Community Stakeholder Salience to the Forestry Resource Firm: A Property-Rights Game-Theoretic Analysis.

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ABSTRACT

In a world of increasing environmental awareness and activism, is it economically advantageous for a forestry resource firm to be proactive in the integration of community stakeholders' desires into the business operations? To what degree, and in what form, does the firm include the local community as a stakeholder? What are the economic consequences to the firm from taking various stances in relationship to the community and the resulting allocation of forest resources to the firm? The objective of this research is to test the hypothesis that large industrial resource companies should decentralize more of the production process to the communities which they draw the resource from as a means of sustaining their profitability within a changing sociopolitical climate of community resource ownership.

The Province of Saskatchewan and more specifically northwest Saskatchewan including the towns of Meadow Lake, Beauval, Green Lake, and north are the geographic focus of this study. This research examines the economic feasibility of decentralizing the Oriented Strand Board (OSB) feedstock manufacturing process to the remote communities where the primary resource is extracted. A game-theoretic approach is used to assess the long-run gain or cost of co-operating with the community and installing a remote stranding facility instead of hauling the unprocessed fiber to a centrally located Oriented Strand Board (OSB) plant.

There are no technical reasons for lack of implementation of remote stranding facilities in North America. Current practices relate to the economics of centralization and to the ownership/control of the resource. This research shows that the major forestry firm's long-term profitability could improve, or diminish less, with a remote stranding plant due to a stabilized wood-supply to the OSB plant. The installation of the remote strander reduces the community's incentive to seeking alternative allocation, through judicial and/or legal means, for the wood fiber that it deems to be its property.

Based on this research, the forestry resource firm needs to examine the ability of the community to process the regional wood fiber instead of the firm. The community development corporation can empower itself through the acquisition of the technical expertise and financial backing to process some of the wood fiber from the region. This would increase their bargaining credibility as a viable threat to the firm, and thus induce co-operation from the resource firm in pursuing community economic development. If they have the capabilities to follow through on alternative processing, the forestry firm should view the community as having a high salience to their long-term profitability.

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TABLE of CONTENTS

Permission to Use i
Abstract ii
Acknowledgements iv
Table of Contents vi
List of Tables viii
List of Figures x
Chapter 1: Introduction 1
    1.1 Background 1
    1.2 Problem Statement 3
    1.3 Objective 4
    1.4 Hypothesis 4
    1.5 Scope of the Study 5
    1.6 Outline of Study 6
Chapter 2: Stakeholder Theory and Resource Property Rights
    2.1 Introduction 7
    2.2 Firm/Stakeholder Co-operation 8
        2.2.1 Paradigm S as an emergent paradigm 11
        2.2.2 Reconciling the needs and aspirations of the Forest Industry and the Resource-Dependent Community 14
    2.3 Forestry Resource Property Rights 20
Chapter 3: Theoretical Considerations
    3.1 Introduction 25
    3.2 Game-Theory and Strategic Decision Making 25
    3.3 Industrial vs. Community Forestry Strategies Expressed as a Prisoner's Dilemma 28
Chapter 4: Forestry Community Development and Oriented Strand Board Manufacturing in Northwest Saskatchewan
    4.1 Introduction 32
    4.2 Historical Background of Collaborative Forestry in Northwest Saskatchewan 33
    4.3 Meadow Lake Partnership Ltd. Oriented Strand Board Plant at Meadow Lake, Saskatchewan 36
    4.4 North West Communities Wood Products Ltd. 40
Chapter 5: Application of the IF/CF PD Model to the Meadow Lake Partnership Ltd. OSB Plant
    5.1 Introduction 44
    5.2 Strategy Option A: OSB does not agree to remote stranding & NWC does not withhold the wood fiber from the region 46
    5.3 Strategy Option B: OSB agrees to remote stranding at Beauval Forks & NWC does not withhold the wood fiber

from the region 50
5.4 Strategy Option C: OSB agrees to remote stranding & NWC withholds wood fiber from the region 60
5.5 Strategy Option D: OSB does not agree to remote stranding & NWC withholds wood fiber from the region 63
5.6 NPV derivations of ten-year payoffs from Strategy options A-D 64
Chapter 6: Results
6.1 Introduction 68
6.2 Baseline Results 69
6.3 Sensitivity Analysis 71
6.3.1 Change in NWC aspen fiber withholding 72
6.3.2 Change in the amount NWC is paid for spruce residues 74
6.3.3 Change in profit that the OSB plant achieves on input fiber 75
6.3.4 Change in the Bulk Density of Wet Strands 78
6.3.5 Change in NWC Cashflow Levels from Withheld Wood fiber 82
6.4 Summary of the Results 83
Chapter 7: Conclusions
7.1 Introduction 85
7.2 Summary of Conclusions 86
7.3 Limitations of the Study and Recommendations for Further Research 91
Works Cited 93
Appendix 98

List of Tables

Table 2-1: Comparison of Industrial and Symbiotic paradigms.............................. 9

Table 2-2: Degree of citizen integration into the firm.. 12

Table 2-3: Industrial Forestry, Localized Forestry, Collaborative Forestry Social Instruments.. 19

Table 5-1: Income from NWC sales of spruce residuals to the ML OSB plant 49

Table 5-2: Strategy B annual payoffs.. 50

Table 5-3 Dividend payout to NWC from trucking of remote produced strands 51

Table 5-4: Transportation Costs of Remotely Processed Wet Strands w/ BD of 317 kgs/m^3: Roundwood hauling 56

Table 5-5: Transportation Costs of Remotely Processed Strands w/ BD of 317 kgs/m^3: Wet strand hauling.. 57

Table 5-6 Proforma Income Statement: Remote stranding plant........................... 58

Table 5-7: Strategy C annual payoffs 60

Table 5-8: Strategy D annual payoffs.. 63

Table 5-9: NPV payoffs (Year 1-10) Strategy A & B.. 65

Table 5-10: NPV payoffs (Year 1-10) Strategy C & D 66

Table 6-1: NPV payoffs (Years 1-10) Strategy A & B Summary 69

Table 6-2: NPV payoffs (Years 1-10) Strategy C & D Summary 70

Table 6-3: Baseline Game ($ millions) 71

Table 6-4: Strategies for NWC aspen fiber withholding 72

Table 6-5: 0% NWC aspen fiber withholding; payoffs; ($ millions) 73

Table 6-6: 100% NWC aspen fiber withholding; ($ millions)................................ 73

Table 6-7: Strategies for NWC spruce residual payment 75

Table 6-8: -$4.00 NWC payment for its spruce residuals; ($ millions) 75

Table 6-9: Strategies for OSB profit per input tonne... 76

Table 6-10: $22.22 OSB profit per input tonne ($ millions) 76

Table 6-11: $11.11 OSB profit per input tonne ($ millions...................................... 77

Table 6-12: $26.44 OSB profit per input tonne ($ millions) 77

Table 6-13: Transportation Costs of Remotely Processed Wet Strands w/ BD of 190 kgs/m^3 79

Table 6-14: Transportation Costs of Remotely Processed Wet Strands w/ BD of 190 kgs/m^3 continued 80

Table 6-15: $24.19/tonne Wet Strand shipping expense; ($ millions) 81

Table 6-16: $21.18/tonne Wet Strand shipping expense; ($ millions) 82

Table 6-17: Strategies for NWC Cashflows per M^3 roundwood withheld 82

Table 6-18: -$22.60 NWC Cashflows per M^3 roundwood withheld ($ millions) 83

Table A-1: General model assumptions for payoff calculations 98

Table A-2: NWC assumptions for payoff calculations 98-100

Table A-3: Tolko assumptions for payoff calculations 101

Table A-3: Proforma Income Statement: remote stranding plant 102

Table A-4: Assumptions: remote strander income statement 103

Table A-5: NWC income statement for spruce slabs 104

Table A-6: NWC Chipper Cashflows 105

Table A-7: 50% NWC aspen fiber withholding; ($ millions) 106

Table A-8: 75% NWC aspen fiber withholding; ($ millions) 106

Table A-9: -$4.00 NWC payment for its spruce residuals; ($ millions) 106

Table A-10: $15.31 NWC payment for its spruce residuals; ($ millions) 107

Table A-11: ($6.92 NWC Cashflows per M^3 roundwood withheld ($ millions) 107

Table A-12: ($3.46 NWC Cashflows per M^3 roundwood withheld ($ millions) 107

List of Figures

Figure 2-1: Reconciling ones concerns with other's 13
Figure 3-1: The Prisoner's Dilemma game 26
Figure 3-2: The Community and the Forestry Firm Actions under PD 30
Figure 4-1: Map of Tolko's Operations 37

Chapter 1

Introduction

1.1 Background

The current rate of global forest industrialization is unprecedented in history (Marchak, 1995; May, 1998). Because of this forest industrialization, the forestry-based communities are undergoing tremendous pressures to redefine where and how they are contributing to society. Many forestry communities have doubts about the current model of development (Hettne, 1990), realizing that the benefits accruing to the community from the fiber usage by the forestry firm are often more than offset by the decline in total forest value (Hawken et al, 1999). For the community to continue supporting harvest of the forests, it needs to receive a fair return on what it considers its property. Without this, the community may attempt to redefine local property rights over the forestry resource deeded by provincial legislative action to the external forestry corporation (Alcorn and Toledo, 1998).

The resource extraction industries of forestry, mining, fishing, oil and gas are at the core of the Canadian economy. These industries have been scrutinized for their lack of sustainable management of the ecosystem and lack of contribution to the resource-based community (Copeland, 1999; Marchak, 1995). How do they interact and co-operate with these communities, enabling the firm to continue to profit from the resource and, at the same time, providing the economic and social returns that the communities require (Urquhart, 2001)?

This research examined the relationship between a multi-community northern development corporation and a forestry firm, and is modeled after North West Communities Wood Products Ltd. (NWC), and Tolko Forest Industries Ltd. (Tolko). The latter organization is a privately held Canadian forestry products company headquartered in Vernon, British Columbia. This research focuses on the situation of Tolko Forest Industries Ltd. and North West Community Wood Products Ltd. for illustrative purposes and concreteness. The data used to derive the financial assumptions of the parties is based on the author's previous work as a community development consultant, and were not provided by Tolko. The result is that the financial assumptions and the resulting player's payoffs are specific to their geographic location, but are generic to the industry, not one particular firm's operations. The research is a synthetic exercise that does not to precisely mirror the financial operations of these firms.

NWC has proposed to Tolko that a remote stranding facility be placed in one of the member communities to process wood fiber from the region and waste from NWC's aspen and spruce sawmill. In this thesis, a game-theoretic approach is used to assess the long-run gain or cost to Tolko for co-operating with NWC and installing the remote stranding facility instead of hauling the fiber to the Oriented Strand Board (OSB) plant in Meadow Lake, Saskatchewan.

1.2 Problem Statement

In a world of increasing environmental awareness and activism, is it economically advantageous for the forestry resource firm to be proactive in the integration of community stakeholders' desires in the business operations? To what degree, and in what form, does the firm include the local community as a stakeholder? What are the economic consequences to the firm from taking various stances in relationship to the community and the resulting allocation of resources to the firm?

It was Friedman's (1970) assertion that a firm's responsibility is solely to the shareholder in terms of maximizing profits. Social concern, beyond the regulatory minimum, detracts from the profit of the firm and hence is not being responsible to the shareholder. For industries or businesses, maximizing the short-term economic gains is the action of choice. The perceived benefits of collaboration relative to the costs of relinquishing power and/or control by management are not deemed worthwhile. Hart (1996); Sharma and Vredenburg (1998); and Russo and Fouts (1997) find that there is an advantage to the firm in pursuing proactive strategies towards the environment and stakeholders. In Perlmutter and Trist's (1986) vernacular, the firm needs to effect an organizational paradigm shift from an Industrial Paradigm (Paradigm I) to Symbiotic Paradigm (Paradigm S).

With forestry resource communities seeking increased property rights to the wood fiber itself, and the resulting economic benefits derived from the surrounding forests, the firm has to decide how to arrive at an advantageous solution for itself. Forestry firms need to assess potential payoffs for co-operating or not co-operating with the community(ies) in their economic development aspirations when faced with the potential of losing 10%, 20% or more of their annual resource allocation from a region through community action.

1.3 Objective

This research examined the decentralizing of the Oriented Strand Board (OSB) feedstock manufacturing process to the remote community where the resource is being extracted. The objective of this research is to test the hypothesis that large industrial resource companies should decentralize more of the production process to the communities from which they draw the resource as a means of sustaining their profitability within a changing sociopolitical climate of community resource ownership. The property-rights game-theoretic model was applied to the concrete example of NWC and Tolko and the possible installation of a remote stranding facility by the parties.

1.4 Hypothesis

Based on the above objective, the hypothesis was delineated that tests the economic profitability to the firm of developing community-based remote processing.

> *Hypothesis: By Meadow Lake Partnership OSB Ltd. vertically de-integrating, i.e. outsourcing its processing services, there will be a long-term improvement in*

their Meadow Lake OSB plant's profitability due to a secure and increased feedstock for the plant, as measured by NPV over a 10 year planning horizon;

It is believed that major resource firm's long-term profitability will improve due to co-operating with the community in the development of its local economy. The installation of the remote strander reduces the community incentive for seeking alternative allocation for the wood fiber that it deems to be its property through judicial and/or legal means.

1.5 Scope of the Study

The Province of Saskatchewan, and more specifically, northwest Saskatchewan including the towns of Meadow Lake, Beauval, and Canoe Narrows are the geographic focus of this study. The study examines the interaction and investments of North West Communities Wood Products Ltd. (NWC), representing a multi-community development organization, and Tolko Industries Ltd., representing a forest industry firm.

Tolko is building an OSB plant near Meadow Lake, Saskatchewan. The case study examines the decentralizing of the first stage of the processing in the production of Oriented Strand Board. The technical feasibility of remote stranding was examined first to ensure that this is not a limitation to the adaptation of remote stranding for supplying feedstock to the OSB plant. An economic analysis followed, using a "Game-Theoretic Prisoner's Dilemma" framework to assess the long-term (10 year) economic payoffs to Tolko and NWC by building a remote strander operation in Beauval, SK as compared with the potential for timber loss through fiber withholding by NWC if the plant is not built. The firm assesses when it would be beneficial to their profitability to build the remote processing facilities based on the community's perceived ability to change the economic property-rights ownership level from the present conditions of 100% firm control.

1.6 Outline of Study

Chapter Two contains a review of stakeholder-firm co-operation, and the issue of economic property-rights. Chapter Three explores game-theory's application to strategic decision-making and develops the conceptual framework with the use of the Prisoner's Dilemma game. Chapter Four delineates the players in the game and the historical context of forestry firm and community collaboration in northwest Saskatchewan. Chapter Five applies the model to NWC and the Tolko OSB plant, located in Meadow Lake, SK. Chapter Six tests whether it is in the long-term interest of the firm to co-operate with the community and decentralize some of its operations, and under what conditions the community and the firm should co-operate and reports the results. Finally, Chapter Seven summarizes the results of the research, discusses the implications and suggests further areas of research.

Chapter 2

Stakeholder Theory and Resource Property Rights

2.1 Introduction

The nature of a forestry-based community and where it fits into the modern forest resource economy has become one of the major political and social issues of rural Canada. How do we bring sustainability to the forestry community? As Beckley states:

> Human dependence upon the forests, whether at the individual, household, community, or regional level, is a multifaceted phenomenon. This is due to the fact, that forests provide a diverse stream of benefits to humans. Forests, or their component parts, provide timber and non-timber commodities, recreational experiences, and sustenance to active forest users. Passive forest users of forest-individuals who attach cultural value to forests-also derive both economic and non-economic benefit from the existence of forests (Beckley, 1998b).

There are changing relationships between the institutions of government, the community, and the forestry firm. These relationships are changing based on:

- Governments increasingly having the firm manage the resource (Natural Resource Canada, 1999);
- The rise in co-management of the resource by the stakeholders (Beckley and Korber, 1996);
- The increased environmental awareness on the part of society and the effect of humanity on the forest (Canadian Council of Forest Ministers, 2000);
- The recognition of the aboriginal/northern community's rights to manage the forestry resource through co-management (Anderson, 1995);
- Communities redefining their goals for development so that they can be sustainable (Copeland, 1999).

The industrial forestry sector looks toward new technology, least cost production, and centralized decision making as the key to the forest sector's sustainability. This *productivist* paradigm is counter to community's needs, profits are exported away from their source, the forest ecosystems are left exhausted, the forest value is seen only as a sum of the trees, and eventually the community is left with no natural or social capital or forest equity (Malenfant, 1997).

2.2 Firm/Stakeholder Co-operation

Perlmutter and Trist (1986) view the players of the world economy as operating in one of three paradigms; Paradigm I (Industrial), Paradigm D (Deindustrial) or Paradigm S (Symbiotic). The societal actions/reactions, as they defined them under the Industrial Paradigm and the Symbiotic Paradigm, are compared and contrasted below (Table 2-1). Under the Industrial Paradigm, society is driven down a path of increasing technology, short-term environmental planning, a me-first competitive stance, and the centralization of benefits. This is non-sustainable from a long-term environmental, economic, and social perspective (Norgaard, 1992).

Social Institutions	*Paradigm I(ndustrial)*	*Paradigm S(ymbiotic)*
Economy	Worldwide free market premised on continuous (blind) growth	World, regional, national and local markets, free and regulated; integration of formal and informal economies; selective managed growth
Corporation	Dominance of large-scale, high-technology firms, bureaucratically organized whether ownership private or public. Trans-Nationals encouraged	All types and scales as appropriate; small-in-large, organizational democracy
Individual	Individualism win-lose, he oriented, having oriented, privatized	Balance of co-operation and competition, "individuation", socially responsible individuality, being-having orientation
Technological Choice	Technological imperative, high technology preferred, nonrenewable resources favored, environment neglected	Limits of systems including the ecological and the use of increased/higher technology to bring increased well-being becomes a guiding principle

Table 2-1: Comparison of Industrial and Symbiotic paradigms (adapted from Perlmutter and Trist (1986:3-8))

Economic literature cites the profit motive, return on equity, and satisfaction of its shareholders as the only goals that should concern a business organization. All activities of the firm are to support this objective while humanistic and ecological issues should be addressed through government policy (Friedman, 1970). Companies operating under the "Industrial" paradigm are:

> in business to produce goods and services and to make money for their owners; everything else [is] seen as a distraction at best, a threat to corporate survival at worst. Ideas such as workplace diversity, community involvement, employee empowerment, work-family balance, and environmental stewardship [are] dismissed by executives as amorphous, feel-good concepts with little or no relevance to the business at hand (Makower, 1994:10).

Paradigm I is what we see represented in the commercial industrial growth society. The firm is an individualistic element of the community, not a core component of the community that has an equal power position with the other stakeholders of the community. Traditionally, the business organization has needs that are asymmetrical to the needs of the employee and society in general.

> Paradigm I is based on premises, values, and modes of interaction that make dominance and dependency a central preoccupation in societal and inter-societal relations. Preoccupation with dominance leads to expansion, accumulation of resources, the maintenance of order through hierarchy, and the tight control of subordinates inside and outside the organization (Perlmutter and Trist, 1986:3).

The business organization is seen as a discreet entity, its interactions with the surrounding environment being the result of threats and opportunities. Egocentric organizations that tend to become *preoccupied with and to over emphasize the importance of themselves, while underplaying the significance of the wider system of relationships in which they exist* are the operating norm (Morgan, 1986:243). Self-referencing, to the exclusion of the other stakeholders' needs, leads to development of important tensions.

These tensions give rise to conflict with the external stakeholders, and to antagonism, disharmony, and a turbulent environment for the business organization to operate within (Trist, 1979). Without managing the demands being placed on it, and adapting to the demands of the environment surrounding it through co-operation and collaboration, the firm will lose its position as a player (Trist, 1979).

2.2.1 Paradigm S as an emergent paradigm

Rather than continuing to operate in an increasingly hostile and crisis-ridden environment, the firm can search for a new paradigm to operate under. The goal of the new operating paradigm is to create a harmonious environment with the stakeholders, with the development of trust, an absolute prerequisite for effective co-operation (Spencer, 1997). Through the act of seeking collaboration, this trust relationship is built. Ouchi, in applying Dirkheim's perspective on co-operation, believes *that trust increases economic efficiency, that is transaction costs*[1] *associated with an exchange will be much less if the parties trust each other* (Maitland, Bryson, and Van de Ven, 1976:63). The commitment to a win-win partnership and excellent channels of communications are also required for the success of the partnership.

The Symbiotic Paradigm will position the firm so that it will fit into society's future needs; a humanist, collective, integrative vision. The symbiotic paradigm does not exclude the characteristics of Paradigm I, but repositions them into a changed and broader context. There is acknowledgment of the value of a two-way relationship of interdependence. *Dominance and dependency are replaced by a*

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[1] Transaction costs are *the negotiating, monitoring, and enforcement costs that have to be borne to allow an exchange between two parties to take place.* (Jones and Hill, 1988:160). Williamson defines them as any costs necessarily incidental to a transaction or series of transactions that are incurred above and beyond the cost of production. These costs are principally associated with trying to guard against opportunism (Williamson, 1975). He later defines transaction costs as those costs involving the planning, adapting, and modifying of contracts and administrative costs (1985).

balance of interdependence and independence (Perlmutter and Trist, 1986:19). Paradigm S is a process rather than a fixed state, where there is a collective vision, with the philosophy based on the logic of co-operation, instead of individualistic goal driven industrial and bureaucratic paradigms (Craig, 1989). In Arnstein's (1969) ordering of citizen's participation, society will have moved from "non-participation", which includes manipulation as a mode of operation by the business firm, to an arena that encompasses consultation, placation, partnership, and delegated power by the firm towards the public. Conflict resolution literature argues that the participation process diffuses tensions and emerging crisis's (Buchy and Hoverman, 2000).

Degree of citizen power	8	Citizen control
	7	Delegated power
Degree of Tokenism	6	Partnerships
	5	Placation
	4	Consultation
	3	Informing
Non-participation	2	Therapy
	1	Manipulation

Table 2-2: Degree of citizen integration into the firm (Arnstein, 1969)

Under Paradigm S, the business operations paradigm that seeks convergence in their interaction with the community, rather than divergence, is desirable.

These models of interaction are framed around co-operation and collaboration. They can take the form of: networks; strategic alliances; joint-ventures; co-operatives; co-management boards; and co-operative entrepreneurships (Morrison, 1991).

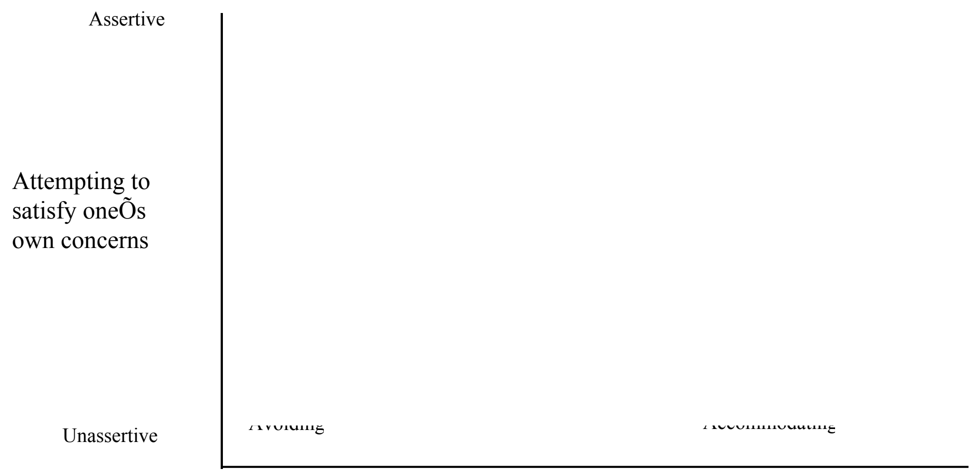

Figure 2-1: Reconciling ones concerns with other's (Morgan, 1986:192)

Organizational networking is a form of social interaction, taking the form of an informal mutual aid relationship or being as formal as co-determination. The latter, as defined by Morgan, is *the form of rule where opposing parties combine in the joint management of mutual interests, as in coalition government or corpratism, each party drawning on a specific powerbase* (1986:145). Networking is seen as necessary to keep abreast with the market, technology and needs of the customer (Peters, 1992). The network's capability is its ability to bring knowledge to the situation at hand quickly. Alliances are seen as a way of operating in an interconnected world.

Grey (1989) explores "what is collectively good", and how can the organization satisfy its own interests within this context? Collaboration is:

> a process through which parties who see different aspects of a problem can constructively explore their differences and search for solutions that go beyond their own limited vision of what is possible. The objective of collaboration is to create a richer, more comprehensive appreciation of the problem among the stakeholders than any one of them could construct alone (5).

The collaborative model gives the community the forum to reaffirm themselves as community in the face of adversity. A shared stewardship becomes the *means for organizing across organizations to manage interdependence* (Grey, 1989:270). Joint gains instead of individual gains become the objective. Wilkinson (1996) stressed that without a change in consciousness and the development of support structures, the community will be unable to change its paradigm readily. Craig (1989) develops a similar argument from the organizational perspective, the firm needing to adopt a collaborative paradigm of operations if it is to be able to respond readily to a changing landscape.

2.2.2 Reconciling the needs and aspirations of the Forest Industry and Resource-Dependent Community

Community can be defined based on three elements: location, social system, and a common identity (Flora, 1992). Community offers a sense of identity, a set of social institutions, and a place. Beckley (1998a) defines the debate of the definition of the rural community as one of an interest focus versus one of a geographic focus. The community is seen as having “a shared set of interests and institutional affiliations” or “a common geographical context or a combination of both.” The forestry community that is seeking co-management and utilization of the region’s forestry resource locally is a stakeholder community of geography due to the location of the town and it’s resources and also a community of common identity framed around it’s interests of improved economic betterment for the region’s citizens. There is a unification of vision for the geographic community. With this unification of a vision of local control of the forestry resource, other geographic communities can join into this community, creating a community clustering that increases the presence and political sway of this stakeholder group. In British Columbia, over forty communities have formed a coalition or community of identity that is seeking increased geographic community resource management from the provincial forest management authorities (Copeland, 1999).

Communities have a desire to prosper. They increasingly view the resources that they are endowed with as a source of economic capital to aid in their prosperity. As community stakeholders acquire greater influence in the management of the resource, the firm’s managers have to give greater credence to the community. Trust, loyalty, norms, and networks are elements of co-operative behavior and influences management’s relationship to the community leaders (Wall et al, 1998). With trust and a strong network between communities of the region and with the firm, there is an increased tendency to take into account the community's needs and desires in terms of forest planning, local hiring, and direct community investment process.

To what degree and in what form does the firm include the resource community as a stakeholder/partner? What are the economic effects experienced by the firm from taking various stances in relationship to the community? To fully anticipate the effect of the community on the allocation of the resources, the firm needs to examine the current and future:

- Perceived empowerment of the community;
- Social profits[2] distributed to the community;
- Relationships between the government as a regulator and the community;
- Rise in community demands for return of ownership rights; and
- Weakening of corporate ownership of the resource through legislation.

Its resource endowment forms the basis or foundation for the firm's existence and the source of its profit. This endowment of Crown assets is delineated by Provincial legislative action. The regulatory body has the final say in the allocation unless the community takes direct action. If there is a perception that the firm is decreasing the capital[3] of the region, then regulatory actions are taken

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[2] The term social profit includes a broader range of benefits to the community than just economic profit. There are social, economic, and ecological dimensions.

[3] Bourdieu defines various forms of capital as:

that could include fines and/or loss of fiber allocation. From this framework, management can assess whether the community(ies) can add or subtract from their long-term profits. The salience of the community stakeholders to the firm is dependent on their power to sway government resource or property-rights allocation, the ability of the community to take direct action to limit the resource from leaving the region, the needs of the firm for a local labour pool, and general corporate policy.

The question remains how to implement this model, and which organizational paradigm could best serve the needs of the community and the forestry firm. For this research, the original Trist delineations were adapted and applied to the forestry sector and defined, respectively, as Industrial Forestry (IF), Localized-Forestry (LF), and Collaborative-Forestry (CF or SF) (Table 2-3).

Under the Symbiotic paradigm, communities and forestry firms are looking for a common solution, with the company treating the community as a

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> "[C]apital can present itself in three fundamental guises: as economic capital, which is immediately convertible into money and may be institutionalized in the form of property rights; as cultural capital, which is convertible, on certain conditions, into economic capital and may be institutionalized in the form of educational qualifications; and as social capital, made up of social obligations ('connections'), which is convertible, in certain conditions, into economic capital and may be institutionalized in the form of title of nobility" (1986:243).

Hawken (1999) includes ecological or natural capital in the broader definitions of capital.

partner/stakeholder, assisting them in their own development and sustainability with neither player dominating the outcomes to strictly suit their own individual interests. Collaborative-Forestry seeks to maximize benefits to the firm and community and acknowledges that they are interlinked. For the community to become part of this paradigm, they need to be included as stakeholders in the decision processes. For the community to overcome resistance to their inclusion into the economic development available from the area's resources, they have two mechanisms available; the acquiring and enforcement of property rights to the wood fiber or the adoption of co-management/utilization of the resource. They gain access to the resource through enforcement against the industrial property rights holder or active participation with the industrial partner. Enforcement of access is usually a political process, either via direct action or with government acting as intermediaries (Beckley and Korber, 1996). The firm is forced to the negotiating table, where the outcome is perceived to be one of competition or possibly compromise. There is still a win - lose philosophy on the part of the representatives of the firm. As an alternative, the forestry firm can co-operate.

Social Institutions	*Industrial Forestry*	*Localized Forestry*	*Collaborative Forestry*
"Rationality" of system	Private economic (Malenfant, 1997); win-lose	"Eco-centric"; localized to the exclusion of the outside	Multiple objective - social economic with limits on the system by eco-system requirements; consensual (Story and Lickers,1997)
Government	In lockstep with industry's "needs"(Malenfant, 1997)	Government as a non-legitimate partner, with no rights	Government as a decentralized partner, system policy maker
Technology	High technology with the goal to minimize labour costs and disruptions	Low to intermediate technologies with the goal to distance themselves from the "capitalist" system	Use of high technology to minimize ecological impact, provide safe, high value jobs, and lower cost timber for industry
Economic system objective	Maximum profits for the firm	Minimal capital; disconnection from the system; philosophical survival;	Maximum benefits for society and local communities
Eco-system objective	Primacy of the anthropocentric	Primacy of the perceived eco-system needs over anthro-centric needs; humans are not considered part of the ecosystem	Anthropocentric needs as a component of the eco-systems survival
Sustainability economically socially environmentally	Nonsustainable to the local community and the ecosystem (Bernard and Young, 1997)	Ecologically sustainable; socially if economic needs are minimal; eliminates industry from the picture	Sustainable through the balancing of the needs of labour, the mill, community use of the forest, and the ecosystem

Table 2-3: Industrial Forestry, Localized Forestry, Collaborative Forestry - Social Institutional Relationship

2.3 Forestry Resource Property Rights

The ability to consume directly or convert the forest resources into products implies rights to the resource. Property rights specify how benefits and harms are designated to persons or are externalized[4] to others, and who must pay whom to modify the actions made by affected parties (Mitchell and Carson, 1986). Barzel defines economic property rights as the individual's ability to directly control the consumption of the services of an asset, or to consume it indirectly through exchange (1997:90). Legal rights are what the government delineates and enforces as a person's economic property. Legal ownership is a means to internalize the economic benefits from the resource.

In Canada, forests are generally in state ownership[5] (de jure rights). Canadian Crown timber leases, as a form of forestry resource tenure, have been in force since the middle of the 19th century. There is a transfer of only subsets of rights – the firm gets the right to the wood fiber in return for payment of royalties and/or ground rents, plus the requirement of some degree of forest

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[4] Externalities occur where there is a discrepancy between the private marginal product and the social cost(s) from an economic activity (Conybeare, 1980). A classic case of this would be the pollution to a river eco-system by improper logging practices. The forestry company and the loggers are not directly affected, but gain from their activity, while the fish, other wildlife, fishermen, downstream residents, etc. are all affected negatively.

[5] Of a total forested area of 471.6 million ha, only 6% or 25.1 million ha is in private or industrial woodlots (Natural Resource Canada, 1999). The majority of the private woodlot ownership is in Quebec and New Brunswick.

management. Crown forest tenures vary from province to province, but share a number of common traits. These are:

- There is generally the conference of exclusive rights to the wood fiber, without the granted rights being comprehensive;
- The allotments are either volume or land area based;
- The duration of the tenures are limited or fixed, with time periods of one to five years being the norm for smaller operators, to twenty to twenty-five years for the larger industrial players. There is often a renewal clause in the contract, where the a window of renewal opens every five years, with the contract then being extended for another full term with the accepting of the new requirements (Natural Resource Canada, 1999).

These tenure systems are economic contracts created by the Government, conferring economic rights and timber management responsibilities for the wood fiber to other parties. This is a means for the Government to increase the net gains from the forests through the division of commodity ownership (Barzel, 1997). The production objective guides the government in its assignment of rights to the forest. (Laarman, 1995) In Canada, this objective has been embodied through economic development and the industrial development of the forestry. Forests provide a source of new jobs, raising the national income, but they also impose social, environmental, and political costs on a country (Laarman, 1995).

Present Saskatchewan forest tenure licenses assign the Crown rights to the wood fiber to the forestry firm in return for stumpage payments. The local community does not have a direct say in the management of the forest and receives none of the stumpage payments. Effectively, the Government has converted a community's forestry commons to a Government property, which then preempts the local community from reasserting their right to the wood fiber. Due to the perceived disparity in allocation of benefits derived from the resource, the community becomes concerned about economic rights and governance over the resource. Economic property rights of tangible and intangible resources, and the resulting conversion into economic capital by the firm becomes the focus of the community/firm interaction.

Coase (1960) suggests that, absent transaction costs, the distribution of property rights is non-consequential to economic efficiency. The wealth distribution may not be socially optimal, but is economically efficient. The Pigovian[6] solution to the creation of externalities or an imperfect distribution of cost and benefits from the resource is to use government action, i.e. taxes, to rebalance the situation. The problem with this solution is that the community does not directly have access to the taxes except in the form of social services. In northern single-resource communities, forestry resources are the only means of improving their economic well-being. To affect a shift in the firm's operating paradigm from I to S, within a world that continues to operate under Paradigm I, the community has to acquire the property rights to the wood fiber that the firm now holds.

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[6] Pigou suggested that the role for governments is to efficiently allocate resources by inducing private actors to internalize externalities through taxation, i.e. making the producer of externalities liable for the harmful effects. (Conybeare, 1980)

At the international level, there has been a call for a more local ownership and management to provide for sustainable communities and reduce impoverishment (United Nations, 1992). The community has to take actions to reassert their legal property rights to local resources as a response to the perceived inequitable distribution of economic property rights and the resulting lack of wealth generation for the community. These actions could take the form of:

- Legal action against the state and the firm to change the resource property rights allocation or resource tenure between the state and the firm; or
- Civil disobedience to block access to or withhold resources from the firm, forcing them to share the economic wealth generated by the resource with the community.

The community moves to withhold the fiber supply, get the property rights reassigned, and seek alternative uses for the wood fiber that yield greater returns on their equity.

As an alternative, the firm and the community can choose active participation as their collaborative or co-operative operating system. The firm and the community would partner in sharing the wealth generated from the resource. The firm is still assertive in regards to its concerns, but it views the community's desires as valid and mutual satisfaction as the objective. The outcome of this co-operation is a forestry firm that now includes in its operating paradigm:

- Mechanisms for stakeholder interaction;
- Property rights to the wood fiber that is not readily challenged;

- Sharing of the decision process;
- Maximization of local profits;
- Meeting the needs of the local people and the forestry firm; and
- Sustaining the social fabric.

The community is transformed from one of dependence to a community of stakeholders. With this paradigm shift from an Industrial logic, that favors exchange value, to a Collaborative Forestry paradigm, that favors quality of life, the community becomes an active participant, redefining the structures that affect it (Copeland, 1999). The major forestry firm will experience benefits by operating in a more harmonious, less turbulent, environment. The forestry tenure is still held by the firm, but the community that the resource is being drawn from derives a return on its fair share of the forest equity.

Chapter 3

Theoretical Considerations

3.1 Introduction

Chapter 3 addresses the use of game-theory to assess strategic decision making on the part of the firm and the community. Section 3.2 defines the Prisoner's Dilemma (PD) game. The PD game will be used to assess the results of actions and the resulting responses between the community and forestry firm to adopting a co-operative or non-co-operative stance with each other. Section 3.3 defines the Resource-constraint model in broad theoretic terms, with the model being implemented into a non-co-operative PD game in Section 3.4.

3.2 Game-Theory and Strategic decision making

Game-theory is concerned with decision-making. It provides a structure for the *description of conscious, goal-oriented decision-making processes involving one or more individuals* (Shubik, 1972:37). Bacharach defines a game as having four elements:

- A well-defined set of possible strategies for each player;
- Well-defined preferences of each player among possible outcomes of the game;
- The player's outcome is interdependent on the other player's course of action in the game;
- All players have full knowledge of the strategies and expected payoffs (1977).

Games are either non-co-operative or co-operative. The co-operative game is defined as a game where the players have the ability to communicate and negotiate an enforceable contract. In the non-co-operative game, players can or cannot communicate depending on the rule-set, but there is no enforceability of the contract. In all games, whether co-operative or non-co-operative, there is interdependence between the players. It is through this interdependence that organizational strategies should be understood as rational actions between parties (Aram, 1989).

The Prisoner's Dilemma (PD) game models a non-zero-sum game[7] between two players with two strategies per player. It applies to *enterprise-constituent relations in which parties are organized and active, the long-term ability of each group to attain its goals depends on the survival and success of the other and the most desirable outcomes for* {each of} *the interdependent parties in an immediate situation are incompatible* (Aram, 1989:268).

Prisoner's Dilemma Game		Player B	
		Silent	Defect
Player A	Silent	(3,3)	(0,5)
	Defect	(5,0)	(1,1)

Figure 3-1: The Prisoner's Dilemma game (Camerer, 1991)

[7] Zero-sum refers to games of pure opposition, where the winning player acquires the entire payoff, with the other player losing an equal amount (Shubik, 1972). A Non-Zero-Sum game gives each player various degrees of payoff, with the resulting bundle not equaling zero. By their nature, the goals of the players in a non-zero-sum game are not necessarily directly opposed and there is no longer a clear conflict of interest.

The non-co-operative or traditional PD game, models a single iteration game, with each player aware of the others possible strategies and payoffs. They move simultaneously. Because of the non-iterative/repetitive nature of the game, there is no feedback loop to the other player to develop trust in the other player's choice and enforce a contract between them. The players are non-trusting and are seeking the best outcome for themselves exclusive of the other party's welfare. It demonstrates the consequences of non-co-operative behavior between two parties, and illustrates the importance of trust in relationships (Aram, 1989).

The players can choose to keep silent or defect, without coalition building or information transfer between the players (Table 3-1). Player A can be "Silent", resulting in the best play of "Defect" by Player B to maximize his immediate self-gain[8], yielding a payoff pair of (0,5). If the player chooses to "Defect", the other player's best choice is still to "Defect", therefore "Defect" dominates the game. However, when both players pursue this logic, they are both worse off than if they had maintained their silence (payoff=(1,1) instead of (3,3)), yielding the Nash equilibrium or outcome for a non-co-operative game (Shubik, 1972; Camerer, 1997). This leads to a sub-optimal solution or a Pareto-inefficient state (Binmore, 1994).

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[8] Shubik defines the difference between individual and social rationality to be: *individual rationality calls for the individual to refuse to take less than he can get by himself. Societal rationality suggests that the group as a whole should always be efficient regardless of how it divides [the] total product among participants* (1972:50)

If the rules of the PD game are relaxed and allow communication, and more importantly enforceable co-operation, the payoffs can improve. There is a reduction or elimination of uncertainty in the play or action of the other player, and hence the players move from the defensive solution to one of mutual maximization. Under a co-operative game, with the players choosing a course of action, and the resulting payoff pair together, there is a Pareto-improvement (Bacharach, 1977; Binmore, 1994). In the game illustrated above (Figure 3-1), there is a unique solution of co-operate:co-operate -> (3,3). In order to advance their own individual interests, accommodation and coordinated behavior, i.e. co-operation, is often necessary.

3.3 Industrial vs. Collaborative Forestry Strategies Expressed as a Prisoner's Dilemma Game

The game is defined as a Prisoner's Dilemma with a decision space of two players, with two strategies on the part of each player, the community and the firm. The firm can choose to continue with Industrial Forestry Paradigm (IF) and not acknowledge the community's economic property rights to a portion of the wood fiber, or it can collaborate under a Collaborative Forestry Paradigm (CF). Lejano and Davis view this as an:

> efficiency/equity dilemma, where efficiency might favor centralized regional facilities so as to take advantage of economies of scale, whereas equity might favor more dispersed siting schemes to equitably distribute the … impacts of these facilities among participating communities (2002:251).

ThePrisoner's Dilemma game is analyzed, testing the hypothesis that co-operation on the part of the firm, as manifested under Paradigm CF, is in the firm's long-run self-interest.

The community's actions depend on the enforceable claim[9] (0%, 25%, 50%, 75%, 100%) that they can establish over wood fiber leaving the region unprocessed by their labour force. Depending on the power of the community, it will move to limit the exodus of forest resources from the region if there is enough of a discrepancy between what the firm offers as economic returns, and what the community perceives as its rightful returns from its economic rights. Under the Community resource withholding strategy:

- The community would negotiate, at the onset, with the firm for decentralized processing facility to be placed in their community in return for the use of the wood fiber from the region; or
- They would holdup the supply of wood fiber to the mill through legal and/or direct action in the form of blockades. This is where the Government is introduced into the game-theoretic model, through judicial challenge(s) to the current Forest License Agreement or other contracts that allocate wood to the firm; and
- The community would reallocate what is decided as their equity share of the wood fiber to their own processing facility and market channels.

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[9] The Government and/or the Judicial system have to recognize this as the community's equity. Without this, the community can move to holdup 100% of the wood fiber in the short-term, but this is considered a non-enforceable threat for the sake of gaming unless the community can affect a governmental or firm buy-in through its direct action.

Graphically, the game, presented in its strategic or normal form, is depicted in Figure 3-2.

		Forestry Firm	
	Strategies	Paradigm CF	Paradigm IF
		decentralize production	centralize production
Community	Don't Holdup wood fiber to Firm plant	NPV of actions of each party based on strategy	NPV of actions of each party based on strategy
	Holdup wood fiber to Firm plant	NPV of actions of each party based on strategy	NPV of actions of each party based on strategy

Figure 3-2: The Community and the Forestry Firm Actions under PD

Payoffs are based on the Net Present Value (NPV) of ten years of cashflows from each party's actions/reactions under each strategy. This is expressed in the formula:

$$NPV= [CF_1/(1+k)^1+ CF_2/(1+k)^2+ \ldots + CF_n/(1+k)^n]-C$$ (Brigham et al., 1985)(1)

where:

NPV is the Net Present Value of future cashflows;

CF is the period's cashflows;

k is the cost of capital; and

C is the original capital investment.

The discount rate used in the calculation of NPV is:

$k = A + R + I$,

where:

- k is the time value or discount rate of a future money stream. This rate generally runs between 5-9%;
- A is the interest cost of a risk-free alternative use of the money. Usually 3-5%;
- R is the interest rate premium based on the risk of the investment payback;
- I is the expected inflation rate over the time of the project.

Chapter 4

Forestry Community Development and Oriented Strand Board Manufacturing in Northwest Saskatchewan

4.1 Introduction

Based on the model of collaboration, how does the forestry system shift to the new paradigm? Industry has to be presented with a system that includes strong economic benefits for themselves, care for the ecosystem, and that is conducive to the current demands of society and industry.

There have been a number of Collaborative Forestry successes in northwest Saskatchewan, notably, NorSask Forest Products, owned by the Meadow Lake Tribal Council (MLTC). Several northern Metis villages have observed the success of the MLTC forestry enterprise, and are implementing a similar model for their communities in the form of North West Community Wood Products Ltd. (NWC), based in Beauval, Saskatchewan. NWC's mandate is *to make the NWC a major owner in the regional northwest forest economy* (Hatton, 2001).

The reallocation of wood fiber[10] from Millar-Western, Meadow Lake; Weyerhaeuser Canada, Price Albert; and NorSask, Meadow Lake has given rise to business opportunities for other industrial and community forestry players. Tolko Forest Industries Ltd., a privately held Canadian forestry products

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[10] The majority of this reallocated fiber is aspen, a lower density hardwood and broad leaf deciduous tree.

company from Vernon, B.C., is establishing an Oriented Strand Board (OSB) Plant 26 km southeast of Meadow Lake, SK. Tolko, in establishing an OBS mill has partnered with the Saskatchewan Crown Investments Corporation (CIC), NWC, and the Meadow Lake Tribal Council (MLTC). Tolko has a majority position (70%), managing and marketing the product from the OSB facility. (Meadow Lake OSB Limited Partnership, 2003).

Local NWC community economic benefits could be increased by the installation of a remote strander facility at Beauval Forks, SK. This facility, assumed to be owned by Tolko, would process local roundwood and residuals from the NWC mill and other local sawmills into strands suitable as feedstock for the Meadow Lake OSB plant. This research examines the effects of decentralizing the OSB feedstock manufacturing process to the remote community from where the resource is harvested.

4.2 Historical Background of Collaborative Forestry in Northwest Saskatchewan

The NorSask Forest Management License Agreement area, located in the northwest region of Saskatchewan, is unique in the province with local community members inclusion into the creation of an institutional structure that include local views, values and concerns (Beckley and Korber, 1996). The resulting institutional structure, labeled co-management, is a co-operative resource management regime.

The affected communities/stakeholder groups, as defined by the northern fur block boundaries[11], have become the driving force for the adoption of the co-management model of forest development (Anderson, 1995). Local stakeholders consider it the responsibility of NorSask Forest Products Ltd. (NorSask)[12] to carry out the economic development vision of local stakeholders, as well as providing a forum for the community to participate in co-operative management of the forest.

Treaty Indian stakeholders have accomplished this through indirect ownership (MLTC as 100% owners of NorSask) and political presence. Anderson observed that as First Nations, they:

> "acknowledge the necessity of participation in the global economy and are attempting to create a distinct mode of development. Central to that mode is a strategy of business creation in various forms of partnerships and alliances (supply contracts, subcontracting, joint ventures, etc.) with other First Nations and non-First Nations. .... First Nations' values, traditions, and organizational structures demand input from, and control by, people at the "grassroots"(Anderson, 1995:126).

These values were actualized at the corporate structural level and community economic development level. Millar-Western, a business partner, was to build and operate the pulp mill necessary to utilize the aspen wood fiber from the

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[11] The northern fur conservation blocks, as defined by the Saskatchewan Government, are used to define stakeholder management board membership boundaries. The co-management boards are selected from residents within that region.

[12] NorSask is a Spruce/Fir/Pine (SPF) dimension mill that manufactures primarily 2X3, 2X4, 2X6 framing lumber for shipment to the U.S. housing market.

region. The inclusion of the community was multi-faceted, with local harvesting contracts being tendered to community-based contractors. Forestry management decisions are jointly made by the Forestry Branch of the Saskatchewan government, Mistik Management (owned by NorSask and Millar-Western) and a local resource management board from the fur-block where harvesting is proposed. This is a major shift in forestry corporate practice: *historically, industry has accommodated societal demand for greater public involvement in forest management only after legislative or policy change required them to do so, or in reaction to particularly effective popular protest (blockades, boycotts, and the like)* (Beckley and Korber, 1996:14).

The operations of the co-management model, as implemented in the NorSask Forest Management License Area (FMLA), provided a number of lessons (Beckley and Korber, 1996). These lessons include:

- The need for clear and open lines of communication at all times;
- The need to define the boundaries: included parties (i.e. stakeholders) versus those excluded from participating or defining the structure;
- That the existing structure and embedded culture *may have significant barriers to the development of consensual decision making* (Beckley and Korber, 1996:15).

Co-management implementation in the NorSask FLMA attempts to satisfy the stakeholders involved in the process. Although a number of conflicts have arisen over harvesting methods and rights to wood supply by local small operators, the process continues to move forward. The Co-management boards are looking at increasing the scope of their authority to include all resource issues.

4.3 Meadow Lake Partnership Ltd. Oriented Strand Board Plant[13] at Meadow Lake, Saskatchewan

Tolko Industries Ltd. is a private family owned Canadian forestry company with its head office in Vernon, B.C. Tolko employs over 2,300 people, with manufacturing divisions in British Columbia, Alberta, and Manitoba. Its Manufacturing plants produce lumber, kraft paper, and panel and engineered wood products (Tolko Annual Review 2001). Sales in 2002 were $896 million (Tolko Annual Review 2002). The majority of Tolko operations are located in the B.C. interior (Figure 4-1), while the High Level, AB and Meadow Lake, SK OSB plants are expected to lead future growth for the company.

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[13] While this research examines the situation of Tolko Forest Industries Ltd. and North West Community Wood Products Ltd., the data used to derive the financial assumptions of the parties is based on the author's previous work as an community development consultant, and was not provided by Tolko. The result is that the financial assumptions and the resulting player's payoffs are specific to their geographic location, but are generic to the industry, not one particular firm's operation. The research is a synthetic exercise that does not to precisely mirror the financial operations of these firms.

Figure 4-1: Map of Tolko operations (http//:www.Tolko.com)

In June 2001, Tolko signed a partnering agreement with the Saskatchewan Crown Investments Corporation (CIC), the Meadow Lake Tribal Council (MLTC), and North West Communities Forest Products (NWC) to build an Oriented Strand Board (OSB) manufacturing facility south of Meadow Lake, Saskatchewan. Tolko is a 70% managing partner, and NWC presently has 1.5% share and will have a 10% ownership position once it buys the additional shares from CIC. The environmental review, financing, and final site selection was completed in the summer of 2002, with actual construction of the plant planned for September 2002. With an eighteen months construction phase, the first product rolled off the line in December 2003.

In 2001, North American panel production was 7.6 billion square feet (3/8″ basis) or 19.4 million cubic meters (Structural Board Association, 2003). The majority of this is used in residential construction for floor systems, exterior wall sheathing, roof sheathing, and exterior siding. Originally introduced in 1964, OSB, an engineered wood fiber based structural panel formed from long strands, is becoming a major substitute for construction plywood. Because it is an engineered product, it can be custom manufactured to meet customer specifications in thickness, density, panel size, surface texture, strength, and rigidity.

The plant will produce 600 million sq.ft./yr (3/8″ basis) or about 20 million 4′ x 8′ sheets per year. One cubic meter of OSB (equivalent to 31 sheets of 4 x 8 x 3/8″) requires 1.6 cubic meters of solid wood equivalent in roundwood, with the plant requiring a wood supply of 900,000 cubic meters per year[14]. Of this, 90,000 cubic meters will come from the NWC region. It will operate 3 shifts per day, with a direct employment of 130 people from the Meadow Lake area.

[14] To place this volume in context, 900,000 cubic meters of tree-length logs, stacked 10 meters high, would form a stack of wood approximately 28 km long.

The Meadow Lake OSB Partnership is not pursuing a Forest Management Agreement with the province for timber supply for the plant. The wood supply will come from already established third party Timber Supply Licenses and private/Crown leased woodlots south of Meadow Lake. The wood species that the plant processes: Aspen, Black Poplar, Birch, and Jack Pine are all currently underutilized in the Province (Stantec, 2001).

The process steps in the production of OSB at the Meadow Lake plant are:

1. Harvesting of aspen (70%), black poplar (7%), Jack Pine/Black Spruce[15] (22%), and Birch (<1%) into 8 or 16 ft bolts using mechanized cut-to-length logging equipment. Harvesting will be carried out by independent contractors from wood source regions. Because of mechanized harvesting, the employment per cubic meter of fiber harvested will be low, with the 90,000 cubic meters from NWC's region yielding 6 to 10 harvesting jobs;
2. The transportation of the bolts from the source region to the plant will be by carried out by independent trucking contractors, utilizing Super-B trailers to maximize the legal payload hauled and minimize the cost of roundwood transport. 22,500 loads of logs are anticipated to enter the mill-yard, with 80% of that delivered in the winter to take advantage of the increased legal haul weights. Of this total, 10% or 2,250 loads would be from the NWC region;
3. Once in the mill-yard, the bolts will be offloaded and inventoried by overhead crane, with a six month supply of logs to be stored at any one time;

[15] Boreal softwoods are unique in that their physical properties yield an OSB panel that is comparable to those using the tradition deciduous wood fibers. This can give the northern OSB mills a production cost advantage by utilizing softwood waste residue from dimension mills. For many of the community-based dimension mills, this would give them an additional source of revenue, enhancing their profitability (Gary Stein, Director of Research, Tolko, personal communications).

4. The logs to be processed will be placed in log conditioning ponds, where the logs will move slowly through the heated water (45C) for eight hours. This prepares the wood for debarking and stranding, brings the fiber to an even temperature throughout, and allows a higher feedrate into the strander knives;
5. After the strand production, the wet strands are conveyed into metering bins for temporary storage;
6. From the wet strand metering bins, strands will be dried in a biomass-energy fired dryer, and stored in dry strand metering bins for feeding into the mat production line;
7. Blenders introduce the structural resin and waxes into the strands, which are then moved into the forming line where the strands are oriented and formed into mats;
8. The actual OSB panels are formed from the layers of mat, and put through heat presses, where the combination of high heat (177C-224C) and pressure creates the final panel;
9. The OSB panels are then sawn to size, stacked and strapped, ready for rail transport to market.

4.4 North West Communities Wood Products Ltd.

North West Communities Wood Products, Ltd (NWC) is a corporate entity owned equally and exclusively by the Northern Metis communities of Beauval, Buffalo Narrows, Green Lake, Ile a la Crosse, La Loche, Pataunak, and Pinehouse, with a Board of Directors consisting of members appointed from each of the seven communities. The member communities came together to foster co-operative development of the forest resource in order to promote economic and social development within the communities and the region as a whole. It is anticipated that further discussion will be required to involve other Metis communities in the Region, notably Buffalo Narrows, Jans Bay and Cole Bay (NWC, 2000).

NWC has set several development goals. These include:

> "the achievement of economic self sufficiency for NWC by the creation of viable economic projects for NWC,"
>
> "to make the NWC a major owner in the Regional Northwest Forest Economy,"

and finally, to

> "make the highest and best use of the lumber from the area, resulting in the creation of forestry jobs and wealth for the region"(Hatton, 2001)

To derive the maximum economic value from their regional wood fiber, NWC has installed a combination softwood dimension and hardwood cut-stock mill at Beauval Forks, SK to process a portion of the 251,000 cubic meters of annual wood supply awarded to them under their acquired Timber Supply Agreement (TSL).

NWC has an active interest in the western 2/3 of the Besnard Forest Management Block as well as the Churchill Forest Management Block, located north of Meadow Lake, SK. On March 18, 1999, a Letter of Intent between the Minister responsible for Saskatchewan Environmental and Resource Management (SERM) and NWC specified the requirements for the formal assignment of the Besnard Block to NWC. This marked the beginning of NWC's involvement in the Besnard area. A second Letter of Intent was signed between NWC and the Minister responsible for SERM on February 12, 2001, outlining the conditions for inclusion of the Churchill Block into the NWC's possession and the forest management responsibilities required. With the inclusion of La Loche, SK into NWC as a community partner, the Turner East and Turner West blocks were brought into NWC's authority As a result, NWC's total TSL annual harvest volume is 251,000 m^3. The Meadow Lake OSB partnership is allocated 90,0000 m^3 of hardwood, as a precondition for approval of NWC's TSL, and 7,000 m^3 low grade softwood culled from NWC's sawmill; the Green Lake sawmill is allocated 20,000 m^3 hardwood and 40,000 m^3 softwood as a condition of NWC's 30% ownership in the mill, with 50,000 m^3 additional softwood available for purchase by the mill. NWC's Beauval Forks operations will use 14,000 m^3 for the post and pole plant; with 30,000 m^3 aspen and 90,000 m^3 of softwood processed by the dimension/cut-stock mill.

In discussions with Tolko, NWC has indicated that the concept of a remote strander plant providing the Meadow Lake OSB mill with a wet aspen strand product to be located in Beauval Forks, , would be beneficial to the communities. Instead of the logs destined for the new Tolko OSB plant traversing the territory without NWC's member communities deriving economic benefits, NWC would be involved in the custom processing of the Tolko logs at a remote strander facility. This would mean increased economic activity for the communities. The remote strander wood mill would replicate the initial processing system of the Meadow Lake OSB mill, duplicating steps 3-5 (as defined above). The wet strands would be transported to the Meadow Lake OSB plant through NWC''s trucking partnership with Northern Resource Trucking (NRT). The Meadow Lake mill would then store the strands in storage/metering bins for introduction into the dryers and further processing into the final product. The capital, production and management expertise requirements of the actual panel production dictate that it be implemented in a centralized site.

NWC expects to achieve direct social and economic benefits from the remote stranding plant in the form of:

- 2 plant operator jobs, a grinder/knife maintenance position, a loader operator, a yard operator position and an operations manager for a total salary increase for the region of $305,000;
- Additional revenues for its sawmill from the sale of residuals;
- The training and development of a technically skilled labour pool;
- The training and development of a managerial pool;
- The harvesting and hauling of the log supply;
- A forum for more local entrepreneurs to create and/or expand their business;
- A closing of the knowledge gap through training and exposure to modern business operations;
- Financial dividends from the 50% ownership in NWC/NRT Trucking. NWC/NRT Trucking is expected to haul the roundwood from the bush, the wet strands to the ML OSB plant, and bundled sawmill residues from Canoe Narrows to Beauval Forks.

Chapter 5

Application of the IF/CF PD Model to the Meadow Lake Partnership Ltd. OSB plant

5.1 Introduction

To test outcomes based on the interplays between the community and forestry firm from an installation of a remote stranding facility in Beauval, SK, this research applied the Prisoner's Dilemma model delineated in Chapter 3. Applying Trist and Perlmutter's paradigms to the PD matrix , there were four strategy pairs for community, and the forestry firm: co-operate, co-operate; defect, co-operate; co-operate, defect; and defect, defect. For the forestry firm, represented in this exercise by Meadow Lake OSB Partnership Ltd., a choice exists to pursue an Industrial Forestry Paradigm (IF) (defect), or a Collaborative Forestry Paradigm (CF) (co-operate), leading to either decentralizing the production of the strands from NWC's wood fiber to the region (Remote Stranding (RS) or refusing to decentralize the production of wet strands (do not Remote Strand (nRS). The community can choose not to act to limit the OSB plant access to the wood (co-operate – (do not holdup (nH), or to pursue political and/or legal means to holdup wood fiber (defect – holdup (H)), considered their equity, for alternative local processing facilities that will yield improved economic benefits to the community.

Under the theoretic non-co-operative PD game, the dominant solution is for both players to defect, the community holding up the wood fiber from the plant and the firm centralizing production. They both lose in this situation, with the firm losing the marginal profits it would have had from the wood fiber. The community loses a larger forestry firm with its resulting expertise and capital, and is forced to create a market for the wood fiber on its own.

Assumptions at the start of the analysis were:

- The OSB Mill[16] plant will be the owner and manager of the remote stranding plant. NWC will realize their returns on their wood equity in direct employment at the remote strander, increased economic activity in the region, a potentially higher net return on their residuals, dividends from the NWC/NRT Trucking Partnership and dividends from the Meadow Lake OSB plant partnership;
- Expected profits per cubic meter of roundwood or the equivalent strands to the OSB plant is $44.44, which is based on: 28.6% return on investment[17]; $140 million investment; 900,000 cubic meters of roundwood delivered to the plant;
- Payoffs are based on the change from Strategy A: no remote stranding and no holdup of wood fiber by NWC (nH/nRS);
- NWC will be using the dividends paid out to shareholders from the Meadow Lake OSB partnership to acquire more shares in the

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[16] OSB Mill is used as a generic namesake for the forestry firm.

[17] Based on conversations with Marcel L'Heureux, Manager of New Business Development for NWC, the payback period for the OSB plant would be 2 – 5 years depending on the markets for OSB panels. Using an average of 3.5 yrs for a payback period, the mill will generate "net cashflows" above costs of $40 million per year or a 28.6% return on the $140 million investment. Based on 900,000 m^3 of fiber input, the net cashflow per cubic meter is $44.44. Because of the generalized nature of the estimates used to derive this number, a sensitivity analysis will be run with 50% and 75% lower returns and the results reported in chapter 6.

partnership from the Saskatchewan Crown Investments Corporation, therefore there will be no direct payments to NWC;

- NWC has the political and/or legal means to holdup a percentage of the 90M cubic meters of aspen wood fiber currently allocated to the OSB plant based on their economic rights to the fiber, i.e. they are a credible threat. For the initial run of the model it is assumed that NWC has the ability to holdup 25% of the 90M cubic meters of aspen (22,500 cubic meters) allocated to the OSB Mill plant under NWC's TSL;
- NWC is not interested in side payments or transferable utility – they want local employment.

The annual payoff table is a 8 X 18 matrix, with the players' payoffs based on the strategy options A through D across the horizontal, and activities associated with each action made by the players on the vertical access. Activities are clustered under three broad developments: the present Meadow Lake OSB plant; the Remote Stranding plant; and NWC's Cut-stock mill expansion. Under each of these classifications, the payoffs are further subdivided into community and forestry firm's change in activities based on the four strategies (nH/nRS or nH/RS or H/RS or H/nRS). The payoffs are cashflow based as required for the calculation of NPV's, rather than net income based.

5.2 Strategy option A: OSB Mill does not agree to remote stranding and NWC does not withhold the wood fiber from the region

This is the baseline situation, with no resulting payoffs from activities. This scenario represents the current situation, with community co-operating and the firm pursuing an industrial paradigm of centralization to the exclusion of community development objectives. 90,000 cubic meters of aspen roundwood are shipped from the region without any economic benefits to NWC members beyond the harvesting.

NWC intends to sell waste from its operations to the Tolko - Meadow Lake OSB Limited Partnership (OSB Mill) to satisfy Saskatchewan Environment and Resource Management's requirement for as full utilization of the harvested wood fiber as possible. The saleable waste stream from NWC will be from their spruce operations, with the aspen cut stock operation chipping their waste and swapping it for sawlog grade logs with Millar-Western. US pulp mills are paying more for the fiber in the form of chips than the OSB plants are willing to pay considering the present market conditions (Al Lewis, Vice-President of Operations, Norboard of Toronto, Canada, 2002, personal communications). Because the profits and economic benefits derived by NWC are much higher producing aspen cut-stock than strands, it is NWC's economic interest to acquire an increased supply of sawlogs for processing into cut-stock. Therefore, NWC is not expected to ship their residual aspen fiber to the OSB plant, but continue to ship chips to Millar-Western up to the maximum exchange volume of 20,000 m^3. NWC does not have this option for their spruce and Tolko has agreed to accept the debarked bundled spruce residues at $30/tonne.

The waste form sold is dependent on the OSB requirements for efficient infeed handling and their ability to process the species presented. Five classes of byproduct are generated by the NWC dimension and cut stock mills and are handled in different ways. These are:

1. Sub-sawlog grade or pulp grade logs. These logs are those that are brought to the yard as sawlogs, cut to length for the cut-stock or dimension mill, yet are found to be sub-grade either upon cutting to length , or at the debarker.
2. Long mill byproduct. This waste comes from edgings and slabs, and can be descrambled, bundled and shipped to Tolko or sent directly to onsite processing in the form of a chipper or remote stranding. Pieces longer than 48" can be used for this purpose. For this research, this volume was assumed to be 50% of the mill byproduct.
3. Small mill byproduct. This product consists primarily of trim blocks and other mill refuse that is less than 48" in length. This waste will be fed into a secondary processing facility, such as a chipper or remote strander. It is considered too short to bundle with any efficiency.
4. Sawdust from the cut-stock mill. NWC will have to either dispose of this as waste in an on-site landfill, install a bio-mass fired strand dryer system, or incorporate it into a biomass heating line being developed for Beauval.
5. Bark. Again, NWC will have to dispose of this product, but could possibly incorporate it into a biomass strand dryer line.

NWC's dimension mill produces 20,866 tonnes of strandable spruce waste, comprised of 14,916 tonnes of spruce mill byproduct and 5,950 tonnes of spruce pulp logs. One-half of the spruce residuals (7,458 tonnes), the long mill byproduct, are bundled and shipped to Meadow Lake for processing into strands, along with the pulpwood for a total tonnage shipped for stranding of 13,405 tonnes.

Compared to their waste disposal costs through local burning of $4.00 per tonne or $53,620 per annum, this yields NWC a loss of $6.17/tonne and $83,000 per year at this rate (Table 5-1), (Sprague and Gray, 2002). This is not an economically beneficial option for waste disposal, but is undertaken to satisfy the requirements of SERM.

NWC income statement for the sale of spruce slabs to the ML OSB plant	
Revenues on spruce slabs and pulp wood (does not include the disposal cost savings)	$402,000
Cost of sales[18]	$317,000
Cost of transportation	$168,000
Net income on bundled spruce slabs and pulp wood shipped to ML OSB	-$83,000
Total spruce residuals that are shipped to ML OSB (tonnes)	13,405
Revenue per tonne for bundled slabs	$30.00
Cost of sales ($/tonne)	$23.67
Cost of transportation ($/tonne)	$12.50
Cost of transportation ($/trip)	$400
Average load (tonnes)	32.0
Cost of bundling ($/tonne)	$11.17
Tonnes per shift (based on 500 shifts)	26.8
Salaries per shift (3 personnel @ 15.00/hr w/ benefits)	$240.00
Loader expense per tonne	$14.17
Net income per tonne of bundled spruce slabs shipped to ML OSB	-$6.17

Table 5-1: Income from NWC sales of spruce residuals to the ML OSB plant

Under this scenario, OSB Mill would be making an extra $294,000 net cashflow due to the spruce fiber shipped into the plant by NWC. In the future, NWC may demand more for the fiber depending on the loss it continues to sustain, and whether Tolko decides to invest in the remote stranding plant.

[18] The cost of sales includes: the labour costs for performing the bundling of the residuals; the loader expenses for moving the bundles into inventory and loading the truck for shipping; and steel banding for bundling.

5.3 Strategy option B: OSB Mill agrees to remote stranding at Beauval Forks and NWC does not withhold the wood fiber from the region

Strategy B annual payoffs: nH/RS		
NWC Strategy	**Don't holdup wood**	
OSB Mill Strategy	**Remote stranding**	
Player	**NWC**	**OSB Mill**
Net Payoff for strategy	**$432**	**$586**
Activity		
Present ML OSB plant		
NWC		
Sale of NWC spruce waste (bundled and shipped to Tolko)	$83	
OSB Mill		
Profit loss because of NWC region fiber to remote strander		-$4,000
Profits to the ML OSB from remote produced strands		$5,000
Working capital savings on trucking of inventory at the ML OSB plant		$54
NWC spruce waste (slabs, etc. bundled and shipped to Meadow Lake)		-$271
Remote stranding plant		
NWC		
Sale of NWC spruce waste (remote stranded and shipped to Tolko)	$0	
Savings on the disposal of the spruce residuals not shippable to ML	$30	
NWC region direct employment from remote strander	$305	
NWC share of profit from the remote strander plant	$0	
NWC share of profit: NWC/NRT Trucking strand haul to ML OSB plant	$15	
OSB Mill		
Debt repayment (principal and interest)		-$625
Net Profit before interest and depreciation		$428

Table 5-2: Strategy B annual payoffs ($1,000)

This scenario represents the co-operate (NWC), co-operate (OSB Mill) strategy pair of the matrix. For NWC, the activity payoffs for OSB Mill installing the remote strander are based on:

- The sale of spruce waste from NWC's dimension mill directly to the remote strander. As the residues will be delivered with minimal handling via belt-feed systems, the remote strander can utilize all of the spruce residues produced instead of the only the larger slabs (50% of produced residues) shipped to the OSB Mill plant. This yields an income on the residuals of $0.00, based on NWC receiving $0.00 per tonne for the residuals, but saving on the sawmill residue disposal expenses. These savings include $30,000 saved on the cost of disposing of the residuals not previously shipped to Meadow Lake, SK., and the $83,000 it was losing satisfying the SERM requirement of minimal waste disposal and fuller utilization of fiber within the province;

- A local payroll at the remote strander of $305,000 per year will be generated, based on 6 person-years of employment: 2 plant operator jobs, a grinder/knife maintenance position, a loader operator, a yard operator position and an operations manager;
- NRT/NWC Trucking contract, based on profits of 4% of revenues, 50% retained earnings, and evenly divided between the partners, yields NWC an annual share of the profits of $15,000 (1% of revenues).

Dividend payout to NWC from trucking of remote produced strands	
Dividends paid to NWC by NWC/NRT Trucking for strand haul to ML OSB (no holdup)	$15,000
Profits as a percent of revenues	4.0%
Percent of dividends paid out vs. retained as earnings	50.0%
Revenues on the strand haul (no holdup)	$1,482,000
NWC share of partnership	50.0%

Table 5-3: Dividend payout to NWC from trucking of remote produced strands

The change in profits for OSB Mill from installing the remote strander is a function of:

- The loss of the 90,000 M^3 of NWC region roundwood shipped directly to the Meadow Lake OSB millyard. Based on a $44.44 income before taxes per tonne of roundwood input, this would be a $4.0 million loss;
- The loss of $271,000 profit from the spruce waste that was shipped to the M.L. OSB plant;
- The availability of additional fiber from NWC's spruce residuals due to the proximity of the remote stranding plant and its ability to process smaller pieces, plus the availability of Canoe Lake Forest Products (CLFP) sawmill residues. The remote produced strands would yield a profit of $5,000,000 to the OSB Mill plant because of the extra fiber made available. This figure includes strands produced from the NWC region roundwood, NWC's spruce waste, and 50% of CLFP's waste, but does not include any losses incurred at the remote stranding plant. The M.L. OSB plant is expected to pay $60.00 per delivered tonne of wet strands;
- OSB Mill owning and operating the remote stranding plant;
- Working Capital financing will be saved from the previous requirement for six months of roundwood inventory trucking, yielding a $53,654 payoff;
- The additional capital costs for the remote stranding plant. Based on informal quotes made by CAE, a major manufacturer of

stranding equipment, the capital costs are estimated to be $4.6 million Cdn.

The OSB Mill plant would like to enlist additional sources of wood fiber in the form of wood residues from various communities and small privately owned sawmills that are abundant in northern Saskatchewan. Many of these mills could be made more economically viable with a market for their residues (Gary Stein, Director of Research, Tolko, personal communications, 2002).

The primary source of additional fiber would be the spruce residuals from the NWC dimension/cut-stock mill not currently bundled and shipped to Meadow Lake. Presently, the OSB Mill plant will not accept the small mill byproduct wood fiber, and it would be an additional source of fiber for the OSB Mill plant if remote stranded. NWC is estimated to produce 8,771 tonnes of this residue, yielding 5,263 tonnes of strands. Additional fiber sourced from the Canoe Lake First Nation's sawmill operation (CLFP), located 35km west of Beauval Forks, was included in this research as example of the use of other sawmills residues. Because CLFP does not have a chipper facility and no contract for fiber swapping with Millar-Western, they would have unusable residual aspen pulp-grade logs, aspen residues, and spruce residues available for remote stranding.

The total NWC spruce residues have an input volume of 14,910 tonnes and an output volume equivalent to 10,437 tonnes of wet strands. An additional 7,000m^3 of pulp grade spruce logs will be culled from the sawlog merchandising, yielding a total wet strand tonnage of 16,387 per annum. There is estimated to be

5,005 tonnes of additional spruce and 2,395 tonnes of aspen sawmill residue available within a less than 50km distance of Beauval Forks, along with 4,000 tonnes of pulp-grade aspen roundwood from CLFP's harvesting operations, yielding 4,158 tonnes of wet strands per annum. This is based on only shipping one-half of the spruce and aspen residues due to the inefficiency of bundling the random short waste.

Because of processing and the elimination of bark and fines[19] (20%) from the roundwood at Beauval Forks instead of at Meadow Lake, 72,000 tonnes of roundwood-based fiber will be hauled instead of 90,000 tonnes of roundwood. The 90,000 cubic meters of roundwood would be 2,250 loads of roundwood hauled into the Meadow Lake OSB Mill millyard. The hauling cost per trip is based on a trip distance of 185km from Beauval Forks[20] to the Meadow Lake site. It was assumed that the smaller mill byproducts yield non-usable fines of 40%, with 60% of the input volumes becoming strands, with the balance of the input fiber producing 20% fines. From a transportation perspective, with the fines

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[19] Fines would be the by-product of processing that is eliminated in the screening due to its particle size being too small for manufacturing of the end product. This residual would have to be disposed of in the same fashion as the bark residuals.

[20] The roundwood will be hauled from various points within NWC's region, with most wood going through Beauval Forks, the site of the proposed remote stranding plant. If the remote stranding plant is in operation, the wood would then be off-loaded at the plant instead of continuing along to the Meadow Lake plant, therefore to compare the two options only the cost of hauling from Beauval Forks to the OSB plant is included.

from the sawmill residuals being up to 40%, it would be more economical per tonne to ship strands instead of bundled waste to the Meadow Lake OSB plant to realize this profit.

Remote stranding is viewed as technically feasible, although the economics of the transportation are one of the deciding factors in implementation (Knutsen, B., Forentek, 2002: personal communications). Roundwood, chips, and strands delivered from the NWC TSL area would be hauled on Route 162, a secondary highway between Beauval Forks and Green Lake, SK. Because of its status as a secondary highway, there is a large differential in legal haul weights between the winter months of December 1st to March 15th and the June 1st to November 30th hauling period. The winter season haul weight limits are 62,500 Kg, with a payload weight of 37,955 Kg for northern haul outfitted tractor -Super B trailer combination (Glen Ertell, Northern Resource Trucking, 2003, personal communication). The summer season haul weight limit would be reduced to 54,500 Kg, with a tarre weight of 29,955 Kg.

The bulk density of the loaded strands is a critical variable in the economics of remote stranding due to its effect on the cost of transportation. Dry aspen strands have a bulk density (BD) from 95 to 190 Kg per cubic meter, with 10lbs per ft^3 or 158 Kg per m^3 used as the industrial average (Carlos Vieira, Capital Sales Project Manager, CAE Machinery, Burnaby, B.C., personal communications). To convert the dry strand BD to wet strand BD a moisture factor of 2X was assumed, yielding an industrial average BD for wet strands of 317 Kg per m^3.

Based on a trailer capacity of 117 cubic meters, NRT could haul between 22,246 Kg and 46,347 Kg, with an average of 37,077 Kg, with the seasonally averaged maximum payload for Route 162 of 32,902 Kg or 32.902 tonnes. At a bulk density of 281 Kgs/m^3 and higher, the loads are limited by weight instead of volume. For a BD of 20.0lbs/ft^3 or 317kgs/m^3, strand shipping costs are $16.46 per tonne or 88.38% of the expense of shipping the equivalent roundwood (Tables 5-4 & 5-5).

Cost per delivered wet strand tonne comparison between roundwood and remote processed strands.	
(based on industrial average for bulk density of strands)	
Roundwood volume hauled from the region (M cubic meters)	90.000
Roundwood tonnes hauled from the region	90,000
roundwood haul cost per net tonne of wet strands	$18.63
Wet strand tonnes hauled from the region from roundwood	72,000
Transportation cost per net tonne of wet strands	$16.46
$ difference in haul cost between wet strands and the equivalent roundwood	-$2.17
Percentage difference in haul cost between wet strands and the equivalent roundwood	88%
Roundwood hauling assumptions	
Tonnes of roundwood hauled per trip(wted. avg. for winter/summer seasons)	36.355
Winter load limit (assume legal load wts, not oversize permitted loads) (net tarre (kgs))	37,955
Summer load limit - net tarre (kgs)	29,955
Percent of roundwood hauled in winter	80%
Trips per annum from the region	2476
Trips per tractor unit during the winter haul	4.0
Trailer purchase price (Super-B log haul)	$120,000
Trailer maintenance per annum	$8,000
Years of use	7
Trailer costs per annum	$18,286
Number of the trailers on the haul	5
Trailer costs per trip	$37
Transportation charge by NWC/NRT Trucking per trip (8 axle-truck only)	$505
Roundwood haul cost per trip (Beauval-ML OSB)	$542
Roundwood haul cost per tonne	$14.90

Table 5-4: Transportation Costs of Remotely Processed Wet Strands w/ BD of 317 kgs/m^3: Roundwood hauling.

Wet Strand hauling assumptions	
Maximum tonnes of strands hauled per trip by weight(wted. avg. for winter/summer seasons)	32.902
Maximum tonnes of strands hauled per trip by volume(wted. avg. for winter/summer seasons)	37.077
Maximum load limit based on:	weight
Winter load limit (assume legal load wts, not oversize permitted loads) (net tarre (kgs))	37,955
Summer load limit - net tarre (kgs)	29,955
Percent of strands hauled in winter	37%
Trips per annum from the region	2188
Annual mileage per tractor unit (km)	240712
Trailer purchase price (Super-B side tip)	$180,000
Trailer maintenance per annum	$8,000
Years of use	7
Trailer costs per annum	$26,857
Number of the trailers on the haul	3
Trailer costs per trip	$37
Hauling charge by NWC/NRT Trucking per trip (8 axle-truck only)	$505
Strand haul cost per trip (Beauval-ML OSB)	$542
Bulk density of wet strands: industrial average (kgs per cubic meter)	317
Side-tip Super-B trailer capacity (m3)	117

Table 5-5: Transportation Costs of Remotely Processed Strands w/ BD of 317 kgs/m^3: Wet strand hauling.

The remote stranding operation will yield a $428,000 net profit before interest and depreciation and a net income of -$107,000 in years 1-5 and -$32,000 in years 6-10 (Table 5-6). An estimated 90,000 tonnes of wet strands would be produced and shipped to Meadow Lake. Appendix Table A-5 details the inputs to the Remote Strander Proforma Income Statement.

Proforma Income Statement: remote stranding plant	
Based on industry average of 20lbs/ft3 for the bulk density of wet strands	
Revenues	**$5,400**
Revenues on aspen roundwood	$4,320
Revenues on NWC spruce residuals	$626
Revenues on NWC aspen residuals	$0
Revenues on other local sawmills spruce residuals	$105
Revenues on other local sawmill aspen residuals	$349
Cost of Sales	**$4,884**
Personnel	$245
Cost of NWC spruce residuals	$0
Cost of NWC aspen residuals	$0
Cost of NWC hardwood roundwood	$2,652
Cost of CLFP spruce residuals	$50
Cost of CLFP aspen residuals	$15
Cost of CLFP hardwood roundwood	$222
Maintenance	$10
Consumables	$54
Clamps/carriers/anvils, etc.	$50
Power	$89
Misc.	$15
Loading and transportation	$1,482
Gross Profit	**$515**
Management and administration expenses	$87
Net profit before interest and depreciation	**$428**
Equipment financing interest	$76
Depreciation	$460
Net Income	**-$107**
Net income per tonne of input ($/tonne)	-$1.02
% of revenues	-1.98%

Table 5-6: Proforma Income Statement: Remote stranding plant. ($1,000)

Roundwood hauling from the forestry blocks of the NWC region will be 80% by tonnage in the winter months and the fiber will be inventoried for six months on average. Based on the roundwood trucking cost per tonne of $14.90 (Table 5-4), the working capital financing costs for the trucking of 90,000 cubic meters of roundwood from the NWC TSL would be $54,000[21]. Remote stranding would have similar inventory levels, but not have invested in the log haul to Meadow Lake and would deliver strands just-in-time.

The capital costs for the installation of the remote stranding plant include: all infeed systems including the conditioning ponds, debarking and chopping equipment; the actual stranding line; outfeed, short-term storage, and overhead loading systems. OSB Mill will invest 40% of the cost ($1.84 million) and the balance will be commercially financed over five years at the prime lending rate of 5%. No risk premium on the financing was assumed due to OSB Mill's financial strength. The annual debt repayment would be $625,000[22].

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[21] Based on a finance rate of 8% on the trucking expenses ($14.90 per tonne X 90,000 m3 -> $1,341,000 X 4% ->$53,640) of hauling 90,000m^3 of NWC TSL wood, for six months. (1 m^3 of aspen roundwood equals 1 tonne).

[22] Based on a 60 months payment period with constant monthly payments of $52,085 and a constant interest rate of 5%.

5.4 Strategy option C: OSB Mill agrees to remote stranding and NWC withholds wood fiber from the region

Strategy C annual payoffs: H/RS		
NWC Strategy	**Holdup wood**	
OSB Mill Strategy	**Remote stranding**	
	NWC	**OSB Mill**
Heldup wood volumes (%)	**25%**	
Net Payoff for strategy	**$889**	**-$542**
Activity		
Present ML OSB plant		
NWC		
Sale of NWC spruce waste (slabs, etc. bundled and shipped to OSB)	$83	
OSB Mill		
Profit loss because of NWC region roundwood fiber to remote strander		-$3,000
Profit loss because of NWC region roundwood fiber holdup		-$1,000
Profits to the ML OSB from remote produced strands		$4,000
Working capital savings on trucking of inventory at the ML OSB plant		$40
NWC spruce waste (slabs, etc. bundled and shipped to Meadow Lake)		-$271
Remote stranding plant		
NWC		
Sale of NWC spruce waste (remote stranded and shipped to OSB)	$0	
Savings on the disposal of the spruce residuals not shippable to ML	$30	
NWC region direct employment from remote strander	$305	
NWC share of profit from the remote strander plant	$0	
NWC share of profit: NWC/NRT Trucking strand haul to ML OSB plant	$12	
OSB Mill		
Debt repayment (principal and interest)		-$625
Net Profit before interest and depreciation		$313
NWC Cut-stock mill expansion		
NWC		
Debt repayment (principal and interest)	-$89	
Net Profit before interest and depreciation	$187	
Equipment replacement/refurbishing as an annualized expense	-$32	
Chipping the waste to MW	$167	
Additional payroll @ NWC mill due to held-up wood	$226	

Table 5-7: Strategy C annual payoffs ($1,000)

This scenario represents the non-co-operative (NWC), co-operate (OSB Mill) strategy pair of the matrix. The holdup of wood supply from the NWC TSL would be a legal and/or political process. There is the possibility of a temporary loss of all roundwood from the region due to direct action, but the model for this research only takes into account the permanent holdup volumes equal to what is deemed as the region's equity in the wood fiber. Direct action would be seen as a means to legitimize NWC's right to a percentage of the wood fiber with the Government by participants.

Under co-operation, with its binding agreements and trust of the other party's actions, this scenario would not happen. It is only under an antagonistic relationship, where NWC uses the holdup of wood supply as a threat, that this could materialize. The OSB Mill plant may still pursue the strategy of installing the remote strander, because to not do it would even more costly. Even under fiber holdup or diversion by NWC, if there is large amounts of additional wood fiber they could access due to the installation of the remote stranding plant, the OSB plant would profit. The action of holding up wood supply would be considered irrational on the part of NWC under a general game if they gained the establishment of the remote stranding plant, yet may be rational for NWC in this specific game if they gain more from diverting the wood fiber to their own mill.

For NWC and OSB Mill, the activity payoffs for OSB Mill installing the remote strander would be the same as Strategy B, with the exceptions of:

- NWC would holdup 25% of the 90,000 cubic meters of aspen (22,500 cubic meters) allocated to Tolko under NWC's TSL. Of this 22,500 cubic meters, 65% would grade as sawlogs (14,625 cubic meters), with the balance of 7,875 cubic meters being shipped to Millar-Western as pulp logs;
- Under the holdup of wood supply, NWC will build additional capacity into its present aspen cut-stock mill or build a separate

cut-stock plant to handle the extra wood fiber available for processing. The cost of this expansion would be $42.34 per cubic meter of capacity (Sprague and Gray, 2002). At a 25% holdup, the extra capacity would cost NWC $619,000. The efficiency of the mill is assumed to be constant across different holdup volumes, with the equipment and manpower choices made to optimize the system for the established volume of wood. They have the available capital and debt financing, along with management personnel to be able to build and operate the plant under the additional volumes. An annualized expense of $31,000[23] is allocated for equipment replacement and/or refurbishing;

- There would be a positive cashflow of $189,000, directly made by NWC on the 25% withheld wood fiber. A net cashflow of $13.84 per additional cubic meter of sawlogs processed by the mill is assumed (Sprague and Gray, 2002);
- The strand haul by NWC/NRT Trucking would be diminished by the volume of wood withheld and thus the dividends realized by NWC would diminish to $12,000 from $15,000;
- All aspen residues would be chipped and sent to the Millar-Western pulpmill. As these volumes will be above the sawlog/chips swap volume of 20Mm^3, MW will pay NWC $30.00 per tonne for the chips (Appendix Table A-6: NWC Chipper Cashflows);
- An additional payroll for NWC at its sawmill due to the extra volumes processed of $226,000. This is considered a positive number for NWC because its community members are benefiting. The cost of the payroll is accounted for in the $13.84 per cubic meter of held-up wood that NWC gains in cashflow;
- OSB Mill will realize $1 million lower profits ($4.0 million) on the reduced remotely produced strand volume;
- The Working Capital savings on the cost of transportation will be lower due to less roundwood having been available to haul.

[23] This annual equipment expenses is based on a replacement expense of 50% of the original capital expenses over 10 years.

5.5 Strategy option D: OSB Mill does not agree to remote stranding and NWC withholds wood fiber from the region

Strategy D annual payoffs: H/nRS		
NWC Strategy	**Holdup wood**	
OSB Mill Strategy	**No remote stranding**	
	NWC	**OSB Mill**
Heldup wood volumes (%)	**25%**	
Net Payoff for strategy	**$439**	**-$1,000**
Activity		
Present ML OSB plant		
NWC		
Sale of NWC spruce waste (slabs, etc. bundled and shipped to OSB)	-$83	
Disposal cost of spruce waste that could be shipped to OSB		
OSB Mill		
Profit loss because of NWC region roundwood fiber to remote strander		NA
Profit loss because of NWC region roundwood fiber holdup		-$1,000
Profits to the ML OSB from remote produced strands		NA
Working capital savings on trucking of inventory at the ML OSB plant		NA
NWC spruce waste (slabs, etc. bundled and shipped to Meadow Lake)		$0
NWC Cut-stock mill expansion		
NWC		
Debt repayment (principal and interest)	-$89	
Net Profit before interest and depreciation	$187	
Equipment replacement/refurbishing as an annualized expense	-$31	
Chipping the waste to MW	$167	
Additional payroll @ NWC mill due to held-up wood	$226	

Table 5-8: Strategy D annual payoffs ($1,000)

This would be the most aggressive non-co-operative stance on the part of each player, and represents the non-co-operate (NWC), non-co-operate (OSB Mill) payoff box of the matrix. For NWC, the activity payoffs for OSB Mill not installing the remote strander are based on Strategies A and C. NWC sawmill residues are handled as in Strategy A, with NWC losing $83,000 on the spruce slabs shipped to Meadow Lake and gaining no payoffs from residues that would be remote stranded under Strategy B & C. The withheld aspen fiber would be processed as in Strategy C, with NWC building and operating additional processing capacity.

The OSB Mill plant's change in activity payoffs from Strategy A are affected by the loss in wood fiber due to the NWC holdup, and hence the effect on the net cashflows of the Meadow Lake OSB plant. The OSB Mill plant will continue to accept the bundled spruce waste from the NWC dimension mill even though NWC has withheld a percentage of the roundwood and diverted it to their cut-stock mill. It is in the OSB Mill plant's financial interest to continue to access this increased fiber source. Retaliation is not a viable threat to NWC changing its withholding tactics, because NWC would gain financially by not having a market for their spruce waste.

5.6 NPV derivation of ten-year payoffs from Strategy options A-D

The annual cashflow-based payoffs for each player's action under Strategies A – D are summarized and imported into a 10 year NPV table (Table 5-9 and 5-10). Capital expenses in the remote strander and/or NWC's sawmill expansion are input at year 0 and have a zero salvage value at the end of ten years. These capital expenses are financed for 5 years in both OSB Mill and NWC's case. Years 6 – 10 reflect the debt repayment savings of $625,000 and $89,000, respectively, where the players have made initial capital investments.

Equipment upgrades and refurbishing of the remote strander are made in year 5, and are based on 50% of the initial capital expenses ($1,390,000). This is reflected in OSB Mill payoffs for year 5 of: Strategy B: -$804,000 and Strategy C: -$1,932,000. OSB Mill's years 6 – 10 reflect that these expenses are internally financed and do not decrease the annual payoffs with debt repayment.

NPV payoff table (Year 1-10)

	Strategy A:		**Strategy B:**	
NWC Strategy	**Don't holdup wood**		**Don't holdup wood**	
OSB Mill Strategy	**No Remote stranding**		**Remote stranding**	
	NWC	**OSB Mill**	**NWC**	**OSB Mill**
Heldup wood volumes (%)	**NA**		**NA**	
Net Present Value of Payoffs	**$0**	**$0**	**$2,901**	**$2,845**
Net Joint payoff	**$0**		**$5,746**	
Annual Net Payoffs				
Year 0 (equity investments in plants)				-$1,840
Year 1	$0	$0	$432	$586
Year 2	$0	$0	$432	$586
Year 3	$0	$0	$432	$586
Year 4	$0	$0	$432	$586
Year 5	$0	$0	$432	-$803
Year 6	$0	$0	$432	$1,211
Year 7	$0	$0	$432	$1,211
Year 8	$0	$0	$432	$1,211
Year 9	$0	$0	$432	$1,211
Year 10	$0	$0	$432	$1,211

Table 5-9: NPV payoffs (Year 1-10) Strategy A and B ($1,000)

NPV payoff table (Year 1-10)				
	Strategy C:		Strategy D:	
NWC Strategy	Withhold wood		Withhold wood	
OSB Mill Strategy	Remote stranding		No remote stranding	
	NWC	**OSB Mill**	**NWC**	**OSB Mill**
Withheld wood volumes (%)	**25.0%**		**25.0%**	
Net Present Value of Payoffs	**$6,205**	**($4,728)**	**$3,323**	**($6,710)**
Net Joint payoff	**$1,477**		**($3,387)**	
Annual Net Payoffs				
Year 0 (equity investments in plants)	$0	-$1,840	$0	
Year 1	$888	-$542	$459	-$1,000
Year 2	$888	-$542	$459	-$1,000
Year 3	$888	-$542	$459	-$1,000
Year 4	$888	-$542	$459	-$1,000
Year 5	$888	-$1,932	$459	-$1,000
Year 6	$977	$82	$548	-$1,000
Year 7	$977	$82	$548	-$1,000
Year 8	$977	$82	$548	-$1,000
Year 9	$977	$82	$548	-$1,000
Year 10	$977	$82	$548	-$1,000

Table 5-10: NPV payoffs (Year 1-10) Strategy C and D ($1,000)

The net joint payoffs are calculated by summing the two players NPV payoffs under each case. The co-operate/co-operate (nH/RS) strategy pair of Strategy B has the highest net joint payoff of $5.7 million, and the non-co-operate/non-co-operate (H/nRS) strategy pair of Strategy D has the lowest net joint payoff of -$3.4 million.

Chapter 6

Results

6.1 Introduction

Chapter 6 will examine the results and the basis for these results under the four different scenarios presented in Chapter 5. The base results are reported for what is considered a likely scenario: NWC's holdup of 25% of the regional aspen allocation to the OSB Mill plant, the payment of $0.00/tonne to NWC for its residues into the remote strander, and OSB Mill's profit of $44.44 per cubic meter of roundwood input. The dominance of the base model's outcome is then tested with a sensitivity analysis. Changes in NWC's withhold level, the price that NWC is paid for its spruce residuals, the profit that the OSB Mill plant would achieve per cubic meter of roundwood or equivalent fiber input, and the bulk density of the wet strands shipped from the remote strander plant to Meadow Lake and its effect on the OSB Mill plant's transportation expenses are tested.

The rules of the game used in this research are:

- This is a one-off game, without iterations;
- The options of the players are limited to the four cases, i.e. OSB Mill's actions cannot be influenced by outside investment options[24];

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[24] This rule will be relaxed, allowing the OSB Mill plant to choose to make $4.6 million in outside investments rather than into the remote strander plant, effectively eliminating Strategy C from the decision set. In Chapter 7, the resulting response from NWC and under what scenarios NWC would be induced to co-operate will be examined.

- There is full transparency of the payoffs of each player to both players, i.e. common knowledge of the payoffs, but no joint decisions on the strategies;
- The players are economically rational, i.e. they choose a strategy that maximizes their expected payoff.

6.2 Baseline Results

The initial model run was performed with the baseline assumptions of:

- NWC can achieve a 25% holdup on the aspen allocation to the OSB plant under NWC's TSL;
- NWC is being paid $0.00 for the spruce residues delivered to the remote strander;
- The Meadow Lake OSB plant achieves a profit of $44.44 per cubic meter of aspen round wood or equivalent input;
- The wet strand bulk density is 20lbs per ft^3 or 317 Kgs per M^3 for transportation purposes;
- NWC's net cashflow on the withheld fiber is $13.84 per cubic meter. (For a complete list of assumptions, refer to Appendix I)

Tables 6-1 and 62 report the results. Strategy A results are equal to zero, with Strategies B-D expressed as the difference from Strategy A. Strategy B (nH/RS) offers OSB Mill the only gains, and also offers the highest Net Joint Players payoff ($5.7 million). NWC gains the highest payoff under Strategy C ($6.6 million).

NPV payoffs (Years 1-10)				
	Strategy A:		Strategy B:	
NWC Strategy	Don't holdup wood		Don't holdup wood	
OSB Mill Strategy	No Remote stranding		Remote stranding	
	NWC	OSB Mill	NWC	OSB Mill
Net Present Value of Payoffs	$0	$0	$2,902	$2,846
Net Joint Players payoff	$0		$5,747	

Table 6-1: NPV payoffs ($1,000) (Years 1-10) Strategy A and B Summary

NPV payoffs (Years 1-10)				
NWC Strategy OSB Mill Strategy	Strategy C: Holdup wood Remote stranding		Strategy D: Holdup wood No remote stranding	
	NWC	OSB Mill	NWC	OSB Mill
Heldup wood volumes (%)	25.0%		25.0%	
Net Present Value of Payoffs	$6,205	($4,728)	$3,323	($6,710)
Net Joint Players payoff	$1,477		($3,387)	

Table 6-2: NPV payoffs ($1,000) (Years 1-10) Strategy C and D Summary

Expressed in the 2x2 matrix of the PD game, as delineated in Chapter 3, it shows the interaction of the players' strategies. Players assess their own payoffs relative to the other player's possible actions. In the case of a 2x2 matrix, the player has to analyze his play under each of the other player's two choices of action. The logic of play is based on economic rationality, maximizing the gain or minimizing the loss under the strict rules of the game. In most game plays a dominant strategy will arise for each player, yielding a dominant outcome or Nash equilibrium for the game.

For the baseline game, the players' logic is: NWC reasons that the other player OSB Mill can build the remote strander (RS) or not build the remote strander (nRS). If OSB Mill builds the strander, NWC would holdup up wood supply (H) for a 10 years payoff of $6.62 million. If OSB Mill doesn't build the remote strander, NWC will still holdup for a payoff of $3.19 million, therefore NWC will holdup. To holdup is NWC's dominant strategy.

		OSB Mill	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.90, 2.85)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (6.20, -4.73)	Strategy D: (3.32, -6.71)

Table 6-3: (Baseline game; ($ millions))

OSB Mill reasons that NWC can holdup 25% of the wood fiber (H) or not holdup fiber (nH). If NWC doesn't hold up fiber, OSB Mill would install the remote strander, yielding a payoff of $2.85 million and if NWC holds up, OSB Mill would lose less by investing in the remote strander (-$4.73 vs. -$6.71 million). The dominant joint strategy of the game is to Hold/build the Remote Strander (H/RS).

6.3 Sensitivity Analysis

How dominant is the outcome Hold/Remote Strand (H/RS) from the baseline model run? What variables can be changed that would result in NWC co-operating with OSB Mill, yielding a nH/RS outcome? To test this, a sensitivity analysis was run with:

- NWC achieving a 0%, 25%, 50%, 75%, and 100% holdup on the aspen allocation to the OSB Mill plant under NWC's TSL;
- NWC being paid -$4.00 (the alternative cost of disposal), $0.00, and $15.94 (the breakeven price paid to CLFP, adjusted for the cost of transportation) for the spruce residues delivered to the remote strander;

- The OSB Mill plant achieves a profit of $44.44, 50% of $44.44 or $22.22, and $11.11 per cubic meter of aspen round wood or equivalent input;
- The wet strand bulk densities of 20lbs per ft3 or 317 Kg per M3 or 12lbs per ft^3 or 190 Kg per m^3; and
- NWC achieving a net cashflow of $13.84, $6.92, $3.46, and $0.00 per additional cubic meter of sawlogs processed by the NWC aspen cut-stock mill.

6.3.1 Change in NWC aspen fiber withholding

OSB needs to assess what percentage of equity the community would be able to access control over through political and/or legal means. Based on the wood fiber equity of the communities and the need for steady flows of wood fiber into the OSB plant, OSB can assess whether it should build and operate the remote stranding facility or not, to secure long-term profitability for the OSB plant. For this research, the holdup and NWC using 0%, 25%, 50%, 75%, and 100% of the 90M cubic meters of the NWC regional wood were run.

Of the five holdup levels tested, 0% and 100% are the only levels that produce a strategy that differs from the baseline 25% withholding (Table 6-4).

	Dominant Strategy		
% fiber withheld	NWC	OSB Mill	Joint
0% fiber	nH	RS	nH/RS
25% fiber (Table 6-3)	H	RS	H/RS
50% fiber (Table A-7)	H	RS	H/RS
75% fiber (Table A-8)	H	RS	H/RS
100% fiber (Table 6-6)	H	Na	H/nRS

Table 6-4: (Strategies for NWC aspen fiber withholding)

Under 0% NWC holdup, the NPV values are:

		OSB Mill	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.90, 2.85)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (2.90, 2.85)	Strategy D: (0.00, 0.00)

Table 6-5: (0% NWC aspen fiber withholding; payoffs; ($ millions))

This yields nH/RS as the dominant strategy pair.

Under 100% NWC holdup, the NPV values are:

		OSB Mill	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.90, 2.85)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (15.98, -27.45)	Strategy D: (13.16, -26.84)

Table 6-6: (100% NWC aspen fiber withholding; ($ millions))

At 100% NWC holdup, OSB Mill does not have a dominant strategy, but relies on NWC's dominate strategy of Holding up (H) to develop its own strategy. The game plays: NWC holds up under both nRS and RS, therefore H dominants. OSB Mill would RS with no holdup, and nRS with NWC holdup, but they reason that NWC will always H, therefore OSB MILL nRS. The dominant play becomes H/nRS, being individually and jointly sub-optimal.

Saddle points lead to indeterminate outcomes. These saddle points are indifference points for each of the players in taking action, NWC to hold or not to hold, or OSB MILL to remote strand or to not remote strand. NWC's saddle point to OSB Mill's action of building or not building the remote stranding is at 0.1% fiber holdup. Such a low percentage holdup positive payoff for NWC would not bode well for OSB MILL assuming a non-adversarial stance from NWC as they will always move for holdup unless there is explicit co-operation[25]. If outside investments are not a possibility for OSB Mill, they become indifferent to building the remote strander under holdup at 83% holdup.

6.3.2 Change in the amount NWC is paid for spruce residues

NWC sells 50% of its spruce residues directly to the Meadow Lake OSB plant and disposes of the remaining 50% at -$4.00 per tonne. For this research, three residual price points were used; -$4.00, $0.00, and $15.31 per tonne of input fiber to the remote strander facility. The -$4.00 is based on the current local disposal cost for NWC. CLFP will be paid the break-even price of $15.31, plus transportation expenses, per tonne for their bundled residuals. The NWC board may demand that they be paid at least as much as CLFP is paid for their fiber, and hence the $15.31 was tested for its outcome on the game.

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[25] Co-operation is defined as a joint decision that is fully binding on both parties.

	Dominant Strategy		
$ paid NWC for spruce residuals per tonne	NWC	OSB Mill	Joint
-$ 4.00 (Table A-9)	NH	RS	nH/RS
$ 0.00 (Table 6-3)	H	RS	H/RS
$15.31 (Table A-10)	H	RS	H/RS

Table 6-7: (Strategies for NWC spruce residual payment)

If Strategy C is eliminated from the possibility set, at what point would NWC be indifferent to holding up under nRS and RS? At ($1.30) per tonne NWC payment for disposal of its spruce residuals, the NPV values are:

		OSB Mill	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.77, 2.55)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (6.07, -4.60)	Strategy D: (2.77, -6.71)

Table 6-8: (-$4.00 NWC payment for its spruce residuals; ($ millions))

Holding up under nRS would yield NWC the same payoff as not holding up under RS. If NWC then co-operated with OSB Mill in the building of the Remote Strander, OSB Mill would gain $9.26 million under Strategy B over Strategy D.

6.3.3 Change in the profit that the OSB plant achieves on input fiber

For this research, $44.44, $22.22, and $11.11 profit per cubic meter of roundwood input into the OSB plant was tested. Table 6-9 summarizes the outcomes.

	Dominant Strategy		
$ Profit: OSB Mill plant per input tonne	NWC	OSB Mill	Joint
$ 44.00 (Table 6-3)	H	RS	H/RS
$ 22.22 (Table 6-8)	H	nRS	H/nRS
$11.11 (Table 6-11)	H	nRS	H/nRS

Table 6-9: (Strategies for OSB Mill profit per input tonne)

Under $22.22 profit per cubic meter of roundwood or equivalent input, the NPV values are:

		OSB Mill	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.90, 0.40)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (6.20, -3.82)	Strategy D: (3.32, -3.36)

Table 6-10: ($22.22 OSB Mill profit per input tonne ($ millions))

NWC holds up under both nRS and RS, therefore H dominates. OSB Mill will Remote Strand (RS) with no holdup, and will not Remote Strand (nRS) with NWC holdup, but they reason that NWC will always H, therefore OSB Mill nRS. The dominant play becomes H/nRS, being individually and jointly sub-optimal.

Under $11.11 profit per cubic meter of roundwood or equivalent input, the NPV values are:

		OSB Mill	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.90, -0.82)	Strategy A: (0, 0)
	Holdup wood fiber to Firm plant	Strategy C: (6.20, -3.36)	Strategy D: (3.32, -1.68)

Table 6-11: ($11.11 OSB Mill profit per input tonne ($ millions))

NWC holds up under both nRS and RS, therefore H dominates. OSB Mill will not Remote Strand (nRS) under both nH and H, therefore nRS dominates, giving a play of H/nRS.

The saddle point is at $26.44 profit per m^3 of roundwood input to the OSB Mill plant or 59.5% of the baseline $44.44 where OSB Mill becomes indifferent under holdup by NWC, and won't build the remote strander.

		OSB Mill	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.90, 0.86)	Strategy A: (0, 0)
	Holdup wood fiber to Firm plant	Strategy C: (6.20, -3.99)	Strategy D: (3.32, -3.99)

Table 6-12: ($26.44 OSB Mill profit per input tonne ($ millions))

Under this scenario, OSB Mill reasons that NWC can H or nH. Under nH, they would RS, but NWC would H under RS, therefore, since there is no gain for OSB under H/RS, OSB will nRS. Strategy D becomes the dominant strategy (H/nRS), which is sub-optimal individually and jointly for NWC and OSB.

6.3.4 Change in the Bulk Density of Wet Strands

Two analyses were performed to assess the difference in shipping the wet strands between Beauval Forks and the Meadow Lake OSB plant, based on the dry bulk densities of 6.0 or 10.0 lbs per ft^3. A moisture factor of 2X was assumed, to yield wet strand BDs of 12.0, and 20.0 lbs per ft3 or 190 and 317 Kgs per m^3. For a BD of 190, strand shipping costs were $24.19 per tonne or 130% of the expense of shipping the equivalent roundwood (Tables 6-11 and 6-12).

Cost per delivered wet strand tonne comparison between roundwood and remote processed strands.	
(based on low density for bulk density of strands)	
roundwood volume hauled from the region (M cubic meters)	90.000
roundwood tonnes hauled from the region	90,000
roundwood haul cost per net tonne of wet strands	$18.63
wet strand tonnes hauled from the region	72,000
haul cost per net tonne of wet strands	$24.19
$ difference in haul cost between wet strands and the equivalent roundwood	$5.56
percentage difference in haul cost between wet strands and the equivalent roundwood	129.83%
Roundwood hauling	
tonnes of roundwood hauled per trip(wted. avg. for winter/summer seasons)	36.355
winter load limit (assume legal load wts, not oversize permitted loads) (net tarre (kgs))	37,955
summer load limit - net tarre (kgs)	29,955
percent of roundwood hauled in winter	80%
trips per annum from the region	2476
trailer purchase price (Super-B log haul)	$120,000
trailer maintenance per annum	$8,000
years of use	7
trailer costs per annum	$18,286
number of the trailers on the haul	5
trailer costs per trip	$37
hauling charge by NWC/NRT Trucking per trip (8 axle-truck only)	$505
roundwood haul cost per trip (Beauval-ML OSB)	$542
roundwood haul cost per tonne	$14.90
roundwood haul cost per net tonne of wet strands	$18.63

Table 6-13: Transportation Costs of Remotely Processed Wet Strands w/ BD of 190 kgs/m^3

Wet Strand hauling	
maximum tonnes of strands hauled per trip by weight(wted. avg. for winter/summer seasons)	32.902
maximum tonnes of strands hauled per trip by volume(wted. avg. for winter/summer seasons)	22.246
winter load limit (assume legal load wts, not oversize permitted loads) (net tarre (kgs))	37,955
summer load limit - net tarre (kgs)	29,955
percent of strands hauled in winter	37%
trips per annum from the region	3236
trailer purchase price (Super-B side tip)	$180,000
trailer maintenance per annum	$8,000
years of use	7
trailer costs per annum	$26,857
number of the trailers on the haul	4
trailer costs per trip	$33
hauling charge by NWC/NRT Trucking per trip (8 axle-truck only)	$505
strand haul cost per trip (Beauval-ML OSB)	$538
strand haul cost per tonne	$24.19
Assumptions:	
distance from Beauval Forks to ML OSB plant (km)	165
hauling charge by NWC/NRT Trucking per Km (8 axle-truck only)	$1.53
aspen weight per m3 (tonne)	1.00
no back haul to offset the expenses	
no salvage value on the trailer	
roundwood weight loss to residuals	20.0%
bulk density of wet strands: low bulk density (kgs per cubic meter)	190
Side-tip Super-B trailer capacity (m3)	117

Table 6-14: Transportation Costs of Remotely Processed Wet Strands w/ BD of 190 kgs/m^3 continued.

For a BD of 20.0lbs/ft^3 or 317kgs/m^3, strand shipping costs were $16.46 per tonne or 88.38% of the expense of shipping the equivalent roundwood (Table 6-12). At a bulk density of 281 kgs/m^3 and higher, the loads are limited by weight instead of volume. This would be the point of most efficient use of the trailers volume capacity, while minimizing strand degrade due to fiber crushing and breakage.

The two strand shipping costs, the baseline of \$16.46 and \$24.19 per tonne were input into the PD model. The baseline expense of \$16.46 per tonne wet strand shipping costs yielded a joint strategy of H/RS. The \$24.19 shipping cost yielded the NPV values of:

		OSB Mill	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.95, -1.82)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (6.24, -8.46)	Strategy D: (3.32, -6.71)

Table 6-15: (\$24.19/tonne Wet Strand shipping expense; \$ millions))

NWC will Holdup (H) in both strategies, therefore H is dominant. For OSB Mill, nRS is dominant. H/nRS becomes the dominant strategy. There is minimal impact on NWC from the increase in shipping costs, but OSB Mill sees a 142% increase in its losses (\$-4.73 -> \$-6.71(millions)).

Under nH on the part of NWC, OSB Mill is indifferent to nRS vs. RS at a Bulk Density of 217 Kg/M^3, with a shipping cost of \$21.18 per tonne. With NWC holding up as its dominant play, the BD would have to be greater than 223 Kg per M^3, with a shipping cost of \$20.61 per tonne of wet strands or less, for OSB Mill to pursue the RS strategy (Table 6-16).

		OSB	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.93, 0.34)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (6.22, -6.73)	Strategy D: (3.32, -6.71)

Table 6-16: ($21.18/tonne Wet Strand shipping expense ($ millions))

6.3.5 Change in NWC Cashflow Levels from the Withheld Wood fiber

NWC witholding wood supply from the region dominates, therefore the research tested the effect on NWC's decision process by reducing the cashflows gained from the withheld wood. The original run set the NWC cashflow per cubic meter of roundwood withheld at $13.84. 50% ($6.92) and 25% ($3.46), and $0.00 levels were run to test for the dominance of H/RS. Table 6-15 summarizes the results.

	Dominant Strategy		
NWC cashflow per M^3 of withheld roundwood	NWC	OSB MILL	Joint
$13.84 cashflow per M^3 (Table 6-3)	H	RS	H/RS
$ 6.92 cashflow per M^3 (Table A-11)	H	RS	H/RS
$ 3.46 cashflow per M^3 (Table 6-3)	H	RS	H/RS
$ 0.00 cashflow per M^3 (Table 6-3)	H	RS	H/RS
-$22.60 cashflow per M^3 (Table 6-18)	na	RS	Saddle

Table 6-17: (Strategy outcomes for NWC Cashflows per M^3 roundwood withheld)

The H/RS joint strategy dominates until NWC's cashflows per m^3 of roundwood fall below ($22.60).

		OSB MILL	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.90, 2.85)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (2.90, -4.73)	Strategy D: (0.02, -6.71)

Table 6-18: (-$22.60 NWC Cashflows per M^3 roundwood withheld ($ millions))

The indifference point for NWC holding up or not holding up fiber would be a ($22.60).

6.4 Summary of the Results

For the standard game, with only two choices of action per player, H/RS is the overall dominant strategy, with rare exception. NWC will not move to withhold wood supply under the conditions of:

- No legal ability to perform a long-term holdup. They may be able to affect short-term holdup through direct action, but that was not modeled; or
- NWC would need to lose $22.60 or more per cubic meter of aspen roundwood that they withhold and process in their own mill.

OSB MILL will not invest and operate the remote strander under the conditions of:

- NWC controlling and diverting to their regional sawmill greater than 83% of the wood from the region;
- OSB MILL makes less than $26.44 net cashflow per cubic meter of roundwood or the equivalent fiber from strands;
- The cost of transport of the remote processed strands is greater than $20.61 per tonne, which is based on a bulk density of less than 223 Kg/M^3.

Chapter 7 examines the implications of these results and the relaxed strategy where OSB MILL would invest outside, eliminating Strategy C from the game set. Conditions under which OSB MILL and NWC should co-operate will be delineated.

Chapter 7
Conclusion

7.1 Introduction

The rate of global forest industrialization is unprecedented in history. With this comes the potential for conflict between stakeholders. In many areas of the world, the use of power by the forestry major to enact full access to the regional resource against the community will has been extreme. To balance this, community based stakeholders take a stance against their exploitation, moving to withhold local resources from the firm. The alternative to this radical outcome is to co-operate. The consciousness and moral codes shift to ones where interdependency, sharing and the development of trust become the main guide points (Craig, 1989). With this shift, comes a paradigm shift in how the business organization is expected to operate, what its goals are, and what it gives back to society.

The forestry major can continue to feed the dependent, reactive model of community or become part of the solution. The forestry firm is in a position as leader and potential collaborator to bring the resources forward to facilitate the paradigm shift to a symbiotic mode of operating for both parties. They gain through their adoption of a more symbiotic attitude by being able to operate in a less turbulent environment, allowing them to concentrate on the technical issues of wood product manufacturing and marketing. Wood supply, environmental use of the forest, and local community economic development are less politicized.

This research examined under what economic circumstances would the forestry firm, the Meadow Lake OSB Partnership Ltd., and the regional development authority, as expressed by NWC, co-operate or not co-operate in the processing of wood fiber from the region. A Prisoner's Dilemma 2x2 game was the lens for analysis.

7.2 Summary of Conclusions

The original hypothesis was:

> *By Meadow Lake OSB Partnership Ltd. vertically de-integrating, i.e. outsourcing its processing services, there will be a long-term improvement in their Meadow Lake OSB plant's profitability due to a secure and increased feedstock for the plant, as measured by NPV over a 10 year planning horizon;*

This research has shown that the major forestry firm's long-term profitability will improve or diminish less with a remote stranding plant, due to stabilized wood-supply to the OSB MILL plant instead of the community seeking alternative allocations for wood fiber from the region. The question for Tolko is how to move or under what circumstances would the community group enter a co-operative relationship instead of the dominant adversarial holdup scenario?

Why would the players consider acting in a co-operative way to the other player of the game? In the majority of the model runs, the Meadow Lake OSB Partnership Ltd building and operating the remote strander was the dominant play. It is in the firm's long-term economic self-interest to build and operate the remote strander, either to minimize losses incurred because of fiber loss due to NWC holdup, or to make a profit. Under all non-holdup plays, Tolko would build the Remote strander, except where:

- Tolko's profits on input fiber are below $18.60 per tonne of roundwood or equivalent;
- The bulk density of the wet strands is less than 217 Kgs per M3;

Under the strict game, NWC would not holdup where:

- NWC loses $22.60 or more per cubic meter of aspen roundwood that they holdup and process in their own mill.

If OSB Mill where to move outside the strict rules of the game and openly communicate their refusal to Strategy C (H/RS) because they have investment options for the $4.6 million that will yield a greater return than the losses sustained from NWC's holdup under RS, NWC would be induced to co-operate if one of these scenarios is true:

- NWC has the ability to holdup 21.8% or less of the fiber;
- NWC receives greater than -$1.90 per tonne for the spruce waste delivered to the remote strander, i.e. they pay less than $1.90 per tonne for residual disposal; or
- NWC expects to make less than $9.20 per cubic meter of wood input into their mill.

Based on this research, the forestry resource firm needs to examine the ability of the community to process the regional fiber as an alternative to the firm processing it. If they have the capabilities to follow through on alternative processing, the forestry firm should view the community as having a high salience to their long-term profitability.

The community development corporation can empower itself through the acquisition of the technical expertise and financial backing to process some of the wood fiber from the region. This would increase their bargaining credibility as a viable threat to the firm, and thus induce co-operation in the community economic development.

There are no technical engineering reasons for lack of implementation of remote stranding facilities in North America other than the idea of duplication. Remote or satellite stranding implementation, or lack there of, relates to the economics of centralization and ownership/control of the resource.

When one examines only the cost of transportation of the roundwood versus shipping the equivalent strands, the results yield minimal if any cost savings compared to the capital investment, making remote strand look economically infeasible. If one includes the potential for additional fiber being available to the OSB MILL operator, and the ability to politically ensure a consistent fiber supply into a high fixed cost business, the $4.6 million investment is deemed worthwhile.

The ecological and environmental engineering ramifications of the decision to build a remote stranding facility include:

- fuller utilization of the wood fiber from the region because there is a higher use of the residuals from the communities' (NWC and CLFP mills) sawmills;

- less wood fiber weight hauled over the northern highways per ft^2 of OSB panel production – yielding less impact on the northern road system;
- lower disposal volumes of fines at the Meadow Lake site – cited as a potential storage problem in the Environmental Assessment review (Stantec, 2001);
- availability of a ready supply of biomass fuel for the community of Beauval, SK to reduce their use of imported propane for domestic and municipal heating requirements.

For the large forestry firm to decentralize some of its production facilities and move from the status quo of centralization, they have to believe that the community group could affect the supply of wood into their operation, and that the modeling technique and outcomes reflect their operating reality. Many of the forestry firms have moved to limit any availability of wood fiber to community-based sawmill operations to limit the development of a creditable threat that would have the political sway, financial backing, and technical skills to succeed. Effectively, the firms have acted to limit the environment where this game could develop. How long can the firm control this environment?

Internationally, there have been many sweeping reforms of the forestry allocation practices as democratic pressures force the governments to respond to its citizens needs and the degradation of the forest ecosystem with forestry sector readjustments. In Indonesia, under the Suharto regime, the national government held complete administrative authority to the forestry resources. Under this control, over 20 million m^3 of unprocessed timber was exported per year, yielding minimal local community benefits, with most of the export earnings going to institutional power holders within the state apparatus (Barr, 2001).

With the political reforms of the post-Suharto period providing for the decentralization and devolution of administrative authority in the forestry sector from the national government to the provincial and district governments. With these reforms came the need for many of the multi-national and previously monopolistic forestry processing and export firms to adjust their organization's operating paradigm in regards to the forestry communities' welfare to ensure wood supply. Timber shortages at the firm lead the Bob Hasan Group to create an 180,000 ha Acacia plantation, and import wood from Malaysia and Australia.

This example points to the fact that resource firms may be able to control their resource allocations for a period of time, but outside dynamics can fundamentally change their rights to the resource. In British Columbia, the Provincial Government has the responsibility and legal right to manage forestry fiber allocations. Their alliances have been with the large provincial and multi-national forestry processors in the province. Increasingly, communities have moved to have the province allocate them some form of local rights to manage the forest resource as the local community deems would benefit it. As individual communities, they have received little in the decentralization of allocation of wood fiber (Gill and Reed, 1999). These once individual forestry communities have now joined into a forestry community group of 40 communities to petition the provincial government for increased devolution of resource allocation and management to the local (Copeland, 1999).

With the adoption of the model of decentralization of components of the fiber process earlier in the process, the major forestry firms of BC could minimize disruptions to their wood supply and hence profits. Without earlier adoption, the firm is more likely to be in conflict with the communities, risking alienation and diminishment of its fiber inflows. Community collaborative forestry agreements could provide operating environment stability for the firm in the context of changing property rights to the forest fiber. For the exercise examined in this research, it takes very little reallocation of fiber, i.e. a small recognition by the Province of community rights to the fiber, for the profit picture of the firm to change by several million dollars.

7.3 Limitations of the Study and Recommendations for Further Research

The Player's rationality is limited to economic maximization. The community actions are dictated by the drive for community economic development, not the more encompassing community well-being. A game could be designed that used players' utilities as payoffs, but to measure a community and/or a region's non-economic utility from the installation of a remote processing plant, with any degree of confidence, may prove to be impossible.

This game was expressed as a closed environment, with only two players and non-iterative, one-off with limited actions/reactions. The player's actions were final, limiting the interplay. With a multiple iteration game, where the dynamics of co-operation/non-co-operation can play out over a time horizon, players would build a sense of trust or non-trust of the other player, modifying his actions accordingly. In a multi-iterative game, co-operation along a convergence path may yield a more jointly profitable solution than choosing the joint solution immediately (Camerer, 1997).

There is no modeling for decision-making under uncertainty. This research did not use risk-adjusted payoffs. If risk or uncertainty was introduced into the model, the player's may be induced to co-operate more readily, depending on their risk preferences. One would have to assign probabilities to the payoffs and to the various levels of wood fiber that NWC would be able to withhold from the OSB MILL plant. Because (H/RS) was so dominant within the sensitivity analysis, this work may not yield anymore valid a model than what was already derived in this research.

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Appendix

General assumptions	
present aspen volumes harvested from NWC TSL for Tolko (M cubic meters)	90.000
% community equity in aspen	25.0%
aspen withheld and diverted to NWC mill (M cubic meters)	22.500
prime financing rate	5.00%
discount rate used for NPV calculations	8.00%
conversion volumes of m3 aspen->strands	3
ft3 per m3	34.86
weight of m3 of spruce (kgs)	820
percent of a tonne: spruce	82.00%
weight of m3 of aspen (kgs)	1000
weight of m3 of aspen (lbs)	2200
percent of a tonne: aspen	100.00%
bulk density of dry aspen strands (lbs. per ft3)	12.5
bulk density of dry aspen strands (lbs. per M3)	436
bulk density of dry aspen strands (Kgs. per M3)	198
multiplication factor for moisture	2.0
bulk density of wet aspen strands used for model Hi (Kgs. per M3)	396
bulk density of wet aspen strands used for model industry average @10lbs/ft3 dry(Kgs. per M3)	317
bulk density of wet aspen strands used for model Low (kgs. per M3)	190

Table A-1: General model assumptions for payoff calculations

NWC assumptions	
NWC sawmill(s)	
projected capital expenses	$1,738,097
projected net profit when operating at 100% of expected output	$568,130
Cut-stock mill sawlogs requirement (cubic meters)	41,047
Non-sawgrade timber harvested	22,102
Total timber harvested	63,149
projected net cashflows per M cubic meters of sawlog input	$13,841
projected Operations labour costs per annum	$486,080
projected Operations labour costs per M cubic meters of sawlog input	$11,842
projected management/administration costs per annum	$200,000
projected management/administration costs per M cubic meters of sawlog input	$4,872
projected total payroll per M cubic meters of sawlog input	$16,714
equipment and loader annual depreciation	$189,513
equipment and loader annual depreciation per M cubic meter	$4,617
percent of depreciation required for equipment refurbishing/replacement	50.0%
equipment and loader annual refurbishing/replacement per M cubic meter	$2,308

Table A-2: NWC assumptions for payoff calculations

NWC present operations	
delivered millyard cost of aspen logs ($ per cubic meter)	$29.47
total aspen log volume into primary breakdown (Mm3)	40.500
total spruce log volume into primary breakdown (Mm3)	90.000
chip/strandable aspen sawmill waste produced (%)	45.9%
chip/strandable aspen sawmill waste produced (Mm3)	
chip/strandable aspen sawmill waste produced (tonne)	30,607
strandable spruce sawmill waste produced (%)	19.5%
strandable spruce sawmill waste produced (Mm3)	
strandable spruce sawmill waste produced (tonne)	14,910
total aspen residuals chipped and shipped to Millar-Western (tonnes)	30,607
total aspen residuals stranded and/or shipped to ML OSB	0
spruce pulp wood produced (tonnes)	5,950
total spruce residuals that could be shipped to ML OSB (tonnes)	13,405
NWC additional operations with community equity wood	
harvested wood to sawlog grade wood (%)	65%
percent of harvested logs shipped as pulpwood to Mistik	35%
community equity sawlogs (M cubic meters)	14.625
community equity non-sawlogs (M cubic meters)	7.875
Cut-stock mill residual waste (% of cut-stock log input)	20.0%
maximum volume of chips that can be swapped with Millar-Western for graded tree-length (Ktonnes)	20.000
additional capital expenses to support the additional volume ($ per cubic meter sawlogs)	$42.34
additional capital expenses to support the additional volume (total $)	$619,284
NWC equity (%)	40%
NWC equity ($)	$247,714
Debt financing (%)	60%
Debt financing ($)	$371,571
cost of financing risk premium (%)	2.50%
cost of financing (% per annum)	7.50%
debt financing term (months)	60
debt financing expense ($ per month)	($7,446)
cost of financing ($ per annum (interest only))	

Table A-2: NWC assumptions for payoff calculations (cont.)

Meadow Lake OSB	
revenues on spruce slabs and pulp wood (without the disposal cost savings)	$402,152
cost of sales	$317,355
cost of transportation	$167,563
net income on bundled spruce slabs and pulpwood shipped to ML OSB	-$82,766
total spruce residuals that could be shipped to ML OSB (tonnes)	13,405
revenue per tonne for bundled slabs	$30.00
residue disposal cost savings ($ per tonne)	$4.00
cost of sales ($/tonne)	$23.67
cost of transportation ($/tonne)	$12.50
cost of the haul	$400.00
average load (tonnes)	32.0
cost of bundling ($/tonne)	$11.17
tonnes per shift (based on 500 shifts)	26.8
salaries per shift (2 personnel @ 15.00/hr w/ benefits)	$240.00
loader (@$65/hr x 1/4hr)	$59.58
net income per tonne of bundled spruce slabs shipped to ML OSB	-$6.17
Remote Stranding plant	
sale of spruce slabs	
spruce slabs sold to remote stranding plant (tonnes)	13,405
spruce residuals besides the slabs sold to remote stranding plant (tonnes)	1,505
value of NWC spruce residuals into remote strander ($/tonne)	$0.00
total aspen residuals stranded and/or shipped to ML OSB	0
projected payroll for remote stranding plant ($ total per annum)	$305,000
Grinder Technician	$60,000
General Operations (2x)	$90,000
Loader Operator	$50,000
Yard Operations (1x)	$45,000
Operations Manager	$60,000
dividends paid to NWC by NWC/NRT Trucking for strand haul to ML OSB (no holdup)	$14,818
dividends paid to NWC by NWC/NRT Trucking for strand haul to ML OSB (w/ holdup)	$11,854
profits as a percent of revenues	4.0%
percent of dividends paid out vs. retained as earnings	50.0%
Revenues on the strand haul (no holdup)	$1,481,774
Revenues on the strand haul (w/ holdup)	$1,185,414
NWC share of partnership	50.0%

Table A-2: NWC assumptions for payoff calculations (cont.)

TOLKO assumptions	
Meadow Lake OSB	
delivered millyard cost of aspen logs ($ per cubic meter)	$30.00
delivered millyard cost of aspen logs ($ per cubic tonne)	$30.00
distance from Beauval Forks to ML OSB plant (km)	165
roundwood weight loss to residuals	20.0%
wood shipped from NWC TSL with NWC holdup (M cubic meters per annum)	67.500
change in wood shipped from NWC TSL with NWC holdup (M cubic meters per yr.)	-22.500
income per m3 of input of roundwood ($ per tonne)	$44.44
payback period (yrs)	3.5
capital investment	$140,000,000
payback per year	$40,000,000
total fiber into plant (M m3)	900
income per m3 of input of strands ($ per tonne)	$55.56
profits to the ML OSB from remote produced strands	$4,999,911
working capital savings on trucking of inventory at the ML OSB plant	$53,654
Remote Stranding plant	
initial equipment only costs	$2,780,000
initial capital costs (estimated from CAE Ainsworth study)	$4,600,000
Tolko equity (%)	40%
Tolko equity ($)	$1,840,000
Debt financing (%)	60%
Debt financing ($)	$2,760,000
cost of financing risk premium (%)	0.00%
cost of financing (%)	5.00%
debt financing term (months)	60
debt financing expense ($ per month (interest only))	$6,299
debt financing expense ($ per month)	($52,085)
depreciation per annum (based on 10yr straight line)	10.0%
long slab residual wood fines	20.00%
nonlong slab residual wood fines	40.00%
roundwood weight loss to non-usable fines	20.00%
slab to other strandable residuals	50.00%
maximum throughput based on CAE 37/118 - 24 knife flaker per annum (tonnes)	145,455
Mlbs per hr capacity of dry	40
moisture factor	200%
shifts per annum	500
hrs per shift	8
total weight of strands delivered to ML OSB plant	89,998
additional weight of fiber delivered to the ML OSB plant	12,034
total weight of aspen roundwood strands (tonnes)	77,200
total weight of spruce residual strands (tonnes)	12,189
total weight of aspen residual strands (tonne)	609

Table A-3: Tolko assumptions for payoff calculations

Proforma Income Statement: remote stranding plant	
based on industry average of 20lbs/ft3 for the bulk density of wet strands	
No withholding of wood supply by NWC	
Revenues	**$5,399,904**
revenues on aspen roundwood	$4,320,000
revenues on NWC spruce residuals	$626,226
revenues on NWC aspen residuals	$0
revenues on other local sawmills spruce residuals	$105,112
revenues on other local sawmill aspen residuals	$348,565
Cost of Sales	**$4,884,494**
personnel	$245,000
cost of NWC spruce residuals	$0
cost of NWC aspen residuals	$0
cost of NWC hardwood roundwood	$2,652,300
cost of CLFP spruce residuals	$50,054
cost of CLFP aspen residuals	$15,235
cost of CLFP hardwood roundwood	$222,025
maintenance	$10,000
consumables	$53,760
clamps/carriers/anvils, etc.	$50,000
power	$89,347
misc.	$15,000
loading and transportation	$1,481,774
Gross Profit	**$515,410**
management and administration expenses	$87,000
Net profit before interest and depreciation	**$428,410**
equipment financing interest	$75,587
depreciation	$460,000
Net Income	**-$107,177**
net income per tonne of input ($/tonne)	-$1.02
% of revenues	-1.98%

Table A-3: Proforma Income Statement: remote stranding plant

Assumptions: Remote Strander Income Statement	
input pricing on NWC spruce residuals ($/tonne)	$0.00
input pricing on NWC aspen residuals ($/tonne)	$0.00
input pricing on NWC TSL hardwood roundwood ($/m3)	$29.47
input pricing on CLFP spruce residuals ($/tonne)	$20.00
input pricing on CLFP aspen residuals ($/tonne)	$20.00
input pricing on CLFP roundwood ($/m3)	$34.16
total weight of strands delivered to ML OSB plant	89,998
additional weight of fiber delivered to the ML OSB plant	12,034
total weight of aspen roundwood strands (tonnes)	77,200
total weight of spruce residual strands (tonnes)	12,189
total weight of aspen residual strands (tonne)	609
payload per trip (seasonally averaged) tonnes	32.902
trips per year	2,735
input volumes of NWC aspen roundwood (Mm3)	90.0
input weight of NWC aspen roundwood (tonnes)	90,000
output weight of NWC aspen roundwood strands (tonnes)	72,000
input of NWC spruce residuals (tonne)	14,910
output weight of strands made from NWC spruce residuals	10,437
equivalent output weight of spruce strands already shipped to ML OSB	
input of NWC aspen residuals (tonnes)	0
output weight of strands made from NWC aspen residuals	0
input volumes of CLFP aspen roundwood (Mm3)	6.5
input weight of CLFP aspen roundwood (tonnes)	6,500
output weight of CLFP aspen roundwood strands (tonnes)	5,200
input of CLFP spruce residuals (tonne)	2,503
output weight of strands made from CLFP spruce residuals	1,752
input of CLFP aspen residuals (tonnes)	762
output weight of strands made from CLFP aspen residuals	609
tonne:m3 of spruce residuals	1.00
tonne:m3 of aspen residuals	1
tonne:m3 of aspen roundwood	1
long slab residual wood fines	20.0%
non-long slab residual wood fines	40.0%
roundwood weight loss to non-usable fines	20.0%
delivered wet strand price to ML OSB ($/tonne)	$60.00
cost of transportation to ML OSB ($/tonne)	$16.46
net wet strand price fob Beauval Forks ($/tonne)	$43.54
administration expenses as % of revenues	0.50%
depreciation per annum (based on 10yr straight line)	10.00%
discount rate	8.00%
financing rate	5.00%
financing period (mths)	60
debt financing expense ($ per month (interest only))	$6,299
Meadow Lake NWC region wood inventory (months)	6
roundwood delivered cost per tonne to ML OSB plant	$30.00
roundwood trucking cost per tonne to ML OSB plant	$14.90

Table A-4: Assumptions for remote strander income statement

NWC income statement for the sale of spruce slabs to the ML OSB plant	
revenues on spruce slabs and pulp wood (includes the disposal cost savings)	$402,152
cost of sales	$317,355
cost of transportation	$167,563
net income on bundled spruce slabs and pulp wood shipped to ML OSB	-$82,766
Assumptions:	
total spruce residuals that are shipped to ML OSB (tonnes)	13,405
revenue per tonne for bundled slabs	$30.00
cost of sales ($/tonne)	$23.67
cost of transportation ($/tonne)	$12.50
cost of the haul	$400
average load (tonnes)	32.0
cost of bundling ($/tonne)	$11.17
tonnes per shift (based on 500 shifts)	26.8
salaries per shift (3 personnel @ 15.00/hr w/ benefits)	$240.00
loader (@$65/hr x 1/4hr)	$59.58
net income per tonne of bundled spruce slabs shipped to ML OSB	-$6.17

Table A-5: NWC income statement for spruce slabs

NWC Chipper Cashflows		
Chip volume shipped (tonnes)	30,607	based on: 25% NWC wood equity withheld
sawlogs received from Mistik (Mm3)	20.000	
Net sawlog log credit for chips	20.000	based on the log to chip swap ratio of 1.2
Cash on hand (beginning)	$0	
Revenues	$1,007,599	
Expenses	$859,331	
Cash on hand (end)	$148,268	
Revenues	$1,007,599	
Value of logs (net value into board stock mill as sawlogs)	$589,400	this is the value of the 20Mm3 treelength sawlogs delivered by MW
Value of logs shipped beyond the chip volume credit	$0	
Chip sales beyond swap volumes	$418,199	
Expenses	$859,331	
millwright assistant (@1/2 time* 2 shift)	$22,080	
electricity	$27,240	
maintenance	$104,134	based on 5 yr replacement of equipment
repairs		up front cost plus annual maintenance
transportation	$610,505	see transportation expense sheet
financing	$95,372	based on 9% interest, 60 months on debt financing
		assumed paying principal and interest on debt
Assumptions:		
sawlog value ($/M3)	$29.47	
cash chip value ($/tonne)	$30.00	
cash chip value ($/cubic meter)	$30.00	
millwright assistant wage w/ benefits	$13.80	per hr.
benefits	15.00%	
shifts per yr. (2002-3)	150	
shifts per yr. (2003-5)	400	

Table A-6: NWC Chipper Cashflows

		OSB MILL	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.90, 2.85)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (9.46, -12.30)	Strategy D: (6.60, -13.42)

Table A-7: (50% NWC aspen fiber withholding; ($ millions))

		OSB MILL	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.90, 2.85)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (12.72, -19.87)	Strategy D: (9.88, -20.13)

Table A-8: (75% NWC aspen fiber withholding; ($ millions))

		OSB MILL	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.50, 3.25)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (5.80, -4.33)	Strategy D: (2.77, -6.71)

Table A-9: (-$4.00 NWC payment for its spruce residuals; ($ millions))

		OSB MILL	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (4.43, 1.31)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (7.74, -6.26)	Strategy D: (2.77, -6.71)

Table A-10: ($15.31 NWC payment for its spruce residuals; ($ millions))

		OSB MILL	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.90, 2.85)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (5.58, -4.73)	Strategy D: (2.70, -6.71)

Table A-11: ($6.92 NWC Cashflows per M^3 roundwood withheld ($ millions))

		OSB MILL	
	Strategies	Paradigm CF	Paradigm IF
		Remote Strander	No Remote Strander
NWC	Don't Holdup wood fiber to Firm plant	Strategy B: (2.90, 2.85)	Strategy A: (0.00, 0.00)
	Holdup wood fiber to Firm plant	Strategy C: (5.26, -4.73)	Strategy D: (2.38, -6.71)

Table A-12: ($3.46 NWC Cashflows per M^3 roundwood withheld ($ millions))