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WOOD IN THE WEST

A Study of Innovation and Clustering in the Secondary Wood Industry in three Western Provinces (B.C. Alberta, and Manitoba)

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Introduction

Wood is an important economic factor in Canada's western provinces accounting for a significant amount of jobs, exports and revenues. Although wood is the leading commodity in only one province, B.C., where it accounts for almost half of the exports, it is also a major factor in the three other provinces. To be sure, the main export commodities in Alberta are petroleum and natural gas, in Saskatchewan wheat, potash and oil, and in Manitoba, wheat and machinery, but wood or rather wood products are important parts of their provincial economies as well.

This chapter looks at innovation and cluster patterns of the secondary wood industry in three of Canada's western provinces. Like the other chapters in this volume which focus on different industries, it is part of a larger study on innovation and clusters. This larger study is based on the assumption that the capacity for sustained innovation is dependent on communities of firms that share, and benefit from, a common knowledge base and various other resources, ranging from raw materials to a trained workforce. This latter focus is the approach of the cluster theory (Porter 1998) which sees clusters, geographic concentrations of interconnected companies and institutions in particular areas of economic activity, as an important phenomenon explaining knowledge flows through both interactive networks and unintended spill-over effects. Cluster theory emphasises the significance of the spatial dimension for innovative capabilities.

The wood, or more precisely, secondary wood manufacturing industries, the focus of this chapter, are challenging to analyze. First, it is difficult to define the industry which is in many ways closely connected to the forest sector (Schaan, 2003; Schuetze, 2002)yet has quite distinct characteristics and features. The way that it is captured by statistical classifications contributes to the problem of dealing with these distinct features. Another difficulty is to grasp the complexity of the industry itself which ranges from highly sophisticated, semi-automated and high tech companies to companies working with old equipment, outdated management practices, and a largely uneducated and low pay workforce. Partly these differences have to do with the size of the firm, and partly with type of activity or product. For example, re-manufacturing of low quality wood for use as standard building materials is typically a low tech, low skills industry, whereas the manufacturing of windows is typically more high tech, requiring advanced skills, at least from part of the workforce. But neither type of product nor firm size are determining factors as examples to the contrary can be found in all categories.

A third element which contributes to the great variation between companies in this sector is that the industry is in the middle of a massive change. There are especially two driving factors of this change. The first is the integration of different parts of the production and commercialisation process through the gradual use of information and communication technologies (ICTs) which have opened up a great potential for rationalisation and flexible small batch or customer-specific production. The second major factor of change is globalisation which not only give companies easier access to new markets and to new business partnerships, sub-contractors and suppliers but also exposes them to world wide competition, especially from the US, Europe and China. Both factors are rapidly changing an industry that in the past has been rather traditional and slow to change. Their effect has been equally influential for firms of all sizes, with the exception of very small craft firms, so that there is no easy pattern discernible that would link innovation to company size.

The sector is of great interest to policy makers and various industry stakeholders, for a number of reasons. Canada is world wide the number one exporting country for forest products, in 1989, forest products, including newsprint, accounted for 22 percent of world exports in this group and the sector formed 16.5 per cent of total Canadian exports (Porter 1999). However, the bulk of these products are not very sophisticated and Canada is not internationally competitive in machinery, equipment or services for the forest sector (ibid.). Moreover, sales of these products are dependent on volatile markets and import restrictions such as the on-going software lumber trade dispute with the US, the main market for Canadian wood products. In spite of the strong overall position of Canadian forestry exports market share and competitiveness in many of the lower value products have declined sharply because of global market supply changes and shifts in domestic user patterns. For the forest product industry to become globally competitive many analysts believe there is "a new mix (needed) of (a) traditional products from the '2x4 economy' and (b) an increasing proportion of higher value forest products arriving from 'the knowledge-based forest products economy'" (Woodbridge, 1999, p.1).

Governments look at the secondary industry as it is more labour intensive than the primary sector and thus creates greater amounts of value and of jobs per cubic metre of wood. Especially the latter is seen as crucial as the primary industry has lost a considerable portion of jobs due to significant productivity increases and the substitution of capital equipment for jobs. Also, environmentalists see secondary manufacturing as a way of saving forests and creating more value from trees than the primary sector did. As other good employment opportunities in the rural areas are not readily available outside the resources sector and as displaced forestry workers are seen as having some essential skills that would be useful for, and thus make them employable in the secondary sector, the secondary industry is seen as an essential plank of industrial and employment policy (Wilson et al, 1999).

This chapter is structured as follows. In Section 1, the wood manufacturing sector in Canada is defined as well as described with regard to its main characteristics. Section 2 provides an overview of the methodology of the research study that forms the base of this chapter. The main findings of that study will be presented and discussed in Section 3. In the fourth section the factors will be discussed that determine or influence the location of wood manufacturing firms in the west. Innovation and clustering in the wood industry are the focus of the final section.

1. Wood in the West: Definition and Description

The secondary wood industry, alternatively called 'secondary wood manufacturing', wood products, or 'value added' industry, comprises a variety of producers and products.

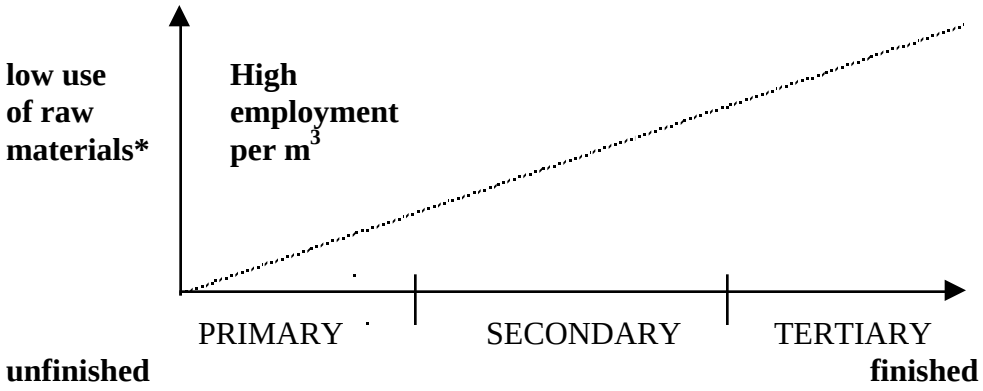
Essentially, value-added manufacturing means finished or semi-finished products rather than simply raw materials and unfinished basic products. However, as value is added in all stages from cutting the tree and various ways of processing wood, the 'added value' term is not very precise. Certainly saw mills would fall under this term which cut trees into standard dimension lumber, mainly for building construction.

Neither is the term 'wood manufacturing', precise as it suggests a specific mode of processing, i.e. the use of machinery for standardised products. This would exclude however a craft mode of processing wood, as it is common in many smaller companies building products to customers' specification. Thus both terms, value-added and manufacturing apply both to processes used in the primary industry and the secondary industry. While 'secondary wood manufacturing' is not

entirely clear either, it captures better than these terms the differences between the two sectors (Wilson et al, 1999). Therefore, secondary wood manufacturing seems the most appropriate term to eliminate logging and forestry services, saw milling of standard size construction ,lumber and of pulp and paper production.

To define the "secondary wood" industry requires therefore distinguishing it from the "primary industry" (basically logging and standard saw milling) on the one hand and the "tertiary" on the other (industries) that use wood but not exclusively or primarily (e.g. boat building). The exact definition of what should be included in the three groups is difficult as this is a matter of degree rather than categorical definition, as shown in Tables 1 and 2. What falls into the three respective groups is therefore best defined on a sliding scale, as show in Fig. 1.

Figure 1: Determinants and boundaries of the secondary wood industry



* see Table 1

Thus remanufacturing (mostly finger-joining of 2 x 4 lumber) is using lots of raw materials while using little manpower, while cabinets and furniture use comparatively little amounts of wood but provide more jobs per amount of wood used. (see table 1).

Table 1: Estimated Raw Material Use and Employment for Various Wood Product Groups (in BC)

Business Type	% Raw Material Use	Est.cubic meters (000s)	Jobs per 1000 cubic meters	Est.total Jobs
remanufacturers	50.50%	6,767	0.5	3,384
Panel board	23.40%	3,136	0.75	2,352
engineered wood products	6.80%	911	1.84	1,677
Shakes and shingles	8.70%	1,166	0.96	1,119
millwork	4.00%	536	1.75	938
cabinets	0.60%	80	10.33	831
furniture	0.40%	54	7.66	411
Other wood products	4.30%	576	0.7	403
pallets and containers	1.40%	188	0.82	154

Source: Wilson et al. 1999

However, the exact classification of which product falls into which broad category can probably be left open as we are mostly interested in how industry is organized around clusters. Thus, while it is clear that primary and secondary wood industries have been closely related historically, they are fairly distinct and independent of each other, even if there is a certain overlap in the margin.

The classification which appears to best fit the secondary industry is shown in the following list of product groups, organized under nine major categories:

Table 2: Classification of Secondary Wood Products

1.	Remanufactured Products	
	- lumber secialities	- sawmill specialities
	- custom processing	- fencing
	- cutstock	- siding
	- decking	
2.	Engineered Wood Products	
	- laminated beams	- log homes
	- trusses	- treated wood
	- prefab buildings	- laminated veneer lumber
3.	Millwork	
	- doors	- architectural woodwork
	- windows	- turned wood
	- moulding	- stairs
	- flooring	
4.	Cabinets	
	- kitchen cabinets	- cabinet doors
	- vanity cabinets	- countertops
5.	Furniture	
6.	Pallets and Containers	
	- pallets	- boxes, bins & crates
	- shipping materials	
7.	Shakes and Shingles	
8.	Panelboards	

	- plywood	- oriented strandboard
	- particleboard	-medium density fibreboard
9.	Other Wood Products	
	- poles & posts	- wood novelties
	- veneer	- woodcrafts
	- instruments	

The focus of the study is thus not on the logging and saw milling and re-manufacturing products but on products further up the added-value chain.

Statistical classification

Besides logging (NAIC 1135) and paper manufacturing (NAIC 322) the following groups are distinguished statistically with respect to wood manufacturing:

1) **Sawmills and wood preservation (NAIC 3211)**
   Manufacturing boards, dimension lumber, timber, poles and ties from logs and bolts; producing lumber that may be rough or dressed by a planing machine but generally not further worked as shaped; preserving wood.

2) **Veneer, plywood and engineered wood products manufacturing (NAIC 3212)**
   Manufacture softwood and hardwood veneer and plywood; structural wood members, except lumber; and reconstituted wood products, engineered wood

3) **Other wood products manufacturing not classified elsewhere (NAIC 3219)**
   Millwork, wood windows/doors, containers, prefabricated wood buildings, mobile homes, all other, generally using woodworking machinery; includes seasoning and planing of purchased lumber (baseboards, flooring, panelling, handles, toothpicks, clothespins etc.)

4) **Household and institutional furniture and kitchen cabinet manufacturing (NAIC 3371)**

Of these four groups, the first belongs, although manufacturing of wood is involved, to the primary sector rather than the secondary (see above). Therefore, only categories 2) to 4) were included in the present study.

While all of these products lumped together in these three statistical categories (NAICS 3212, 3119, and 3371) are (mostly) made of wood, they are fairly different. No single company

produces all of them, rather there is a high amount of specialisation among companies. Thus, rather than looking at one coherent industry of secondary wood manufacturing, we are seeing companies producing different products, often in different organizational forms and with different equipment requiring different skills from the workforce. This specialisation within the industry has the effect that knowledge flows and spill-overs between companies in these three sub-sectors of the industry are typically not occurring in a regular fashion. Therefore elements of clusters can be more easily observed within several sub-sectors, for example, the furniture or the kitchen cabinet industries.

Size of the sector

Secondary wood manufacturing in Western Canada is a small yet growing sector. Exact and systematic numbers are difficult to come by. Provincial directories and lists draw on the membership lists of various producer or industry associations, commercial directories, and regional lists compiled by economic development offices or specialised bodies such as the (now defunct) Forestry Renewal Crown Corporation in BC.

For BC, the Victoria office of the Canadian Forest Service, which has conducted several surveys of the industry, had identified 774 companies in BC in 1998.

Table 3: Secondary Wood Manufacturing Companies in BC (1998)

Business type	No. of Firms	Sales (% of total)	Jobs (% of total)
Remanufacturing	190	40	32
Engineered Wood	152	14	15
Millwork	121	7	11
Cabinets	100	3	7
Furniture	64	2	5
Pallets & Containers	17	1	1
Panelboards	19	22	19
Shakes & Shingles	72	7	8
Other Wood Products	39	4	3
Total:	774	100	100

Source: Wilson et al (1999)

The total amount of sales (turn-over) was $3.87 billion, up 75% from 1990; the total number of jobs was 19.490, up 24% from 1990.

The number of firms is smaller in Alberta. According to an inventory drawn up in 1996 there were 690 companies in total, with an employment of 14.225 workers (Table 4).

Table 4: Secondary Wood Manufacturing Companies in Alberta

Business type	No. of Firms	Jobs
Remanufacturing	53	
Engineered Wood	29	
Millwork	98	
Cabinets	127	
Furniture	88	
Pallets & Containers	25	
Other Wood Products	53	
Sub Total Others	473 117	
Total:	690	14.225

Source: Technology Brokers 1996

No comparable list of companies could be obtained from Manitoba. Estimates of direct employment in the secondary wood industry were at 13,500 direct jobs. (Ex 22)

In terms of geographic distribution, data available from BC and Alberta show the following picture (Tables 5 and 6):

Table 5: Secondary wood clusters in B.C.

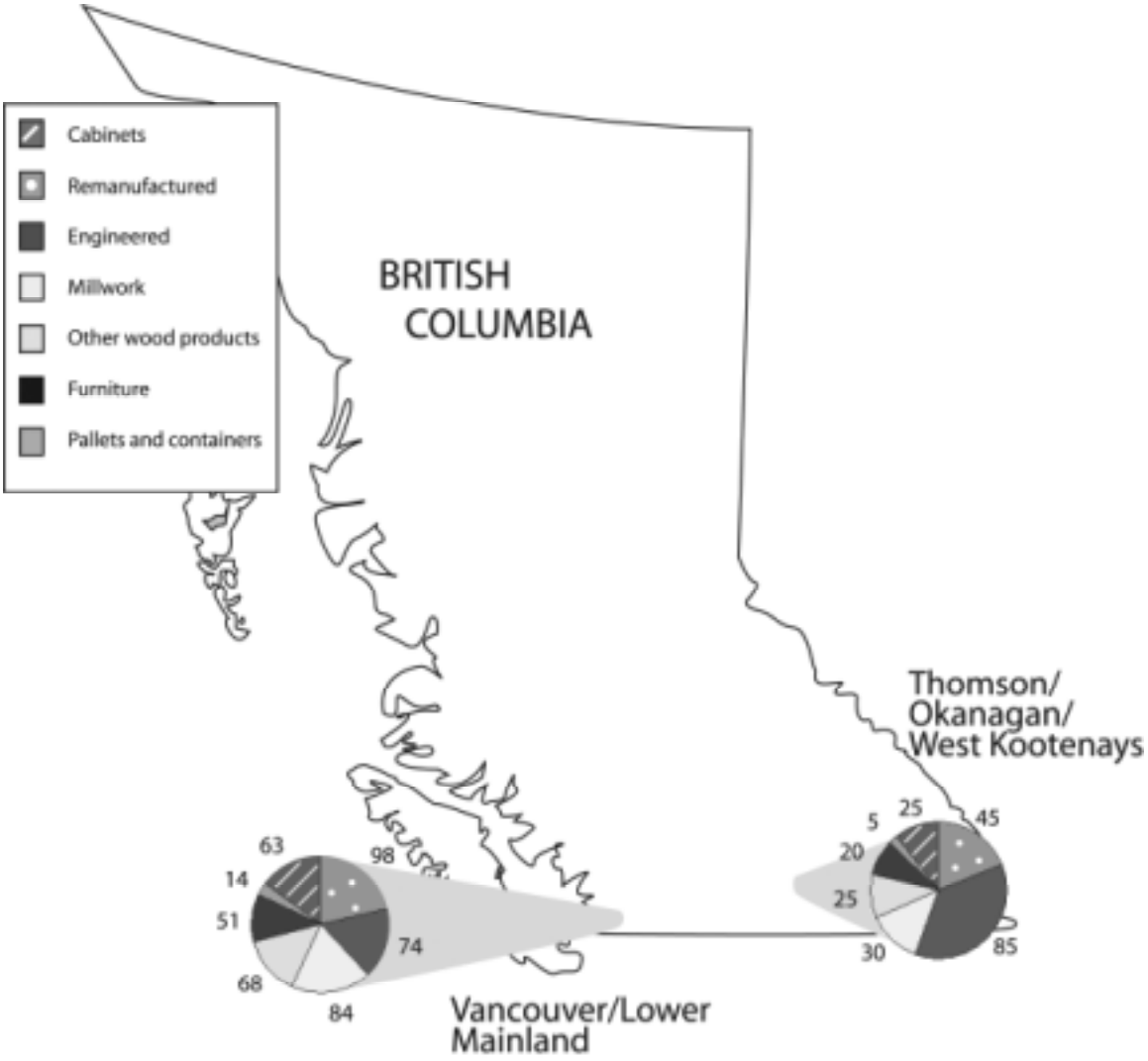
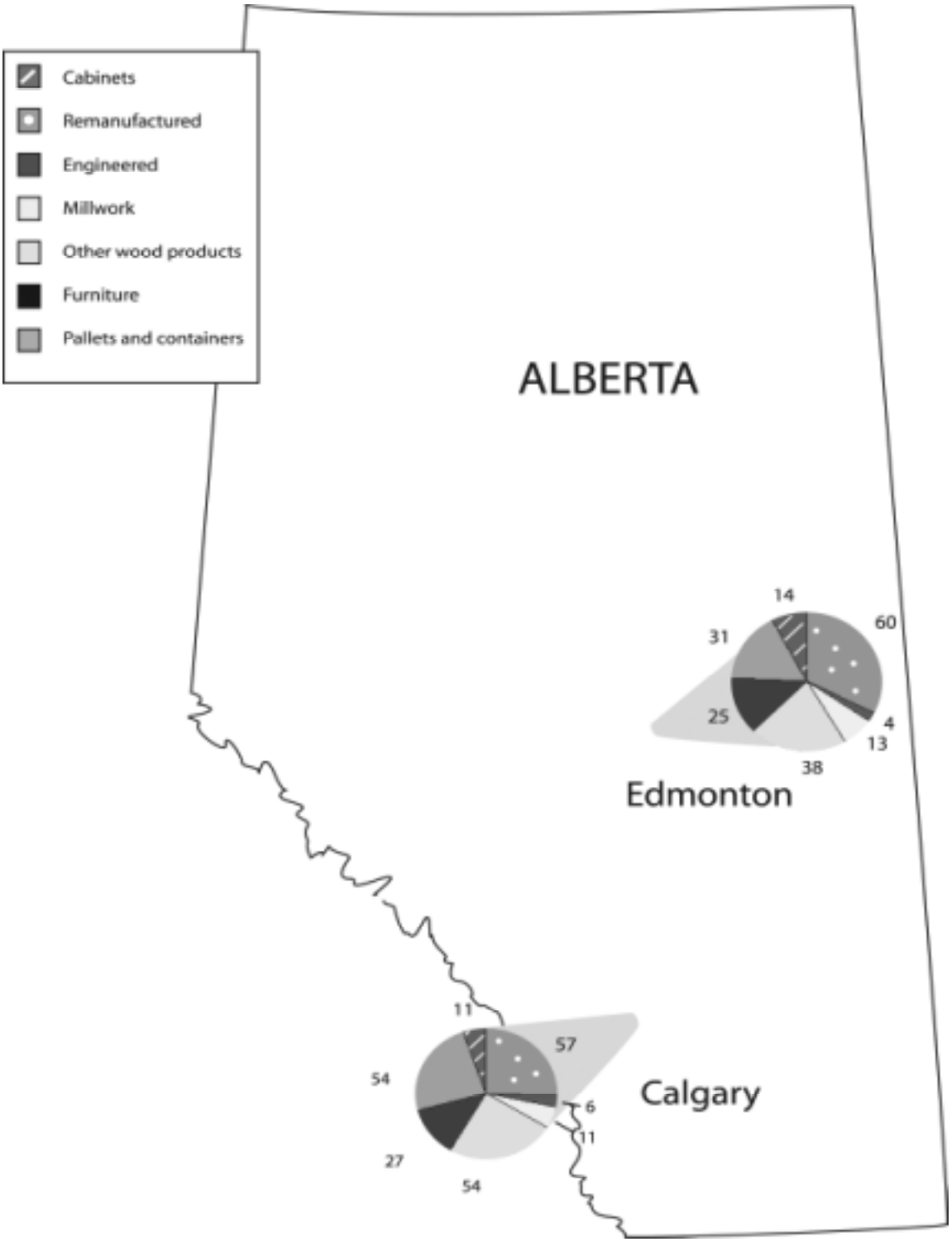


Table 6: Secondary wood clusters in Alberta



As can be seen from the tables, the are two areas which resemble secondary wood clusters in both Alberta and B.C. Companies in and around Edmonton are primarily focused on remanufacturing whereas the Calgary region has many millwork, furniture and cabinet companies. In B.C, the two regions where a larger contingent of the province's secondary wood firms are located, are Vancouver and the Lower Mainland, and Thompson/Okanagan, with Kelowna as a hub and reaching to Kamloops in the North, Pendicton in the South and the (West) Kootenays in the East.

2. Overview of the Study: Objectives, Methodology and Data

Objectives

This study is concerned with the viability of the wood product industry in Canada's western provinces. It partly builds on and extends an earlier study, which focussed on innovation in the secondary wood industry in four different regions in British Columbia (Schuetze, 2002). As in this earlier study, the focus is on innovative capacity of firms and how their environment affected this capacity. The present study broadens the focus geographically by looking into the other western regions. As a contributing study to a pan-Canadian analysis of dynamic, regional clusters in various industries, it also extends the focus to capture particular locational elements and patterns that were not of primary interest in the previous study.

The Framework

The overall conceptual framework for the innovation and cluster study had been developed, like the interview guides, collectively by the group of co-investigators. As it has been published separately (See ISRN 2001), it is sufficient here to summarise the main features.

Central to the present research framework are the notions of 'innovation' and of 'clusters'. Companies' innovative capacity is rooted in a complex set of interchanges and relationships with their environment, especially with other companies and with networks of institutions that have an impact, direct or indirect, on the way the companies operate. Main elements of this 'system of innovation' within which companies work and of which they are a part, are a common culture, a shared knowledge base, a pool of skilled workers, and social capital or 'trust'. As proximity of the main actors in such a system of innovation contributes to the sharing of information and knowledge and the building of social capital clusters, geographic concentrations of companies and institutions in a particular field of economic activity are seen as related concepts. According to Porter (1998), the location of a firm in a cluster enhances its productivity since it has better access than from outside the cluster to specialised inputs such as technical support and therefore diminishes transaction costs, i.e. for transportation from distant suppliers, or reliable information about market trends and technological developments.

Central both to innovation systems and cluster theories is a knowledge and skill base that can be commonly used by all companies belonging to the local/regional innovation system or cluster. An important plank of the cluster theory is also the existence of a large firm, or concentration of several large firms ("anchor firms") that facilitate the process of new firm formation through either spin-offs or by attracting specialised and innovative sub-contractors or experienced service providers. In sum, "clusters" are geographically proximate groups of interconnected companies

and supporting networks of institutions that share a common information and knowledge base and benefit from their shared access to a unique set of resources. The assumption is that the local or regional proximity of these companies and institutions contributes to the generation and sharing of knowledge.

Methodology

As part of a larger national study on innovation and clusters in selected sectors of economic activity, the methodology was not developed independently but rather developed with the other co-investigators.

This particular study's methodology was evolving in three steps. The first was the discussion with two focus groups about the applicability of the cluster concept for the secondary wood manufacturing industry and the issues at stake in the industry's innovative capacity.

In order to make the 'cluster' concept applicable to the secondary wood sector, the panel members were asked five questions:

1. What is the "secondary wood" industry? Is there a sufficiently clear border that distinguishes it from the primary (forestry and logging) sector?

2. Do companies in the secondary industry form clusters, and why? Is it the proximity to the raw materials, or to the markets where products are sold? Is it the proximity to specialised support institutions, such as IRAP, FORINTEC, or university labs, or specialised training institutions? Are pools of labour, both trained and non-skilled a main reason for companies for locating and clustering?

3. Does the proximity of small companies to a larger one (a so-called 'anchor' company of which they may have been spawned, or to which they are sub-contractors) play a role in an industry where small and medium sized firms (SMEs) are forming the large majority of the population?

4. Where are secondary wood clusters in the Western provinces?

5. Which companies are seen as being both innovative and belonging to a cluster? In which way is the cluster essential to their innovativeness?

In response to question 1, experts agreed with the observation, introduced above in section 2 (Fig 1), that the distinction between primary, secondary and tertiary wood sectors had to be seen as be on a gliding scale rather than falling into clearly distinct categories of products or activities. Nevertheless, there was agreement for most industry sectors, with remanufacturing of lumber and speciality sawmills sitting somewhat on the borderline between primary and secondary. In other words, the exact definition of what should be included in the three groups is a matter of degree rather than categorical definition. This is in line with Porter's view of 'borders' which he sees as 'often a matter of degree [involving] a creative process informed by understanding the most important linkages and complementarities across industries and institutions' (1998, p.200).

As to questions 2 and 4, responses varied considerably reflecting both particular geographical and institutional perspectives. Most experts agreed that there were indeed established or emerging clusters in secondary wood, even if there was no clear consensus as to how 'geographical proximity' should be defined, some of them suggesting that the modern communication technologies and transportation links allowed for larger areas to be more tightly connected than in the past. Also there was some difference of opinion as to the meaning of 'concentration' and 'critical mass'. While Porter (1998) suggests a wider definition of geographic scope stating that a 'cluster can range from a single city or state to a country or even a network of neighbouring countries' (p. 1998), most experts consulted though that for the wood industry a narrower scope was more appropriate. Thus, most of them considered the suggestion to distinguish one cluster in coastal and interior BC on the one hand, and another one at the East side of the Rockies which extends as far as Manitoba as too wide and favoured the notion of clusters that are operating in smaller geographical regions. Thus Edmonton/Grand Prairie and Calgary were considered viable secondary wood clusters in Alberta as well, and the Lower Mainland (with approx. 50% of all secondary wood companies), and Thompson-Okanagan (with approx. 25%) in B.C. The Western Kootenays were thought by some as belonging to the Okanagan cluster. Although Saskatchewan has a number of successful secondary companies, experts agreed that there was not sufficient of a concentration to see them operating as a cluster. In contrast, Manitoba was seen as having at least two clusters, one in Winnipeg, and another one in South Manitoba (Morden, Winkler and Steinbach).

Porter (1988) attributes a significant role to larger firms yet also considers a 'concentration of like firms' (p. 200) as equivalent. In response to the question of 'anchor' companies in the Western provinces, experts pointed out that there were indeed a few larger companies in the clusters identified but that , with the exception of two or three large firms in the Manitoba clusters, none had the role of an 'anchor' for other, smaller firms. Yet both in B.C. and in Alberta, mid-sized 'like firms' were identified that did provide industry leadership and critical mass to numerous smaller companies and were main partners to suppliers, business services and public training and R&D institutions.

Data

The study is based on three types and sources of data. The first is survey data collected by Statistics Canada as part of their innovation survey. A second source is the research literature and documents from governments and a variety of other sources. Thirdly and most importantly, data came from the interviews with experts and companies. Expert interviews were both informal and formal. There was a great number of the former and 33 formal interviews. Interviewees were asked, in addition to the questions that had been addressed to the panels, about the specific role their institution had in the secondary wood industry and in particular how they contributed to innovation and clustering of the industry. Some of the experts were from government agencies, including IRAP, five from industry associations, and two from financial institutions. There were two representatives of R & D institutions and five from education and training programs.

The third phase consisted of interviews and site visits at companies. A total of 34 companies were visited, ranging in size from small operations to large speciality production line facilities. The selection of these firms was based on the expert panels and interviews and generally only companies were included that were seen as both innovative and belonging to a geographic cluster by at least two experts.

For the interviews a semi-structured interview guide was used that had been jointly developed for case studies in all industrial sectors included in the national innovation and cluster study. The interview guide was adjusted however to reflect the particular situation of the wood industry.

Case study companies
The following tables (Tables 7 a to 9 a) show some of the characteristics of the case study firms.

As can be seen, companies are of very different size, produce various different products, and serve different markets. They also display very different characteristics, attitudes and dynamics with regard to innovation and clustering. This will be shown in more detail in the following section (As tables 7 a t 9a show, firms have been coded and will be referred to under this code. So have the experts interviewed).

3. Innovation in the Secondary Wood Industry in the Western Provinces

Innovation has been defined as consisting of any of five phenomena (Schumpeter, 1934):
(1) the introduction of a new product or
(2) a new method of production;
(3) the opening of a new market,
(4) the conquest of a new source of supply of raw materials or unfinished goods, and
(5) the implementation of a new form of organisation.

While innovation surveys measure only two of these, product and process innovation, it seems useful for this study where we are not concerned with statistical data and 'benchmarking' that we use the broader and more inclusive definition.

There have been few studies on innovation in the secondary wood sector. Besides the innovation surveys administered by Statistics Canada (see below), most of these are smaller surveys, often sponsored by local or regional development agencies, that focus primarily on other problems such as market opportunities and obstacles to realising them, such as demand for skilled manpower, training needs, access to new materials, or other issues (Wilson et al, 1999). Some of them address questions that are related to innovative activities, such as R & D activities, the protection or utilisation of intellectual property, and the introduction of new technologies. Academic research studies have either been on research and technology in product innovation (e.g. Cohen, 2002) or have addressed innovation issues in sociological and economic terms, for example, the links between innovation and skill development (Schuetze et al, 1997; Schuetze, 1998), and the role of regional and local business environments and support infrastructures for innovativeness and viability of secondary wood companies (Schuetze, 2001).

Survey of Innovation

The 1999 Statistics Canada Innovation Survey on manufacturing industries sheds some light on some of the sectors that re relevant to this study, namely engineered wood products (NAIC 3212) and other manufactured wood products (NAIC 3219). In contrast, the furniture and (kitchen) cabinet sector (NAIC 3371) was not included.

For a number of reasons, especially the 'fuzziness' of the concept of 'innovation', the methodology of the survey (Godin, 2002) and the effects of lumping together different industrial sub-sectors, the usefulness of the data is somewhat limited. Nonetheless, they can serve as a backdrop and benchmark to the results of the case studies with respect to R&D, training, and collaboration with other companies and institutions. Overall, 65 percent of respondents in the engineered wood sector and 77 percent in the other wood category think themselves as innovators.

The basic results of the innovation survey are summarised in Table 10.

Chapter Table 10: Selected results from the Innovation Survey for two wood manufacturing sectors

	Engineered products (percent)	Other wood products (percent)
R & D	56.8	56.2
Acquisition of process equipment	69.7	73.5
Industrial design and engineering	52.0	49.7
Tooling up and production start-up	58.9	64.3
External Sources of Information Contributing to Innovation		
Parent or subsidiary firms	37.7	23.2
Suppliers	80.2	63.
Clients	44.5	59.2
Competitors	20.2	35.5
Consultancy firms	26.4	14.9
Universities & colleges	13.2	3.0
Trade fairs	51.4	62.8
Professional conferences, publications	71.1	38.8
Internet based information	19.3	25.8
Problems and Obstacles to Innovation (top ten)		
High development cost	73.7	49.4
Staff shortage	69.8	46.2
Inability to access government assistance	14.2	22.8
Lack of skilled personnel	26.2	36.3
Lack of financing	17.9	22.9
Lack of marketing capability	33.0	15.1
Lack of customer responsiveness to new products	23.2	19.3
Organisational responsibilities	19.9	12.8
Government regulations	12.1	16.1
Lack of external technical support services	16.5	15.4

Source: Statistics Canada (1999)

As can be seen from the high percentage of firms that have acquired new equipment and machinery, most wood manufacturers are engaged in process innovation, suppliers and customers play an important role as sources of external knowledge-flows. In contrast, the influence of universities and colleges for innovation-related information is very small, if, of course, the contribution of highly educated personnel from such institutions is not taken into account.

Case study results

Although all case study companies were considered innovative by the experts consulted, there were, as could have been expected, a great deal of variation in the kind of innovation activities (see Tables 7 b, 8 b, 9 b).

The degree to which they were really 'novel' when compared to other companies. Thus, many of the innovations were new to the specific company only, often consisting of buying and installing new machinery and equipment or using improved types of materials, for example, glues. Much of this appears to be incremental rather than more fundamental or radical, although the line between the two is sometimes difficult to draw with precision. Thus, for example, in the home furniture industry, many innovations concern design and choice of materials and colours. Furniture is a "fashion industry" (AB6), so the change of design and fabrics is an important element of sales as customer demand depends not primarily on quality but on design and style. The close contact to customers is crucial for any changes in the products. However, there is also a conservative group of customers who prefer traditionally designed and made wood furniture. In companies serving this market segment, there is no or little product as process innovation as products are manufactured with known technology (BC6).

Type of innovation

By far the largest percentages of innovations are, as could be expected, incremental innovations. Many of them concern the gradual improvement of products, while most involve the utilisation, and adjustment to the particular production process, of new equipment and machinery, new glues, or paints, or new materials. However, more radical forms of innovation can also be found. Often process innovation requires not just the installation of new machinery and its adjustment to the specific needs and existing infrastructure of the company, but major organisational changes as well. Thus, in the case of the case study firms (BC1 and AB3 and 4) the introduction of an integrated IT system with which formerly separate operations and units were linked also meant significant changes in the management structures, production modes and the marketing system. Two of these companies, middle-sized manufacturers of windows and doors, have changed from small crafts based millwork companies to 'mass customisation'. Change in these companies has been massive, transferring almost everything the way it is done. It is not, as it was the case with other innovations, a one time event, but is an ongoing process of continued adjustment and improvement requiring a changed mindset and understanding on the part of the entire workforce.

> Half of the change is technology and half is culture. Companies must be ready for change, but are not as much as they think they are. For example, placing mature sales people on the Internet for computer-based sales: This is a cultural change – and a skill change. (This) culture change was a 2-3 year process. We still have a long way to go. Many staff don't realise this is a continual process which must go on – we still get resistance (AB3).

Part of the change affected the relationship with customers and the middlemen, dealers. Mass customisation does not only mean a highly flexible and integrated production system but also an intensive communication process:

> As we became more of a custom manufacturer and custom marketer we began to realise that the dealer – manufacturer relationship was somewhat adversarial. The dealer perspective was to purchase the product as cheaply as possible and sell it for as much profit as possible. So they were trying to continually grind us, be secretive about who they were dealing with, and use us as a loss leader. They were also unknowledgeable about custom manufacturing – they were we used to selling out of a book.
>
> Our marketing approach is radically different – we go to the architectural community and ask them what they would like to design and then build it for them. So there is a much greater communication demand for us and a much higher knowledge content for our reps in the field. The dealers would not put the time in to learn that content – they just wanted to carry many products and not know much about each. We need to be in verbal communication with architects, contractors, site superintendents, and the homeowners – whereas the dealer didn't want us to know the customer. (BC1)

As the innovation survey shows, the lack of marketing capabilities was mentioned as a problem by one third of respondents from engineered wood companies, and the lack of customer responsiveness to new products by almost one quarter (see Table 11 above). Introducing their products to new markets, especially foreign markets are therefore an imperative to many companies. Not just the larger companies, but also a number of smaller companies have made significant efforts with regard to foreign markets (e.g. BC6, 11, 13, and 18; AB 4 and 6; MB 1 and 4).

One of these, BC15, has been particularly entrepreneurial and successful. The present owner (who had come first to the company as a coop student of the University of Waterloo and was later hired as the CEO) tried to diversify the company, which had until then produced laminated beams and trusses for the local construction market, by looking for work abroad. He undertook a number of travels, some of them as part of trade missions with the BC Wood Specialities Group. Countries visited included Japan, Korean, Taiwan and some other Asian countries. He contracted a number of projects in Japan and during the period 1989-93 about 80% of his business was with Japanese constructors, mainly for building private homes but also some commercial applications. Due to the economic depression in Japan, most of this business dried up as of 1995. He was successful replacing it by increasing contracts with constructors in the United States.

The company has been very innovative with respect to its marketing strategies. Development of partnerships in order to advance the use of laminated wood and architecture wood and the use of reference product for it's advertising and targeted outreach for new customers have been central elements. The company or the owner respectively, is also a main networker. The owner is a member to a number of associations and committees, both in B.C., Canada, the US and Japan.

Overall, innovation is often of a 'firm first' rather than an 'industry first'. The process by which firms innovate is often emulation of successful models rather than an original solution of their own. It is described by the owner a very innovative and successful case study firms:

> There is no penalty for plagiarism in this business. So part of our genius, if you will, is that we shamelessly borrow from any models as we possibly can…. We develop and new product concepts both from a market ability standpoint as well as from an engineering and other standpoints. We have to do that because we have a liability in these fields. (MB3)

Another major method of R&D is trial-and-error:

> Part of our ethic is 'Fail fast, fail cheap, fail often'. It means, try something, make sure the risk is measured and limited and when it fails don't let that stop you from trying again. … Every failure is a parable or a story that you can learn from. So keep failing, keep trying, and accumulate your lessons, and keep trying again. (MB3)

R&D and Intellectual property

R&D which, under the assumptions of a linear model of innovation, was believed to be at the origin of all innovations, at least technical innovations, plays a role but not a dominant one. Only a handful of case study firms engaged in collaboration with university laboratories or researchers, a few others have worked occasionally with FORINTEK. Testing of materials and products, e.g. windows which is required for exporting them to the US, is mostly done by external labs, but there seems to be little knowledge-flows from such limited co-operation.

Most of research and development which takes place in-house is of the trial-and-error kind, which was just described by MB3 above. Often suppliers of machinery or products, such as glues or paints, are involved in this process, as they are interested in improving and increasing sales of their product. However there is also in-house R&D which is of a more systematic nature and several companies have successfully filed for patents. As documented in other studies, patents may however be of no great use for smaller firms:

> [Our] 'building stud' was patented at one time but we have dropped since the maintenance of that patent. We had also a patent on joining a corner this way with we had a special machine we built ourselves that joined a measured corner with an internal fastener. We still use the machine today. We found a bunch of people were starting to use our method and it actually was helping us more than hindering us having them use it to gain wider acceptance, and so on so we never pursued anybody for licence agreements. Eventually after ten years, we decided why do we bother maintaining a patent when we are not really willing to enforce it. It's only helping us to have other people use the patent. My whole idea about patents has changed over the years. I have come to a realisation that 'You have to out-perform people, not out-patent people' to be competitive in business. And there is a lot of other things about performance than just having a good idea! (MB1)

In sum, innovation in the secondary industry takes place in many shapes and forms. Except for the furniture industry where, like in the fashion industry, consumer demand changes and recurrently requires new forms and fabrics, thus product innovation, most innovation in the industry is related to gradual improvements in the production process, in marketing and management. There are several examples however of more radical innovation. Most of these can be observed in conjunction with the comprehensive application of ITCs that integrate formerly different parts of the business process, ranging from marketing, design, ordering, manufacturing, and shipping, thereby changing significantly work organisation, management structures,

production patterns and customer relations. The other main field of more radical innovation is marketing. Even several of the smaller companies are exporting a significant share of their products, not just to the large market to the South, but also to South East Asia, and some of them are targeting exclusively these foreign markets, producing to the demands, standards and tastes of clients in Japan or China. Also, the global organisation of the production process is no longer a prerogative of multinational or large firms: Even small firms, for example BC7, are out-sourcing some of their manufacturing to China, while others, for example BC15, are establishing partnerships with foreign companies or setting up joint ventures abroad.

4. Location and Clusters

As shown above in Table 5, there seem to be clusters of secondary wood firms in two locations in B.C., the Lower Mainland and the Okanagan, whereas in Alberta, clusters seem to exist in and around Calgary and Edmonton (Table 6). Likewise in Manitoba, two clusters were identified, one in and around Winnipeg and a second one in the South, just north of the US border, clustered around the small Mennonite settlements of Winkler, Morden and Steinbach.

Clusters are assured to build up because of one or several factors. For the secondary wood industry, the principal locational factors (Table 11) are probably not dissimilar to those for other industries, even if the proximity and easy access to timber was, at least in the past, the dominant factor.

Table 11. Factors influencing the decision to locate or stay

Functional factors

- Proximity to raw material ('fibre', wood)
- Proximity to clients/market
- Proximity to other companies in the same or related fields
- Proximity to labour pool; training institutions
- Proximity to R & D institutions
- Access to business services
- Access to technical services

Other factors

- Immigration

Work ethic and entrepreneurism

Proximity of, and access to wood fibre

All experts and many of the case study firms cited the supply with wood as of primary importance, and in some cases, of great concern. However, when looking at the six secondary wood clusters identified, none of them, with the possible exception of the Thompson Okanagan area, is located close to the fibre that they use. As other factors are becoming increasingly more important, the proximity to where fibre grows and is harvested becomes less relevant[1].

One of the case study companies in BC is an example: First located in a major forestry region approximately 250km and a ferry ride away from the Lower Mainland, the owner closed the shop and re-opened operations in the Lower Mainland.

> [After we had located in the North, we discovered that] things were not as they seemed. First, there was no kiln where wood could be dried, the mills were not economical, and in fact the wood was actually more expensive than in the Lower Mainland. So we ended up buying wood in the Lower Mainland and shipped it all the way up North, turned it into garden furniture, and shipped it all the way back to the Lower Mainland (BC7).

Similarly, most case study firms purchase their fibre from wood dealers and brokers from outside the cluster region and, while transportation costs are a factor, they were not considered a major problem.

Proximity to markets

With the exception of those firms that work primarily for the local market where proximity is key (e.g. BC 5, 7 and AB 1, 2, and 10), most firms serve primarily clients and markets outside the region where they are located. Some of these cater to both the larger Canadian and US markets while a few are specializing only on foreign markets using their specific edge and cost advantage. Like with innovation, size of the company is not a major factor, and both larger and smaller companies are successful in selling to clients abroad. One example for the former is case study firm AB4 which produces elements for kitchen cabinets. The owner, who had just recently founded the company after selling another successful company also producing kitchen cabinets, is shipping all of its production to the US market. In fact, the company produces for three US companies, which have also been purchased recently by the AB4 owner.

An example for a smaller firm producing exclusively for the South East Asian market is BC6, which has ten employees and produces pre-manufactured homes for Japan, Korea, Taiwan and China. The owner is 2nd generation Japanese and the workers are mainly from Asia speaking Japanese and Mandarin. All the office work is done in either language not English. The company is building according to the Japanese building code and was waiting (at the time of the interview)

[1] There is a parallel in the primary wood industry. As the forestry industry in the 1980s and 1990s focused on producing low-cost, high value products, especially dimension lumber and other structural products destined for the housing markets in the US and Japan (see Schuetze, 2002), logs were no longer processed by mills in the region where they had been cut but shipped to new high volume mills at central locations.

for building codes to be established in China and Taiwan to expand their business to these countries. Transportation costs are no concern:

> Freight is reasonable, even if the tariff for fuel surcharges has gone up. The costs for long distance shipping have been coming down steadily. Back in 1995, we used to spend $1500 a month [on transportation], and now it is under $ 250,- a month with those low cost carriers. Also, the Internet allows us to send information back and forth at not cost. (BC6)

Obviously, proximity to major transportation hubs or routes as well as the availability of reasonably priced carriers is of utmost importance. This is one of the big advantages of major hubs like Vancouver, Calgary and Winnipeg, with major airports, railway connections, highways, and in the case of Vancouver, a deep-sea harbour. The Okanagan and the South Manitoba companies have none of these, except highways and distances to the main markets or distribution centres in the US are very short.

Poximity to other companies in related fields

Synergy effects of co-location by companies in the same sector, often competing for markets, clients, supplies or raw materials and workers, are one of the main rationales of clusters. Especially knowledge spillovers, traded or non-traded dependencies between companies located in a cluster, are seen as the main element of cluster dynamics. Also, often companies collaborate in order to share costs, spread risk, access new markets or distribution channels and co-operate in larger projects which are too big for a single firm to handle.

Collaborative arrangements are either struck bilaterally between individual firms or a number of companies form associations which bring together members in order to inform, discuss, or take action on problems common to the sector. Collaborative arrangements of the former kind do not necessarily involve companies from the same local area but companies often seek partners in different regions, especially for the purpose of marketing and distribution.

An example is BC15 which has established, as mentioned already, a number of partnerships and joint ventures with other business partners, thus with a wood home company, based in Seattle, for which it manufactures and cuts parts, further a 50% joint venture with a Vancouver-based wood design firm, and another 50% venture with a nearby speciality mill to produce timber frame houses.

There is however a good deal of evidence from the case studies of local interaction and collaboration. This can take several firms and degrees of intensity ranging from occasional arrangements to formal partnerships.

One of the firms engaged in multiple arrangements is AB1, which is located in a small town in Manitoba manufacturing wood components such as mouldings as well as interiors for trucks and trailers. The owners, two brothers, have formed two other companies on a 50:50 partnership basis, mainly to develop new products and new ways of processing their standard products.

Another example is AB1, a large crafts-based firm that uses advanced modern technology and applies elements of industrial manufacturing techniques, based in Calgary. The owner, a Swiss

immigrant, is member of the local chapter of ARMAC (Architectural Woodworking ManufacturingAssociation)[2].

> We meet each month. Only four companies of the 16 can keep up with the standards. However, we often subcontract to them. So we work together on contracts, especially if we are busy. We favour each other, so if my competition is doing fine, I am doing fine, too. (AB1)

Both companies belong to the group of 'other' wood manufacturing (NAIC 3219). According to the Innovation Survey mentioned (Statistics Canada, 1999), 65 percent in this category have collaborative arrangements with their competitors within a 100-km range. In contrast, all companies (100 percent) in engineered wood products (NAIC 3212) engage in collaboration with their local competition. It is difficult to explain this discrepancy from case study data. Rather the evidence from the case studies seems to suggest that the degree to which firms are actively collaborating depends more on the culture of the particular region and the familiarity and trust between the companies.

Especially for the smaller companies industry associations are important linkage mechanisms for sharing information and data and for various forms of collaboration. ARMAC was already mentioned. BC Wood is another example in which most secondary wood firms are members. BC Wood organises trade missions, helps members to attend international trade shows and provides them with market information and contacts in other countries. It had also an important role in providing training for the secondary industry, both out of a training centre in the Lower Mainland and throughout the province. This came to a halt when the newly elected liberal government came to power in 2001 when government money for training dried up on the grounds that funding of secondary wood specific training was seen as a subsidy ('If the industry needs to train its staff, then they need to pay for it themselves" – EX 3).

There is a good number and great variety of industry associations for the secondary wood industry reflecting the variety of products that are subsumed under this category. Industry associations operate in small regions, province-wide or throughout the Western provinces. An example for the latter is Furniture West, which provides a number of services to their members and organises an annual furniture show for some 130 manufacturers, members and non-members to showcase their product lines to retailers. Some industry associations operate Canada or North America-wide and have therefore, unless they have local chapters, a different role than the local or regional ones. Some of the associations are narrowly specialised (e.g. the Juvenile Products Manufacturing Association), while others, for example BC Wood, are umbrella organisations covering all (or most) of the different sub-sectors.

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<u>Proximity to skilled labour and training institutions</u>

A pool of trained workers and proximity to, or special relationship with a training institution are a major part of the cluster rationale. Especially since Lundvall (1992) showed that innovation is

[2] There are several chapters of ARMAC in Canada: in Calgary, Edmonton, Regina, BC, Manitoba, Ontario and Quebec. Each architect has an ARMAC manual, which, being updates/rewritten each five or six years, provides guidelines on how to build with wood, which specifications veneered wood should have, etc. If an architect specifies that the building has to conform to ARMAC standards, an inspector will check and control the quality.

based on knowledge and that therefore knowledge and skill acquisition, i.e. learning is a prerequisite of innovation, and Nonaka and Takeuchi (1995) pointed to the importance of organizational knowledge and process for creating and passing on knowledge, knowledge and skills are seen as a crucial foundation for the knowledge-based economy.

For the secondary wood industry this applies only to part of the workforce. As an earlier study has demonstrated (Schuetze et al, 1997), 80 percent of the workforce in BC secondary firms had only a high school diploma or less, 6.5 percent a degree, and 13.5 percent technical or vocational qualifications from community colleges, institutes, or private training institutions. While this picture looks very different in the crafts type companies, for example AB1 and 8) where the entire staff is either qualified or receives training to become qualified, the majority of firms has a workforce of which a large part is unqualified. Turnover in these companies tends to be a major problem. Thus, for example, three middle-sized furniture companies in Calgary (AB4 to 6) have regular turnover of 50 to 70 percent of their workforce. This is not always induced by the workers looking for better jobs or pay, but some companies use 'numerical flexibility' laying off parts of their workers in order to react to slacks in demand for their products. An example is AB4:

> Concerning staff levels, we have been a business unlike most large corporations since we still operate like a small shop. If the business is down, we reduce our staff and accommodate to the size of business. If the business goes up, we hire people, we do on-the-job training, and we try and react to it that way. So, unfortunately, its not necessarily looked favourably upon by the community or people within the areas because you may be going through these wild springs over months of hiring and then layoffs, then hiring and layoffs, but on the other hand, we are able to very quickly react to the way the business is and ramp up very quickly.

At the same time, some of the workforce becomes lower skilled while those to be screened for entering the core group of employees receive more training:

> [Before moving into this new facility] we probably had a higher percentage of work force as operators or people that were skilled. [M]oving in here, through efficiencies and some of the changes that we made, the lower-end and the lesser trained, or the labour-type people that were here took over as the larger portion of our work staff. So we had to change the pay structure… offering them something they would want to be coming here for, and trying to take some of those people on and eventually move them into our core staff. (AB4)

In general, training in the industry of non-core staff is normally kept to a minimum, mostly for fear that workers will walk out of the door with their newly acquired skills and work for another company. There are exceptions, though. Besides the crafts type firms mentioned, some of the more technically advanced companies do see the need for training, e.g. AB3:

> We have the responsibility to train people and they have the responsibility to be trained – so we reward people who take on that responsibility with promotion. They are the ones that grow with us – the young people want this more than the older ones. …The senior people of the company know the process of manufacturing and are logical thinkers, e.g. accountants…. Anyone above the supervisor position knows the computer system.

> Western Canada doesn't have a strong technological manufacturing base. Even if people have computer experience, they don't have the practical … experience for design, machinery and processing etc. We are high tech so need this type of worker – not so much a craft worker.

AB3 and the other high tech companies, but also the crafts type firms work together with training institutions and employ their graduates. Especially graduates from the BC Institute of Technology (BCIT) and Okanagan Community College (OCC) in BC, the Southern and Northern Alberta Institutes of Technology (SAIT and NAIT) in Alberta, the Red River College (RRC) in Manitoba, and Conostoga College in Ontario have specific wood programs who are in high demand. This does not always mean that these programs are viable, as there is a lack of demand on the part of young people who see the wood industry as backward and work in the as unattractive. Thus the program at NAIT was closed down for lack of demand.

A special place among the training institutions has the UBC's CAWP, which offers a degree in wood processing as well as continuing education programs for industry employees. Originally laid out for 150 undergraduate students, the program now trains 90 to 100, also because of the low tech and small shop image of the industry (EX7). A major problem for the secondary industry is that most graduates find employment in the primary industry – and want to stay in BC rather than returning, or going to the prairies. Thus, the great expectations that were harboured with the establishment of CAWP have not, or not yet materialised.

Summing up this section, the secondary wood is only slowly developing into a high skill industry. Much of the workforce is still unqualified or semi-skilled. Most of the professionals in the field, the new owners and managers, come from other fields rather than wood processing, e.g. accounting, civil and computer engineering, marketing and management, and apply their skills in the wood industry without knowing much of the very ropes and traditions of wood working or processing. Although traditional woodworking skills are sought after, this is in many cases for working in the technical and middle management positions rather than top level management. Although this is different in smaller, more crafts type companies, training institutions and programs for the industry do not seem to form an important magnet for firms to locate.

<u>Proximity to business and technical services</u>

Business and technical services are important elements of successful operating, especially for smaller firm that need to use external resources while larger firms have often integrated the most important of these services. Thus, for example, the lack of personnel in the region to maintain or repair his machinery, and the cost to bring them to the remote place where he had first set up shop, was a strong reason for the owner of BC7 to move his business to the Lower Mainland.

One argument against a thriving secondary wood clusters in the West is the absence in the region of wood manufacturing machinery and equipment:

> There is a cluster around the primary industry – BC is one of the biggest exporters – the US produces four times as much as we do. As a result of that sawmill industry here there is a cluster. [The primary industry] has equipment suppliers and manufacturers as opposed to equipment distributors. There is a large support network around the primary industry – in terms of consulting

> firms in BC that have supported the building and development of plants. Quite a few equipment manufacturers that actually build equipment here.
>
> [In contrast] you won't find almost any manufacturers for equipment of secondary manufacturers in BC and very few consultants who know about secondary manufacturing. Most of the equipment used by secondary manufacturing industry in BC comes from the Germany, Italy, the Scandinavian countries Britain and the US. The two major suppliers of moulders which are used throughout the millwork industry come from Germany and the UK. They are sold through NA divisions, which are based in North Carolina. So when you talk about clusters in BC and western Canada – there has not been a lot of support from the equipment side, i.e. manufacturing equipment. You have sales and distribution people here but they have limited capability in servicing a lot of this equipment. (EX 6).

The weak supply of technology information and service is one of the problems mentioned as an obstacle to innovation by secondary wood manufacturers in the 1999 Innovation Survey. However, case study firms seemed to access information through trade and especially technology and specialised machine shows, like the annual Inter-Ligna in Hannover, Germany. Maintenance and down-time was mentioned as problematic but technical personnel are based in Eastern Canada or the US and are usually very quick in arriving in case there is a major failure. Also spare parts are quickly flown in by the machine suppliers. Thus in times of ITCs and fast plane connections, proximity to equipment suppliers and technical services seems to have lost its crucial importance.

Having briefly discussed the classical elements of cluster building, there might be a few others, which might explain clusters better than these. One of these is immigration patterns and another is, closely related to it, entrepreneurism and work ethic as part of religious faith and life philosophy. A third one, more elusive, is 'quality of life'.

Immigration

Canada is a country of immigrants and many of these brought skills and traditions from their home countries, until the second half of the 20th century mainly from Europe. Woodworking, mostly in the form of a learned craft or trade, was the background of many immigrants, even in more recent times. Thus, the owners of BC7 and AB1 are skilled crafts people who arrived from Europe in the 1980s to set up their own shop in the West.

> [A] lot of secondary industry has relied on the skills of immigrant workers who were apprenticeship programs in Europe and have brought those skills with them. Unfortunately in recent years I think it has been more difficult for Europeans workers to immigrate to Canada – or maybe the skill sets that they have haven't been on priority list by Immigration Canada so it has been more difficult for them to come in. And I think that is having a negative impact on the industry. (EX6)

Others who had arrived earlier had brought with them the crafts tradition, even if in a related or completely different trade, as well as a sense of entrepreneurism and work ethic that was applied to everything they did. There were immigrants from many countries who came to the West and started a wood products company, e.g. Poland (MB6), Germany (AB9 and 10), and Denmark (AB 4). Although there may be a bit of a Polish 'cluster' in Winnipeg, a German one in

Edmonton, and an East Indian one in Calgary, the companies in Winnipeg and South of Manitoba seem particularly interesting as they are all owned by people with a Mennonite background.

> Manitoba, especially the area around Winnipeg and South of it has two of the larger manufacturers in Canada – MB3, the biggest wood manufacturer in Canada, … and Pallister. This is the thing about secondary industry – it is the Mennonite community. The company started small and they were a success locally and then expanded and they are close to the US Midwest and Ontario markets. They supply to BC now and ship to Japan. The people were good at it – low cost labour, and non-unionised. (EX6)

Mennonite sense of community and work ethic

The 'Mennonite ' cluster however is interesting for another reason besides the work ethic and entrepreneurial spirit of people who arrived in Canada several generations ago from Ukraine and Germany, because they were prosecuted and harassed because of their faith. 'Singing from the same songbook', in this case literally, and observing their cultural rituals makes for a strong feeling of community and trust, the glue that also clusters together. However, Mennonite families are not only in the wood products business, but also in many others, for example farming and machining. Mennonite ties can therefore not only observed in the secondary wood industry, especially furniture and windows and doors, but there is also strong evidence of collaboration between Mennonite entrepreneurs from different sectors of economic activity.

Quality of life

Quality of life and life style were mentioned by several of the interviewees as a reason why they first came, or why they do not think of re-locating elsewhere, even if the business climate and markets seem to them to be better elsewhere. The real meaning of such quality-of-life arguments are difficult to determine and the term appears rather to be a convenient umbrella term for different sentiments and factors.

Summing up this section, it seems that there are some of the typical factors in place that explain industrial clusters, while others are weak or missing. It is clear from the evidence of the case studies that there is no such thing as unified secondary wood clusters, rather, as hypothesised above, clustering can be observed within some of the sub-sectors, especially in cabinet building, furniture, and millwork. In comparison however to other industrial clusters, including the primary sector, the cohesion and interaction between the various actors and the synergy effects appear rather weak. On the other hand, there are ethnic or religious communities which have a strong sense of cohesion and mutual trust which is the basis for close business relationships among the members of these communities, irrespective of the specific nature of the business they are in.

5. Innovation and clustering

As suggested in the introduction, a study about innovation and clustering in the secondary wood industry is challenging as the sector is in the process of massive change. Partly, the industry is still a low tech industry with management structures and styles from the (pre-)industrial age:

> the secondary or wood manufacturing industries, generally speaking, are very low IQ industries. Secondary is primarily a entrepreneur driven, not necessarily engineering or strategically driven and as a result we have good practitioners and good risk-oriented crafts based industries but not really good engineering and strategically driven business. As a result we don't necessarily organise ourselves very well or invest in a good collaborative. (MB3)

Partly however, the industry is changing fast, due to three major developments: Globalisation of markets, the full use and impact of the ICTs, and the professionalization of management. While these factors have a major role in innovation in this as in other industries, it has the potential to gradually change the industry from a low tech and backwater image, from a field characterised by woodworkers and self-educated entrepreneurs to a field dominated by professional managers and technical and marketing experts.

Globalization makes itself manifest in several ways, all of which can be observed in secondary wood. The challenge of world wide competition and, concomitantly, the need for the industry to orient itself to world standards of novelty and quality, the increasing use of partnerships and joint ventures, corporate mergers and strategic agreements across national borders, as well as a growing division of labour through multi-site production and outsourcing – all of these developments are well underway and examples for all can be found in the evidence from the case study companies.

The use of the ICTs for integrating the different activities of the business cycle within the companies and in the relationship with their customers and suppliers changes the whole way things are being done. It is a steep learning process for management and the core staff – and an ongoing one. As a consequence, it is quite probable that the percentage of these (semi-)skilled people required for this complex system of customised mass production will increase whereas the no-skills, no-learning production worker will disappear as the rationalisation process continues.

Finally, the professionalization of management and senior staff will change the image and standing of the industry thus attracting young, talented people to work in it. Wages and career pattern will (have to) change accordingly and the current discrepancies between income in the primary and the secondary wood industry will end and maybe even reverse.

These three developments are not only changing the industry, they also will change locational patterns. As globalization makes many of the companies operate beyond their cluster region, they engage in partnerships with companies, designers, architects, developers etc elsewhere. Because of the new ICTs which make international communication easy and cheap, and as travel and transportation cost are falling, there will be increased linkages to and business dealings with distant partners. Professionals will communicate with and meet, like professionals from other

fields, their colleagues and groups of peers all over the country and the world, coming together periodically at international trade fairs, conferences and equipment shows.

With respect to the phenomenon of clusters it seems possible to distinguish three generations of developments:

- a first generation in which clusters emerged due to the immigration of skilled labour and entrepreneurs, proximity to raw materials, and local markets and major clients;

- a second generation during which new firms were attracted to an emerging cluster, new companies were spawned off by larger companies, and more specialisation was occurring within the clusters; and

- a third generation where a process of de-clustering can be observed, This de-clustering is due the move towards new international markets for products, raw materials and technical equipment, a high degree of specialisation which re-enforces a world-wide division of labour but also world wide partnerships, and the professionalization of management and core staff.

While parts of the industry are on the move into the direction indicated, there will be others that will not be affected to the same extent. Crafts firms and smaller industrial manufacturers that serve local or small speciality markets will likely be unchanged in a major way. On the other hand, with the world-wide and increasing demand for fibre, primary industries will have to change harvesting and marketing strategies, adding more value than now to the logs they are cutting. This will mean new alliances between primary and secondary industries which, until recently, have not existed.

Summary

The picture that emerges from this study shows a sector in the middle of a massive transition from traditional crafts and manufacturing which was primarily serving the local, domestic and, to some extent, the US market to a more technology intensive and internationally operating sector. The effects in particular of advanced ICT systems which are increasingly used for integrating the entire business process, and not just for automating production, are being embraced by an increasing number of firms, primarily by the larger ones. So are the opportunities of globalization. While this does not entail the disappearance of specialized crafts firms operating in niche markets, it forces all firms to be more innovative in design, quality, and customer services in order to become and remain competitive. Whereas the industry was characterized by a fair amount of clustering in the past, as many firms located in particular around the sources of raw materials, major markets, or places close to major transportation ways, increasingly clusters in the traditional sense are replaced by networks of business partners and collaborating firms that are typically located at a greater distance. As pointed out above, this pattern is a development that is closely linked to both technological change, i.e. the use of advanced ITCs, but also to generational change, with a new brand of professional owners and managers.

So far, the industry has turned technological change and globalization to a clear advantage, as the secondary wood industry as a whole is clearly thriving in Canada's Western provinces. This will not necessarily stay this way as competitors will avail themselves of the same opportunities. Especially the fast rise of China as a major competitor and the effect of

cheaper goods from Southeast Asia which are severely destabilizing the North American market for mass wood products is seen by many of the firms and experts interviewed as a warning sign that great challenges for the industry lie ahead. So far, most producers of design-intensive goods and with up-market customers are fairly confident that low priced standard goods from Asia will not affect their market share, and point especially to the advantage they enjoy in terms of customer design, quality, delivery time, and customer services especially the latter of which would be very difficult to match by producers who operate from overseas locations. However, most are aware that there is little room for complacency as business networks and partnerships are becoming increasingly international, bringing the industry into the realm of world wide competition.

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Appendix: Characteristics of case study firms

Table 7 a: Case study companies in British Columbia

	Estd	Founder/ Owner/CEO	Products	Markets	Competition	Workforce (growth)	Skills Training
BC 1	1991	Insurance broker	Windows & doors	Cdn, US, Japan	Quebec, US, Europe	280 (unionised) (from 28)	Continuous on-the-job training
2	1980	Bought in 1993 by present owner; CEO MBA/marketg	Furniture for babies/ children	Cdn 50%, US 50%	Mainly US, some from Europe	158 (unionised) (from 87)	On-the-job traing as required
3	1992	Maj.Owner and his brother worked for several	High end kitchen cabinets.	West Cdn 50%, Japan 50%	No or little competition for Jap.markey	25	Semi-skilled On-the-job and external training
4	1969	Owner immigrated from Eastn Europe	Doors and windows	Local 80% US 20%	Kelowna, LM, Alberta	20	Semi-skilled On-the-job training
5	1980	Owner ualified wood worker	High quality office furniture	Local /regional	No local competition	15	Un/semi-skilled In-house training
6	1980	Founder is Japanese immigrant, son now CEO	Prefabricated homes, kitchen cabinets,flooring.	Japan 90%, China, Korea	Several local competitors	12	Un/semi-skilled prod.workers, qualif'd draftsmen; office/dales pers. Speak Jap/Chin.
7	1986	Owner is German immigrant; journeyman	Hardwood flooring/millwork	Local 30% US 70%	Little local competition	10	Un/semi-skilled; On-the-job training
8	1939	Founder was immigrant from Eastern Europe; son now owner and CEO	Commodity lumber, mill-work, comp'ts, panelling,floo-ring	Cdn/BC 60% US 30% Asia 10%	US, Scandinavia, Russia, China	110	Production workers nn/semi-skilled; several prof. and mngt.;On-the-job traing; appr. traing
9	1913	Founded by present owner's grandfather	Millwork, wood components, panelling, decking and siding	BC/Cdn 10% US 85% Japan 5%	Regional, US, China	185	Production workers nn/semi-skilled; several prof. and mngt.;On-the-job training;
10	1966	Founder was immigrant from Westn Europe; son owner and CEO; other fam.members work in firm	High end kitchen cabinets, vanities, millwork	Local 75% Cdn 20% US 5%	No regional, some Europe	53	Semi-skilled workers; In-house and on-the-job traing; appr. traing
11	1982	Father (journey-man) and son (mngt degree) founders and	Custom hotel furniture	Local 10% CDN 25% US (50%)	Alberta, Ont. US; increasingly China	60 (from 5)	70% unskilled; 30% skilled. On-the-job training
12	1984	Father (design background) founder, son (bus.adm, accounting)	Higher end kitchen and bath toiletry	US 65% Alberta, BC 35%	Mainly local	35	un/semi-skilled On-the-job training
13	1986	local group of business men, with large European engineerg .firm	Ready -to - assemble furniture, made of pine	Cdn 70% US 30%	Europe	130 (unionised) (from 150)	Production workers un/semi-skilled; several prof. and mngt.;on-the-job training; some appr. traing.

14	1964	Two former employees of main local competitor	Structural laminated beams and trusses	Local/regional	Local, BC and Alberta	25 (unionised)	nn/semi-skilled. On-the-job training;
15	1962	Several local construction firms	Custom flue lawn trusses and heavy timber frames for industrial operations	20% Cdn; formerly Japan, now US 80%	Local, Alberta, Ont. Quebec; US	60-70	Semin-skilled. External and in-house training, use of coop stdents
16	1998	current owner has background though no formal traing in wood manufacturg	High end traditional wood furniture	Canada - a high end speciality chain is main client	LM and Alberta	28 (from 6)	nn/semi-skilled. On-the-job training;
17	1998	Owner is German immigrant with marketing and training background	Prefabricated frames and walls for timber frame houses	BC, Alberta,	BC, CDN, US	2, plus several sub-contractors	N/A
18	1983	current owner (degree in civil engin'g; work experience in several wood manuf.co.s) & partner	Speciality pine products, esp. furniture panels, interior wall cladding	CDN 40% US 60%	Northern BC, Alberta, Quebec	90	Un/semin-skilled. External and in-house training

Table 8 a; Case study companies Alberta

	Estd	Founder/ Owner/CEO	Products	Markets	Competition	Workforce (growth)	Skills Training
AB 1	1984	Owner immigrant from West Europe, qualified carpenter	Custom woodwork, doors, panels	Local 80% US 20%	Local competition only; SE Asian companies cannot do custom work	50 plus 12-15 as sub-contractors; initially mainly Swiss/European trained workforce	6 apprentices and other forms of formal training. Close collaboration with NAIT
2	1980	Two present (but now absent) owners; two managers run operations	Trusses, beams, pre-fabricated walls, staircases	Local 80% AB&CDN 15% US 5%	Several local competitors	145 (from 8)	Mostly unskilled, 2 apprentices; on-the-job training (buddy system)
3	1983	4 partners; Of which 1 accountant, 2 markt'g backgr'd, 1 wood expertise	Windows and doors	20% US, Asia, Europe, 80% Cdn	Lots of competitors (2 major ones in Calgary and Edmonton)	800 (from 30)	In-house training centre collaboration with SAIT and actual training programs
4	1983	Owner had previously owned (with his brother) 2 companies, which went both bankrupt in early 80s. Present company was bought by large US firm.	Office furniture systems incl. movable walls and flooring	Only company that offers office systems solutions – therefore no competition.	Mainly US	850 (from 2,000 two years before)	In-house, mainly on-the-job training
5	1979	East Indian immigrant from East Africa. His brother owns AB 6	Low to middle end market furniture and upholstery	35% US, 65% Cdn;. sell to large chains of dept. stores (B.?k, Sears)	In Calgary and elsewhere mostly smaller companies, some former AB5 employees	300 (from 380 year before)	Low skilled workers; one third immigrants. High turnover. on-the-job training
6	1982	East Indian immigrant from East Africa. His brother owns AB 5	Low end bedroom suites and occasional furniture	40% Cdn 60%U.S	China	500, mostly unskilled. High turnover of staff	No local competition but smaller companies in BC, Ont and Quebec.
7	1993	Owner has varied background (sales, wood plants, stairs)	Customized circular stairs and wood railings	Cdn/AB 60% US 30% Intl 10%	No much competition(2 small companies in Calgary).	70 in plant Use sub-contractors for installations (43 in Cdn),	30% are trained workers; own apprenticeship program
8	1987	Owner is journeyman	Architectural millwork, speciality products(60% commercial, 40% residential).	Local 40% rest of Alberta;5% works for several contractors	Some local	4	All staff qualified

9	1994	Founder/ owner (German immigrant)and son are journey men.	Original kitchen cabinets, now veneers, panels, railgs, architectural doors.	Western Cdn & US	Some local and ACO in Calgary.	5	on-the-job training , and through SAIT.
10	1970	Owner worked as equipment mechanic for oil company - no wood backgrd	Industrial trailers and camps,includin g installation.	NA/Alberta Second plant in Poland, managed independently.	ATCO in Calgary	100-150	Mostly unskilled workforce; few qualified staff. Most speciality jobs(plumbing, electrical) are contracted out.

Table 9 a: Case study firms Manitoba

	Estd	**Founder/ Owner/CEO**	**Products**	**Markets**	**Competition**	**Workforce (growth)**	**7 Skills Training**
MB 1	1983	two co-owners (brothers) with mechanics background and engineerg degree resp. Mennonite family.	Wood components (mouldings,sh apes) etc.	Local 39% MA 5% Cdn 25% US 35%	China	150 of which many (semi-) skilled; young(average age 25yrs).	Mostly skilled and semi-skilled workforce, intensive and continuous in-firm training, partly with ext'l trainers.
2	1977	two co-owners (2 brothers and 1 brother-in –law). Mennonite family.	Customatized kitchen cabinets	Local 59% Cdn 25% US 75%	Little competition because of customozation(nic he market).	250	Continuous in-house training
3	1905	owner's grand father and great grand uncle. Mennonite family.	Windows and doors	Local/regional 5% Cdn 25% US 70%	US	1,450	On-the-job and some external traing
4	2002	Mennonite family; had operated and sold successful kitchen cabinet company in same location	Parts for kitchen cabinets	US 100%	Big company next door(of which MB4 owner was previous owner); US, Calgary, Sask.	60	In-house training Use of coop students.
5	.	Bought in 1995 by present owner from his father. Mennonite family.	Non-customized) residential furniture, cabinets	Local 13% Cdn 70% US 17%	not much competition, (more focus China so far).	185	Production workers mostly unskilled . On-the-job and some external traing (collab'n with local college)
6	1998.	5 brothers/first cousins from 3rd generation immigrant family from Eastn Europe run the company	Customized high end windows and doors(wood and PVC).	Local 35% Cdn 15% US 50%		90	Un/semi-skilled workforce. High turn-over. Continuous in-house and some externl training

Table 7 b: Innovation and Clustering: Case Study Companies British Columbia

	R&D	Technology Use	Type of Innovation	External Knowledge- flows	Other Cluster Elements	Location rationale
BC 1	In-house R&D; Development of complex software sysrtem; Coop with external R&D inst's. No tax credits	ICTs - fully integrated production process	Radical Process: MassCustomiza-tion/	Direct customer contacts; Some collab'n with R&D intsitutions	Undetermined	Location of company acquired
2	In-house product testing (US certified)	Traditional; non-integrated process	Radical: Marketing; outsourcing	Undetermined	No membership in ind. Assn's	Location of company acquired
3	None; One-time coop with external R&D inst.	Standard wood machinery	Radical: Marketing	Direct customer contacts(Japanese builders);	Active membership in several ind. Assn's; Owner and brother worked in several similar firms before	Proximity to transportation; labour pool; Quality of life
4	External product testing	Standard wood machinery	Some minor ncremental: Process	Direct customer contacts (local home builders);	None	Owner immigrated here
5	none	Advanced wood machinery	Incremental: organization, marketing	Direct customer contacts	Undetermined	Owner lived here
6	coop with external R&D inst. ReChinese building code	Standard wood machinery	Some radical product: Earth-quake resistant device	Direct customer contacts (Japanese home buildg firms);	Active membership in several ind. Assn's;	Owner's father immigrated here
7	Some In-house development	Standard wood machinery	Incremental: Marketing and outsourcing (Partner firm in China)	Direct customer contacts (local home builders); trade fairs	Active membership in ind. Assn;	Proximity to services; labour pool; other companies in same field
8	Some In-house development	Standard wood machinery	Some incremental, e.g. Recycling of sawdust and shavings waste	Direct customer contacts (e.g. value-added firms)	Active membership in several ind. Assn's;	Owner's father and uncles immigrated here; proximity to raw materials
9	Internal R&D and coop with external R&D inst	Some advanced/state-of-the-art wood machinery	Turning waste shavings into a product coating	Contacts, R&D collaboration with supplier	Active membership in several ind. Assn's; membership R&D inst (FORINTEK)	proximity to raw materials, US market.
10	Some In-house development	Standard wood machinery	Incremental product, esp. design; Incremental process	Direct customer contacts; trade shows.	membership in several ind. Assn's; (marketing). Several employees have left to set up own shop	proximity to Alberta, US markets.
11	Some development	Standard wood machinery	Incremental product (quality) Incremental process	Direct customer contacts; trade shows.	membership in several ind. Assn's; (marketing; quality assurance).	Proximity to labour pool, trans-portation routes; dry climate;quality of life
12	none	Standard wood machinery	Incremental product (design) Marketing	Direct customer contacts (US builders); Trade shows	One key employee left to set up own shop	Owner's father located here; quality of life
13		State of-the-art machinery	Product idea and design largely emulated from large European retailer; Incremental process innovation	Direct customer contacts (design); trade and machinery shows.	Active membership in several ind. Assn's; UBC Adv.Wood processsing progrm	Proximity to labour pool, dry climate;quality of life.

14	none	Mature machinery	Incremental process (glue)	Direct customer contacts;no trade and machinery shows	membership in ind. Assn.	Both partners lived here; good transportation routes.
15	Some R&D in collaboration with university lab's and other companies	Some State of-the-art machinery	Incremental product, and process; Radical innovation in marketing	Partnership with US construction firm; two joint ventures with Cdn firms	**Active membership in several ind. Assn's in BC, , the US and Japan. One key employee left to set up own shop next door (BC 14)**	Proximity to labour pool, transpotation routes;quality of life.
16	No R&D	Standard machinery	Incremental to radical marketing innovation (franchising/sub-contracting)	Indirect and customer contact; trade show	membership in ind. Assn.	No particular locational advantages, except no information flow, spill-over to competition
17	Some development; marketing research	N/A	Radical innovation: Marketing and outsourcing	Direct customer contacts	Membership in local, regional Chambres of Commerce, Visit of trade shows;	Quality of life
18		Standard and some state-of-the-art machinery	Incremental Process and market innovation;	Directs contacts with machine producers and competitors in Northern Europe	Contacts with other firms in related fields	Proximity to raw material (pine), transportation routes; dry climate.

Table 8b: Innovation and Clustering: Case study companies in Alberta

	R&D	**Technology Use**	**Innovation**	**Exter'l Know-ledge- flows**	**Cluster Elements**	**Location Rationale**
AB 1	In-house developmnt	state-of-the-art machinery; no integration through ICT	Incremental product and process innovation,.e.g. using polyester in conjunction with wood	Trade shows, suppliers; competitor firms	Active member in Calgary Chapter of the ARMAC – Collaboration with competitors	Dry climate, quality of life
2	No R&D	Standard wood machinery and IT software	Incremental process (esp. quality improvement)	Direct customer and supplier contacts	Active in Western Truss Assn. Many semi-skilled workers have left and work for competitors.	Close to major city and transportation routes, but none of the congestion; Quality of life.
3	Intensive in-house R&D; Collab. With U. of Calgary. Grants from NRC and Alberta RC	state-of-the-art machinery Fully integrated pr0duction-marketg process	Some incremental product, radical process innov.(just-in-time productn).	Partners own two other plants in Calgary (aluminium) and Edmonton (vinyl).	Membership but no active involvement in ind. Ass'ns Coop wit univ. researchers, repres'n at SAIT Board	Business climate (low taxes, no unions).
4	Intensive in-house R&D; collaboratn with SAIT, universits.	state-of-the-art machinery Fully integrated pr0duction-marketg process	Radical product innov..(Design of complete office systems); radical/inremental process innov (Integrated design/ productn/marke	depts. & individual professional staff belong to various professional assns. Role of personal networks. Some spill-over from/ to new US parent firm	Several staff on univ/SAIT.advisory boards.	Business climate (low taxes, no unions).

			ting/shipping system)			
5	No in-house R&D	Standard wood machinery	Some incremental process (ISO 9000 certificat'n); some product innov. (design)	Direct contact with suppliers; No relationships with other firms/ competitors, except AB6. No membership in Ind. Assns. But display at Furniture West Show	Large family network formerly from east Africa (several brothers/cousins in related business in US).	Owner's family immigrated here
6	No in-house R&D;	Standard to low-tech machinery	Some incremental process; some product innov. (design)	No formal partner but part of larger family network. Collaboration with AB5 on several fronts, e.g insurance	Large family network formerly from east Africa (several brothers/cousins in related business in US).	Owner's family immigrated here
7	Some in-house D, no R.	Standard to low-tech machinery;	Some incremental process; some more radical marketing and org. innov.	Spill-over from/to other staircase plants (2 in US, 1 in Edmonton). Direct customer (builders) contacts	Membership in one ind. Assn; no trade shows	Owner located here (fromOnt.); quality of life; Business climate (low taxes, no unions).
8	No R&D	Standard to low-tech machinery;	some product innov. (design)	Direct customer (builders nd households) contacts	Owner belongs to Craft Council, but no impact on business	Owner was born, lived here.
9	Some D	some standard high tech equipment.	Incremental process innovation	No formal alliance but long term business association with a company in BC.	Father and son had/have connections to NAIT wood program	Owner immigrated here
10	Some D	Standard to low-tech machinery;	Some incremental process and product innov. (concept, design)	Close and direct customer (oil companies) contacts	Active in several business associations. Active immigrant networks (Owner Dutch, project manager German).	Owner immigrated here; Connection to the oilfields in the North.

Table 9b: Innovation and Clustering: Case Study Companies Manitoba

	Estb	R&D	Technology Use	Innovation	Extn' know-ledge flows	Other Cluster Elements	Location rationale
MB 1	1983	Intensive in-house R&D. Two patents.	High tech machinery	Radical and incremental product (Design and construction of ready-to- assemble cabinetry and other interior wood work) and process innovation. .	Formed another company for a specified product with another company(50:50 ownership).	Outsourcing of parts production. Strong Mennonite network. Involved in community affairs.	Owners' family immigrated here 3 generations ago.
2	1977	No R, but some in house D	State-of-the-art and standard machinery (integrated IT system).	Incremental process	On-going collaborative relationship with other Mennonite firm in BC	Strong Mennonite network.	Owner's family immigrated here 3 generations ago.
3	1905	In-house some collaboration with UofManitoba and UBC	State-of-the-art and standard machinery (integrated IT system).	Incremental Innovation, Trial and error, failure seen as necessary part of innovation.	No formal alliances	Strong Mennonite network; continuous commuity involvement (high school et al)	Owner's family immigrated here 3 generations ago.
4	2002	In house D, together with technology suppliers.	State-of-the-art and standard machinery	Some minor process and some radical marketing innovation	Experience from building, operating a successful company; spill overs from and to three Us sister companies.	Owner and family active in local Mennonite network.	Owner's family immigrated here 3 generations ago.
5	.	Some in-house R&D	standard machinery; Low IT use.	Some incremental product (design) and process innovation.	Spill-overs from/to several enterprises, some in related fields(glass, upholstery) which belong to same family or other Mennonites	Representatn on Board of RRCStrong Mennonite network; occasional clooabn with IRAP	Owner's family immigrated here 3 generations ago.
6	1998.	Some in-house testing and application(R&D tax credits)	Winnipeg grandfather immigrated from Poland.	Soome improved products..Incre-mental process innnov't . Testing by indept labs-	Strong family/East European immigrat'n ties	Strong immigrant family connection)non-Memmonite) strong with same suppliers.	Owner's family immigrated here 3 generations ago.

Figures & Tables: