents showed positive signs of strategic thinking capability (Table 4.2.4.6). In this respect, 89% of respondents stated that their decision-making was driven by their vision for their farm business. 96% agreed or strongly agreed that they considered how different parts of the farm system impact on each other, showing a degree of systems thinking which is an important element of strategic thinking. The same proportion of respondents (96%) considered a range of possibilities when resolving a strategic problem. 64.7% of the respondents disagreed or strongly disagreed in response to always sticking to their original plans regardless of the situation. Finally, respondents' answers to item 5 were the ones that varied the most with neutrality being the most representative answer (45%).

Table 4.2.4.6. Distribution of respondents by their strategic thinking profile.

Item	Count	Count %
1) My decision-making is driven by my vision for my farm business.		
Strongly agree	170	41
Agree	199	48
Neutral	39	9
Disagree	3	1
Strongly disagree	4	1
Total	415	100
2) I consider how different parts of the farm system impact on each other.		
Strongly agree	168	41
Agree	231	56
Neutral	10	2
Disagree	2	0
Strongly disagree	3	1
Total	414	100
3) When resolving a strategic problem I consider a range of possibilities.		
Strongly agree	118	28
Agree	284	68
Neutral	13	3
Disagree	0	0
Strongly disagree	0	0
Total	415	100
4) No matter what happens, I always stick to my original plans.		
Strongly agree	4	1
Agree	38	9
Neutral	105	25
Disagree	226	54
Strongly disagree	43	10
Total	416	100
5) I do not search for patterns when confronted with rich information.		
Strongly agree	18	5
Agree	117	30
Neutral	177	45
Disagree	74	19
Strongly disagree	8	2
Total	394	100

There were no other studies providing information for comparison with the descriptive statistics from the items that were used to capture the six resilience attributes in this survey. However, there was variability in responses across items, which ensured that differences among respondents could be derived. Nevertheless the variability in responses varied across items. While some of the items had good variability of answers (e.g. the item "It is easy for me to stick to my aims and accomplish my goals" in Table 4.2.4.3), other items had limited variability in responses (e.g. "When resolving a strategic problem, I consider a range of possibilities" in Table 4.2.4.6). The latter indicated that the questions were not very well developed or that the sample was biased in a way that farmers with similar characteristics responded in the same way. Nevertheless, the first step for the analysis of these responses in order to obtain farmer typologies was to perform principal component analysis on items grouped by attribute. Principal

components analysis resulted in farmer scores for each attribute that were weighted by the variability in responses, with items that had the most variability in responses contributing more to generate the final score of an attribute.

4.2.5. Perception of the farm business environment.

No respondent reported that they considered that all of the sources of risk listed in the survey were changing at the same pace. Perceptions of change varied across respondents (Table 4.2.5.1).

Table 4.2.5.1. Respondents' perception of the changing conditions of different risk sources in the farm business environment in the last 10 years.

				% of responses				
Source of risk[†]	N	Mean[‡]	Median[‡]	Decreasing rapidly	Decreasing slowly	Constant	Increasing slowly	Increasing rapidly
Local body laws and regulations (R)	408	4.2	4	1.2	3.7	6.9	47.1	41.2
Input prices and availability (M)	401	4.1	4	0.0	2.5	12.5	59.9	25.2
Global competitors & competition (M)	403	4.1	4	0.0	2.0	16.6	54.3	27.0
Technological changes (T)	407	4.0	4	0.2	7.4	12.3	48.2	31.9
Government laws and policies (R)	406	4.0	4	1.5	4.2	18.0	49.5	26.8
Land values (F)	405	4.0	4	0.2	5.9	16.5	52.6	24.7
Global supply and demand for food (M)	405	3.9	4	1.7	9.1	10.6	52.3	26.2
Milk price (M)	402	3.6	4	3.5	9.7	20.1	53.2	13.4
Global econ. and political situation (M)	404	3.6	4	0.7	15.8	25.7	38.9	18.8
Skills and knowledge (H)	407	3.5	4	1.2	13.8	22.9	55.0	7.1
Dairy industry structure (M)	402	3.5	4	1.0	15.2	28.9	43.0	11.9
Reputation and image of industry (M)	406	3.3	4	4.9	20.4	24.1	37.2	13.3
Interest rates (F)	403	3.1	4	3.5	23.6	34.7	35.5	2.7
Climate (P)	409	3.5	3	0.2	5.1	47.7	37.7	9.3
Pasture/crop/animal health (P)	404	3.4	3	0.0	14.4	39.6	39.1	6.9
Availability of capital (F)	402	3.3	3	1.0	13.2	47.3	29.9	8.7
Business relationships (M)	399	3.3	3	0.5	11.5	48.1	37.8	2.0
Availability of labour (H)	405	3.1	3	3.0	24.0	39.8	26.2	7.2
Other	41	4.2	5	4.9	7.3	7.3	24.4	56.1

[†] Type of risk between brackets: F=financial, H=human, M=market, P= production, R=regulatory, T=technological risk.
[‡] Score scales: 1= Very low, 2= Low, 3= Moderate, 4= High, 5= Very high.

Table 4.2.5.1 shows that 14 out of the 19 sources of risk in the list were considered to have been increasing, either rapidly or slowly, by more than 50% of respondents, while the remaining five (climate, pasture/crop/animal health, availability of capital, business relationships, and

availability of labour) were considered to have been constant by about half the respondents. Although there were respondents who considered that some of the sources of risk were decreasing either slowly or rapidly, these were a relatively small proportion of the total responses in the survey. The two sources of risk that were considered to be decreasing slowly or rapidly by a relatively high proportion of respondents were interest rates and the reputation and image of the dairy industry which accounted for 27% and 25% of responses, respectively.

The sources that were most associated with an increasing rate of change were regulatory risks, technological risks and market risks. In this respect, 88% and 76% of respondents considered that local body laws and regulations, and government laws and policies respectively, had been increasing either rapidly or slowly. Likewise, 80% of respondents considered that technological changes were also increasing either rapidly or slowly. As for market risks, seven out of the eight sources of market risk listed in the survey (input prices and availability; global competitors & competition; global supply and demand for food; milk price; global economic and political situation; dairy industry structure; and reputation and image of industry) were reported to have been changing at an increasingly slow or rapid pace by more than 50% of respondents. Business relationships, was the only source of market risk that was not considered to be increasing by most respondents. This source of risk was reported by 48% of respondents to be remaining constant. The other two sources considered to be increasing by more than 50% of respondents were land values and skills and knowledge of those associated with the business, the former being a risk associated to finance and the latter with human resources.

Respondents did not consider that there were any changes in the sources of production risk. Relating to this, climate and pasture/crop/animal health were associated with a constant pace of change by 48% and 40% of respondents respectively. Other sources of risk that were considered unaltered by a relatively high proportion of respondents were: availability of capital (47%), business relationships (48%), and availability of labour (40%).

A small number of respondents (n=41) indicated that "other" sources of risk were also relevant to them to characterise change in the farm business environment. Among this latter group of respondents, 56% reported that this source of risk was changing at an increasingly rapid pace. Farmer concerns were mostly related to the "environment" with many of the comments relating to the cost of compliance with environmental regulations or plainly "environmental issues". A few respondents (2) were concerned about the increment in the cost of labour.

Respondent perception of volatility is shown in Table 4.2.5.2.

Table 4.2.5.2. Respondent perception of the volatility of the different risk sources in the farm business environment in the last 10 years.

Source of risk[†]	N	Mean[‡]	Median[‡]	% of responses				
				Very low	Low	Moderate	High	Very high
Milk price (M)	401	3.9	4	0.2	2.2	25.9	48.1	23.4
Input prices and availability (M)	396	3.5	4	0.3	6.3	43.4	39.9	10.1
Climate (P)	401	3.4	3	1.0	6.2	54.1	32.2	6.5
Land values (F)	401	3.3	3	0.5	13.5	42.4	38.4	5.2
Availability of labour (H)	400	3.1	3	3.8	19.5	49.0	20.5	7.3
Interest rates (F)	399	3.0	3	3.0	24.3	46.4	23.3	3.0
Availability of capital (F)	395	3.0	3	2.8	21.8	53.7	19.2	2.5
Skills and knowledge (H)	398	2.9	3	3.0	26.4	53.5	15.1	2.0
Pasture/crop/animal health (P)	391	2.8	3	1.3	28.1	59.3	10.2	1.0
Other	30	4.0	4	0.0	3.3	23.3	43.3	30.0

[†] Type of risk between brackets: F=financial, H=human, M=market, P= production, R=regulatory, T=technological risk.
[‡] Score scales: 1= Very low, 2= Low, 3= Moderate, 4= High, 5= Very high.

More than half of respondents considered that the volatility of two of the sources of risk: milk price and input prices and availability were high or very high. On the other hand, around half of respondents considered that each of the remaining sources of risk (climate; land values; availability of labour; interest rates; availability of capital; skills and knowledge; and pasture/crop/animal health) were low to moderate in volatility. A small number of respondents (n=30) indicated that "other" sources of risk (mostly associated with environmental issues) were also highly volatile.

None of the survey respondents reported to have perceived all of the sources of risk as opportunities, threats, nor opportunities and threats for their farm businesses; rather, respondent perception of each of the risk sources listed in the survey varied. Figure 4.2.5.1 shows the variability in responses relating to the perception of risk for the sources of risk listed in the survey. The list of sources of risk is ordered by the percentage of respondents that perceived them as opportunities, followed by the percentage that answered opportunities and threats, and then threats. Therefore, the risk sources at the top of the chart were the ones that were perceived to provide opportunities for most of respondents; whereas the ones at the bottom were considered to be threats by most respondents.

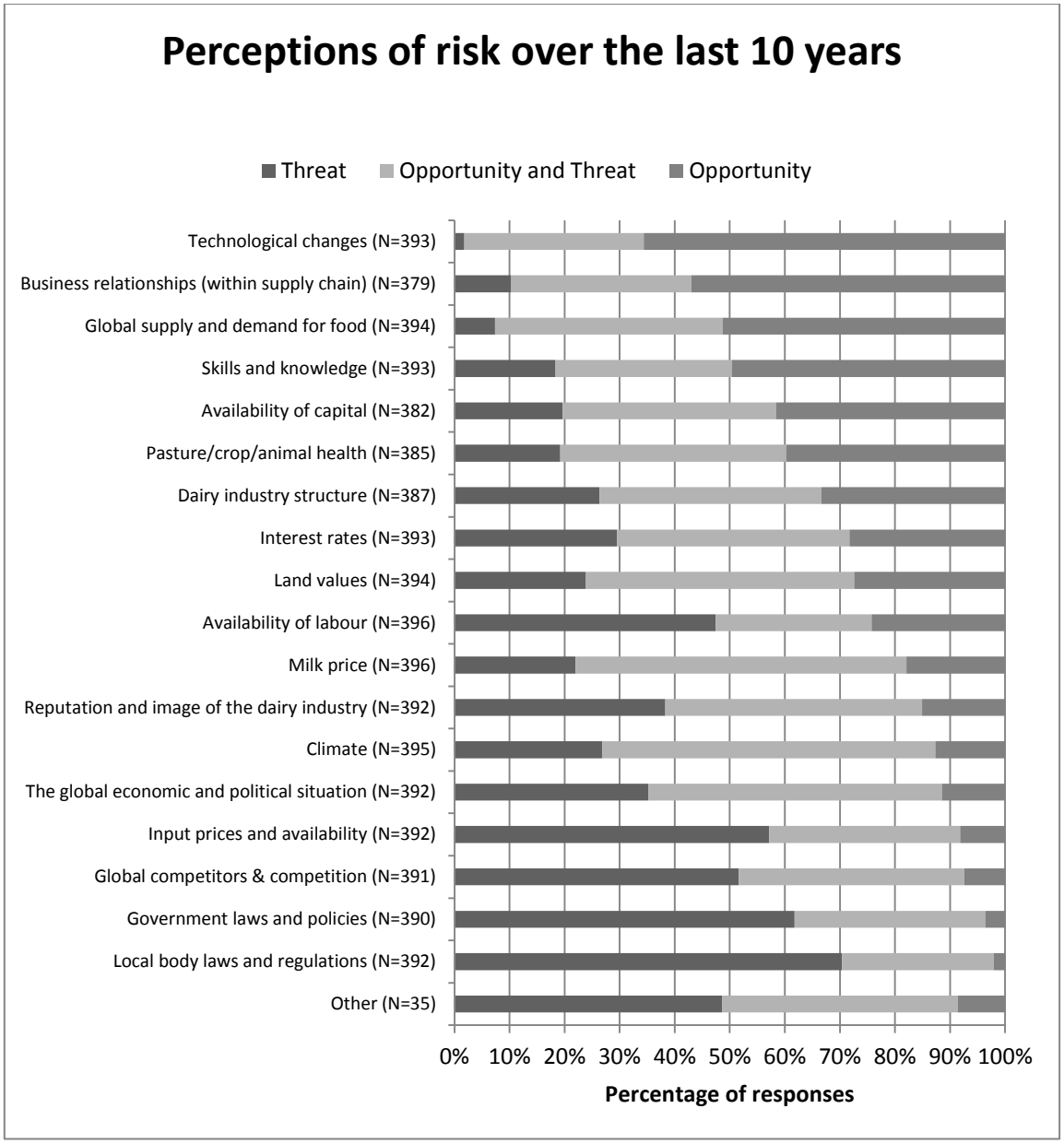


Figure 4.2.5.1. Perception of risk as an opportunity, threat, or opportunity and threat, for each of the sources of risk affecting their farm businesses in the last 10 years.

More than 50% of respondents reported that the following sources of risk presented an opportunity but not a threat: 1) technological changes; 2) business relationships within the supply chain; 3) the global supply and demand for food; and 4) skills and knowledge of those associated with the business, ranked in that order of representativeness. In contrast, the ranking of the most threatening risk sources was: 1) local body laws and regulations; 2) government laws and policies; 3) global competitors and competition; and 4) input prices and availability. These four were reported as "threats" without any opportunities by more than 50% of respondents. As for the sources of risk that presented both opportunities and threats, more than 50% of respondents

reported that these were: 1) climate; 2) milk price; 3) the global economic and political situation; and 4) land values.

Combining the results from Tables 4.2.5.1, 4.2.5.2, and Figure 4.2.5.1 it can be summarised that most farmers (>50% of respondents) believed regulatory risks were increasing rapidly and presented a threat to their farm business. Likewise, some market risks that have been increasing rapidly, such as global competitors and competition and input prices and availability, were also perceived as threats by most farmers, the latter risk also being associated with high volatility. In contrast, some increasing rapid changes in sources of market risks and technological risks were mostly associated with opportunities. In this regard, most farmers saw global supply and demand for food and technology as rapid increasing changes that presented an opportunity for their business. Other sources of risk that remained constant and were opportunities for farm businesses were the business relationships within the supply chain and the skills and knowledge of those associated with the businesses. Milk price was reported to be the most volatile of all risk sources (more than 70% of respondents reported its volatility had been high or very high); this was reflected in the high proportion of farmers reporting this risk as both opportunity and threat.

Although these results showed how farmers saw the environment retrospectively, similar results were obtained by Shadbolt and Olubode-Awosola (2013) and Pinochet-Chateau et al. (2005a) who also asked farmers to assess risks but from a future perspective. The results from this research are consistent with Shadbolt and Olubode-Awosola (2013) who identified the same three risks (global supply, technology, skills and knowledge of the people associated with the business) as among the risks that farmers believed would give them the most benefit in the long term. Similarly, the findings from this research match the findings of Shadbolt and Olubode-Awosola (2013) and Pinochet-Chateau et al. (2005a) who found input prices, local body laws and regulation, global situation and the government were among the most threatening risks. Finally and in accordance with Shadbolt and Olubode-Awosola (2013), the results from this work reinforced the idea that some risks such as milk price and climate present both opportunities and threats for farmers. The notion that some risk sources present both an opportunity and a threat for farm businesses is a core idea in the concept of resilience and risk management; this is because the identification of the sources of risk and the risk management strategies aimed to capture both upside and downside risks arising from these sources provide the first clue of how farmers might build resilient farm systems.

4.2.6. Risk management strategies.

Table 4.2.6.1 shows the percentages of farmers using or not using the risk management strategies listed on the survey. Strategies are ordered so that the strategies at the top are the most widely adopted and the strategies at the bottom are the least widely adopted. Usage percentages from other studies are also reported in the table for comparison.

Table 4.2.6.1. Risk management strategy user percentages from respondents in this survey and other studies.

	% of responses in this survey				% of farmers (Shadbolt and Olubode-Awosola, 2013)			% of farmers (Pinochet-Chateau et al., 2005a)	% of farmers (Martin , 1994)
Risk management strategy*	N	Using	Not using	N/A	Using	Not using	N/A	Using	Using
Maintaining feed reserves (P)	404	95.3	3.2	1.5	94.6	5.1	0.4	95.0	96.0
Planning of capital spending (F)	400	95.0	3.5	1.5	95.6	4.4	0.0	84.0	86.0
Managing debt (F)	400	94.0	2.3	3.8	96.5	2.4	1.2	83.0	68.0
Using practical planning steps (O)	399	91.5	6.5	2.0	96.0	4.0	0.0	90.0	n/a
Having long term flexibility (O)	397	91.2	6.8	2.0	87.5	9.8	2.7	81.0	73.0
Strategic purpose (O)	400	89.3	9.8	1.0	86.2	11.9	2.0	28.0	n/a
Insurance (F)	402	89.1	8.7	2.2	92.2	6.7	1.2	81.0	77.0
Routine spraying or drenching (P)	401	88.5	9.2	2.2	86.3	10.9	2.7	88.0	92.0
Having short term flexibility (O)	402	87.6	9.7	2.7	89.9	9.7	0.4	78.0	80.0
SWOT analysis (O)	398	87.2	11.8	1.0	83.1	15.4	1.6	84.0	
Implementing technological innovation(s) (T)	399	87.0	12.0	1.0	n/a	n/a	n/a	n/a	n/a
Adjusting production methods/system (R)	397	85.1	11.8	3.0	n/a	n/a	n/a	n/a	n/a
Arranging overdraft reserves (F)	404	78.2	13.1	8.7	85.9	11.2	2.8	75.0	75.0
Monitoring programme for pest and diseases (P)	402	77.1	17.4	5.5	87.5	9.8	2.7	63.0	49.0
Maintaining financial reserves (F)	402	76.9	18.4	4.7	74.1	23.5	2.4	66.0	72.0
Gathering market information (M)	398	70.1	18.8	11.1	74.2	18.7	7.1	58.0	51.0
Using financial ratios to assist with decision making (O)	398	67.8	26.1	6.0	70.5	28.3	1.2	56.0	n/a
Keeping debt low (F)	399	64.4	30.3	5.3	62.9	35.2	2.0	63.0	85.0
Not producing to full capacity (P)	398	39.7	53.0	7.3	39.1	58.6	2.3	39.0	43.0
Forward contracting (M)	398	37.9	36.7	25.4	43.0	45.1	11.9	17.0	15.0
Spreading sales (M)	397	28.0	50.1	21.9	31.3	48.5	20.2	27.0	41.0
Irrigation (P)	400	27.8	0.0	72.3	29.2	53.4	17.4	18.0	10.0
Geographic diversity (P)	401	25.4	28.7	45.9	21.2	62.3	16.5	27.0	34.0
Main farm operator or family working off property (F)	398	25.1	52.3	22.6	25.8	69.3	4.9	n/a	n/a
Having more than one type of animal or other enterprises (O)	402	22.9	57.2	19.9	28.9	65.2	5.9	n/a	n/a
Using futures markets (M)	399	8.3	54.4	37.3	4.4	82.8	12.8	7.0	9.0
Other	13	86.7	6.7	6.7	n/a	n/a	n/a	n/a	n/a

*The risk the strategy aims to manage is shown between brackets: F=financial risk, M=market risk, O=overall risk, P= production risk, R=regulatory risk, T=technological risk.

Out of the 27 risk management strategies listed in the survey, none of the respondents reported using all of them or none of them in their farm businesses. There was variation across responses

with respect to whether each of the risk management strategies was used, not used, or was applicable to the farm businesses surveyed. However, most of the strategies listed in the survey were widely adopted by farmers (Table 4.2.6.1). The top seventeen strategies in the list were adopted by more than 65% of farmers, with maintaining feed reserves, planning of capital spending, managing debt, using practical planning steps in your farm business, and having long term flexibility being the most widely adopted strategies (used by more than 91% of respondents). In contrast, using futures markets, having more than one type of animal or other enterprises on your property, main farm operator or family working off property, geographic diversity, irrigation, spreading sales, forward contracting, and not producing to full capacity were the least adopted strategies (<40% of use).

The percentages of strategy use by respondents in this survey were mostly consistent with the results obtained by Shadbolt and Olubode-Awosola (2013), Pinochet-Chateau et al. (2005a) and Martin (1994). However, some differences were observed. The percentage use for the strategy gathering of market info (70%) was similar to that reported by Shadbolt and Olubode-Awosola (2013) (74%), with both percentages being slightly higher than the percentages reported by Pinochet-Chateau et al. (2005a) (58%) and Martin (1994) (51%). In contrast to Martin (1994), who reported 85% of dairy farmers used keeping debt low in 1992, fewer farmers in this survey (64 %) reported using that strategy. However, similar percentages were reported by Shadbolt and Olubode-Awosola (2013) and Pinochet-Chateau et al. (2005a), 62% and 63% respectively. A very high percentage of farmers in this survey (94%) managed debt, similar to the 95% was reported by Shadbolt and Olubode-Awosola (2013). However, a lower percentage was reported by Pinochet-Chateau et al. (2005a) (83%) and Martin (1994) (68%). These results are in accordance with the trend described by Pinochet-Chateau et al. (2005a), who noticed a change in farmers' focus from having less debt to starting to manage that debt as the years passed.

There was a slightly lower percentage of users in the survey that used monitoring programmes for pests and diseases (77%) compared to the study by Shadbolt and Olubode-Awosola (2013) (87%); although it was slightly higher than the percentages reported by Pinochet-Chateau et al. (2005a) and Martin (1994) which were 63% and 49%, respectively. Likewise, a lower percentage of respondents in this study were using arranging overdraft (78%) when compared with Shadbolt and Olubode-Awosola (2013) (86%). However, similar percentages were reported by Pinochet-Chateau et al. (2005a) and Martin (1994) (75% in both studies). The percentage of dairy farmers using irrigation found in this survey (28%) was similar to that reported by Shadbolt and Olubode-Awosola (2013) (29%), but higher than that reported by Pinochet-Chateau et al.

(2005a) (18%) and Martin (1994) (10%). There was a considerable time between studies and results indicate that there have been an increase in adoption of irrigation and the intensification of dairying in NZ as reported earlier by MacLeod and Moller (2006).

Interestingly, a small number of survey respondents (n=13) indicated they used "other" risk management strategies. The strategies described were: engaging in inherently profitable business opportunities; building a strong network of professionals; balancing work with lifestyle; taking some time off the farm for relaxation; recognising the environmental footprint of their business; educating others within the business as well as the public; employing family members; keeping a business focus; planning the succession of the farm business; ensuring timely decision making; and becoming more self-contained for feed and wintering.

As for the level of importance attributed to each risk management strategy, no respondent reported the same level of importance for all of the risk management strategies listed in the survey. Moreover, the level of importance for each of the risk management strategies varied among respondents (Table 4.2.6.2). The strategies listed in Table 4.2.6.2 are ordered by the level of importance given by survey respondents so that the strategies at the top of the table are the ones that had the highest median and mean importance scores and the ones at the bottom are the ones with the lowest median and mean scores.

Table 4.2.6.2. Importance of risk management strategies to respondents in this survey and other studies.

Score scale: 1= Very low (VL), 2= Low (L), 3= Moderate (M), 4= High (H), 5= Very high (VH).

	% of responses in the Survey									Shadbolt and Olubode-Awosola (2013)		Pinochet-Chateau et al. (2005a)
Risk management strategy†	N	VL (1)	L (2)	M (3)	H (4)	VH (5)	Mean	Med.		Mean	Med.	Mean‡
Managing debt (F)	384	0.8	2.3	13.0	47.7	36.2	4.2	4		4.3	4	3.8
Maintaining feed reserves (P)	400	0.3	2.8	19.5	42.0	35.5	4.1	4		3.9	4	3.9
Planning of capital spending (F)	390	0.3	2.1	23.3	45.9	28.5	4.0	4		4.1	4	3.6
Strategic purpose (O)	390	2.8	4.4	21.0	47.4	24.4	3.9	4		4.0	4	2.6
SWOT analysis (O)	389	1.8	7.2	27.8	40.9	22.4	3.7	4		3.7	4	3.6
Having short term flexibility (O)	384	1.3	5.7	29.2	46.1	17.7	3.7	4		3.9	4	3.7
Using practical planning steps (O)	387	1.3	5.4	32.0	44.2	17.1	3.7	4		4.0	4	3.8
Having long term flexibility (O)	385	1.3	5.5	34.5	40.8	17.9	3.7	4		3.9	4	3.6
Insurance (F)	385	2.9	7.5	32.2	34.3	23.1	3.7	4		3.8	4	3.6
Routine spraying or drenching (P)	391	2.8	8.2	27.6	43.7	17.6	3.7	4		3.6	4	3.9
Adjusting production methods/system (R)	383	2.9	5.5	36.8	40.7	14.1	3.6	4		n/a	n/a	n/a
Arranging overdraft reserves (F)	371	7.8	10.8	33.7	35.0	12.7	3.3	4		3.5	4	3.4
Keeping debt low (F)	374	2.4	12.8	38.0	29.9	16.8	3.5	3		3.4	3	3.3
Maintaining financial reserves (F)	377	3.7	10.9	37.1	32.6	15.6	3.5	3		3.5	4	3.4
Monitoring programme for pest and diseases (P)	386	1.8	14.0	39.9	31.9	12.4	3.4	3		3.8	4	3.3
Using financial ratios to assist with decision making (O)	364	5.2	13.7	35.7	32.4	12.9	3.3	3		3.5	4	3.1
Implementing technological innovation(s) (T)	384	3.1	12.2	46.6	29.9	8.1	3.3	3		n/a	n/a	n/a
Gathering market information (M)	350	6.9	15.4	38.0	27.4	12.3	3.2	3		3.3	3	3.1
Irrigation (P)	218	28.4	11.0	17.0	12.8	30.7	3.1	3		2.7	2	2.2
Not producing to full capacity (P)	364	14.3	25.3	34.1	20.3	6.0	2.8	3		2.4	2	2.7
Forward contracting (M)	287	21.3	18.1	37.3	18.8	4.5	2.7	3		2.6	3	1.2
Geographic diversity (P)	233	26.2	16.7	31.3	18.0	7.7	2.6	3		2.2	2	2.3
Spreading sales (M)	290	18.3	30.3	30.0	15.2	6.2	2.6	3		2.4	2	2.5
Main farm operator or family working off property (F)	285	28.8	27.7	22.8	15.1	5.6	2.4	2		2.0	2	n/a
Having more than one type of animal or other enterprises (O)	295	23.4	33.9	26.4	12.5	3.7	2.4	2		2.2	2	n/a
Using futures markets (M)	228	40.4	29.8	21.5	6.1	2.2	2.0	2		1.8	2	2.1
Other	15	6.7	0.0	0.0	40.0	53.3	4.3	5		n/a	n/a	n/a

† The type of risk the strategy aims to manage is shown between brackets: F=financial risk, M=market risk, O=overall risk, P= production risk, R=regulatory risk, T=technological risk.

Respondents in the survey considered that the most important strategies for managing risk in their farm businesses were, in order of importance: 1) managing debt; 2) maintaining feed reserves; 3) planning of capital spending; 4) having a clear and shared vision or strategic purpose for your operation; 5) SWOT analysis; 6) having short term flexibility; 7) using practical planning steps in your business; 8) having long term flexibility; 9) insurance; 10) routine spraying or drenching; and 11) adjusting your production method to comply with laws and regulations (Table 4.2.6.2.). These eleven strategies were considered of high or very high importance by more than 50% of respondents (Table 4.2.6.2.). In contrast, having the main farm operator or family working off property, having more than one type of animal or other enterprises, and using futures markets were considered of low or very low importance by more than 50% of respondents.

Most of the strategies that were ranked high were overall strategies relating to being aware of where the business was going and why. Likewise, financial management strategies were also ranked relatively highly; whereas production and marketing strategies were ranked among the least important. The low ranking of strategies relating to managing market risks may be explained by the intervention of the cooperative Fonterra, which has a key role in managing market risks for New Zealand dairy farmers. The strategies that were ranked as having very high or high importance by more than half of respondents were also the ones most widely adopted (more than 85% of respondents used these strategies). The only exceptions were irrigation and "other". Although these two strategies were among the most important, they were only adopted by a small number of respondents, 25% and 3 % of total respondents respectively.

Previous studies (Pinochet-Chateau et al., 2005a; Shadbolt & Olubode-Awosola, 2013) reported similar median and mean importance scores to the ones obtained in this survey (Table 4.2.6.2.). Both studies (Pinochet-Chateau et al., 2005a; Shadbolt & Olubode-Awosola, 2013) reported that the most important strategies were also the most widely adopted ones. All three studies obtained high importance scores and adoption percentages for managing debt, maintaining feed reserves, having short and long term flexibility, managing debt, planning of capital expenditure, insurance, and for a range of business planning strategies. Also, the strategies not producing to full capacity, spreading sales, geographic diversity, main farm operator or family member working off property, forward contracting, and future markets were ranked low in both use and importance by respondents in this survey and in the results shown by Pinochet-Chateau et al. (2005a) and Shadbolt and Olubode-Awosola (2013).

Some slight differences were also observed between studies. Respondents in this survey gave relatively less importance (median of 3) to maintaining financial reserves, monitoring programmes for pest and diseases and using financial ratios to assist with decision making compared to the findings of Shadbolt and Olubode-Awosola (2013) (median of 4). Conversely, higher importance median scores were observed in this survey for irrigation, not producing to full capacity, forward contracting, and geographic diversity when contrasted with the median scores reported by Shadbolt and Olubode-Awosola (2013).

4.2.7. Respondents' characteristics and choice of survey response method

Of the 436 survey responses gathered, 160 were collected electronically and 276 were collected by post. T–test and Chi-square tests were performed between respondents' preferred method for undertaking the survey and their profile in relation to: a) farm experience; b) age; c) highest level of formal education achieved; d) current situation; and e) farm business location.

A significant relationship was found between the reply method and farming experience; respondents who preferred the online method had less experience (M=31, SD=11.9) than respondents who chose postal (M=34, SD=11.4), t (401)=-2.7, p=.02 .

There was a significant relationship between reply method and formal education $\chi^2(5, N=420)=12$, p=.02. The Chi-square test was mostly explained by differences between observed counts and expected counts of farmers who had NCEA level 1 or School Certificate and those who had a graduate degree (Table 4.2.7.1.). While farmers with NCEA level 1 or School Certificate tended to prefer the postal method, respondents with graduate degree were more associated with the online method.

Table 4.2.7.1. Relationship between survey reply method and level of formal education achieved.

		Online survey	Postal survey	Total
NCEA level 1/ School Certificate	Count	29	87	116
	Expected Count	42.3	73.7	116
	Adjusted Residual	-3	3	
University entrance/bursary/NCEA level 2 or 3	Count	34	41	75
	Expected Count	27.3	47.7	75
	Adjusted Residual	1.8	-1.8	
Diploma graduate	Count	26	46	72
	Expected Count	26.2	45.8	72
	Adjusted Residual	-0.1	0.1	
Degree graduate	Count	31	37	68
	Expected Count	24.8	43.2	68
	Adjusted Residual	1.7	-1.7	
Postgraduate	Count	12	14	26
	Expected Count	9.5	16.5	26
	Adjusted Residual	1.1	-1.1	
Other	Count	21	42	63
	Expected Count	23	40.1	63
	Adjusted Residual	-0.6	0.6	
Total	Count	153	267	420
	Expected Count	153	267	420

No relationships were found between: reply method and age, $\chi^2(5, N=430)= 8$, $p=.14$; reply method and location $\chi^2(14, N=406)= 9.7$, $p=.78$,; or reply method and current situation $\chi^2(7, N=430)= 8.7$, $p=.27$.

These results suggest that farmers who are less experienced and/or have high degrees of formal education would rather complete an online survey rather than a postal one. This may be because farmers with this profile probably prefer to use computers over farmers who are more experienced or less educated. Interestingly, there was no association between preferred method and age.

These results may be interesting for understanding the effect of different survey methods on plausible survey bias. However, since both methods were offered for this survey, it is arguable that the preferred method for replying should have no bias effect on the responses obtained. Future research using survey methods and aiming to capture a representative sample of farmers should take this into consideration in order to avoid bias. Alternatively, if their aim is to capture the attributes of a particular group of respondents, one method could be the preferred choice over the other for conducting survey research.

4.2.8. General remarks and discussion about respondents profile.

Overall, survey respondents were slightly older, had slightly more experience in farming, and had higher levels of formal education than that observed in other studies (Fairweather & Mulet-Marquis, 2009; Fairweather et al., 2007; Pinochet Chateau, 2005; Shadbolt & Olubode-Awosola, 2013). At the same time, while the proportion of survey respondents that were dairy farm owner-operators was a fair representation of the national figures (DairyNZ, 2014b), the proportion of sharemilkers was under-represented, and a new role category, the "farm owner-non-operator", appeared in a relatively high proportion (20%). Consequently, the vast majority of survey respondents were farm owners (89%), regardless of their involvement in the operation of their farms. Moreover, respondents of this survey also had a high or very high influence on the long term business decisions (see Figure 4.2.1.5)

The differences in age observed between respondents in this survey and the national statistics described by Fairweather and Mulet-Marquis (2009) and the study by Pinochet Chateau (2005) may be explained because the age statistics were captured in different years (2014 and 2006 and 2005 respectively), and, thus, demographics could have slightly changed in that period because of the ageing of farmers and fewer younger people entering the dairy farming industry. Yet, the eight years difference between when the studies were conducted may justify the difference in results in this area. However, more recent research (Shadbolt & Olubode-Awosola, 2013) reported a similar age profile to the one observed for respondents in this survey.

Differences in farming experience between respondents in this survey and in Shadbolt and Olubode-Awosola (2013), and also the high percentage of farm owner-non-operators and low proportion of sharemilkers observed in this survey when compared to other studies (DairyNZ, 2014b; Pinochet Chateau, 2005; Shadbolt & Olubode-Awosola, 2013) may be related to the time of the year in which the survey was sent out. The survey was sent out near calving, and younger farmers with less experience, or sharemilkers, may have needed more time to commit to on-farm duties and, therefore, may have decided to not participate in the survey due to their lack of free time. On the other hand, farmers with more farming experience, or non-operating farmers who did little on-farm work during this period may have had more free time to commit to the survey, thus deciding to participate in the survey. These differences in free time may have reflected differences in experience and current situation in survey responses. To support this idea, five out of the 23 surveys that were sent back with no answered questions had comments apologising for not participating and explaining that that this was because they were busy calving. Likewise, this

may be a plausible explanation of the higher percentage of businesses in the "entry of next generation" or "exit" stages in the business life cycle in this survey compared to that reported by Shadbolt and Olubode-Awosola (2013).

A key characteristic of most survey respondents was that they had high or very high influence on long-term decision-making. This is important to note because it means that the strategies implemented by these farmers were likely to be the result of their own decision-making, and thus a reflection of their own personal attributes.

With regard to the farm businesses production figures collected in this survey, these were typical of dairy farms in New Zealand. However, there seemed to be slight differences relating to the regional distribution of farm businesses (slightly more cows in the Central Plateau, Bay of Plenty and South Canterbury regions and fewer cows in Waikato and North Canterbury compared to national statistics). A first, a plausible explanation for the differences could be that respondents might have confused the location of their farms with respect to the categories used in this survey, particularly for those regions that were close. For example, respondents might have chosen to locate their farms in the Bay of Plenty rather than Central Plateau and this resulted in an over-representation of cows in Bay of Plenty. The same might have happened between the South and North Canterbury categories.

A second possible explanation for differences in the location could be that there were respondents with multiple operations or respondents were asked to answer location regarding only one farm business (the one in which they had the most influence), which could have resulted in the over-representation of cows in some locations over others. This could be the case of respondents who might have had farm businesses in the Waikato or Central Plateau as well as in South Canterbury but responded to the survey in relation to their Canterbury farm. Although there was little data to support this idea, one important figure that supports this is that 34% and 47% of respondents in the Waikato and Central Plateau, respectively, were owner operators with multiple farm business. Nevertheless, because the differences between the sample and the national statistics were not large, and because the objective of this research was more focused on farmer attributes rather than farm attributes, the sample was considered to be sufficiently representative of the dairy farm population.

The commonality between the risk profiles of respondents in this survey and the results reported by Shadbolt and Olubode-Awosola (2013), describing a relatively high proportion of farmers who are risk averse and who had a good sense of control over external events, is typical of the

typology described in the literature as cautious strategists by Olsson (1988) or pragmatic entrepreneurs by McCarthy (2000). These types present a representative description of the dairy farmer population in New Zealand (Shadbolt & Olubode-Awosola, 2013).

With regard to respondent resilience profiles, results showed that farmer responses to questions regarding their willingness to accept uncertainty and to change, locus of control, self-efficacy, open-mindedness, strategic thinking and sense-making varied slightly. However, there was evidence of a bias reflecting positive attributes for some of the questions on each attribute. This may have been related to a poor adaptation of the questions to the context of farm management. Unfortunately, there was no information from other studies to compare the results from this survey with. Nevertheless, further PCA weighted questions based on the variability in responses gave less weighting to those of low variability, reducing the effect from these questions in the final scores for resilience attributes.

As for respondent perception of the sources of risk in the farm business environment, in general, survey responses on risks in the industry suggested that the major sources of change in the last 10 years came from regulatory risks which presented a major threat to farm businesses. In contrast, the most volatile risks were market risks, with the two risks identified with the highest volatility being input price and availability and milk price, which presented a threat and an opportunity and a threat for farm businesses, respectively. No other studies have analysed the farm business environment using a similar approach. This approach is useful for understanding how farmers perceived the environment in term of change and volatility of different risk sources and could be used to identify these factors as plausible drivers for strategic decisions implemented for farm businesses.

Finally, despite some small differences, respondent profiles with respect to their risk management strategies were a fair representation of the results reported in previous studies (Martin, 1994; Pinochet-Chateau et al., 2005a; Shadbolt & Olubode-Awosola, 2013). This indicated that respondents in the survey were typical of farmers in previous studies in their risk management strategies, particularly when compared with the most recent research (Shadbolt & Olubode-Awosola, 2013). Moreover, high importance was placed on strategies relating to strategic management, indicating entrepreneurism, which relates to people who are in constant search for opportunities (McCarthy, 2000). It also aligns with a purposeful cautious defensive strategy (Olsson, 1988), which is also typical of dairy farmers in New Zealand (Shadbolt & Olubode-Awosola, 2013; Shadbolt, Olubode-Awasola, Gray, & Dooley, 2010).

4.3. Resilient and risk farmer typologies.

The following sections outline the results from the principal components analysis performed on farmer responses to the resilience and risk profile questions grouped by the attributes identified in the literature. This allowed for a reduction in the questions to a number of derived attributes for resilience and risk profile which are described in sections 4.3.2 and 4.3.3 respectively. Moreover, farmer typologies based on the derived resilience and risk profile attributes are described in sections 4.3.4 and 4.3.5 respectively. Finally, the relationship between farmer types is described in section 4.3.6.

4.3.1. Data used in analysis.

All responses were considered useful for the purposes of describing the sample. However, for the purposes of principal components analysis and cluster analysis, only complete data sets were required, thus only the 364 responses from the farmers who answered all of the questions in the resilience attributes section were used (i.e. listwise deletion method). Allison (2002) argued that listwise deletion is more beneficial than imputation methods such as maximum likelihood or multiple imputations because it gives valid inferences when missing data is missing completely at random (MCAR). However, Meyers et al. (2006) suggested that the listwise deletion method may result in five problems: 1) the loss of cases may represent a loss in resources (time and economic); 2) the reduction of a sample size may increase the estimate of standard errors; 3) the reduction of the sample size may drop the sample below the number needed for most multivariate procedures; 4) the loss of sample size lowers the statistical power of the analysis; and 5) if the cases deleted were not representative of the sample, the results of any analysis may be less generalisable due to bias. It was assumed that a sample size of 364 farmers was a good enough sample for data analysis (i.e. assumptions regarding sample size for principal component analysis, cluster analysis and statistical tests were met) and, therefore, would be sufficient for reduction of the incidence of problems 2, 3 and 4 suggested by Meyers et al. (2006). Likewise, the missing data in the dataset was proven to be randomly missing (i.e. problem 5). Therefore, the PCA results obtained from the analysis of the dataset after listwise deletion were similar to the PCA results obtained by using random hot deck imputation. Therefore, it was assumed that missing data was missing randomly and, therefore, results were not biased by non-response of unanswered questions.

4.3.2. Derived resilience attributes.

Results from the PCAs indicated that one or two principal components (PCs) explained most of the variance in farmer response to the resilience questions aggregated in the attributes identified in the literature. This indicated that there were one or two underlying attributes behind each of the original attributes. The derived attributes that resulted from the interpretation of the principal components are shown in Table 4.3.2.1. Moreover, the component loadings that resulted from the PCAs are shown in Table 4.3.2.2. These component loadings indicated the relationship between each item and a principal component. A component loading with an absolute value of 0.4 or greater indicated that an item was strongly related to a principal component. Therefore, strongly related items were useful for interpreting each of the PCs and giving meaning to the derived attributes.

Table 4.3.2.1. Original and derived resilience attributes.

Original attribute found in the literature	Principal component (variance between brackets)	Derived resilience attribute (relevant items in brackets, refer to Table 4.3.2.2 for items #)
Willingness to accept uncertainty and to change	PC1 (50.5%) PC2 (34.5%)	Willingness to accept uncertainty (1,2) Willingness to change (3)
Open-mindedness	PC1 (61.4%)	Open-mindedness (shared learning) (5)
Self-efficacy	PC1 (50.7%)	General self-efficacy (6,7,8)
Locus of control	PC1 (72%)	Locus of control (farm business success) (9, 10)
Sense-making	PC1 (39.4%) PC2 (23.5%)	Social sense-making (13, 14) Individual sense-making (11)
Strategic thinking	PC1 (32.7%) PC2 (28.4%)	Strategic thinking focus (16, 17) Strategic planning focus (16, 20)

Table 4.3.2.2. Relationships between resilience attribute items and principal components.

Original attribute found in the literature	Item #	Description	PC1	PC2
Willingness to accept uncertainty and to change	1	I intend to make time to implement changes required in my farm business.	-0.204	-0.734*
	2	I am willing to make changes to my farm business.	-0.115	-0.639*
	3	I am willing to accept uncertainty in my farm business	-0.972*	0.230
Open-mindedness	4	I value the knowledge of others from inside and outside the farm business.	-0.240	
	5	I consider everyone in the dairy industry learns from each other.	-0.971*	
Self-efficacy	6	It is easy for me to stick to my aims and accomplish my goals.	-0.605*	
	7	No matter how hard I try, I struggle to solve difficult problems.	0.426*	
	8	I am confident that I can deal efficiently with unexpected events.	-0.673*	
Locus of control	9	The success of my farm business is mostly determined by factors outside of my control.	0.909*	
	10	The weather and commodity prices can knock the business around in the short term, but in the long term, there is still a lot I can do to stay ahead of the game.	-0.416*	
Sense-making	11	I am not good at making sense of ambiguous and uncertain situations.	0.274	0.836*
	12	I do not pay close attention to conditions outside the dairy industry.	0.384	0.357
	13	I have regular contact with other farmers where we discuss trends in the industry.	-0.647*	0.297
	14	I have regular contact with other members of the industry to acquire knowledge.	-0.572*	0.284
	15	When confronted with a new situation, I review past experiences to assess the situation.	-0.177	0.063
Strategic thinking	16	My decision-making is driven by my vision for my farm business.	-0.554*	0.437*
	17	I do not search for patterns when confronted with rich information.	0.697*	0.339
	18	I consider how different parts of the farm system impact on each other.	-0.399*	0.237
	19	When resolving a strategic problem, I consider a range of possibilities.	-0.195	0.024
	20	No matter what happens, I always stick to my original plans	0.130	0.798*

* Relevant item for explaining variance of responses explained by the PC (component loading ≥0.4)

The attribute "willingness to accept uncertainty and to change", derived in two different attributes: "willingness to accept uncertainty" and "willingness to change" (Table 4.3.2.1).

The derived attribute "willingness to accept uncertainty", which resulted from PC1 accounted for 50.5% of the variance in farmer response to the original questions (Table 4.3.2.1). The item that contributed the most to this variance was "I am willing to accept uncertainty in my farm business" (*component loading*= -0.97) (Table 4.3.2.2). This item was negatively related to PC1, which meant that the more a farmer agreed he/she was willing to accept uncertainty in their farm business, the lower he/she would score for PC1. In other words, PC1 captured a farmer's "unwillingness" to accept uncertainty in their farm business. Nevertheless, since the relationship between willingness to accept uncertainty and a resilient personality is positive (Boxelaar et al., 2006; Coutu, 2002), the new attribute derived from PC1 was termed in accordance to the positive relationship (Table 4.3.2.2).

The derived attribute "willingness to change" that resulted from the interpretation of PC2, explained 34.5% of farmer response to the original questions (Table 4.3.2.1). PC2 was mostly associated with the items "I intend to make time to implement changes required in my farm

business" (*component loading*=-0.73) and "I am willing to make changes to my farm business" (*component loading*=-0.64) (Table 4.3.2.2). Both of these items were related to willingness to change. However, since the component loadings were negative, the underlying attribute in PC2 was actually capturing a farmer's "unwillingness" to make changes in their farm business. Nevertheless, since the relationship between willingness to change and a resilient personality is positive (Coutu, 2002), the new attribute derived from PC2 was named in accordance to the positive relationship (Table 4.3.2.2).

The attribute "open-mindedness" derived into a single attribute termed "open-mindedness (shared learning)" (Table 4.3.2.1). The related PC accounted for 61.4% of the variance in farmer response. The item that contributed the most to this variance was "I consider everyone in the dairy industry learn from each other" (*component loading*=-0.97) (Table 4.3.2.1). In contrast, the item "I value the knowledge of others from inside and outside the dairy industry" did not load well on the PC (*component loading*=-0.24). This meant that the variability captured in this PC was more related to whether farmers accepted that those in the dairy industry share their learning, rather than whether farmers valued the knowledge stored in different networks. The sense of direction of the relationship between the item that loaded the most and the PC was negative, meaning that the PC reflected a farmer's "closed-minded" personality with respect to their acceptance that those in the dairy industry share their learning. Nevertheless, because the relationship between open-mindedness and a resilient personality is positive (Darnhofer, 2010; Webb, 2013), the attribute derived from this PC was named in accordance to the positive relationship. The fact that value of the knowledge in different networks did not load well on this PC may be explained by the idea that farmers may tend to put higher value on the knowledge from networks they trust (Fisher, 2013). Therefore, the inclusion of valuing knowledge of people from outside the dairy industry in the construct may have resulted in an item which was too ambiguous and did not help to capture variability in responses for the first PC nor loaded on a second PC.

The attribute "self-efficacy" derived in a single attribute termed "general self-efficacy". The related PC accounted for 50.7% of the variance in farmer response (Table 4.3.2.1). All of the items in the attribute contributed to explain this variance (Table 4.3.2.2). This PC was negatively associated with the ease with which a farmer sticks to their aims and accomplishes their goals (*component loading*=-0.60), and with their confidence in their ability to deal efficiently with unexpected events (*component loading*=-0.67). In contrast, the PC was positively associated with a farmer's lack of confidence in their ability to solve difficult problems (*component loading*=0.43)

(Table 4.3.2.2). The relationships of the three items with the PC indicated that the resulting PC had a negative association with general self-efficacy beliefs. Nevertheless, because the relationship between general self-efficacy beliefs and a resilient personality is positive (Reich et al., 2010; Schwarzer & Warner, 2013), the attribute derived from the interpretation of the PC was named in accordance to the positive relationship.

The attribute "locus of control" derived in a single attribute termed "locus of control (farm business success)". The related PC accounted for 72% of the variance in farmer response (Table 4.3.2.1). Both of the items in the original attribute contributed to explain this variance (Table 4.3.2.2). However, the item that contributed the most to this variance was "the success of my farm business is mostly determined by factors outside of my control" (*component loading*=0.90), with a positive relationship between this item and the PC. Likewise, the second item, "the weather and commodity prices can knock the business around in the short term but in the long term there is still a lot I can do to stay ahead of the game", also loaded well on the PC (*component loading*=-0.42), but the sense of direction of the relationship between this item and the PC was negative. The relationships between the two items and the PC indicated that the resulting PC had a negative association with locus of control. This negative association was reflected by a low perceived ability to control elements leading to farm business success. Nevertheless, because the relationship between locus of control and a resilient personality is positive (Skodol, 2010), the attribute derived from the interpretation of the PC was named "locus of control (farm business success)".

The attribute "sense-making", derived in two different attributes: "social sense-making" and "individual sense-making" (Table 4.3.2.1). The derived attribute "social sense-making", which resulted from PC1 accounted for 39.4% of the variance in farmer response to the original questions (Table 4.3.2.1). PC1 was mostly associated to the items "I have regular contact with other farmers where we discuss trends in the industry" (*component loading*= -0.65) and "I have regular contact with other members of the industry to acquire knowledge" (*component loading*= -0.57 (Table 4.3.2.2). These two items reflected a farmer's social networking behaviour in the form of having regular contact with others in the dairy industry to acquire knowledge and discuss industry trends. This social networking behaviour is similar to the social aspect of sense-making described by Weick et al. (2005), who indicated that sense-making comprised a social networking activity, in which plausible stories were preserved, retained or shared. The results of this research indicated that PC1 may be related to the use of social networking skills as a means of making sense of a situation. However, because the component loadings for the two items were negative,

PC1 reflected farmer responses with regard to a "low" social network skill set. Nevertheless, because the relationship between social networking skills and a resilient personality is positive (McCann et al., 2009; McCann & Selsky, 2012), the attribute derived from the interpretation of PC1 was named in accordance to the positive relationship.

The derived attribute "individual sense-making" that resulted from the interpretation of PC2 explained 23.5% of farmer response to the original questions (Table 4.3.2.1). This variance was mostly associated with a farmer's own perception of their ability to make sense of ambiguous and uncertain situations (*component loading*=0.84) (Table 4.3.2.2). Thus, PC2 may have captured a farmer's individual self-assessment of the efficiency of their sense-making process (Klein et al., 2006b). For this reason, the derived attribute that resulted from the interpretation of PC2 was named "individual sense-making".

The attribute "strategic thinking" was derived in two different attributes: "strategic thinking focus" and "strategic planning focus" (Table 4.3.2.1). The derived attribute "strategic thinking focus", which resulted from PC1 accounted for 32.7% of the variance in farmer response to the original questions (Table 4.3.2.1). Three items were mostly related to this variance: "my decision-making is driven by my vision for my farm business" (*component loading*=-0.55), "I do not search for patterns when confronted with rich information" (*component loading*=-0.70), and "I consider how different parts of the farm system impact on each other" (*component loading*=-0.40) (Table 4.3.2.2). These items reflected a farmer's focus on strategic decision-making, their focus in the recognition of patterns in information and their focus on conceiving the farm from a systems perspective. These three elements are closely linked to strategic thinking (Graetz, 2002; Mintzberg et al., 1998; Pisapia et al., 2005) and thus, PC1 may have reflected a farmer's strategic thinking focus. Nevertheless, because the component loadings for the items were negative, the new attribute resulting from PC1 denoted a "low" focus for strategic thinking. Yet, because strategic thinking is positively associated with a resilient personality (Sloan, 2013), the attribute derived from the interpretation of PC1 was named "strategic thinking focus".

The derived attribute "strategic planning focus", which resulted from the interpretation of PC2, accounted for 28.4% of the variance in farmer response to the original questions (Table 4.3.2.1). The item that contributed the most for this variance was "no matter what happens, I always stick to my original plans" (*component loading*=0.80); however, a second item "my decision-making is driven by my vision for my farm business" also loaded well on PC2 (*component loading*=0.44) (Table 4.3.2.2). These two items reflected a farmer's vision for strategy and their focus on the

plan as the ultimate objective of strategy; therefore, the items reflected farmer focus on the planning aspect of strategy. These elements were closely associated with a strategic planning capability (Graetz, 2002; Liedtka, 1998a), and so for this reason, the underlying attribute in PC2 was interpreted and named "strategic planning focus".

4.3.3. Derived risk profile attributes.

Results from the PCA performed on the questions aggregated in the attributes of a risk profile indicated that two principal components explained most of the variance in farmer responses. This indicated that there were two underlying attributes behind the original attribute. The derived attributes that resulted from the interpretation of the principal components are shown in Table 4.3.3.1. Moreover, the component loadings that resulted from the PCA are shown in Table 4.3.3.2.

Table 4.3.3.1. Derived risk profile attributes.

Original attribute found in the literature	Principal component (variance between brackets)	Derived risk profile attribute (relevant items in brackets, refer to Table 4.3.3.2 for items #)
Risk profile (Shadbolt and Olubode-Awosola, 2013)	PC1 (40.2%)	Risk management capability (3, 4)
	PC2 (22.4%)	Risk attitude (play it safe) (5)

Table 4.3.3.2. Relationships between risk profile items and principal components.

#	Item	PC1	PC2
1	Within a season, I am able to manage almost all uncertainty that occurs.	-0.197	0.323
2	Over the long term, I am able to manage almost all uncertainty that occurs.	-0.225	0.261
3	I find planning difficult because the future is so uncertain.	0.808*	0.120
4	When there are a number of solutions to a problem, I find it difficult to make a choice.	0.457*	-0.344
5	When it comes to business, I like to play it safe.	0.220	0.833*

* Relevant item for explaining variance of responses explained by the PC (component loading ≥0.4)

The attribute "risk profile" derived in two different attributes: "risk management capability" and "risk attitude (play it safe)" (Table 4.3.3.1).

The derived attribute "risk management capability", which resulted from PC1 accounted for 40% of the variance in farmer response to the original questions (Table 4.3.3.1). Two items were mostly related to this variance: "I find planning difficult because the future is so uncertain" (*component loading*=0.81), and "when there are a number of solutions to a problem, I find it difficult to make a choice" (*component loading*=0.46) (Table 4.3.3.2). These two items reflected a farmer's ability to manage risk from a normative (i.e. rational) management process perspective (French, 2009c; Mintzberg et al., 1998). In this respect, the items reflected farmer skills in two

main activities of the management process: a) the development of a plan based on a future perspective; and b) the ability to make choices. Because these elements reflected skills in management capability, the underlying attribute derived from the interpretation of PC1 was named "risk management capability".

On the other hand, the derived attribute "risk attitude (play it safe), which resulted from PC2, accounted for 22% of the variance in farmer response to the original questions (Table 4.3.3.1). One item, "when it comes to business, I like to play it safe", contributed the most to this variance (*component loading*=0.83) (Table 4.3.3.2). This item reflected a farmer's conservative attitude towards risk, or in other words, their degree of risk aversion when it came to doing business. For this reason, the underlying attribute that resulted from the interpretation of PC2 was named "risk attitude (play it safe)". The findings from the risk profile PCA were similar to the findings of Shadbolt and Olubode-Awosola (2013) that used multiple correspondence analysis (MCA) on the same items to characterise the risk profile of a sample of dairy farmers in NZ and found similar patterns in farmer response.

4.3.4. Resilient farmer typology.

The cluster analysis performed on the set of PC scores for the derived resilience attributes resulted in two clusters of farmers. Based on the profiles to be discussed, the clusters were nicknamed as follows:

- Cluster 1, which grouped 245 farmers, was typified as the "low resilient farmer".
- Cluster 2, which grouped 119 farmers, was typified as the "high resilient farmer".

The average Silhouette coefficient obtained for the cluster model was 0.2. The Silhouette coefficient is a measurement of the degree of cohesion and separation of clusters (Kaufman & Rousseeuw, 1990). This coefficient ranges from -1 to 1; the closer the measurement is to 1, the more different the clusters are from each other. A value of 0.2, reflects weak to moderate significant evidence of cluster structure (Kaufman & Rousseeuw, 1990). Moreover, five of the nine derived resilience attributes were relevant for discriminating the clusters (Figure 4.3.4.1). Figure 4.3.4.1, shows the predictor importance (*PI*) of each of the derived resilience attributes. The PI is an estimator of the relative importance of each derived attribute on estimating the cluster model. The higher the PI, the less likely that the variation of an attribute between clusters is due to chance and the more likely it is due to an underlying difference.

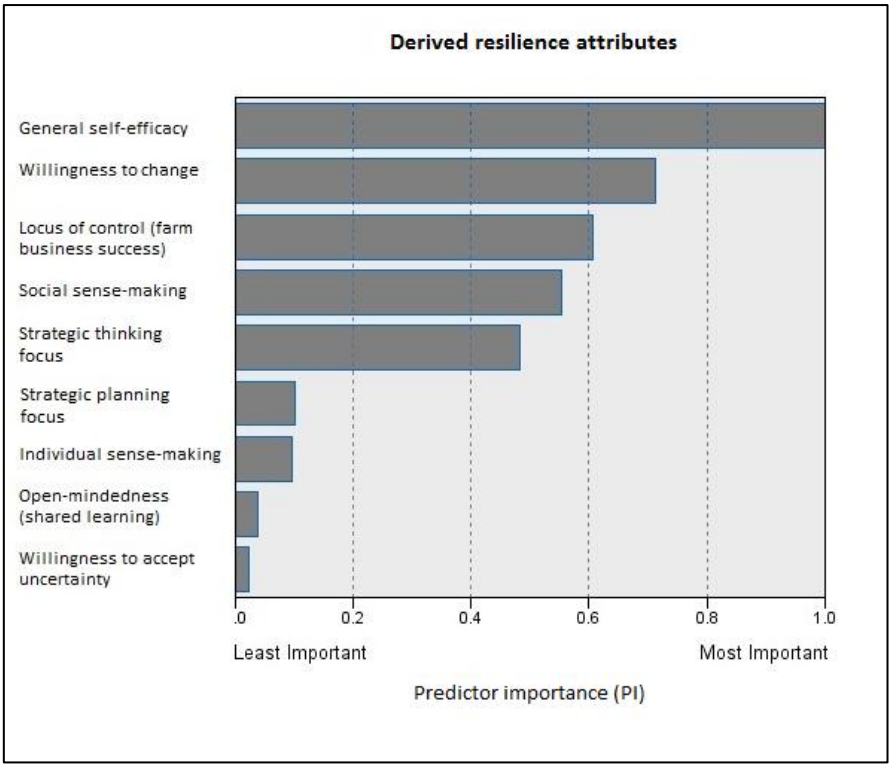


Figure 4.3.4.1. Relative importance of the derived resilience attributes on estimating resilient farmer clusters.

As shown in Figure 4.3.4.1, general self-efficacy, willingness to change, locus of control (farm business success), social sense-making, and strategic thinking focus were the attributes that contributed most in discriminating the resilient farmer clusters.

Table 4.3.4 shows the mean PC scores for the nine derived resilience attributes for the two clusters. It is important to note that PC scores were presented as z-scores, which meant that the overall PC score considering all survey responses is 0. A cluster with a mean PC score above 0 in one of the resilience derived attributes indicates that farmers in that cluster had a PC score that was above the overall mean PC score for that attribute.

Table 4.3.4. Mean PC scores for the derived resilience attributes by resilient farmer clusters.

Cluster	General self-efficacy	Willingness to change	Locus of control (farm business success)	Social sense-making	Strategic thinking focus	Strategic planning focus	Individual sense-making	Open-mindedness (shared learning)	Willingness to accept uncertainty
1	-0.43	-0.26	-0.28	-0.37	-0.28	-0.11	-0.12	-0.06	0.05
2	0.88	0.54	0.58	0.76	0.57	0.23	0.24	0.13	-0.1
Overall	0	0	0	0	0	0	0	0	0

Farmers grouped in cluster 1 exhibited negative mean PC scores for each of the derived attributes of resilience with the exception of "willingness to accept uncertainty" which had a positive mean PC score (*M*=0.05) (Table 4.3.4). In contrast, farmers in cluster 2 exhibited positive mean PC scores for each of the derived attributes of resilience with the exception of "willingness to accept uncertainty". For this latter attribute, the mean PC score for cluster 2 farmers was negative (*M*=-0.1).

The variability in PC scores of each of the attributes for farmers in both of the clusters and in overall responses is shown in Figure 4.3.4.2. Overall, farmer response variability is displayed as background boxplots that show the overall median and the interquartile range. The variability in response for farmers in each cluster is displayed as overlaid boxplots in which square point markers and horizontal lines indicate the median value and the interquartile range, respectively.

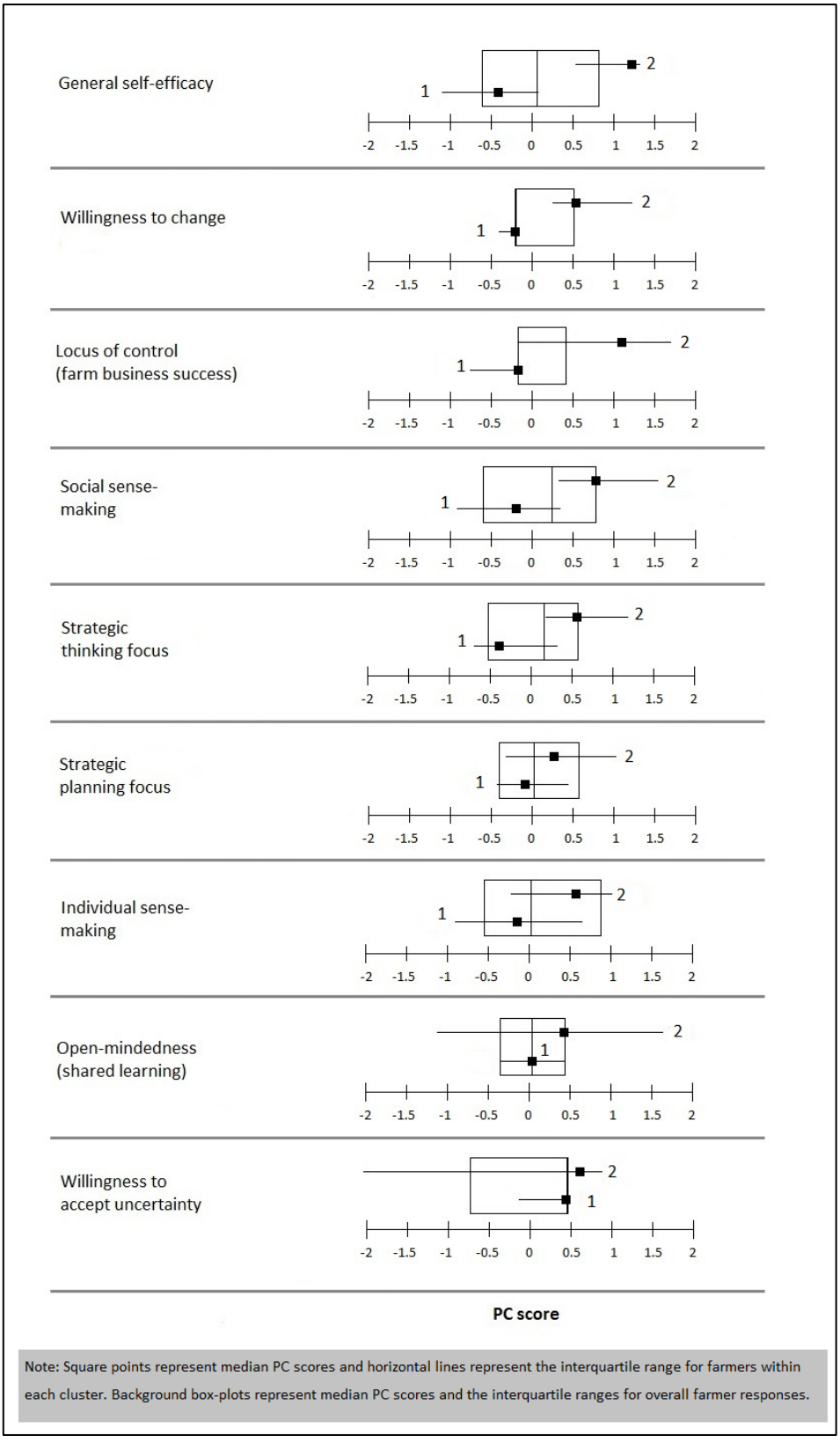


Figure 4.3.4.2. Comparison between resilient farmer clusters 1 and 2.

Figure 4.3.4.2 shows that the PC scores observed for each of the derived resilient attributes between both of the clusters were clearly different between clusters, particularly for those

attributes that were of more importance for defining the clusters (general self-efficacy, willingness to change, locus of control (farm business success), social sense-making, strategic thinking focus) since there was no overlap in the PC scores for these five attributes between clusters.

Farmers in cluster 2 had higher median PC scores for all of the attributes compared to farmers in cluster 1. The median PC scores for most important attributes: general self-efficacy, willingness to change, locus of control (farm business success), social sense-making, strategic thinking focus, were 1.12, 0.46, 0.81, 0.72, and 0.53, respectively for farmers in cluster 2 and 0.10, -0.19, -0.10, -0.28, and -0.48, respectively for farmers in cluster 1 (Figure 4.3.4.2).

Although there were differences between clusters in their median PC scores for the remaining attributes (strategic planning focus, individual sense-making, open-mindedness (shared learning), and willingness to accept uncertainty), their interquartile ranges tended to overlap, which indicated that farmers in both clusters were not very different one from another with respect to these attributes (Figure 4.3.4.2).

Because farmers in cluster 1 exhibited lower qualities for the attributes that were used to define the resilient farmer type than farmers in cluster 2, farmers in cluster 1 were termed "low resilient farmers" and farmers in cluster 2 were termed "high resilient farmers".

The findings from this cluster analysis were consistent with the description of resilient people provided by Coutu (2002), Reich et al. (2010), and Schwarzer and Warner (2013) who identified a direct link between perceived self-efficacy and a resilient personality. Likewise, these results were consistent with the findings described by Connor and Davidson (2003) and Coutu (2002), who found a direct relationship between a resilient person and their willingness to change, and Skodol (2010) who acknowledged that an internal locus of control is as an important attribute of resilient individuals. Moreover, a resilient personality was also linked with an enhanced ability for networking due to its effect on individual sense-making, as described by Darnhofer (2010), Goldstein (2009) and Hahn, Schultz, Folke, and Olsson (2008). These results are also consistent with Fazey (2010) and Walker and Salt (2006) who suggested that strategic thinking is an important prerequisite of resilience.

4.3.5. Risk farmer typology.

The cluster analysis performed on the set of PC scores for the two derived risk profile attributes resulted in four clusters of farmers. Based on the resulting profiles to be discussed, their similarities with the theoretical farm manager types described by Olsson (1988) and with the risk farmer types identified by Shadbolt and Olubode-Awosola (2013), the clusters were nicknamed following the typology of Olsson (1988) as:

- Cluster 1, which grouped 96 farmers, was typified as the "gambler farmer".
- Cluster 2, which grouped 69 farmers, was typified as the "entrepreneur farmer".
- Cluster 3, which grouped 125 farmers, was typified as the "cautious strategist farmer".
- Cluster 4, which grouped 74 farmers, was typified as the "defensive strategist farmer".

There was evidence of a strong cluster structure in the four cluster model (*Silhouette coefficient*=0.5) (Kaufman & Rousseeuw, 1990). Moreover, the two derived risk profile attributes were both relevant for discriminating these clusters. Nevertheless, risk management capability was of more importance (*PI*= 1) for determining the clusters compared to risk attitude (play it safe) (*PI*= 0.52) (Figure 4.3.5.1).

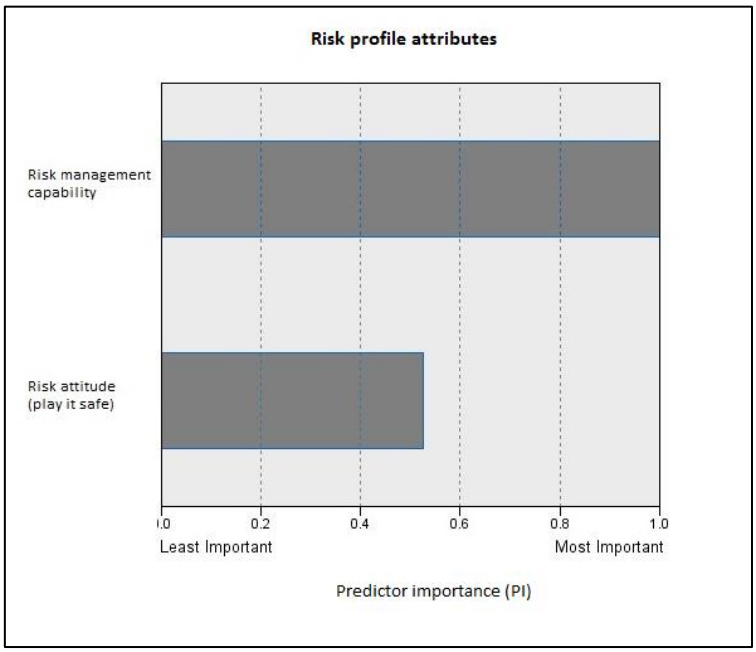


Figure 4.3.5.1. Relative importance of the derived risk profile attributes on estimating farmer clusters according to their risk profile.

Table 4.3.5 shows the mean PC scores for risk management capability and risk attitude (play it safe) for the four clusters.

Table 4.3.5. Mean PC scores for the derived risk profile attributes by risk profile clusters.

Cluster	Risk management capability	Risk attitude (play it safe)
1	-0.1	-0.77
2	1.38	-0.53
3	0.39	0.75
4	-1.81	0.22
overall	0	0

The variability in PC scores for risk management capability and risk attitude (play it safe) for farmers in the four clusters and in the overall response is shown in Figure 4.3.5.2.

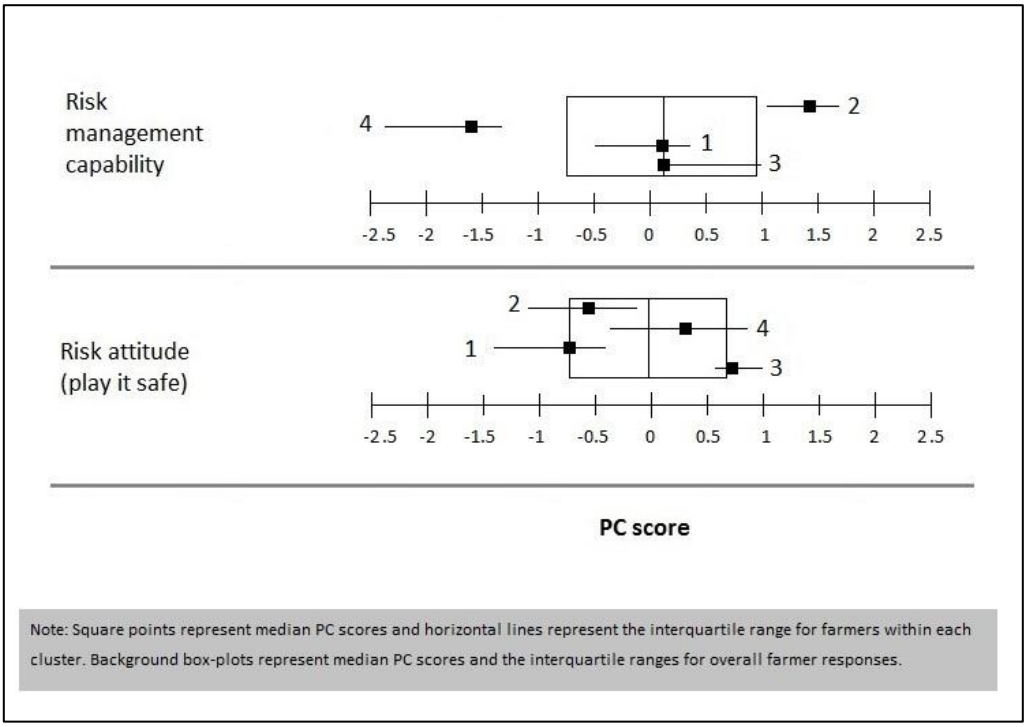


Figure 4.3.5.2. Comparison between risk profile farmer clusters 1, 2, 3 and 4.

Farmers in cluster 1 exhibited negative mean PC scores for both risk management capability (*M*=-0.1) and risk attitude (*M*=-0.77) (Table 4.3.5). The negative sign of these PC scores meant that these farmers had lower mean PC scores than the mean scores for all respondents for the two risk profile attributes. However, cluster 1 farmers' mean PC score for risk management capability was close to 0, which meant that the difference in magnitude between the mean PC scores for this cluster and the overall dataset was not of a considerable magnitude. Figure 4.3.5.2, shows the median value of risk management capability for cluster 1 (*Mdn*=0.07), which was similar to the median of the overall sample (*Mdn*=0.09). It is important to note that farmers in cluster 1 had the lowest mean PC score for risk aversion among all four clusters, followed by farmers in cluster 2 who had the second lowest mean PC score (*M*=-0.53) (Table 4.3.5). The risk

aversion profiles for farmers in clusters 1 and 2 were similar, with Figure 4.3.5.2 showing that the interquartile ranges of both clusters overlap.

The farmers in cluster 2 had mean PC scores of 1.38 and -0.53 for risk management capability and risk aversion, respectively (Table 4.3.5). The mean PC score for risk management capability of cluster 2 farmers was the highest among all clusters and it was higher than that of farmers in the overall dataset. Figure 4.3.5.2 shows that the distribution of risk management capability PC scores of farmers in cluster 2 was symmetric and there was no overlap with farmers from other clusters, which meant that these farmers were clearly different from the rest. On the other hand, the mean PC score for risk aversion of cluster 2 farmers (M=-0.53) was lower than those farmers in the overall sample, and it was the second lowest of all clusters (Table 4.3.5).

Cluster 3 had the largest number of farmers (125). These farmers had mean PC scores of 0.39 and 0.75 for risk management capability and risk attitude (play it safe), respectively (Table 4.3.5). The fact that both of the mean scores were positive meant that cluster 3 farmers had a higher degree of risk management capability and risk averseness than the mean PC scores for farmers in the overall dataset. Furthermore, cluster 3 farmers had the highest mean PC score for risk aversion of all four clusters (Table 4.3.5). Figure 4.3.5 shows that farmers in this cluster exhibited low variability in their PC scores for risk aversion since the interquartile range for this factor was relatively low. The mean PC score for risk management capability for cluster 3 farmers was the second highest of the four clusters (M=0.39); however, it was also quite diverse and right skewed (the interquartile rage was 0.85 and the median PC score 0.09). Finally, even though some of the farmers in cluster 3 exhibited high PC scores for risk management capability, none of them was higher than the PC scores observed for farmers in cluster 2 (Figure 4.3.5.2).

Farmers in cluster 4 exhibited mean PC scores of -1.81 and 0.22 for risk management capability and risk attitude (play it safe), respectively (Table 4.3.5). The signs of the PC scores indicated that farmers in this cluster had a lower degree of risk management capability and a higher degree of risk averseness in comparison to those in the overall dataset. Moreover, farmers in this cluster had the lowest risk management capability mean PC score of all clusters (M=-1.81) and a higher degree of risk aversion than farmers in clusters 1 (M=-0.77) and 2 (M=-0.53) (Table 4.3.5). Within cluster 4, PC scores for risk attitude was normally distributed (Figure 4.3.5.2). Figure 4.3.5.2 also shows that some overlap existed between the PC scores for risk attitudes of cluster 4 farmers and cluster 2 farmers, and between cluster 4 farmers and cluster 3 farmers. In contrast,

PC scores for risk management capability of farmers in cluster 4 were clearly different than the PC scores observed in their counterparts in clusters 1, 2 and 3 (Figure 4.3.5.2).

These findings show that even though farmers in cluster 1 did not have a high risk management capability score compared to farmers in other clusters, they were still very keen on taking a risky approach to business. These results were consistent with Olsson (1988) who described similar characteristics in farmers who he typified as "gamblers" (p. 254). Olsson (1988) described gambler farmers as those that have strong risk seeking behaviour, and that this behaviour would eventually affect the continuity of their farm business because their success overly depends on luck rather than their own skills. Given the similarity observed between the results obtained in this study and Olsson's (1988) description of gambler farmers, cluster 1 farmers were typified as "gamblers".

Farmers in cluster 2 had very good risk management skills and were also keen on taking a risky approach to business. These characteristics seem to correspond with the description of the entrepreneurial farm manager described by Olsson (1988) and the entrepreneur risk farmer type identified by Shadbolt and Olubode-Awosola (2013). According to Olsson (1988) and Shadbolt and Olubode-Awosola (2013), entrepreneurial farmers have good managerial skills and are active risk seekers. Olsson (1988) argues that their risk attitude seems to be more related to seizing opportunities rather than focusing on mitigating threats and that this is the key to their success in business. Likewise, Shadbolt and Olubode-Awosola (2013) describe that entrepreneurial farmers are likely to seek out opportunities to maximise their profit even in risky situations. Because of the similarities that exist between the findings observed for farmers in cluster 2 and the description of the entrepreneur farmer described by Olsson (1988) and Shadbolt and Olubode-Awosola (2013), farmers in cluster 2 were typified as "entrepreneurs".

Farmers in cluster 3 had good skills for managing risks and were also very risk averse. These results were consistent with the Olsson (1988) description of the "cautious strategist" farm manager (p. 255), and the Shadbolt and Olubode-Awosola (2013) description of the "experienced but cautious" risk farmer type. According to Olsson (1988) and Shadbolt and Olubode-Awosola (2013), these types of farmers have good risk management skills that have developed throughout years of farming experience, but despite their skills, they would rather not take risks or experiment with activities that are outside their field of competence. Nevertheless, they prove to be sucessful farmers (Olsson, 1988; Shadbolt & Olubode-Awosola, 2013). Interestingly, farmers in cluster 3 did not differ from those in other clusters in the number years

of farming experience (p>0.05). However, because of the similarities between the findings observed for cluster 3 farmers and the description of Olsson (1988) and Shadbolt and Olubode-Awosola (2013), farmers in this cluster were typified as "cautious strategists".

Finally, results from the cluster analysis also suggest that cluster 4 farmers have poor risk management capability and are also risk averse. These results are consistent with Olsson's (1988) description of the "defensive strategist" farm manager (p. 255) and with Shadbolt and Olubode-Awosola's (2013) description of the "here and now" conservative farmer type. According to Olsson (1988), defensive strategists tend to have a defensive attitude towards decision-making that results in poor management decisions. Shadbolt and Olubode-Awosola (2013) described that "here and now" conservative farmers have difficulty in planning for the future, perhaps because they are not sure they know what the future will look like, and, therefore, decide to settle for expected return rather than taking any risk. Although Olsson (1988) did not describe the capability of these farmers in managing risk, it was assumed that, because he described them as "unsuccessful", a low risk management capability contributed to this. Because of the similarities that existed between the findings observed for farmers in cluster 4 and the literature (Olsson, 1988; Shadbolt & Olubode-Awosola, 2013), farmers in cluster 4 were typified following the theoretical description of Olsson (1988) as "defensive strategists".

4.3.6. Relationship between resilient farmer and risk farmer types.

Table 4.3.6 shows cross tabulation results between resilient farmer types and risk farmer types.

Table 4.3.6. Cross tabulation results for resilient farmer types against risk farmer types.

Resilient farmer type	Risk farmer type	Gambler	Entrepreneur	Cautious strategist	Defensive strategist	Total
Low Resilient	Count	83	28	76	58	245
	Expected Count	64.6	46.4	84.1	49.8	245
	% within resilient type	33.9	11.4	31.0	23.7	100
	Adj. Std. Residual	4.7*	-5.3*	-1.9*	2.3*	
High Resilient	Count	13	41	49	16	119
	Expected Count	31.4	22.6	40.9	24.2	119
	% within resilient type	10.9	34.5	41.2	13.4	100
	Adj. Std. Residual	-4.7*	5.3*	1.9*	-2.3*	
Total	Count	96	69	125	74	364
	Expected Count	96	69	125	74	364
	% within resilient type	26.4	19	34.3	20.3	100

* Significant difference between observed and expected counts at 5% level or less

The results of the chi-square test of independence performed between resilient farmer types and risk farmer types indicated that there was a significant relationship between these two farmer types, $\chi^2(3, N=364)= 44.929$, $p<0.001$. Moreover, the strength of the association between these

two variables was moderate (*Cramer's V*=0.351). This relationship was explained by the differences between the observed and expected counts of gambler, entrepreneurial and defensive strategist farmer types at a 5% significance level (adjusted standard residuals greater or lower than +/- 1.96) and between the observed and expected counts of cautious strategist farmer type at a 10% significance level (adjusted standard residuals greater or lower than +/- 1.64), within each of the resilient farmers (Table 4.3.6).

High resilient farmers were positively associated with the entrepreneurial and cautious strategist risk farmer types and negatively associated with gambler and defensive strategist risk farmer types (Table 4.3.6). In contrast, low resilient farmers were positively associated with gambler and defensive strategist risk farmer types and negatively associated with entrepreneurial and cautious strategist risk farmer types. Most of the high resilient farmers (41.2%) were cautious strategists, while most of the low resilient farmers (33.9%) were gamblers (Table 4.3.6).

Considering that high resilient farmers have greater capability in coping with risks and adapting to changes in the environment than low resilient farmers, it is to be expected that under conditions of risk and uncertainty, high resilient farmers would be more successful than low resilient farmers in the achievement of their goals, both personal and ones related to their objectives (i.e. economic goals). Nevertheless, this survey collected little information about farm business performance to test these differences (differences between high resilient and low resilient farmers regarding some farm business figures are presented and discussed in section 4.4). However, it is noticeable how the high resilient farmer type was positively associated with the two "successful" farm manager types and was negatively associated with the two "unsuccessful" farm manager types described by Olsson (1988), whereas the opposite happened with the low resilient farmer type. Likewise, Shadbolt and Olubode-Awosola (2013) reported that the farmers that they named "experienced but cautious", who share traits with the cautious strategist risk farmer type, had better economic figures (a lower debt to asset percentage, produced the highest milk production per cow and return on equity, had more cash operating surplus per hectare) compared to other farmer types that were less successful.

The attributes that were of most importance in differentiating high resilient farmers from low resilient farmers (general self-efficacy, willingness to change, locus of control (farm business success), social sense-making, strategic thinking focus) were also associated in the literature with an entrepreneurial personality. In this regard, entrepreneurs were associated with an enhanced general self-efficacy (Lee, Wong, Foo, & Leung, 2011), a positive attitude towards change (McCarthy, 2000; Olsson, 1988), an internal locus of control (Low & MacMillan, 1988),

networking attitude, and strategic thinking (Olsson, 1988). All these elements were related to an enhanced ability to recognise opportunities during decision-making. The high resilient farmers were also associated with the cautious strategist risk farmer type. The link between high resilient farmer attributes and cautious strategists may be explained by their enhanced general self-efficacy which would correspond with a greater competence in farm management (Krueger & Dickson, 1994), and social sense-making skills (Olsson, 1988). Olsson (1988) described cautious strategists as experienced, competent farmers who were keen to discuss farm-related issues with their peers for information gathering. A major differentiating factor between entrepreneurial farmers and cautious strategist farmers was their risk attitude, and since both of these types were linked with a high resilient personality, there is evidence to suggest that a high resilient personality is more associated with an enhanced capability in managing risks than in having different attitudes towards risk. Nevertheless, it is important to note that high resilient farmers had a higher degree of risk aversion (mean PC score for risk attitude (play it safe)=.23) than low resilient farmers (mean PC score for risk attitude (play it safe)=-.11), $t(362)=-3.4$, $p=.00$.

The association among low resilient farmers, gamblers and defensive strategists may be related to the idea that the three farmer types consistently failed in the achievement of their goals. In the case of low resilient farmers, failure may be explained by a lower sense of general self-efficacy when these farmers were compared to high resilient farmers, and in the case of gamblers and defensive strategists, by their lower degree of risk management capability when both of these farmers were compared with entrepreneurs and cautious strategists.

Olsson (1988) described gambler farmers are optimistic despite not being strong managers. Overall, low resilient farmers were positively associated with a willingness to accept uncertainty, a factor that was associated with an optimistic personality by Holm, Nee, and Opper (2010). Low resilient farmers were also poorly associated with having purposeful regular meetings with other farmers and members of the industry to gather information which may help them in their decision making (i.e. social sense-making). The latter idea is consistent with Olsson (1988) who described that gamblers tended to use arbitrary methods of information gathering. An important point of differentiation between gamblers and defensive strategists was that the former were significantly more willing to accept uncertainty ($M=0.19$) than the latter ($M=-0.21$), $t(168)= 3.36$, $p<0.001$, which meant that defensive strategists were less optimistic than gamblers. This difference might be an explanation for the high degree of risk averseness observed in defensive strategists. However, it is important to note that willingness to accept uncertainty was of little importance in the differentiation between high and low resilient farmers (refer to section 4.3.4 for importance of attributes on defining resilient farmer types).

4.4. High and low resilient farmers: individual and farm business differences.

The following sections outline the differences between resilient farmer types with respect to individual farmer characteristics (section 4.4.1) and farm business characteristics (section 4.4.2). General remarks and discussion about differences between resilient farmer types with respect to their individual and farm business characteristics are detailed in section 4.4.3.

4.4.1. Individual differences.

The result for the chi-square test of independence performed on resilient farmer type against respondents' level of formal education achieved, indicated that there was no relationship between these two variables, $\chi^2(5, N=364)= 1.5$, $p=.92$. Likewise, no significant relationship was found between resilient farmer type and farmers' farming experience, $t(339)=.49$, $p=.63$. Nevertheless, there was a significant relationship between resilient farmer type and the farmers' current situation in the farm business with respect to their ownership structure, $\chi^2(7, N=364)= 31.796$, $p=.000$. The strength of the association between these two variables was moderate (*Cramer's V*=0.29).

Table 4.4.1.1 shows frequencies of farmers grouped by resilient type and farmer's current situation of ownership categories.

Table 4.4.1.1. Cross tabulation results between resilient farmer type and the current situation of farmer in the farm business.

Res. type†		Farm manager/ contract milker/ VOS	Sharemilkr/ Lessee (1 herd)	Sharemilkr/ Lessee (>1 herd)	A farm owner-operator	A farm owner-non-operator	Farm owner-operator (>1 operation)	Equity partner	Other	Total
LR	Count	5	7	2	111	56	53	10	1	245
	Expected Count	4.0	4.7	2.0	102.3	48.5	72.0	8.1	3.4	245
	% in R	2	2.9	.8	45.3	22.9	21.6	4.1	.4	100
	Adj. Std. Residual	.8	1.9	.0	2.0*	2.1*	-4.7*	1.2	-2.3*	
HR	Count	1	0	1	41	16	54	2	4	119
	Expected Count	2.0	2.3	1.0	49.7	23.5	35.0	3.9	1.6	119
	% in R	.8	0	.8	34.5	13.4	45.4	1.7	3.4	100
	Adj. Std. Residual	-.8	-1.9	.0	-2.0*	-2.1*	4.7*	-1.2	2.3*	
Total	Count	6	7	3	152	72	107	12	5	364
	Expected Count	6.0	7.0	3.0	152.0	72.0	107.0	12.0	5.0	364
	% in R	1.6	1.9	.8	41.8	19.8	29.4	3.3	1.4	100

* Significant difference between observed and expected counts at 5% level or less

† LR: low resilient farmer, HR: high resilient farmer

Adjusted standard residual values in Table 4.4.1.1 indicate which of the combinations of categories were of most importance in explaining the relationship between the two variables. It also indicates the adjusted standard residuals (i.e. residuals converted to z scores) which indicate how far the observed count is from the expected count if the data has a standard normal distribution with a mean value of 0. Thus, adjusted standard residuals that have a positive value meant that the actual data was over-represented, while a negative value meant that the data was under-represented compared to the expected count. An adjusted standard residual value of +/- 1.96 is critical for noting the combinations of categories that explained the significance of the Chi-square test.

As shown in Table 4.4.1.1, high resilient farmers were more likely to be farm owner-operators with multiple operations and to "other" situations while being negatively associated with being farm owner operators with a single farm business or farm owner non-operators. Conversely, low resilient famers were negatively associated with being farm owner operators with multiple operations and "other" situations and positively associated to being farm owner operators with a single farm business or farm owner non-operators.

Results from the Mann-Whitney U test performed between resilient farmer type and farmer influence on decision making (long term, within the season, and day-to-day) are shown in Table 4.4.1.2.

Table 4.4.1.2. Mann-Whitney U tests results for farmer's influence on decision making affecting the farm business in the long term, within the season, and day-to-day grouped by resilient farmer type.

	Resilient type	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Exact Sig. (2-tailed)
Influence DM-Long term	LR	245	174.03	42637.5		
	HR	119	199.94	23792.5	12502.5	.008*
	Total	364				
Influence DM-Within the season	LR	242	176.12	42621.5		
	HR	119	190.92	22719.5	13218.5	.177
	Total	361				
Influence DM-Day-to-day	LR	242	181.67	43964.0		
	HR	119	179.64	21377.0	14237.0	.858
	Total	361				

*significant at 5 % level.

Results in Table 4.4.1.2 showed that the distributions of ranks for farmer influence on decision making in the long term were significantly different between high resilient farmers and low resilient farmers (Mann-Whitney U= 12502.5, n_1=245, n_2=119, p<0.05). In contrast, no

statistically significant differences (p>0.05) were observed in the distributions of ranks for the other two variables (influence of decision making affecting the farm business within the season and day-to-day) between high resilient and low resilient farmers. High resilient farmers exhibited a higher mean rank and sum of ranks value for influence in decision-making in the long term than low resilient farmers, meaning that high resilient farmers tended to have higher degrees of influence than low resilient farmers.

Table 4.4.1.3 shows the relationship between resilient farmer type and the categories used for capturing farmer influence in long term decision making. It also corroborates that the difference in influence in long term decision making between high and low resilient farmers was due to differences in the influence categories "high" and "very high", with the former being more likely to be associated with low resilient farmers and the latter with high resilient farmers, *Fisher's exact test*(N=364)=11.8, p=.01.

Table 4.4.1.3. Cross tabulation between resilient farmer type and farmer influence in long term decision making.

		Influence in long term decision-making					
		Very little	Little	Some	High	Very high	Total
Low resilient	Count	1	6	24	61	153	245
	Expected Count	0.7	4	24.2	51.2	164.9	245
	Adjusted Residual	0.7	1.7	-0.1	2.7*	-2.8*	
High resilient	Count	0	0	12	15	92	119
	Expected Count	0.3	2	11.8	24.8	80.1	119
	Adjusted Residual	-0.7	-1.7	0.1	-2.7*	2.8*	
Total	Count	1	6	36	76	245	364
	Expected Count	1	6	36	76	245	364

* Significant difference between observed and expected counts at 5% level or less

The relationship between resilient farmer type and farmer influence in long term decision-making may also be influenced by the effect that ownership structure has on a farmer's influence in decision making (long term, within the season, or day-to-day).

4.4.2. Farm business differences.

Results from the t-tests performed on the nine numerical farm business demographical variables grouped by resilient farmer type are shown in Table 4.4.2.1.

Table 4.4.2. T-test results for numerical farm business demographic variables comparing low resilient (LR) and high resilient (HR) farmers.

Variable	Resilient type	N	Mean	Std. Dev.	t	df	Sig. (2-tailed)
Effective milking area (ha)	LR	230	213.5	286.27	-1.235	344	.218
	HR	116	260.6	416.00			
Cows milked at peak in 2013/14	LR	239	619.6	821.40	-1.796	352	.073
	HR	115	844.1	1529.68			
Milksolids produced in 2013/14 (kg)	LR	236	247864.5	328251.19	-1.700	346	.090
	HR	112	329957.5	568939.53			
Cow production (kgMS/cow)	LR	236	388.9	67.27	-.357	346	.721
	HR	112	391.7	71.87			
Stocking rate (cow/ha)	LR	229	2.9	0.56	-2.568	340	.011*
	HR	113	3.0	0.61			
Production per effective hectare (kgMS/ha)	LR	226	1133.9	347.12	-1.455	334	.147
	HR	110	1193.2	356.93			
Labour-Family (FTE)	LR	236	1.8	1.16	-2.525	349	.012*
	HR	115	2.1	1.56			
Labour-Non-family (FTE)	LR	236	3.3	4.86	-2.138	349	.033*
	HR	115	5.1	10.42			
Total Labour productivity (KgMS/FTE)	LR	226	50212.4	46966	1.037	332	.300
	HR	108	45311.7	20614			

*significant at 5 % level.

Table 4.4.2 shows that there were significant differences (p<0.05) between resilient farmer types with regard to stocking rate, number of family members involved in business and number of non-family members involved in the business.

High resilient farmers had a higher stocking rate (M=3.04, SD=0.61) than low resilient farmers (M=2.89, SD=0.56) (Table 4.4.2). In addition, high resilient farmers made use of a higher amount of family labour (M=2.1, SD=1.6) and non-family labour (M=5.1, SD=10.4) than low resilient farmers (M=1.8, SD=1.2) and (M=3.3, SD=4.86), respectively. Interestingly, total labour productivity was not different between high and low resilient farmers, because high resilient farmers produced the same amount of milksolids per total labour (FTEs) than low resilient farmers. However, this might be explained by the fact that the difference in total milksolids produced was not significant at a 5% level, but it was significantly different at a 10% level. If the p value was set at 0.1, then high resilient farmers would have produced more milksolids than low resilient farmers.

Finally, no significant relationship was found between resilient type and the stage of the business in the business cycle (χ^2(4, N=363)=1.7, p=.78).

4.4.3. General remarks and discussion on individual and farm business differences between high and low resilient farmers.

Although all of the individual and farm business demographic variables captured in this survey were not intended to measure farmer resilience or farm resilience, they provided an idea of what a farmer and their farm business looked like for the two different resilient farmer types (refer to section 4.3.2 for the description of resilient farmer types). In this regard, high resilient farmers were positively associated with being owner-operators with multiple operations (farms/equity partnerships/ herd owning sharemilking contracts), employed more people on their farms (family and non-family staff), used higher stocking rates and had higher influence in long term decision making (i.e. strategic decisions) than low resilient farmers.

The fact that high resilient farmers were associated with having multiple operations is consistent with general resilience theory that suggests that nurturing diversity in its many forms is a strategy for building resilience at many levels (Berkes, 2007; Folke, Carpenter, Walker, Scheffer, Elmqvist, Gunderson, & Holling, 2004; Walker et al., 2004). In this sense, having multiple operations might be regarded as a diversification strategy aimed at reducing risks (by spreading them out, as in an investment portfolio), and increasing options in the face of hazard (strategies for managing risk between resilience farmer types will be further discussed in section 4.6). Resilience was also associated with other forms of diversity such as having different kinds of education, expertise, and occupations (Walker et al., 2004).

Interestingly, no significant relationships were found in this study linking resilient farmer type and level of formal education or farmer experience in farming. Although a high level of formal education might not be necessarily considered a different kind of education, it was expected that a high resilient personality may have had a higher level of formal education because of the positive effect that education has on locus of control (Tanewski et al., 2000; Van Kooten et al., 1986). Yet, no significant relationship was found between the resilient farmer type and education. However, this finding is consistent with Sriskandarajah, Bawden, Blackmore, Tidball, and Wals (2010) and Sterling (2010) who suggested that although formal education was relevant for developing some individual skills critical to developing resilience such as problem solving, formal education was not a useful proxy for individual resilience. In this respect, Sterling (2010)

suggested that individual resilience is fostered by experiential learning and social learning which are considered higher orders of learning compared to formal schooling.

High resilient farmers were associated with a greater influence in long term decision making than low resilient farmers. Although this relationship may be a consequence of high resilient farmers having high levels of general self-efficacy beliefs and an internal locus of control (Bandura, 1997, 2000; Tanewski et al., 2000), it is important to note that influence in long-term decision making may be more associated to the farm business ownership structure. Indeed, there were significant relationships between farmer current situation with respect to their business ownership structure and their degree of influence in long-term decision making, *Fisher's exact test*(N=364)=78.4, p<.00. Table 4.4.3, shows how these two variables were associated.

Table 4.4.3. Cross tabulation between farmer current situation with regard to the business ownership structure and their influence in long-term decision making.

		Influence in long term decision-making					
		Very little	Little	Some	High	Very high	Total
Farm manager / contract milker / variable order sharemilker	Count	0	0	0	3	3	6
	Expected Count	0	0.1	0.6	1.3	4	6
	Adjusted Residual	-0.1	-0.3	-0.8	1.8	-0.9	
Sharemilker/Lessee (1 herd)	Count	0	2	0	2	3	7
	Expected Count	0	0.1	0.7	1.5	4.7	7
	Adjusted Residual	-0.1	5.6*	-0.9	0.5	-1.4	
Sharemilker/Lessee (>1 herd)	Count	0	0	1	1	1	3
	Expected Count	0	0	0.3	0.6	2	3
	Adjusted Residual	-0.1	-0.2	1.4	0.5	-1.3	
Farm owner-operator	Count	0	0	13	25	114	152
	Expected Count	0.4	2.5	15	31.7	102.3	152
	Adjusted Residual	-0.8	-2.1*	-0.7	-1.8	2.6*	
Farm owner-non-operator	Count	0	3	11	23	35	72
	Expected Count	0.2	1.2	7.1	15	48.5	72
	Adjusted Residual	-0.5	1.9	1.7	2.6*	-3.8*	
Farm owner operator with multiple operations	Count	1	1	7	14	84	107
	Expected Count	0.3	1.8	10.6	22.3	72	107
	Adjusted Residual	1.6	-0.7	-1.4	-2.4*	2.9*	
Equity partnership managing partner	Count	0	0	4	7	1	12
	Expected Count	0	0.2	1.2	2.5	8.1	12
	Adjusted Residual	-0.2	-0.5	2.8*	3.2*	-4.4*	
Other	Count	0	0	0	1	4	5
	Expected Count	0	0.1	0.5	1	3.4	5
	Adjusted Residual	-0.1	-0.3	-0.7	0	0.6	
Total	Count	1	6	36	76	245	364
	Expected Count	1	6	36	76	245	364

* Significant difference between observed and expected counts at 5% level or less

Table 4.4.3 shows that farm owner-operators (with a single or multiple operations) had very high influence in long term decision making, whereas farm owner-non-operators had high influence,

equity partnerships had high or some influence, and sharemilkers (who owned a single herd) had little influence. These associations were understandable; in the case of farmers who are owners of their farm business and who work in their operations on a daily basis, their decision making may have little influence of external parties because most of these decisions involve the use of their own resources and, therefore, these farmers have a very high influence in their strategic decisions (Shadbolt & Bywater, 2005). Something similar may be happening with farm owners-non-operators. Since these farmers have ownership of the land, livestock and machinery, their influence in long term decisions is high; however, because they do not operate their farm business, their decision making may be influenced by some external parties. As for the case of equity partnerships, strategic decisions may be decided among partners, and thus, the influence in these decisions is shared (Reekers, Shadbolt, Dooley, & Bewsell, 2007). Finally, because sharemilkers may have relatively fewer resources than farmers in the other ownership structures, their strategic decision making may be more externally constrained (e.g. by land owners) for making some of the decisions that affect their business in the long term (e.g. decisions based on land use) (Reekers et al., 2007). These results are important to note because the long term strategies that a farmer implements in their business may be more related to their situation with respect to the ownership structure of the farm business than whether they have low or high resilience.

Although there was little evidence in the literature of other studies making the link between a resilient personality and a resilient farm, the results of this research show that high resilient farmers had more intensified (i.e. higher stocking rates) farms than low resilient farmers. However, no significant differences were found between the resilient farmer type and the productivity variables captured in this study (Table 4.4.3). These results contrast with the findings of Shadbolt et al. (2011) who found that resilient dairy farms (i.e. dairy farms with superior buffer capacity) produced more milk per kgMS, hectare and labour unit than less resilient farms over a period of three seasons (2006/7, 2007/8 and 2008/9). It is important to note that in this study, resilient farmer types were defined with emphasis in their adaptive capacity, with Shadbolt et al. (2011) identifying resilient farms based on their buffer capacity. Nevertheless it was expected that high resilient farmers performed better than low resilient farmers; a possible reason for this may be that this survey only used data for the 2013/14 season, and that this season was extraordinary good for milk production due to good pasture growth throughout the country and relatively cheap feed (DairyNZ, 2014a). Grass productivity and a high use of imported feed may have resulted in no significant differences in the productivity observed in farms owned and/or managed by both resilient farmer types. Unfortunately, no

information about the production system was gathered in this research. Nevertheless, it is important to realise that the resilience construct used to identify resilient farmer types developed in this research was based on attributes that emphasise the adaptive aspects of resilience and, therefore, attempt to capture differences in strategic decisions which eventually have a long term impact on farm businesses rather than tactical decisions that have an impact in the short term. Further work combining Shadbolt *et al.* 's (2011) framework for capturing buffer capacity and the framework developed in this study, which empasises farmer adaptive capacity is required in order to develop a more complete picture of what resilience means for the management of a dairy farm.

4.5. High and low resilient farmer perceptions of the farm business environment.

The following section outlines differences between resilient farmer types with respect to their perception of change, volatility and opportunity/threat for each of the sources of risk in the farm business environment in sections 4.5.1, 4.5.2, and 4.5.3 respectively. Moreover, differences between resilient farmer types regarding their overall perceptions of the farm business environment are outlined in section 4.5.4.

4.5.1. Resilient farmer type's perceptions of change.

Only three sources of risk from the total listed in the survey were considered to change differently between high and low resilient farmers (refer to appendix III, Table 4.5.1A for the Chi-square tests and Fisher's exact tests, which tested all the relationships between farmer types and changes for the different sources of risk). There were significant relationships between resilient farmer type and farmer perception of change for: climate (*Fisher's exact test*(N=364)=11.8, p<.01); pasture/crop/animal health (χ^2(3, N=360)= 11.2, p=.01); and technological changes (*Fisher's exact test*(N=362)=8.5, p<.07). However, the strength of these associations were low, *Cramer's V*< .2. Table 4.5.1 shows the cross tabulation results between resilient farmer type and farmer perception of change for the sources of risk that were perceived differently by high and low resilient farmers.

Table 4.5.1. Cross tabulation results between resilient farmer type and farmer perception of change.

Source of risk†	Res. type‡		Rate of change					Total
			Decreasing rapidly	Decreasing slowly	Constant	Increasing slowly	Increasing rapidly	
Climate (P)	LR	Count	1	14	108	92	30	245
		Expected Count	0.7	13.5	116.4	92.2	22.2	245
		% within R type	0.4	5.7	44.1	37.6	12.2	100
		Adj. St. Residual	0.7	0.3	-1.9*	0	3*	
	HR	Count	0	6	65	45	3	119
		Expected Count	0.3	6.5	56.6	44.8	10.8	119
		% within R type	0	5	54.6	37.8	2.5	100
		Adj. St. Residual	-0.7	-0.3	1.9*	0	-3*	
Pasture/ crop/ animal health (P)	LR	Count		30	94	104	14	242
		Expected Count		36.3	98.1	90.8	16.8	242
		% within R type		12.4	38.8	43.0	5.8	100
		Adj. St. Residual		-2*	-0.9	3.1*	-1.2	
	HR	Count		24	52	31	11	118
		Expected Count		17.7	47.9	44.3	8.2	118
		% within R type		20.3	44.1	26.3	9.3	100
		Adj. St. Residual		2*	0.9	-3.1*	1.2	
Tech. changes (T)	LR	Count	0	17	36	123	67	243
		Expected Count	0.7	16.8	33.6	114.8	77.2	243
		% within R type	0	7	14.8	50.6	27.6	100
		Adj. St. Residual	-1.4	0.1	0.8	1.8	-2.5*	
	HR	Count	1	8	14	48	48	119
		Expected Count	0.3	8.2	16.4	56.2	37.8	119
		% within R type	0.8	6.7	11.8	40.3	40.3	100
		Adj. St. Residual	1.4	-0.1	-0.8	-1.8	2.5*	

* Significant difference between observed and expected counts at 5% level or less.
† Type of risk between brackets: P= production, T=technological risk.
‡LR: low resilient farmer, HR: high resilient farmer

Cross tabulation results indicated that the Fisher exact test for independence between resilient farmer type and farmer perception of change for climate was mostly explained by differences between observed and expected counts in farmer response on climate being constant or increasing rapidly. In this regard, more farmers than expected in the high resilient group considered that climate had remained constant (55% of the total farmers in the high resilient group) while fewer high resilient farmers than expected (2.5% of the total farmers in the high resilient group) stated that climate had been increasing rapidly (Table 4.5.1). In contrast, low resilient farmers perceived that climate had been changing at an increasingly rapid pace, since more farmers than expected in this group (12% of the total farmers in the low resilient group) responded accordingly; whereas, fewer farmers than expected (44% of the total farmers in the low resilient group) responded that climate had remained constant (Table 4.5.1).

The Chi-square test which tested the relationship between resilient farmer type and farmer perception of change in pasture/crop/animal health was mostly explained by differences

between observed and expected counts in farmer response suggesting that that this source of risk had been decreasing or increasing slowly (Table 4.5.1). In this respect, the observed count of farmers in the high resilient group that responded that this source of risk had been decreasing slowly (20.3% of the total farmers in the high resilient group) was higher than the expected count. However, the observed count of high resilient farmers that responded that pasture/crop/animal health had been increasing slowly (26% of the total farmers in the high resilient group) was fewer than the expected count (Table 4.5.1). In contrast, more farmers than expected in the low resilient group (43% of the total farmers in the low resilient group) responded that the change of this source of risk had been increasingly rapidly; whereas, fewer low resilient farmers than expected (12% of the total farmers in the low resilient group) responded that climate had been changing decreasingly slowly (Table 4.5.1).

The Fisher exact test which tested a significant relationship ($p<.1$) between resilient farmer type and farmer perception of change in technological changes was mostly explained by differences between observed and expected counts of farmer response to the category increasing rapidly (Table 4.5.1). In this regard, technological changes was reported to be changing at an increasing rapid pace by more farmers than expected in the high resilient group (40.3% of the total farmers in the high resilient group); while, on the other hand, fewer farmers than expected in the low resilient group (28% of the total farmers in the low resilient group) answered in the same way (Table 4.5.1).

4.5.2. Resilient farmer type's perception of volatility.

Only one source of risk from the total listed in the survey, was considered of different volatility between high and low resilient farmers (Table 4.5.2) (refer to appendix III, Table 4.5.2A for the Chi-square tests and Fisher's exact tests, which tested all the relationships between farmer type and volatility for the different sources of risk). The relationship between resilient farmer type and farmer perception of volatility in availability of labour was tested significant at 10% level, $\chi^2(4, N=359)= 8.6$, $p=.07$. Nevertheless, the strength of this association was low; *Cramer's V*=.15. Table 4.5.2 shows the cross tabulation results between resilient farmer type and farmer perception of volatility in the availability of labour.

Table 4.5.2. Cross tabulation results between resilient farmer type and farmer perception of volatility in the availability of labour (market risk).

		Volatility					
Resilient type		Very low	Low	Moderate	High	Very high	Total
Low resilient	Count	8	42	116	60	16	242
	Expected Count	10.1	45.8	117.3	50.6	18.2	242
	% within resilient type	3.3	17.4	47.9	24.8	6.6	100
	Adj. St. Residual	-1.2	-1.1	-0.3	2.6*	-0.9	
High resilient	Count	7	26	58	15	11	117
	Expected Count	4.9	22.2	56.7	24.4	8.8	117
	% within resilient type	6	22.2	49.6	12.8	9.4	100
	Adj. St. Residual	1.2	1.1	0.3	-2.6*	0.9	
Total	Count	15	68	174	75	27	359
	Expected Count	15	68	174	75	27	359
	% within resilient type	4.2	18.9	48.5	20.9	7.5	100%

* Significant difference between observed and expected counts at 5% level or less.

The cross tabulation results in Table 4.5.2 indicated that the Chi-square test which tested the relationship between resilient farmer type and volatility of labour availability was mostly explained by differences between observed and expected counts in farmer response, claiming that the volatility of this source had been high. In this regard, the observed count of farmers in the high resilient group that responded "high" (13% of the total farmers in the high resilient group) was fewer than the expected count; whereas, the observed count of farmers in the low resilient group that replied the same (25% of the total farmers in the low resilient group) was higher than expected.

4.5.3. Resilient farmer types perceptions of risk.

There were six sources of risk from the total listed in the survey that were perceived differently between high and low resilient farmers (refer to appendix III, Table 4.5.3A for the Chi-square tests and Fisher's exact tests, which tested all the relationships between farmer type and farmer perceptions of risk for the different sources of risk). There were significant relationships between resilient farmer type and farmer perception of risk for: climate (χ^2(2, N=354)=7.7, p=.02); pasture/crop/animal health (χ^2(2, N=345)=8.5, p=.01); interest rates (χ^2(2, N=355)=6.2, p=.04); land values (χ^2(2, N=354)=7.6, p=.02); global supply and demand for food (χ^2(2, N=353)=10.1, p=.00); and local body laws and regulations (χ^2(2, N=353)=4.8, p=.08). However, the strength of these associations was low, with a *Cramer's V*< .2. Table 4.5.3 shows the cross tabulation results between resilient farmer type and farmer perception of risk for the sources of risk that were perceived differently by high and low resilient farmers.

Table 4.5.3. Cross tabulation results between resilient farmer type and farmer perception of risk.

Source of risk[†]	Res. Type		Opportunity	Threat	Opportunity and threat	Total
Climate (P)	Low resilient	Count	20	70	150	240
		Expected Count	27.1	63.7	149.2	240
		% within resilient type	8.3	29.2	62.5	100
		Adj. St. Residual	-2.6*	1.6	0.2	
	High resilient	Count	20	24	70	114
		Expected Count	12.9	30.3	70.8	114
		% within resilient type	17.5	21.1	61.4	100
		Adj. St. Residual	2.6*	-1.6	-0.2	
Pasture/ crop/ animal health (P)	Low resilient	Count	79	51	103	233
		Expected Count	91.2	45.2	96.6	233
		% within resilient type	33.9	21.9	44.2	100
		Adj. St. Residual	-2.9*	1.7	1.5	
	High resilient	Count	56	16	40	112
		Expected Count	43.8	21.8	46.4	112
		% within resilient type	50	14.3	35.7	100
		Adj. St. Residual	2.9*	-1.7	-1.5	
Interest rates (F)	Low resilient	Count	60	75	104	239
		Expected Count	70	70.7	98.3	239
		% within resilient type	25.1	34.4	43.5	100
		Adj. St. Residual	-2.5*	1.1	1.3	
	High resilient	Count	44	30	42	116
		Expected Count	34	34.3	47.7	116
		% within resilient type	37.9	25.9	36.2	100
		Adj. St. Residual	2.5*	-1.1	-1.3	
Land values (F)	Low resilient	Count	55	60	123	238
		Expected Count	65.9	56.5	115.6	238
		% within resilient type	23.1	25.2	51.7	100
		Adj. St. Residual	-2.8*	0.9	1.7	
	High resilient	Count	43	24	49	116
		Expected Count	32.1	27.5	56.4	116
		% within resilient type	32.1	27.5	56.4	100
		Adj. St. Residual	2.8*	-0.9	-1.7	
Global supply and demand for food (M)	Low resilient	Count	118	24	96	238
		Expected Count	123.4	16.9	97.8	238
		% within resilient type	49.6	10.1	40.3	100
		Adj. St. Residual	-1.2	3.2*	-0.4	
	High resilient	Count	65	1	49	115
		Expected Count	59.6	8.1	47.2	115
		% within resilient type	56.5	0.9	42.6	100
		Adj. St. Residual	1.2	-3.2*	0.4	
Local body laws and regulations (R)	Low resilient	Count	4	177	57	238
		Expected Count	5.4	168.6	64.1	238
		% within resilient type	1.7	74.4	23.9	100
		Adj. St. Residual	-1.1	2.1*	-1.8	
	High resilient	Count	4	73	38	115
		Expected Count	2.6	81.4	30.9	115
		% within resilient type	3.5	63.5	33	100
		Adj. St. Residual	1.1	-2.1*	1.8	

* Significant difference between observed and expected counts at 5% level or less.

[†] Type of risk between brackets: F=financial, H=human, M=market, P= production, R= regulatory.

The cross tabulation results indicated that the Chi-square test for independence between resilient farmer type and farmer perception of risk (opportunity/threat) for climate was mostly explained by differences between observed and expected counts in farmer responses in "opportunity" (Table 4.5.3). In this respect, the observed count of farmers in the high resilient group that responded that climate offered an opportunity (17.5% of the total farmers in the high resilient group) was significantly higher than its expected count. In contrast, the observed count of low resilient farmers that responded that climate had been an opportunity (8% of the total farmers in the low resilient group) was fewer than expected (Table 4.5.3).

As for the significant relationship detected between resilient farmer type and farmer perception of risk (opportunity/threat) for pasture, crop, and or animal health, the Chi-square test was mostly explained by farmer responses in the category "opportunity" (Table 4.5.3). In this regard, the observed count of farmers in the high resilient group that responded "opportunity" (50% of the total farmers in the high resilient group) was significantly higher than the expected count. In contrast, the observed count of farmers in the low resilient group that responded "opportunity" (34% of the total farmers in the low resilient group) was fewer than expected (Table 4.5.3).

Interest rates were more likely to be perceived as an opportunity by high resilient farmers than low resilient farmers (Table 4.5.3). In this regard, the Chi-square test for independence was explained by a significantly higher than expected count of farmers in the high resilient group that responded that interest rates was an "opportunity" (38% of the total farmers in the high resilient group). In contrast, the count of farmers in the low resilient group that responded "opportunity" (25% of the total farmers in the low resilient group) was significantly lower than expected (Table 4.5.3).

Land value was also perceived as an opportunity by high resilient farmers (Table 4.5.3). The Chi-square test for independence was explained by a significantly higher than expected count of farmers in the high resilient group who responded that interest rates was an "opportunity" (38% of the total farmers in the high resilient group). On the other hand, the count of farmers in the low resilient group who answered "opportunity" (25% of the total farmers in the low resilient group) was fewer than the expected count (Table 4.5.3).

With regard to the significant relationship detected between resilient farmer type and farmer perception of risk (opportunity/threat) for global supply and demand for food, the Chi-square test was mostly explained by differences between observed and expected counts in farmer responses in the category "threat" (Table 4.5.3). In this respect, 10% of farmers in the low

resilient group, more than the expected count, responded that global supply and demand for food represented a "threat". In contrast, fewer farmers than expected in the high resilient group (1% of the total farmers in the high resilient group) responded that this source of risk was a "threat" (Table 4.5.3).

Finally, the Chi-square test that indicated the significant relationship (p<.1) between resilient farmer type and perception of local body laws and regulations was mostly explained by differences between observed and expected counts in farmer response in the category "threat" (Table 4.5.3). In this respect, more farmers than expected in the low resilient group responded that this source was a threat (74.4% of the total farmers in the low resilient group). In contrast, fewer farmers than expected in the high resilient group (63.5% of the total farmers in the high resilient group) responded that this source of risk represented a threat for their farm business (Table 4.5.3).

4.5.4. Overall farm business environment indices.

Overall, farm business environment indexes for farmer perception on change, volatility, opportunity, threat, and opportunity/threat were developed in order to have an overall characterisation of the farm business environment that considered all the sources of risk listed in the survey for each individual farmer (refer to section 3.7.1 in the methodology chapter for indices calculations). Table 4.5.4 shows the results from the Mann-Whitney U tests which were conducted to test the independence between resilient farmer type and the overall indices.

Table 4.5.4. Differences in overall farm business environment indices between resilient farmer types.

Index	Resilient type†	N	Median	Mean Rank	Sum of Ranks	Mann-Whitney U	Exact Sig. (2-tailed)	Effect size r
Overall Change Index	LR	245	.17	178.5	43724	13589	.29	-.06
	HR	119	.17	190.8	22706			
	Total	364						
Overall Volatility Index	LR	243	.33	182.3	44298	14022	.732	-.02
	HR	118	.33	178.3	21043			
	Total	361						
Overall Opportunity Index	LR	244	.24	172.1	42005.5	12115.5	.02*	-.12
	HR	117	.28	199.4	23335.5			
	Total	361						
Overall Threat Index	LR	244	.33	188.2	45916	12522	.048*	-.10
	HR	117	.28	166.0	19425			
	Total	361						
Overall Opportunity/Threat Index	LR	244	.41	183.8	44839.5	13598.5	.466	-.04
	HR	117	.39	175.2	20501.5			
	Total	361						

* significant at 5% level.
†HR: high resilient farmer type, LR: low resilient farmer type

High resilient farmer perceptions of opportunities in the farm business environment (Mdn=.28) were higher than the perceptions of low resilient farmers (Mdn=.24), U=12115.5, p<.05' however, the strength of this association was weak, r=-.12. This higher proportion of risk sources being seen as opportunities was counter to their perceptions of threats in the environment. In this regard, high resilient farmers had a lower overall threat index (Mdn=.28) compared to low resilient farmers (Mdn=.33), U=12522, p<.05, r -1. There were no significant differences between resilient farmer types and their overall perception of sources of risk as being both opportunities and threats, nor in their overall perception of change and volatility in the sources of risk in the farm business environment.

These results are consistent with Cooper, Estes, and Allen (2004) and Manzano-García et al. (2013) who described resilient people as often seeing opportunities where others see threats. Manzano-García *et al.* (2013) linked this characteristic to a particular type of resilient personality: the resilient entrepreneurs. A comparison between entrepreneurs and cautious strategists (two risk farmer types found in this research that were associated with the high resilient farmer type) regarding their overall perception of opportunities, threats and opportunities and threats, indicated that there was no difference between these two groups in their overall opportunity index (U=3656, p=.1.8), or their overall opportunity/threat index (U=3945, p=.44), yet there was a significant difference in their perception of threats (U=3371, p=.02). In this regard, cautious

strategists perceived a higher proportion of threats in the environment (Mdn=.28) than entrepreneurs (Mdn=.22).

4.6. Differences in risk management strategies between high and low resilient farmers.

The following sections outline the differences between resilient farmer types regarding their use of the risk management strategies and their relative importance.

4.6.1. Resilient farmer types use of risk management strategies.

There were nine strategies that were used differently between high and low resilient farmers (refer to appendix III, Table 4.6.1A for the Chi-square tests and Fisher's exact tests, which tested all the relationships between farmer type and the use of all risk management strategies). There were significant relationships between resilient farmer type and their use of strategy for having long term flexibility (*Fisher's exact test*(N=354)=5.8, p<.05); having strategic purpose (*Fisher's exact test*(N=356)=10.1, p<.00); using SWOT analysis (*Fisher's exact test*(N=355)=8.4, p<.00); implementing technological innovations (*Fisher's exact test*(N=357)=10.1, p<.04); gathering market information (χ^2(2, N=354)=7.3, p=.02); using financial ratios to assist with decision-making (χ^2(2, N=356)=13.1, p=.00); using geographic diversity (χ^2(2, N=358)=7.1, p=.03); having the main farm operator or family working off property (χ^2(2, N=354)=5.8, p=.05); and using future markets (χ^2(2, N=355)=9.9, p=.00). However, the strength of the associations was low, with *Cramer's V*< .2. Table 4.6.1, shows the cross tabulation results between resilient farmer type and farmer use of risk management strategy for the strategies that were used differently by high and low resilient farmers.

Table 4.6.1. Cross tabulation results between resilient farmer type and use of risk management strategy.

Risk management strategy	Resilient type		Yes	No	N/A	Total
Having long term flexibility (O)	Low resilient	Count	212	22	4	238
		Expected Count	217.8	16.8	3.4	238
		% within resilient type	89.1	9.2	1.7	100
		Adj. St. Residual	-2.4*	2.3*	0.6	
	High resilient	Count	112	3	1	116
		Expected Count	106.2	8.2	1.6	116
		% within resilient type	96	2.6	0.9	100
		Adj. St. Residual	2.4*	-2.3*	-0.6	
Strategic purpose (O)	Low resilient	Count	206	31	4	241
		Expected Count	214.6	23.7	2.7	241
		% within resilient type	85.5	12.9	1.7	100
		Adj. St. Residual	-3.1*	2.8*	1.4	
	High resilient	Count	111	4	0	115
		Expected Count	102.4	11.3	1.3	115
		% within resilient type	96.5	3.5	0	100
		Adj. St. Residual	3.1*	-2.8*	-1.4	
SWOT analysis (O)	Low resilient	Count	201	35	3	239
		Expected Count	209.4	27.6	2	239
		% within resilient type	84.1	14.6	1.3	100
		Adj. St. Residual	-2.9*	2.6*	1.2	
	High resilient	Count	110	6	0	116
		Expected Count	101.6	13.4	1	116
		% within resilient type	94.8	5.2	0	100
		Adj. St. Residual	2.9*	-2.6*	-1.2	
Implementing technological innovation(s) (T)	Low resilient	Count	203	35	3	241
		Expected Count	209.9	28.4	2.7	241
		% within resilient type	84.2	14.5	1.2	100
		Adj. St. Residual	-2.3*	2.3*	0.3	
	High resilient	Count	108	7	1	116
		Expected Count	101.1	13.6	1.3	116
		% within resilient type	93.1	6	0.9	100
		Adj. St. Residual	2.3*	-2.3*	-0.3	
Gathering market information (M)	Low resilient	Count	158	49	31	238
		Expected Count	168.8	43	26.2	238
		% within resilient type	66.4	20.6	13	100
		Adj. St. Residual	-2.7*	1.8*	1.7	
	High resilient	Count	93	15	8	116
		Expected Count	82.2	21	12.8	116
		% within resilient type	80.2	12.9	6.9	100
		Adj. St. Residual	2.7*	-1.8*	-1.7	
Using financial ratios to assist with decision making (O)	Low resilient	Count	147	76	18	241
		Expected Count	161.8	65	14.2	241
		% within resilient type	61	35.5	7.5	100
		Adj. St. Residual	-3.6*	2.8*	1.8	
	High resilient	Count	92	20	3	115
		Expected Count	77.2	31	6.8	115
		% within resilient type	80	17.4	2.6	100
		Adj. St. Residual	3.6*	-2.8*	-1.8	

Table 4.6.1. (Cont.)

Geographic diversity (P)	Low resilient	Count	57	66	118	241
		Expected Count	64	70.7	106.4	241
		% within resilient type	23.7	27.4	49	100
		Adj. St. Residual	-1.8	-1.2	2.6*	
	High resilient	Count	38	39	40	117
		Expected Count	31	34.3	51.6	117
		% within resilient type	32.5	33.3	34.2	100
		Adj. St. Residual	1.8	1.2	-2.6*	
Main farm operator or family working off property (F)	Low resilient	Count	56	123	62	241
		Expected Count	62	125.3	53.8	241
		% within resilient type	23.2	51	25.7	100
		Adj. St. Residual	-1.6	-0.5	2.3*	
	High resilient	Count	35	61	17	113
		Expected Count	29	58.7	25.2	113
		% within resilient type	31	54	15	100
		Adj. St. Residual	1.6	0.5	-2.3*	
Using futures markets (M)	Low resilient	Count	13	134	93	240
		Expected Count	20.3	133.9	85.9	240
		% within resilient type	5.4	55.8	38.8	100
		Adj. St. Residual	-3*	0	1.7	
	High resilient	Count	17	64	34	115
		Expected Count	9.7	64.1	41.1	115
		% within resilient type	14.8	55.7	29.6	100
		Adj. St. Residual	3*	0	-1.7	

* Significant difference between observed and expected counts at 5% level or less.
† Type of risk the strategy aims to manage is shown in brackets: F=financial, M=market, P= production, T= technology, O= overall.

The cross tabulation results in Table 4.6.1 show that the Fisher's exact test for independence which indicated a significant relationship ($p<.1$) between resilient farmer type and the use of the strategy "having long term flexibility" was mostly explained by differences in farmer response regarding using or not using this strategy for managing risk. In this regard, more farmers than expected in the high resilient group (96% of farmers in the high resilient group) used this strategy whereas fewer farmers than expected (3% of farmers in the high resilient group) did not use this strategy (Table 4.6.1). In contrast, more farmers than expected in the low resilient group (9% of farmers in the low resilient group) used this strategy while fewer farmers than expected in this same group (89% of farmers in the low resilient group) did not use it (Table 4.6.1).

The Fisher exact test performed between resilient farmer type and the use of having a clear and shared vision or strategic purpose for your operation as a strategy for managing risk was mostly explained by differences in farmer response regarding using or not using this strategy. In this sense, more farmers than expected in the high resilient group (96.5% of farmers in the high resilient group) used this strategy while fewer high resilient farmers than expected (3.5% of farmers in the high resilient group) did not (Table 4.6.1). In contrast, more farmers than

expected in the low resilient group (13% of farmers in the low resilient group) did not use this strategy whereas fewer farmers than expected in this same group (85.5% of farmers in the low resilient group) used it (Table 4.6.1).

As for the relationship between resilient farmer type and the use of SWOT analysis, the Fisher exact test was mostly explained by differences between observed and expected count in farmer response regarding using or not using this strategy (Table 4.6.1). In this respect, more farmers than expected in the high resilient group (95% of farmers in the high resilient group) used this strategy; whereas, fewer farmers than expected (5% of farmers in the high resilient group) responded they did not use SWOT analysis for managing risks in their farm business (Table 4.6.1). In contrast, more farmers than expected in the low resilient group (15% of farmers in the low resilient group) responded they did not use this strategy, while fewer low resilient farmers than the expected count (84% of farmers in the low resilient group) responded they did (Table 4.6.1).

The Fisher exact test which indicated a significant relationship between resilient farmer type and the use of "implementing technological innovation(s)" was mostly explained by differences in farmer response regarding using or not using this strategy for managing risk (Table 4.6.1). More farmers than expected in the high resilient group (93% of farmers in the high resilient group) used this strategy; whereas, fewer farmers than expected (6% of farmers in the high resilient group) did not use it. Conversely, more farmers than the expected count in the low resilient group (14.5% of farmers in the low resilient group) did not use this strategy while and fewer farmers than expected (84% of farmers in the low resilient group) used it (Table 4.6.1).

With regard to the significant relationship observed between resilient farmer type and the use of gathering market information, the Chi-square test was mostly explained by differences in farmer response with regard to whether they used or did not use this strategy (Table 4.6.1). More farmers than expected in the high resilient group (80% of farmers in the high resilient group) responded they did use this strategy while less high resilient farmers than expected (13% of farmers in the high resilient group) did not use this strategy. In contrast, more farmers than expected in the low resilient group (21% of farmers in the low resilient group) did not use this strategy whereas fewer farmers than expected (67% of farmers in the low resilient group) used it (Table 4.6.1).

The Chi-square test performed between resilient farmer type and use of financial ratios to assist with decision making as a strategy for managing risks was mostly explained by differences

between observed and expected counts in farmer responses regarding whether they used or did not use this risk management strategy (Table 4.6.1). More farmers than expected in the high resilient group (80% of farmers in the high resilient group) used this strategy whereas fewer responses than expected were observed for this same group (17% of farmers in the high resilient group) did not use it (Table 4.6.1). In contrast, more farmers than expected in the low resilient group (31.5% of farmers in the low resilient group) did not use this strategy, while fewer farmers than expected (61% of farmers in the high resilient group) used it (Table 4.6.1).

The Chi-square test of independence between resilient farmer type and use of geographic diversity was mostly explained by differences between observed and expected counts in farmer responses regarding the use or non-applicability of this strategy (Table 4.6.1). In this regard, more farmers than the expected count in the high resilient group (32.5% of farmers in the high resilient group) responded they had used this strategy; whereas, fewer high resilient farmers than expected (34% of farmers in the high resilient group) responded that this strategy was not applicable for their farm business (Table 4.6.1). In contrast, more farmers than expected in the low resilient group (49% of farmers in the low resilient group) responded that this strategy was not applicable while fewer farmers than expected in this group (28% of farmers in the low resilient group) stated they did use it (Table 4.6.1).

The Chi-square test for independence which informed a significant relationship ($p<.1$) between resilient farmer type and use of having the main farm operator or family working off farm was mostly explained by differences in the non-applicability of this strategy among resilient farmer types (Table 4.6.1). Fewer farmers than expected in the high resilient group (15% of farmers in the high resilient group) responded that this strategy was not applicable to their farm business (Table 4.6.1). In contrast, more farmers than the expected count in the low resilient group (27.5% of farmers in the low resilient group) responded that this strategy was not applicable for managing risk in their farm business (Table 4.6.1).

Finally, the Chi-square test performed between resilient farmer types and using futures markets was mostly explained by differences observed in farmer responses with regard to using this strategy (Table 4.6.1). More farmers than the expected count in the high resilient group (15% of farmers in the high resilient group) responded that they used this strategy while fewer farmers than expected in the low resilient group (5% of farmers in the low resilient group) stated to have used it as well (Table 4.6.1).

4.6.2. Resilient farmer types views on the importance of the risk management strategies.

Table 4.6.2 shows the results from the Mann-Whitney U tests for independence performed between resilient farmer types and the importance of each risk management strategy to them.

Table 4.6.2 shows that there were significant differences between resilient farmer types in the importance given to 13 of the 27 risk management strategies listed in the survey. High resilient farmers had higher mean ranks (i.e. gave more importance to) for eleven of the thirteen strategies ("gathering market information", "managing debt", "planning capital spending", "having personal or business insurance", "having short term flexibility", "having long term flexibility", "using practical planning steps in your farm business", "SWOT analysis", "having a clear and shared vision or strategic purpose", "using financial ratios to assist with decision making", and "implementing technological innovation(s)") compared to low resilient farmers (Table 4.6.2). In contrast, low resilient farmers had higher mean ranks for "not producing at full capacity" and "keeping debt low" than high resilient farmers. Moreover, the strengths of the associations in all these relationships were moderate to weak ($-.3 > r > -.1$) (Table 4.6.2).

In both of the groups of resilient farmers, high and low resilient, there was a predominance of business strategies relevant for ensuring the business knows where it is going and why (high median scores and mean ranks scores) (Table 4.6.2). In this respect, both resilient farmer types scored high in strategy which reflected strategic focus such as "having a clear and shared vision or strategic purpose for your operation" or "SWOT analysis". Other strategies that were highly ranked with both resilient groups were more related to ensuring the continuity of the farm business such as "maintaining feed reserves" or "routine spraying or drenching" (Table 4.6.2). These results are consistent with Pinochet-Chateau et al. (2005a) and Shadbolt and Olubode-Awosola (2013) who identified similar rankings of importance for the same strategies in a sample of dairy farmers in New Zealand (refer to section 4.2.7). Like Shadbolt and Olubode-Awosola (2013), this research found little differences in the importance for most of the risk management strategies when comparing different farmer types.

Table 4.6.2. Differences in importance of risk management strategies between resilient farmer types.
Median Score Scale: 1 = very low importance, 5 = very high importance

Risk management strategy†	Resilient type	N	Mean Rank	Sum of Ranks	Mdn.	Mann-Whitney U	Exact. Sig (2 tailed)	Effect size r
Maintaining feed reserves (P)	LR	243	178.0	43255	4	13609	0.672	-.02
	HR	115	182.6	21006	4			
Not producing to full capacity (P)	LR	222	171.7	38127	3	9935.5	0.026*	-.12
	HR	105	147.6	15500	3			
Monitoring programme for pest and diseases (P)	LR	233	167.1	38926	3	11665	0.122	-.08
	HR	111	183.9	20414	4			
Routine spraying or drenching (P)	LR	239	172.3	41185	4	12505.5	0.439	-.04
	HR	110	180.8	19889	4			
Irrigation (P)	LR	137	101.4	13897	3	4444.5	0.841	-.01
	HR	66	103.2	680	3			
Geographic diversity (P)	LR	142	106.8	15160	3	5007	0.56	-.04
	HR	74	111.8	8276	3			
Using futures markets (M)	LR	139	105.1	14614	2	4884.5	0.767	-.02
	HR	72	107.7	7751	2			
Forward contracting (M)	LR	176	131.0	23065	3	7489.5	0.767	-.02
	HR	87	133.9	11650	3			
Gathering market information (M)	LR	211	142.2	30010	3	7644	0.000*	-.25
	HR	103	188.8	19445	4			
Spreading sales (M)	LR	179	132.8	23771	2	7661	0.95	-.00
	HR	86	133.4	11474	3			
Arranging overdraft reserves (F)	LR	223	163.4	36439	3	11463.5	0.381	-.05
	HR	109	172.8	18838	4			
Maintaining financial reserves (F)	LR	229	164.1	37581	3	11246.5	0.123	-.08
	HR	109	180.8	19709	4			
Main farm operator or family working off property (F)	LR	169	131.1	22162	2	7075	0.511	-.04
	HR	88	124.9	10991	2			
Managing debt (F)	LR	232	158.4	36757	4	9729	0.000*	-.22
	HR	111	200.3	22239	5			
Keeping debt low (F)	LR	229	176.2	40342	4	10496	0.027*	-.12
	HR	107	152.1	16274	3			
Planning of capital spending (F)	LR	237	160.2	37977	4	9774	0.000*	-.22
	HR	111	204.9	22749	4			
Having personal and/or business insurance (O)	LR	231	162.5	37545	4	10749	0.008*	-.14
	HR	112	191.5	21451	4			
Having short term flexibility (O)	LR	233	156.4	36452	4	9191	0.000*	-.25
	HR	111	206.2	22888	4			
Having long term flexibility (O)	LR	234	158.2	37014	4	9519.5	0.000*	-.24
	HR	113	206.8	23363	4			
Having more than one type of animal or other enterprises (O)	LR	180	133.0	23940	2	7650.5	0.875	-.01
	HR	86	134.5	11570	2			
Using practical planning steps in your farm business (O)	LR	233	157.6	36732	4	9471.5	0.000*	-.24
	HR	113	206.2	23298	4			
SWOT analysis (O)	LR	235	158.1	37159	4	9429	0.000*	-.25
	HR	113	208.6	23567	4			
Having a clear and shared vision or strategic purpose (O)	LR	235	161.2	37892	4	10162	0.000*	-.20
	HR	113	202.1	22834	4			
Using financial ratios to assist with decision making (O)	LR	220	151.3	33276	3	8966.5	0.000*	-.20
	HR	107	190.2	20351	4			
Implementing technological innovation(s) (T)	LR	232	164.5	38163	3	11135	0.03*	-.12
	HR	111	187.7	20833	3			
Adjusting production methods/system to comply with laws and policies (R)	LR	234	168.5	39426	4	11931.5	0.245	-.06
	HR	110	181.0	19913	4			
Other	LR	6	5.2	31	4	10.5	0.714	-.12
	HR	4	5.9	23	4			

* significant at 5% level.

† The risk the strategy aims to manage is shown between brackets: F=financial risk, M=market risk, O=overall risk, P= production risk, R=regulatory risk, T=technological risk.

4.6.3. General remarks and discussion about risk management strategies.

This section aims to summarise and discuss the differences observed between high and low resilient farmers with regard to their use of, and importance given to, risk management strategies. The results from the comparison between high resilient and low resilient farmers with respect of the use of strategies (section 4.6.1) and the importance given by these farmers to each strategy for managing risk in their farm businesses (section 4.6.2), showed that there were three groups of strategies (Figure 4.6.3).

Figure 4.6.3. Main differences in use and importance of strategies between high and low resilient farmers organised in three sets of strategies.

The strategies in group 1 were among the least important for managing risk for both high resilient and low resilient farmers (Figure 4.6.3). The use of geographic diversity by high resilient farmers corresponded with the fact that these farmers were also more likely to be owner-operators with multiple operations. On the other hand, high resilient farmers also tended to have more family members and non-family staff employed in their farm businesses which may explain the fact that they were less likely to have the main farmer operator working off-farm.

The identification of the second group of strategies is important because it shows the difference in the focus that both resilient farmer types placed on strategies they both used interchangeably. This can be used in further research aiming to identify differences in the implementation of these strategies between high and low resilient farmer types.

The differences identified across the three groups of strategies showed that high resilient farmers used, and placed more importance on strategies that coped with risk in a more proactive way than low resilient farmers did (Figure 4.6.3). High resilient farmers placed relatively higher importance on strategies for coping with risks from a strategic management perspective compared to low resilient farmers. These strategies are related to planning where the business is heading and why. This is explained by the greater strategic thinking focus of high resilient farmers when compared to low resilient farmers. These findings are consistent with Miller et al. (2004) who suggested that having a strategic purpose or implementing SWOT analysis were proxies of the capability a farm business to recognise when strategic adjustments are necessary, and thus a reflection of their adaptive capacity. Likewise, high resilient farmers used and acknowledged that flexibility was an important strategy for coping with risks in the long term; once again, this may have been explained by high resilient farmers' high strategic thinking focus. A high strategic focus may be related to recognising that positioning the farm business for flexibility is important for coping with downside and upside risks (Darnhofer et al., 2008a, 2010a; Miller et al., 2004). Miller et al. (2004) and Darnhofer et al. (2010a) both suggested that positioning a firm for flexibility was a relevant strategy for responding to changing circumstances, and thus is a strategy related to adaptive capacity.

High resilient farmers were likely to use and give more importance to the strategy of gathering market information than low resilient farmers. This may have been a reflection of their higher social sense-making skills and, therefore, reflect farmer learning about the environment, in this case related to the market. The gathering of any kind of relevant information for decision making also described a relevant strategy that ensures adaptive capacity through learning (Darnhofer et al., 2008a; Folke et al., 2010).

Another important characteristic of high resilient farmers is that they used and placed relatively high importance on managing debt and planning capital spending, which meant that these farmers were less concerned about having debt; instead, they were more concerned in doing something "useful" with that debt. This was consistent with Parsonson-Ensor and Saunders (2011) who described that as farming in New Zealand has become more industrialised over time, acquiring debt has been a strategy adopted by most farms in New Zealand (70%), and that it was an important means of overcoming periods of economic hardship. Therefore, farmers may have been relying on having debt as a strategy for financing investments or expenses. This finding challenges Darnhofer (2010) who described keeping debt low, rather than having and managing debt, as a sign of resilient farms. However, it is important to note that Darnhofer (2010) described this strategy as being relevant for building resilience in farms in Austria where farmers are less exposed to the external environment because of an agricultural policy that subsidises farms so that farm businesses remain operating regardless of the environment. New Zealand farmers, however, operate in a non-subsidised environment in which finance may be needed.

High resilient farmers were also more likely to adopt, and give more importance to, implementing technological innovations. This may be related to these farmers' willingness to change, and thus reflects adaptation in the form of new techniques or approaches to cope with risk, either by reducing threats or capturing opportunities. However, the idea that these innovations result in a resilient farm business can be debated, because it depends on how useful or successful the implementation of the innovation is. Parsonson-Ensor and Saunders (2011) identified that being innovative and adopting new technologies was a source of farms' adaptive capacity. However, they also argued that innovations can also present a source of risk if farmers are not being able to implement them properly, and because of quickly changing trends meaning that technology can also become obsolete quickly and result in a loss of markets and revenue.

Low resilient farmers placed relatively more importance on strategies which were more reactive and targeted to buffering the negative effect of risks, such as not producing to full capacity and keeping debt low, strategies that aimed to reduce the threats to production and financial risks, respectively. These results suggest that low resilient farmers were not seeking opportunities; rather, they felt more comfortable in managing what they knew. This is consistent with resilience theory which suggests that although buffer capacity is a key aspect of resilience, resilience goes beyond being simply a buffer for retaining and maintaining the status quo, but that it is also about being able to adapt to new situations (Folke et al., 2010). Moreover, the results from the research in this study were consistent with Darnhofer (2010) and Miller et al. (2004) who identified that these two strategies were relevant for coping with threats in the short-term and,

therefore, a reflection of a farm's buffer capacity. Conversely, Shadbolt and Olubode-Awosola (2013) found that the latter two strategies were thought to be of relatively high importance by farmers who they termed "experienced but cautious" and of relatively lower importance to those they termed "entrepreneurs"; the former being more a successful farmer type than the latter.

4.7. Resilient farmer types: Summary of results.

The aim of this research was to define resilient farmer types based on a set of desirable attributes identified in the literature, and to use this framework to identify different resilient types in a sample of dairy farmers in New Zealand. Furthermore, this research aimed to identify any differences between resilient farmer types in relation to some of their individual and farm business characteristics, as well as their perception of risks in the farm business environment, and their use, and importance given to, strategies for managing risks in their farm businesses. Table 4.7 shows a summary of the findings of this research.

Table 4.7. Summary of the differences between high and low resilient farmers

Defining resilience attributes	High resilient farmer	Low resilient farmer
General self-efficacy	+	-
Willingness to change	+	-
Locus of control	+	-
Social sense-making	+	-
Strategic thinking focus	+	-
Individual characteristics		
Risk aversion	+	-
Ownership structure	Farm owner with multiple operations	Farm owner with a single operation
Influence in strategic decisions	+	-
Farm business characteristics		
Stocking rate	+	-
Family members involved in farm duties	+	-
Non-family staff employed	+	-
General perception of risk in the farm business environment	See more opportunities	See more threats
Risk management focus	Strategic	Tactical

Two resilient farmer types, high and low resilient farmer types, were identified based on their differences in five defining resilience attributes: general self-efficacy; willingness to change; locus of control; social sense-making; and strategic thinking focus (Table 4.7). Interestingly, high resilient farmers were more likely to be more risk averse than low resilient farmers. Moreover, high resilient farmers were more likely to be farm owner-operators with multiple operations whereas low resilient farmers were more likely to be farm owner-operators of a single operation. Furthermore, high resilient farmers had more influence on strategic decisions than low resilient farmers.

Little differences were observed between the farm businesses owned and/or operated by high and low resilient farmers. High resilient farmers were more likely to use higher stocking rates, have more family working on farm, and employ more staff in their farm businesses than low resilient farmers.

High resilient farmers were more likely to see more opportunities in the sources of risks in the farm business environment, while low resilient farmers were more likely to see more threats in the same sources of risk.

Finally, high resilient farmers were more likely to be focused on managing risks by using and placing more importance to strategies that cope with risks in the long-term (e.g. having strategic purpose, using practical planning steps, long term flexibility, managing debt) and on prevention of uncertain events (e.g. having farm and personal insurance); whereas, low resilient farmers used and/or gave more importance to strategies that aimed to manage risks in the short-term (i.e. more tactical) such as having the main farm operator working off-farm and not producing to full capacity. From the differences observed between high and low resilient farmers in terms of their risk management focus, it is understandable then why low resilient farmers tended to see more threats in the sources of risks in the farm business environment.

Chapter five

5. Conclusions

This study set out to define the attributes of a resilient farmer and to identify different farmer types based on their resilience attributes. Furthermore, this research sought to investigate any differences between resilient farmer types regarding their use of, and importance given to, strategies for managing risks in their farm businesses and to explore their perceptions of sources of risks in the farm business environment. This research was justified on the grounds that if New Zealand dairy farmers are moving into a period where they will be facing an increasingly turbulent environment that poses significant risk to the survival of their farms (Gray et al., 2008; Shadbolt et al., 2011), they must develop resilience (Shadbolt et al., 2011). However, little was known about what makes a farmer resilient, and moreover, whether these farmers differ in their risk management behaviour or their perceptions of the sources of risks in the farm business environment with respect to other farmers. Therefore, this study sought to answer two questions:

Question 1: What are the attributes that define a resilient farmer?

Question 2: Do different resilient farmer types differ in their perceptions of the farm business environment and their risk management behaviour?

This research identified two resilient farmer types: high resilient and low resilient farmer types, based on five individual resilience attributes (general self-efficacy, locus of control, willingness to change, social sense-making and strategic thinking focus). High resilient farmers had a greater sense of self-efficacy, an internal locus of control, were more willing to implement changes in their farm businesses, had more regular contact with other farmers or members of the dairy industry to discuss trends and acquire knowledge (social sense-making), and had a more strategic thinking mind-set compared to low resilient farmers.

This research has highlighted that high resilient farmers, compared to low resilient farmers, are more likely to use, and acknowledge greater importance to: strategies that aim to reduce uncertainty (e.g. gathering market information); strategies that recognise that risk may present both opportunities and threats in the short and long term (e.g. having short-term and long term flexibility); strategies that aim to transfer and reduce risks (e.g. having personal and/or business

insurance and geographic diversity); and being proactive in finding new ways to cope with risk (e.g. implementing technological innovations). These findings highlighted the orientation of high resilient farmers to prevent, react to, and adapt to risks, which was consistent with resilience theory that suggests that since uncertainty is an inherent part of managing systems, managers should be ready to prevent, react to and adapt to risks (Darnhofer et al., 2010b; Folke et al., 2004; Folke et al., 2010). On the other hand, low resilient farmers, compared to high resilient farmers, made more use of, and gave more importance to, strategies that reduced threats in the short-term (i.e. strategies that are more tactical than strategic) such as not producing to full capacity or having the main farm operator working off farm.

This research has identified that high resilient farmers are more likely to perceive more sources of risk in the farm business environment as opportunities rather than threats, whereas low resilient farmers are more likely to perceive more threats than opportunities. This was an important finding because it may imply that a shift is required in the focus of how the farm management discipline has traditionally approached risk, from being widely focused on managing threats, to considering that risks may also present opportunities. Indeed, being able to mitigate threats but also to capture opportunities at the same time are key aspects of resilience. Interestingly, high resilient farmers were more risk averse than low resilient farmers, which indicated that, despite the fact that they noticed more opportunities than threats in the environment and were more strategically focused than low resilient farmers, high resilient farmers may be more careful in the opportunities they choose to position their farm business in the future compared to low resilient farmers.

This research also found that there was no difference in how high and low resilient farmers perceived the rate of change and volatility of all sources of risk in the farm business environment. However, when looking at the sources of risk individually, a few sources of risk were perceived differently between resilient farmer types. High resilient farmers perceived that production risks such as climate, and pasture/crop/animal health risks had remained constant or decreasing slowly, respectively. In contrast, low resilient farmers perceived climate, and pasture/crop/animal health risks had increased rapidly and increased slowly, respectively. This indicated that farmer perceptions of some of the sources of risk in the farm business environment may have a key role in influencing the use of, and importance given to, risk management strategies.

Little difference between resilient farmer type was found regarding farmer, and farm business, demographic characteristics. The only significant differences between resilient farmer types that were found were with respect to the farm ownership structure, with high resilient farmers being more likely to be associated with the ownership and operation of multiple farm businesses and low resilient farmers more likely to be associated with the ownership and operation of a single farm business. These results corresponded with the diversification strategy used by high resilient farmers which was also linked to the concept of resilience by Darnhofer et al. (2008a) and Darnhofer (2010). Other significant differences found between high and low resilient farmers were that high resilient farmers had more people involved in farm duties and had higher stocking rates in their businesses.

5.1. Implications of this research

This research has some implications for the dairy industry. Differences between resilient farmer type and their risk management behaviour need to be acknowledged and identified. First, the identification of the two resilient farmer types can be used to support those farmers identified as low resilient to develop their self-efficacy beliefs and control beliefs. Likewise, low resilient farmers can be targeted to help them to develop soft systems competencies such as strategic thinking skills or networking skills (associated to the social sense-making resilience attribute).

Second, the identification of a set of strategies that is more likely to be used by high resilient farmers than low resilient farmers raises awareness of what the strategies are that are more likely to confer a degree of resilience to farm businesses. Therefore, these are the strategies low resilient farmers can be encouraged to adopt. Furthermore, the higher importance given to a range of business strategies by high resilient farmers compared to low resilient farmers, indicated the awareness and importance of formal processes of strategic management to high resilient farmers. The development of tools for strategic management that could be easily adopted by farmers could be a key area for extension programmes aiming to improve farmer resilience.

5.2. Limitations of the research

Overall, this study was of exploratory nature and therefore the results should be interpreted in the light of the limitations presented including: a limitation on the number of possible resilience attributes used to identify farmer types, a limited number of possible sources of risk used to characterise the farm business environment, and a limited number of strategies able to be included in the research to characterise farmer risk management behaviour. Different factors

may have limited the generalisation of this research. Firstly, resilience and risk management comprises a wide area of research, yet the questions in the survey were restricted to a limited number so that the survey was kept to a reasonable size and questions could be easily completed by farmers without losing attention. If more questions were added, the length of the survey would have increased, increasing the risk of a lower response rate which would have reduced the validity of the findings. Reducing the number of questions was preferred over a longer survey. However, this meant that the six attributes of individual resilience had to be measured using a relatively low number of questions each (less than 5 questions each). Also, each question captured different aspects of the attributes constraining the possibility of estimating the internal consistency (Cronbach's alpha) for each of the resilience attributes constructs (Meyers et al., 2006). Therefore, this research was unable to estimate the stability in respondents' answers to the questions which is an indicator of repeatable research results. Nevertheless, in order to reduce the possibility of low internal consistency, the questions were drawn from other studies in which the consistency of the questions had been tested (refer to Chapter 3).

Another factor that may influence generalisation of results is that survey respondents were over-represented by farm owners since only a small proportion of sharemilkers (1.6%) filled in the survey compared to the national statistics (35%) (DairyNZ, 2014b). This means that the identification of the risk management strategies in the high resilient farmer type is likely to be biased to the strategies used by owners, who were the majority of respondents in this survey. This over-representation of farm owners may have been related to the timing of the survey (25th of July 2014, near calving), which may have reduced the number of sharemilkers participating in the survey because of lack of time.

Finally, it is important to highlight that running different and separate inferential statistical tests on the data set may have led to multiple testing problem. The multiple testing problem relates to the increasing chance of obtaining at least one invalid result when multiple tests are performed, which may be a limitation for the interpretation of the results of this study. However, triangulation of different results in the discussion may have help to reduce the risk of committing errors. Nevertheless, the risk of multiple testing problem should be acknowledged and corrected if further research is to be done using the data set and framework developed in this research.

5.3. Future research

In order to test the reliability of the questions on resilience attributes used in this survey, further surveys could be undertaken using the same questions over time. Likewise, conducting further

research using the group of questions that were significantly associated with the attributes and performing confirmatory factor analysis could be done in order to confirm or reject the resilience attributes construct developed in this study. Moreover, the results from this study could be improved by associating the findings in this research with farm businesses financial data.

More importantly to improve the knowledge about resilience and risk management, further research could be undertaken in at least three other related areas:

a) Contribution of each individual attribute to strategies for managing risk

Regression models could be performed using the same dataset from this survey in order to determine the significance and importance of each of the attributes of resilience for predicting the use or importance of risk management strategies. Furthermore, these models could be further improved by including factors such farmer perception of change and volatility of the sources of risk in the farm business environment. By doing this, it could be determined to what extent farmers' behaviour with respect to their strategic risk management was influenced by what personality traits and skills, and which were influenced by factors in the external environment. The same data set used in this research could be used for this research.

b) Difference between buffer capacity, adaptive capacity, and transformability

Although this research identified resilient farmer types based on attributes that defined their resilience, it is important to note that the resilience construct developed in this research was based on attributes that emphasise the adaptive aspects of resilience. Nevertheless, as the literature review has highlighted, resilience comprises other aspects, namely buffer capacity and transformability. Further research is required to differentiate buffer capacity, adaptive capacity and transformability from each other. A plausible option to explore the differences between buffer capacity and adaptive capacity would be to identify farmers based on a combination of the resilience attributes developed in this study, and the framework developed by Shadbolt *et al.* (2011) for capturing buffer capacity. Another option would be to undertake qualitative research with different resilient farmer types and to inquire about the reasons that lead them to choose the the strategies they use for managing risk.

c) Increasing the number of potential resilience attributes

Since resilience is a broad topic, the resilience construct developed in this research was based on a literature review which identified the resilience attributes relevant to different aspects of decision making. However, other attributes not linked to decision making could be included in order to improve the construct. For example, psychological attributes related to the expression

of personal emotions or empathy towards others are also two attributes closely related to a resilient personality (Skodol, 2010).

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Appendices

7.1 Appendix I: Survey form.

1 You and your farm business

1.1 You Fill-in or **circle** what best describes **you**.

1.1.1 Please **fill-in** the total number of years of farming experience you have had.

Given the years of experience indicated above, please allocate these years to the most predominant role at the time:

Farm worker	
Farm manager and/or contract milker and/or variable order sharemilker	
Herd-owning sharemilker	
Farm owner (operator and/or non-operator)	
Equity partner (operator and/or non-operator)	

1.1.2 Please **circle** your age according the following ranges:

A	20-30 years	D	51-60 years
B	31-40 years	E	61-70 years
C	41-50 years	F	71 years or more

1.1.3 Please **circle** your highest level of formal education

A	NCEA level 1 / school certificate	D	Degree graduate
B	University entrance / bursary / NCEA level 2 or 3	E	Postgraduate
C	Diploma graduate	F	Other (please specify):

1.1.4 Please **circle** the letter that best describes your current situation:

A	A farm manager and/or contract milker and/or variable order sharemilker
B	A herd-owning Sharemilker/Lessee
C	A herd-owning Sharemilker/Lessee with more than one herd
D	A farm owner-operator
E	A farm owner-non-operator
F	A farm owner operator with multiple operations (farms, equity partnerships and/or herd owni sharemilking contracts)
G	An equity partnership managing partner
H	Other (please specify):

1.2 Your farm business

Please **circle** or **fill-in** what best describes the situation of **your farm business** today. If you operate more than one farm business, please answer with reference to the business in which you have the most influence.

1.2.1 Please **circle** the location of this farm business

North island							South Island			
A	Northland	E	Central Plateau	I	Taranaki	L	Nelson/Marlborough	P	Otago
B	Auckland	F	Western Uplands	J	Manawatu	M	West Coast	Q	Southland
C	Waikato	G	East Coast	K	Wairarapa	N	North Canterbury		
D	Bay of Plenty	H	Hawkes Bay			O	South Canterbury		

1.2.2 Please **fill-in** the following figures for this farm business

Effective milking area (ha)	
Number of cows milked at peak in the 2013/14 season	
Total milksolids produced in the 2013/14 season (kg)	

1.2.3 Please **circle** the appropriate letter that best describes the stage you are in this farm business

A	Entry	C	Consolidation	E	Entry of next generation
B	Growth	D	Exit		

1.2.4 Please **fill-in** the number of people involved in this farm business (use full time equivalents)

Family members involved in farm duties			Non-family staff employed		

1.2.5 Please **circle** your role in this farm business

A	Sharemilker (variable order)	E	Equity partner (operator)
B	Sharemilker (herd owning)	F	Equity partner (non-operator)
C	Owner (operator)	G	Farm manager
D	Owner (non-operator)	H	Other (please specify):

1.2.6 In terms of long term, within the season, and day-to-day decision making on this farm business, how much influence do you think you have?
Please **circle** one option (1= very little; 2= little; 3= some; 4= high; 5= very high) for each of the time-frames:

	Very little	Little	Some	High	Very High
Long term	1	2	3	4	5
Within the season	1	2	3	4	5
Day-to-day	1	2	3	4	5

2 Resilience attributes

Please **circle** to what extent you disagree or agree (**1**= strongly disagree; **2**= disagree; **3**= neutral; **4**= agree; **5**= strongly agree) with the following statements:

Statement	
When there are a number of solutions to a problem, I find it difficult to make a choice.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
I am not good at making sense of ambiguous and uncertain situations.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
I am confident that I can deal efficiently with unexpected events.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
I consider how different parts of the farm system impact on each other.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
When confronted with a new situation, I review past experiences to assess the situation.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
My decision-making is driven by my vision for my farm business.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
I find planning difficult because the future is so uncertain.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
I have regular contact with other members of the industry to acquire knowledge.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
No matter what happens, I always stick to my original plans.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
It is easy for me to stick to my aims and accomplish my goals.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
Within a season, I am able to manage almost all uncertainty that occurs.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
When it comes to business, I like to play it safe.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
The weather and commodity prices can knock the business around in the short term but in the long term there is still a lot I can do to stay ahead of the game.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
When resolving a strategic problem I consider a range of possibilities.	Strongly disagree 1 · Disagree 2 · Neutral 3 · Agree 4 · Strongly agree 5
I consider everyone in the dairy industry learns from each other.	Strongly disagree · Disagree · Neutral · Agree · Strongly agree

	1 2 3 4 5
The success of my farm business is mostly determined by factors outside of my control.	Strongly disagree Disagree Neutral Agree Strongly agree 1 2 3 4 5
I am willing to make changes to my farm business.	Strongly disagree Disagree Neutral Agree Strongly agree 1 2 3 4 5
I do not search for patterns when confronted with rich information.	Strongly disagree Disagree Neutral Agree Strongly agree 1 2 3 4 5
I am willing to accept uncertainty in my farm business.	Strongly disagree Disagree Neutral Agree Strongly agree 1 2 3 4 5
I have regular contact with other farmers where we discuss trends in the industry.	Strongly disagree Disagree Neutral Agree Strongly agree 1 2 3 4 5
No matter how hard I try, I struggle to solve difficult problems.	Strongly disagree Disagree Neutral Agree Strongly agree 1 2 3 4 5
Over the long term, I am able to manage almost all uncertainty that occurs.	Strongly disagree Disagree Neutral Agree Strongly agree 1 2 3 4 5
I do not pay close attention to conditions outside the dairy industry.	Strongly disagree Disagree Neutral Agree Strongly agree 1 2 3 4 5
I value the knowledge of others from inside and outside the farm business.	Strongly disagree Disagree Neutral Agree Strongly agree 1 2 3 4 5
I intend to make time to implement changes required in my farm business.	Strongly disagree Disagree Neutral Agree Strongly agree 1 2 3 4 5

3 Perception of the farm business environment

For each of the following **sources of risk**, please **answer**:

- **a)** How do you think this source of risk has been **changing** in the last 10 years? Use a scale that goes from: **1**= decreasing rapidly; **2**= decreasing slowly; **3**= constant; **4**= increasing slowly; **5**= increasing rapidly, to **circle** your answer.
- **b)** How **volatile** this source of risk has been in the last 10 years? Here volatility is understood as the variation of the listed source of risk in the last 10 years. Use a scale that goes from: **1**= very low; **2**= low; **3**= moderate; **4**= high; **5**= very high.
- **c)** Do you believe that this source of risk has presented an **opportunity and/or threat** for your farm business in the last 10 years? If you believe the source presented an opportunity circle "**1**"; if you believe the source presents a threat circle "**2**"; if both, circle "**3**".

Note: you might want to choose to answer these questions by filling one row at a time, or by filling one column at a time.

Source of risk	**(a) Change** (last 10 years)	**(b) Volatility** (last 10 years)	**(c) Risk** (last 10 years)
Climate	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5	Very Low 1 · Low 2 · Moderate 3 · High 4 · Very High 5	1 Opportunity · 2 Threat · 3 Opportunity and Threat
Pasture/crop/animal health	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5	Very Low 1 · Low 2 · Moderate 3 · High 4 · Very High 5	1 Opportunity · 2 Threat · 3 Opportunity and Threat
Interest rates	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5	Very Low 1 · Low 2 · Moderate 3 · High 4 · Very High 5	1 Opportunity · 2 Threat · 3 Opportunity and Threat
Land values	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5	Very Low 1 · Low 2 · Moderate 3 · High 4 · Very High 5	1 Opportunity · 2 Threat · 3 Opportunity and Threat
Availability of capital	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5	Very Low 1 · Low 2 · Moderate 3 · High 4 · Very High 5	1 Opportunity · 2 Threat · 3 Opportunity and Threat
Milk price	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5	Very Low 1 · Low 2 · Moderate 3 · High 4 · Very High 5	1 Opportunity · 2 Threat · 3 Opportunity and Threat
Input prices and availability	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5	Very Low 1 · Low 2 · Moderate 3 · High 4 · Very High 5	1 Opportunity · 2 Threat · 3 Opportunity and Threat
Availability of labour (self and family, employees, contractors)	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5	Very Low 1 · Low 2 · Moderate 3 · High 4 · Very High 5	1 Opportunity · 2 Threat · 3 Opportunity and Threat

Source of risk	(a) Change (last 10 years)	(b) Volatility (last 10 years)	(c) Risk (last 10 years)
Skills and knowledge of those associated with the business	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5	Very Low 1 · Low 2 · Moderate 3 · High 4 · Very High 5	1 Opportunity · 2 Threat · 3 Opportunity and Threat
Business relationships (within supply chain)	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5		1 Opportunity · 2 Threat · 3 Opportunity and Threat
Dairy industry structure	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5		1 Opportunity · 2 Threat · 3 Opportunity and Threat
The global economic and political situation	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5		1 Opportunity · 2 Threat · 3 Opportunity and Threat
Global supply and demand for food	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5		1 Opportunity · 2 Threat · 3 Opportunity and Threat
Global competitors & competition	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5		1 Opportunity · 2 Threat · 3 Opportunity and Threat
Reputation and image of the dairy industry	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5		1 Opportunity · 2 Threat · 3 Opportunity and Threat
Government laws and policies	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5		1 Opportunity · 2 Threat · 3 Opportunity and Threat
Local body laws and regulations	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5		1 Opportunity · 2 Threat · 3 Opportunity and Threat
Technological changes	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5		1 Opportunity · 2 Threat · 3 Opportunity and Threat
Other (please specify):	Decreasing Rapidly 1 · Decreasing Slowly 2 · Constant 3 · Increasing Slowly 4 · Increasing Rapidly 5	Very Low 1 · Low 2 · Moderate 3 · High 4 · Very High 5	1 Opportunity · 2 Threat · 3 Opportunity and Threat

4 Management responses to risk

There are a number of recognised strategies for managing risk; the following list includes some, but by no means all, of the strategies observed on dairy farms.

For each of the following **risk management strategies**, please **answer**:

a) Have you **used** this management strategy to manage risk in any of your farm businesses? Please **circle "1"** if you have used it or **"2"** if you have not used it as a strategy to manage risk in any of your farm businesses. If a risk management option is not applicable for your farm business, please circle **"3"**.

b) How **important** do you believe this management strategy is for managing risk in any of your farm businesses? Please **circle** the importance that you think this management strategy has by using e a scale that goes from: **1**= very low; **2**= low; **3**= medium; **4**= high; **5**= very high.

Risk management strategy	**(a) Use of risk management strategy**			**(b) Importance**				
	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
Maintaining feed reserves	1	2	3	1	2	3	4	5
Not producing to full capacity so there are reserves in the system	1	2	3	1	2	3	4	5
Monitoring programme for pest and diseases	1	2	3	1	2	3	4	5
Routine spraying or drenching	1	2	3	1	2	3	4	5
Irrigation	1	2	3	1	2	3	4	5
Geographic diversity through having properties in different areas	1	2	3	1	2	3	4	5
Using futures markets	1	2	3	1	2	3	4	5
Forward contracting	1	2	3	1	2	3	4	5
Gathering market information	1	2	3	1	2	3	4	5
Spreading sales (reducing seasonality in milk production)	1	2	3	1	2	3	4	5
Arranging overdraft reserves	1	2	3	1	2	3	4	5
Maintaining financial reserves: having cash and easily converted financial assets	1	2	3	1	2	3	4	5

Risk management response	(a) Use of risk management strategy			(b) Importance				
Main farm operator or family working off property	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Managing debt	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Keeping debt low	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Planning of capital spending	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Having personal and/or business insurance	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Having short term flexibility to adjust quickly to weather, price and other factors	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Having long term flexibility	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Having more than one type of animal or other enterprises on your property	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Using practical planning steps in your farm business	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Assessing strengths, weaknesses, threats and opportunities of your farm business	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Having a clear and shared vision or strategic purpose for your operation	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Using financial ratios to assist with decision making	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Implementing technological innovation(s)	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Adjusting production methods/system to comply with laws and policies	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5
Other (please specify):	Yes	No	Not applicable	Very Low	Low	Moderate	High	Very High
	1	2	3	1	2	3	4	5

Do you wish to be in the draw for a RD1 Gift Card valued at $250?

Please **circle**:

YES NO

Thank you very much for your participation on this project.

A summary of this research project will be available on www.onefarm.ac.nz at the end of this project.

7.2 Appendix II: Cover letters and information sheet.

E-mail cover letter.

OneFarm
Ko te Toi Whakahaere Pakihi Ahuwhenua
Centre of Excellence in Farm Business Management

Dear Farmer,

How well do you believe you cope with uncertainty? In a complex world in which turbulence has become the common currency, developing resilience is paramount to business success. Unfortunately, little is known about resilience in dairy farm businesses. We consider that a farmer's behaviour with respect to risk management is a cornerstone to resilience in dairy farm businesses. That is why I would like to invite you to participate in my research project.

My name is Federico Duranovich and I have chosen this topic as part of my Masters of AgriCommerce studies at Massey University. This project is under the supervision of Prof. Nicola Shadbolt and Dr Liz Dooley from the Institute of Agriculture and Environment at Massey University and is supported by OneFarm: The Centre of Excellence in Farm business Management.

We are surveying a random selected sample of dairy farmers from across New Zealand: the more responses we get, the more accurately the outcomes from this research can be extrapolated to the larger NZ dairy farmer population. Your response to this survey is valuable.

All your answers will remain anonymous and confidential. In addition, data will be analysed collectively so that no individual can be identified from the results of this project.

This survey is designed to take about 30 minutes of your time. You can choose not to answer a question should you prefer not to do so. We suggest you to fully complete the survey once you start. However, you can leave the survey at any time and resume it later. Should you decide to finish the survey later, your changes will be saved automatically and the survey will resume at the same point you left it.

You can access the on line survey by clicking on the link below, or by copying and pasting the link in to a new web browser.

http://masseybusiness.eu.qualtrics.com/SE/?SID=SV_5zJgvARrIBSIFzT

A summary of the results will be available at www.onefarm.co.nz at the end of this research project. For more information about the project or myself, please see the "information sheet" at the end of this email.

We acknowledge that for some of you calving has started and that you will be busy so we thank you in advance for your valuable time in doing this survey.

By completing this online survey you are eligible for the prize draw of a RD1 Gift Card valued at $250, but you need to supply your email address in the survey for the draw. Supplying your email in the online survey will also ensure you will not get a follow up email or postal survey. Be assured that your email address will only be retained for the purpose of the draw and will not be linked to survey data or results.

Thank you very much for your time and participation in this project.

Yours sincerely,

Federico Duranovich

Masters of AgriCommerce student

Massey University

Palmerston North

Postal cover letter

OneFarm
Ko te Toi Whakahaere Pakihi Ahuwhenua
Centre of Excellence in Farm Business Management

Dear Farmer,

How well do you believe you cope with uncertainty? In a complex world in which turbulence has become the common currency, developing resilience is paramount to business success. Unfortunately, little is known about resilience in dairy farm businesses. We consider that a farmer's behaviour with respect to risk management is a cornerstone to resilience in dairy farm businesses. That is why I would like to invite you to participate in my research project.

My name is Federico Duranovich and I have chosen this topic as part of my Masters of AgriCommerce studies at Massey University. This project is under the supervision of Prof. Nicola Shadbolt and Dr Liz Dooley from the Institute of Agriculture and Environment at Massey University and is supported by OneFarm: The Centre of Excellence in Farm business Management.

We are surveying a random selected sample of dairy farmers from across New Zealand: the more responses we get, the more accurately the outcomes from this research can be extrapolated to the larger NZ dairy farmer population. Your response to this survey is valuable.

All your answers will remain anonymous and confidential. In addition, data will be analysed collectively so that no individual can be identified from the results of this project.

This survey is designed to take about 30 minutes of your time. You can choose not to answer a question should you prefer not to do so. A summary of the results will be available at www.onefarm.co.nz at the end of this research project. For more information about the project or myself, please see the "information sheet" enclosed to this mail.

We acknowledge that for some of you calving has started and that you will be busy so we thank you in advance for your valuable time in doing this survey.

By completing this survey you are eligible for the prize draw of a RD1 Gift Card valued at $250. Please don't forget to respond the last question in the survey if you want to be included in the draw.

Thank you very much for your time and participation in this project.

Yours sincerely,

Federico Duranovich

Masters of AgriCommerce student

Massey University

Palmerston North

Information sheet: online and postal

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Institute of Agriculture and Environment (College of Sciences)
Private Bag 11222
Palmerston North 4442

Project title: "Exploring the relationship between a farmer's resilience attributes and their response to a turbulent business environment"

Information sheet

My name is Federico Duranovich and I am currently undertaking a Masters of AgriCommerce at Massey University. My research project entitled "Exploring the relationship between a farmer's resilience attributes and their response to a turbulent business environment" aims to identify and typify strategic management responses in relation to the attributes that define resilient farmers. It is expected that a farmer's resiliency should contribute to the resilience of their dairy farm businesses.

This project is under the supervision of Prof. Nicola Shadbolt and Dr Liz Dooley from the Institute of Agriculture and Environment and is supported by OneFarm: The Centre of Excellence in Farm business Management. This work is part of a larger OneFarm project, partially founded by DairyNZ, studying farmer's decision making under risk (see www.onefarm.ac.nz).

For this survey, you have been randomly selected from a database of farmer names as being representative of a New Zealand dairy farmer and your input is valuable. Your answers are confidential. Personal details such as your name and address are not recorded with the data from this survey. The survey covers a range of questions about your behaviour in decision-making, your perceptions of the dairy farm business environment, and risk management responses to the farm business environment. Multivariate regression analysis will be used to explore the relationships between resilience attributes, perception of the farm business environment, and risk management responses. Data will be analysed collectively so that no person can be identified from the results of this project. Survey responses will be kept in aggregate form and securely stored for five years for audit purposes if required. After five years, the data collected for this project will be disposed of.

Completion of this survey questionnaire implies consent to participate. You have the right to decline to answer any of the questions in this survey.

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director, Research Ethics, telephone 06 350 5249, email: humanethics@massey.ac.nz

If you have any queries about this survey please contact me via email (F.N.Duranovich@massey.ac.nz) or phone me at 063569099 ext. 84819 and I will get back to you as soon as possible.

Thank you. Your participation in this research project is very much appreciated.

Federico Duranovich

People involved in this research project:

Federico Duranovich (Student) Institute of Agriculture and Environment - PN 433 Private Bag 11222 Palmerston North 4442 Phone: (06) 356 9099 ext. 84819/e-mail: F.N.Duranovich@massey.ac.nz
Dr Liz Dooley (Supervisor) Institute of Agriculture and Environment - PN 433 Private Bag 11222 Palmerston North 4442 Phone: (06) 356 9099 ext. 84827/e-mail: A.E.Dooley@massey.ac.nz
Prof. Nicola Shadbolt (Supervisor) Institute of Agriculture and Environment - PN 433 Private Bag 11222 Palmerston North 4442 Phone: (06) 356 9099 ext. 84793/e-mail: N.M.Shadbolt@massey.ac.nz

7.3 Appendix III: Chi Square tests results.

Table 4.5.1A. Results of the chi-square tests for independence performed between farmer perception of change for each of the sources of risk and resilient farmer type

Source of risk	Statistic	Statistic Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Climate	Pearson Chi-Square	10.779[b]	4	.029**	.021**
	Fisher's Exact Test	11.855			.012**
	Cramer's V	.172		.029**	.021**
Pasture/crop/animal health	Pearson Chi-Square	11.201[a]	3	.011**	.010**
	Cramer's V	.176		.011**	.010**
Interest rates	Pearson Chi-Square	.372[a]	4	.985	.984
	Cramer's V	.032		.985	.984
Land values	Pearson Chi-Square	1.761[b]	4	.780	.823
	Fisher's Exact Test	1.811			.816
	Cramer's V	.070		.780	.823
Availability of capital	Pearson Chi-Square	2.791[a]	4	.593	.611
	Cramer's V	.088		.593	.611
Milk price	Pearson Chi-Square	2.625[a]	4	.622	.626
	Cramer's V	.085		.622	.626
Input prices and availability	Pearson Chi-Square	5.344[a]	3	.148	.150
	Cramer's V	.122		.148	.150
Availability of labour	Pearson Chi-Square	7.436[a]	4	.115	.114
	Cramer's V	.144		.115	.114
Skills and knowledge of those associated with the business	Pearson Chi-Square	1.756[a]	4	.781	.790
	Cramer's V	.070		.781	.790
Business relationships	Pearson Chi-Square	5.354[b]	4	.253	.251
	Fisher's Exact Test	5.656			.193
	Cramer's V	.123		.253	.251
Dairy industry structure	Pearson Chi-Square	2.551[a]	4	.636	.661
	Cramer's V	.084		.636	.661
The global economic and political situation	Pearson Chi-Square	4.254[a]	4	.373	.368
	Cramer's V	.109		.373	.368
Global supply and demand for food	Pearson Chi-Square	2.814[a]	4	.589	
	Cramer's V	.088		.589	.601
Global competitors and competition	Pearson Chi-Square	2.121[a]	3	.548	.549
	Cramer's V	.077		.548	.549
Reputation and image of the dairy industry	Pearson Chi-Square	5.698[a]	4	.223	.224
	Cramer's V	.126		.223	.224
Government laws and policies	Pearson Chi-Square	3.955[b]	4	.412	.415
	Fisher's Exact Test	3.653			.450
	Cramer's V	.105		.412	.415
Local body laws and regulations	Pearson Chi-Square	4.320[b]	4	.364	.369
	Fisher's Exact Test	4.257			.362
	Cramer's V	.109		.364	.369
Technological changes	Pearson Chi-Square	8.473[b]	4	.076*	.061*
	Fisher's Exact Test	8.187			.066*
	Cramer's V	.153		.076	.061
Other	Pearson Chi-Square	2.751[b]	4	.600	.691
	Fisher's Exact Test	2.804			.699
	Cramer's V	.273		.600	.691

[a] The assumptions of minimum expected counts were met

[b] The assumptions of minimum expected counts were **NOT** met

** significant at 5% level; * significant at 10% level

Table 4.5.2A. Results of the chi-square tests for independence performed between farmer perception of volatility for each of the sources of risk and resilient farmer type.

Source of risk	Statistic	Statistic Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Climate	Pearson Chi-Square	2.874[a]	4	.579	.598
	Cramer's V	.089		.579	.598
Pasture/crop/animal health	Pearson Chi-Square	2.224[b]	4	.695	.724
	Fisher's Exact Test	2.444			.682
	Cramer's V	.080		.695	.724
Interest rates	Pearson Chi-Square	.951[a]	4	.917	.921
	Cramer's V	.052		.917	.921
Land values	Pearson Chi-Square	2.608[a]	4	.625	.627
	Cramer's V	.085		.625	.627
Availability of capital	Pearson Chi-Square	.332[a]	4	.988	.991
	Cramer's V	.031		.988	.991
Milk price	Pearson Chi-Square	1.683[b]	4	.794	.844
	Fisher's Exact Test	1.833			.825
	Cramer's V	.068		.794	.844
Input prices and availability	Pearson Chi-Square	2.754[a]	4	.600	.641
	Cramer's V	.088		.600	.641
Availability of labour	Pearson Chi-Square	8.611[a]	4	.072*	.071*
	Cramer's V	.155		.072*	.071*
Skills and knowledge of those associated with the business	Pearson Chi-Square	.994[b]	4	.911	.918
	Fisher's Exact Test	1.091			.911
	Cramer's V	.053		.911	.918
Other	Pearson Chi-Square	2.016[b]	3	.569	.633
	Fisher's Exact Test	2.060			.633
	Cramer's V	.268		.569	.633

[a] The assumptions of minimum expected counts were met

[b] The assumptions of minimum expected counts were **NOT** met

* significant at 10% level

Table 4.5.3A. Results of the chi-square tests for independence performed between farmer perception of risk for each of the sources of risk and resilient farmer type

Source of risk	Statistic	Statistic Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Climate	Pearson Chi-Square	7.734[a]	2	.021**	.022**
	Cramer's V	.148		.021**	.022**
Pasture/crop/animal health	Pearson Chi-Square	8.574[a]	2	.014**	.014**
	Cramer's V	.158		.014**	.014**
Interest rates	Pearson Chi-Square	6.204[a]	2	.045**	.046**
	Cramer's V	.132		.045**	.046**
Land values	Pearson Chi-Square	7.592[a]	2	.022**	.024**
	Cramer's V	.146		.022**	.024**
Availability of capital	Pearson Chi-Square	2.153[a]	2	.341	.356
	Cramer's V	.079		.341	.356
Milk price	Pearson Chi-Square	3.475[a]	2	.176	.173
	Cramer's V	.099		.176	.173
Input prices and availability	Pearson Chi-Square	.083[a]	2	.960	.968
	Cramer's V	.015		.960	.968
Availability of labour	Pearson Chi-Square	1.694[a]	2	.429	.432
	Cramer's V	.069		.429	.432
Skills and knowledge of those associated with the business	Pearson Chi-Square	1.431[a]	2	.489	.485
	Cramer's V	.064		.489	.485
Business relationships	Pearson Chi-Square	.349[a]	2	.840	.836
	Cramer's V	.032		.840	.836
Dairy industry structure	Pearson Chi-Square	.094[a]	2	.954	.968
	Cramer's V	.016		.954	.968
The global economic and political situation	Pearson Chi-Square	3.162[a]	2	.206	.214
	Cramer's V	.095		.206	.214
Global supply and demand for food	Pearson Chi-Square	10.114[a]	2	.006**	.006**
	Cramer's V	.169		.006**	.006**
Global competitors and competition	Pearson Chi-Square	.495[a]	2	.781	.793
	Cramer's V	.038		.781	.793
Reputation and image of the dairy industry	Pearson Chi-Square	2.200[a]	2	.333	.343
	Cramer's V	.079		.333	.343
Government laws and policies	Pearson Chi-Square	2.482[a]	2	.289	.280
	Cramer's V	.084		.289	.280
Local body laws and regulations	Pearson Chi-Square	4.787[a]	2	.091*	.086*
	Cramer's V	.116		.091*	.086*
Technological changes	Pearson Chi-Square	2.043[b]	2	.360	.377
	Fisher's Exact Test	2.128			.364
	Cramer's V	.076		.360	.377
Other	Pearson Chi-Square	1.361[b]	2	.506	.579
	Fisher's Exact Test	1.444			.579
	Cramer's V	.206		.506	.579

[a] The assumptions of minimum expected counts were met

[b] The assumptions of minimum expected counts were **NOT** met

** significant at 5% level; * significant at 10% level

Table 4.6.1A. Results of the chi-square tests for independence performed between resilient farmer type and use of risk management strategy.

Risk management strategy	Statistic	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Maintaining feed reserves	Pearson Chi-Square	.650[b]	2	.723	.805
	Fisher's Exact Test	.966			.733
	Cramer's V	.042		.723	.805
Not producing to full capacity so there are reserves in the system	Pearson Chi-Square	3.881[a]	2	.144	.142
	Cramer's V	.105		.144	.142
Monitoring programme for pest and diseases	Pearson Chi-Square	4.126[a]	2	.127	.127
	Cramer's V	.107		.127	.127
Routine spraying or drenching	Pearson Chi-Square	.218[a]	2	.897	.920
	Cramer's V	.025		.897	.920
Irrigation	Pearson Chi-Square	.831[a]	1	.362	.387
	Cramer's V	.048		.362	.387
Geographic diversity through having properties in different areas	Pearson Chi-Square	7.158[a]	2	.028**	.028**
	Cramer's V	.141		.028**	.028**
Using futures markets	Pearson Chi-Square	9.904[a]	2	.007**	.007**
	Cramer's V	.167		.007**	.007**
Forward contracting	Pearson Chi-Square	3.138[a]	2	.208	.209
	Cramer's V	.094		.208	.209
Gathering market information	Pearson Chi-Square	7.279[a]	2	.026**	.026**
	Cramer's V	.143		.026**	.026**
Spreading sales (reducing seasonality in milk production)	Pearson Chi-Square	.302[a]	2	.860	.867
	Cramer's V	.029		.860	.867
Arranging overdraft reserves	Pearson Chi-Square	1.829[a]	2	.401	.406
	Cramer's V	.071		.401	.406
Maintaining financial reserves: having cash and easily converted financial assets	Pearson Chi-Square	1.304[a]	2	.521	.531
	Cramer's V	.060		.521	.531
Main farm operator or family working off property	Pearson Chi-Square	5.853[a]	2	.054*	.054*
	Cramer's V	.129		.054*	.054*
Managing debt	Pearson Chi-Square	1.356[b]	2	.508	.561
	Fisher's Exact Test	1.148			.669
	Cramer's V	.062		.508	.561
Keeping debt low	Pearson Chi-Square	3.614[a]	2	.164	.176
	Cramer's V	.101		.164	.176
Planning of capital spending	Pearson Chi-Square	3.099[b]	2	.212	.219
	Fisher's Exact Test	2.960			.219
	Cramer's V	.093		.212	.219
Having personal and/or business insurance	Pearson Chi-Square	.915[a]	2	.633	.653
	Cramer's V	.051		.633	.653
Having short term flexibility to adjust quickly to weather, price and other factors	Pearson Chi-Square	2.386[a]	2	.303	.305
	Cramer's V	.049		.303	.305
Having long term flexibility	Pearson Chi-Square	5.741[b]	2	.057*	.053*
	Fisher's Exact Test	5.891			.040
	Cramer's V	.127		.057*	.053*
Having more than one type of animal or other enterprises on your property	Pearson Chi-Square	1.030[a]	2	.597	.603
	Cramer's V	.054		.597	.603
Using practical planning steps in your farm business	Pearson Chi-Square	1.108[b]	2	.575	.628
	Fisher's Exact Test	1.015			.628
	Cramer's V	.056		.575	.628
SWOT	Pearson Chi-Square	8.549[b]	2	.014**	.010**
	Fisher's Exact Test	8.446			.009**
	Cramer's V	.155		.014**	.010**
Having a clear and shared vision or strategic purpose for your operation	Pearson Chi-Square	9.949[b]	2	.007**	.006**
	Fisher's Exact Test	10.132			.004**
	Cramer's V	.167		.007**	.006**

[a] The assumptions of minimum expected counts were met

[b] The assumptions of minimum expected counts were **NOT** met

** significant at 5% level; * significant at 10% level

Table 4.6.1A (Cont.). Results of the chi-square tests for independence performed between resilient farmer type and use of risk management strategy.

Risk management strategy	Statistic	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Using financial ratios to assist with decision making	Pearson Chi-Square	13.081[a]	2	.001**	.001**
	Cramer's V	.192		.001**	.001**
Implementing technological innovation(s)	Pearson Chi-Square	5.606[b]	2	.061*	.055*
	Fisher's Exact Test	5.823			.040**
	Cramer's V	.125		.061*	.055*
Adjusting production methods/system to comply with laws and policies	Pearson Chi-Square	.553[a]	2	.758	.807
	Cramer's V	.039		.758	.807
Other	Pearson Chi-Square	1.667[b]	1	.197	.400
	Fisher's Exact Test				.400
	Cramer's V	.408		.197	.400

[a] The assumptions of minimum expected counts were met
[b] The assumptions of minimum expected counts were **NOT** met
** significant at 5% level; * significant at 10% level