A Framework for Assessing The Exchange Costs in the Flax Fibre Supply Chain

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ABSTRACT

Canada has been recognized as the largest exporter of flax seed in the world. Currently, very little flax straw is further processed, despite its potential as a value added product, with only about 7-10% of Canadian flax seed producers harvesting residual flax straw rather than burning the straw. A traditional use of flax straw has been for the production of fibre for the linen industry. Interest in flax fibre has been rekindled with the impetus to seek out bioproducts that replace non-renewal resources and provide value-added opportunities for agricultural producers. Flax fibre also has a range of potential uses in automotive parts, geotextiles, insulation material, etc. Despite this potential, the Canadian flax fibre sector remains largely underdeveloped, with fledgling supply chains and lack of investment in the necessary processing capacity. This paper develops a framework for analysing the relational exchanges at different stage of the supply chain to determine if the paucity in investment is the result of prohibitively high exchange costs.

A number of distinct stages in the flax fibre supply chain can be identified: farmers producing flax seed and/or straw; processors who extract the natural fibre from the straw; and manufacturers who use the fibre in their products. The paper develops a framework that draws together insights from Transaction Cost Economics, Agency Theory and Bargaining Theory. The role of institutions in facilitating quality measurement and providing participants with information is also considered. The theoretical framework identifies asset specificity, agency measurement costs, bargaining power and under-developed institutions as key factors in the development of the flax

fibre sector. From the theoretical framework, a set of propositions is developed that examine the anticipated effect of these factors on vertical coordination in the sector.

The theoretical propositions are explored through a series of semi-structured interviews with parties at each stage of the supply chain (producers, fibre processors, final manufacturers), as well as with industry experts. Information from the interviews is used to identify the transaction characteristics and the institutional framework characterizing the flax fibre sector in Canada. This is analysed through a comparative case study approach with the flax fibre sector in Europe, and the wool fibre sector in New Zealand as an example of a fully developed and long-standing fibre sector. By also noting the different vertical coordination strategies that are present in these supply chains, a connection is drawn between the presence of certain transaction characteristics and the corresponding cost-minimizing exchange relationships. The case studies are used to investigate the propositions developed from the theoretical framework regarding the impact of transaction characteristics on the optimal vertical coordination strategy and the impediments to development and investment in the sector.

The propositions developed in the framework are verified to a great extent by the comparative case study. The uncertainty in the exchange environment regarding the future direction of the flax fibre industry and the high measurement costs due to the absent quality and grading regime in the Canadian flax fibre set the two industries apart from each other. Both of these dimensions impact the exchange costs of a transaction and subsequently, the extent to which the parties are closely coordinated. The case studies verify that using a framework to analyze transactions provides additional insights because of the joint consideration of several features of the transaction.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

1.1 Background

Canada is the largest exporter of flax seed in the world. The flax plant is generally viewed as an easy crop to manage and it is used in rotation with other crops on the prairies. The flax plant is a dual-purpose plant – oil and fibre. The oilseed is used mainly for industrial purposes, such as flooring and paint varnishes. There is also a variety of oilseed flax that is edible and has various health benefits.[1] Flax can be harvested for either its fibrous straw or its high quality oilseed, with different varieties available for each purpose. In Canada, however, only the oilseed variety is available to producers. In other areas of the world, flax is harvested specifically for its fibre and farmers derive their income from marketing the straw. For instance, producers in western European countries such as Belgium and France harvest high quality flax straw that is further processed with the fibre destined for linen manufacturers in Asia. In Canada, however, the flax plant is cultivated for its oilseed with producers deriving their revenue from marketing the oilseed. The fibrous flax straw is viewed as a nuisance. This is in spite of the fact that straw from the oilseed variety of flax also contains potentially valuable fibre. The usage rate of oilseed flax straw is very low, leaving much of the straw to be burned in fields. Approximately 7-10 percent of available flax straw was used for further processing in 2001 (SAFRR, 2005a).

In recent years, however, flax fibre has received more attention. Interest in flax fibre has been in part rekindled. There is an interested by policy makers in bioproducts

[1] This variety of flax, Linola, accounts for only a small fraction of flax acres

because of their potential to replace non-renewal resources and to provide value-added opportunities for agricultural producers. A bioproduct is defined as a commercial or industrial product (other than food or feed) that utilizes biological products or renewable domestic agricultural (plant, animal, or marine) or forestry products (BioAlberta, 2005). Oilseed flax straw has the potential to produce fibre of adequate quality for various industrial applications. Canadian produced flax fibre can be used in automotive parts, geotextiles[2], pulp sweetners[3] insulation material, and various other industrial applications (SAFRR, 2004b). When used for industrial purposes, flax fibre serves mainly as an additive in the manufacturing process. Research to date has indicated that flax fibre has superior strength characteristics and can compete effectively with other chemically based strengthening agents (AAFRD, 2003).

The flax fibre industry is still in its infancy and, thus far, its growth has been slow. The large number of acres devoted to flax in Canada means that there is a large volume of flax straw available for value added processing. Despite the large potential for utilizing this valuable by-product, growth at all stages of the supply chain has been stagnant, or growing very slowly. Entry into the industry has been slow, with only a handful of processors of flax straw currently operating in Canada. Similarly, manufacturers have been slow to adopt flax fibre in their production processes.

1.2 Problem Statement

Traditional neoclassical economics examines industries and firms primarily from a production point of view. Slow industry growth can thus be explained by technological

[2] Geotextiles are a mesh of fibres (including flax fibres) that are used at road, railroad, and building sites to reduce the levels of dust and erosion that are produced during construction (SAFRR, 2004b).
[3] Pulp sweetners are the addition of extra strong fibre into a pulp mix of recycled paper to give it the necessary strength.

difficulties creating high production costs that limit profitability in production. This thesis takes a different approach. Slow industry growth is not viewed from a production point of view but from a transaction point of view. Business relationships are necessary in a supply chain to move the product between stages of production, or to market the product to downstream buyers. Efficient marketing is the ability to move a product through the supply chain at the least cost, and eventually capture a segment of consumers willing to pay the price for the product's bundle of attributes (Kohls, 1967). Following New Institutional Economics (NIE), the efficiency of exchange relationships is measured in terms of transaction costs. Prevailing business relationships thus minimize transaction costs (Williamson, 1986a).

The lack of development in the flax fibre industry is hypothesised to be related to the efficiency of marketing in the supply chain. It is therefore proposed that inefficient marketing, or the inefficiency of business relationships in a supply chain plays a role in the slow development of an industry.

The premise of this thesis is that there are several factors in the transaction, the transaction environment and the characteristics of the transacting parties that are creating high exchange costs for existing and potential participants in the Canadian flax fibre supply industry. These high exchange costs are prohibiting or slowing the development of the sector due to the requirement of closely vertically coordinated relationships in the industry.

1.3 Objectives

This thesis has several components tied to fulfilling particular objectives. The first objective is to provide an overview of the current state of the industry and identify

issues that characterize the industry. Therefore, the main players in the supply chain and their roles, as well as the environment in which they carry out exchanges, are presented. Through this examination of the industry, critical elements will be identified that influence different features of the transactions.

The second main objective is to comprehensively characterize transactions. Different concepts of NIE, as well as other constructs are combined in a theoretical framework. A framework, as opposed to a model, allows a number of different concepts to be incorporated for analyzing a problem. Therefore, the analysis is not limited to a single theoretical construct. The framework includes a number of concepts from NIE to not only analyze the exchange relationship, but also gain an insight into the transaction environment and the characteristics of the exchange parties. The framework develops propositions to examine how exchange costs stemming from each of the different concepts affect coordination between participants in the sector. Given the paucity of data available pertaining to the flax fibre industry, the development of the theoretical framework regarding business transactions constitutes the largest component of this thesis.

The third and final objective of the thesis is to investigate the propositions developed in the theoretical framework. Given the limitations of data in the Canadian flax fibre industry, an appropriate technique must be used to examine the propositions developed in the theoretical framework. A verification of the propositions on the anticipated effect on vertical coordination is undertaken using comparative case studies. A number of dimensions of transactions and the corresponding vertical strategies in the flax fibre industry will be compared to those in another natural fibre industry; wool fibre.

1.4 Focus of the Thesis

Given positive transaction costs, prevailing business exchanges will be efficient in the sense that they minimize transaction costs. Transaction costs result from various different elements. Therefore, business relationships should be examined from different perspectives to generate an in-depth understanding of all of the different sources of transaction costs and their impact on vertical coordination strategies. It is assumed that the interaction of transaction costs, the institutional environment in which the transaction takes place, and the characteristics of the transacting parties all contribute to the ultimate cost of transacting. Therefore, the main argument in this thesis is that examining vertical coordination through several different lenses, results in a more robust prediction regarding prevailing exchange relationships. This prediction requires the analyst to consider the characteristics of the business relationship, the parties in the business relationship, and the environment in which they transact. By considering all of these elements jointly greater accuracy of predictions regarding the vertical coordination strategies that will emerge are enhanced by a joint consideration of these elements.

1.5 Organization of the Thesis

This thesis is comprised of six chapters. The next chapter is the industry background chapter and provides an overview of the current state of the Canadian flax fibre industry and several characteristics that represent issues for the industry's development. Chapter three provides a brief overview of the different aspects of the literature that will be used in the comprehensive theoretical framework. Previous applications of the literature are also included in the literature review chapter. The theoretical framework follows in chapter four. This chapter develops several

propositions about vertical coordination strategies. Each of the propositions regarding vertical coordination is developed from a different strand of the literature. Therefore, the propositions cover all of the relevant features of transactions in the Canadian flax fibre industry. In chapter five, a comparative case study analysis to investigate the propositions follows the theoretical framework developed in chapter four. The comparative case study analysis is comprised of a comparison of the features of the transaction, as well as a comparison of the vertical coordination strategies in similar industries. Finally, the last chapter includes the conclusions, suggestions for further research and some limitations of the research.

2.0 INDUSTRY BACKGROUND

2.1 Introduction

The purpose of this chapter is to give a brief introduction to flax fibre and flax fibre supply chains in Canada. Flax fibre production and processing in Canada was prominent at the end of the nineteenth century but has significantly decreased since that time. In recent years, however, with the impetus to seek out bioproducts that replace non-renewable resources and provide value-added opportunities for agricultural producers, a blossoming Canadian flax fibre industry appears a possibility. Despite this new interest, however, the Canadian flax fibre sector continues to be largely underdeveloped, with fledgling supply chains and lack of investment in the necessary processing capacity. This chapter concludes with an outline of some key factors that appear to play a role in the lethargic development of the industry.

2.1.1 Introduction to Flax Fibre

Flax straw contains a valuable fibre that can be used in many different applications, ranging from textile production to additives in construction materials, to inputs into automotive parts. Louis Hebert, a European settler, first introduced the flax plant to Canada in 1617 (Flax Council, 2005).[4] At that time the flax plant was mainly grown for the production of fibre for linen. However, the introduction of mechanized cotton fibre extractors during the Industrial Revolution, and the introduction of synthetic fibres shortly after World War II, quickly eroded the market share of flax fibre. The natural flax fibre's quality variability made it difficult for it to compete with standardized

[4] The first known use of flax fibre dates back to 3000 B.C. when it was used for producing linen (Flax Council, 2005).

blends of cotton and man-made synthetic fibres. As a result flax was no longer grown for its fibre in Canada after the second half of the twentieth century. In several Western European countries, however, producers of flax especially for the fibre have remained active and have perfected their production of high quality fibre to meet linen manufacturer's demands.

All of the flax fibre currently produced in Canada is derived from oilseed flax straw, which is a byproduct of the harvest of oilseed flax in Canada. Approximately 1.3 million acres of oilseed flax were harvested in Canada in the 2004 crop season (AAFRD, 2005). The majority of flax is harvested in Saskatchewan where 1 million flax acres were harvested in 2004 (SAFRR, 2005b). In Saskatchewan, there are approximately 13,000-18,000 farmers who harvest oilseed flax annually. An oilseed flax producer is left with about ¾ tonnes of straw per acre of oilseed flax after the oilseed has been harvested. Therefore, there is close to a million tonnes of flax straw available for value added processing in Canada. Processing of flax straw for downstream manufacturing, however, has been limited. In 2001, of the one million tonnes of flax straw available for use in Canada, only 230,000 tonnes were processed according to one study (AAFRD, 2003). Background research in the industry indicated however, that the largest processor of flax straw purchases between 100,000 and 120,000 tonnes of straw yearly. Therefore, the exact usage rate of flax straw is currently somewhat uncertain.

Currently, the fibrous straw of oilseed flax is viewed as a waste product and most producers find it cumbersome to handle. Producers who cannot sell their straw to processors generally burn the straw in their fields, since it is costly to bale and store the

straw.[5] New uses for flax fibre are emerging that would eliminate the problem of burning flax straw in the field. In recent years, flax fibre has been gaining attention as a natural alternative to petrochemicals and other non-renewable raw materials in various industrial products. As will be explored in the next section, flax straw processing and flax fibre utilization could be advantageous for the environment in several ways.

2.2 The Role of Flax Fibre in the Biobased Economy

Flax fibre is capable of transforming many industrial products into bioproducts because it is a renewable resource obtained from a plant.[6] The broad term bioproduct includes non-food products of plants including biopharmaceuticals, industrial products such as biofuels and bioplastics, as well as products for pollution cleanup and prevention (CARC, 2003). Bioproducts have an environmental advantage because they replace some of the polluting chemicals or non-renewable fossil fuels inputs with natural renewable resources. The use of renewable resources in the production of such industrial products as plastic and paper is anticipated to reduce the amount of greenhouse gases as well as limit the emission of toxins into the air, land and water (Crawford, 2001). Using flax fibre as an input can therefore alleviate some of the environmental damage caused in the production of plastic composites and paper. Development of a biobased economy would aid the government of Canada to attain the goals of the Kyoto Protocol. Canada ratified the Protocol in 2002, and has thereby agreed to reduce greenhouse gases six percent below their 1990 levels by the period 2009-2012 (Government of Canada, 2002). Furthermore, the utilization of flax straw in flax fibre processing eliminates flax straw burning in the fields, which releases harmful carbon dioxide into the environment.

[5] Unlike some cereal straws, flax straw is not very suitable for animal bedding

[6] There are currently no apparent standards regarding renewable resource content for a product to qualify as a bioproduct.

Potential end use of flax fibre derived from Canadian grown oilseed flax will be discussed later in the chapter.

2.3 Components of the Flax Plant

There are two main types of flax plants: long line flax and oilseed flax. The long line variety of flax produces straw of up to 1 meter in length and the resultant fibres are generally longer than 50 centimeters. Long line flax is grown primarily for fibre that is used in the production of linen. Production of long line flax takes place on a relatively large scale in Europe, where high quality fibre is produced primarily in France, Belgium and the Netherlands (AAFRD, 2003). The long line variety of flax is currently not grown commercially in Canada, mainly due to the perception that the dry weather on the prairies makes the production of high quality fibre unattainable.[7] The yield and quality of the oilseed obtained from this plant is low and considered a byproduct. The oilseed variety of flax, on the other hand, has a shorter stem, approximately 50 centimeters, and thus produces shorter fibres. Fibre content[8] can range from a high of 40 percent in a long line variety of flax to a low of 8 percent in an oilseed variety of plant (SAFRR, 2004b). Therefore, while the oilseed yield is high and of good quality, the fibre yield from the short straw is low and of lower quality. When the producer intends to use a flax crop for oilseed revenue, the producer will plant the short variety of flax and regard straw as a byproduct. There are currently no long line varieties of flax licensed and available for producers to purchase and seed in Canada.

[7] Dry weather negatively impacts the length of the plant as well as the quality of the fibre.
[8] The ratio of fibre in a given straw sample.

2.3.1 The Oilseed

Canada has been the largest exporter of flax oilseed in the world since 1994 (Flax Council, 2004). The oilseed from the flax plant can be used for both industrial products and for the improvement of human and animal diets. Linseed oil extracted from the oilseed is used as a base in many sealant industrial products, which is a well-established industry. In recent years, however, the health benefits of the linola oilseed variety of flax have come to the forefront. The fatty acids of the oilseed are useful as a nutritional supplement to reduce high cholesterol (Flax Council, 2005).

While there appears to be a possibility of growth in the market for oilseed, the expansion of acres planted with flax is not reflecting this potential. Industry observers have suggested that the expansion is hindered, in part, because of producers' difficulty with managing the straw (SAFRR, 2004a). Therefore, the development of a value added flax straw market would also provide benefits to the value added oilseed flax sector.

2.3.2 The Straw

Unlike cereal straw, flax straw is not particularly suitable for animal bedding, and its long and tough structure makes it difficult to work into the soil after harvesting the oilseed. Industry observers estimate that approximately 90 percent of farmers collect the straw in their field and burn it. However, with appropriate straw management, the potential end uses of flax straw and fibre greatly increases.

Besides the choice of variety, the fibre content and quality of flax straw is influenced by several elements. Management of oilseed flax straw plays an important role in obtaining high quality fibre; however none of the oilseed flax straw is managed in Canada. Some management practices that play an important role in fibre content and

quality are: harvesting the seed without putting the straw through the combine, placing the straw evenly in contact with the soil to improve retting, and measuring fibre content to determine the potential of the straw (Saskflax, 2005).

An important aspect of flax straw management is the retting process. Retting essentially means to rot the straw to some extent to start the process of releasing the fibre. The retting process softens the pectin and lignin, which are glue-like substances that bind the bast fibre with the inner core of the straw. The retting process begins when the straw is laid out in rows in the field and makes contact with the soil's moisture and bacteria. The length of the retting process depends on the soil's moisture content and climatic conditions. The process can take anywhere from a few weeks to months, depending on the weather conditions. In Canada, producers only allow a few weeks for the retting process, which is generally not enough time to properly ret the straw. Producers want to prepare their fields for spring seeding before the winter starts, leaving little time for the straw to ret in the field. A successful retting technique has arguably the greatest effect on fibre content and quality. The success of the retting process is determined by the interaction of the dew, rain, sun and the soil-borne bacteria of the field.[9] Hot and moist weather is ideal for the bacteria and micro flora to grow and start the retting process. Once retting is finished, the straw is baled into large round bales that are shipped on trucks to nearby processors' stockyards where they are stored until the mill is ready to

[9] The retting process can take place in the farmer's field as well as in a laboratory using chemicals, steam, ultrasound or enzymes. Generally the retting process is more even in a controlled laboratory setting, making straw processing more efficient. However, the majority of flax straw around the world is retted in the field because of the high cost of retting straw in a laboratory.

process the straw. Flax straw is generally not stored longer than one winter because it is bulky and takes up considerable room.[10]

2.3.3 The Fibre

The fibre contained in flax straw is classified as a bast fibre. Bast fibre is obtained from a stalk that has a woody inner part and a fibrous outer layer. Bast fibres are found in the stems of plants as opposed to fibres found in leaves or seedpods (SAFRR, 2004a). The woody inner core of the flax plant is known as the shive. The fibre is released from the shive to some extent during the retting process. Flax fibre processors prefer successfully retted straw because it makes fibre extraction easier and it results in longer and cleaner fibres (SAFRR, 2004a).

Fibre from unmanaged oilseed flax straw is of generally low quality and therefore only suitable for low value uses. There is currently no management of flax straw taking place in Canada. The low value of Canadian flax straw limits the interest by potential buyers. Currently, only specialty paper manufacturers and building material manufacturers, who do not demand high quality fibre, are purchasing Canadian flax fibre. The total value of flax fibre exports range from $20 to $30 million annually (SAFRR, 2004b). However, the fibrous quality of (managed) oilseed flax straw makes it suitable for the production of pulp sweetners, insulation material, composite materials and cottonized flax (SAFRR, 2004b). The next section of this chapter will look at some of the potential end uses of Canadian produced flax fibre.

2.4 Potential End Uses of Flax Fibre

A likely use of Canadian flax fibre is as an additive or strengthening agent in various applications. Flax fibre would compete with other strengthening agents such as

[10] Flax straw can be stored for several years and the quality of fibre will not decrease to a great extent

natural wood fibre, as well as non-wood natural fibres such as hemp and kenaf. As in other competitive input markets, for flax fibre to be used as an input, it must either be cost effective or create a higher valued product. One apparently successful and growing market for flax fibre is as an input for composite materials.

2.4.1 Composite Materials

Plant fibres have been found to be a good replacement for glass fibre in composite materials. It was estimated that for the period 2000-2005, consumption of all natural fibres for non-textile uses was expected to have an annual growth rate of fifty-three percent in North America (AAFRD, 2003). Composite materials can be defined as all products that are made up of a combination of different materials that are bonded together physically. In 2000, eight million pounds of flax fibre was used in the North American plastic composite market (AAFRD, 2003).[11] The natural strength of flax fibre makes it highly suitable as a strengthener in the manufacturing of composite materials. The plastic composite market can be divided into the following segments: building products, industrial/consumer segment, automotive segment and infrastructure/marine segment (AAFRD, 2003).

The automotive sector in Europe is at the forefront of incorporating some flax fibre reinforced material in their cars.[12] The automotive sector requires large volumes of consistent quality fibre for their production line and the natural variability of flax straw has made it difficult for flax fibre processors to provide a consistent supply (SAFRR, 2004b). According to one automotive supplier in Germany, their demand for natural materials is dependent on the ability of processors to deliver a consistent supply of even

[11] Wood flour accounted for 96 percent of the 401 million pounds of natural fibre consumed in North America in 2000 (AAFRD, 2003).

[12] Short fibres that are a by-product of long line fibre processing are used for these plastic composites.

quality fibre (MAFRI, 2005). In the construction industry, the use of natural fibres in decking is the largest and fastest growing segment of the market with an annual growth rate of 60 percent from 2000-2005 (AAFRD, 2003). Currently, only one Canadian flax processor is selling its product as an additive in construction materials. The majority of Canadian flax fibre is utilized as a pulp sweetner in specialty paper manufacturing.

2.4.2 Pulp Sweetners

Canadian flax fibre has been used in the specialty paper industry for many years as a pulp sweetner. A pulp sweetner is the extra strong fibre that is added to a pulp mix of recycled paper. Traditionally, wood fibres are the primary raw material for pulp and paper production but the rising demand for fibre in the paper industry is creating a worldwide shortage of pulp strengtheners (AAFRD, 2003). Flax fibre, which is a suitable substitute of wood flour is seen as a product that can alleviate some of this shortage (AAFRD, 2003). Plant fibres such as flax and hemp already play an important role in the niche markets for specialty papers and also for enhancing pulps based on recycled paper. The wider application of flax fibre in pulp and paper milling is therefore seen as a potential application of flax fibre. Flax fibre is a worthwhile fibre in this application because it is significantly stronger and longer than wood fibres, which means that a smaller amount of flax needs to be used in the pulp mixture (SAFRR, 2004b). The two largest flax fibre processors in Canada supply specialty paper manufacturers that use it as a pulp sweetner. The quality of flax fibre does not need to be very high for this market segment and it is therefore a good outlet for an infant flax fibre industry where the participants are sill learning good practices (Karus et al, 2000).

2.4.3 Insulation Material

In many countries the market for ecologically produced insulation is growing faster than the traditional insulation market. When plant fibres are used to replace glass fibre it provides potential health, energy and environmental benefits (AAFRD, 2003). An additional benefit of using flax fibre insulation, as opposed to fibreglass, is that it can be more easily decomposed when its useful life is over (SAFRR, 2004b). The global market for insulation made from bast fibres is estimated at 1 million tonnes (Western Economic Diversification, 2005). The use of flax fibre as an input in the insulation sector is popular in new and inexperienced flax producing countries such as the United Kingdom, Germany and the Scandinavian countries. The further development of this market, however, is dependent upon the lowering of production costs of insulation materials made from flax fibre (Karus et al., 2000).

2.4.4 Cottonized Flax

Ultimate fibres are the small bundles of tiny fibres in the bast fibre that can be used in weaving. Cottonized flax is derived from the ultimate fibres that could be spun on cotton equipment (SAFRR, 2004b). Cottonized flax fibre has the potential to capture some of the textile market that is currently dominated by cotton fibres and synthetic materials. Flax fibre has superior moisture absorbing qualities in comparison to cotton, making clothes with cottonized flax fibre cooler and drier during hot and humid days. The extraction process of these ultimate fibres has, to date, only been possible with evenly retted straw,[13]. Straw retted in the field is often not even because it is difficult to align straw such that all of it makes even contact with the soil's bacteria and weather conditions also play a factor in the unevenness of retting. Straw that is retted in a

[13] Retting done in a laboratory, for example.

laboratory will generate evenly retted straw but its high cost means that cottonized flax is to date not able to compete with the lower priced cotton fibre. However, researchers have had recent breakthroughs in finding ways to reduce the costs of producing a more consistent, lower cost fibre. Thus, there appears to be a growing potential to build processing plants that produce cottonized flax that can compete on a cost basis with cotton (SAFRR, 2004b).

The supply chain of short flax fibre for an industrial application is comprised of only a few stages of production. The next section will explore the different stages of a flax fibre supply chain.

2.5 The Canadian Flax Fibre Supply Chain

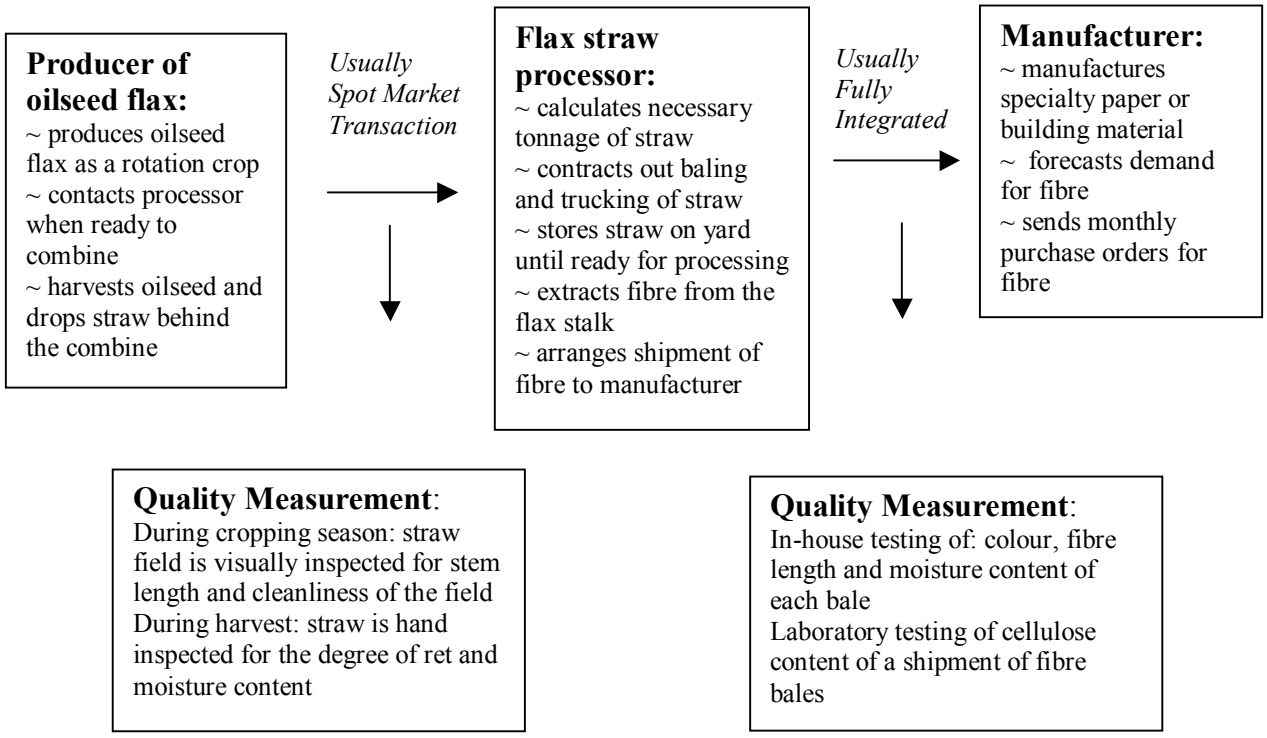
The supply chain of long line fibre in the textile industry is longer than for short line fibre, with more stages of production because textile manufacturers desire high quality and clean fibre. Flax fibre intended for use in industrial products tends to go through a much shorter supply chain with fewer stages of production. Currently, the oilseed flax fibre supply chain in Canada is comprised of three separable stages of production. These stages are: producers of flax, processors of flax straw and manufacturers of industrial products using flax fibre. Producers of flax are mainly located in Saskatchewan and Manitoba, with only a small number in Alberta. There are two flax straw processors located in Winkler, Manitoba: Schweitzer-Mauduit Canada Inc. and Ecusta Fibres Ltd. The third Canadian commercially operating flax straw processor is Bio-Fibre Industries Ltd. and it is located in Canora, Saskatchewan

There are currently no brokers, auctions, or middlemen in the Canadian flax straw and flax fibre market. There are also no stages in the supply chain where quality

measurement by an independent party takes place to grade and sort the straw or fibre, except for cellulose content. There are a few service industries that mainly transport the raw material from one stage of production to the next. For example, independent custom balers are hired by the processors to bale the straw for producers and transport the straw bales with their trucks to the processor. After processing, the flax fibre is generally transported in trucks by the processor to the rail cars that ship it to the US.

A simple diagram of a typical Canadian oilseed flax fibre supply chain with the main players and their responsibilities, as well as the quality measurements that take place, is depicted in figure 2.1.

Figure 2.1 A Typical Canadian Flax Fibre Supply Chain



Straw buyers, who work for the processors, carry out the quality measurement of straw. The processor and manufacturer of the fibre measure the quality of flax fibre.

An independent laboratory close to the two largest processors of flax straw in Canada measures the cellulose content[14] of fibre samples before the fibre is shipped to the U.S.

2.6 Industry Associations

There are currently no industry associations in the Canadian flax fibre industry. Most of the information that is available to supply chain participants and potential entrants is from oilseed flax industry associations. The Flax Council of Canada and the Saskatchewan Flax Development Commission are two prominent oilseed flax industry associations providing some information about flax straw and fibre. There are also no known natural fibre associations in Canada to disseminate information about flax fibre market prospects, flax fibre properties, or its potential uses.

The Flax Council of Canada is a national organization that represents producers, grain handlers, shippers, exporters and end-users of oilseed flax. The Flax Council's mandate is flax market development, market and production research and crop promotion (Flax Council, 2004). The province of Saskatchewan has its own flax industry association called the Saskatchewan Flax Development Commission. The Commission's mandate is to develop the flax industry in Saskatchewan. Its main functions are to promote the industry to various industry participants, collect and disseminate information relating to all aspects of the industry, and coordinate research and development programs

[14] Cellulose content is measured because it is an important attribute for pulp and paper milling.

(Saskflax, 2005). The Commission has hired Biolin Research Inc., an organization specializing in the development of the flax fibre industry, to promote flax fibre in Canada, as well as to undertake research. Additional public information is available from the provincial government of Saskatchewan website regarding the potential of flax fibre, as well as information on the proper management of flax straw (SAFRR, 2005a).[15]

A new initiative called Flax Canada 2015 has recently been created. Agriculture and Agri-Food Canada, the Flax Council of Canada, the Saskatchewan Flax Development Commission and the provinces of Manitoba, Saskatchewan and Alberta all fund Flax Canada 2015. The initiative has a fibre pillar that focuses on increasing the value added of flax straw (Flax Council, 2004). The overall aim of the initiative is to obtain additional farm gate value from flax by establishing linkages between researchers, industry, the health care community and government to develop new lines of business for higher-value flax based products and processes. To date, the amount of useful information that this initiative has provided industry participants is minimal.

The growth of flax fibre supply chains has been slow and interrupted in Canada. The abundance of low cost flax straw and the range of potential end uses of flax fibre have not led to a burgeoning flax fibre industry in Canada. There have been some initiatives in the processing sector but many of these have failed, and interest from the manufacturing sector has been nominal. The U.S. imports approximately US$150 million worth of flax fibre annually that is used in the manufacturing of textiles, nonwoven, and wet-laid nonwoven, composite, and fiberboard products (Foulk et al., 2002). Therefore, Canadian exports account for approximately one-fifth of U.S. imports.

[15]The information available on the proper management of oilseed flax straw is not complete, however, as the research is still quite preliminary.

U.S. researchers have indicated that a flax fibre industry in the U.S. would help expand their bio-based economy. Foulk et al. (2002) also indicated that major technical problems associated with establishing a flax fibre industry in the US are the efficiency of harvest methods, fibre extraction (retting), and the lack of standards for judging fibre quality.

Background research into the Canadian industry provided some insight into factors that may be contributing to the absence of development in the industry. Some of these factors are examined in what follows.

2.7 Issues Contributing to the Slow Development of the Flax Fibre Industry

There appear to be several factors that are contributing to the laconic development in the North American flax fibre industry. Some potential factors that have been identified through background research are: lack of a vision, specificity of processing equipment and knowledge, paucity of research and development on the properties of flax fibre, limited number of processors and manufacturers in the industry, and the absence of a recognized quality and grading regime for flax straw and fibre.

The most relevant aspects of the flax fibre industry as they pertain to industry development are explored in the following table, which provides a preliminary insight into the potential impact these factors may have on business relationships. Each factor is explored further following the table. Many of the issues are interrelated and a combination of these issues is leading to difficulty in establishing supply chain relationships to move the product through the supply chain. A discussion of each factor follows the table.

Table 2.1 Flax Fibre Industry Characteristics

Industry Characteristics/Issues	Impact on Transaction Relationship	
	Producer-Processor	**Processor-Manufacturer**
Infant Industry	Lack of information about the potential value of flax straw has limited the interest of producers in managing their oilseed flax straw to increase quality and fibre content	Insufficient evidence about the earning potential for processing flax straw or utilizing flax fibre in manufacturing has limited entry into the industry
Specificity of Equipment and Knowledge	Processors must invest significant resources in asset specific equipment and human capital, which makes an on-going business relationship important to safeguard investments	Manufacturers must also make asset specific investments which means that both parties have an incentive to have a continuous business relationship
Absence of Research and Development	Research on correct oilseed flax straw management practices to increase fibre content fibre quality has been minimal to date. Producers are therefore not convinced that straw management will increase their returns	The paucity of information regarding flax fibre properties and how flax fibre can be used in manufacturing industries has limited commercialization opportunities for processors, limiting the development of business relationships with manufacturers
Limited Number of Players in the Industry	Producers of oilseed flax do not have much information regarding the potential value of their flax straw. They are therefore satisfied with the current spot market transaction with processors that does not provide them with an important source of revenue	The lack of information regarding the potential uses of flax fibre has constrained entry by processors and manufacturers, limiting alternative sources of supply and thereby increasing exposure to opportunistic behaviour and unequal bargaining power
Lack of an Industry-wide Recognized Quality and Grading Regime	Producers are not compensated based on the quality of their straw, which limits their motivation to manage their straw to obtain higher quality straw	The lack of a recognized quality measurement system for fibre means the manufacturer must trust that the processor is practicing good fibre extraction processes.

2.7.1 Infant Industry

Institutions that produce and disseminate information in the infant flax fibre industry are poorly developed. Therefore, the paucity of information in the industry can be attributed to the underdeveloped nature of the economic institutional framework in the industry. It has been indicated that it will take time for processors and producers to learn the management techniques needed and, subsequently, make the necessary capital

investments to produce more consistent, higher-grade types of fibre (SAFRR, 2004b). Producers and processors currently have no, or very little information, about proper straw management practices to produce high quality straw. More information is needed before management techniques can be refined to produce high quality fibre. Flax straw that is not managed has generally low fibre content and quality, and can only be used in a low value application. The low quality of straw currently available to processors, in turn, limits their possibilities of commercializing the flax fibre into higher value applications.

The infancy of the industry means there is little confirmation available of success in the industry for potential entrants. Associated with the infancy of the industry, there is a limited amount of research and development activity pertaining to flax fibre. Therefore, the knowledge about possible end uses and earning potential of flax fibre has, to date, been quite small. There is currently insufficient evidence regarding earning potential for investors to become eager about committing their resources. In essence, the paucity of information creates uncertainty for potential supply chain participants and they are thus less likely to enter into business relationships in the flax fibre supply chain.

2.7.2 Specificity of Equipment and Knowledge

The processing stage of the flax fibre supply chain requires perhaps the greatest investment in resources and knowledge. The seasonality of purchasing straw requires knowledgeable and experienced straw buyers. Processors must ensure that during the small window of harvest, enough straw is purchased to keep the mill operating year-round. Harvest of the flax crop takes place in the fall and it generally only lasts a couple of months. The short purchasing season for straw means that buying decisions must be made quickly and efficiently. Straw buyers must therefore be knowledgeable of the

location of flax acres in their areas, as well as being able to take accurate quantity measurements of straw. The approximate tonnage of straw in a field is determined by measuring the length of an average flax plant stalk as well as the number of acres. In addition to the specific knowledge required by processors, the processing equipment is also highly specific to flax straw and only suitable for producing flax of a certain quality. Well-trained personnel with many years of experience usually operate the processing plant. It becomes apparent that processors would desire on-going business relationships to avoid losses on these specific investments.

2.7.3 Low Levels of Research and Development on the Properties of Flax Fibre

It has been identified that a significant challenge for natural fibre processors is that there must be a demand-pull by downstream manufacturers (AAFRD, 2003). The lack of publicly available information about flax fibre properties has likely played a role since only a small number of manufacturers use flax fibre in their production process. Therefore, the minimal amount of commercialization of flax fibre can be attributed to the limited amount of research about the properties of flax fibre and its potential uses in industrial products. Manufacturers are generally accustomed to ISO-certified inputs and their hesitancy to use a natural material such as flax fibre is therefore understandable. Given that manufacturers are accustomed to using inputs with internationally recognized quality standards, they desire a breadth of information about the properties and standards of a natural fibre such as flax fibre. It is presumed that the lack of information surrounding flax fibre properties and its performance in different applications plays a role in the slow rate of adoption of flax fibre by manufacturers.

Thus far, uncertainty regarding the future success of the industry, specificity of processing equipment and knowledge, and the limited research on flax fibre properties appear to have inhibited investment in the industry. The limited number of participants in the industry is the subject of the next section.

2.7.4 Limited Number of Players in the Industry

The limited number of North American processors and manufacturers of flax fibre is a concern for the industry. The small number of processors and manufacturers creates what is known as the 'small numbers bargaining problem'. In Canada, there are currently three processors of flax straw operating beyond the pilot scale, which were identified in section 2.5 earlier in this chapter. There are numerous manufacturers that use flax fibre in the US, but each Canadian processor currently supplies only one manufacturer on a long-term basis. Background research indicated that the difficulty and costs of commercializing flax fibre is limiting the number of different manufacturers in the industry. While flax fibre can be shipped great distances because of its ability to be compacted, it is nevertheless more difficult and costly for manufacturers to procure flax fibre from sources outside of North America. Supply chain participants therefore have an incentive to establish long-term business relationships. Close vertically coordinated relationships that are long-term in nature safeguard losses from investments if supply of raw material would fall away or buyers discontinue purchasing. Creating stable business relationships with single buyers or sellers can, in turn, be costly because of contract negotiation and management of the relationship for both parties. The effect of the small numbers bargaining problem on vertical coordination structures in the supply chain of flax fibre is explored more fully in the theoretical framework chapter.

2.7.5 Absence of a Recognized Quality and Grading Regime

Industry observers indicated that perhaps the greatest impediment for growth in the flax fibre industry is the absence of a recognized quality and grading regime for flax fibre. As a natural fibre, which has natural quality fluctuations, flax fibre would benefit considerably from quality grading. The main functions of quality measurements and grading are to facilitate handling and long-distance trade as well as differentiate products for buyers (Bockstael, 1987). Grading in essence provides a basis for determining the appropriate value of the product that is moved along the supply chain. Canadian flax fibre is generally sold in large quantities and also travels a great distance to US manufacturers. Therefore, a system of grades and standards is critical in conveying valuable information across physical distance about the product to determine the price and to define the delivery contract (Giovannuci and Reardon, 2000). Other natural fibres such as cotton and wool are subjected to extensive testing and quality standards that provide objective measurements for buyers and sellers to utilize when negotiating transactions.

A quality and grading regime would also make it possible to sort the different qualities of fibre according to their potential end use. Flax fibre is currently not sorted according to quality and therefore is generally used in applications that do not need high quality or any particular specifications of fibre. Quality standards would therefore complement the research on different uses of flax fibre because it could make sorting the fibre to suit different end uses more efficient and effective.

The absence of quality standards and a grading regime not only makes spot market transacting inefficient, it also deprives producers of feedback on quality. The lack

of feedback regarding the quality of their product has limited producers' interest in managing oilseed flax straw. Feedback about quality, combined with research about good flax straw management practices, could in turn motivate producers to manage oilseed flax straw to increase fibre content and quality. Processors, in particular, would benefit from higher quality flax straw that increases processing efficiency as well as increases the potential for commercializing the fibre into industries that have higher quality requirements.

2.8 Summary and Conclusions

This chapter provided a brief overview of the flax plant and the developing flax fibre industry in Canada. The industry is still in its infancy, with no producers currently managing oilseed flax straw, and few processors and manufacturers processing and utilizing flax fibre. Some issues pertinent to the industry have also been outlined in this chapter. The apparent inability of the Canadian flax fibre industry to grow is hypothesized to be partly a result of these issues, and they form the basis of this thesis. These issues will be examined with regard to their effect on supply chain coordination. The following chapter presents a review of the literature that will be used in the development of the framework. Several themes from the literature are combined in a framework to allow for an in-depth exploration of how all of the features of the industry affect business relationships.

3.0 LITERATURE REVIEW

3.1 Introduction

The following chapter provides an overview of the theories that are included in the theoretical framework. Several bodies of analyses are examined simultaneously to provide a comprehensive framework to examine supply chain relationship formation in the flax fibre industry. The theories that are most applicable to the supply chain of flax fibre are those that concern the institutional environment, the transaction environment, the agency relationship and the relative bargaining power of the participants in the supply chain. Firstly, this chapter provides a brief overview of New Institutional Economics (NIE), which was developed to answer questions about the relationships between firms and markets that neoclassical economic theory could not answer. Subsequently, each theory comprising the framework is explored individually, highlighting how each theory predicts the type of exchange relationship that is most likely to emerge. This chapter also includes a brief overview of applications of the various theories.

3.2 Introduction to New Institutional Economics

Neoclassical economic theory did not, and still does not, provide insight into how markets are formed. Neoclassical economic theory includes assumptions about the firm and markets that makes it a useful benchmark of economic efficiency, but has limited its usefulness in explaining why and how inter-firm relationships form. The firm is in essence viewed as a 'black box' that transforms inputs into outputs (Hobbs and Kerr, 1999). The theory of New Institutional Economics was developed as a counterpart to neoclassical theory to provide insight into the interaction between firms. In 1937, Ronald

H. Coase authored the seminal article "The Nature of the Firm" in which he examined the boundaries between firms and a market. Coase explored the idea of positive transaction costs to determine why some transactions occur within firms, while others occur across a market interface.[16] This article would become the foundation of New Institutional Economics (NIE).

Positive transaction costs, or the cost of using the market mechanism, is the underpinning of NIE (Eggertsson, 1990; North, 1990). The market mechanism is costly because information necessary to conduct a transaction is incomplete and it takes resources to obtain. A clear-cut definition of transaction costs is hard to find in the literature. For our purpose, transaction costs are those costs that arise from the interaction necessary to exchange a product between two separate stages of production.[17] Coase (1937) argues that when the costs of carrying out the transaction internally are less than using the market mechanism, the firm will expand its operation, undertaking successive downstream or upstream tasks internally. Internalizing transactions does not eliminate transaction costs, however, and the firm still incurs 'transaction costs' to coordinate production between different departments. In addition, the firm incurs managerial costs to oversee all of the production processes and personnel (Coase, 1937).

When applying NIE, the term governance structure, or a framework within which the transaction takes place, is often used as a synonym for the firm (Williamson, 1986a). A critical assumption of NIE is that the contractual relationship observed between firms

[16] There would be no need for firms if all exchanges were costless; in which case, it would be most efficient for individuals that have specialized in a part of the production process to exchange with other individuals who have also specialized in part of the production process.

[17] The interaction to exchange a product between different stages of production can also be termed the transaction, the exchange, or the business relationship, and will be used interchangeably in this thesis.

is the most efficient given the costs of using the market mechanism and the costs associated with internalizing the transaction (Williamson, 1986a).

There are many ways exchanges can be shaped. According to Mighell and Jones (1963), there is a continuum of types of exchanges. They argue that there is always some form of vertical coordination taking place between the parties, and that vertical coordination increases as the exchange moves from the spot market end to the vertical integration end of the continuum.[18] Coordination in spot markets is mainly through the price mechanism, where buyers and sellers use prices to co-ordinate the exchange. A vertically integrated relationship results when one firm owns more than one stage of production and the transaction occurs internally. In a hierarchy, one party is usually the employer of the other party and interdependence between the parties is complete (Henderson and Frank, 1998). Therefore, as the exchange moves along the continuum from the spot market end of the spectrum to the hierarchy end of the spectrum, closer vertical coordination is observed. For instance, an exchange relationship that is governed by a contract represents closer vertical coordination than a business relationship that is governed by a handshake. Spot market relationships, at one end of the spectrum, are said to have weak vertical coordination. On the opposite end of the spectrum, when one party acquires another stage of production, the relationship is said to be most closely coordinated.

The magnitude of transaction costs is only meaningful when it can be compared with alternative governance structures or exchange relationships. The vertical coordination strategy that emerges will be that which minimizes the sum of production

[18] The vertical coordination in spot markets is mainly through the price mechanism. At the other end of the continuum, vertical coordination in a vertically integrated relationship is generally by means of an employee-employer contract.

and transaction costs (Williamson, 1986a). Therefore, the efficiency of alternative governance structures is only meaningful when they are evaluated either across industries in different regions, across somewhat similar industries, or in the same industry over a given time period, when transaction costs change. Following the previous assumption, differing transaction costs will result in different types of vertical coordination that minimize transaction costs in that region, industry, or time period.

NIE has replaced the neoclassical theory view of the firm as a 'black box' with a microanalytic approach that examines how firms form and make exchanges. The microanalytic approach has evolved into several themes that each examine the exchange from a somewhat different perspective. Each of these theories, however, is rooted in the reality of costly information and the impact this has on the efficiency of different governance structures. These theories include: Transaction Cost Economics, Agency Theory, Market Structure Theory and the Economics of Institutions. An exploration of each theory will follow.

3.3 Transaction Cost Economics

Similar to other theories in NIE, Transaction Cost Economics establishes a causal link between the cost of transacting, the most efficient type of transaction, and thus the boundary of a firm. Also similar to the other theories, the exchange is the unit of analysis, and the most efficient mode of exchange is the one that minimizes transaction costs. Oliver E. Williamson is a major contributor to the present day understanding of TCE by characterizing transactions along three dimensions, as well as incorporating several behavioural assumptions. Williamson characterized transactions according to: (i) the level of uncertainty surrounding the transaction; (ii) the frequency with which they

occur and; (iii) the degree of asset specificity of the investments that must be made for the transaction to take place. Williamson also included two key behavioural assumptions in the analysis of the transaction. The assumptions that economic agents have the tendency to behave opportunistically, as well as their limited capacity to make rational decisions, plays a crucial role in making market transactions costly. Opportunistic behaviour is self-interested behaviour that is intended to gain rents at the expense of the other economic party.[19] Bounded, or limited, rationality stems from the lack of information processing capacity of economic agents, which contributes to incomplete information in exchanges (North, 1990; Williamson, 1986a). Given the assumption of bounded rationality, parties to an exchange can not be certain about the advent of opportunistic behaviour. Therefore, parties are faced with being potentially exposed to opportunistic behaviour when asset specific investments are made during an exchange. The assumption of costly information and the behavioural assumptions leads to positive transaction costs. Ceteris parabus, if the lack of information results in prohibitively high costs of using the market mechanism, the parties will choose to organize the exchange internally.

Arguably, the most important determinant of what type of contractual relationship is most efficient depends on the extent to which asset specific investments characterize the exchange. The degree of asset specificity refers to the value that assets will have outside of the contractual relationship. If these assets are not redeployable in another context, or in another contractual relationship, the trading relationship in which they can

[19] Literature by Barzel (2000) states that the incompleteness of ownership of property rights results in transaction costs because of disputes that can arise over determination of prices for instance. Transaction costs are also the result of the uncertainty associated with how the state enforces economic property rights. For the purpose of this research the literature by Williamson and his assumption regarding opportunistic behaviour is followed.

be used takes on 'real economic value' (Williamson, 1986b). Klein et al. (1978) refer to this economic value as a quasi rent that can be sought after by opportunistic agents. Therefore, a transaction cost stems from the potential exposure to opportunistic behaviour when asset specific investments have been made and ex-post competition is not present.

The risk of opportunistic behaviour in exchange relationships that arises when asset specific investments have created quasi rents is compounded when uncertainty characterizes the exchange. Uncertainty, the second characteristic of the exchange, arises due to a lack of information about the industry, the products and other participants. Uncertainty in the contractual environment generally prevails in new industries. Uncertainty exists because contract terms have to be renegotiated frequently due to unanticipated developments (Williamson, 1986a). There is a risk of exposure to opportunistic behaviour every time a renegotiation of the terms of a transaction has to take place. The more uncertain is the transaction environment, and thus renegotiations have to take place, the more likely a governance structure will develop to avoid instances of opportunistic behaviour. For example, opportunistic behaviour can be controlled through long-term or relational contracts with long-term benefits that outweigh the short-term benefits of opportunism. Another alternative is to internalize the exchange and create a unified governance structure encompassing the two entities. The risk of opportunistic behaviour disappears to a considerable degree within a firm because the parties realize that opportunistic behaviour reduces joint profit maximization (Williamson, 1986a).

Following Williamson, frequency is the third characteristic of a transaction. Each time a transaction takes place a cost is incurred and, therefore, the more often it re-occurs,

the higher the transaction cost will be over a given time period. The cost of transacting when assets are not specific is generally low enough that spot market transacting is the most economical means of organizing the transaction for any given level of frequency. When mixed, or intermediate levels of asset specific investments are made, some type of relational contracting through long term contract types will be most efficient, according to TCE. When asset specificity is high, and the transaction occurs frequently, a unified governance structure is most economical. Following the characterization of transactions according to Williamson, the table below depicts which type of contracting will be most efficient.

Table 3.1 Transaction Cost Economics Characteristics

Asset Specificity	**Frequency**		**Uncertainty**	
	Occasional	*Frequent*	*High*	*Low*
Low	Spot market governance	Spot market governance	Spot market governance	Spot market governance
Mixed	Neoclassical Contracting	Relational Contracting	Depends on frequency	Spot market governance
High	Neoclassical Contracting	Unified governance	Unified governance	Relational (long-term) contracting

Source: Williamson (1986a)

Williamson (1986a) makes a distinction between relational and neoclassical contracting. Both types of contracting involve asset specific investments, and therefore the successful completion of the contract is desired to avoid losses from the non-salvageable investments. The main difference between relational and neoclassical contracting lies in the use of third party arbitration. In neoclassical contracting, third party arbitration is used in cases when there is a danger that the contractual relationship will break down. In relational contracting, adjustments to the contract are made to create

incentives for the successful continuation of the contractual relationship when there is a chance of contract breach. The difference in the benefits of each of the two types of contracting lies in the level of frequency with which a transaction takes place when mixed asset specific investments have to be made. When the degree of asset specific investments is mixed, and there is high uncertainty in the exchange environment, a bilateral governance structure is likely as the frequency increases. Therefore, when the frequency of the transaction is low, standardized spot markets will be more likely (Williamson, 1986a). Evidently, TCE has developed into a detailed analysis of the transaction environment.

3.3.1 Empirical Applications of Transaction Cost Economics

To express transaction costs quantitatively is not an easy task. The measurement of transaction costs can be made easier by separating the cost of transacting into three categories: (i) information/search costs, (ii) negotiation costs and (iii) monitoring/enforcement costs (Hobbs, 1996). Information and search costs occur ex ante to the exchange and include all of the costs involved in setting up the exchange relationship. Examples include the costs associated with finding information on current prices, quantity requirements, quality and grade requirements, as well as the costs related to finding suitable exchange partners who are able to supply (buy) the quantity specified and are generally accountable and trustworthy. Negotiation costs arise at the time a contract is drawn up or an exchange is agreed to. Negotiation costs can include lawyer and brokerage fees, as well as auction commissions that are applicable when the exchange is organized through an auction. Finally, monitoring and enforcement costs arise after the exchange has been negotiated and executed. Examples of monitoring and

enforcement costs include quality verification and any legal fees that may have to be paid in the case of non-fulfillment of contract terms (Hobbs, 1996).

The numerical measurement of the transaction costs stemming from asset specificity or uncertainty is not simple and second-best proxies must often be used. Hobbs (1997) strives to find support for TCE and demonstrates a successful method for measuring the importance of transaction costs in the cattle market of the United Kingdom. The empirical evidence indicates that both information and monitoring costs are a significant factor in determining which marketing channel is chosen. Boger (2000) performs an empirical test to examine the relationship between asset-specific investments, contracts, quality, prices and their impact on the type of marketing channel for hogs in Poland. Key variables are quantified either through ordinal selection, ranking or through proxies. A multinomial logit model is applied by Boger to establish a link between the transaction characteristics and the mode of exchange. The results are not entirely supportive of the theory of TCE, which is not unusual of empirical applications in this field. Maher (1997) uses case studies to examine the effects of transaction costs on governance structures in several different industries. The case studies support the proposition that characteristics of transactions are a determinant of governance structures.[20] The case studies highlight the important role that asset specificity plays in the exchange relationship, which has been tested in numerous empirical applications. Monteverde and Teece (1982) found that backward integration was an efficient response to the asset specificity of supplier know-how in the automobile industry, and Masten et al. (1989) found that, in the same industry, quasi vertical integration is relied upon to

[20] The case studies done by Maher also indicated that factors other than those identified in TCE play an important role in the efficiency of different exchange relationships.

control opportunism and maladaptation stemming from investment in asset specific investments.

In a different study, Hobbs and Young (2000) attempt to find the *causes* of transaction costs. The impact of product characteristics such as perishability, product differentiation and the visibility of quality and regulatory and technological drivers on the three transaction characteristics and resulting costs is discussed. While the work was preliminary, they did find exchange relationships could be indirectly explained by the effect of changing product characteristics on transaction characteristics.

3.4 Agency Theory

There are many similarities between Agency theory and Transaction Cost Economics. Both theories are rooted in the costliness of information assumption, and both characterize the exchange to determine the most efficient mode of exchange. Agency theory, however, is primarily concerned with minimizing ex post exchange costs, which in TCE are equivalent to monitoring and enforcement costs. Agency theory has developed into two branches. The unit of analysis, or the dependent variable, in either of the branches is the same and it is the contract between the parties (Eisenhardt, 1989). The main difference between the two branches of Agency theory lies in their approach to examining the agency relationship.

Positive Agency theory is essentially non-mathematical and empirically oriented[21], while its counterpart, principal-agent theory, has mainly developed theoretically but not empirically (Eggertsson, 1990). Positive agency theory has focused on describing governance mechanisms that limit the agent's self-serving behaviour

[21] Positive agency theory is almost exclusively applied to principal-agent relationship between owners and managers of large, public corporations.

(Eisenhardt, 1989). Jensen (1983) regards positive Agency theory as a theory that offers a more complex view of organizations without making any inferences regarding which mode of organization is more efficient. Principal-agent theory, on the other hand, makes specific assumptions and is mathematically demanding, but it provides clear and precise conclusion about contractual terms that will be most efficient to maximize the returns of the principal (Eisenhardt, 1989).

For the purpose of this thesis, principal-agent theory (PA theory) will be used because of its broader focus and method of characterizing the transaction and insight into the efficiency of different vertical coordination strategies.

Every agency relationship consists of a principal and an agent. An agency relationship arises when the principal delegates some work to an agent and the parties are thus involved in a cooperative relationship. In property rights terms, a principal is the individual, or firm, in the contractual relationship who rents out his property rights to an agent, which is the other individual or firm, in the contractual relationship, to do the delegated work (Eggertsson, 1990; Eisenhardt, 1989; Jensen and Meckling, 1976). The goal of PA theory is to determine the optimal contract between the principal and the agent (Eisenhardt, 1989). The optimal contract contains appropriate incentives for the agent to behave, or create output, in such a way that maximizes the returns to the principal.

Several behavioural and information assumptions are made in PA theory. Arguably the most important assumption made in principal agent theory is that information is not distributed symmetrically between the principal and the agent and it is

costly for the principal to obtain.[22] The behavioural assumptions of bounded rationality and self-interest are shared with Transaction Cost Economics. Additional behavioural assumptions in PA theory are that the principal and agent have differing risk preferences and goals. These assumptions, however, do not limit the applicability of PA theory to many diverse exchange relationships. Some examples of agency relationships include: landlords and tenants, patients and physicians, and voters and elected representatives in a democracy (Sauvee, 1998).

Given the assumptions regarding agent behaviour and costly and asymmetrically distributed information, every agency relationship contains a 'agency problem' (Eisenhardt, 1989). The agency problem arises because the parties have different goals and access to information, leading to the agent not always behaving in the best interest of the principal. The principal must therefore incur measurement costs of either the agent's behaviour or output to minimize the agency problem.

The agency problem can be separated into two different problems: the adverse selection problem and the moral hazard problem. Adverse selection arises because principals do not have all of the information necessary to select the most apt agent for the contract (Eisenhardt, 1989). Arrow (1963) first introduced the problem of moral hazard. Moral hazard arises in agency relationships when the actions of the agent are unobservable to the principal, or cannot be logically extrapolated from the outcome (Bierman and Fernandez, 1993). Moral hazard essentially means that there is a tendency

[22] The principal can incur costs ex ante to entering the relationship by screening potential agents or monitoring the output or behaviour of agents once the relationship is established

for the agent to shirk on those actions that are unobservable to the principal, which is disadvantageous for the principal. [23]

The measurements that the principal undertakes to avoid the two types of agency problems will determine the optimal type of agency relationship. The measurement costs that the principal incurs can also be seen as the costs to acquire the information that is incomplete to him in the relationship. The principal has to make a trade-off between measuring the behaviour (actions) of the agent, or the outcomes of those actions. The terms of trade, or type of contract, will depend on which measurement will be less costly. An outcome based contract is similar to spot market transactions at one end of the continuum, where compensation is based on a measurement of the outcome of the agent's actions, or his output (Eisenhardt, 1989). If, on the other hand, information about the agent's behaviour is relatively cheap to obtain, then a behaviour-based type of contract is likely to be most efficient. Behaviour-based contracts roughly correspond to hierarchies, which are at the other end of the continuum, where agents are paid salaries for their behaviour regardless of the outcomes (Eisenhardt, 1989).

3.4.1 Empirical Applications of Principal Agent Theory

Empirical validation of the agency problem is not as widespread as that of Transaction Cost Economics. PA theory has been empirically validated using questionnaires, secondary sources, laboratory experiments and interviews (Eisenhardt, 1989). Empirical work has generally focused on the effect that measurement costs of agent output versus monitoring costs of agent behaviour play in shaping agency relationships. For instance, Eisenhardt (1985) used PA theory to determine whether salary or commission is the optimal compensation scheme in retail stores. It was found

[23] The agent has an incentive to shirk because this will bring him closer to his goal of more leisure time.

that much of the empirical work of PA theory has been done in conjunction with other relevant theories. Eisenhardt (1985) expanded her earlier work in the retailing sector by adding institutional theory predictions and the results supported agency theory predictions, that principal agent variables significantly predict compensation in the retailing industry. Anderson (1985) integrated PA theory and Transaction Cost Economics to examine the choice of compensation among a sample of electronics firms. This study found that high measurement costs associated with the agent's actions were positively related with using a corporate sales force, or a behaviour-based contract.

3.5 Market Structure Theory

The sources and impacts of bargaining power is an important topic in neoclassical economic theory. However, the literature on the significance of bargaining power on exchange relationships is not well developed. Bargaining power is the result of a firm having market power, which is commonly measured by its market share relative to other firms in the same market (Carlton and Perloff, 2000). A firm may have market power due to barriers to entry or exit, selling a differentiated product, or market power can arise naturally (Carlton and Perloff, 2000). Neoclassical economic theory has often examined the effects of bargaining power on prices and the overall welfare impact. Bargaining power however can also influence the efficiency of different business relationships. Unequal bargaining power can be used to acquire favourable terms of trade, thereby affecting transaction costs and exchange structures. Thus, the relative bargaining power that separate firms have in an exchange is considered to be an important element in the structure of the exchange relationship.

A firm has market and bargaining power when it does not have to compete with other firms in the same market for input suppliers or buyers. Single buyers are called monopsonies and single sellers are known as monopolies. When a downstream firm has market power, it essentially means upstream firms are locked into a relationship with one, or only a few buyers. One instance when a lock-in situation arises is when asset specific investments have been made, which limits the number of potential buyers and sellers to exchange with. Williamson first elaborated on the small numbers bargaining problem in his TCE literature. The small numbers bargaining problem, which can arise after asset specific investments have been made, exposes parties to opportunistic behaviour. Klein (2005) points out, however, that while asset specific investments may create the small numbers bargaining problem, it can also arise from numerous other causes. For instance, market power may result from high barriers to entry and therefore only a few firms have incurred the necessary costs to enter the industry. Thus, the small numbers bargaining problem is present ex ante to the exchange relationship. When a downstream firm has market power, upstream firms do not have alternative buyers for their output if they are dissatisfied with the exchange. Therefore, the downstream firm can exercise its bargaining power, and most importantly behave opportunistically to gain favourable terms of trade, since upstream firms have incurred costs to enter the industry.

3.5.1 Empirical Applications of Market Structure Theory

The empirical evidence of the effects of market power on vertical coordination strategies is not very extensive. On one occasion, empirical evidence of the effects of market power on the type of governance structure was found somewhat by accident. Maher (1997) sought to verify the Williamson transaction cost model by undertaking case

studies in several different industries. In her case studies, however, she found that in addition to transaction costs, risk of opportunism when a firm has market power is also an important determinant of vertical coordination. Market power considerations were observed to affect vertical coordination strategies.

3.6 Institutions

Douglas C. North contributed significantly to NIE by developing an institutional framework within which to examine transactions. North (1990) deems that institutions influence the costs of exchange and production. He makes an analogy between institutions and the 'the rules of a game' in an exchange to define what an institution is. North thereby makes an important distinction between organizations and institutions. Organizations, or firms, are analogous to the players that abide by the rules of the game, or institutions. A comprehensive institutional framework is comprised of legal rules, organizational forms, enforcement and norms of behaviour. Political institutions incorporate the creation of legal rules as well as the enforcement mechanism. Economic institutions include coordinating organizations, quality and grading regimes. Social institutions can also be viewed as norms of behaviour. The firm is therefore an organization that must abide by the rules provided by social, political and economic institutions (North, 1990).

Institutions, in essence, have an indirect influence on the efficiency of alternative exchange structures by impacting the comprehensive set of exchange characteristics whether they stem from TCE, PA theory or Market Structure theory. The impact of the 'rules of the game' on exchange characteristics becomes obvious when institutions are considered as a set of constraints on the behaviour of economic agents. The constraints

that institutions place on human interaction essentially solve human interaction problems that arise in a world where specialization has created the need for many cooperative exchanges (North, 1991). To illustrate this it is necessary to refer back to Williamson and his behavioural assumption of bounded rationality. North (1990) contributes to Williamson's notion of bounded rationality by stating that one of the reasons economic agents are only partially rational is due to their inability to fully decipher the environment within which exchange decisions are made. The framework of institutions, by limiting the choice set of behaviours, provides a structure for human interaction during exchanges. Institutions therefore, provide a code for exchange that parties can utilize when they do not have the capacity to make fully rational decisions about how to coordinate the exchange.

Constraints on behaviour can be divided into formal and informal constraints. Informal constraints are the codes of conduct, norms of behaviour and conventions that influence how the economic agents interact during the exchange. For example, a handshake between individuals in certain societies can be as consequential as a fully contingent and written contract in other societies. Thus, uncertainty in an exchange can be reduced to some extent by referring to codes of conduct that have evolved over time. Formal constraints include political, legal, economic rules and contracts that restrict human choices and behaviour (North, 1990).

Legal and political institutions that set and make public rules reduce uncertainty in the exchange environment. For example, the outcome of third party settlement when an exchange is not fulfilled entirely by either party is made predictable by a well-functioning judicial institution. Economic institutions that perform quality measurements

and grade products also support the parties in the exchange by providing a common language for value parameters. The more elaborate and transparent is the institutional framework, the less need there is for elaborate exchange structures. When the costs of transacting are reduced through a set of institutions, ceteris paribus, spot market transactions will be most efficient.

3.6.1 Empirical Applications of Institutional Analysis

The importance of institutions for the organization of transactions is easily highlighted in economies in transition from central planning to market based systems. Institutions are often lacking in economies in transition because a centrally planned economy can also be viewed as a hierarchy. While still embedded in an institutional framework, hierarchies, to a great extent, make use of internal management and supervision to ensure cooperative behaviour. According to Hobbs et al. (1997), at the outset of transition, transactions costs in agrifood sectors of former command economies were high, which can be attributed to the lack of the appropriate market institutions.

An analysis of institutions is often conceptual and therefore, empirical evidence is generally expressed qualitatively. An assessment of institutions is generally a component of an empirical analysis of another NIE theory. Boger (2000) investigates how a quality and grading institution in a transition economy affects transaction costs. A quality and grading system is shown to be an important economic institution in lowering transaction costs. An analysis of institutions is also included in the work of Hobbs (1997), who measures transaction costs in the UK cattle market. In the UK, a well developed set of institutions provide price information which means that this is not a significant factor for farmers in choosing a marketing channel. Thus, due to these institutions, the cost of

transacting is reduced and exchange relationships do not have to evolve to counter-act high price information costs. Information on grades through an existing quality and grading institution is found to be a significant factor in the producer's choice of marketing channel, indicating the importance of this type of institution.

3.7 Summary and Conclusions

The literature under the NIE umbrella has expanded in several different directions. Distinct theories surrounding transaction costs, institutions, agency problems and market structure have developed over time. Each theory explores the business relationship from a different viewpoint. The commonality between the different theories is that vertical coordination is the dependent variable. Each theory essentially focuses on a single dimension of the business relationship to predict vertical coordination strategies. The following chapter develops the theoretical framework from the bodies of literature introduced in this chapter.

4.0 THEORETICAL FRAMEWORK

4.1 Introduction

This chapter develops the theoretical framework. The framework incorporates concepts of New Institutional Economics (NIE) to provide a comprehensive insight into the costs of transacting. Within the NIE paradigm, the cost of transacting on the market is the most important explanatory variable for the shape of exchange relationships. Transaction Cost Economics (TCE) is perhaps the most widely used literature to analyze transaction relationships. There is a growing belief, however, that analyzing the transaction from one dimension, namely TCE, is not sufficient to predict the supply chain structures.

For instance, even the founder of transaction cost economics, Ronald H. Coase (1998), now acknowledges the importance of including the institutional environment when analyzing governance structures. Other New Institutional economists also argue that various theories and concepts need to be combined to build a more solid framework for predicting exchange structures. Eisenhardt (1988) claims that examining a problem from multiple perspectives can contribute to robustness in explaining phenomena by emphasizing complementary facets of the different theories. Sykuta and James (2004) contribute to this notion by arguing that the future work of NIE should include, among other things, an increased integration of theories from a variety of social science disciplines. Van der Meer-Kooistra and Vosselman (2000) used several contracting theories to analyze management control in inter-firm relationships. The framework presented in this chapter is also an attempt at integrating several bodies of literature to

provide insights into supply chain coordination. Therefore, in this framework the different approaches are not tested against each other, instead they are combined in the framework to allow for interaction between the variables.

A brief overview of why a framework is useful in examining supply chain relationships is explored first in this chapter. Next, an in-depth analysis of each theory is presented. Each theory analyses the cost of transacting by examining the transaction from a different point of view, and each theory contributes a proposition regarding supply chain coordination.

4.2 Objective of the Framework

The framework is primarily concerned with the sources of exchange costs and how they affect supply chain coordination. The framework combines different literatures to provide a more comprehensive insight into the problem of the slow evolution of the flax fibre supply chain. The value of the framework approach therefore lies in the ability to examine a problem through the lens of several different theories, by using many variables. The theories included in the framework are those mentioned in the previous chapter: Transaction Cost Economics, Agency theory, Market Structure theory and the Economics of Institutions.

Each of these theories analyzes a different dimension of the transaction. The comprehensive framework analyzes transactions by not only exploring the characteristics of the transaction, but also the characteristics of the environment in which the transaction takes place, as well as the characteristics of the parties that are involved in the transaction. The following table depicts what insights different strands of the literature add to the framework. The characteristics of the transaction are essentially determined by

applying Transaction Cost Economics and Agency theory, the relevant facets of the transaction environment are determined through an analysis of institutions, and finally insights from the characteristics of the transaction parties are determined by applying both Agency theory and Market Structure theory.

Table 4.1 Comprehensive Set of Transaction Characteristics

	Characteristics of the transaction	**Characteristics of the transaction environment**	**Characteristics of the transaction parties**
Features of the Transaction	~ Degree and type of asset specificity required by transacting parties ~ Frequency and repetition of the transaction ~ Length of the transaction period ~ Measurability of activities and output	~ Uncertainty about future contingencies ~ Degree of market risks: institutional, environmental (rules, systems and organizations)	~ Information asymmetry ~ Reputation ~ Risk and goal preferences ~ Bargaining power
Relevant Concepts	**TCE and Agency Theory**	**Institutional Analysis**	**Agency Theory and Market Structure Theory**

Source: Adapted from Van der Meer-Kooistra and Vosselman, 2000.

The framework is used to develop several relevant propositions regarding the impact of different features of the transaction on vertical coordination. In addition, the interaction between the variables in the framework provides additional insights into vertical coordination along a supply chain.

4.3 Definition of a Framework

The use of frameworks in economic analysis is not as common as the use of models. Economic models have been popular because of their clear outcomes and in-depth analysis of a few variables. Economic models usually include limiting assumptions about the environment and have a restricted number of variables. The number of

variables must be restricted, otherwise the models tend to become too complex mathematically and the outcome can become ambiguous. However, the limited number of variables leads to a loss of realism in the model, as well as the inability to apply it to different situations (Porter, 1991). Frameworks, on the other hand, require less restrictive assumptions than models and they are also more descriptive in nature. Michael E. Porter provides perhaps the most well-known definition of a framework in his 1991 article on strategy:

> *Frameworks identify the relevant variables and the questions which the user must answer in order to develop conclusions tailored to a particular industry and company. In this sense, they can be seen as almost expert systems. The theory embodied in a framework is contained in the choice of included variables, the way variables are organized, the interactions among the variables, and the way in which alternative patterns of variables and company choices affect outcomes. (p. 98)*

The framework analyzes the transaction comprehensively by amalgamating several different theories. The framework combines these literatures into a synthesis to gain valuable insights into vertical coordination along the flax fibre supply chain. An exploration of each concept included in the framework follows.

4.4 Insights from Transaction Cost Economics

The main characteristics of transactions according to the TCE literature are discussed below. Williamson (1986a) identified asset specificity, environmental uncertainty and frequency as the three most important characteristics of a transaction that create positive transaction costs. Williamson (1986a) also highlights the importance of including assumptions about individual behaviour. Williamson argues that the underlying behavioural assumptions of opportunism and bounded rationality interact with the characteristics of the transaction to generate positive transaction costs.

Frequency does not play a large role in this framework. The frequency of a transaction is measured by how often the transaction takes place with the same party over a given period of time. The more often a similar exchange takes place with the same party, the more likely the transaction will be governed internally to avoid incurring search/information costs, negotiation costs and finally the monitoring and enforcement costs to ensure the parties fulfill their obligations in the exchange every time the transaction takes place through the market mechanism. More frequent transactions may, on the other hand, lead to spot market transacting because higher levels of trust may be developed through repeat transacting. Therefore, the effect of frequency on vertical coordination is somewhat ambiguous. Given that the background research of the flax fibre industry did not indicate that frequency of the transaction plays an important role in business relationships, it is omitted from the framework. The transaction characteristic of asset specificity, however, was identified through background research to play an important role in shaping business relationships and it is explored in what follows.

4.4.1 The Significance of Asset Specificity

As outlined in the literature review chapter, asset specificity is arguably the most influential transaction characteristic on vertical coordination strategies (Williamson, 1986b). An exchange relationship is identified by asset specificity when there is a need to make an investment into a production element whose value is diminished outside of the relationship. In other words, the specific identity of the other party becomes important and valuable in the transaction. The bilateral dependency in idiosyncratic exchanges[24] exposes parties to rent-seeking behaviour because alternative trading

[24] Idiosyncratic exchanges are where parties have to make asset specific investments such that the specific identity of the parties has transaction cost consequences (Williamson, 1986a).

partners are no longer available. The paucity of trading partners after asset specific investments have been made is termed the 'small numbers bargaining problem' by Williamson.

Williamson defines opportunistic behaviour as 'self-interest seeking with guile' (1986a).[25] The main objective of opportunistic behaviour is to extract post contractual rent and it can arise when the parties are locked into a bilateral trading relationship because of asset specific investments, or contractual gaps necessitate renegotiations of terms of trade (Hobbs and Kerr, 1999; Klein et al., 1978; Williamson, 1986a). Agents behave opportunistically when they trade long-term joint gains for short-term gains that are obtained through making false and misleading statements (Williamson, 1986a). When there are contractual gaps, parties are exposed to potential opportunistic behaviour each time a contractual renegotiation has to take place. Given the transaction characteristics of asset specificity and the behavioural assumption that economic agents are likely to behave opportunistically, the following proposition emerges.

Proposition 1: The presence of asset specific investments exposes the parties to opportunistic behaviour, leading to high exchange costs and closer vertical coordination.

A closely coordinated business relationship is a contractual solution for reducing opportunistic behaviour. When one party completely integrates with another party, it will have complete control over the decision making process. Thereby when contractual adaptations are necessary, the costly negotiation process where each party haggles over rent is eliminated. When two parties vertically integrate their goals will be aligned and joint maximization of profits will be more economical than pursuing other sub-goals

[25] It is important to note that opportunistic behaviour is distinctly separate from the neoclassical assumption that man is 'self-interested'.

during costly haggling. Similarly, potential opportunistic behaviour is mitigated when business relationships are fortified with stipulations regarding arbitration procedures in the case of a breach.

An idiosyncratic exchange can be the result of the need for parties to invest in physical capital, human capital, or due to a specific location of a plant. All three types of asset specific investments characterize exchange relationships in the flax fibre supply chain. Fibre extraction equipment is an example of a physical capital investment that must be made by processors. The extraction equipment is only valuable when processors are able to source straw and sell their fibre to down-stream manufacturers. Processors make arguably relatively the most asset specific investments in physical capital, making them most vulnerable to opportunistic behaviour by producers and manufacturers. To successfully incorporate flax fibre in their process, manufacturers must invest in research and development. For instance, research regarding the effect on the final properties of the good from incorporating flax fibre must be done. The manufacturing incorporates flax fibre in his process if it is believed that returns will increase either by reducing costs or increasing revenues. Therefore, the investment in research and development creates value in having an on-going relationship with a fibre supplier.

Since both parties to the exchange must make investments that are asset specific, these investments can be viewed as hostages that each party to the exchange holds. Sporleder (1994) argues that the presence of hostage assets generally lead to closer vertical coordination because they increase the opportunity cost of a non-successful agreement. A closely vertically coordinated relationship between processors and manufacturers is thus predicted when taking into consideration that the asset specific

investments are mutual. The joint consideration of mutual asset specificity and uncertainty follows in the next section.

In the producer-processor relationship only the processor is required to make asset specific investments. In addition to asset specific extraction equipment, the processors must also invest in a plant location that is site specific. Therefore, relationships with producers in relatively close proximity take on real value because of the saving on transportation costs. Given the asset specificity in the transaction, closer vertical coordination would appear likely.

4.4.2 The Relevance of Uncertainty

The degree of uncertainty of a transaction can be measured by the number of disturbances that require renegotiation of the exchange (Williamson, 1986a). As noted earlier in Chapter 3, every time renegotiation takes place the risk of rent-seeking behaviour is a reality and efficient adaptations are replaced with haggling over contract terms (Williamson, 1986a). The following proposition is relevant to contracting in the flax fibre supply chain.

Proposition 2: Uncertainty in an exchange relationship generally leads to closer vertical coordination.

The effect of uncertainty on the exchange relationship is not as straightforward as is, for example, asset specificity. In this framework, uncertainty is assumed to lead to a closely coordinated relationship because the uncertainty stems to a great extent from a lack of information in the exchange environment.[26] Uncertainty leads to gaps in contracts

[26] Technological uncertainty, as opposed to environmental uncertainty, is likely to lead to weaker vertical coordination because a hierarchical relationship with technology uncertainty may not be flexible enough to adapt frequently. A spot market relationship, where there is very little negotiation between the buyer and

regarding such factors as price, quality specifications, and quantity. The contract is thus incomplete. Given the relative incompleteness of the contract, the parties are at risk of being exposed to opportunistic behaviour to a greater degree. To accommodate unanticipated future events in the industry, renegotiation of these contractual elements are likely to be needed on a frequent basis. For instance, information about flax fibre properties is minimal at this point and therefore, quality specifications of flax straw and fibre are uncertain and subject to change as new research is conducted and new information is revealed. To guard against opportunism, parties seek a relationship that reduces benefits from opportunistic behaviour.

It can be argued that when both asset specificity and uncertainty characterize a transaction, closer vertical coordination is highly likely. Douma and Schreuder (1992) note this in their discussion of the critical dimensions of contracts. The authors first comment that a long-term contractual relationship, or in other words relatively close vertical coordination, results when two parties have mutually high asset specificity. Both parties realize that if either party violates the long-term contract, each of them will be hurt. Douma and Schreuder then remark that when a high degree of uncertainty also characterizes the exchange relationship, vertical integration is the most efficient. Vertical integration, which is the closest form of coordination, is most efficient because the level of uncertainty makes it difficult to write fully contingent contracts. Therefore, if exchange relationships in the flax fibre supply are characterized both by mutual asset specificity and a high degree of uncertainty, close vertical coordination results.

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seller, may thus be a more efficient governance structure when adaptations are easier when the parties are not vertically integrated.

The level of uncertainty in transaction relationships is closely related to the institutional environment in which the transaction takes place. The insufficient dissemination of information by industry associations contributes to the degree of uncertainty in the transaction environment. Industry associations play a key role in providing information on market prices, key trends, issues and events affecting an industry. Industry participants can use all of this information to reduce contractual gaps and thereby exchange costs. The benefit of using a framework to analyze transactions is apparent here. As institutions play an important role in the uncertainty of transacting, it is necessary to examine them jointly to gain insight into vertical coordination strategies along a supply chain. The impact of the institutional environment on such elements as the degree of uncertainty in exchanges will be examined later in this chapter.

4.5 Propositions Drawn from Agency Theory

Agency theory, as with Transaction Cost Economics, is rooted in the notion that information is costly. A crucial assumption in agency theory is the asymmetrical distribution of information between the principal and the agent, where the principal does not know what the agent has done. The costs of obtaining information makes it impossible for the principal to know exactly what the agent has done. In agency theory the focus is on determining the most efficient contract given several assumptions regarding party's attitude towards risk, goal conflict and information (Eisenhardt, 1989). As was outlined in further detail in chapter three, agency theory assumes that parties have different attitudes towards risk, there is a goal conflict in the relationship and information is incomplete and costly to obtain.

A principal-agent relationship characterizes most exchanges in a supply chain. In general, the principal will be downstream from the agent and delegates, or sources the supply of an input to the agent. In the flax fibre supply chain, for example, the manufacturer sources fibre extraction from a processor, and the processor sources straw production from producers. Therefore, two principal-agent relationships exist in the flax fibre supply chain. Every agency relationship is characterized by the agency problem, and this problem is explored below.

The agency problem arises in principal-agent relationships because of (a) the misalignment of goals, and (b) the inability, or high costs, for the principal to determine if the agent behaved properly. There is an obvious misalignment of goals between producers and processors in the Canadian flax fibre supply chain.[27] In order to maximize payoffs of harvesting flax, the producer maximizes the yield of his oilseed because the revenue it provides is much higher than the revenue obtained from the straw. The principal's payoff is maximized when he receives straw with high fibre content and quality because it increases processing efficiency.

The agent can behave improperly in two ways, leading to the agency problem of adverse selection and moral hazard. Adverse selection is the misrepresentation of ability by the agent to gain a contract (Eisenhardt, 1989). The problem of adverse selection is unimportant in the producer-processor agency relationship because background research indicated that processors select producers mainly based on their proximity to the plant to reduce high transportation costs. Manufacturers are also faced with making a decision of which processor to source fibre from since they have very little information. The relative

[27] If goals were completely aligned then the measurement of either behaviours or outcomes would be unnecessary because there is no reason for the agent not to behave in the best interest of the principal. The behaviour of the agent would always be his best interest and the best interest of the principal.

infancy of the industry means that information regarding abilities and reputation is not available, contributing to the problem of adverse selection.

The majority of information obtained by the principal is to reduce the moral hazard problem. Moral hazard refers to the lack of effort on the part of the agent that is unobservable to the principal. The propositions drawn from agency theory that are included in this framework deal with the costs of obtaining information to reduce the moral hazard problem. Eisenhardt (1989) developed ten propositions regarding agency contracts, and the propositions included in this framework are based on her work. Two propositions regarding measurement costs and outcome uncertainty were determined to be most relevant for this framework. Firstly, monitoring or measurement costs of flax straw and fibre production provide insight into exchange costs and, secondly, outcome uncertainty stemming from the fact that flax straw is an agricultural product also provides insight into the coordination between parties along a supply chain.

4.5.1 Measurement versus Monitoring Costs

To reduce the moral hazard problem in the exchange, the principal can either discover the *behaviour* the agent undertakes to fulfill his obligations and thereby create a behaviour-based contract, or he can measure the *outcomes* of the agent's actions and create an outcome-based contract. The principal has to make a trade-off between measuring the agent's behaviour or the agent's output. The most efficient exchange relationship in terms of measurement costs for the principal will prevail (Demski and Feltham, 1978; Eisenhardt, 1985). Nevertheless, some type of measurement still needs to take place and this leads to the following proposition.

Proposition 3: When outcome measurement costs are high, close coordination will likely result.

Outcome-based contracts are roughly similar to spot market transactions, which are at one end of the vertical coordination continuum, while behaviour-based contracts are roughly similar to closely coordinated relationships, which are at the other end of the continuum. When outcomes are difficult or costly to measure, outcome-based contracts are not likely to prevail. In this case, obtaining information about the behaviour of agents, or monitoring them, is more efficient and behaviour-based contracts prevail. Examples of behaviour-based contracts include salaries and hierarchical governance.

Quality measurement of flax straw must be done quickly during the short harvesting season and current technology is not capable of measuring fibre content in a short period of time.[28] Therefore, since measurement costs are high, outcome-based contracts become inefficient and behaviour-based contracts are likely. Given the measurement difficulties associated with assessing straw quality, it is more efficient to compensate the producer on elements of his behaviour. This means that we expect processors to compensate producers based on their monitoring of flax straw management techniques. The absence of quality measurements for flax fibre also affects the efficiency of outcome-based contracts between processors and manufacturers. Behaviour-based relationships are likely between manufacturers and processors because of the prohibitively high cost of measuring fibre output without a standardized procedure for measuring fibre quality that is recognized industry-wide.

[28] Near Infrared technology has been developed by Biolin Rsearch Inc. that can measure fibre content of flax straw but it is not able to provide the quality information in a practical amount of time for straw buyers who have to make purchase decisions quickly during harvesting season.

In the flax fibre industry high measurement costs are directly related to the absence of a grading and quality system for both the flax straw and the fibre. A grading and quality regime is an example of an economic institution. The impact of a grading and quality institution on measurement costs in business relationships in the flax fibre supply chain is examined in detail in Section 4.7.1.

4.5.2 Outcome Uncertainty

In 1985, Eisenhardt's empirical research supported outcome uncertainty as a key factor in the analysis and selection of either behavior-based or performance-based contracts. Outcome uncertainty generally stems from exogenous forces that affect the outcome of the agent's actions that are beyond his control. The interference of exogenous factors makes it impossible for the principal to deduce the outcome from agent behaviour. Many agricultural products, including oilseed flax straw, are subject to exogenous forces that produce uncontrollable variations in output.

Outcome uncertainty essentially creates risk in production, which must be borne by either the principal or the agent. Risk stemming from outcome uncertainty in turn creates positive transaction costs in exchange relationships. Allen and Lueck (1993) note that outcome uncertainty from weather and other natural forces are the source of transaction costs (in agribusiness) and these transaction costs subsequently impact the optimal contract design. The following proposition expresses the impact of outcome uncertainty on vertical coordination.

Proposition 3a: When outcome uncertainty increases, weaker vertical coordination is likely.

Outcome uncertainty in a principal-agent relationship creates risk that must be borne by either the principal or the agent. An outcome-based contract transfers production risk to the agent. Behaviour-based contracts, on the other hand, transfer production risk to principals since they compensate agents based on their behaviour, no matter what the outcome. Therefore, the parties' relative attitude towards risk determines whether an exchange relationship will be either outcome or behaviour-based when outcome uncertainty characterizes the relationship.

The contractual element of outcome uncertainty plays a large role in business relationships in the flax fibre supply chain. Climatic conditions are a crucial element in the success of the retting process leading to a high degree of outcome uncertainty. Given the relatively diverse stream of income from farming, the producer is assumed to be less risk averse. The processor, on the other hand, is required to make a large amount of investment in resources, which are only suitable for flax straw processing. Therefore, the processor is likely to be more risk averse and an outcome-based contract that shifts risk to the producer is more efficient.

Since the quality of flax straw determines the quality of fibre, the variability in flax straw quality translates into variability of flax fibre quality. Therefore, the outcome uncertainty of the quality of flax fibre is similarly high. Outcome-based contracts are thus also likely to prevail between processors and manufacturers.

4.6 Insights from Market Structure Theory

As noted earlier in the chapter in Table 4.1, besides the transaction and the environment in which the transaction takes place, the characteristics of transacting parties are also an important feature of the transaction. The impact of market structure is not

often applied by New Institutional Economists, but it is considered valuable in this framework approach to measuring exchange costs.

4.6.1 Bargaining Power

According to Carlton and Perloff (2000), a firm can gain market, or bargaining power at its stage of the supply chain through: the acquisition of special knowledge, the government may protect it from the entry of other firms, the market it is in may only be large enough for a single firm to produce profitably, or as a result of strategic behaviour. Similar to the acquisition of special knowledge, bargaining power can also be gained when the other party to the exchange is required to invest in asset specific equipment. The acquisition of special equipment in essence increases the costs associated with a breakdown in the exchange relationship. Therefore, the party with relatively less specific equipment has greater bargaining power in the relationship since the loss incurred with a breach in the exchange is relatively less. Unequal bargaining power has been an issue in agricultural markets for a long time according to Young and Hobbs (2002). Unequal bargaining power makes transacting costly due to unequal rent distribution when contractual renegotiations take place. Considering the infancy of the flax fibre industry, contractual renegotiations will be a likely and relatively frequent event. Therefore, the element of bargaining power is included in the framework and its proposed impact on business relationships is explored next.

Proposition 4: Unequal bargaining power leads to high exchange costs and closer vertical coordination.

The party with relatively less bargaining power suffers a loss in welfare because the other party is able to capture post-contractual rents during contractual renegotiations.

In other words, the party with relatively more bargaining power can use this power to appropriate a larger part of the quasi-surplus in cases when ex-post contractual renegotiations take place (Bijman and Hendrikse, 1999). The steps that are required to prevent appropriation of rents creates transaction costs that direct the relationship towards closer vertical coordination. The realization of uneven bargaining power ex ante entering the relationship, and the risk of losing post-contractual rents, may cause a hold-up in the exchange. The party with less bargaining power realizes that he may be forced to accept worse contractual terms when contractual renegotiations are required. Close vertical coordination is thus a solution when there is underinvestment by the party with relatively less bargaining power. For instance, a monopsonist can invest in the necessary resources, or acquire a current supplier. By vertically integrating backwards the monopsonist circumvents the hold-up problem and secures a consistent and stable supply of raw material.

Unequal bargaining power appears to be a factor in the flax fibre supply chain. The infancy of the flax fibre industry means that very few manufacturers and processors have invested resources to date, leading to a high level of concentration and very little competition in those markets. As a result producers are likely to have relatively the least amount of bargaining power in the supply chain. Therefore, according to the proposition, closer vertical coordination is likely between producers and processors. Competition in the manufacturing and processing sectors is absent, giving both parties an amount of bargaining power. Whether either party will exercise his bargaining power depends on the potential for each party to gain post-contractual rents as a result of bargaining.

4.7 The Importance of the Institutional Environment

The environment within which a transaction takes place is another important aspect determining the efficiency of different methods of vertical coordination. In this framework institutions are viewed as playing an over-arching role in exchange relationships, drawing on the literature by Douglas C. North. Institutions mainly determine the environment within which the transaction takes place. According to North (1990) "how well institutions solve the problems of coordinating and production is determined by the motivation of the players..., the complexity of the environment, and the ability of the players to decipher and order the environment (measurement and enforcement)" pg. 34. Therefore, assuming the bounded rationality of parties, the institutional environment influences, among other things, the degree of uncertainty and measurement costs in the exchange. Including an institutional analysis in the framework is crucial in a comprehensive analysis of exchange relationships.

Institutions can be separated into social, economic and political institutions. The following table lists the different categories of institutions and the type of information each of them bring to the exchange.

Table 4.2 Categories of Institutions

Institution	Type of Information	Industry Examples
Economic	Demand, Supply, Price Information, General Industry Information	Industry associations that disseminate regular information bulletins, have a website with information and hand out newsletters
	Value Parameters	Grading and quality regime
	Information about flax fibre properties and potential end uses	Coordinated research and development performed by various different organizations ranging from private research labs to federal research stations
Political	Information about how breaches in the contract resolved	Transparent judicial system and arbitration procedures
	What legal terms apply to the exchange	Institutions that specialize in setting up legal contracts between parties
Social	The trust in an exchange relationship	Observed code of conduct between current participants

Given that transaction costs are rooted in the notion that information is costly and imperfect, institutions that infuse information in the exchange are an important feature of the transaction. This leads to the following proposition.

Proposition 5: An underdeveloped institutional framework leads to high exchange costs and closer vertical coordination.

An underdeveloped institutional framework fails to infuse information into the exchange environment. Internal organization of the exchange greatly reduces the need for information provided by institutions because of internal communications.

Examining the impact of the institutional environment is most useful when done in conjunction with the transaction characteristics influenced by the institutional environment. Therefore, a further analysis of the interaction between the institutional environment and its affect on other facets of the exchange is explored in further detail next.

4.7.1 Economic Institutions and Measurement Costs

According to table 4.2, economic institutions that reduce information costs include industry associations that disseminate market statistics, as well as a grading and quality system. Through coordinated research, industry associations can provide information on potential end products and markets, current market prices, and information on new technologies. This information generally reduces contractual gaps and uncertainty in the exchange relationship. Since uncertainty is particularly prevalent in infant industries, economic institutions that provide information for parties to an exchange play an important role in reducing transaction costs. The dearth of economic institutions in the flax fibre supply chain leads to high information costs to set up exchanges, making closer vertical coordination likely.

The absence of a quality and grading institution is important in the flax fibre supply chain. As indicated from Agency theory, high measurement costs translate into high transaction costs. A recognized, industry-wide quality and grading regime lowers the costs of measuring the output of the agent's actions, and therefore makes outcome-based contracts more efficient. Without a mechanism to measure the outcome of the agent's actions, the principal must incur costs to obtain information about the agent's behaviour, or effort. Thus, in the absence of a grading and quality regime, behaviour-based contractual arrangements where the principal incurs costs to monitor the behaviour of the agent are likely. A quality and grading system also provides information about quality specifications that reduces negotiation costs in transactions by establishing a common language to communicate value parameters. Spot market transactions are

difficult and thus costly to negotiate without common terminology about quality specifications.

Research and development (R&D) in flax fibre is another example of an institution that provides information. R&D into the properties of flax fibre and potential end uses of flax fibre infuses information into the exchange environment. Processors can use this information to more readily match their flax straw to the requirements of different manufacturing industries. A high degree of uncertainty characterizes the transaction between processors and manufacturers due to the unanswered questions regarding flax fibre properties. Information from R&D would reduce contractual gaps and thus the degree to which uncertainty leads to costly transacting.

4.7.2 Political Institutions and Uncertainty

Political institutions provide information for parties to an exchange regarding how contractual breaches will be resolved. An example of a political institution is the judicial system that is in place to deal with breaches in exchange contracts. According to Williamson (1986a), third party arbitration is useful in contracts that are characterized by asset specific investments but that do not take place frequently enough to justify unification costs. Costly uncertainty in the exchange is reduced when parties know they can rely on a bipartisan arbitration system to solve contractual disputes and uphold the exchange.[29] When political institutions fail to provide this information to parties to the exchange, internal organization is likely because breaches in exchanges can then be managed through company policy. Therefore, exchanges entail weaker, or less formal,

[29] Note that exchanges still occur when two firms have internalised the exchange. The exchange merely takes place within the unified governance structure between the employer and employees for example.

vertical coordination when parties can easily obtain information regarding legal outcomes of contract breaches.

4.7.3 The Social Institution of Trust and Uncertainty

The social institution of trust is the third category of institution that influences the cost of transacting. Trust can be defined as the belief of either party that the other party will not exploit him. According to (Dyer and Chu, 2003) trust between firms is generally based on three related components: reliability, fairness, and goodwill/benevolence. Therefore, when trust exists in a relationship, the parties will be less concerned with the possibility that the other party will behave opportunistically during contractual renegotiations. A secondary component of trust is the belief in the competence of the other party (Ullmann-Margalit, 2002).

The benefit of incorporating trust in the framework resides in the effect it has on the impact of uncertainty in an exchange. Dyer and Chu (2003) note that trust is necessary in relationships where transactors make asset specific investments and where there is a high degree of uncertainty. The higher is the level of trust in an exchange, the lower is the risk of opportunism and the resulting transaction costs. In a transaction environment that is characterized by uncertainty, the bounded rationality of economic agents to identify whether potential supply chain participants will act opportunistically to capture rents created by the asset specific investments increases the transaction costs of entering into this relationship (Hobbs and Young, 2000). Uncertainty surrounding the likelihood of opportunistic behaviour is mitigated with a high level of trust (Burchell and Wilkinson, 1997). In the absence of trust in a spot market exchange, tighter vertical coordination is a response to eliminate high exchange costs. Given the infancy of the flax

fibre supply chain, a high level of trust generally does not exist, as yet, between new participants.

4.8 Synthesizing the Different Components of the Framework

Williamson (1986a) indicates in his work on transaction costs that discovering the full ramifications for governance requires the simultaneous consideration of asset specificity, uncertainty and frequency. For instance, uncertainty in an exchange environment where asset specific investments are required makes it imperative that an efficient method for resolving contractual gaps is in place (Williamson, 1986a). This framework goes beyond the transaction cost literature and includes other dimensions of transactions developed from Agency theory, Market Structure theory and the economics of institutions.

The following table provides an overview of the different bodies of literature and the proposition(s) regarding vertical coordination from each body of literature. The propositions draw a connection between the feature of the transaction and the extent of vertical coordination in an exchange. Some transaction features have a positive effect on vertical coordination, meaning that closer vertical coordination results when this feature characterizes the exchange. The opposite is the case when transaction features have a negative effect on vertical coordination.

Table 4.3 Summary of the Framework

Characteristics of the Transaction	Characteristics of the Transaction	Effect on Vertical Coordination
Transaction Cost Economics	Asset Specificity	Positive
	Uncertainty	Positive
Agency Theory	Measurement Costs	Positive
	Outcome Uncertainty	Positive
Market Structure Theory	Bargaining Power	Positive
Institutional Analysis	Economic Institutions (industry associations, publicly available statistical data, grading and quality system, R&D	Negative
	Political Institutions (judicial and legal systems)	Negative
	Social Institutions (trust)	Negative

Considered alone, features of the transaction may not provide convincing cases for different vertical coordination strategies. A combination of several factors, however, may provide more insight into the extent of exchange costs and their overall impact on vertical coordination strategies.

For instance, uncertainty in the transaction environment, the necessity of asset specific investments and the small numbers bargaining problem all characterize business relationships between flax fibre processors and manufacturers. All of these features combined lead to high exchange costs and thus solicit a closely vertically coordinated relationship. The weakness of the institutional environment does not appear to offset the high exchange costs created by these elements, hence witnessing relationships that are closely vertically coordinated becomes likely.

4.9 Summary and Conclusions

The framework developed in this chapter includes several different strands of the existing literature. Examining business relationships with a framework provides a comprehensive insight into the costliness of transacting. The following chapter makes use of the different concepts in an in-depth analysis of vertical coordination in the flax fibre supply chain, using a comparative case analysis.

5.0 COMPARATIVE CASE STUDY ANALYSIS

5.1 Introduction

This chapter presents case studies of the Canadian flax fibre industry and the New Zealand wool fibre industry. The case studies are used to investigate the validity of the propositions developed in the theoretical framework. As highlighted in Chapter two, an absolute measurement of transaction costs is not useful. Therefore, a comparative analysis of the transaction characteristics and vertical coordination strategies follows both of the case studies. A comparison is drawn between the different characteristics of the transactions taking place in the two different industries to determine the validity of the propositions regarding vertical coordination strategies. Therefore, the main focus of the case studies is on the type of business relationships that have formed between industry participants at the different stages of production.

A typical wool fibre supply chain in New Zealand is used for comparison with the Canadian flax fibre industry because of several similarities in the product. Both wool and flax fibre are natural fibres that can be used in a range of end products. Both wool and flax fibre are by-products from meat and oilseed flax production, respectively.[30] The case studies were prepared following background research and interviews with participants and industry experts in each of the industries.

[30] It should be noted that not all flax and wool fibre is a byproduct. For instance, long line flax fibre is harvested specifically for its fibre in countries such as France and Belgium, and Merino sheep are raised especially for their wool in New Zealand. Both long line flax fibre and Merino wool fibre are used in the textile manufacturing industry.

5.2 The Interview Process

Given the infancy of the industry, a case study of the Canadian flax fibre industry, rather than a quantitative empirical analysis, was appropriate. To date there are few participants in the industry, which means that a quantitative analysis using statistical inference based on a survey technique was not feasible. Moreover, gathering data for the case study through semi-structured interviews allowed the researcher to gain in-depth insights from each participant in the industry regarding their business relationships.

Several interviews were conducted with Canadian producers, processors and industry experts to obtain an insight into the business relationships in the Canadian flax fibre industry. Interviews were also conducted with several individuals involved in the New Zealand wool fibre industry. The case study of the Canadian flax fibre industry is arguably more in-depth because the main focus of this thesis is on this industry. The New Zealand case study is only used as a comparison. Fewer interviews and more secondary information was used for the New Zealand case study. Given its established nature, more useful secondary information was available about exchange relationships in the New Zealand wool fibre industry than in the Canadian flax fibre industry.

The interviews took place in March and April 2005. Before the interviews took place, the University of Saskatchewan Behavioural Research Ethics Committee approved the interview process. Information on the transaction characteristics, the transaction environment and the characteristics of the exchange parties were gathered. In addition, the interviews also allowed information to be collected on the structure of business relationships between participants in each of the supply chains.

Most participants were contacted directly to set up an interview. All of the participants were required by the University of Saskatchewan Behavioural Research Ethics Committee to formally consent to the interview. The interviews were conducted either in person or by phone and the researcher took notes during the interviews.[31] The interviews took approximately one hour. In accordance with the Behavioural Research Ethics rules, the researcher sent notes of the interview to the participant, who had the chance to review and suggest any changes to make the notes more accurate. All of the questions were open-ended to gain as much insight into the business relationships as possible. Two different interview guides were developed; one for industry experts and one for supply chain participants. Each semi-structured interview included somewhat different questions to reflect the participant's expertise, or position in the supply chain. The two styles of interview guides are included in appendix A. Four industry experts, two processors and three producers were interviewed for the case study of the Canadian flax fibre industry. One former participant, two current participants and one industry expert were interviewed for the New Zealand wool fibre case study. References are made to industry participants in general to preserve the confidentiality of individual interviewees. For example, references to "producers of flax straw" or "processors of flax straw" are included in the case study.

General information regarding supply chains of flax fibre is presented next. First, a brief introduction to flax fibre and wool fibre supply chains is presented and the different stages of production are described. A characterization of the transactions in each industry according to the framework follows. An assessment of the propositions described in chapter four concludes this chapter.

[31] All of the interviews with individuals in the New Zealand wool fibre industry were conducted by phone.

5.3 Supply Chain of Flax Fibre in Canada

Producers and processors of flax straw comprise the main stages of production in the Canadian flax fibre industry. Figure 2.1 in the Industry Background chapter depicted a typical Canadian flax fibre supply chain. All of the buyers of Canadian flax fibre are located in the United States (US). All of the flax straw that is available for fibre processing is obtained from oilseed flax. An initial survey of the North American flax fibre industry indicated that there were no brokers or middlemen between participants in the flax fibre supply chain. Therefore, only two transactions are taking place in the flax fibre supply chain to move the product through the supply chain. The main stages of production in the Canadian flax fibre supply chain are explored below.

5.4 The Main Stages of Production of the Flax Fibre Supply Chain

The main players in the flax fibre supply chain are: producers of oilseed flax, processors of flax straw and manufacturers of end products who use flax fibre as one of their inputs. There is a less of a focus on manufacturing, as, at this point, all of the manufacturers who use flax fibre are located in the US. A brief overview of the main stages of production is described next.

5.4.1 Production

Approximately 1.3 million acres of oilseed flax were harvested in Canada in the 2004 crop season (AAFRD, 2005). The majority of flax is harvested in Saskatchewan, where one million flax acres were harvested in 2004 (SAFRR, 2005a). Therefore, most of Canada's flax is currently harvested in Saskatchewan: approximately 70% in Saskatchewan, 25% in Manitoba and the remaining 5% in Alberta (MAFRI, 2005). There are approximately 13,000 to 18,000 producers in Saskatchewan who grow flax in

rotation with other crops. Generally, flax does well after cereals or corn, and wheat is the most acceptable crop to follow flax. Flax is generally viewed as a 'clean up crop' on the prairies (Flax Council, 2005).

As indicated in Chapter 2, the flax plant can be cultivated for two purposes: the fibre and the oilseed. Producers in Canada derive most of their revenue from the oilseed and therefore direct the majority of their efforts to achieving a high yielding oilseed crop. Seed variety selection, crop management and harvesting techniques are all designed to produce the highest yielding oilseed crop. Flax producers thus do not proactively manage their flax straw. Producers receive minimal compensation for the straw such that there is no incentive to manage the straw. Managed oilseed flax straw, however, can create many different possibilities for the potential end uses of the fibre. As outlined in Chapter 2, some different uses of oilseed flax straw include: composite materials, pulp sweetners for specialty paper, insulation material and cottonized flax. To obtain high fibre content and high quality fibre from an oilseed variety of flax requires some different production decisions and investment in specialized harvesting and retting equipment by the producer (Saskflax, 2004). Factors such as seed variety, seeding date, plant population, plant distribution, soil fertility, weed control, harvest techniques and the degree of retting are all important elements influencing the fibre content and quality of straw (SAFRR, 2004). A diagram of the different processing techniques and end products from managed oilseed flax straw can be found in appendix B.

5.4.2 Processing

There are currently three commercial processors of flax straw operating in Canada. The largest Canadian processor of flax straw purchases straw from producers in

Saskatchewan, Alberta, Manitoba and North Dakota. This processor is located in Manitoba and sells its fibre to a specialty paper manufacturer in the U.S. Flax straw processing is carried out by either of two different processing facilities. One facility is permanent and is located in southern Manitoba, while the other facility is portable and is moved between storage yards located in Manitoba. The demand for higher quality fibre necessitated the construction of a permanent facility with more suitable equipment. The future operation of the portable facility is questionable.

The other two flax straw processors in Canada operate on a smaller scale. They each process their straw in permanent facilities, with one also located in Manitoba and the other in Saskatchewan. One processor supplies a manufacturer who uses the fibre in construction material, while the other manufacturer sells the fibre to a facility in the US that further processes it for the European specialty paper industry. One processor indicated that economies of scale in processing flax straw is an important factor in the success of the facility. A high throughput of flax straw is needed to recover the high expenditure on capital and personnel costs.

There are several steps to the fibre extraction process. The process is not highly technical in nature but the equipment that is utilized is specifically designed to extract flax fibre from flax straw.[32] The straw has basically two components: the fibre and the shive. Scutching is the process by which the flax straw is separated into the waste shive and the saleable fibre. The low-end application of the fibre means that further processing to clean the fibre from the shive is not necessary.[33]

[32] Two processors indicated that their equipment is not heavy enough to handle other fibre crops such as hemp and kenaf.
[33] High end use of fibre in linen manufacturing requires thoroughly cleaned fibre that has been through both scutching and hackling, which means to 'comb' the fibre to align it more properly.

Independent custom balers are hired by processors to bale the straw for a fee. Balers deliver the straw to processor's storage yards. At each of the permanent facilities in Manitoba, a tractor and trailer unit is used to transport the bales from the stacks to the processing facility, or the mill. First the bales are loaded into a slicing machine in the mill, one bale at a time. After the bales have been sliced, the separation of the shives and fibre can take place. Separating the fibre from the shive is a mechanical process where the straw passes through metal rollers to "break" and the smaller bits of shive are collected and later discarded. The shive is the inner core material of the straw, which is not fibrous and makes up 60-70 percent of the straw.[34] The shives are collected and put into semi-trucks and transported to farms in the area that use it for animal bedding. At the largest processing plant in Manitoba, approximately one semi-truck load of shive is produced per hour. The high amount of shive waste product is a significant cost of processing oilseed flax straw because processors have to give the straw away; there is not currently a market for it.

The quality of fibre that a processor supplies to his buyer is to a considerable extent dependent upon the quality of the straw he receives. Essentially, the one quality element that the processor has control over is the shive content of the fibre. The time that is spent on separating the fibre from the shive determines the cleanliness of the fibre. Most fibre that is exported from Canada has almost 25 percent shive content, which is considered high for flax fibre and thus limits its use in high value end products.

[34] This is the shive content of oilseed flax straw. The long line variety of flax straw used for linen will have significantly lower shive content.

5.4.3 Manufacturing

The potential end uses of flax fibre in the manufacturing sector are influenced by the preceding stages of production. For example, the lack of oilseed flax straw management and the relatively low intensity of flax straw processing means the end uses of Canadian flax fibre is limited to low-end uses like pulp and paper milling. The largest processors in Canada have equipment that is not readily capable of producing fibre for higher quality flax fibre applications.

Canadian processors currently export all of their flax fibre to the U.S., where it is mainly used in specialty pulp and paper milling.[35] The flax fibre serves as a strengthening agent in the pulp mixture of specialty paper, such as cigarette paper. The number of manufacturers who use Canadian flax fibre are small in number and are in long-term relationships with the Canadian flax straw processors.

A similar introduction to the wool fibre supply chain in New Zealand follows.

5.5 Supply Chain of Wool Fibre in New Zealand

New Zealand is the second largest exporter of wool in the world, second only to Australia. The wool industry adds approximately NZ$735 million annually to the New Zealand economy. Sheep were first introduced to New Zealand in the late 1700s for fine wool production but it was found that the harsh climate was not very suitable for that particular breed of sheep. The introduction of refrigerated meat shipments in the late nineteenth century increased the demand for dual-purpose sheep in New Zealand. Therefore, dual-purpose English breeds such as Lincoln and English Leicester became popular, as they were highly suited to the New Zealand landscape. Currently, the most

[35] A small amount of fibre produced by one of the processors is used in the building construction manufacturing sector.

common breed of sheep in New Zealand is the Romney, accounting for approximately sixty percent of the entire sheep flock (Wool Board, 2005). The originally English breed of sheep has been developed for the New Zealand countryside[36] and responds well to changing meat requirements. Romney sheep are therefore a dual-purpose sheep that produce strong wool, which is used to make carpets, blankets, heavy clothing and furnishings.

Similar to flax fibre, wool fibre also faces competition from synthetic fibres. In 1969/70 New Zealand exported 237,500 tonnes of wool (clean), while for the year ended June 2002 it exported only 151,000 tonnes. For many years wool has lost market share to synthetic fibres and this has been the main driver of the declining returns and reduced competitiveness of the industry (MAF, 2005a). To counter the negative effects of lost market share, New Zealand has invested heavily in R&D. This has led to continually improving wool product characteristics and functionality and achieved dramatic processing efficiency gains, however it has not so far reversed the long-term decline in wool's competitiveness as a fibre in most applications. The major constraints on the industry include conditions in international textile markets, severe competition from synthetics, and production constraints arising from declining sheep numbers. Wool and meat are co-products of sheep production and wool volumes are dependent on sheep numbers (MAF, 2005a).

Sheep farmers who raise dual-purpose sheep focus largely on meat production because wool is effectively a lower value, though still important, co-product (MAF, 2005b). An industry expert indicated that sheep numbers have been in decline as a result of the higher returns that cattle brings to farmers which has resulted in farmers switching

[36] Farmers generally keep breeds that best suit their type of farmland and the weather in their regions.

their sheep flock for cattle. Therefore, the quantity of wool fibre is affected by the market conditions of the meat. Sheep producers, therefore, have to make a trade-off between other livestock and dual-purpose sheep. The type of wool fibre, most often measured by the width of the fibre, is largely determined by the breed of sheep a farmer selects. Breed selection, in turn, is largely based on the landscape in the region, as well as climatic conditions.

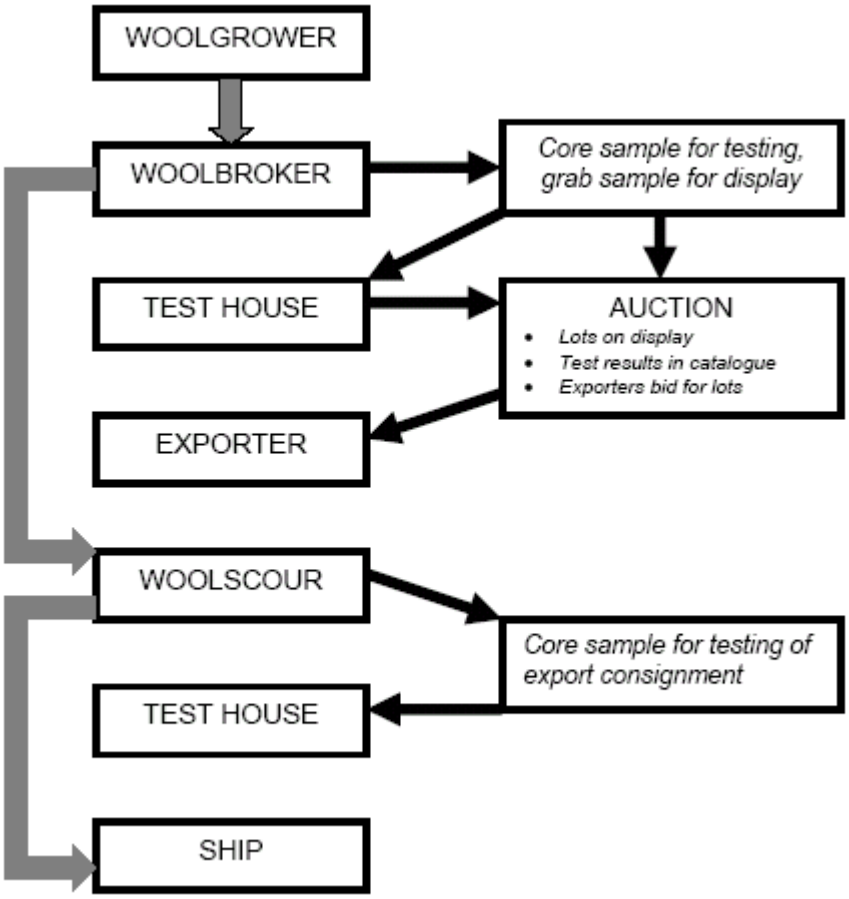
There are two main types of supply chains for wool in New Zealand. About 45 percent of the New Zealand wool clip is sold by means of auction, where wool brokers and wool exporters come together to sell and purchase wool for further processing. Farmers sell a similar quantity of wool to private merchants, who in turn sell the wool directly to wool exporters. The auction system generally determines the price of wool, and private merchants use the auction prices as guidelines when purchasing wool at the farmgate. An industry expert pointed out that selling to private merchants is especially popular in times of low prices since the farmer receives cash for the wool at the farmgate, providing a greater degree of certainty of returns. In addition, farmers are developing relationships with spinning mills so they can adjust their wool specifications to information received about market requirements. Persistent low prices for wool and an increased desire by manufacturers to have an influence on wool fibre characteristics has decreased the amount of wool sold through auctions in the last two decades.

A restructuring of the entire wool industry has taken place in recent years. Research and development is increasingly done by privately owned and regulated entities. Since 1984 several New Zealand governments have taken action to create a less regulated economy in New Zealand. Some of these actions to create a more market-

oriented economy have included floating the New Zealand dollar, privatising or corporatising many state-owned industries, progressively removing subsidies and import restrictions, de-regulating the labour market, and repaying long-term debt. As a result, the New Zealand government has pushed for the deregulation of many producer boards, one of which was the New Zealand Wool Board. The deregulation of the Wool Board and the privatization of R&D in the wool industry appears to be directly related to these moves to create a free market. The restructuring of industry associations in the wool fibre industry is discussed in further detail in section 5.8.

The case study of the wool fibre industry is based on a supply chain that includes an auction for selling wool fibre. All of the people contacted for an interview were most familiar with this supply chain governance structure, and most of the literature about the wool fibre industry assumes the wool is sold at an auction. A supply chain diagram of wool sold through the auction system is shown below.

Figure 5.1 New Zealand Wool Fibre Supply Chain Diagram



Source: Canesis, 2002

5.6 The Main Stages of Production in the Wool Fibre Supply Chain

The wool supply chain in New Zealand is arguably quite long, especially in comparison to the Canadian flax fibre supply chain. Beyond the farmgate, the main sellers of wool are wool brokers and the main buyers of wool are wool exporters who buy the wool for mills abroad. The test house, auction, wool scour and shipping stages of the supply chain play facilitating roles in the supply chain, but do not actually move the product through the supply chain. Interestingly, the woolgrower owns the wool until it is bought by the wool exporter, as the wool broker does not actually buy the wool to supply

to the auction. Wool brokers, however, play a crucial role in moving the wool through the supply chain by collecting wool from woolgrowers and organizing weekly auctions. Wool scourers are generally consigned by wool exporters to clean the wool and do not take ownership of the wool. Therefore, the main transactions taking place to move the wool are between woolgrowers and wool brokers, between wool brokers and wool exporters by means of the auction, and between wool exporters and spinners of wool. The yarn is then sold to different manufacturers. Following is a brief description of the role of the main supply chain players.

5.6.1 Woolgrower

Around 44 million sheep make up the flock in New Zealand, which means that sheep outnumber people eleven to one. An average woolgrower has a flock of 2,500 ewes that he keeps along with some stock rams and a herd of cattle. A large sheep farm has between 6,000 and 10,000 sheep. A typical ewe produces about 5.4 kilograms of wool per shearing, and most cross-breds are shorn twice per year (Wool Board, 2005). During shearing season the farmer hires a shearing gang and a wool "classer" to shear his sheep and classify the wool before it is sold to a wool broker. Wool classers initially classify the wool based on visual inspections during shearing and sort the different qualities of wool. Wool classers essentially set up the classification of wool for the rest of the supply chain, since they arrange the bales based on their classifications. A bale of wool leaving the farm weighs approximately 150kg. Most woolgrowers will ensure that they have at least enough sheep to bring one lot of wool to the auction. Wool exporters

generally buy wool in lots at auctions and prefer to buy lots that come from a single farm and have not been combined.[37]

5.6.2 Wool Broker

Wool brokers essentially act as agents for woolgrowers and sell wool on their behalf. In an industry association's online directory, eight wool brokering firms were found, and a number of them have field representatives that source wool from the main wool producing regions in New Zealand (Meat and Wool, 2005). Representatives arrange agreements with woolgrowers to broker their wool and organize the transportation of the wool from the farm to an aggregation centre. At an aggregation centre two different samples of wool are taken from each bale. A core sample is taken from each bale that is sent to the testing facility and a "grab" sample[38] is taken from each bale that will be displayed at the auction. The wool broker also weighs the bales and has adequate storage facilities to store the bales both before and after the auction takes place. The wool broker prepares a catalogue for every auction that, amongst other things, contains the information from the test certificate of the wool. After the auction takes place, wool brokers must organize the shipment of their wool to the scouring facility if it is to be scoured in New Zealand, or otherwise ship it directly to the shipping terminal.[39] The woolgrower must pay a standard fee to the wool broker for his services, and it is subtracted from the sale price of his wool.

The role of the wool broker goes far beyond merely selling wool on behalf of the woolgrower. Most wool brokers stockbrokers sell merchandise for raising sheep to

[37] In some cases spinning mills specify which farms they prefer the wool exporter to buy wool from and a combined lot is therefore not useful to the wool exporter.
[38] A grab sample is a term that indicates the sample is intended for display at auction as opposed to the core sample that is intended for the testing.
[39] There are 17 scouring plants in New Zealand.

woolgrowers. Wool brokers can also help with financing the woolgrower's operation. Perhaps most interestingly, the wool broker provides woolgrowers with information concerning wool production. Representatives of the wool broker provide guidance on which sheep to breed as well as proper ram selection to optimize wool quality.

5.6.3 Wool Exporter

There are approximately 100 wool exporters in New Zealand that work on behalf of spinning mills. Approximately 20 percent of wool exporters handle 90 percent of wool exports (MAF, 2005b). A wool exporter generally first negotiates a contract with a mill to supply the mill with a consignment of wool at a future date. The wool exporter then attends the auction and purchases wool that meets the quality specifications indicated by the mill. After the wool exporter purchases wool at an auction, he gives the broker instructions on how to deliver the wool. Most often the wool that exporters purchase is blended at scouring facilities in New Zealand into a uniform quality grade to satisfy the spinning mill's requirements. Brokers consign the wool to a scouring company after the sale. All of the wool that is used for spinning needs to be scoured.[40] Wool scouring is the process of washing wool in hot water to remove the non-wool contaminants and then drying it. At the scouring facility the wool is densely baled to minimize transportation costs to spinning mills abroad.

5.6.4 Spinning Mill

The majority of New Zealand wool is exported to spinning mills abroad, similar to the export of flax fibre to manufacturers in the US. For the past seven years, the largest export markets have been China including Hong Kong. The most common end

[40] Most of the wool is scoured in New Zealand before it is shipped abroad. However, countries such as China are developing their own scouring facilities that can scour the wool at a lower cost than New Zealand facilities.

use of wool is for machine-made carpets. Over 30 percent of New Zealand wool is used for this purpose (Wool Board, 2005). Spinning is a capital-intensive operation that involves creation of yarns suitable for weaving, tufting or knitting processes, which turn yarn into end products. An industry expert noted that transportation costs do not deter spinning mills from shipping their yarn to manufacturers across the world. Spinning mills that are located in low labour cost countries that have a cost advantage and the declining margins in the industry are forcing some spinning mills in Western countries out of business.

The testing of wool in New Zealand follows internationally recognized standards. The following section takes a more in-depth look at the attributes of wool that are tested at the testing facilities.

5.7 Wool Testing

Wool testing in New Zealand is highly specialized and produces objective quality measurements useful in valuing wool fibres. Wool tests are performed according to the procedures specified by the International Wool Textile Organization (IWTO). The IWTO is an international body representing the interests of the world's wool-textile trade and industry[41]. One of its objectives is to oversee the development and correct application of scientific test methods and regulations among its membership. All of the wool produced in New Zealand is tested according to these procedures. There are two independent testing facilities in New Zealand. The New Zealand Wool Testing Authority

[41] The IWTO head office is located in Brussels, Belgium. It was created in 1927 when representative bodies of the wool-textile industries in Britain and France signed an arbitration agreement for solving disputes. Membership is restricted to representative national associations of the wool-textile trade and industry, which means that membership is on a national basis. Currently the IWTO has 26 member countries. The IWTO has several committees that all report to the Assembly which ratifies all of the decisions made by the committees. The IWTO seeks funding from member countries for several of its research and marketing activities.

and the SGS Wool Testing Services Ltd. both offer identical testing services. The Australian Wool Testing Authority Ltd owns 50 percent of the New Zealand Wool Testing Authority and Wool Equities Ltd owns the other 50 percent. SGS Wool Testing Services Ltd. is a sister company to Wool Testing Services International, based in Bradford, England, which provides similar services to clients throughout Europe, Central Asia, and South America.

The two testing facilities charge approximately the same price for testing a lot of wool, about NZD$60. While wool can be tested both before the auction and after the scouring process, approximately 80 percent of all the wool is tested before the auction (Canesis, 2002). When the wool is tested presale, the wool broker subtracts the testing costs from the wool grower's payout. When the testing takes place post sale, the wool exporter pays for the testing of the wool.

The pre-sale test assesses the following quality parameters of the wool: wool yield or wool base, fibre diameter or micron, and colour. Before testing begins, all of the core samples from a lot are blended to ensure the tests are representative of the entire lot. Wool yield is the weight of clean wool, after impurities have been removed in a specialized cleaning process. The most common impurity is vegetable matter and it is generally listed on the test certificate since it increases the loss of wool fibre during processing. Essentially, the wool yield gives an accurate indication of the quantity of usable wool but does not provide any information about the potential uses of the wool. The fibre diameter is arguably the most important quality parameter because it determines how the fibre will be used. The fibre diameter of wool is expressed in terms of microns, which is one millionth of a metre. New Zealand cross-bred wool generally

has a 31 micron[42] or greater. In most cases the price of wool increases as the micron decreases. Finally, the colour of the wool fibre is determined at the testing facility. The colour measurement will assist the manufacturer with the potential for dying the wool.[43] When the manufacturer intends to dye the wool a light pastel colour, the wool must be very white and bright (NZWTA, 2005). The information that wool testing provides participants in the supply chain with is crucial in valuing the wool.

5.8 Industry Associations

The breadth of industry associations that support the wool fibre industry also sets the industry apart from the Canadian flax fibre industry. As mentioned in section 5.5, a large restructuring of various industry associations has taken place in recent years. Previously the New Zealand Wool Board had the main functions of, collecting levies, organizing industry research and development (R&D), and promoting New Zealand wool. The Wool Board was entirely funded by woolgrowers who contributed five percent of annual wool sales. In June McKinsey 2000 & Company completed a report for the wool industry that recommended the dissolution of the Wool Board and the establishment of new industry-good[44] structures for the wool industry (McKinsey and Company, 2000). In August 2000, 91 percent of grower respondents in a poll supported these recommendations. Since then, new commercial industry-good structures have emerged and are replacing the current New Zealand Wool Board (MAF, 2005c). The Wool Board operations have been taken over by the newly formed Wool Equities Ltd.

[42] A micron is one millionth of a meter. The average of a fine fleece of wool is approximately 14-15 micron and this type of wool is used in luxury garments and baby clothes. Fibre with a micron of 23-26 is used for knitting of most type of garments

[43] Dying is an additive process and it is therefore impossible to dye the wool lighter than its original colour.

[44] Industry-good structures do functions that benefit the industry. Therefore, research and development, technology transfer, education, and training are all functions of an industry-good structure. It is essentially an industry association that further develops the industry.

(WEL), and the Merino Grower Investments Ltd in 2004. WEL is a farmer-owned investment company that specializes in the wool, sheep and primary industry sectors and in wool research and development (WEL, 2005). WEL partially owns several research organizations that conduct research in areas from carpet making technology commercialization (Ovita) to organizations that collect and disseminate market information on wool export prices and volumes and wool types (Tectra). A levy of two percent is currently collected by Meat and Wool New Zealand[45] that is used to fund industry good research. Meat and Wool New Zealand collected NZD$32.5 million in wool levies and received approximately NZD$99 million in cash and resources from government, industry, and offshore collaborations. The two percent levy is approximately six cents per kilogram of wool (Meat and Wool, 2003).

The International Wool Textile Organization (IWTO) has developed, and keeps up to date, 'The Blue book'. Every member country of the IWTO must adhere to the principles of arbitration outlined in the book. The Blue book represents the basis for the conditions under which most of the world wool trade conducts its business. The rules contained in it are agreed between the numerous players in the wool-textile trade and industry. The Blue book also contains the International Wool Textile Arbitration Agreement that provides information for the resolution of disputes arising between partners from different countries. Arbitrators from the industry use the procedures outlined in the Agreement to ensure a fair and efficient settlement. The Blue book is available to any individual for a small fee, approximately CAN$ 80 (IWTO, 2005)

[45] Meat & Wool New Zealand is funded by livestock producers through a levy on all beef, sheep and goats slaughtered in New Zealand. Its role is to help in the attainment, in the interests of livestock farmers, of the best possible net ongoing returns for New Zealand livestock (which include sheep, cattle and goats), meat products and co-products.

R&D activities by the IWTO, WEL and other industry associations play a key role in new market development for New Zealand's wool fibre. In addition to providing woolgrowers, spinning mills and carpet manufacturers with technical information regarding wool, these industry associations also provide a breadth of market information to participants that is reduces information search costs when drawing up agreements.

5.9 Transactions in Each of the Industries

The remainder of the chapter is an analysis of the propositions that were developed in the theoretical framework in the preceding chapter. The transactions in each of the industry have been characterized following Transaction Cost Economics, Principal Agent theory, Market Structure theory and the economics of Institutions. A comparison of both the transaction characteristics and the type of relationship between parties[46] in each of the industries is undertaken to examine the validity of the propositions.

5.9.1 Transactions in the Flax Fibre Supply Chain

The following table lists the characteristics of transactions in the Canadian flax fibre industry that were identified through the interviews. The table, in essence, summarizes the responses from the interviews. The following table is used for the analysis of the propositions done in section 5.12 of this chapter.

[46] Only those relationships between participants who market the product through the supply chain are analysed. Therefore, relationships with transportation companies for example, are not examined since they play a facilitating role in the supply chain and do not actually market the product.

Table 5.2 Summary of Transaction Characteristics in the Canadian Flax Fibre Industry

Characterization of Transactions in the Canadian Flax Fibre Industry Cont'd

Asset Specific Investments	**Producer**	**Processor**	**Manufacturer**
Equipment (Physical)	None	Specialized equipment that is only suitable for lower quality flax fibre production	Process can accommodate flax fibre material with minor adjustments
Knowledge (Human Capital)	None	Knowledgeable people are required to operate the mill	Needs to know the characteristics of the fibre and how the properties of the end product changes with the addition of the fibre
Location (Site Specific)	N/A	Important to be close to the straw	None
Bargaining Power	**Producer**	**Processor**	**Manufacturer**
Price	None	Sets price for straw but is a price taker for the fibre	Compensates processor based on a cost-plus calculation[47]
Quantity	None	Calculate the demand for straw based on the demand for fibre from buyer and buys straw to fill this demand	Calculates demand for fibre and purchases fibre to fill this demand
Measurement vs. Monitoring Costs	**Producer**	**Processor**	**Manufacturer**
Measurement/Monitoring Costs	N/A	High because no technology currently exists to measure straw quality quickly	High because no technology currently exists to measure fibre quality quickly
Outcome Uncertainty	N/A	Climate conditions influence the success of the retting process, which in turn affects the quality variability of the straw	Quality variability of straw is transferred into quality variability of fibre, resulting in a certain degree of outcome uncertainty

[47] In the event that the end market does not justify cost plus, or even cost, it is likely that the manufacturer will substitute to a different pulp strenghthener and the and a breach in the exchange with the processor results

Characterization of Transactions in the Canadian Flax Fibre Industry Cont'd

Institutions	
(Economic) Industry Associations	Industry associations provide information on oilseed flax such as Flax Council of Canada and the Saskatchewan Flax Development Commission that have directed minimal resources to researching the (potential) market for flax fibre. Some natural fibre industry associations, but none specifically for flax fibre.
(Economic) Quality and grading	NIR technology[48] for testing fibre content in flax straw is still at the pilot scale. Some laboratory testing of cellulose content of the fibre, but in-house (subjective) testing of foreign matter, colour and moisture of the fibre.
(Economic) Research and Development	Biolin Research Inc. undertakes some research on optimal management practices of flax straw. Flax Canada 2015 initiative has recently been created to coordinate research on different uses of flax fibre.
(Political) Judicial and arbitration procedures	Current exchange arrangements do not benefit from this type of information and it does not appear that legal advice is sought when negotiation arrangements, especially not between producers and processors.
(Social) Trust	Trust is an important component of each business relationship and it currently appears to exist between in all exchange relationships.

[48] Near Infrared Technology that has been developed by Biolin Research Inc. but is not commercially available

5.9.2 Transactions in the Wool Fibre Supply Chain

Similar to the characterization of the transactions of the Canadian flax fibre industry, the New Zealand wool fibre industry transactions have been characterized. The characterization of transactions is undertaken according to the concepts included in the framework. The following table summarizes the responses from the interviews, as well as secondary information. The following table is also used for the analysis of the propositions in section 5.12 of this chapter.

Table 5.3 Summary of Transaction Characteristics in New Zealand Wool Fibre Industry

Characterization of Transactions in the New Zealand Wool Fibre Industry				
Asset Specificity	**Wool Grower**	**Wool Broker**	**Wool Exporter**	**Spinning Mills**
Equipment (Physical)	Investment in specific breeds is required to produce high quality wool. Ram selection is very important for the quality of wool.	Specialized equipment that takes core and grab samples as well as weighs the bales. The wool broker also has large warehouses to store the wool pre and post auction	None	Equipment can handle wools with a variety of different qualities, or microns
Knowledge (Human Capital)	Woolgrower knowledge is high that has been passed down through generations.	Wool broker needs in-depth knowledge of sheep to be able to provide advice to wool growers feed, variety selection, etc.	Has an in-depth knowledge of how certain characteristics of the fibre will impact the manufacturer's end product. Wool exporter also needs many connections in the spinning sector to get contracts	Needs to have good knowledge of the end product market to ensure the right yarn is spun
Location (Site specific)	N/A	Located auctions in main centres to attract wool exporters	Located in a main centre for ease of traveling abroad to mills as well as to auctions	Yarn is easily shipped to world-wide manufacturers
Bargaining Power	**Wool Grower**	**Wool Broker**	**Wool Exporter**	**Spinning Mill**
Price	None, they can only chose to sell either to a broker or a private merchant.	None since they have to compete with private merchants, as well as with other wool brokers for woolgrower's wool[49]	None, since they exist in large numbers[50]	Subject to market demand for products made with wool yarn[51]
Quantity	None, they can only chose to sell either to a broker or a private merchant	None since they provide a service for woolgrowers	None, since they provide a service for spinning mills	Subject to market demand for products made with wool yarn

[49] Wool brokers essentially provide a service for woolgrowers, which their bargaining power in the supply chain immaterial.
[50] Wool exporters essentially provide a service for spinning mills, which their bargaining power in the supply chain immaterial.
[51] A declining market demand for wool yarn has meant that in recent years spinning mills and manufacturers have had relatively more bargaining power in the supply chain.

Characterization of Transactions in the New Zealand Wool Fibre Industry Cont'd

Measurement vs. Monitoring Costs	**Wool Grower**	**Wool Broker**	**Wool Exporter**	**Spinning Mill**
Measurement/Monitoring Costs	N/A	Certified and objective quality measurement of wool fibre provide low-cost information on outcomes	Certified and objective quality measurement of wool fibre provide low-cost information on outcomes	Certified and objective quality measurement of wool fibre provide low-cost information on outcomes
Outcome uncertainty	N/A	Task programmability of wool production is relatively high and wool brokers provide information to woolgrowers which makes outcome uncertainty negligible	Wool brokers do not transform the product and therefore there is no element beyond their control that increase outcome uncertainty any further	Blending of sold lots when the wool is scoured reduces the variability in the wool between different lots in a shipment to a spinning mill
Institutions	**Wool Grower**	**Wool Broker**	**Wool Exporter**	**Spinning Mill**
(Economic) Industry Associations	The New Zealand Sheep Breeder's Association - fosters the improvement of all sheep breeds by collecting information from producers Meat and Wool New Zealand – collects levies for R&D programs, as well as promotes market access of wool Wool Equities Ltd. – a large investment company that partially owns various other more specialized research entities such as: (1) Ovita (33.3%) – a leader in areas of sheep genome research (2) Canesis (33.5%) - a leader in wool science and textile technology and incorporates many of the research and development activities undertaken previously by WRONZ (3) NZWTA (50%) – the largest tester of wool in New Zealand (4) Keratec (67%) – researches and develops innovative new uses for keratin proteins extracted from wool (5) Tectra (100%) - undertakes many of the industry service and training activities previously provided by WoolPro			
(Economic) Quality and grading	Testing is done according to internationally recognized standards put forth by the IWTO. Fibre is generally tested pre-sale and wool exporters rely on test results and visual inspection of samples at the auction to make buying decisions. The yield, fibre diameter, and colour are determined at two different testing facilities in New Zealand.			
(Economic) Research and Development	R&D is increasingly being done by commercial entities. The WEL coordinates most of the R&D done in the industry. R&D is focused on increasing the potential end uses of wool fibre and creates more value in the supply chain.			
(Political) Judicial and arbitration procedures	Arbitration procedures laid out by the IWTO are used in the case of a contractual breach between any members of the supply chain.			
(Social) Trust	Trust is not found to be an important component in each of the business relationships. It was noted that objective quality measurements reduced the need for trust in the exchange relationships.			

5.10 Analysis of the Propositions

The following table compares the transactions in the two different supply chains. Each feature of the transaction that was explored in the framework is included in the table. Each dimension of the transaction and the corresponding proposition will be explored more in-depth following the table.

Table 5.4 Comparison of Transaction Features

	Canadian Flax Fibre Supply Chain Relationships		**New Zealand Wool Fibre Supply Chain Relationships**		
	Producer-Processor	**Processor-Manufacturer**	**Woolgrower-Wool Broker**	**Wool Broker-Wool Exporter**	**Wool Exporter-Spinning Mill/Manufacturer**
Transaction Cost Economics					
Asset Specificity	idiosyncratic[52]	idiosyncratic	mixed[53]	mixed	mixed
Uncertainty	high	high	low	low	low
Market Structure Theory					
Bargaining Power	none	equal	none	none	unequal[54]
Agency Theory					
Measurement/Monitoring Costs	high	high	low	low	low
Outcome Uncertainty	high	high	low	low	low
Institutional Analysis					
(Economic) Industry Associations	none specifically for flax straw or flax fibre		a wide range of industry associations that provide market information available to all supply chain participants		
(Economic) Quality and Grading Regime	none		well-recognized		
(Economic) R&D Initiatives	few and low-budget		widespread and range from technical to market related research		
(Political) Judicial and Arbitration Procedures	none		standardized contractual arrangements and transparent arbitration procedures[55]		
(Social) Trust	plays an important role in exchange relationships		does not play an important role in exchange relationships		

[52] Idiosyncratic investments have little or no value outside of the business relationship.
[53] Mixed investments are somewhere in between the two extremes of investments: non-specific which can be applied in many different relationships and idiosyncratic which are not redeployable outside of the transaction it was intended for.
[54] The manufacturer, who is closer to the end consumer generally has the most bargaining power. However, the state of the wool fibre economy, whether it is in decline or not, also determines who has the greatest bargaining power in the business relationship.
[55] Due to the long history of the wool trade in New Zealand and the involvement of the IWTO, exchange agreements have become standardized over the years.

Evidently there are numerous differences in the transaction, transaction environment and characteristics of the transaction parties between the two industries. To examine the propositions, the different vertical coordination structures between the two supply chains are also compared, as shown in Table 5.4.

Table 5.5 Comparison of Business Relationships in the Canadian Flax Fibre Supply Chain and the New Zealand Wool Fibre Supply Chain

Canadian Flax Fibre Supply Chain Relationships		**New Zealand Wool Fibre Supply Chain Relationships**		
Producer-Processor	**Processor-Manufacturer**	**Woolgrower-Wool Broker**	**Wool Broker-Wool Exporter**	**Wool Exporter-Spinning Mill/Manufacturer**
(generally recurring) Spot Market Relationship[56]	(long-term) Contractual Relationship or Full Integration	(generally recurring) Spot Market Relationship[57]	Spot Market Relationship at Auction	Contractual Relationship

A spot market relationship is observed between producers and processors of flax straw. Straw buyers who work for the processors generally approach producers of oilseed flax during the cropping season. The same producers are usually approached year after year, as long as they keep their fields relatively clean of contamination material. A spot market relationship also exists between woolgrowers and wool brokers in the New Zealand wool fibre supply chain. The woolgrower generally sells to the same wool broker during every shearing season. Therefore, the exchange is generally recurring and a long-term relationship is fostered between woolgrowers and wool brokers. Wool brokers provide woolgrowers with production information to increase the yield and value of their wool, which most likely helps to cultivate these long-term relationships.

[56] Every harvest season the processor approaches producers of oilseed flax who are in the area and their fields appear to be in good condition after a short visual inspection by straw buyers. Often the same producers are contacted year after year.

[57] During shearing season wool brokers vie for the wool from woolgrowers. Generally woolgrowers sell their wool to the same wool brokers but there are no promises for future arrangements made.

Therefore, even though both exchanges occur on the spot market, the relationship between woolgrowers and wool brokers is considered closer because of the greater information sharing by the wool broker.

There are no brokers presently purchasing Canadian produced flax fibre and, therefore, transactions are taking place directly between processors and manufacturers. Processors and manufacturers in the downstream flax fibre supply chain are in a long-term contractual relationship, or fully integrated in the case of one processor. Each of the Canadian processors sell all of their fibre to one manufacturer and therefore tailor their entire production line to one manufacturer. In New Zealand, wool brokers play an integral part in moving the wool through the supply chain. Wool brokers organize auctions where wool exporters purchase the wool on contract for a spinning mill. Independent wool exporters generally have contractual relationships with spinning mills in the downstream New Zealand wool fibre industry. The wool exporter enters into a contract in which he agrees to deliver a certain quantity and quality of wool at a specified price and time.

Given the information on the comprehensive characteristics of the transactions and the observed vertical coordination strategies in the two supply chains, a verification of the propositions follows.

5.10.1 Asset Specificity

Specific investments are not required by oilseed flax producers to sell their straw to processors. Processors of flax straw on the other hand do require specialized fibre extraction equipment, as well as knowledgeable personnel to operate and maintain the equipment. Canadian processors have invested in fibre extraction equipment that is

capable of producing fibre quality that can only be utilized in low-value applications. The cleanliness of the fibre is not very high and is therefore not suitable for higher value applications. Therefore, the processing equipment that Canadian processors own limits the type of applications of the fibre, and thus the number of buyers. Given the already limited number of players in the manufacturing sector, processors are essentially locking themselves into a bilateral exchange relationship with a certain type of manufacturer when they invest in processing equipment. Therefore, both the structure of the market and the nature of the processing equipment exposes processors to potential opportunistic behaviour when they enter the flax fibre supply chain. Manufacturers similarly have to make asset specific investments because they have to invest resources in the R&D necessary to incorporate flax fibre into their process. The asset specific nature of this R&D exposes the manufacturer to potential opportunistic behaviour.

New Zealand woolgrowers, for the most part, produce a grade of wool fibre that is used for heavier applications such as carpet and upholstery manufacturing. Sheep producers in New Zealand do not have to make asset specific investments to enter into an agreement with any of the wool brokers. Wool brokers require some specialized equipment at their aggregation centres to take core and grab samples, as well as weigh the bales. Spinning mills make perhaps the largest investment in equipment of all the other participants in the supply chain. The spinning equipment can handle different qualities of wool fibre, but is not suitable for spinning other natural fibres, such as cotton for example. Seemingly none of the investments lock participants into bilateral exchange relationships but the equipment can not be easily used for a purpose unrelated to wool production. The investments made by participants in the wool fibre supply chain have

thus been characterized as mixed. The proposition developed in the theoretical framework stated the following regarding asset specific investments:

Proposition 1: The presence of asset specific investments exposes the parties to opportunistic behaviour, leading to high exchange costs and closer vertical coordination.

The case studies indicated that the degree of asset specific investments is greater in the downstream flax fibre supply chain. Therefore, it was expected that closer vertical coordination to limit opportunistic behaviour would be observed. This is indeed the case in the flax fibre supply chain. The exchange relationship between processors and manufacturers is close to, and in one case, at the hierarchical end of the spectrum. This is the most efficient means of coordinating the business relationship given the mutual asset specificity or hostage assets that are present in the relationship. The presence of hostage assets diminishes the joint maximization in the event of a breach in the relationship.

A spot market relationship, as opposed to closer vertical coordination, is observed between producers and processors. The irrelevance of the proposition in this relationship can be explained by two realities in the flax fibre industry. Firstly, there is an abundance of raw material on the prairies and secondly, producers have a great desire for processors to organize baling and transportation of the straw so it does not have to be burned. Therefore, the processor does not have to safeguard secure sources of this raw material and thereby does not need to set up on-going business relationships with producers.

In the New Zealand wool fibre supply chain asset specificity does not lock woolgrowers, wool brokers and wool exporters into bilateral relationships. None of the investments were found to be relationship-specific, only industry-specific. The fact that there are many players at each stage of the supply chain means that any investments

(knowledge or equipment) that are necessary to enter the industry are not at risk of becoming a sunk cost because alternative exchange partners could not be found. Ex post competition at each stage of the supply chain reduces the risk of opportunism in each of the business relationships. Less formal vertical coordination is likely to characterize these relationships. This is indeed observed, as spot market transaction relationships are generally the norm. Spinning mills make perhaps the greatest degree of asset specific investments because of high spinning equipment costs and limited alternative uses of the spinning equipment. The need for a specific quality of wool fibre means that written contracts are formed between spinning mills and wool exporters. These written contracts make use of the objective quality measurements to specify requirements. The second concept of the transaction cost literature is uncertainty and it is examined below.

5.10.2 Uncertainty

Apparent from the framework, the level of uncertainty in the transaction environment is closely related to the degree to which institutions provide information to the parties to the exchange. The infancy of the flax fibre industry and thus the lack of information about its future creates a transaction environment with high uncertainty at all of the stages of the supply chain. The New Zealand wool fibre industry, on the other hand, is characterized by a low level of uncertainty and contractual gaps are not common-place in this well-developed industry. According to the following proposition, closer vertical coordination in Canadian flax fibre supply chain is to be expected than in wool fibre supply chains in New Zealand.

Proposition 2: Uncertainty in an exchange relationship generally leads to closer vertical coordination.

According to the proposition, parties will fortify their relationships to avoid costly haggling over post-contractual rents in exchange agreements that have gaps stemming from uncertainty. The close vertical coordination observed between processors and manufacturers in the flax fibre supply chain can be attributed to the contractual gaps stemming from a lack of information regarding a fair price and quality specifications of the fibre. Contractual gaps in the New Zealand wool fibre industry are not common-place because of the low level of uncertainty in the transaction environment. Market prices are easily determined through the market mechanism and information regarding the appropriate quality specifications needed by spinning mills is readily available. R&D initiatives have provided spinning mills with information on carpet manufacturing and accredited testing facilities provide a breadth of information on wool fibre quality specifications. The low level of uncertainty in exchange relationships does not contribute to high exchange costs and thus close vertical coordination is not required.

5.10.3 Measurement versus Monitoring Costs

Transactions in the flax fibre supply chain are characterized by high measurement costs because of the absence of quality measurement and grading of flax straw and fibre. Quality measurement of wool fibre in New Zealand, on the other hand, is highly technical and produces third party objective quality measurements that are relied upon in exchange relationships to value the wool fibre. Therefore, measurement costs of outcomes in principal-agent relationships in the wool fibre supply chain are significantly less relative to measurement costs in the principal-agent relationships in the flax fibre supply chain. The difference in relative measurement costs leads to different vertical coordination

strategies between the supply chains according to the proposition developed in the framework.

Proposition 3: When outcome measurement costs are high, closer vertical coordination will likely result.

Extensive and credible wool testing that is recognized industry-wide in New Zealand and abroad makes outcome-based contracts between participants most efficient. There is very little asymmetric information in principal-agent relationships in the supply chain as a result of the extensive quality measurements of wool fibre. Objective quality measurement of wool fibre eliminates the need for wool exporters to incur costs to monitor the effort, or behaviour of woolgrowers. Wool exporters buy wool at auctions and the information regarding the wool that is provided in the catalogues is sufficient to make a purchase decision. Wool exporters are able to fulfill the outcome-based contracts they have with spinning mills by viewing samples at the auction and reading the catalogue that includes all of the test information. An auction mechanism for flax straw in Canada is not possible in part because there are no quality standards that processors could use to value straw samples.[58]

Despite the high cost of measuring producer outcomes, the producer is compensated based on the tonnage of straw salvaged from the field. Therefore, measurement costs of straw in the agency relationship between producers and processors do not appear to play a crucial role in shaping the relationship. One would predict a behaviour-based relationship instead, given the high outcome measurement costs. However, the absence of information regarding proper straw management techniques makes a behaviour-based relationship inefficient as well. Currently, research is

[58] The limited number of buyers of flax straw makes auctions for flax straw ineffective also.

inconclusive regarding proper flax crop and straw management techniques that processors could monitor. Therefore, the efficiency of a behaviour-based contract is compromised and measuring the tonnage of flax straw becomes a suitable proxy for the outcome of the producer.

A behaviour-based contract is observed between processors and manufacturers in the downstream flax fibre supply chain. Unlike wool fibre, flax fibre properties can not be specified in standardized contractual arrangements. Therefore, a spot market type relationship between processors and manufacturers where the agreement is largely based on specific quality measurements of flax fibre is not possible. As a result, manufacturers and processors enter into long-term highly vertically coordinated relationships in which compensation is not based on quality. This is indeed the case as two processors of flax straw indicated they are compensated on a cost-plus basis, which is similar to a behaviour-based contract.

Outcome uncertainty is another element of Agency theory that is included in the framework, and is examined below.

5.10.4 Outcome Uncertainty

Outcome uncertainty is often observed in the agricultural sector. There are numerous factors that impact the quality of agricultural products that are beyond the control of primary producers. Producers indicated that exogenous factors affecting the oilseed crop include the weather, health of the soil, and contamination of their field by people passing on nearby roads. Most interviewees indicated that the most important factor affecting the variability of straw and fibre quality are the climatic conditions. Climatic conditions largely influence the success of the retting process, which in turn

largely determines the quality of the fibre. Wool production is also characterized by outcome uncertainty, but to a lesser extent. Woolgrowers generally choose a breed of sheep that suits the landscape and climatic conditions in their region. Therefore, outcome uncertainty does not appear to play a large role in the relationship. Proposition 3a dealt with outcome uncertainty:

Proposition 3a: When outcome uncertainty increases, weaker vertical coordination is likely.

Outcome uncertainty is a less important feature of transactions in the wool fibre supply chain compared to the flax fibre supply chain. An outcome-based exchange relationship between woolgrowers and wool brokers is efficient since the woolgrower is willing to absorb the minimal amount of production risk stemming from climatic conditions. Research indicated that outcome uncertainty at later stages of the wool fibre supply chain was not significant.

Flax straw quality, on the other hand, is significantly impacted by weather conditions, creating a production risk. This would theoretically lead to behaviour-based contracts between producers and processors. The small amount of compensation that producers receive for their straw, makes them unwilling to accept risk stemming from outcome uncertainty. The opposite was observed, however. The effect of weather on the quality of straw actually led one Canadian processor to stop contracting with producers. Given the abundance of flax straw on the prairies, processors prefer to observe weather patterns and base buying patterns on these observations. Therefore, spot market transactions are most efficient with the high outcome uncertainty because it

preserves the processor's opportunity to source straw from producers in areas with good cropping and retting conditions.

Goal diversion between producers and processors of flax straw is also a major cause of outcome uncertainty in the flax fibre supply chain. Producers manage their oilseed crop solely for maximizing oilseed yield and quality, not considering the effect on straw quality. Since variability in flax straw translates into variability of flax fibre, outcome uncertainty also plays a major role in transactions between processors and manufacturers. The high level of outcome uncertainty in the production of flax straw and fibre increases the efficiency of behaviour-based contracts to avoid shifting production risk to the agent in the transaction relationship. Goal diversity does not exist to the same extent in the wool fibre supply chain. Research indicated that sheep producers actively manage their flock for both the meat and the wool. Sheep breeds are chosen that are most efficient for the type of landscape in the region as well as according to climatic conditions. Judicious sheep selection thus decreases the degree of outcome uncertainty is therefore lower. Producers gain approximately 25 percent of their revenue from the wool, which is a greater percentage than flax producers receive for their straw.[59]

5.10.5 Bargaining Power

To determine which party in each of the supply chains has the greatest level of bargaining power is not easy. Interviewees in both industries said that relative bargaining power is determined by the market situation of the end product. Especially in the wool fibre industry it was found that whether or not the carpet market is in decline strongly influenced which party holds relatively the most bargaining power. For instance, when

[59] One New Zealand wool fibre industry expert mentioned that the percentage revenue woolgrowers derive from wool is declining due to declining wool prices, which results in weaker incentives to manage their sheep flock for the wool.

the carpet market is in decline, manufacturers and spinning mills have most of the bargaining power because of oversupply of wool fibre in the supply chain. From the framework, the proposition regarding the effect of bargaining power on vertical coordination is as follows:

Proposition 4: Unequal bargaining power leads to high exchange costs and closer vertical coordination.

The processing sector is made up of only three processors on the prairies, thereby severely limiting the number of buyers of flax straw. Considering the small number of processors, the producer is a price taker and faces a perfectly elastic demand curve for his flax straw.[60] The monopsony power of processors puts producers, who are in a competitive market, at a relative bargaining disadvantage. Interview responses by producers indicated that they do not appear to be very concerned with their lack of bargaining power in the supply chain. The primary reason appears to be that producers view their straw as a waste by-product. In addition, considering the small amount of compensation producers get for their flax straw, the loss in welfare from exposure to bargaining power currently is insignificant for producers. Hence, the fact that unequal bargaining power is present in the producer-processor exchange relationship is not reflected in the cost of exchange. If at a future date information about proper straw management techniques require asset specific investments, the inequality in bargaining power in the exchange relationship may serve as a significant exchange cost.

The interviewees from the New Zealand wool fibre industry indicated that downstream manufacturers hold relatively the most bargaining power because of the declining demand for wool fibre products. Neither the interviewees nor the current

[60] The flax straw market is therefore a buyer's market.

literature on the industry indicated that the unequal bargaining power alone played a significant role in shaping exchange relationships. Therefore, only in the processor-manufacturer relationship in the Canadian flax fibre supply chain does bargaining power appear to influence the shape of the exchange relationship.

When bargaining power is considered in conjunction with the degree of asset specificity in a transaction, however, the impact on vertical coordination may be more conclusive. In a closely vertically coordinated relationship, such as a hierarchy, neither party benefits from exercising bargaining power or behaving opportunistically since the costly haggling and lack of cooperation often reduces joint profit. The potential exposure to bargaining power and opportunistic behaviour makes closer vertical coordination more efficient.

In the flax fibre sector the conjunction of both asset specificity and bargaining power appears to play a role in the downstream relationship between processors and manufacturers. Both the processor and the manufacturer have to make investments in asset specific resources and both parties have bargaining power stemming from the lack of competition at these stages of the supply chain. Close vertical coordination is indeed observed between processors and manufacturers since exchange costs are high. Close vertical coordination is not observed in the downstream wool fibre industry because a declining market and competition among wool exporters ensures spinning mills gain favourable terms of trade without having to initiate a closely coordinated relationship.

The final feature of the framework is the institutional environment in which the transaction takes place. An assessment of the proposition regarding the impact of an underdeveloped institutional environment follows.

5.10.6 The Institutional Environment

Institutions can facilitate transactions by lowering measurement costs and reducing uncertainty. Transacting along a supply chain is costly in the absence of institutions that provide this information, and fortified business relationships are required to avoid the hold-up problem. Development of an infant industry greatly benefits from institutions that reduce information asymmetries. Therefore, institutions impact several facets of the transaction, and the following proposition was developed in the theoretical framework.

Proposition 5: An underdeveloped institutional framework leads to high exchange costs, and closer vertical coordination.

A comparison of the institutional environment between the two industries highlights several differences. Exchanges in the wool fibre supply chain, as opposed to exchanges in the flax fibre supply chain, take place in a well-developed institutional environment. The information regarding end-user markets, market prices, market trends and arbitration procedures available to participants in the New Zealand wool fibre industry is much greater in comparison to the availability of this type of information in the Canadian flax fibre supply chain.

A quality and grading regime is well-established in New Zealand, reducing measurement costs for wool buyers and providing information regarding quality specifications that are useful for wool exporters and spinning mills to negotiate agreements. A quality and grading regime also provides parties to the transaction with information that can be used to reduce future uncertainty and thus contractual gaps. Different production decisions to increase flax straw quality and reduce quality

variability can be made once feedback has been received from effective quality measurements. Therefore, in addition to reducing uncertainty regarding the fair value of the production that is being exchanged, a quality and grading regime can also serve to further reduce future uncertainty for transacting parties.

Wool fibre industry associations in New Zealand are also widespread and provide a breadth of R&D, especially to woolgrowers, spinning mills and manufacturers of carpet. This information reduces uncertainty in the industry and thus exchange costs. For instance, the IWTO has an objective to ensure the functioning of the International Wool Textile Arbitration Agreement in wool production. Therefore, this political institution provides information to supply chain participants regarding the outcome of potential contract breaches. Uncertainty in the flax fibre supply chain is much higher in comparison, leading to relatively higher exchange costs. The importance of trust in exchanges in the New Zealand wool fibre supply chain is diminished because of the objectivity of quality measurements. Objective quality measurements reduce the need for trust in exchanges because these measurements are sufficient to determine the value of the wool. The lack of objective quality measurements, combined with the lack of trust between new entrants in an infant flax fibre industry means exchange costs are high. The strongly coordinated relationship that is observed between processors and manufacturers can be attributed to the need to eliminate high exchange costs.

5.11 Summary and Conclusions

This chapter investigates the validity of the theoretical framework developed in Chapter 4. Business relationships in the Canadian flax fibre industry were compared with business relationships in the New Zealand wool fibre industry. After an introduction to

each of the industries, the business relationships were characterized according to the concepts in the framework. Tables comparing the transaction characteristics and vertical coordination strategies were developed. An analysis of the different propositions was then possible. The propositions were generally validated and additional insights into vertical coordination between parties were gained because of the combined effect of several of the transaction features. The following chapter concludes this research and includes a brief discussion of conclusions and implications for the industry.

6.0 SUMMARY AND CONCLUSIONS

6.1 Introduction

This chapter concludes the thesis. It summarizes the key research findings and discusses some constraints to industry development that have been identified through the analysis of business relationships. This chapter also includes a section that highlights limitations of the research, as well as areas for further research.

The subject of the thesis is the flax fibre supply chain. Supply chains of flax fibre are emerging in Canada, but at a significantly slower pace than would be expected considering the abundance of raw material and the large manufacturing sector that could utilize flax fibre. Several issues were identified through background research that appeared to play a role in the slow development of the industry. These issues included the infancy of the industry, the specificity of processing equipment and knowledge, the lack of research and development on the properties of flax fibre, the limited number of processors and manufacturers in the industry, and the absence of a recognized quality and grading regime for flax straw.

The use of New Institutional Economic (NIE) theory to discover exchange costs and the slow development of the flax fibre industry was chosen in this thesis. Neoclassical economics could also have been used to examine the slow development of the industry. An examination of the cost of production at different stages of the supply chain would have been required with the neoclassical approach. While in-depth evidence of cost of production was not gathered during the interviews, it did not appear to be a constraint to industry development. One element that may have been discovered with

using neoclassical economics is the impact of the unpredictability of straw quality on the cost effectiveness of the industry. Considering that flax straw is a by-product in Canada, management of the flax crop is aimed at obtaining a high oilseed yield. In addition, flax straw quality remains to a large extent dependent on the weather conditions for retting. Therefore, the inability of processors to influence straw quality through pricing schemes may transpire to have a large negative impact on the development of the industry. The high cost of production associated with the unpredictability of flax straw may play a large role in the under-development of the industry.

A new approach was taken in this thesis that combined several different literatures within the NIE paradigm into one framework. Previous research in NlE has generally focused on examining transactions from only one dimension. Transaction Cost Economics is perhaps the most widely used theoretical approach when analyzing vertical coordination structures. The different dimensions for examining transaction relationships have each been validated in previous research. However, using each concept separately often leads to a limited explanation of vertical coordination. The framework developed in this thesis is an attempt to more fully explain how transactions are organized along a supply chain. Therefore, the overall objective of this thesis was to examine holistically the exchange costs in the flax fibre industry and the impact of these exchange costs on supply chain coordination and the development of the industry.

6.2 Summary of Research Findings

Insight into supply chain relationships was gained with the use of a framework developed in the thesis. Each of the propositions from the different concepts of NIE was validated in the comparative case analysis. Therefore, it can be concluded that not only

the characteristics of the transaction, but also the characteristics of the parties in the transaction, as well as the environment within which the transaction takes place influences vertical coordination strategies. Each of these elements played a role in shaping business relationships. Most importantly, it was found that the combined effect of various aspects of transactions played the largest role in shaping business relationships. The underdeveloped institutional environment, in combination with various other aspects of transactions, led to prohibitively high exchange costs for forming business relationships.

The institutional environment within which the transaction takes place is perhaps the most important factor in determining supply chain coordination in the flax fibre supply chain. With its over-arching role in the framework, the institutional environment impacted the measurement costs and degree of uncertainty in business relationships. The absence of a grading and quality system means the measurement costs of the agent's output are high, making spot market transacting prohibitively expensive in the flax fibre supply chain.

Objective quality measurements of wool fibre performed by testing houses accredited by the International Wool Textile Organization, on the other hand, plays a crucial role in making the auction system possible in New Zealand. Wool exporters rely on the information regarding the cleanliness of the fibre, the fibre diameter or micron, and colour when making purchasing decisions to fulfill their contracts with spinning mills. Quality and grade information significantly reduces the costs of acquiring information to reduce information asymmetries between wool buyers and sellers and thus makes easily formed spot market relationships feasible.

The type of business relationship that prevails between producers and processors in the Canadian flax fibre industry is largely influenced by the fact that producers and processors view flax straw as a by-product. In New Zealand, on the other hand, wool fibre is viewed as a valuable co-product that generates 25 percent of revenues for sheep farmers. Producers view flax straw as a costly nuisance and they are therefore willing to sell their straw for any price.[61] Currently, farmers receive around $6 per tonne of flax straw, which is about $4 per acre of oilseed flax. When these prices are compared to oilseed returns that are currently approximately $150 per acre (SAFRR, 2004), it becomes obvious that the revenues generated from straw are insignificant in comparison to the oilseed crop.

6.3 Constraints to Industry Development

There are various hurdles that must first be overcome before the flax fibre industry can enjoy rapid growth. The premise of this research is that the lack of development in the industry is in part due to the costs associated with establishing closely vertically coordinated exchange relationships. This thesis examined the impact of high market exchange costs on vertical coordination strategies and the resultant likelihood of investors to commit resources.

NIE literature states that the most efficient vertical coordination strategy results given the transaction characteristics and exchange costs. While establishing closely vertically coordinated relationships are most efficient in terms of minimizing market exchange costs, new costs associated with administering vertical flows of product and organizing factors of production are incurred (Hobbs, 1996). While carrying out the

[61] Some producers even indicated they would even give their straw for free to the processor just so they could get rid of it.

transaction internally is the most efficient, it may only be marginally so when there are high search and negotiation costs associated with establishing closely vertically coordinated relationships. For instance, the search costs associated with finding an exchange party to a long-term contract are likely higher than the search costs associated with finding a party for an exchange on the spot market. Similarly, setting up a long-term exchange, that necessitates negotiation of several contractual stipulations to account for future events, leads to higher negotiation costs than standardized spot market transactions. Therefore, the close vertical coordination in the flax fibre supply chain may be most efficient in terms of transaction costs, but the development of the industry may nevertheless be hindered. This notion is reinforced by several responses from interviewees who indicated that commercialization of the fibre into different manufacturing industries was a reason for slow growth in the industry.

Slow development of the industry is in part attributable to the absence of a grading and quality regime. According to Barzel (2004) a grading and quality regime that is state-enforced moves an economy to perfect competition where spot market transactions are the norm. Therefore, along with a grading and quality regime, state enforcement is necessary, as well as considerable care must be given to how and which standards arise. How the industry develops will be influenced by the type of standards that are developed. Therefore, while a grading and quality regime is necessary in the industry, there are some aspects that must be carefully considered.

Further development of the industry will require producers to manage their straw to increase fibre content and quality. This will allow the fibre to be used in applications other than pulp and paper milling. The current pricing system of straw, however,

eliminates any incentive for producers to manage their straw. A fixed pricing system is in place partly due to the high costs of quality measurements. Under the current pricing scheme there is no price premium for higher quality straw. Therefore, there is currently no incentive for producers to manage their straw to obtain a higher quality because the price is irrelevant to quality attributes. In addition, the low price that producers receive for their straw is neither conducive to performing any straw management practices. The nuisance of handling the flax straw makes producers eager to hand over their straw to processors, at any price.

The lack of research and development on flax fibre properties is also a constraint to industry development and makes exchanges costly. Commercialization of the flax fibre into different industries is difficult because of the lack of knowledge on how flax fibre can be utilized in different processes. R&D into the potential viability of the industry is also minimal, limiting interest by potential investors. The lack of information about flax fibre properties, and the industry in general, creates high exchange costs, especially considering that asset specific investments have to be made by both processors and manufacturers. The risk of opportunism is a reality every time contractual renegotiations have to take place as a result of contractual gaps. Therefore, lack of research and development on flax fibre properties means the information necessary to reduce environmental uncertainty and the risk of opportunistic behaviour does not exist. Both uncertainty and risk of opportunism stemming from a lack of R&D in the industry create a hold up in establishing business relationships.

Industry associations play an important role in the success of the New Zealand wool fibre industry. They collect funds from woolgrowers and government to organize,

and in some cases conduct, research and development activities. Industry associations that direct their resources to promoting the flax fibre industry through research would fill the institutional vacuum that is currently present in the Canadian flax fibre industry.

6.4 The Potential for Flax Fibre in the Biobased Economy

The potential for flax fibre in the biobased economy is very good because of the superior qualities of flax fibre compared to several other natural fibres. However, a substantial amount of research and development must be done on flax fibre properties. Considering that flax fibre will replace non-renewable resources to convert traditional products into bioproducts, research regarding the effect on end product properties is needed. In addition to technical research, market research on the willingness-to-pay for bioproducts is needed. While research has indicated thus far that flax fibre is advantageous in various applications, it is an expensive alternative. Consumers must be willing to pay a price premium for a product containing flax fibre.

The market value of the bioproduct must be high enough that it allows manufacturers to pay a premium for high quality fibre. A similar incentive needs to exist for producers to manage their straw. Assuming that bioproduct manufacturers require fibres with certain properties, research on appropriate straw management practices as well as fibre handling practices is needed. Therefore, market and technical research is needed for flax fibre to succeed in the bioproducts market.

6.5 Limitations of the Research

As with any other economic research material, this thesis contains some weaknesses. Perhaps the largest weakness is the inability to measure the costs of transacting. Exchange costs are compared between the two different supply chains, but

there is no absolute measurement of transaction costs in either of the two supply chains. A survey such as the one performed by Hobbs (1997) that measured transaction costs in the UK cattle market was possible because of a larger number of producers in the supply chain and a number of different cattle marketing channels in that industry. The infancy of the Canadian flax fibre industry means that there are only three processors of flax straw commercially operating. This meant that the survey technique to measure transaction costs was not feasible. In addition, while all processors of flax straw in Canada were interviewed, the sample size remains very small. Therefore, conclusions regarding vertical coordination from such a small sample size should be treated with caution. A survey of participants in the New Zealand wool fibre industry would have been possible because of the large number of woolgrowers, wool brokers and wool exporters. However, for a comparative analysis, a case study approach to the New Zealand wool fibre industry was necessary. A survey of participants in the New Zealand wool fibre industry would have provided more information for the analysis.

6.6 Areas of Further Research

Further research that is supportive of using a framework approach in investigating supply chain coordination would be beneficial. For instance, comparing the predictions of the framework, to the predictions of only one concept of New Institutional Economics regarding supply chain coordination would be useful. Therefore, measuring the improved predictive capacity of supply chain coordination the framework approach provides would be a logical next step in this type of research.

The concepts included in the framework were tailored to provide insight into transactions along the flax fibre supply chain. Therefore, this framework may not be

highly suited for examining relationships in other supply chains. Creating a different framework that is applicable to many different industries would allow it to be widely applied. Transaction Cost Economics, for instance, is applicable across many different supply chains.

Each of the interview participants indicated that trust is an important component of business relationships. Trust is a social institution between individuals, or firms, that is generally built over time. Expansion of the framework to include concepts outside of the economics literature may be beneficial in gaining greater insight into why and how business relationships form. Another sociological aspect of transactions that may be further explored is the impact of bounded rationality of individuals in deciphering the information from the institutional environment. The bounded rationality of individuals can be further explored to gain insight into how information from institutions is received and subsequently utilized in shaping business relationships.

The slow development of the flax fibre industry can also be examined using a different approach, namely the neoclassical approach. The slow development of the industry could also be attributed to the high costs associated with production at the different stages of the supply chain. These high costs of production may stem from deficient knowledge regarding flax straw harvesting techniques, deficient technology to extract the fibre cost effectively or the unpredictability of straw quality that makes it less lucrative for processors. Therefore, research that explores the flax fibre industry costs of production as well as the benefits would provide another perspective on the slow growth of the industry.

6.7 Summary and Conclusions

This research was an attempt at developing a framework to analyze the governance of business relationships along a developing supply chain. Recent New Institutional Economics literature indicated that business relationships have to be examined through various different lenses. Four different dimensions were used to examine supply chain coordination in the flax fibre supply chain. By investigating the costliness of exchanging in the flax fibre supply chain, insights were provided regarding constraints to industry development. The costs of exchanging in the flax fibre supply chain, which is attributable to various features of the transaction, may be so high in some cases that investors are discouraged from entering the industry. One of the main sources of high exchange costs stems from an underdeveloped institutional environment that fails to reduce the uncertainty and high outcome measurement costs in exchange relationships. Further development of the industry therefore requires a quality and grading regime, as well as R&D that infuses information into exchange relationships to reduce contractual gaps stemming from uncertainty.

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APPENDICES

Appendix A1 - Industry Expert Interview Guide

University of Saskatchewan
Department of Agricultural Economics

CONFIDENTIAL
Date _____
Time _____
Location _____
Company/Role in Supply Chain _____
Contact _____

General information on business relationships and industry environment

The following questions are about the business relationships between supply chain participants.

1. What is/are currently the most common type(s) of exchange relationship between producers, processors and manufacturers in the industry? (e.g. contractual, mutual understanding, not in a committed relationship)
(P-P)_____

(P-M)_____

a. Would you consider each of them to be long-term relationship?
(P-P)_____

(P-M)_____

2. How did each of these business relationships start? (e.g which party initiated the exchange relationship)?
(P-P)_____

(P-M)_____

3. To your knowledge were there any significant obstacles either of the parties had to overcome to enter each of these business relationships?
(P-P)_____

(P-M)_____

4. Do transactions generally occur with the same buyers/suppliers over a period of time?
(P-P)_____

(P-M)_____

5. When business is conducted with the same buyers/suppliers are new contractual terms set up every time, or do the previous contractual terms generally apply?
(P-P)_____

(P-M)_____

6. What determines the frequency of each of the transactions (e.g. production, market demand, the buyer)?
(P-P)_____

(P-M)_____

7. What role does trust play in each of the business relationships in the industry?
(P-P)_____

(P-M)_____

8. In your opinion, what types of things either break trust or reinforce trust between participants in the industry.
(P-P)_____

(P-M)_____

9. How is straw/wool/fibre priced at each stage of the supply chain?
(P-P)_____

(P-M)_____

10. Are there any brokers or middlemen present in the industry? If so, what role do they play in the supply chain?
_____

_____

_____

11. How would you describe the competitive environment at each stage of the production process (e.g. competitive, few firms, only one firm)?
(P)_____

(P)_____

(M)_____

12. Who has the most bargaining power in the supply chain?

_____

a. Why does this party have more bargaining power?

_____

_____

b. What does he have bargaining power over?

_____

_____

Investments

The following questions are regarding investments that industry participants had to make in order to enter the industry. Only those investments that are specific to producing wool, straw or fibre are of interest in this section.

13. Are there any requirements of investing in specialized equipment that essentially lock the parties into a bilateral exchange relationship.

(P)_____

(P)_____

(M)_____

14. Why did producers/processors/final manufacturers locate where they did (i.e. were there any requirements by the buyer or seller to locate near to their operation)?

(P)_____

(P)_____

(M)_____

15. Did either of the parties have to invest time and resources into learning, or otherwise hire trained personnel?

(P)_____

(P)_____

(M)_____

16. To your knowledge were any parties concerned about the lock-in relationship these investments created?
(P)_____

(P)_____

(M)_____

17. Do you think that the nature of the business relationship changed because of the investments that had to be made (e.g. did the exchange relationship become more fortified through formal contracts)?
(P-P)_____

(P-M)_____

18. Do you know of cases when potential participants withheld making the necessary investments because they did not want to be in a locked-in relationship with a buyer?
(P)_____

(P)_____

Information

The following questions are about the sources of information in each of the business relationships regarding prices, contract terms, including quality specifications and the reputation of the parties.

19. Where can supply chain participants get information about current prices (e.g. industry association market reports, the buyer)?
(P)_____

(P)_____

(M)_____

20. Is there a source of information about the reputation or past performance of industry participants that everyone can access?
_____

21. What is the screening process (if there is one) to select parties to exchange with (e.g. capabilities, reputation)?
_____

_____

22. Where do industry participants get information about the specific quality specifications that their product should meet (e.g. industry associations, buyers)?
(P)_____

(P)_____

(M)_____

23. To your knowledge how have exchange agreements been affected by the lack of information about any of the above factors?
(P-P)_____

(P-M)_____

24. Are you aware of any industry associations? (e.g. market reports, list of reputable buyers/suppliers or intermediaries)?

_____

_____

a. What kind of information do they provide producers/processors/final manufacturers with?

_____

_____

Product quality level and variability

The following questions are about the level of quality of straw/wool/fibre product as well as the variability of the level of quality of the product.

25. What factors impact the level of quality of the product that are beyond the control of the participants at each stage of the supply chain?
(P)_____

(P)_____

(M)_____

26. Are there any elements in the business relationship that account for unexpected changes in quality levels? How?
(P-P)_____

(P-M)_____

27. What causes variability in the quality of straw/fibre/wool products that are beyond the control of participants?
(P)_____

(P)_____

(M)_____

28. Are there any elements in the business relationship that account for significant variability in quality (e.g. a range of quality per price point, contract with more suppliers to cover production shortfalls)?
(P-P)_____

(P-M)_____

29. Is there a quality and grading system present in the industry that all supply chain participants can make use of?

_____

30. Briefly, how are product quality measurements done at each stage of the production process?
(P-P)_____

(P-M)_____

a. Do you feel that it is useful and accurate? Why or Why not?

_____

_____

31. How have quality and grade measurements impacted the exchange relationships in the industry (e.g. made them easier to establish, compensation is mainly based on quality)?

_____

_____

32. Are there any government initiatives that have helped participants in the industry (e.g. direct financial assistance through subsidies of production, R&D programs about straw/fibre/wool, assistance in marketing)?

_____

_____

_____

33. In your opinion, how important are these types of initiatives to the continued success of the industry?

_____

34. To your knowledge, have disputes arisen between participants in the industry?

_____

_____

a. To your knowledge, have there been any disputes that had to be solved by a legal or an arbitration system?

_____

Additional Comments

35. Now that you have been exposed to some of the factors that may impact the exchange relationships in the industry, are there any factor(s) that impact supply chain relationships that have not been covered in this interview?

_____

_____

_____

_____

36. Can you identify key factors for establishing a successful for flax/wool fibre industry?

_____

_____

37. What are key constraints/challenges to the further development of the flax/wool fibre industry?

_____

_____

THE END
THANK YOU FOR YOUR PARTICIPATION!

Appendix A2 - Supply Chain Participant Interview Guide

University of Saskatchewan
Department of Agricultural Economics

CONFIDENTIAL
Date _____
Time _____
Location _____
Company/Role in Supply Chain _____
Contact _____

General information on business relationships and industry environment

The following questions are about the business relationships between you and parties at other stages of production along the flax/wool fibre supply chain.

1. Which firms do you have a business relationship with along the flax/wool fibre supply chain (excluding transportation companies but including brokers or agents)?
(P)_____

(P)_____

(M)_____

2. How would you characterize your business relationship with each of these? (e.g. contractual, mutual understanding, not in a committed relationship)
(P-P)_____

(P-M)_____

3. Were there any significant obstacles you had to overcome to enter any of these business relationships?
(P-P)_____

(P-M)_____

4. How long have you been in this business relationship?
(P-P)_____

(P-M)_____

5. What determines the frequency of each of the transactions (e.g. production, market demand, the buyer)?
(P-P)_____

(P-M)_____

6. When repeat business is done with the same party are new contractual terms set up every time, or do the previous contractual terms generally apply?
(P-P)_____

(P-M)_____

7. How did each of these business relationships start? (e.g which party initiated the exchange relationship)?
(P-P)_____

(P-M)_____

8. How important is it to have trust in your business relationship(s)?
(P-P)_____

(P-M)_____

9. In your opinion, what types of things either break trust or reinforce trust in your business relationship(s)?
(P-P)_____

(P-M)_____

10. How is your straw/wool/fibre priced?
(P)_____

(P)_____

(M)_____

11. Are there any brokers or middlemen present in the industry? If so, do you make use of brokers or middlemen?

_____

_____

a. What kind of a business relationship do you have with the broker/middleman?

_____

_____

12. How would you describe the competitive environment at each stage of the production process (e.g. competitive, few firms, only one firm)?
(P)_____

(P)_____

(M)_____

13. Who has the most bargaining power in the supply chain?
_____

a. Why does this party have more bargaining power?
_____

_____

b. What does he have bargaining power over?
_____

_____

14. Are there any government initiatives that have helped participants in the industry (e.g. direct financial assistance through subsidies of production, R&D programs about straw/fibre/wool, assistance in marketing)?
_____

_____

_____

a. In your opinion, how important are these types of initiatives to the continued success of the industry?
_____

15. To your knowledge, have disputes arisen between participants in the industry?
_____

_____

a. To your knowledge, have there been any disputes that had to be solved by a legal or an arbitration system?
_____

Investments

The following questions are regarding investments that you had to make in order to enter the industry. Only those investments that are specific to producing wool, straw or fibre are of interest in this section.

16. Is it necessary to make investments in specialized equipment to enter the business relationship and essentially locks you into a bilateral exchange relationship because it is not valuable outside of the relationship?

(P)_____

(P)_____

(M)_____

17. Why did you locate where you did?

(P)_____

(P)_____

(M)_____

18. Did you have to invest time and resources into learning, or otherwise hire trained personnel when you entered into the business relationship?

(P)_____

(P)_____

(M)_____

19. Were you concerned about the lock-in business relationship these investments created?

(P)_____

(P)_____

(M)_____

20. Do you think that the nature of the business relationship changed because of the investments you had to make (e.g. did the exchange relationship become more fortified through formal contracts)?

(P-P)_____

(P-M)_____

(Buyers only)

21. Do you know of cases when potential suppliers withheld making the necessary investments because they did not want to be in a locked-in relationship with you?
(P)_____

(P)_____

Information

The following questions are about the sources of information in each of your business relationships regarding prices, contract terms, including quality specifications and the reputation of the parties.

22. Where do you get information about current prices (e.g. industry association market reports, the buyer)?
(P)_____

(P)_____

(M)_____

23. When you first entered the business relationship, did you have any information about the reputation of the other party?
(P)_____

(P)_____

(M)_____

24. How did you screen potential parties to do business with before you entered into a business relationship?
(P)_____

(P)_____

(M)_____

25. Where do you get information about the specific quality specifications that your product should meet (e.g. industry associations, buyers)?
(P)_____

(P)_____

(M)_____

26. In your business relationships, have you ever felt that you did not have enough information about any of the above elements? If so, how did this affect your business relationship?
(P-P)_____

(P-M)_____

27. Are you aware of any flax/wool fibre industry associations? (e.g. flax council of Canada, Saskflax)?
_____

a. What kind of information do they provide you with?
_____

_____

Product quality and variability

The following questions are about the level of quality of straw/wool/fibre product as well as the variability of the level of quality of the product.

28. What factors impact the level of quality of your straw/wool/fibre that are beyond your control?
(P)_____

(P)_____

(M)_____

29. Are there any elements in business relationships with buyers/suppliers that account for unexpected changes in quality levels? What are they?
(P-P)_____

(P-M)_____

30. What causes variability in the quality of your straw/fibre/wool that are beyond your control?
(P)_____

(P)_____

(M)_____

31. Are there any elements in the business relationship with buyers/suppliers that account for significant variability in quality (e.g. a range of quality per price point, contract with more suppliers to cover production shortfalls)?
(P-P)_____

(P-M)_____

32. How is your straw/wool/fibre quality measured and graded?
(P)_____

(P)_____

(M)_____

a. Do you feel that it is useful and accurate? Why or Why not?

_____

_____

_____

Additional Comments

33. Now that you have been exposed to some of the factors that may impact your business relationships in the flax/wool fibre industry, are there any factor(s) that impact your business relationships that have not been covered in this interview?

_____

_____

_____

34. Can you identify key factors for establishing a successful flax/wool fibre industry?

_____

_____

35. What are key constraints/challenges to the further development of the flax/wool fibre industry?

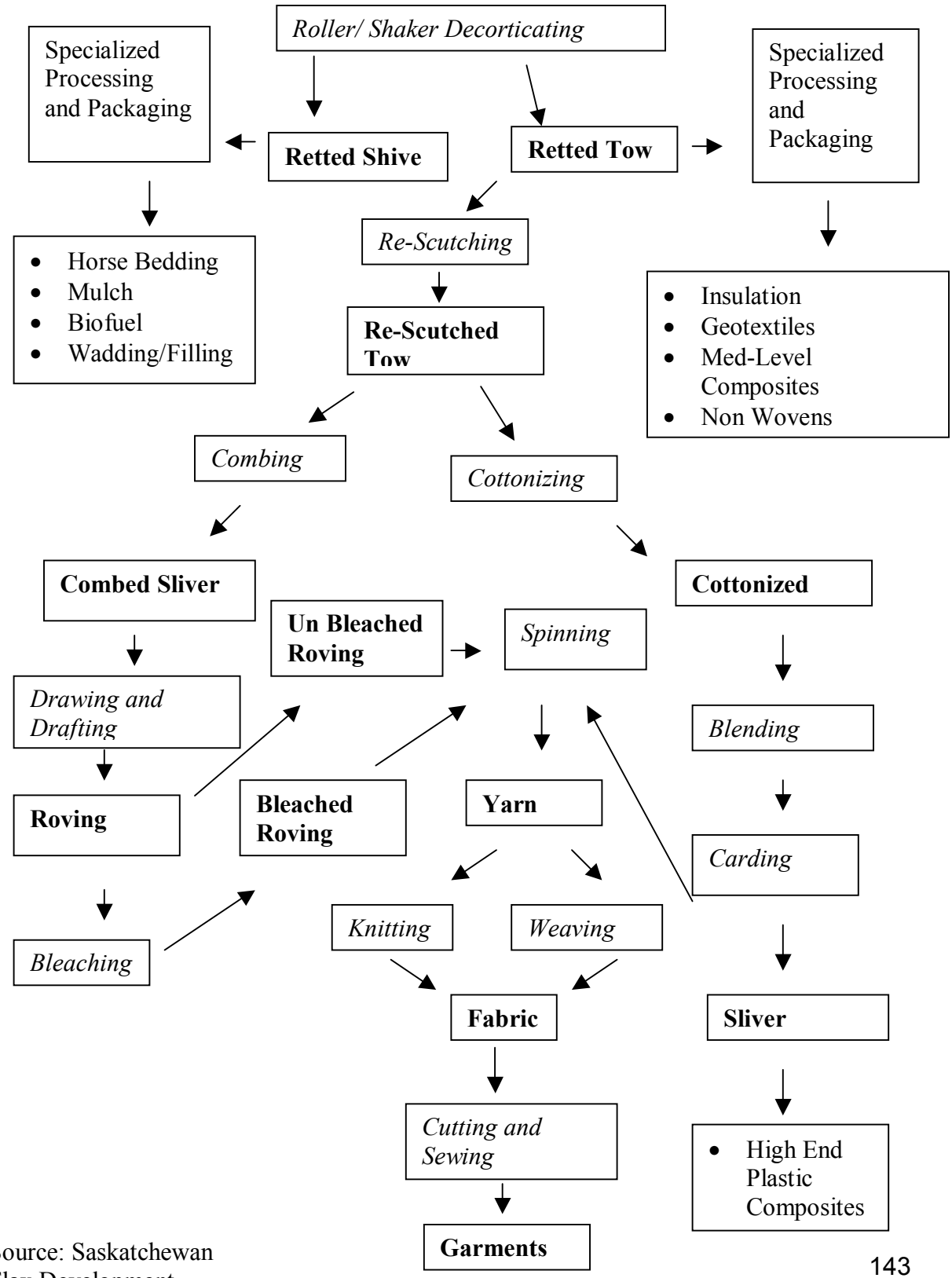
_____

_____

THE END
THANK YOU FOR YOUR PARTICIPATION!

Appendix B

Oilseed Managed Straw for Processing - Processing Flow Chart



Source: Saskatchewan Flax Development Commission 2005