A COMPARATIVE ANALYSIS OF COMPETITIVE POSITION: B.C. AND SWEDISH PULP AND PAPER INDUSTRIES

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. AN INTRODUCTION TO THE PULP AND PAPER INDUSTRY

1.1 Background

International competitiveness is a concept which has moved to the forefront in the past few years. Traditionally, firms were situated in their home countries, and trade flows between nations constituted international economic relations. Investment and employment was protected within a stable, domestic environment. In Canada (and other nations), natural resources supported a high standard of living. Such is not the case today. A new industrial structure is currently being formed, where companies are being forced (or are adapting naturally) to develop a competitive advantage in the global market; "in a global economy, the only lasting security is found in being competitive."[1] Firms must examine the need for strategic international alliances, efficient productivity, availability of skilled labour, a stable economic environment, and access to key markets.

Such is the case for pulp and paper producers. During the late 1980's, world demand for paper increased at a rate of approximately 5% per annum. However, the move toward electronic communications, integrated markets and the inclusion of new productive facilities has created a very dynamic environment for paper manufacturers. For example, in 1990 the former West Germany reported a 4% increase in paper production with a 9% increase in consumption. In contrast, the United Kingdom demonstrated a fall

in paper consumption as a result of their economic climate. For the People's Republic of China, an increase in international business contacts is expected to lead to growing imports of paper and paper products.

A review of the trend in market pulp demand highlights a similar pattern of rapid structural change. Since 1989 the world demand for pulp has diminished, with 60% of bleached chemical pulp demand being satisfied by local, integrated mill production facilities. In absolute terms, demand for market pulp is expected to grow at approximately 2% per annum over the next 20 years. Latin America, Asia and Western Europe show the highest forecasted rates of consumption; H.A. Simons predicts 5.1% and 3.3% per annum for Latin America and Asia respectively. Coupled with a lower demand has been an increase in capacity; "the total world production capacity for chemical pulps is estimated at about 118 million tonnes."[2] For example, the Japanese industry has continued to expand vigorously, resulting in lower imports of pulp and lower utilization of capacity. There also exists a substitution effect as a result of modern technology, where lower priced pulp (ie. Brazilian Eucalyptus) can be used in certain grades of paper without sacrificing quality.

1.2 Problem Definition and Scope of Research

The circumstances facing both pulp and paper manufacturers led me to question what various countries did to support high levels of

productivity in this sector. Was it possible that some nations had a more "global mindset" and this, coupled with their particular attributes, shaped their success? This in itself would be a monumental undertaking, so the scope of the study was limited to Sweden and British Columbia (Canada).

Two objectives were formulated based on this problem definition. The first was to summarize the results of my research on the pulp and paper industries of B.C. and Sweden. This information would include recent changes in the global economy. The second objective was to consider whether B.C. had kept up with the dynamic pressures of international trade. If the research indicated that specific areas in the B.C. industry required change, then proposals for the industrial structure would be made.

1.3 Research Design and Underlying Theoretical Structure

This study will follow a case history format, with quantitative information being used to support or expand descriptions. Data was gathered over a 9-month period, and required two international questionnaires. Overall it was my intention to provide a more holistic view of pulp and paper industries.

"Past explanations of competitiveness have been static and focused on differences between nations due to factor costs, scale, and government subsidies."[3] A recent Price Waterhouse study undertook such a cost competitiveness comparison, ranking pulp and

paper producing regions based on delivered cost. This study is summarized in Table #1; note that the analysis used Canadian dollars as the base currency.

Table 1: Comparative Rankings Based on Delivered Cost

Price Waterhouse - October 1991

	1990	1989	1988	1987	1986
B.C. Interior	4	6	5	3	2
Sweden	5	4	7	7	6
B.C. Coast	7	5	4	5	4

However, global competition has many facets, hence the need for a theoretical structure which is broad in nature, incorporating many factors including macroeconomic and microeconomic conditions. Such a theoretical basis was drawn from Dr. Michael Porter and his text, "Canada at the Crossroads: The Reality of a New Competitive Environment". Dr. Porter's paradigm is referred to as the "Diamond of National Advantage". The underlying principle is that "international competitive advantage results from ongoing improvement and innovation, not from static advantages."[4] This reflects the fact that global trade has decoupled "the firm from the factor endowments of a single nation."[5] There are four broad attributes which determine the "playing field" for a nation's industries. These are:

(a) Factor Conditions: The factor endowments of a country, which include its labour supply, land, natural resources, and infrastructure. Dr. Michael Porter also considers "highly specialized and advanced pools of skills" and "technology" to be factors.[6]

(b) Demand Conditions: Dr. Porter defines this attribute as the domestic demand for output of local industries. In this study, the definition was expanded to include global demand for a nation's production.

(c) Related and Supporting Industries: This entails the presence of local suppliers of specialized industry inputs (physical capital, factor inputs, and knowledge). A key issue is the "presence of sophisticated and demanding local customers <mills> who pressure firms to innovate."[7]

(d) Firm Strategy, Structure and Rivalry: This factor is defined as specific conditions which influence how "companies are created, organized and managed, as well as the structure of domestic rivalry."[8]

Each of these determinants influence the competitive success of a nation. However, integrating them into a "diamond" structure highlights that their interaction as a system is also important in the context of competitiveness. The ability of a firm to innovate or upgrade in light of a specific factor disadvantage is constrained or facilitated by the state of the remaining factors. There are two additional variables which influence the competitive

success of a firm or nation; government and chance. In regards to the former, relevant government policy was examined in relation to the four determinants defined above. Dr. Porter outlines that the "role of government is analyzed by looking at its effects on factor creation and the goals and behaviour of individual firms, its role as a buyer of goods and services, and its influence on the competitive environment through competition policies, regulation, and government ownership of enterprises."[9] The latter variable, chance, was not considered in this study. Although chance does affect the competitive environment of a nation, it did not appear to "fit" within my original problem definition; "chance events are developments outside the control of firms (and usually the nation's government), including, among others, pure inventions, breakthroughs in basic technologies, wars, and external political developments."[10] In addition, "what appears to be accidents are often in fact driven by the conditions of the diamond".[11] Hence the exclusion of chance does not seriously undermine the validity of this study.

This paper is organized into seven chapters, with Chapters 2 through 6 examining the five factors outlined above in the context of B.C.'s and Sweden's pulp and paper industries. More specifically, in Chapter 2 the natural factor endowments (ie. tree stocks, chip imports, labour, etc ..) of B.C. and Sweden are examined. In Chapter 3 the global demand conditions for pulp and paper, as well as the major export patterns for each region, are outlined. Chapter 4 describes the interactions between mills and

supplier industries, with a mail questionnaire forming the basis for analysis. In Chapter 5, secondary data in addition to a mail questionnaire was incorporated as a means of describing current managerial strategies and views. The final factor, government, is outlined in Chapter 6, where relevant policies (past and current) are described for each region. Finally, Chapter 7 highlights the findings for each factor and provides proposals for improving the competitive position of British Columbia. In addition, the underlying theoretical structure of this study will be reviewed in the context of future avenues for research.

1.4 A Summary of Pulp & Paper Terminology

The following is a general glossary of terms often used in the paper, paperboard, and pulp industries (selected from a glossary published by the Canadian Pulp and Paper Association). These terms will be used throughout this study. Consequently, a review of basic definitions will facilitate understanding of industry-specific descriptions.

Newsprint - term describing paper used in the production of newspaper; furnish is largely mechanical wood pulp with some chemical wood pulp.

Mechanical Printing Papers - coated or uncoated papers, excluding newsprint, which contain *more than* 10% of fibres from a mechanical pulping process.

Kraft Papers - utilize wood pulp that has undergone a sulphate

process; coarse, strong grades used primarily as wrappers or packaging material.

Sulphate Paper Grade Pulp - produced by the sulphate process; bleached pulp must achieve a G.E. brightness of more than 75, and semi-bleached a G.E. brightness between 45 - 75. Softwood variety is generally referred to as NBKP, and hardwood variety as LBKP.

Semi-chemical Pulp - high yield pulp produced by a mild chemical treatment followed by a mechanical defiberizing operation.

Stone Groundwood Pulp - produced by grinding logs or wood bolts (approx. 4 feet in length) into relatively short fibres.

Thermomechanical Pulp - high yield pulp process where wood particles are softened by pre-heating under pressure prior to being refined (in a pressurized system). TMP usually replaces or reduces the chemical pulp component in newsprint or groundwood papers.

Chemithermomechanical Pulp (CTMP) - relatively new process where wood chips are treated with chemicals prior to heating and mechanical defibration.

Defibration - characterized by the continuous feeding of wood chips into a steam-heated chamber, followed by mechanical separation of fibres. Note there exists an "exploded" procedure where wood chips

are subjected to high pressure steam, followed by a quick release of pressure. This causes the fibres to separate or "explode".

A brief overview of a traditional, Kraft Pulping process is included in Appendix #1, and may facilitate the understanding of terminology by providing a context. This overview is based on the Intercon mill in Prince George, B.C., which commenced production in May of 1968. The Intercon facility is operated on a 24-hour basis, approximately 340 days per year.

2. Natural Factor Conditions

2.1 Global Natural Resource Demand & Supply Conditions

When one reviews the distribution of forests on a global scale, one finds that there tends to be a shortage of forest where population is heavy, and vice versa. Despite enormous deforestation, particulary in Latin America, one-third of the earth's land mass is still covered with forest. Of this, approximately 10% (1.4 billion hectares) is best described as "open forest" (sparse tree and bush vegetation), with the remainder being "closed" forest land (approximately 3 billion hectares). In terms of forest makeup, natural coniferous forests are predominant in the northern hemisphere, with most deciduous forests being found in tropical and subtropical areas. More specifically, the closed forest lands in the industrialized countries amount to 1.5 billion hectares and 71% are covered with coniferous forest. Developing countries have approximately 1.4 billion hectares of closed forest land, with 94% covered with deciduous forest.

As mentioned in the introduction, the developing countries have made a dramatic entrance into the pulp market. Chile is a low-cost producer of softwood pulp, and Brazil, Spain, and Portugal are major exporters of eucalyptus pulp (a low cost alternative which is reducing the amount of hardwood pulp required in certain paper grades). The president of Island Paper Mills is quoted as saying: "We began using substantial quantities of eucalyptus in 1985. At that time it was priced at a discount to Northern mixed

hardwoods. As you know, we are very positive on eucalyptus as a fibre in fine paper. From Island's point of view it provides exceptional bulk properties, good opacity, and improved formation. Because of its superior quality we can, in fact, reduce the overall hardwood requirement, which is a cost benefit."

The overall consumption of industrial roundwood grew approximately 1.6% per annum from 1980-1990 (1,440 million m^3/year in 1980 to 1,685 million m^3/year in 1990).[12] As an aside, approximately half of the worlds roundwood consumption is used for fuel (mostly in third world countries). Predictions for the next two decades show a moderate slowdown in industrial consumption, with hardwood demand increasing at approximately twice the rate of softwood demand. This reflects the current shift from softwood fibres to hardwood fibres in pulp and paper manufacturing sectors. Specifically, hardwood demand has an annual average growth rate (predicted) of 2.2% from 1990-2000 and 2.0% from 2000-2010. In contrast, softwood has an expected, annual average growth rate of 1.1% from 1990-2000 and 0.9% from 2000-2010.[13] The pulp industry is the major factor for the increase in world softwood consumption, with an expected 620 million m^3 demand in the year 2000.

This begs the questions: where did roundwood fibre originate from in the past? and; who will be the major exporters of the future? During the 1980's, 55% of the increase in softwood fibre supply (approx. 80 million m^3)originated from North America, with Europe and the then USSR following at approximately 23 million m^3 and 19 million m^3 respectively.[14] On a global scale, the world

volume of growing softwood trees was approximately 107,000 million cubic metres, with the previous USSR providing 57% of the world total (B.C. provides 7.1%, the USA 12%, and Europe 9%). Projected increases in softwood supply (years 1990-2000) show a change in trend, with the Asia Pacific and Latin America regions becoming leaders. The hardwood sector shows a different picture, with the Asia Pacific region providing approximately 42% of the supply increase during 1980-1990. However, the Asia Pacific region is expected to lose its leading position as production from natural southeast tropical forests diminishes (years 1990-2000). The future leading producers will be North America and Latin America. While North America has significant reserves of natural hardwood forests, Brazil and other Latin America countries are expected to supply an additional 40 million m^3 of hardwood over the next decade (given expanding and maturing plantations).[15]

2.2 Factor Demand & Supply Conditions in British Columbia

The growth potential of the province varies between the coastal regions and the interior. The climatic conditions of the central interior, where weather is traditionally cold and dry, induces slow growth of trees. Consequently, tree fibres tend to become long, slender, and flexible. This is beneficial since pulp produced from these trees yields a uniform and high-strength product. However, the low growth rate implies that there is a significant lag between the original harvest and harvesting of

second or third-growth forests. In contrast, the coastal forests have growth rates reaching 20 m^3 per hectare per year.[16] Predicted short-term fibre supply trends for the B.C. coast include the use of "less old-growth roundwood and more chips and second-growth roundwood", and for the B.C. interior to "use the surplus chips that are now exported <examined later in chapter>. Some hardwoods from the northeast of British Columbia may also be used unless a higher use is found in waferboard."[17] While Nordic countries have a long history of harvesting managed forests, British Columbia faces the prospect of harvesting more distant, natural forests until second-growth forests mature.

Over a 5-year period from 1986 - 1990, British Columbia contributed to approximately 50% of the Canadian harvest of hardwood and softwood stocks. This translates to an average 84.1 million m^3 of roundwood harvested per annum. In 1990 the B.C. log harvest was 78.3 million m^3, down 10.4% from 1989's harvest. Softwoods are still the leading commercial species in B.C., with hardwoods making up only a fraction of the harvest. Lodgepole Pine, Spruce, and Hemlock are the top three species of wood harvested (1990).[18]

The pulp industry in B.C. currently consumes approximately 31 million m^3 of wood on an annual basis, with a potential at full capacity to consume 35 million m^3 of wood. The majority of wood inputs (approx. 78%) are purchased from surrounding sawmills as residual wood chips or from integrated sawmills with chipping facilities. Approximately 17% of the industries' wood consumption

is met with roundwood pulplogs, with coastal mills being the primary consumers. The remaining 5% of fibre inputs consists of sawdust.

At full capacity, the wood products industry and integrated chipping facilities could produce approximately 32 million m^3 of residual wood chips on an annual basis. Although the current consumption of chips at full capacity is approximately 28 million m^3 per year, if the Allowable Annual Cut (AAC) is reduced the supply of chips would decline to approximately 23 million m^3. Such a scenario is entirely possible, given a current AAC of 73 million m^3 per year, but a long-run sustainable yield of 60 million m^3 per year (based on current state of B.C. Crown forest resources). Thus there is a potential wood fibre deficit of approximately 5 million m^3 per year, assuming that industry capacity as well as technology remain constant, and that exports of wood chips are eliminated. H.A. Simons Ltd. predicts that there is enough pulpwood (from stands excluded from the AAC and as a by-product of commercial thinning) to meet this demand, although "on a regional basis ... some mills could have more difficulty obtaining fibre than others."[19]

If H.A. Simons is wrong, the result of such a wood chip deficit could be profound. Traditionally, North American regions enjoyed a large cost advantage in fibre on a global scale. This is reflected in the following table, where cost figures for British Columbia and competing regions are presented (context of pulp).

Table 2: 1990 Delivered Cost ($ Cdn/tonne)*
*** prior to depreciation**

Price Waterhouse - October 1991

	B.C. Interior	B.C. Coast	Finland	U.S. South
Wood Fibre	$201	$222	$460	$138
Chemicals	61	61	63	79
Energy	37	59	9	24
Labour	101	148	64	70
Other (Mill)	147	138	47	62

Overall, fibre costs declined in 1990 over 1989 due in part to an increased usage of waste paper (recycled fibre) and a decrease in the market price of pulp. However, labour costs are higher in Canada, with one factor being the use of smaller machines.

Roughly 20% of the provincial labour force is employed, either directly or indirectly, by the forest industries; through economic linkages, each job in the forest industry is associated with 2 jobs in related sectors. However, employment in the pulp and paper sector shows a downward trend (annual averages) between 1981 and 1988 inclusive. This is reflected in the following graph (note that the figures for 1989 & 1990 were not available).

Another consideration which directly impacts the natural resource conditions of B.C. involves forest management techniques.

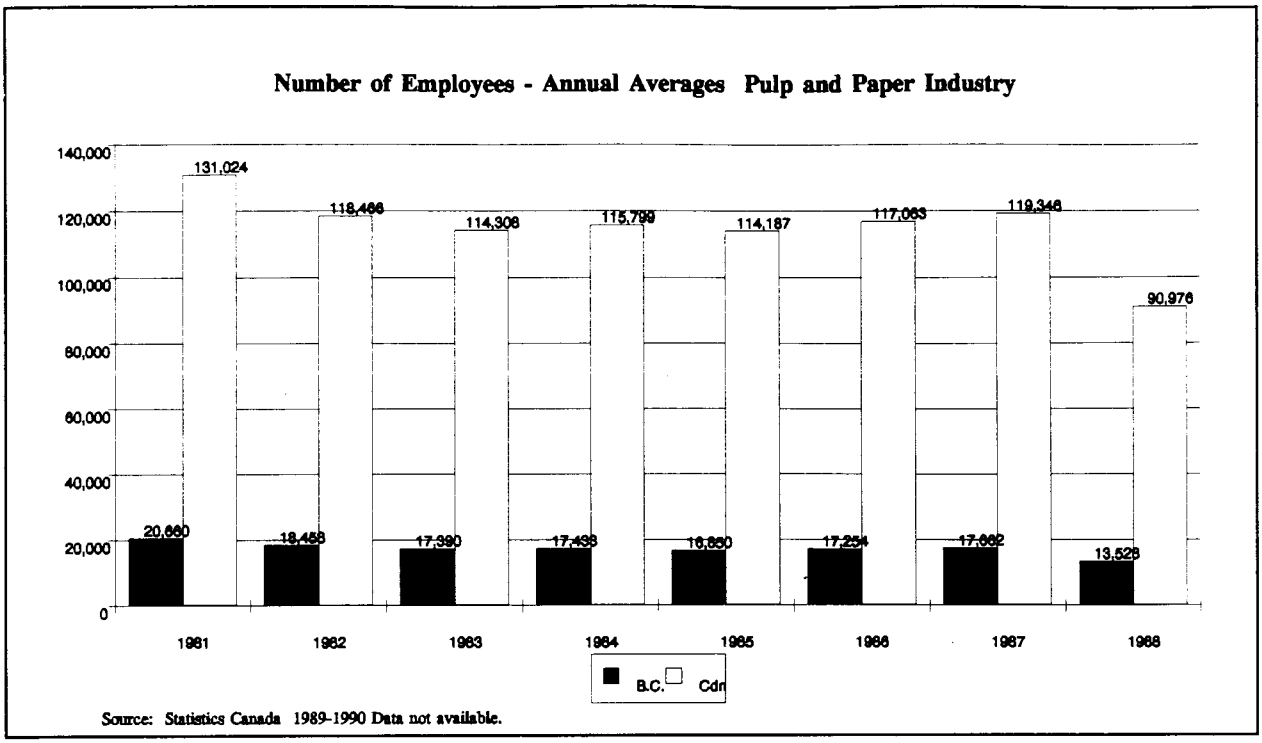

Figure 1

The predominant method of harvest is clearcutting. However, the average size of individual clearcuts has been reduced and selection cutting does occur. Prior to the 1960's, reforestation consisted of allowing the forests to naturally regenerate. Overall, less than 10% of the area that was being logged was being replanted with seedlings. However, more than 200 million trees are planted today on an annual basis, approximately three trees for every one harvested. The average survival rate is 73%, and draws from increases in seedling quality and planting techniques. Approximately 60% of the land area being harvested is now being replanted, leaving the remaining 40% for natural regeneration (1990).[20] The following table presents a regional breakdown of

reforestation between 1984 and 1989.

Table 3: Trees Planted in British Columbia (thousands)

Source: MOF Annual Report

Year	Cariboo	Kamloops	Nelson	Prince George	Total*
1984	9,544	16,445	9,978	41,708	121,714
1985	9,815	19,375	8,690	35,282	116,613
1986	14,113	22,498	14,804	46,546	139,872
1987	20,455	24,231	25,234	66,828	200,009
1988	22,238	28,972	24,056	71,707	198,712
1989	22,425	27,231	24,810	76,018	210,423

* total figures include Prince Rupert and Vancouver

When reviewing the reforestation of crown and private lands, one should examine timber damage and losses due to fire, insects, and disease, and NSR lands (not-satisfactorily restocked lands). For the period 1990-1991, timber damage/loss due to insects, wildfire and disease amounted to 7.5 million m^3 (approximately 8.7% of the annual harvest). Insects and disease claimed 5.7 million m^3, with epidemic infestations of the mountain pine beetle and spruce budworm (interior forests). NSR lands are those on which new forest land has not been established. The "total good and medium site backlog NSR - accessible and inaccessible" is approximately 547,000 ha, where "backlog" refers to areas logged prior to 1982.[21]

Of this, 436,000 ha are classified as accessible, productive forest site (approximately 1.6% of total forest land classified as economically accessible). Although these are not truly barren lands, they usually only contain a small proportion of seedlings, underbrush and some other species which lack any commercial value. It has been estimated that a one percent reduction in the productive forest base would reduce the allowable harvest by 750,000 m^3 (on an annual basis). In terms of direct and indirect employment, this translates into a loss of 2,600 jobs and approximately $100 million in wages and government revenues ceteris paribus.

A final consideration is the ownership of natural resources in British Columbia. Approximately 27.6% of the land owned by the Crown is commercial forest (land which is productive and economically accessible), and another 58.6% is held as non-commercial forest. Private holdings of commercial forest land total 1.8%, with the remaining land base being controlled by water boards, urban management, parks, and farm owners.[22]

2.3 Factor Demand & Supply Conditions in Sweden

"In the days when warships were made from oak wood, it was the custom for the oak to be reserved for the state. In 1829, the Swedish parliament had decided, at the request of the Navy, on extensive oak plantations on crown land. More than one hundred and fifty years later, the oaks had grown into a splendid forest ready

for felling. But the Commander of the Navy at this later date had no interest in wooden ships. No doubt his reply to the Forest Service was couched in rather salty language."[23] This quotation reflects the economic conditions in Sweden in the context of forest management. Given that Sweden is a very long country (41 million hectares stretching from latitude 55° to latitude 69° N), the environment for forest growth varies greatly. Although snow covers most of the country from January until March, northern Sweden receives the brunt of winter (snow can reach more than a metre in depth). Thus the annual growth rate in the north is only a couple of cubic metres per hectare (rotation of a stand is approximately 150 years). In contrast, the growth rate in the south is approximately 10 - 15 m^3 per hectare, with a rotation of 60-70 years.[24]

Forests cover more than half of the country, and with a population of approx. 8 million people, this translates into three hectares of forest per person. The majority of forest land is privately owned. Of the private forest holdings, approximately 25% is held by large forest companies. The remainder is owned by over 250,000 private woodlot holders, with the majority being on farms. Each of these private owners have an average of 42 ha spread over a number of individual woodlots. Approximately one-third also belong to a forest owner association.

Sweden has the earliest silviculture legislation in the world, with massive reforestation taking place over the last century; "this has enabled thin, weak, and severely exploited forests to be replaced with new forests, better able to utilize the natural

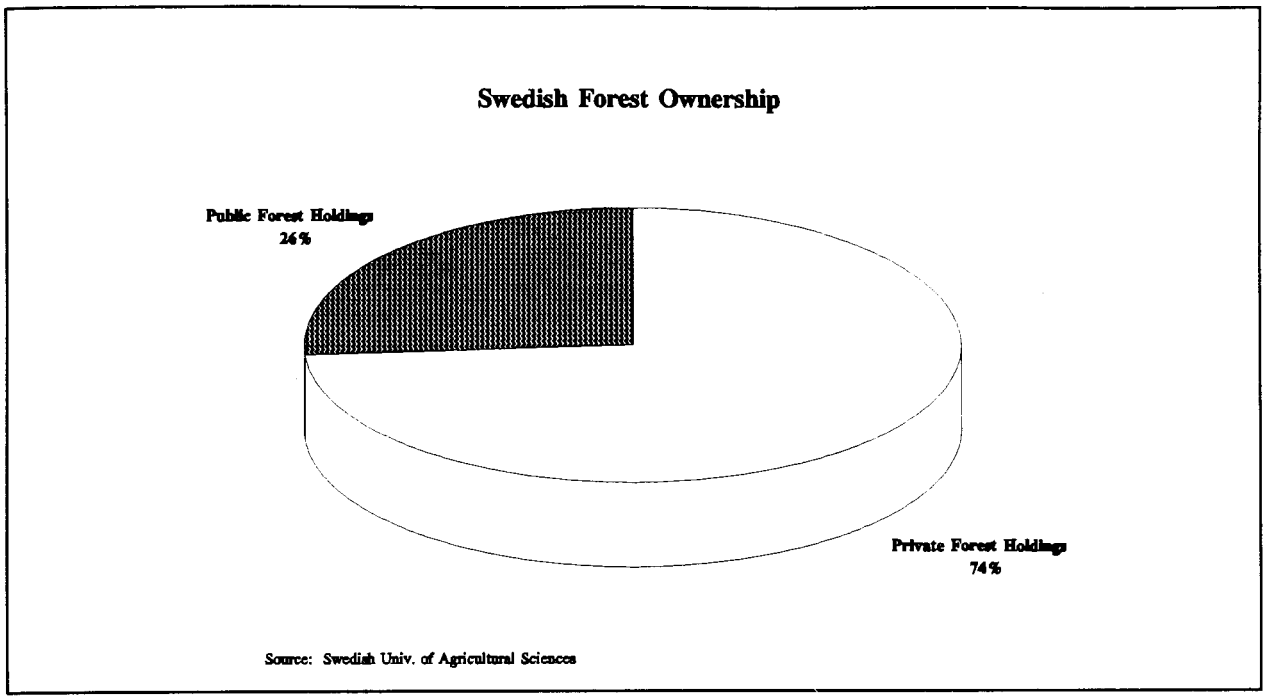

Figure 2

productive power of the land."[25] Swedish forest owners utilize "site adaptation", where forestry is adapted to the varying biological preconditions of the soil (field surveys and aerial pictures are extensively used to divide the forest into stands). Information on each stands biological makeup (species, age, etc..) is gathered in computerized registers for the forest companies, and for use in forest management plans for the individual owners. Productive forest land extends over 23.5 million ha, with over 600 million seedlings being planted every year. After the new stand is established it is "cleaned" (approx. 350,000 ha/year), where trees of poor quality or undesirable species are removed (goal is to leave 1,500 - 1,800 trees per hectare). The stand is then

"thinned" when the trees have reached an age of 30-35 years (approx. 300,000 ha/year), reducing the stand to between 1000 and 1,300 trees per hectare. This process may be repeated as the forest grows older, promoting the development of thick, high quality trees and forming part of the harvest procedure (accounts for approx. one-third of the annual cut).

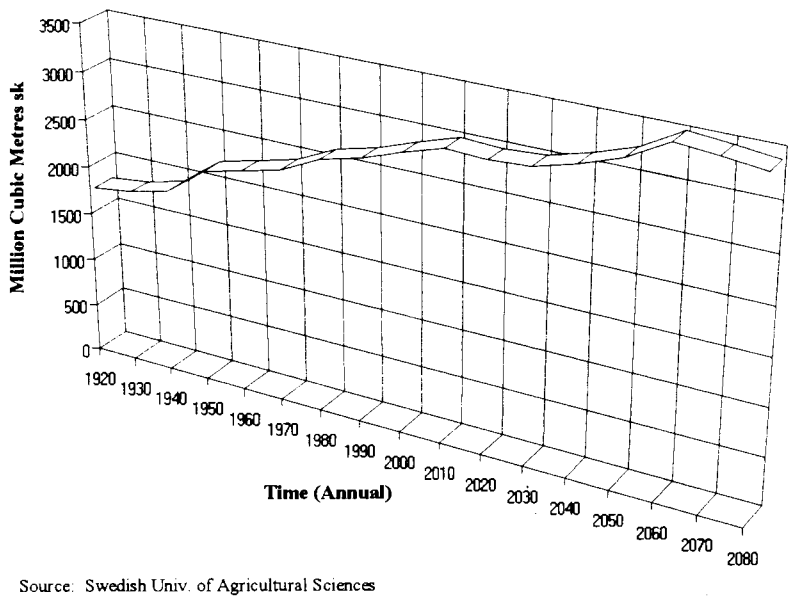

Figure 3

The stocks of hardwood have remained relatively stable, falling below 500 million cubic metres (approx. 15% of all species). The predominant species in Sweden are the Scots pine, Norway spruce, and birch, although in recent years large northern regions have been replanted with Canadian Lodgepole pine (a faster growing and more productive species in harsher climates). Note that based on insufficient regeneration in the past, Sweden has a shortage of

middle aged stocks (approx. 25% of total forest base is aged between 0 and 20 years).

The annual forest growth has increased three-fold over the last century, and currently amounts to approximately 100 million m^3. The annual cut is approximately 70 million m^3, substantially lower than the annual forest growth (excluding last few years of the 1960's). This annual cut is determined according to the amount of mature forest, which explains why long-term possible felling allowances are less than the annual growth rate. This is extremely

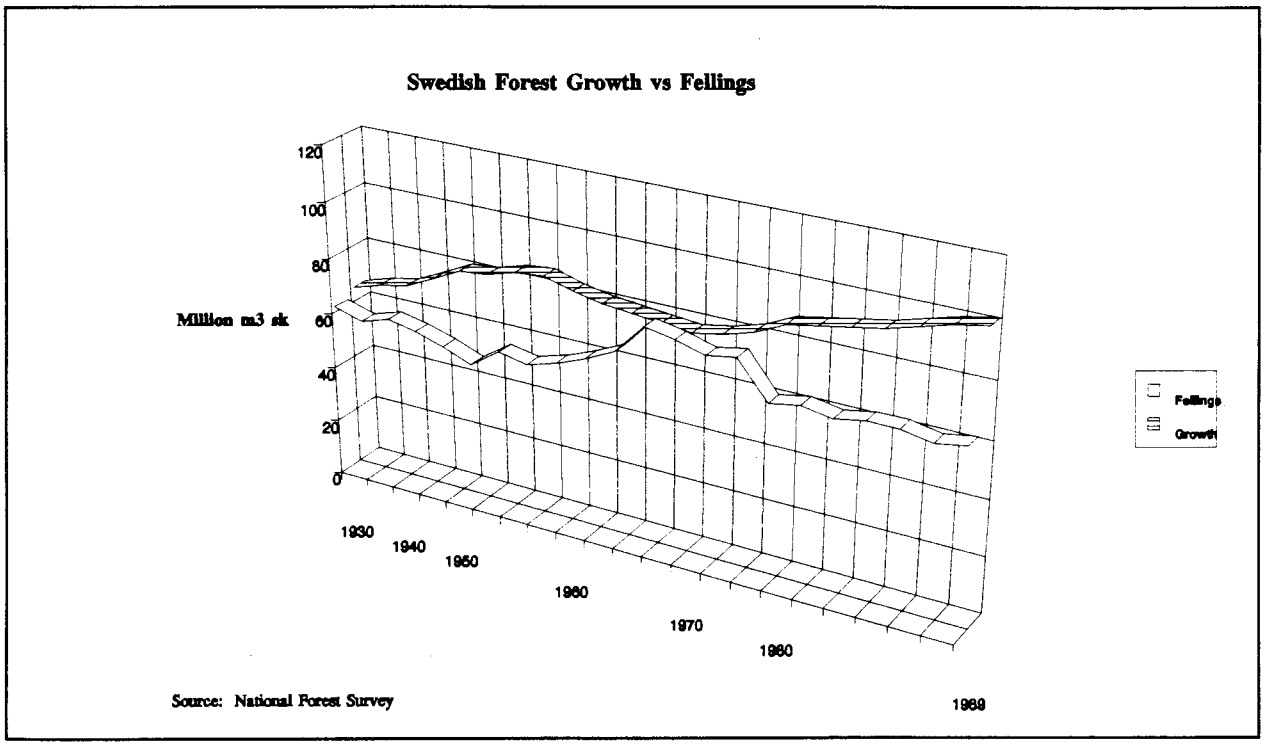

Figure 4

beneficial for Europe as a whole, as a steep rise in demand for timber (352 million m^3 in 1985 to an expected 576 million m^3 in the year 2010) will result in a timber deficit (approx. 50-150 million

m^3) within the next century. The Nordic regions are the only countries within the EEC where there will be a substantial surplus; "there is no doubt whatsoever that [Sweden] will continue to be the woodyard of Europe."[26]

Table 4: European Timber Balance in the Year 2010 (million cubic metres)

Source: IIASA

	Timber Balance	Best Case	Worst Case
Scandinavia	43	+105	+92
EC 9	327	-174	-200
Central Europe	23	+2	-4
Southern Europe	77	-1	-9
Eastern Europe	106	+21	-18
All Europe	576	-47	-139

Note: "+" implies a surplus
"-" implies a deficit

As well as allowing its timber stocks to grow, Sweden has preserved large areas of land as natural and primeval forest reserves. Although this discussion will be expanded upon in the chapter outlining government policies, approximately 9-10% of Sweden's land area, and 3% of its forest land has been set aside. Despite this, new reserves are also required in southern Sweden to protect rare species and unique environments (British Columbia's "Protected Areas Strategy" targets approximately 12% of B.C.'s land area as reserves). Approximately 8.4 million ha (20% of Sweden's

land base) consists of wetlands, and since the 1850's approx. 700,000 ha of wooded wetlands have been drained. New drainings on an annual basis correspond to approximately one-tenth of one percent of the total wetland area.

An important consideration which negatively impacts Sweden's forest reserves is the continuing increase in both the soil acidity and the content of CO_2 in the atmosphere. In response, forest owners have been fertilizing and liming their stands. Scientists estimate that as much as 600,000 ha are in danger and in need of both lime (a neutralizing agent) and nutrient replenishment. Nitrogen and sulphur depositions, as a result of air emissions (traffic, industrial, energy and household), have increased the soil acidification, particularly in the south of Sweden. Sulphur deposition would have to be reduced in this region by at least 75%, and nitrogen by 50%, to help forest stands retain their vitality. The majority of chemical depositions originate from emissions outside of Sweden.

Waste paper is another "natural" resource (existing by-product of consumption) which is being extensively used in Sweden. The total amount of waste paper is approximately 8.2 million tonnes per year (68% industry waste, 32% household). The recovery rate for newspapers is as high as 60%, and in general the rate was 46% in 1990. This propels Sweden into first place on a global basis (looking at average rates between 1974 and 1990). A five year industry forecast estimates that waste paper requirements will increase beyond 1.2 million tonnes. Waste paper supplements virgin

wood fibre to an extent which is determined by the paper product itself (eg. virgin fibre is used for packaging which has direct contact with greasy and liquid foods). Waste paper can also be used to produce energy through incineration. New technology allows Sweden to meet the low emission levels for dioxins as required by German legislation.

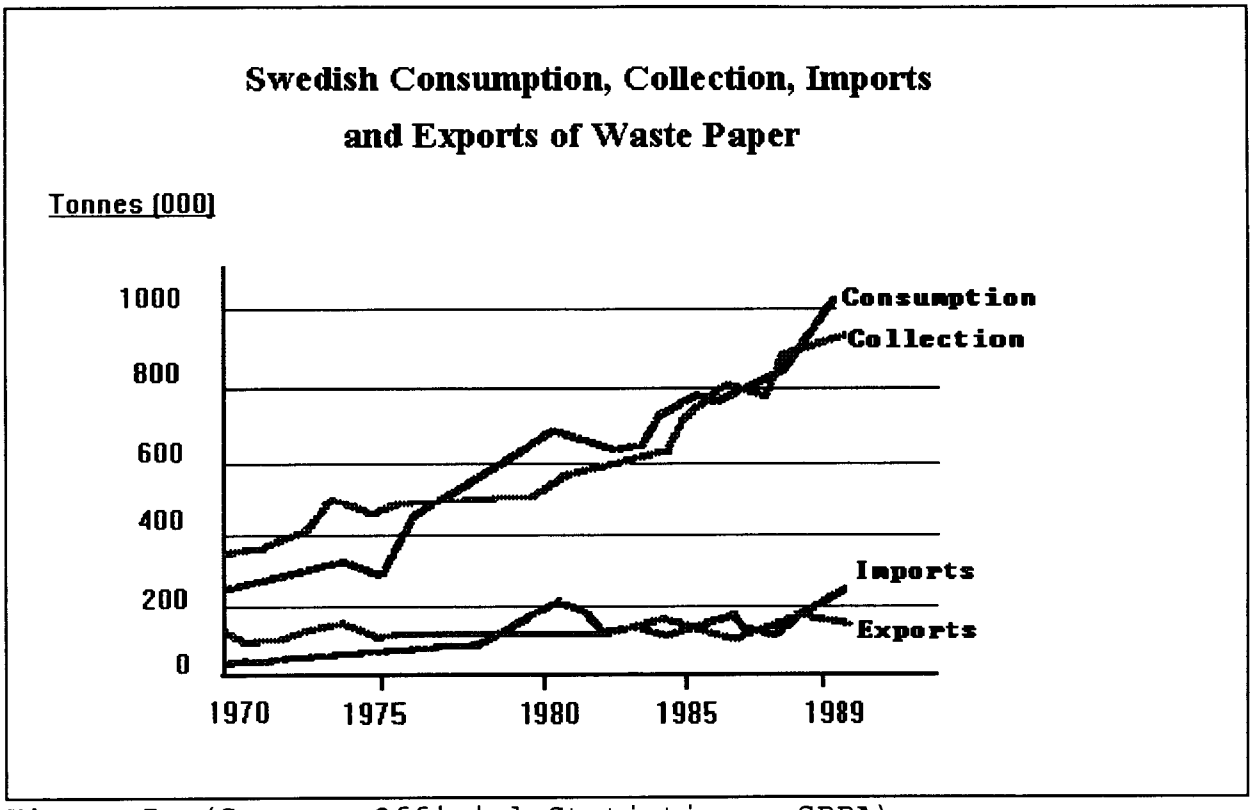

Figure 5 (Source: Official Statistics - SPPA)

The cost of virgin fibre was reviewed under the B.C. section, and to offer a contrast, the 1990 delivered cost for Sweden ($Cdn/tonne) is presented in the following table (context of pulp). As mentioned under factor conditions for B.C., Sweden is at a cost disadvantage in terms of fibre. However, the increased usage of

Table 5: 1990 Delivered Cost ($Cdn/tonne)*
*** prior to depreciation**

Price Waterhouse - October 1991

Factor Input	Sweden	B.C. Interior	B.C. Coast
Wood Fibre	$403	$201	$222
Chemicals	54	61	61
Energy	14	37	59
Labour	102	101	148
Other (mill)	58	147	138

thermomechanical pulp (in contrast with B.C.) has allowed Sweden to reduce their chemical costs. Sweden also enjoys a cost advantage for energy and "other" mill costs (versus B.C.). Approximately one-half of Sweden's electricity power is generated by nuclear installations (the remainder is hydro). Based on a January, 1991 agreement between the governing social democratic party and the two non-socialist opposition parties, planned partial phasing out of nuclear power by 1995-1996 will not take place. The final phase-out deadline of 2010 is also under question. In addition to purchases of electricity, the pulp and paper industry self-generated approximately 3 TWh via back-pressure power turbines. The industries share of total fuel consumption has also dropped from 40% in 1973 to approximately 12% in 1990. This reflects a

greater use of indigenous fuel (weak black liquor and bark) as well as improved technology. Naturally this represents a substantial cost saving as the world price of oil increased from $14.97 US in 1986 to $24.49 US in 1990 (mainly due to hostilities in the Gulf). By August of 1991, world oil prices stabilized around $21 US a barrel.

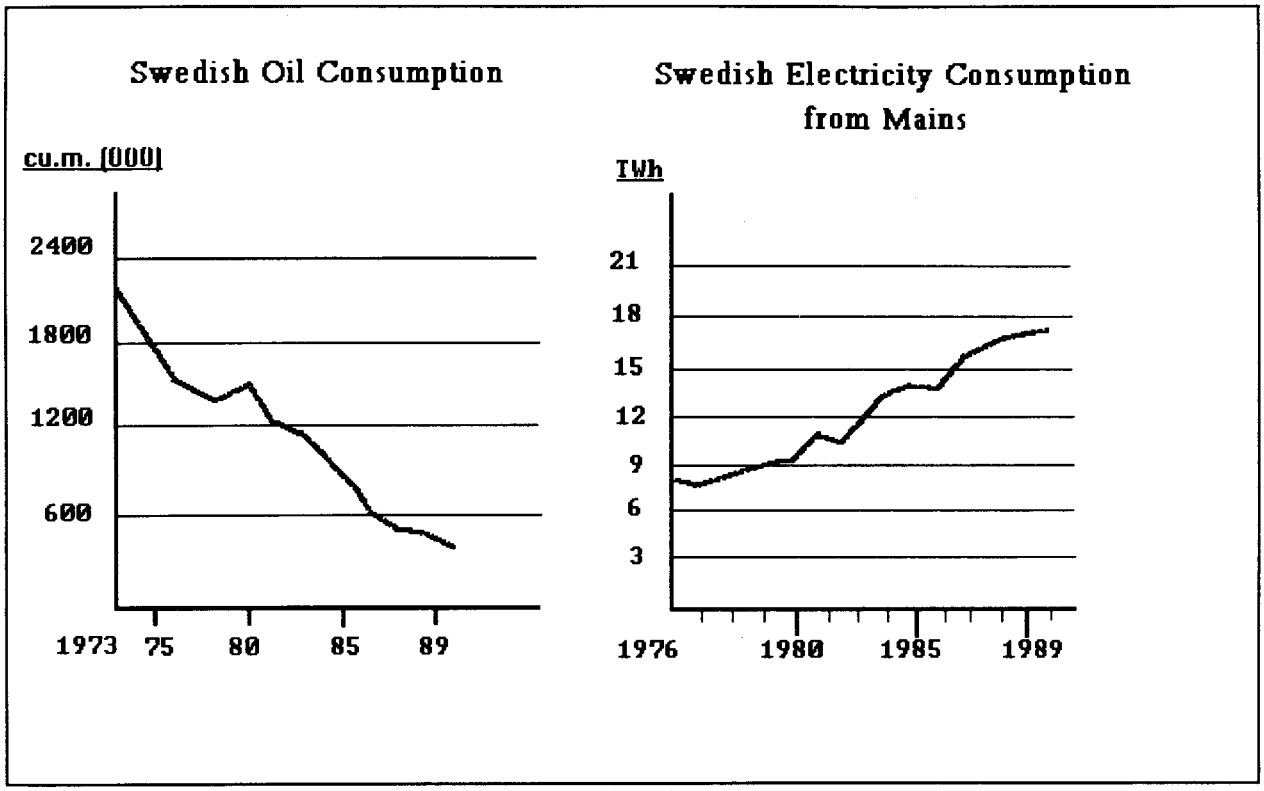

Figure 6 (Source: Official Statistics - SPPA)

As outlined in the general introduction, the demand for hardwood is surpassing the demand for softwood (short hardwood fibre is used for different grades of paper requiring special properties). This increase in hardwood demand exceeds the existing supply in Sweden. Consequently, a significant portion of wood and

chip imports to Sweden consists of hardwood[1]. The Swedish Pulp and Paper Association has stated that investment in Swedish hardwood production is unlikely given the cheaper productive capabilities in warmer countries. Therefore it is most likely that Sweden will continue to import quantities of hardwood, and dedicate forest land to high-quality, long-fibre softwood. Canadian and B.C. exports of wood pulp to Sweden are illustrated in Figure #7.[27] Note that the B.C. series is infrequent and it is expected that the B.C. interior will utilize surplus chips in the near future.

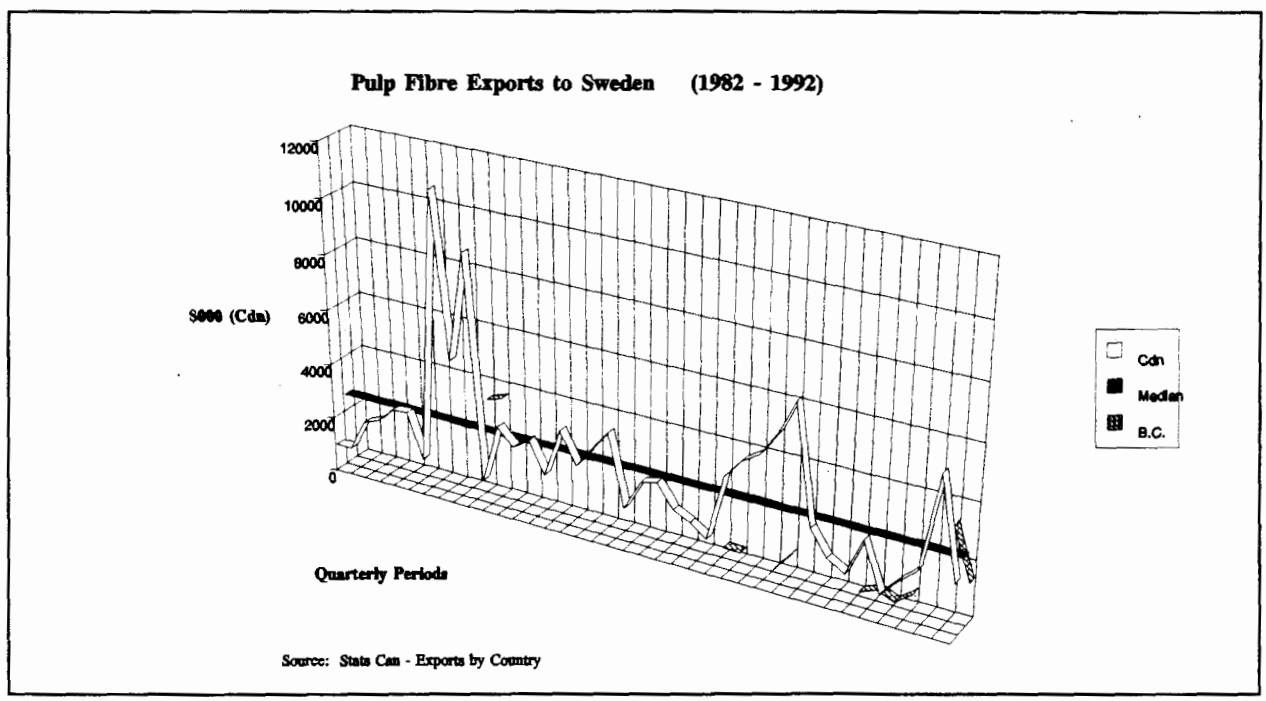

Figure 7

A final consideration is the demand for labour. In 1989, the pulp and paper industry employed 40,000 people. This decreased in

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[1] total imports in 1989 were 6 million m^3 fub and 4 million m^3 fub in 1990; "fub" is timber volume excluding bark.

1990 to approximately 38,000. In contrast, the packaging and other products industry employed 12,000 people in 1989 and 13,000 in 1990. Linkages to secondary industries exist such that for every 100 people employed in the forest industry, job opportunities are created for an additional 66 people (outside the forest sector).

2.4 Highlights

Whereas British Columbia's natural resources are predominantly government property, the majority of forest in Sweden falls under private ownership. British Columbia and Sweden also differ in their methods of forest management. While the B.C. industry relies mainly on the use of clearcut harvesting techniques, Sweden utilizes to a greater extent selective harvesting methods. In addition, Sweden has the earliest silviculture legislation in the world, with over 600 million seedlings being planted on an annual basis in comparison to over 200 million seedlings per year in British Columbia.

With a current AAC of 73 million m^3 per year and a long-run sustainable yield of 60 million m^3 per year, B.C. faces a potential wood fibre deficit of 5 million m^3 per year, ceteris paribus. In contrast, Sweden's annual forest growth amounts to approximately 100 million m^3 with an annual harvest of approximately 70 million m^3. Sweden also utilizes waste paper to supplement virgin wood fibre; with a recovery rate of 46%, Sweden ranks first on a global basis in terms of waste paper collection.

3. Demand Conditions

3.1 Global Demand Conditions for Pulp & Paper

In the context of paper, there are two grades that are regarded as international commodities: newsprint and linerboard. However, printing and writing papers are becoming more and more common in international trade. For newsprint, aggregate export as a percentage of total consumption has decreased with domestic production playing a greater role.[28] The trade flow for newsprint is mainly from Scandinavia to Europe and from Canada to the United States. Note that Canada was the dominant player in 1988, with Canadian exports accounting for approximately 59% of the total world production (14.5 million tonnes). Newsprint prices averaged $500 US/tonne in 1991, a drop from $700 US/tonne in 1990. Recent prices (late 1991 - early 1992) averaged $450 US/tonne on the U.S. West Coast. It is expected that demand and prices will remain low, partly as a result of a shift away from print advertising. For virgin fibre linerboard, Sweden is increasingly being dominated by the United States (context of production), mainly as a result of a lower U.S. dollar rate (1989 analysis). International trade data for both the U.S. and Sweden is presented in Table #6. However, Sweden is a leader in innovative paper packaging (as will be reviewed in the strategy chapter). There are three significant trade flows for printing and writing papers:

(1) Within Europe (from Scandinavia and between EEC members)

(2) From Europe to Developing Countries (particularly Asia)

Table 6: International Trade in Linerboard (million tonnes)

Source: Aurell and Poyry

	1970	1975	1980	1985
United States				
Production	10.1	10.0	12.9	13.7
Export	1.6	1.1	2.3	1.6
% Exported	16	11	18	12
Nordic Countries				
Production	0.8	0.8	1.3	1.5
Export	0.6	0.6	1.0	1.3
% Exported	78	67	80	84

(3) From Europe, Brazil, Mexico & South Africa to the U.S. Overall, the first trade flow, within Europe, is the largest; in 1985, 20,017 thousand tonnes was produced and 8,745 thousand tonnes was exported. In contrast, North America produced 18,881 thousand tonnes in 1985 and exported 1,362 thousand tonnes. In general, the flow of paper is from North America and Western Europe (1985 context) to the remainder of the world.

For pulp, Canada exported 32% of the world's total production (25.5 million tonnes) in 1988. The United States was second at 19% and Sweden third at 12%. Although the trend is toward alternative bleaching processes (to be reviewed in the strategy section), there will most likely continue to be a demand for bleached pulp based on

the need for age-resistant papers, hygienic products, and food-related packaging. In 1990 the average price for pulp was $812 US, which dropped sharply in 1991 to $572 US. The addition of new pulp capacity and the current slow-down in the world economy were major factors underlying these price movements.

When reviewing demand conditions on a global scale, the movements in real exchange rates must be considered. For example, when a spot exchange rate (eg. Canadian price of $1 US) depreciates, it acts as a barrier to imports by increasing their price while facilitating exports through relative price reductions. However, such a "stimulant" is artificial and does not necessarily reflect any change in productive efficiency. Note that by reducing price competition, the incentive for domestic firms to innovate can be diminished. In contrast, an appreciation of a spot exchange rate can have two general effects; it may spur domestic firms to be innovative given increased competition from imports, or it can adversely impact the expansion of domestic industries ("economic scale") through downward pressures (price induced) on exports.

What have been some of the most current world trends? First there appears to be continued demand in Europe and North America for printing and writing papers. There also appears to be continuing international competition which is affecting prices and quality of paper. In general there is a "continued trend in production toward larger, integrated mills and machines."[29] Mainly this is designed to maximize the advantages of scale. Finally, the influence of countries with fast growing plantations will continue

to grow (eg. Brazilian eucalyptus exports).

3.2 Global Demand for British Columbia Production

Dr. Porter states that "home-demand conditions help build competitive advantage when a particular industry segment is larger or more visible in the domestic market than in foreign markets."[30] Consequently, this study will focus more on exports of pulp and paper, versus domestic consumption.

The forest industry "powers" the B.C. economy, accounting for approximately 45.8% of all manufacturing shipments in the province. In 1990, total forest industry exports were valued at $9.267 Billion, and the pulp and paper industry accounted for $4.617 Billion (approximately 50%).[31] The United States and the EEC represented the top two trading partners, with Pacific Rim countries and Japan following respectively. One consideration which influences the trade of newsprint is the use of quotas by the EEC. Newsprint produced within the European community has unrestricted access to other member countries. In contrast, Canadian trade is regulated through a quota system, where there are specific import quotas for the U.K. and general quotas for the EEC. The quota level has dropped since it's introduction in the early 1980's, partly as a result of Canadian exports not exceeding the quota levels. Note that the quota system does not allow duty-free entrance of any grade other than standard newsprint. There is also pressure from the U.S. in the form of legislation requiring

newsprint to be produced using recycled fibre. An example of the B.C. industry responding is the addition of equipment in Macmillan Bloedel's Port Alberni mill (late 1991) which allows it to produce newsprint with a 40% recycled fibre content.

In the context of pulp, B.C. producers market their largest proportion (approx. 45%) to Western Europe, followed by Japan (20%) and North America (19%).[32] One factor influencing this trade flow is the cost of transportation; "B.C. rail freight costs to most Eastern U.S. destinations are significantly higher than ocean shipping contract rates to Europe and Japan."[33]

Production of wood pulp from 1960 - 1990 far outstripped the production of paper (in 1960 production of pulp was roughly twice that of paper, and more than twice the production of paper in 1990). More specifically, pulp production in 1990 reached 6.6 million metric tonnes, whereas newsprint production was 1.8 million metric tonnes and other paper production totalled 1.2 million metric tonnes. In terms of trend turning points, pulp and paper markets suffered a downturn in 1975 and another decline in 1980 as a result of depressed economic conditions. Excess capacity for newsprint in 1983 further inhibited market stability. Both pulp and paper markets began to recover in 1985, with strong performance until 1989. However, pulp production decreased in 1989 - 1990 (6,990 thousand metric tonnes to 6,604 thousand metric tonnes respectively) and then began to recover in 1991. Paper production started to decline (all grades) in 1990, from 2,994 thousand metric tonnes to 2,684 thousand metric tonnes in 1991. Performance is

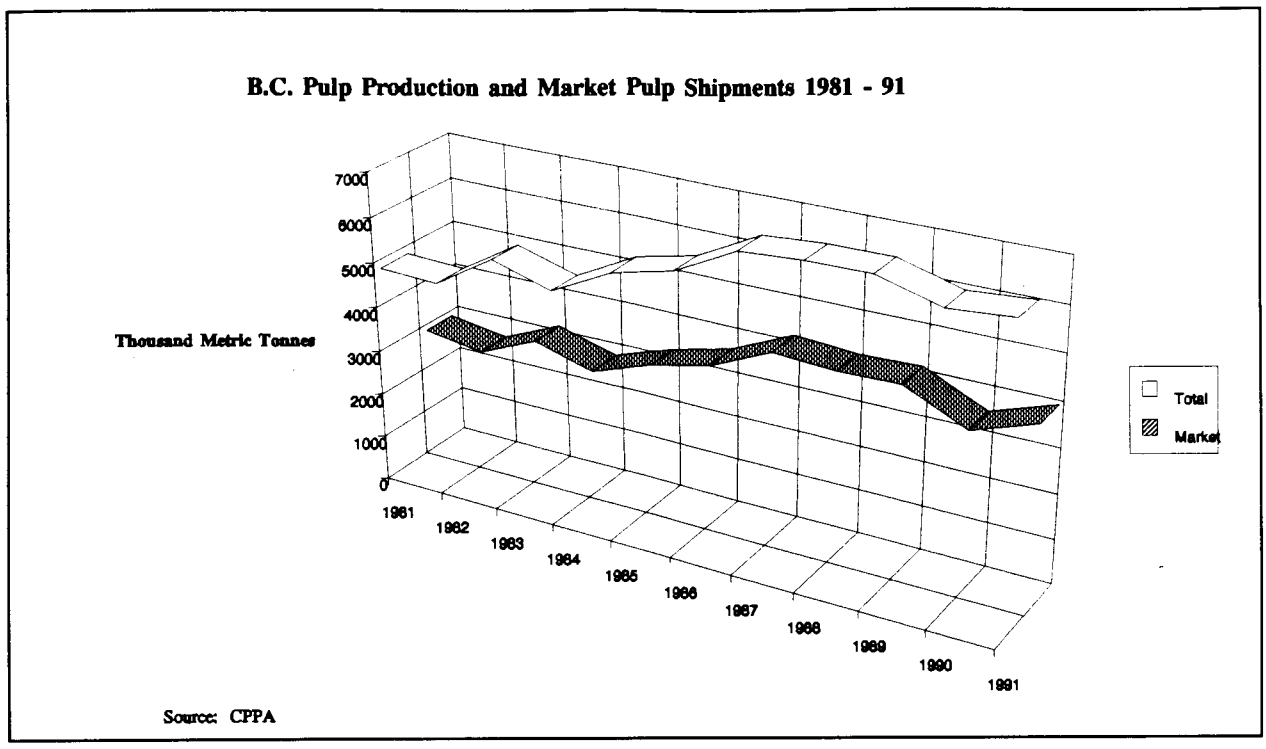

Figure 8

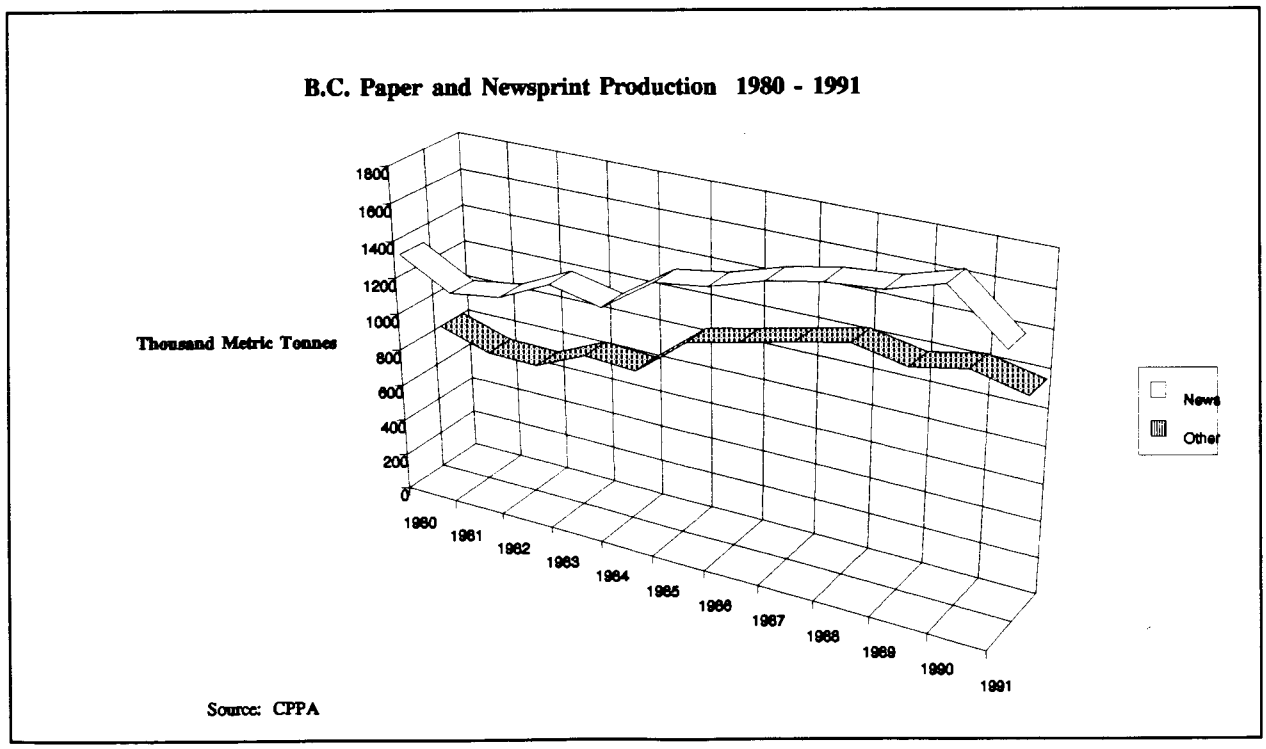

Figure 9

expected to improve in the fourth quarter of 1992 as a result of currency exchange rate fluctuations (considered later in this section). However, some industry analysts state that spot exchange fluctuations "won't be enough to overcome the long-term competitive problems in the industry."[34]

To help see the demand-supply picture from another angle, an ARIMA forecasting process (refer to Appendix #2) was developed for Paper and Allied Products shipments from British Columbia. The Paper and Allied Products group is comprised of four main industries: pulp and paper, asphalt roofing, paper boxes and bags, and other converted paper products. The pulp and paper industries are the largest component, representing roughly 77% of total shipments in 1989. The observations are monthly, in $Cdn millions, and not seasonally adjusted. The timeframe runs from January of 1986 to January of 1992. A forecast will also be made for every month in 1992 (up to January, 1993 inclusive). Forecasts for 1992, along with fitted values from the ARIMA process, are reflected in Figure #10 on the following page.

British Columbia also exported wood chips, which is described in Table #7 on the following page. Recall however that expectations are for chip exports to diminish over the next 50 years.

The final factor which will be reviewed in consideration of its impact on demand conditions is the Canadian exchange rate. The natural resource industries of Canada have "experienced particular difficulty adjusting to the dollar's appreciation since 1986".[35]

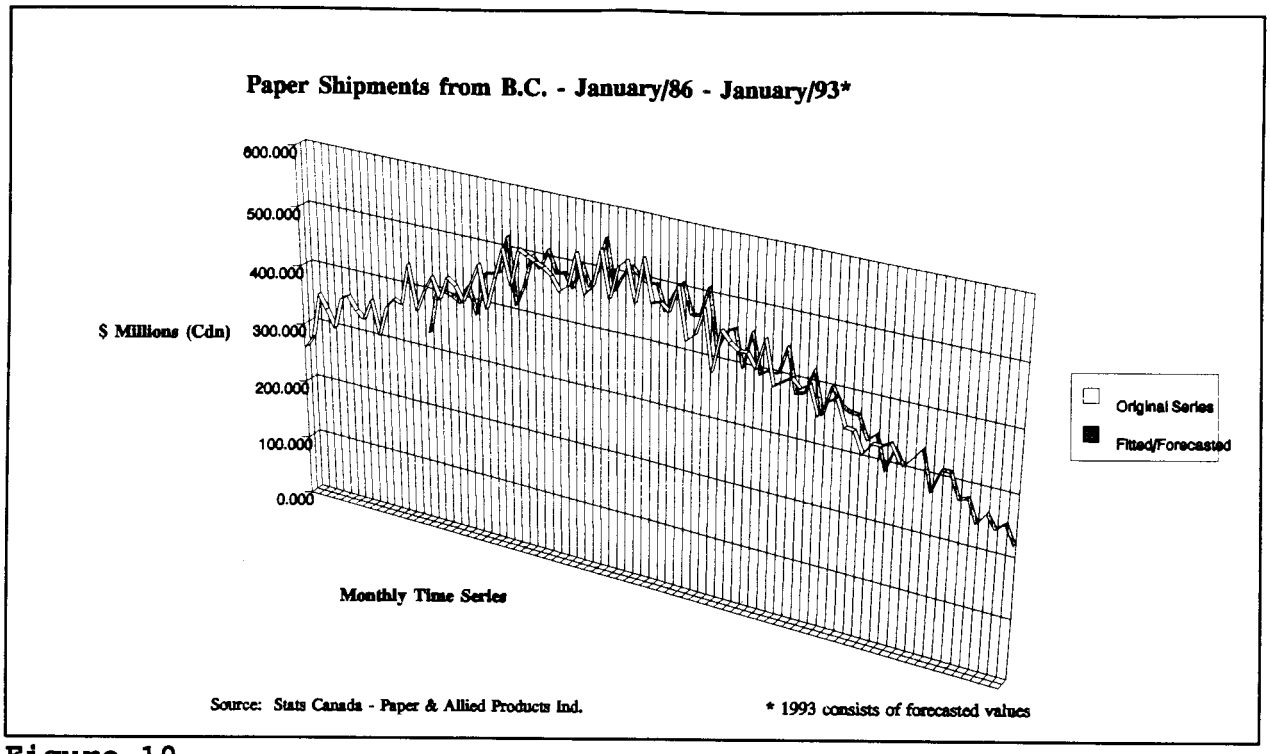

Figure 10

Table 7: British Columbia Wood Chip Exports 1981 - 1990 (thousand metric tonnes)

Source: Statistics Canada

	Destination			
Year	U.S.A.	Japan	Other	Total
1981	669	423	0	1,092
1982	625	396	0	1,021
1983	828	391	0	1,219
1984	559	612	15	1,186
1985	425	485	35	945
1986	373	466	0	839
1987	251	522	2	775
1988	812	604	0	1,416
1989	581	1,068	0	1,649
1990	592	922	0	1,514

As illustrated in Figure #11, the U.S. price of Canadian imports has steadily increased from approximately 1986 to 1990 (and into 1991). The British Pound was included as a contrast. However, as stressed before, competitiveness must be reviewed in a broader sense. Thus exchange rate fluctuations, although influencing competitive stance in a global context, are only short-term considerations; "if <a nation> has to rely on currency depreciation rather than on productivity and technological performance to improve its position in world markets, then it most certainly has a competitiveness problem."[36]

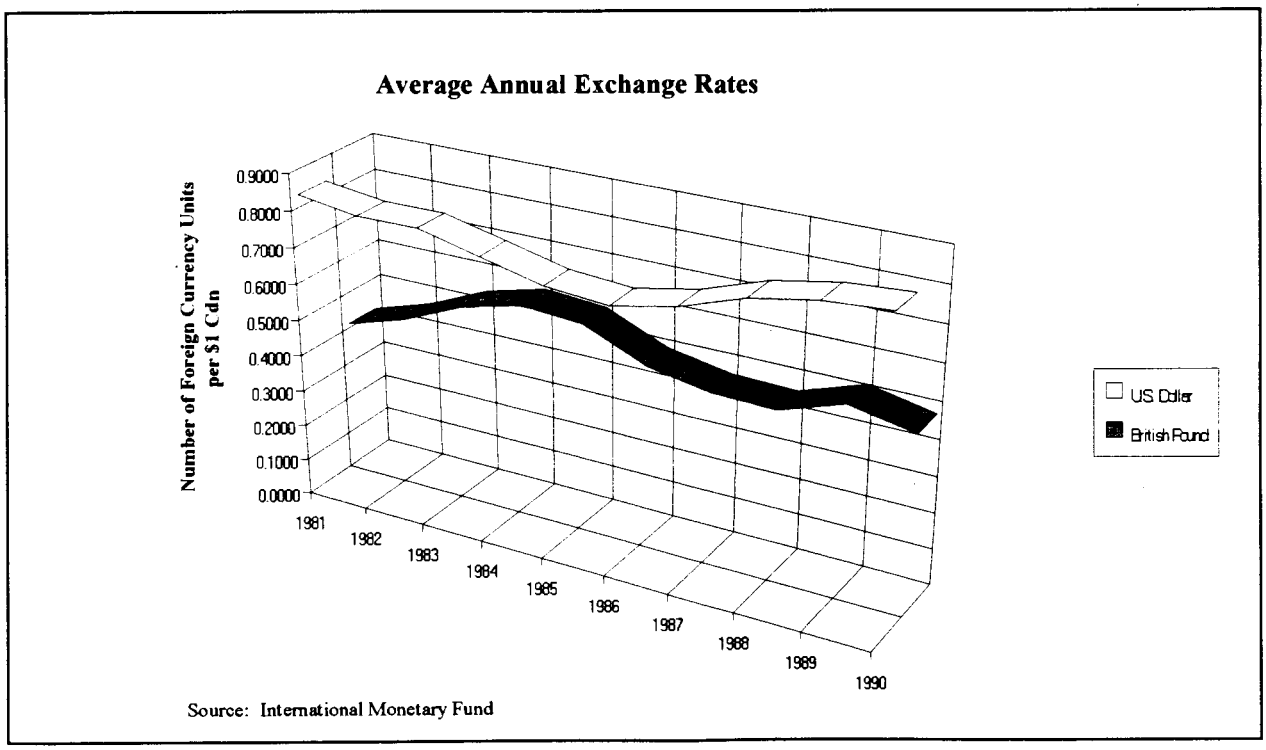

Figure 11

3.3 Global Demand for Swedish Production

In Sweden, the forest industry provides the biggest export surplus. In 1989 the net balance of exports (ie. less imports) was 52.4 Billion SEK, and in 1990 it was 52.7 Billion SEK. As a contrast, the second highest net export surplus was provided by motor vehicles, which in 1989 was 12 Billion SEK. Paper, paperboard, and pulp make up the most significant share of this surplus. In 1989, the forest industry generated gross export revenues amounting to 63 Billion SEK. Paper and paperboard products contributed 31.5 Billion SEK, and pulp 13.4 Billion SEK. Table #8 provides a complete breakdown of forest industry products in the context of export values (for 1989).

Table 8: Export Value of Forest Industry Products (SEK Million)

Source: Swedish Pulp & Paper Association

Product Group	1989 Export Value	Percentage of Exports
Paper/paperboard	31,188	9.4
Sawn/planed timber	10,455	3.1
Paper pulp/waste paper	13,357	4.0
Goods of Paper/pulp	4,304	1.3
Other goods of wood	1,981	0.6
Veneer/plywood	825	0.2
Fibreboard	275	0.1
Pulpwood/roundwood	423	0.2
Total	62,808	18.9 *

* percentage of total exports

Overall, the value of total exports from Sweden (all product groups) in 1989 was 332 Billion SEK, and the forest industry accounted for 18.9% (for 1988 total export value was 305 Billion SEK and forest industry accounted for 19.2%).

The pulp industry demonstrated a downward trend in production; 11,000 thousand tonnes in 1990 and 10,885 thousand tonnes in 1991. However, exports began to recover in 1991 to a level of 2,893 thousand tonnes from a 1990 level of 2,746 thousand tonnes.

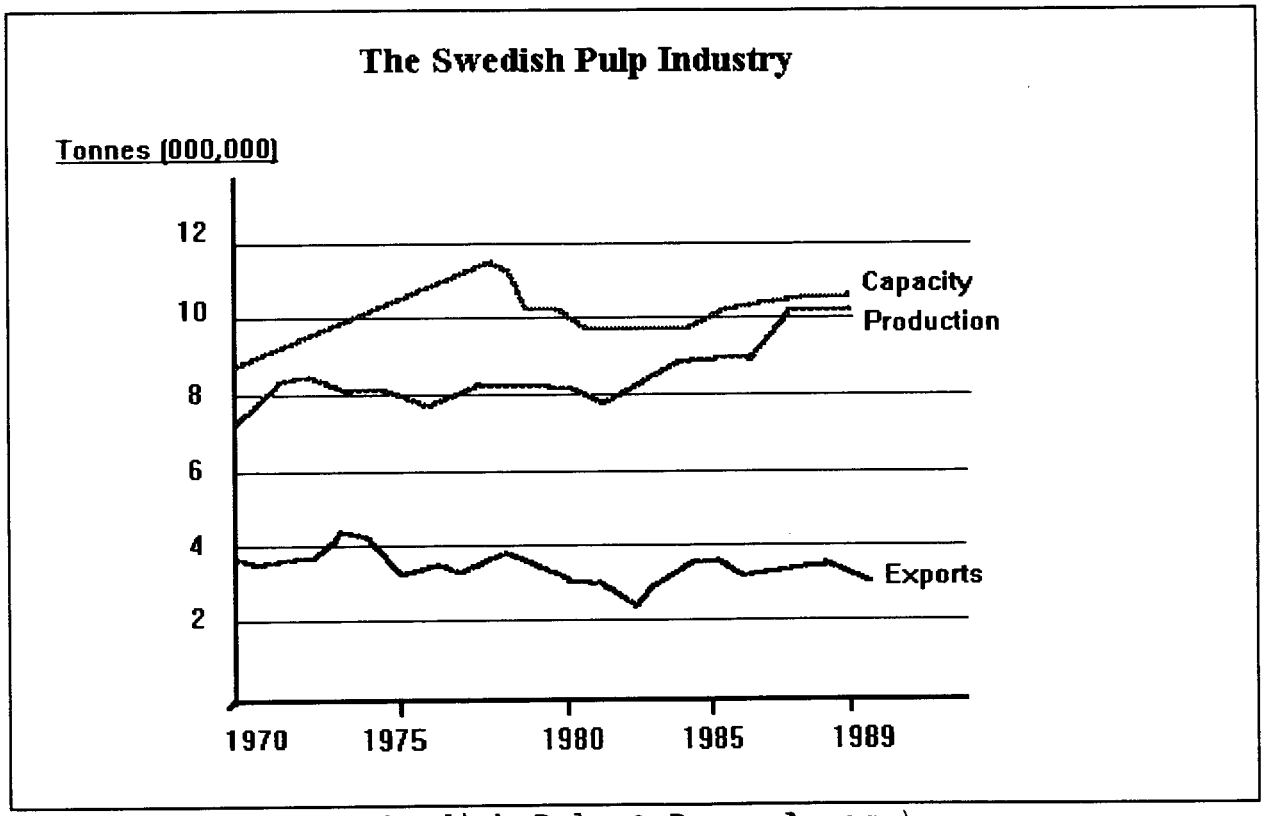

Figure 12 (Source: Swedish Pulp & Paper Assoc.)

In the context of production, there were some significant changes in methods utilized: mechanical pulp declined, as did unbleached

sulphite and unbleached sulphate.[2] However, semi-chemical, bleached sulphite, bleached sulphate and special sulphate all saw an increase in production. The major importing countries for Swedish pulp were: West Germany (imports increased from a 1984-88 average of 685 thousand tonnes to 822 thousand tonnes in 1989), United Kingdom (1989 imports increased by 26 thousand tonnes over 1984-88 average), France and Italy. Note that the latter two demonstrated a decrease in imports in 1989 over 1984-88 averages (15 thousand tonnes and 19 thousand tonnes respectively). Recent changes hold promise for the Swedish pulp industries. More specifically, the Eastern countries and the ex-Soviet Union show a decreasing supply of softwood in readily accessible regions (due to excessive felling levels). The far east anticipates a softwood deficit of 60 million m^3 by the year 2000.

The paper industry demonstrated a strong performance in exports during the 1980's, while production and capacity increased. In the 1990-91 period, exports began to decline (6.618 million tonnes in 1990 to 6.591 million tonnes in 1991) while production figures "levelled off". Only 21% of all paper exports from Sweden are outside of the European Community, with the United Kingdom and West Germany being the biggest export markets. Asia represents the largest market for paper and paperboard outside of the EC (1989), although it has diminished in total size while North America is becoming more important (contrasting 1980 to 1989). Domestic paper

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[2] 1990-91 production figures versus 1989 & 1984-88 averages

consumption is also very high in Sweden (247 kg/inhabitant); as a contrast the United States has a per capita paper consumption of 311 kg, while the European Communities per capita paper consumption is 146 kg.

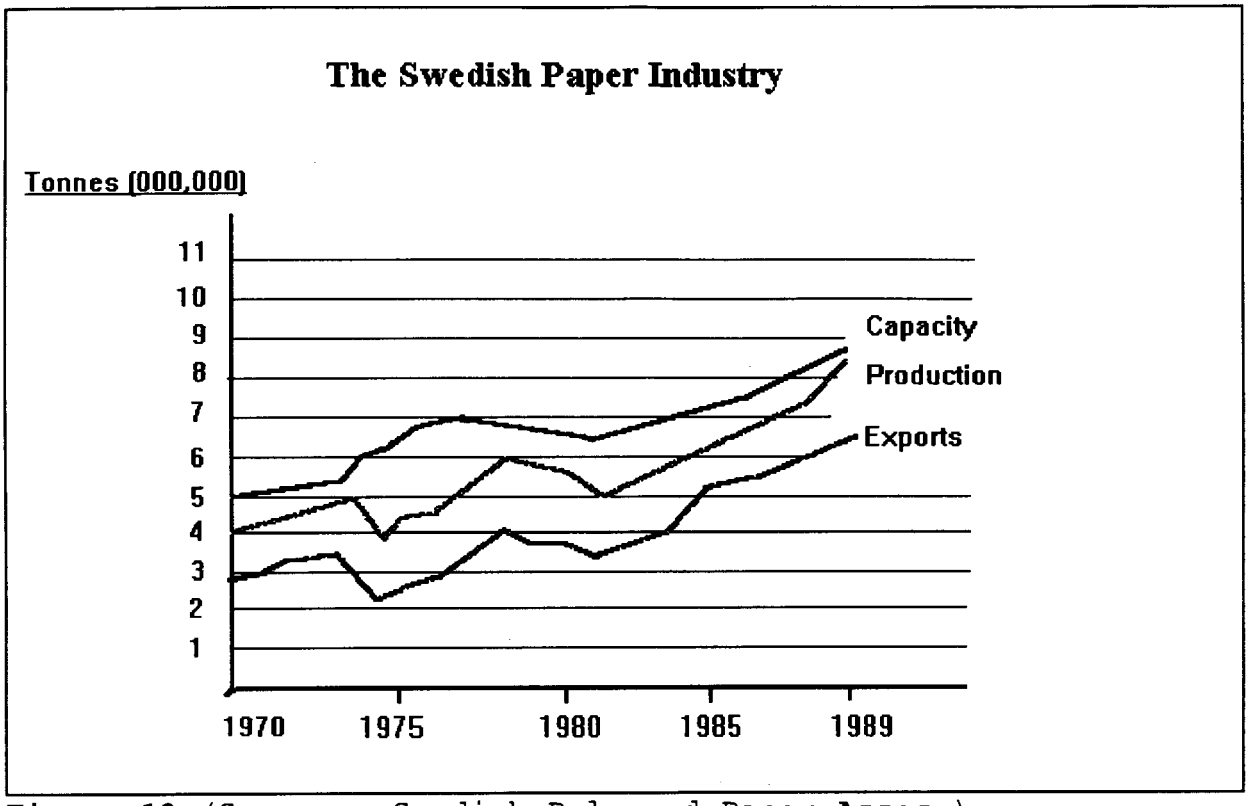

Figure 13 (Source: Swedish Pulp and Paper Assoc.)

With the profound political changes in Eastern Europe, there exists a need for paper and packaging, and Sweden is a potential supplier. For instance, in 1990 approximately 40% of all food produced in the ex-Soviet Union was ruined prior to consumption as a result of inadequate packaging.[37] This potential market is expected to expand at only a moderate pace given the need to develop distribution channels and related infrastructure.

The majority of paper produced and exported is newsprint, although newsprint showed a 15.7% decrease in export levels in 1991 over 1990. Stora, SCA and Holmen are the three major newsprint producers, dominating the market in the United Kingdom in the area of "improved newsprint". Stora markets newsprint through Hylte Bruk, which is owned 75% by Stora and 25% by a West German firm. Wood-containing printing paper showed the highest increase in exports (352 thousand tonnes in 1990 to 521 thousand tonnes in 1991), while wood-free, coated printing paper demonstrated the largest increase in production (395 thousand tonnes in 1989 to 439 thousand tonnes in 1990). Domestic demand for all grades of paper, except wood-containing printing paper, diminished over 1990-91.

The Swedish Krone depreciated (context of units per one Canadian dollar) in the early 1980's, then appreciated from 6.2735 in 1985 to 4.7813 in 1987. In 1991, the average annual exchange rate was 5.2784 (SEK price of one Canadian dollar).

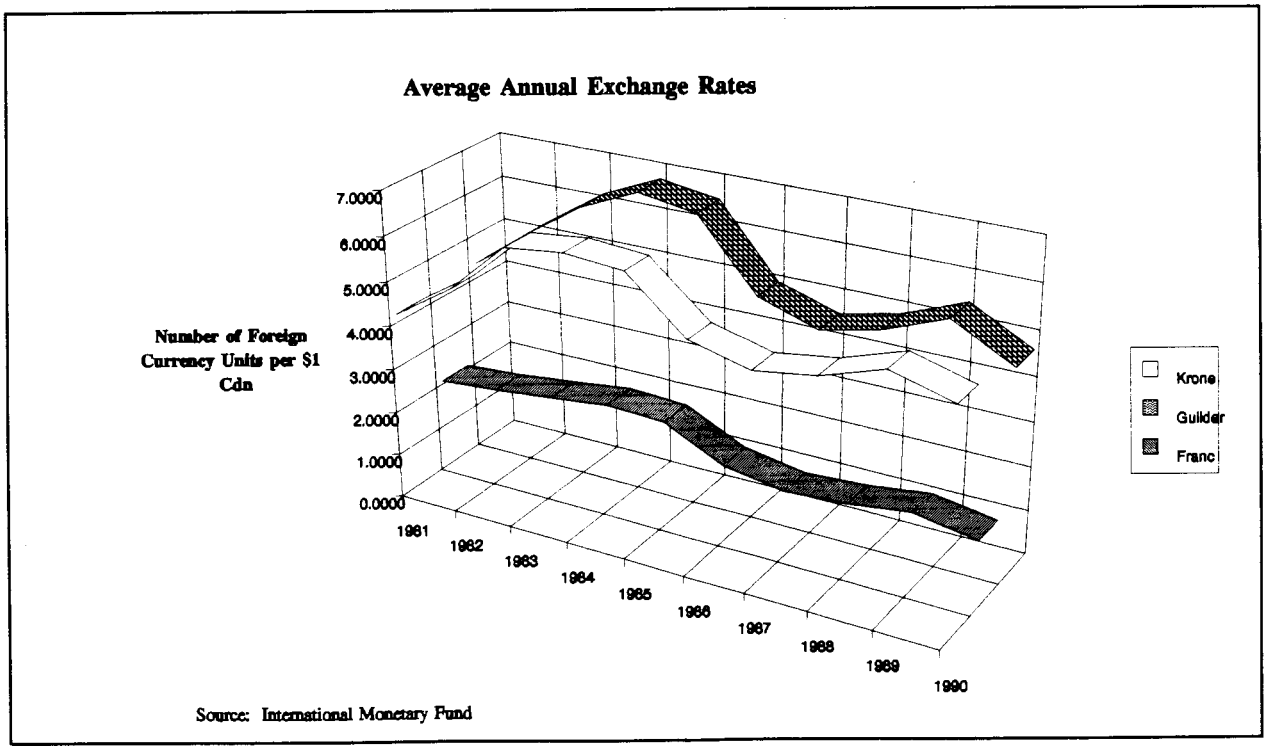

Figure 14

Consequently, the relative price of Swedish exports dropped between 1990 and 1991 (ie. reciprocal exchange rates).

3.4 Highlights

For British Columbia, pulp production is more than twice that of paper. In 1989, approximately 6,990 thousand tonnes of pulp was produced, dropping to 6,604 thousand tonnes in 1990; production demonstrated a recovery in 1991. For paper, production increased in 1989-1990 to 2,994 thousand tonnes and then dropped in 1991 to 2,684 thousand tonnes. Sweden demonstrated a fall in pulp production, from 11,000 thousand tonnes in 1990 to 10,885 thousand tonnes in 1991. However, exports increased from 2,746 thousand tonnes in 1990 to 2,893 thousand tonnes in 1991. For paper, exports dropped from a 1990 level of 6,618 thousand tonnes to 6,591 thousand tonnes in 1991.

While British Columbia's top three trading partners are the United States, EEC and Japan, Sweden focuses primarily on European customers such as West Germany and the United Kingdom. Finally, the U.S. dollar price of $1 Cdn. depreciated between 1986 and 1991 (average 1991 spot rate was $0.87 US). Consequently, the price of Canadian exports to the U.S. increased in relative terms. In contrast, the SEK price of $1 Cdn. appreciated between 1989 and 1990 and then depreciated to an average annual rate of 5.2784 in 1991. Thus the price of Swedish exports to North America (Canada specifically) decreased in relative terms between 1990 and 1991.

4. Supporting Industries

4.1 Supplier Relations and Trends

Dr. Porter contends that one should examine "the presence (or absence) in the country of supplier industries and other related industries that are internationally competitive."[38] But why should one expand this to examine the relationship between suppliers and industrial consumers (mills)? With the international mobility of technology, the ability of a supplier "to capture the returns to a new product or process depends not simply on being the first to market but on remaining competitive in international markets as the innovation diffuses to other producers."[39] Consumers are an integral force, motivating suppliers to remain competitive. Similarly, consumers must examine supplier relationships; "vertical integration and antagonistic supplier relations have come to be seen, in some instances, as competitive liabilities."[40]

Consequently, firms must review the benefits and costs associated with long-term, cooperative relationships, short-term competitive bids, and in-house development. The role of suppliers in product development can be categorized in three basic ways:

(1) suppliers that independently develop a standard product (supplier-proprietary parts)

(2) suppliers that receive technological specifications from consumer firms (mills) and then develop the product (black-box parts)

(3) suppliers that manufacture products based on customer (mill) designs and detailed specifications (detail-controlled parts).[41]

An underlying assumption behind these theories is that research and development is actively being pursued. However, the demand for innovation and new technology appears to vary across nations. Whereas Japan has 8.5 research scientists and engineers for every 1,000 individuals, Canada has only 4.5. In 1991, B.C. industrial capital spending declined by 4% with machinery and equipment expenditures leading the decline (overall, such investment fell by 11%). For Canada as a whole, total research and development expenditures (all industries) are less than 1% of GDP. In fact, "over the 40,000 manufacturing enterprises in this country, only 1,700 carry out R&D."[42] A 1989 Statistics Canada survey highlighted the fact that less than one-half of the manufacturing respondents have implemented any advanced technology (from 22 specified possibilities).

4.2 Survey Results: British Columbia and Sweden

Such information spurred this researcher to develop a questionnaire to explore and describe the current interaction between suppliers and manufacturing enterprises; specifically pulp and paper organizations. To help determine the strategic relationship between mills and suppliers, and the role of suppliers in product development, questions on the degree of vertical

integration, pricing practices, and the degree of cooperation with mills were mailed to both Swedish and B.C. supply firms. The results demonstrate both statistically significant similarities and differences in current practices.

Each respondent received a cover letter explaining the purpose of the research and assurances of complete confidentiality. A database containing questionnaire numbers and associated names/addresses was used for an initial follow-up, and then destroyed when the target deadline date was reached. The questionnaire itself (refer to Appendix #3) contained both categorical questions and interval-scale questions, the latter to help determine strength of preference. Questions and responses related to governmental policies and actions will be reviewed in Chapter Six. The sample consisted of all supplier organizations listed with information-based agencies (the Chamber of Commerce for B.C. and the Swedish Trade Council). Consequently, the measure has external validity on the basis that the sample is more equivalent to a population. Recent theories and published articles using such measures formed a guideline for the development of the questionnaire, hence minimizing any threats to internal validity.

Out of 33 listed sample members in Sweden, 12 questionnaires were returned, a response rate of 36%. The rate of response for British Columbia was higher at 41%, with 14 respondents out of a sample frame of size 34. Note that the original sample frame for B.C. consisted of 35 supply firms, but one company was misrepresented as a supplier to pulp and paper mills. Some of the

technology and expertise which these firms marketed included: waste water treatment, separation technology (ie. fibre from water), prefabricated stainless steel products, hydro-turbine generators, process control engineering, infra-red drying systems, and high-efficiency membrane filters.

The first question on the survey was designed to determine the extent of foreign-control in the supply industry. However, all Swedish respondents listed Europe (Sweden specifically) as the home country of operation. Similarly, B.C. respondents indicated that their operations were based in Canada with the exception of one firm which was associated with a German organization. The second question explored the degree of integration between suppliers and mills. However, all Swedish and B.C. respondents stated that neither were they in-house divisions, nor were they affiliated with any pulp and paper mill (ie. affiliated in the context that such an organization held a minimum of 20% equity ownership).

The pricing practices of supplier firms was the basis for the third question. To help determine statistical significance, a small-sample t-test was used with a null hypothesis that there was no difference between Swedish and B.C. responses:

$$H_0 : \mu_{BC} = \mu_{Sweden} \qquad H_a : \mu_{BC} \neq \mu_{Sweden}$$

$$t = \frac{\overline{X}_{BC} - \overline{X}_{Sweden}}{\sqrt{\frac{(n_{BC}-1)\, s_{BC}^2 + (n_{Sweden}-1)\, s_{Sweden}^2}{n_{BC}+n_{Sweden}-2} + \left(\frac{1}{n_{BC}} + \frac{1}{n_{Sweden}}\right)}}$$

Note that this t-test assumes the variances for the B.C. population and the Swedish population are equivalent. The possible answers for question #3 were coded as:

Competitive Bidding with Flexible Cost Targets - 1

Competitive Bidding with Fixed Cost Targets - 2

Initial Contract Price with Future Negotiation - 3

For Sweden, the mean response was 1.833 while B.C. had a mean of 1.643. With a 95% level of confidence, the difference was not shown to be statistically significant (ie. failed to reject the null hypothesis). Thus the pricing practices for both B.C. and Swedish suppliers tends to be submission of competitive bids with fixed cost targets. This implies that suppliers must compete on price, with an incentive to maximize return by reducing costs over the length of the contract. However, a study of U.S. suppliers found that although competitive bidding forced supply firms to lower prices, wage and other cost increases were passed back to the buyer. A desirable alternative may be to model the Japanese method of "target pricing", where buyers set a target price for factor inputs and then "assist" suppliers in achieving these cost goals. Note that buyers also negotiate periodic reductions in factor input costs based "on the notion that suppliers should be able to reduce their costs through experience and continual efforts to improve their product designs."[43]

The fourth question focused on the typical length of such a contract. Although long-term contracts are more stable, one must also recognize that they tend to be static in nature (ie. prior

finding that expected cost targets are used). Thus there exists an inherent risk in long-term agreements as the business environment is dynamic. B.C. respondents indicated that contracts tended to be less than one year in length (coded as a "1") whereas Swedish respondents utilized to a greater extent contracts with terms from 1-2 years (coded as a "2").

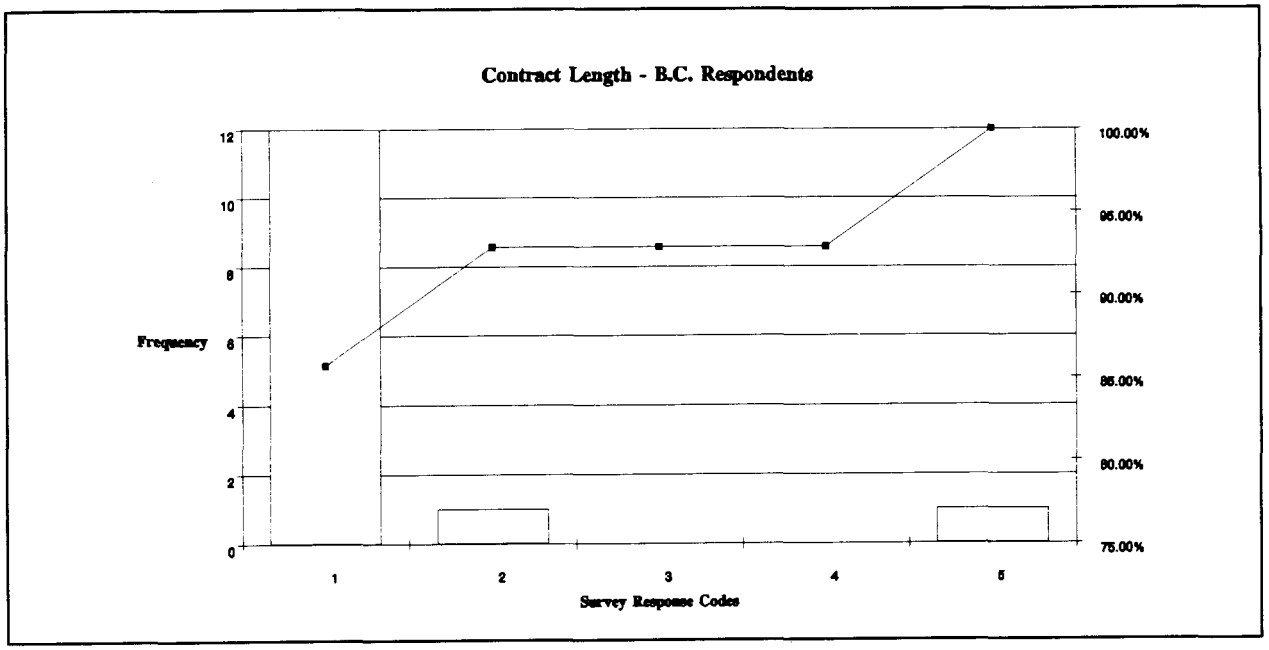

Figure 15

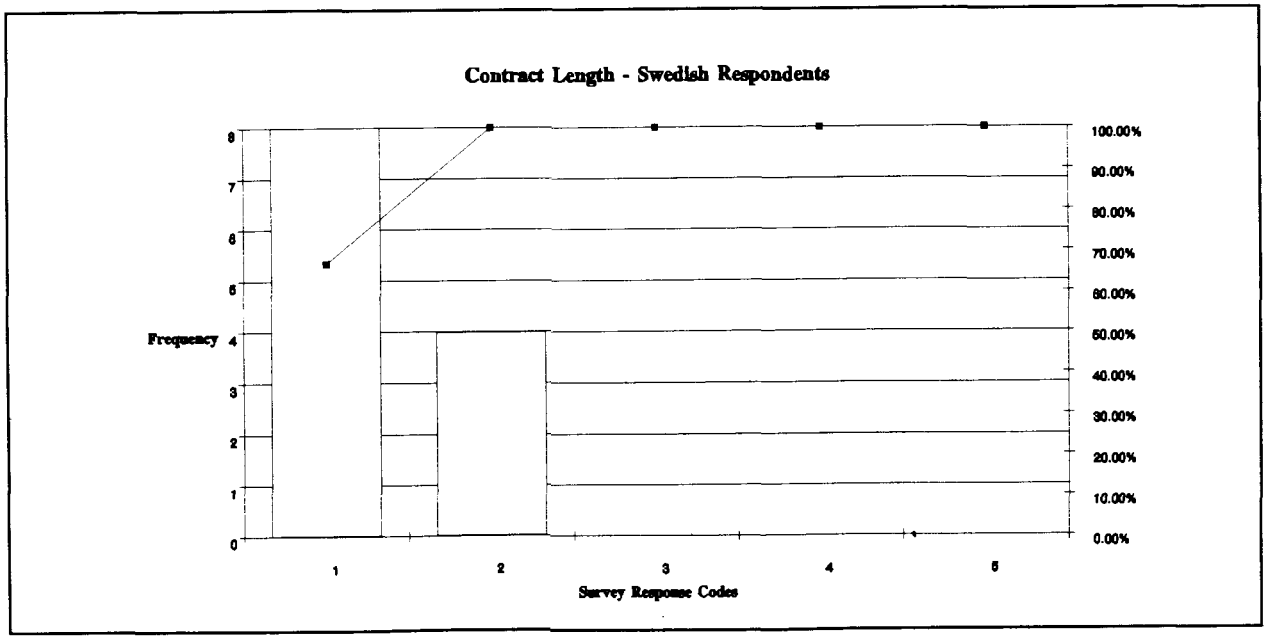

Figure 16

Question #5 on the survey used an interval scale to determine the degree to which suppliers exchange information and cooperate with mills during research and development. Recall that this was defined in the introduction as the role of the supplier in product development. With "frequently" being coded as a "1", and "infrequently" being coded as an "8", the B.C. respondents had a mean response of 5.143 while Sweden had a mean of 4.417. However, this difference was found to be statistically insignificant.[2] Thus one can infer that both Swedish and B.C. supply firms develop "black-box" and "supplier-proprietary" products; the use of detailed customer specifications would be inhibited by the constrained information flow between parties (ie. such a role for suppliers would require "frequent" exchanges of information). This in itself may slow down the development of new technology. Dr. Porter contends that long-run, competitive innovation is only maintained through demanding, sophisticated consumers (which implies extensive communication between suppliers and mills). For instance, "Japanese suppliers become involved in product development earlier than their U.S. counterparts" and "Clark (1989) even estimated that supplier involvement accounted for one-third of a significant Japanese advantage in total engineering".[44]

To examine criteria which "best distinguishes your company from potential competitors", the sixth question asked respondents

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[2] Null Hypothesis: H_0: $\mu_{BC} = \mu_{Sweden}$
Alternate Hypothesis: H_a: $\mu_{BC} \neq \mu_{Sweden}$
Failed to reject null with $\alpha = 0.05$ (small-sample t-test)

to rate seven factors. A numerical scale with bipolar adjectives was presented; "5" was associated with "very important" and "1" denoted "not important". The following ratings were found to be statistically equivalent:

Table 9: Mean Response Rates
"Competitive Criteria" - Question #6

B.C. and Swedish Respondents

Criteria	B.C. Mean	Swedish Mean
Initial Contract Price	3.714	3.250
Cost-reduction Capabilities	3.071	3.000
Product Quality (Standards)	4.571	4.500
Technological Capabilities	4.143	4.417
Importance of Past Relations	4.286	4.250

Thus Swedish and B.C. supply firms attach less importance to contract prices and ability to reduce their costs over the long-run whereas quality standards, technological capabilities, and past business relations are considered more important. B.C. respondents did feel that "delivery capability" was more important than Swedish respondents.[3] This could reflect the geographical markets served

[3] Null Hypothesis: H_0: $\mu_{BC} = \mu_{Sweden}$
Alternate Hypothesis: H_a: $\mu_{BC} > \mu_{Sweden}$
Rejected Null Hypothesis; $\alpha = 0.05$, small-sample t-test

by B.C. suppliers (ie. United States) in comparison to Sweden (ie. EC). Another contrast was found with "design and engineering capability", which was assigned a higher rating by Swedish respondents.[4] Based on this result, one could infer that Swedish suppliers are more likely to be on the cutting edge of technology whereas B.C. firms are more likely to focus on "importing" and adapting existing technologies.

The final question considered in this section dealt with innovative techniques adopted to help reduce costs or improve efficiency. B.C. suppliers replied that adopting more efficient manufacturing processes (coded as a "1"), focusing on direct cost reduction (coded as a "3"), and changing control of inventory (coded as a "7") were the methods utilized most often, both overall and in comparison to Swedish respondents. Swedish suppliers seemed to focus more on changing the design of their products as a means of minimizing cost and maximizing efficiency (coded as a "4"). This supports the previous inference that Swedish supply firms are more innovative in the context of developing new technologies. This does not imply that B.C. firms are not innovative, rather that they may concentrate more on the existing production process. Both the Swedish and B.C. respondents indicated that changes in quality control and factor inputs (variable and fixed) were used to some extent (coded as a "2", "5", and "6" respectively).

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[4] Null Hypothesis: H_0: $\mu_{BC} = \mu_{Sweden}$
Alternate Hypothesis: H_a: $\mu_{BC} < \mu_{Sweden}$
Rejected null hypothesis; $\alpha = 0.05$, small-sample t-test

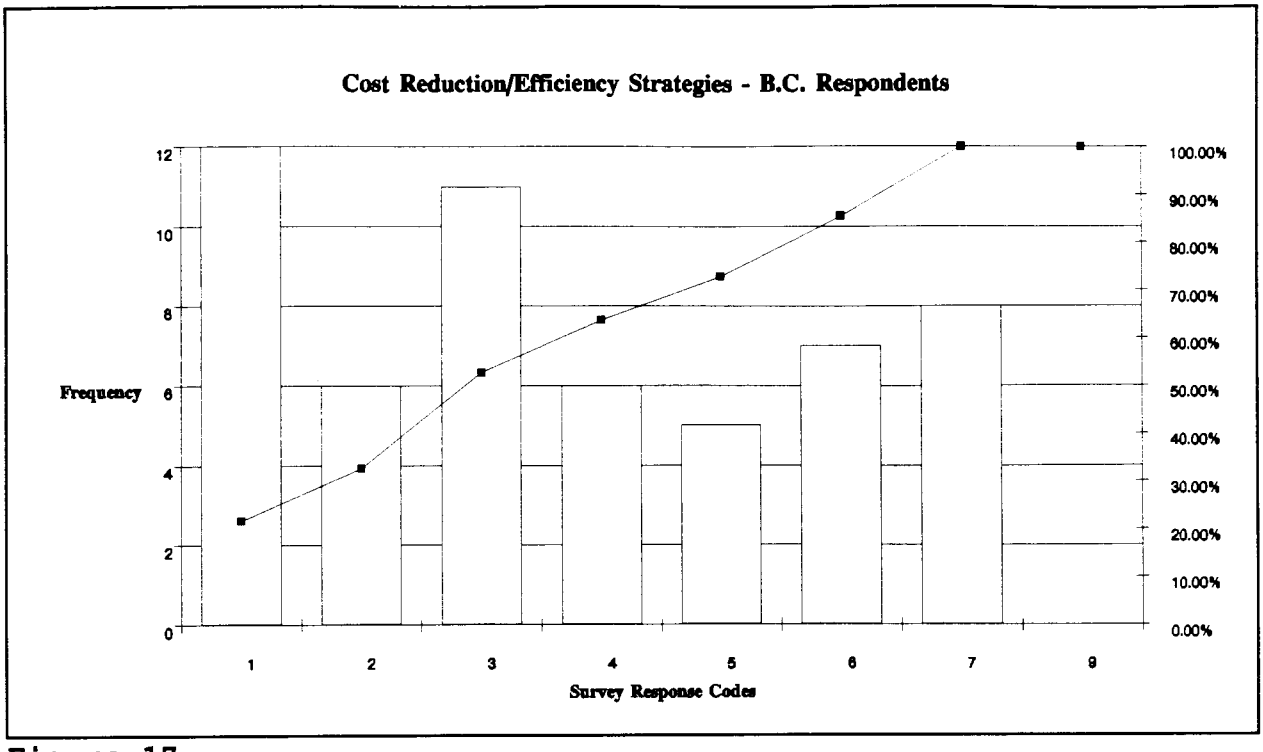

Figure 17

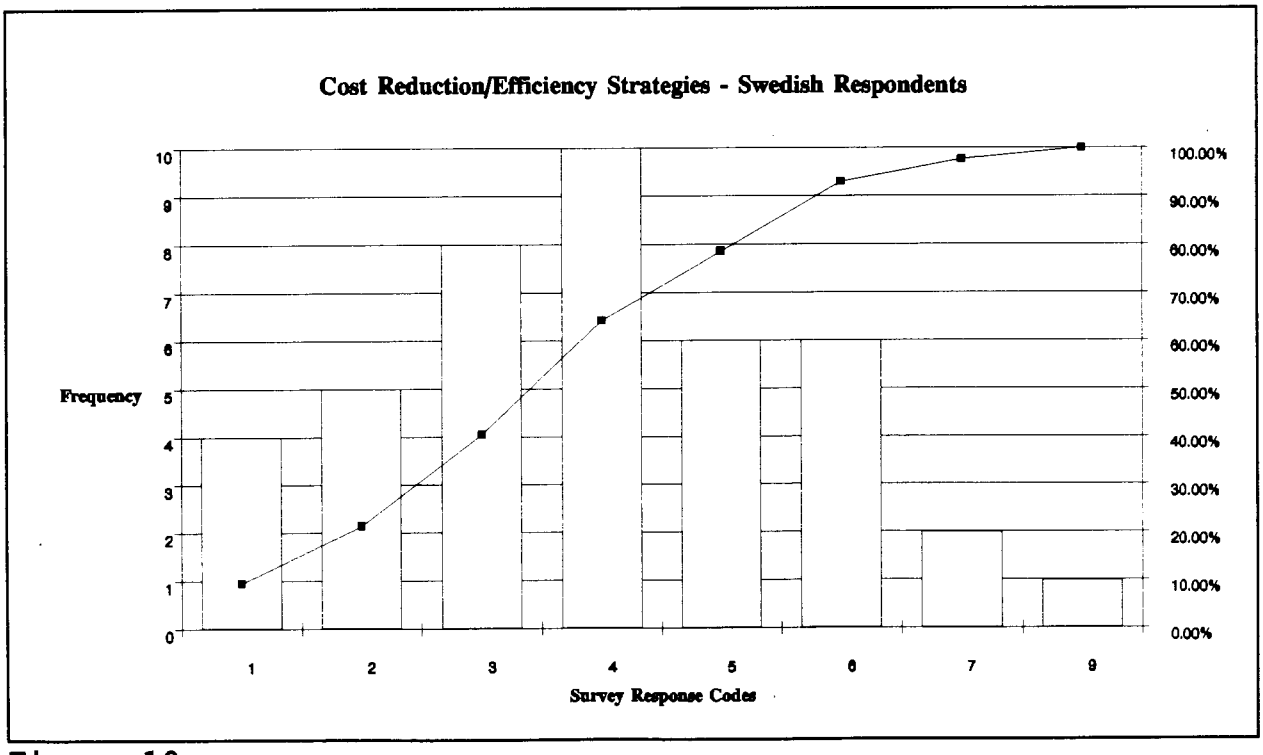

Figure 18

As a final analysis, a crosstabulation was performed between the supplier mail questionnaire and a strategy questionnaire which was mailed to both B.C. and Swedish pulp and paper mills. The pulp and paper organizations were asked, "how do you select the firms which supply your mill with machinery and materials?" A listing of seven options was presented (a nominal scale). Similarly, the questionnaire mailed to suppliers prompted, "of the following criteria, which best distinguishes your company from potential competitors?" The findings are presented in Table #10 (on the following page). B.C. mills and suppliers seem to agree that past business relations are important whereas the initial price offered tends not to be (ie. 58% of mills used price to select firms and 57% of suppliers felt initial price was important). This is relatively equivalent to the corresponding responses by Swedish mills and supply firms, although the Swedish organizations placed even less stress on initial prices (25% of the mills and 33% of supply firms rated this factor as important). Overall, Swedish organizations indicated that past business relations and the quality (standards) of supplier products are important, albeit mills show less of a preference toward quality than suppliers do by approximately 9%. This difference in emphasis on quality is also reflected in the statistics for British Columbia, where 92% of the mills feel quality is important versus 100% of the suppliers. These findings suggest that mills and suppliers tend to have long-term relationships. The increased emphasis on relations and diminished importance of price as factors in choosing suppliers

Table 10:

Crosstab Analysis : Supply Firm Characteristics

Survey 1 (Mills) and Survey 2 (Suppliers)
re: Criteria for Selection and Competitive Importance

Survey Source	Origin	Initial Price Offered	Quality (Standards)	Delivery Capability	Engineering/ Design Capability	Past Business Relations
#2 (Supply)	B.C.	[8] 57%	[14] 100%	[13] 93%	[9] 64%	[13] 93%
#2 (Supply)	Sweden	[4] 33%	[11] 92%	[10] 83%	[11] 92%	[11] 92%
#1 (Mill)	B.C.	[7] 58%	[11] 92%	[8] 67%	[11] 92%	[11] 92%
#1 (Mill)	Sweden	[3] 25%	[10] 83%	[5] 42%	[8] 67%	[10] 83%

Please note that percentages are expressed in terms of the specific survey's total return for that country of origin. For example, [7] under B.C., Survey #1, denotes that 7 out of 12 respondents scored that characteristic as important.

supports this inference. The pattern found for quality ratings may reflect a trend seen in some U.S. firms (context of consumers - mills) which seem "to rely more on detection of errors after-the-fact rather than prevention of problems, with less systematic efforts to learn from their experiences with defective parts".[45]

The greatest differences for B.C. are seen in delivery capability (93% for suppliers and 67% for mills), and engineering/design capabilities (64% for suppliers and 92% for mills). The latter implies that while B.C. suppliers do not place great emphasis on technological design and innovations, mills deem it important. Hence one could question if this in itself is a factor inhibiting competitive ability, given that B.C. mills may be unable to match Swedish mills in terms of new technology (as produced by domestic suppliers). Interestingly enough, Swedish respondents demonstrated a reversed rating for this factor, with suppliers indicating that engineering and design capability is more important (92% versus 67% for mills). Such a finding supports the inference that Sweden enjoys an advantage by having domestic suppliers focus on technological development. Consequently, Swedish mills may be exhibiting a "satiation" response, where R&D is expected and hence considered less important in comparison to other factors.

5. Firm Strategy

5.1 Background

In terms of an organization's evolutionary process, producers of pulp and paper are best described as a mature industry. Dr. Porter has defined some descriptive characteristics of a mature industry: increased competition for market share as a means of achieving growth, prominence of experienced and knowledgeable buyers, orientation of firms on cost as a means of differentiation, a diminished rate of capacity addition, reduced profit margins, and an increase in international competition (based on technological maturity, product standardization, and emphasis on costs).[46] This chapter will explore the prevalence of such characteristics, as defined by Dr. Porter, for both B.C. and Sweden.

However, one must also recognize that an industry can "re-fuel" growth by adopting or developing innovative strategies. This is especially important for the pulp and paper industry, for "after the major capital investment programs are completed for all three countries [Canada, U.S., Sweden], the future competitive positions will largely be determined by technical and managerial efficiency".[47] Consequently, current strategic issues related to leadership will also be reviewed. Such issues may have been deemed unimportant by management in previous years; "rapid growth tends to mask strategic errors and allow most, if not all, companies in the industry to survive and even prosper financially. Strategic

experimentation is high, and a wide variety of strategies can coexist. Strategic sloppiness is generally exposed by industry maturity, however."[48] For example, CTMP technology represents an area of competitive importance; "the growth will be in very competitive white paper mills, lightweight coated mills, CTMP market pulp mills and newsprint mills."[49] However, the Economic Council of Canada found that Canadian companies often fail to adopt new, productive technologies. They conclude that "this is attributable to the way Canadian firms are organized and to the attitude of senior managers towards innovation."[50]

Environmental protection is another strategic issue with a broad potential for development. Pollutants typically take the form of gas emissions, waste water (effluent) discharges, and chemical by-products (refer to Appendix #1). Although technologies exist to handle these forms of pollutants, there is still a need for management to develop and refine long-term environmental policies. One such policy could be the adoption of ultrafiltration for treatment of effluent (a relatively new technology). A porous membrane separates bio-degradable compounds from compounds which can be destroyed in the recovery boiler.

The current "hotbed" of environmental strategy is the discharge of AOX compounds.[5] Governmental policies (reviewed in the next chapter) call for specific levels of allowable AOX discharges. Typically this entails the production of chlorine-free paper

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[5] Absorbable Organic Halogen; typically in the form of chlorinated organic compounds.

(either elemental-chlorine-free, ECF, or total-chlorine-free, TCF). For example, in the European graphic paper market, ECF pulp represents approximately 50% of the total pulp input, with projections of a 75% market share by 1995.[51] Some of the technologies that are being examined in the context of reducing or eliminating AOX compounds are reviewed in Appendix #4. Although governments can regulate a specific level of allowable AOX discharge, firms and management must decide the "means to the end". Thus management must review the costs and benefits of current and expected technologies to match such regulations, and possibly the expected costs of non-compliance.

To help define the strategic approaches of both British Columbian and Swedish management, a mail questionnaire was developed and distributed to pulp and paper mills. Some generic strategies which will be explored are "cost analysis" and "process innovation".[52] Cost analysis entails the removal of unprofitable goods from the product mix and focusing on product lines which enjoy a cost advantage (technological and image-based advantages are also considered). Process innovation is basically the implementation of new product designs (along with associated productive and delivery-based infrastructures) to promote more competitive manufacturing. Such product diversification has been observed in the global fine paper and coated paper industries. Lightweight coated papers (LWC) demonstrated high growth in the early to later 1980's. A related, ongoing area of product innovation is in business communication papers, particularly

"plain-paper copier papers (PPC), computer-output form papers like continuous business form and carbonless copy papers, and facsimile papers such as electrostatic paper and thermal paper."[53]

5.2 Strategic Factors - British Columbia

The first characteristic, as defined by Dr. Porter, which will be examined is British Columbia's relative cost position. H.A. Simons predicts that the pulp and paper industry will see an erosion in their cost competitiveness, with rising wood chip costs being a prime factor (recall that a diminishing chip supply is expected over the next fifty years). In contrast, Chile is expanding their pulp and paper capacity while developing fast-growing tree plantations. Consequently, Chile will remain a low-cost competitor. Overall, the B.C. interior is expected to become a "medium-cost" competitor in the softwood kraft pulp market, whereas the B.C. coast will most likely become a "high-cost" producer before the year 2000. Price Waterhouse analyzed the delivered costs per ADMT[6] for British Columbia's pulp industry during the years 1986-1990. The B.C. interior showed a cumulative 36% increase in costs (domestic currency) from a 1986 level of $480/ADMT to a 1990 cost of $653/ADMT. The B.C. coast demonstrated an even greater cumulative cost increase of 49%, with 1986 costs of $495/ADMT rising to a 1990 level of $735/ADMT. Underlying factors

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[6] Air-dry Metric Tonne

for the B.C. coast included a lower capacity utilization rate and ongoing capital upgrades. B.C. coast producers also "absorbed" a 48% increase in fibre costs (1986-1989) whereas B.C. interior mills faced both a 60% cost increase for wood fibre and a 91% cost increase for maintenance (1986-1990). Note that for newsprint, overall delivery costs have fallen or remained flat due to increased competition between rail and truck transport organizations.

The labour supply is a factor which influences the cost, profit, and international competitiveness characteristics defined by Dr. Porter; "the quality and quantity of skilled people - and the way in which they are organized and managed - are fundamental to successful innovation within the individual firm."[54] B.C. has a history of strikes and lockouts; "Canada has consistently been a close competitor to Italy for the highest strike rate among the seven major OECD countries (United States, Germany, Japan, France, United Kingdom, Italy and Canada)."[55] Naturally, this impacts the productivity of labour; the Economic Council of Canada compared the output per person-hour between the United States and Canada, with Canada being the base (ie. Canada = 100). They found that while the U.S. Paper and Allied Products Industry had an output level of 86 in 1961, in 1980 it surpassed Canada with an output level of 112. This trend continued, with the 1990 level being 138, a 23% increase over the 1980 figure. The perceived relationship between firms and labour, as reported by management, will be examined during the analysis of the questionnaire.

The degree of capital investment was another characteristic defined by Dr. Porter in the context of mature industries. Since 1984, capital and repair expenditures for the pulp and paper industry have reached record levels, with roughly $0.39 Billion in 1984 rising to $1.7 Billion in 1990. During the 1980's, Canada invested twice as much as the United States in newsprint and pulp capacity. Despite this, Canada still lags behind the United States and the Nordic countries in terms of average newsprint machine size and pulp capacity.[7] More specifically, the average pulp capacity on a per mill basis is less than 1000 tonnes/day in Canada, approximately 75% of the average pulp capacity in the U.S. South,

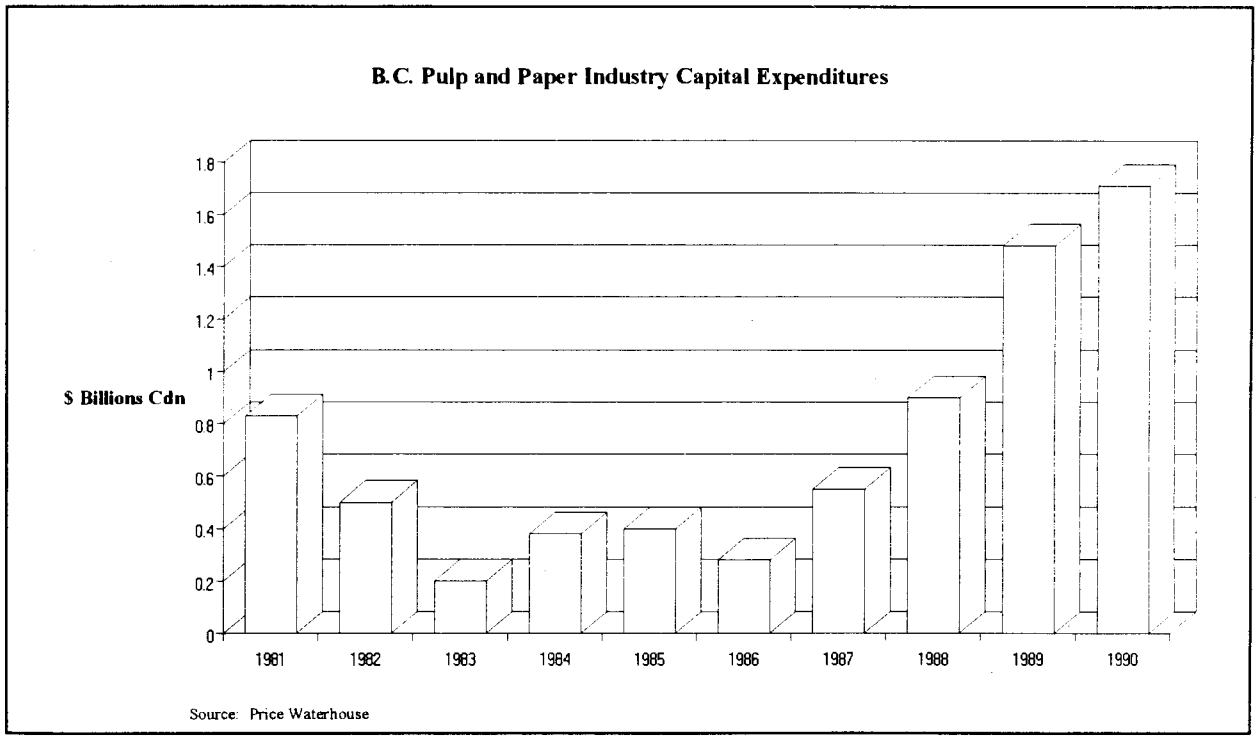

Figure 19

[7] Average machine size in Canada is 104,000 tonnes; U.S. South has an average machine size of 146,000 tonnes while Sweden demonstrates an average of 175,000 tonnes.

Sweden, and Finland. In qualification, capacity may not reflect efficiency. Such is the case for CTMP; "it is taking the economies of scale away from the old newsprint operation with several machines backed up against a kraft pulp mill. It is going to make newsprint production a more local business and it is going to affect the bleached kraft pulp market. This is all to the good, for it means higher yield, simple mills, lower costs, and more value to the consumer."[56] B.C. organizations demonstrated an increase in environmentally-related capital expenditures, from a 1980 level of less than $50 million to a 1990 level of almost $500 million. Total pulp capacity in B.C. has been estimated at 8.3 million tonnes for 1991, and is expected to reach 8.9 million tonnes by 1994. This represents an approximate 8.2% increase in capacity. For market pulp, total capacity in 1991 was approximately 4.7 million tonnes, with a forecasted increase of 9.6% to 5.1 million tonnes in 1994. Paper and paperboard capacity are expected to grow the least in B.C., from a 1991 level of 3.4 million tonnes up to an expected level of approximately 3.7 million tonnes in 1994 (an increase of 6.7%). Overall, approximately 56% of the total pulp capacity is for bleached softwood kraft pulp. Another 14% is for thermomechanical pulp and 15% is for CTMP.

Currently the pulp and paper market is in a state of overcapacity. If Dr. Michael Porter's description of a mature industry holds true, the rate of capacity addition will diminish. Consequently, firms face a myriad of strategic options, including whether to close specific mills, convert low-performance newsprint

mills into users of recycled fibre, or invest company funds to upgrade inefficient mills. If firms increase capacity, it may be in innovative areas such as chlorine-free pulp production. For instance, in February of 1992, Intercon successfully completed a two-day trial for production of chlorine-free pulp.

Dr. Porter also describes diminishing profits as a characteristic of a mature industry. In 1991, several B.C. pulp and paper companies reported record losses. More specifically, out of the top ten B.C. forest companies (public), nine reported a cumulative loss of $363.6 million. Pulp prices fell to approximately $500 US/tonne in late 1991, although increases were achieved in the first few months of 1992. The industry return on assets declined from a peak in 1988 of approximately 12.5% to less than 0% in 1991 and 1992 (first quarter return was -2.0%).[8]

Finally, the strategic implications of the January, 1992, B.C. government regulation on AOX discharges will be considered. Briefly, firms must meet an AOX discharge limit of 1.5 kg/ADt[9] on or before December 31, 1995, and firms must eliminate all such discharges by December 31, 2002. This is an area with a broad potential for strategic innovation and for error; as there exists considerable uncertainty about the cost-effectiveness and ability to produce AOX-free bleached pulp. Many B.C. firms are examining the use of chlorine dioxide, additional secondary treatment, and

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[8] Annualized Income as a Percentage of Assets

[9] Air Dry Tonne - approx. 10% water and 90% fibre

upgrades in screening and washing to reduce toxicity of mill effluent (ie. BOD or Biological Oxygen Demand). This has also reduced the level of AOX discharge. H.A. Simons estimated the capital costs to go beyond these recent expenditures in light of the new AOX regulations. To achieve "virtually zero AOX" could cost a hypothetical $81 to $260 million depending on the current state of the mills technology. The costs to obtain zero AOX fall between $114 and $283 million. This could place B.C. at a serious cost disadvantage compared to such producers as Chile, U.S. South, and Sweden. This stems from the fact that one cannot predict if governments from these competing regions will introduce equivalent regulations. Another strategic consideration is the size of the market for zero AOX pulp. If the market potential is small, then managers and government should recognize that countries such as Chile can satisfy the demand at far less cost.[10] Lastly, B.C. firms should also evaluate investment opportunities in South America and Southeast Asia, where there is little likelihood of a zero AOX regulation; most of these regions are not currently subject to any AOX regulations. In qualification, there are social costs imposed through AOX discharges, and such costs should also be considered.

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[10] Excluding AOX expenditures, the lowest manufacturing cost for B.C. is approx. $550/ADt whereas Chile is $440/ADt.

5.3 Strategic Factors - Sweden

To provide a contrast with the information for British Columbia, the relative cost position of Sweden's pulp and paper industry will now be examined. For pulp, the delivered cost for 1986 was 2899 SEK, which increased in 1990 to 3593 SEK. This represents a cumulative cost change of 24% (below that of the B.C. interior and coast).[57] Converting to Canadian currency yields a 1986 delivered cost of $565.88, with a 25.2% cumulative cost increase to $708.99 in 1990.[11] Between 1989 and 1990, Swedish firms faced a 7% cost increase for fibre, which accounted for approximately one-third of the 11% cumulative cost increase during this period. Swedish producers also saw a drop in the capacity utilization rate from 95% in 1989 to 89% in 1990. For newsprint, the delivered cost per tonne in 1986 was 2878 SEK, with a cumulative cost increase of 11% to 3189 SEK in 1990.[58] When converted to Canadian currency, there is an 11.9% cumulative cost increase from a 1986 figure of $561.78 to a 1990 delivered cost of $628.65.

The historical market for Swedish production is Europe, albeit there has been a shift in the marketing focus. This is reflected in the following table. Sweden has developed an extensive distribution system in Europe, with almost perfect integration between producers, wholesalers and the final consumer. An example

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[11] Utilizing respective, average annual exchange rates as reported by the International Monetary Fund.

of this can be found in Press Papers Ltd. (PPL), a joint

Table 11: Shift in Market Focus
Sweden 1986 - 1990

Source: Price-Waterhouse

Market	1990	1986
Domestic	17%	23%
U.S.	2	8
Europe	77	65
Other	4	4
Total	100%	100%

marketing agency in the United Kingdom for Swedish (Stora, SCA, Holmen) and Norwegian newsprint producers. PPL was one of the largest newsprint suppliers in the U.K., and forged relationships between mills and customers. In addition to conducting regular technical tours, PPL sponsored concerts for potential buyers, fishing trips to Scotland, and a "Golf Day". In 1986 they arranged approximately 20-25 customer visits to production sites. Note that free trade within the European community has existed for paper and paperboard since January 1, 1984. Overall, free trade between members of the European Free Trade Association (EFTA) and the Common Market is based upon individual agreements for all classes of industrial goods.

Closer links within the European community are also being developed through acquisitions. The move of management toward acquisition of firms has exceeded the investments of American and

Japanese companies during the period 1986-1990. The total value of such investments since 1970 is approximately 30 Billion SEK. Currently, there are nearly 160 Swedish-owned production facilities within Europe and in Great Britain. For example, STORA purchased Feldmuhle in Germany while MoDo acquired the French company Alicel/Alipap. Thus Swedish management has developed a strategy which allows them to protect existing market share while penetrating further into the EC; "rest assured, the Swedish corporations will be investing substantial sums in developing the companies they have acquired".[59]

Although the relationship between Swedish management and labour will be examined during the survey analysis, Sweden does appear to have a more participatory environment for labour. Under current collective agreements, employees can choose between a fixed, monthly wage or a combined fixed wage and performance-related bonus. In 1990, approximately 65% of the labour force selected the latter option. Pulp and paper organizations must also pay social costs, transportation costs, and associated expenses which average approximately $158 US per person-day.

As highlighted in the B.C. section, the pulp and paper industry demonstrates a "special problem with investment in larger and larger production units."[60] This investment in capacity tends to occur within a short-time period, and in identical product markets. Since 1960, the Swedish industry has shut-down approximately half of their pulp mills and nearly one-third of all paper mills. At the same time, capacity has increased by 400%

between 1960 and 1986. This is reflected in the following table:

Table 12: Capacity Figures for the Swedish Pulp and Paper Industry 1960 - 1986

Source: SCPF

Mills	1960	1986
Pulp Mills		
Number of Mills	127	55
Total Capacity (000)*	5,588	10,450
Capacity per mill (000)*	44	190
Paper Mills		
Number of Mills	76	55
Total Capacity (000)*	2,280	8,170
Capacity per mill (000)*	30	149

* metric tonnes

The average machine capacity has increased an additional 33% since 1986 (1990 figures), with a capacity utilization rate of 89%. For Sweden, approximately 90% of the pulp capacity is designed for thermomechanical pulp, with approximately 5% being stone groundwood and 4% being kraft pulp. This reflects the relatively high cost for fibre, where high-yield processes such as TMP must be utilized to remain competitive. Although capacity is increasing, an

apparent contradiction to Dr. Porters characteristic of diminishing capacity addition, the majority is being targeted toward new and fast-growing markets. For example, Swedish producers are increasing their newsprint capacity given an ample supply of fibre and electrical energy. However, the move is toward thinner paper with better printability and higher strength. By developing such innovative marketing strategies, Sweden can develop new specialities to help counter the influence of countries which enjoy lower wood and labour costs (ie. Chile, Brazil). Another example of strategic innovation can be seen in the development of high quality "liquid board". The Swedish packaging company Tetra Pak developed a high strength, multi-layered packaging material which incorporates such recent technology as CTMP. Overall, Swedish

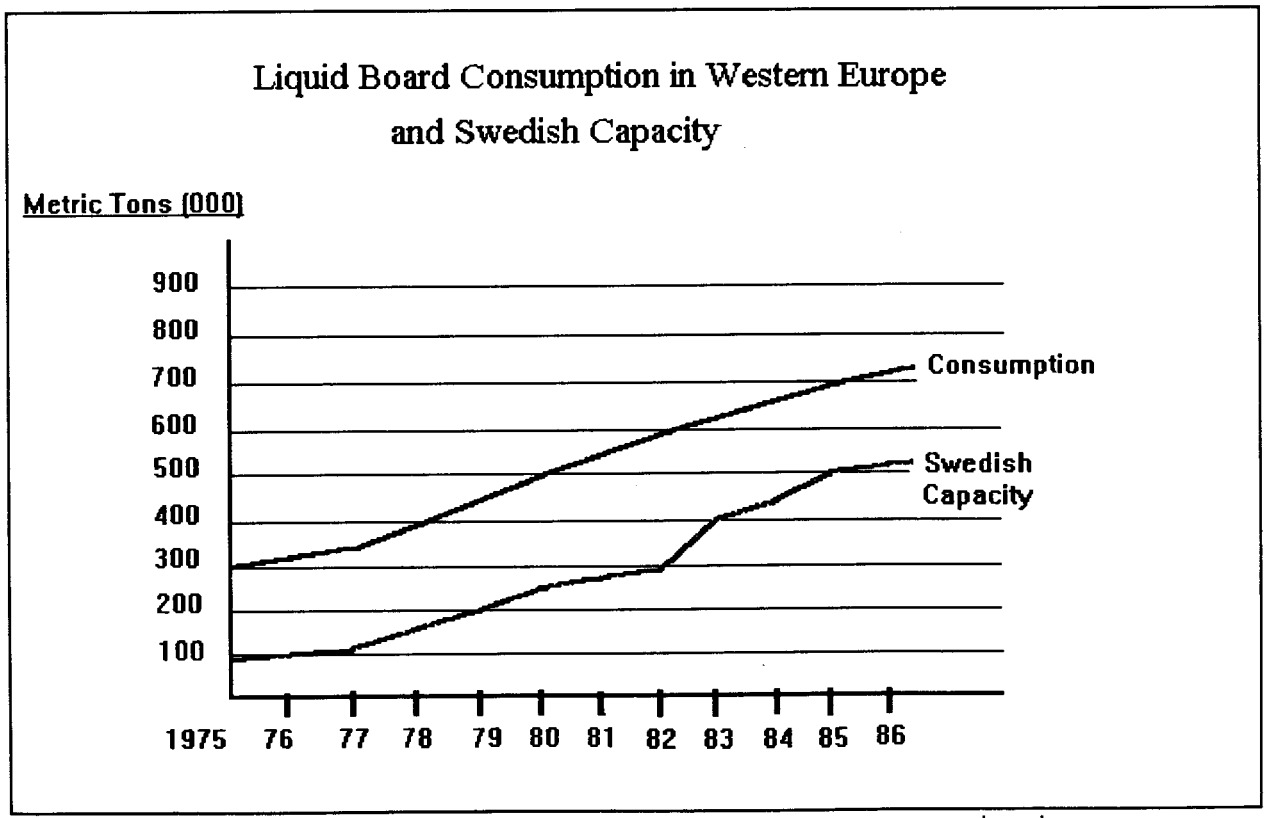

Figure 20 Source: Swedish Pulp and Paper Association

producers seem to be adding capacity while investing in product research and development; "if skill in increasing the high yield of their products and maximizing the economies of scale in their plants has been the characteristic feature in the past, the companies will in the future take aim at upgrading their products and intensifying their marketing efforts."[61]

However, the Swedish pulp and paper industry has not escaped the global deterioration in profits. Increased competition, low prices for pulp and fine paper, and reduced capacity utilization contributed to the downturn in earnings exhibited by the Swedish industry. Note that the earnings illustrated in Figure #21 are before tax, and after scheduled depreciation and net financial items.

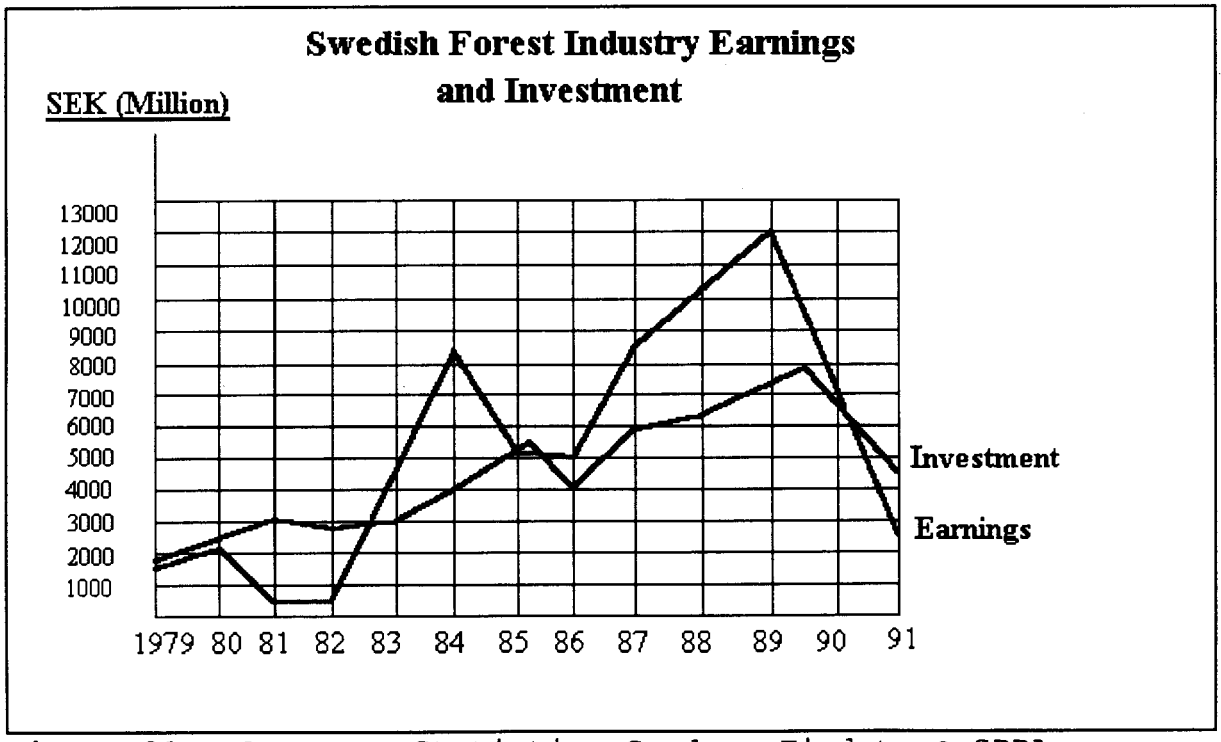

Figure 21 Source: Statistics Sweden, Findata & SPPA

As presented, 1990-91 was a period of reduced profits and investment for the Swedish forest industry; "generally, profits fell to about one-quarter of the levels at the end of the 1980's. Profitability was forced down by global overcapacity, price reductions and weak economic growth".[62] As a result, Swedish management continued to orient itself on improving efficiency and cutting costs, while implementing strategic and marketing innovations. For example, SCA acquired Reedpack in 1990, a corrugated board company, which increased its access to recycled fibre.

Finally, the strategic implications of environmental policy and consumer awareness will be outlined. Sweden has already implemented policies to eliminate the discharge of chlorinated organic compounds from existing pulp and paper mills. Bleached kraft mills must meet a 0.5 kg/ADt level for softwood processing, and a 0.3 kg/ADt limit for hardwood by the year 2000. A "zero AOX" policy was to be implemented by the year 2005, but authorities have since recognized that existing and proposed technology may be unable to efficiently meet such a time deadline. However, with the demand for total-chlorine-free bleached kraft pulp from Germany and other European consumers, Sweden has increased its capability to supply such pulps. As of mid-1992, the following mills are capable of producing TCF kraft pulp: ASPA, ASSI, Karlsborg NCB, Vallvik SCA, Östrand Södra Cell, Mönsterås Södra Cell, Mörrum Södra Cell, Värö Stora, and Norrsundet.[63] In contrast, Canada has only two mills capable of such production, Howe Sound Pulp and Weldwood. As

previously noted, while TCF pulp represents a strategic innovation, the extent to which it will be adopted depends on the degree of demand, regulations, cost and performance (specifically strength and brightness). To date, TCF pulps are priced at a premium given higher production costs. Such pulps also suffer from reduced strength and brightness in contrast to ECF softwood kraft pulps. However, Södra Cell's Mönsterås mill announced in September of 1992 that it has developed a TCF bleaching sequence that roughly matches the strength and brightness of traditional bleached kraft pulp.

As mentioned previously in this paper, Sweden has implemented other environmental policies such as the use of waste paper. It is expected that major investments in waste paper utilization will continue. During the past fifteen to twenty years, Swedish forest companies have dedicated approximately 12 - 14% of their total investment towards environmental measures.

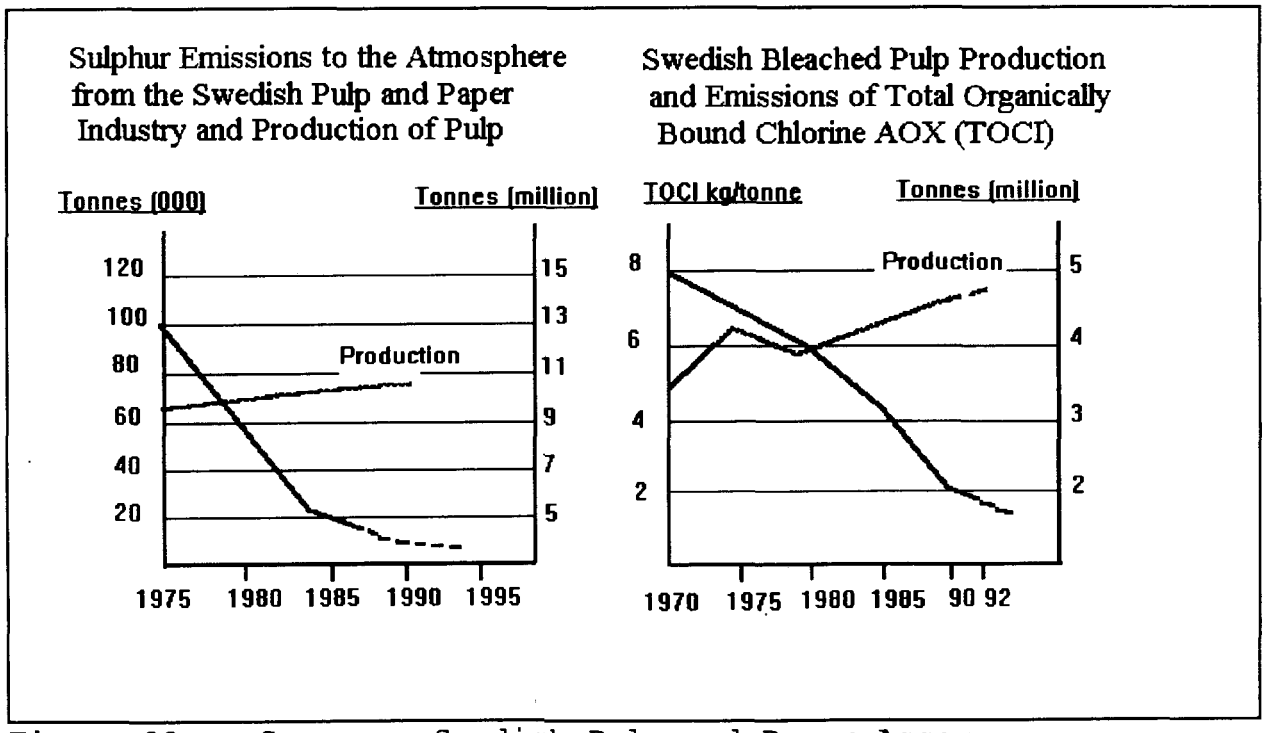

Figure 22 Source: Swedish Pulp and Paper Assoc.

As a result, the emissions of air pollutants and toxic effluents have been drastically reduced. By adopting such long-run strategies, Swedish producers have "hedged" against the risk of increasingly stringent environmental regulations.

5.4 Survey Results for B.C. and Sweden

Both categorical and interval-scaled questions were integrated to help describe current managerial practices in Swedish and British Columbian pulp and paper mills. A listing of B.C. mills was acquired from the Victoria Chamber of Commerce, and similarly a listing of Swedish mills was obtained from the Swedish Pulp and Paper Association. Out of 23 identified B.C. mills, 12 questionnaires were returned, a response rate of 52%. However, the rate of response for Sweden was significantly lower at 15%; out of a sample frame of size 81, only 12 surveys were returned. This may be attributed to the way the questionnaire was administered; the mailing to Sweden took place approximately 1 month prior to Christmas holidays, all envelopes were addressed generically to the "mill manager", and all survey material was composed in English. To help minimize threats to the internal validity of the questionnaire itself, a pilot copy was reviewed by Mr. Dave Shaw (a forest industry specialist). Note that recent theories on research design were also incorporated into the structure of the survey (refer to Appendix #5).

The first question prompted respondents about the home country

of their organization. Although some companies responded that international affiliations and joint ventures did exist, the answers, in comparison to the facts, suggest that the question was too vague. For example, the majority of B.C. respondents indicated that their home country of operation was Canada, with three joint ventures or affiliations being described. The countries involved in these ventures are Finland, the United States, and China. However, other international affiliations do exist and these were not described by the respondents. An example of Japanese projects is presented in Table #13.

Table 13: Japanese Overseas Projects in Pulp and Paper Production

Source: Japan Paper Association

Japanese Company	Ownership	Name of Venture	Date Est.	B.C. Location
Honshu Paper Mitsubishi	32.24% 32.24%	Crestbrook	Jan/67	Skookumchuck
Jujo Paper	14%	Finlay Forest	Nov/68	Mackenzie
Daishowa Paper Marubeni Corp.	50%*	Cariboo P&P	Apr/70	Quesnel
Daishowa Paper	50%	Quesnel River	Apr/77	Quesnel

* through Daishowa-Marubeni International Ltd.

Thus the question should have specified that a home country is

that of the organization which holds the majority of ownership. For Sweden, all respondents indicated Europe as the home country. Once again, a qualification must be made on the basis that the question itself may have not been specific enough.

Question two examined the key competitive advantages being targeted by mills. Recall from the introduction that the option "lower cost" (coded as a "1") can be described as a cost analysis strategy. Similarly, the option "advanced technology" (coded as a "4") can be described as a process innovation strategy. The remaining options, "higher product quality" and "customized products" (codes "2" and "3" respectively) are examples of differentiation. B.C. respondents indicated that management focuses more on cost strategies and differentiation of products.

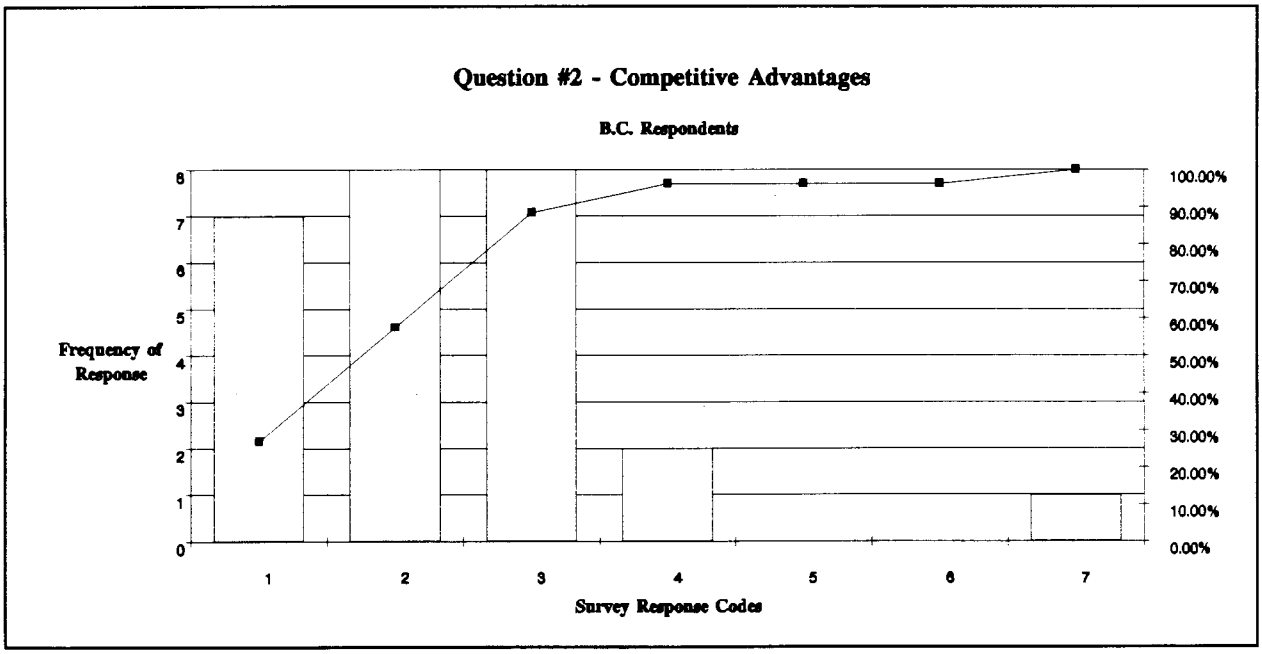

Figure 23

Note that one respondent indicated "service" as a strategic goal.

In contrast, Sweden places less emphasis on cost strategies. However, the use of differentiation was equivalent to that found for B.C. management. Other responses included "flexibility" (coded as a "5") and "knowledge of domestic market needs/participants" (coded as a "6").

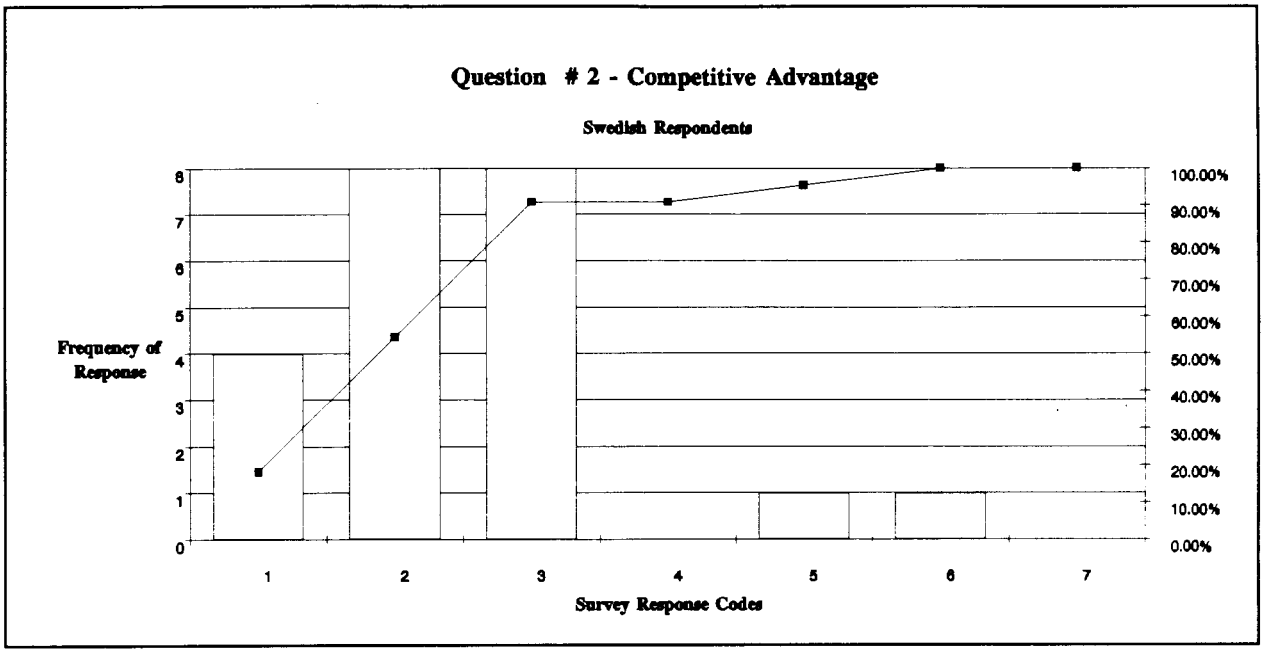

Figure 24

The third question expanded on the use of cost strategies, and asked respondents to specify what measures have been considered. Both B.C. mills and Swedish mills were similar in their responses, except for the option "adopt new technology" which received less emphasis by Swedish respondents.[12] Recall that Swedish mills and suppliers appear to be active in developing and implementing new technology, hence this response may appear less significant to

[12] 5/12 Swedish respondents indicated this option versus 10/12 B.C. respondents

Swedish management in light of other options. This is supported by the observation that Swedish management also placed less emphasis on "upgrading existing machines".[13] Both Swedish and British Columbian managers indicated that "cross training of labour" and "upgrading of workers skills" were important cost strategies. One Swedish respondent also indicated that a lower level of stock and hence faster rotation was another potential policy.

The extent of retraining as provided by mills was the basis for Question four. With "yes" coded as a "1", and "no" coded as a "0", B.C. managers predominantly responded that investment toward worker training does exist. Sweden showed an even greater emphasis

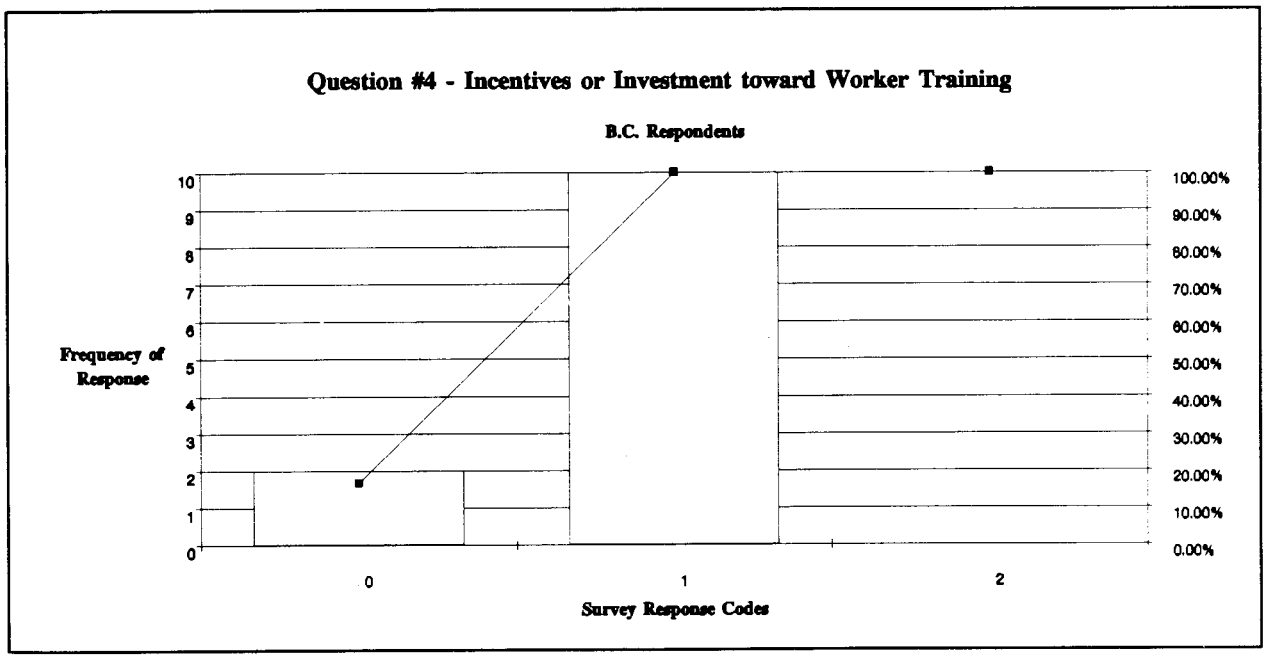

Figure 25

on worker training, with 11 respondents indicating support for

[13] 7/12 Swedish respondents selected this option in contrast to 9/12 for B.C. respondents.

labour education (one respondent indicated "no opinion"). However, the quality of retraining must also be considered. The "1991 World Competitiveness Report" evaluated the in-company training procedures and supply of skilled labour for 23 industrial countries, and Canada was ranked 20th. This reflects that Canada may suffer from an inadequate system of formal education and apprenticeship programs. Of those companies that do provide employee training, the Economic Council of Canada estimates that the average investment per employee is $240 (1987).

Another important consideration which was eluded to previously is the strategic relationship between management and labour. The fifth question on the survey asked management to rate this relationship on a bipolar scale, with the extremes being "partnership" and "adversaries". A small-sample t-test was utilized to determine the statistical significance of mean response differences. With "partnership" being coded as a "1" on a seven-point scale, Sweden had a mean response of 2.083 whereas B.C. had a mean response of 4.417. This difference was shown to be statistically significant.[14] Consequently, Swedish management and labour appear to share a more cooperative relationship. The more adversarial relationship as indicated by B.C. management is damaging to B.C.'s competitive position and explains why real wages have continued to grow when productivity increases have diminished.

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[14] Null Hypothesis: $H_0 : \mu_{BC} = \mu_{Sweden}$
Alternate Hypothesis: $H_a : \mu_{BC} \neq \mu_{Sweden}$
$\alpha = 0.05$; Null is rejected

To sustain competitiveness over the long-run, one must allow real wages to reflect improvements in productivity.

Questions six and seven examined the monitoring of customer satisfaction and emphasis placed by management on consumer happiness. Respondents were asked to rate the importance of consumer satisfaction on a seven-point scale, with the extreme of "crucial" being coded as a "1" (the other extreme presented was "irrelevant"). With B.C. respondents showing a mean of 1.333 and Sweden having a mean response of 1.250, a small-sample t-test was not applied. It can be inferred that both B.C. and Swedish management place great emphasis on consumer satisfaction. The foremost method utilized to monitor customer approval, for both B.C. and Sweden, is direct company follow-up. This would include company representatives phoning a customer or visits to customer sites. While all B.C. respondents indicated postal reply forms or company phonenumbers were not used, Sweden indicated limited application of these methods. One B.C. mill used additional sales as an indicator of consumer satisfaction, while another B.C. mill provided technical assistance with consumer purchases (the latter being another form of direct producer-consumer interaction).

The timeframe for managerial evaluations and the use of dynamic versus static goals was described in Question eight. B.C. management demonstrated a mean response of 3.000 which indicated the use of "short-term planning with fixed goals". In contrast, Sweden had a mean response of 1.583. Thus the emphasis by Swedish management appears to be on "long-term planning with changing

goals". This difference was shown to be statistically significant using a small-sample t-test.[15] The use of fixed goals is beneficial in that it provides a benchmark, but it does not account for the dynamics evident in the global business environment. These findings support those of the Economic Council of Canada, which found that Canadian management tends to emphasize "speedy" results and hence the use of short time horizons. The Council also links Canadian managerial practices with underinvestment in human-resource development, research, and the adoption of innovative technologies. One possible factor that motivates Canadian management in this context is the high cost of funds in comparison to other international competitors. If a company faces an increase in the cost of borrowing, they will tend to focus on short-term investments. Such an approach has been referred to as the "payback" method. However, this practice is considered sub-optimal to the use of net present value analysis, which examines the revenues and costs of an investment over it's entire productive life. Overall, while B.C. management focuses on the short-term, Swedish management is able to develop long-term strategies for improving productivity performance, reducing costs, improving growth and market share, and increasing research and development.

Recall that the supplier survey indicated that mills and suppliers do not exchange information on a frequent basis in the

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[15] Null Hypothesis: $H_0 : \mu_{BC} = \mu_{Sweden}$
Alternate Hypothesis: $H_a : \mu_{BC} \neq \mu_{Sweden}$
$\alpha = 0.05$; Null is rejected

context of technological innovation. Thus it was concluded that suppliers do not develop "detail-controlled parts" where mills provide recommendations on design and specifications. Question ten on the strategy survey explores the perception of management on the role of suppliers in product development. The greatest contrast between Swedish and B.C. management was found with the option of suppliers developing "initial concepts/ideas" (coded as a "1"). Twice as many B.C. respondents found this typical of domestic suppliers. This implies that the production of "supplier-proprietary parts", where the supplier is an independent research and development agent, is more evident in British Columbia. Swedish management placed greater emphasis on suppliers developing the first prototype (coded as a "4") and less on suppliers developing initial models or more detailed specifications (coded as a "2" and "3" respectively).

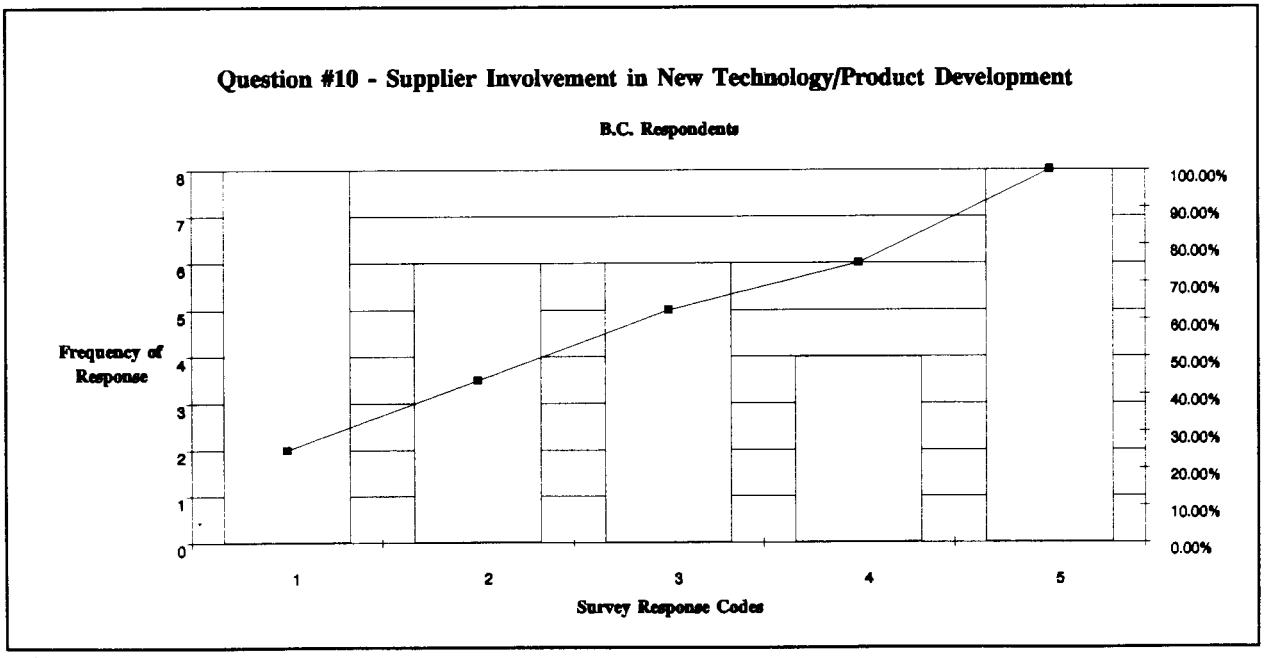

Figure 26

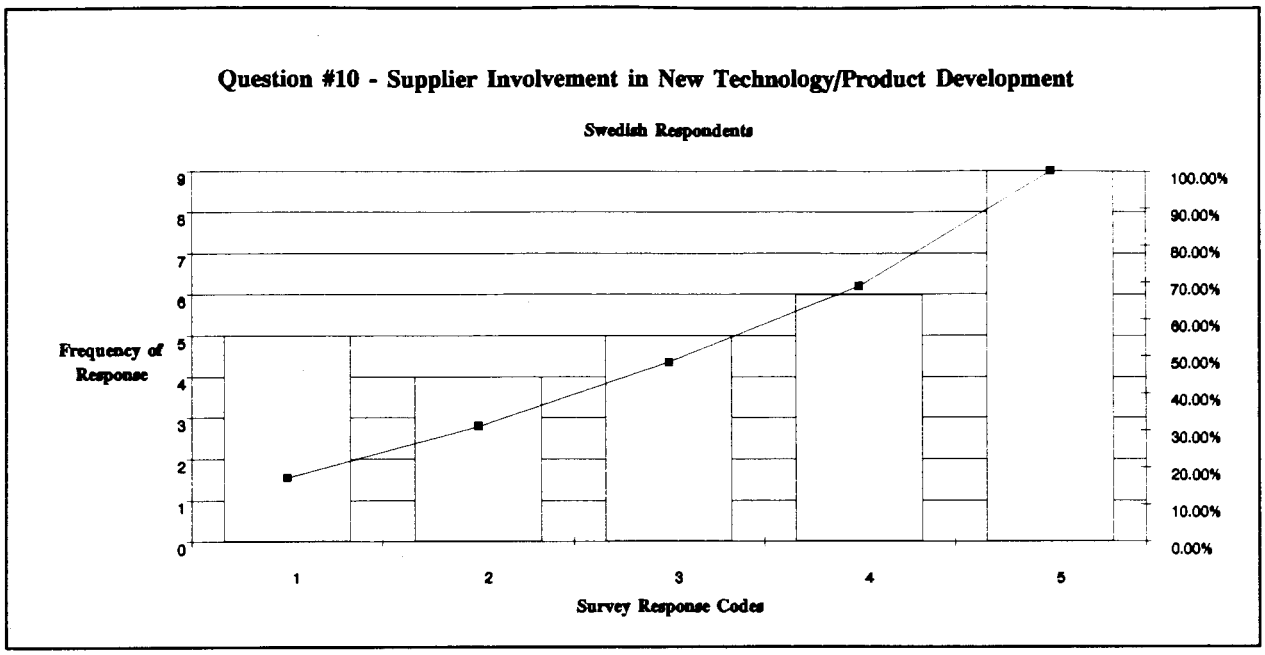

Figure 27

Both Swedish and B.C. mills indicated that the majority of installations (coded response "5") are performed by domestic suppliers.

Finally, Question eleven asked respondents to describe the extent of affiliation between mills and suppliers, and the national background of those suppliers which were used. Recall that the supplier survey indicated that supply firms are independent and that foreign ownership is minimal. Both B.C. and Swedish mills utilize "independent domestic firms" (coded as a "2") the most, with "independent foreign firms" (coded as a "1") falling close behind (the difference is minimal for Sweden). B.C. respondents did indicate, to a greater extent than Sweden, that some suppliers were affiliated (foreign coded as a "3" and domestic as a "4") or an actual "in-house" operation (coded as a "5"). This contrasts

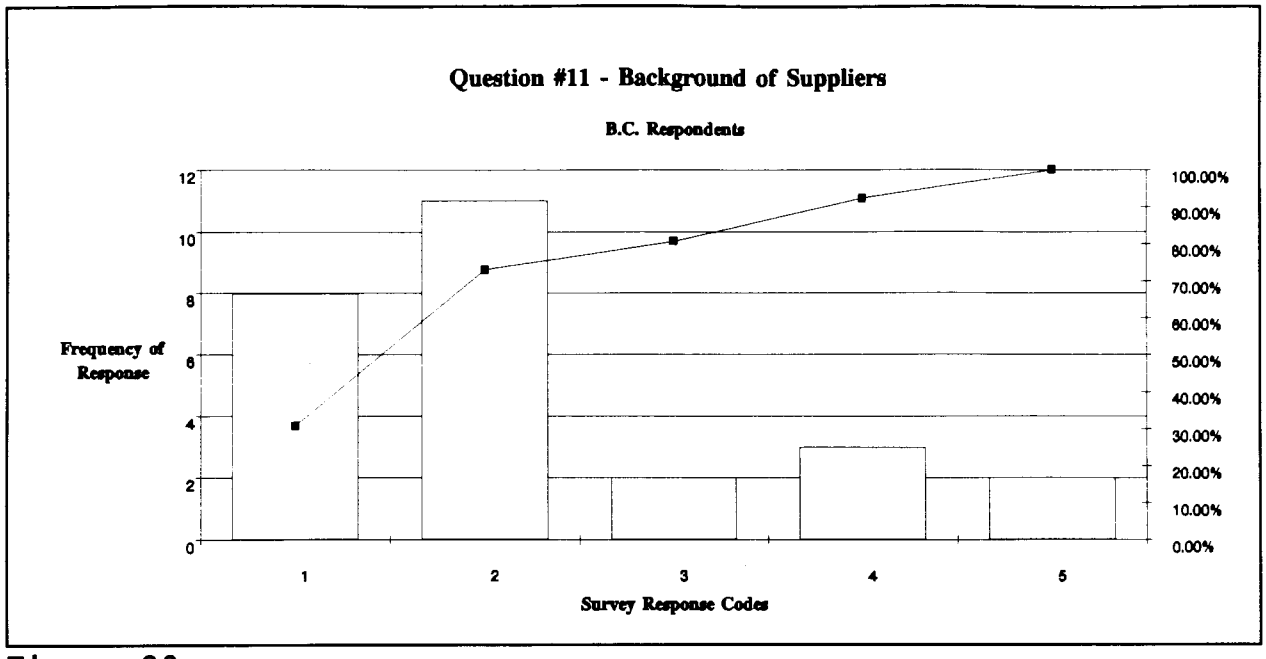

Figure 28

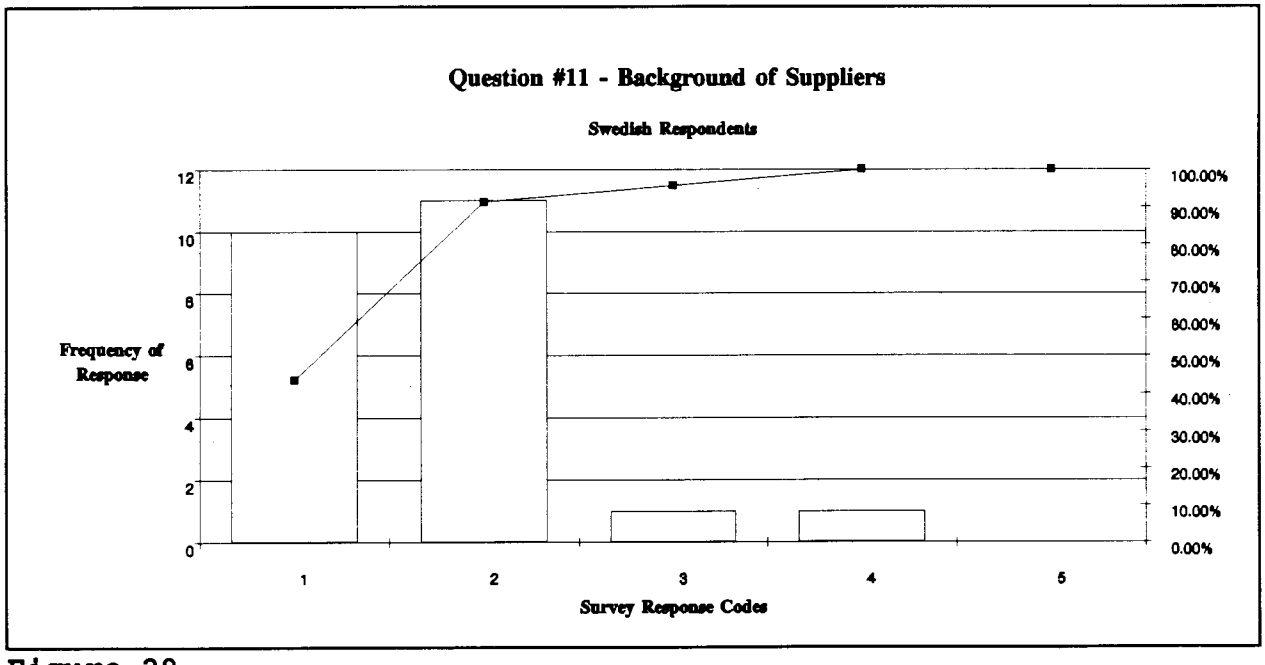

Figure 29

with findings from the supplier survey, where supply firms indicated that they were neither affiliated nor an "in-house" operation in the context of pulp and paper mills. There are two possible factors which could explain this discrepancy, the first being the use of a sample versus a true population. The sources used to form the samples for the supplier survey were published in 1991, and thus may not reflect the true population of supply firms for either region (ie. mills currently face a greater variety of suppliers than that reflected in the related survey). Thus the discrepancy could be described as variance of the sample statistic. The second factor involves the structure of the actual question. No example to help define "affiliated" was provided in the strategy questionnaire. Thus respondents could apply their own definitions. Recall for the supplier survey that this was corrected, with the definition "minimum 20% equity ownership" being used.

5.5 Highlights

The B.C. interior faced a 36% cumulative cost increase for pulp between 1986 & 1990. Similarly, the B.C. coast demonstrated a 49% cumulative cost increase for pulp (1986 - 1990). However, overall delivery costs for newsprint have fallen slightly. Expectations are for wood chip costs to increase as a result of a diminishing supply, and this in turn is a primary factor underlying the erosion in British Columbia's relative cost position. In contrast, Sweden demonstrated a 25.2% cumulative cost increase for

pulp between 1986 and 1990, and a cumulative cost increase of 11.9% for newsprint during the same period.

In the context of labour as a factor influencing cost and international competitiveness, British Columbia has a history of strikes and lockouts. Productivity, measured as output per person-hour, is substantially below that of U.S. counterparts. Sweden appears to have a more participatory environment as reflected in the collective agreements between management and labour; labour has predominantly agreed to some form of performance related bonus.

The average machine size in Canada is approximately 104,000 tonnes. Overall, total pulp capacity in British Columbia is expected to rise to 8.9 million tonnes by 1994 from a level of 8.3 million tonnes in 1991. Paper and paperboard capacity is expected to increase from 3.4 million tonnes (1991) to 3.7 million tonnes (1994). The average machine size in Sweden is approximately 175,000 tonnes. Since 1960, approximately one-half of all pulp mills and nearly one-third of all paper mills have been shut down. During this time period, capacity has been increased by roughly 400%; in 1986 the total capacity for pulp was approximately 10.45 million metric tonnes, whereas total capacity for paper was 8.17 million metric tonnes (1986).

Both the British Columbia and the Swedish forest industry reported a fall in earnings in 1991. Nine out of the top ten public forest companies in B.C. reported a cumulative loss of $363.6 million in 1991. For Sweden, earnings in the forest industry dropped from a high in 1989 of approximately 12,000

million SEK ($2,203.82 million Cdn) to a low in 1991 of roughly 2300 million SEK ($435.74 million Cdn).

In the context of environmental policy, British Columbia faces an AOX discharge limit of 1.5 kg/ADt by December 31, 1995, and elimination of AOX discharges by December 31, 2002. H.A. Simons estimated that capital costs related to the elimination of AOX could range between $114 and $283 million Cdn. In contrast, Sweden faces a 0.5 kg/ADt softwood limit for AOX discharges and a 0.3 kg/ADt hardwood limit; the year 2000 represents the final deadline to meet these regulations. However, the proposed deadline for elimination of all AOX discharges is under question. Currently there are nine mills in Sweden which are capable of producing total-chlorine-free kraft pulp.

6. Government and Relevant Public Policy

6.1 Background

The public sector is an important player in the economic environment, influencing the competitive standing of a country. This influence can take two basic forms: macroeconomic policy and the use of regulations/legislation. Given that global demand conditions were reviewed previously, the procurement of goods and services by the public sector will not be examined. Similarly, other aspects of macroeconomic policy will not be reviewed. This exclusion does not negate the impact monetary and fiscal policy has on the manufacturing and resource industries; "the effects of policies to restore ... competitiveness over the long run can be undermined by misguided macroeconomic policies."[64] Rather, it accounts for the fact that macroeconomic policy is by nature broad in effect. The Economic Council of Canada examined recent trends in global and Canadian fiscal and monetary policies in relation to market forces. For example, in 1972-73 and 1979, the world faced sharp increases in the price for oil. The first increase in oil prices "encouraged a reallocation of resources to energy development, ... <and> fuelled the inflationary surge of the 1970's".[65] Rather than implementing policies aimed at reducing consumption, governments responded with expansionary fiscal policies which increased the rate of inflation over time. While the intention was to protect nations from a drop in real incomes,

the policy "retarded the necessary adjustments in the economy and postponed the conditions for strong, stable, and noninflationary growth."[66] In response to the second oil-price shock and prevalent inflation rates, governments introduced restrictive fiscal and monetary policies. This resulted in higher real interest rates and weak output growth.

Current public regulations and incentives, as they pertain to pulp and paper organizations, will form the basis for this chapter. Dr. Porter stresses that "stringent standards and regulations for product performance and environmental impact can create and upgrade competitive advantage by pressuring firms to improve product and process quality."[67] From this viewpoint, the current environmental standards imposed in British Columbia can be seen as beneficial to the pulp and paper industry. However, public policy should also be designed to incorporate expected global trends. This in itself represents a source of competitive advantage. One such trend which has been mentioned throughout this study is the movement toward open markets and the formation of global trading blocks (ie. EEC). Consequently, the application of trade disincentives, such as tariffs and export taxes, should only be considered as a final resort. Overall, governments must minimize "impediments to the free flow of goods, services, capital and people" and take "steps toward deregulation of key infrastructure industries" in order to promote competitiveness and firm innovation.[68] By pursuing such goals, policymakers can develop measures which "improve <the industries> productivity and enhance its technological performance"

and thus "finance debt repayment not out of future consumption and income levels but out of additional output and income growth and improved competitive position."[69]

6.2 Survey Results on B.C. and Swedish Government Policy

Both the strategy and the supplier questionnaires prompted respondents to rate respective government contributions in the areas of policy, infrastructure, incentives, and promotional activities. An "open" question was also presented such that respondents could indicate which specific regulations, policies, or other governmental aspects they felt were most restrictive. For the ratings, a seven-point scale was used with bipolar adjectives of "positive" (coded as a "1") and "negative" (coded as a "7"). A small-sample t-test was applied to determine the statistical significance between mean response rates.

The first survey which will be examined is the strategy questionnaire, which was mailed to both B.C. and Swedish pulp and paper mills. Question twelve initially prompted "Please rate your governments contribution in the following areas ... Government regulations and policies." The average response for B.C. was 6.091 while Sweden had a mean response of 4.167. This difference was found to be statistically significant.[16] Consequently, British

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[16] Null Hypothesis: H_0: $\mu_{BC} = \mu_{Sweden}$
Alternate Hypothesis: H_a: $\mu_{BC} \neq \mu_{Sweden}$
$\alpha = 0.05$; null is rejected ($t_{calc} > t_{critical}$)

Columbian management has a significantly more negative perception of government involvement through regulations and policies. This was also found to hold true for government contributions in the form of industry infrastructure (ie. roads, railways, water). B.C. had a mean response of 5.000 whereas for Sweden the average response was 3.333; this difference in ratings was found to be statistically significant.[17] However, both B.C. and Swedish management felt that public sector promotional activities (ie. trade shows, industry conferences) were deficient; B.C. had a mean response rate of 5.400, while Sweden had a mean response of 4.917. This difference was found to be statistically insignificant.[18] For B.C. management, some of the policies and regulations which were perceived as most restrictive are: environmental such as pollution standards and cost of permits (coded as a "1"), energy taxes and power costs (coded as a "2"), labour relation laws (coded as a "7"), land usage policies in the form of AAC and stumpage (coded as a "8"), and taxation on firm capital (coded as a "9"). Rail costs (coded as a "5") and lack of incentives for R/D (coded as a "6") were also mentioned.

Similarly, Sweden indicated that environmental policies and energy taxes/power costs were very restrictive. Swedish management

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[17] Null Hypothesis: H_0: $\mu_{BC} = \mu_{Sweden}$
Alternate Hypothesis: H_a: $\mu_{BC} \neq \mu_{Sweden}$
$\alpha = 0.05$; null is rejected ($t_{calc} > t_{critical}$)

[18] Null Hypothesis: H_0: $\mu_{BC} = \mu_{Sweden}$
Alternate Hypothesis: H_a: $\mu_{BC} \neq \mu_{Sweden}$
$\alpha = 0.05$; fail to reject null ($t_{calc} < t_{critical}$)

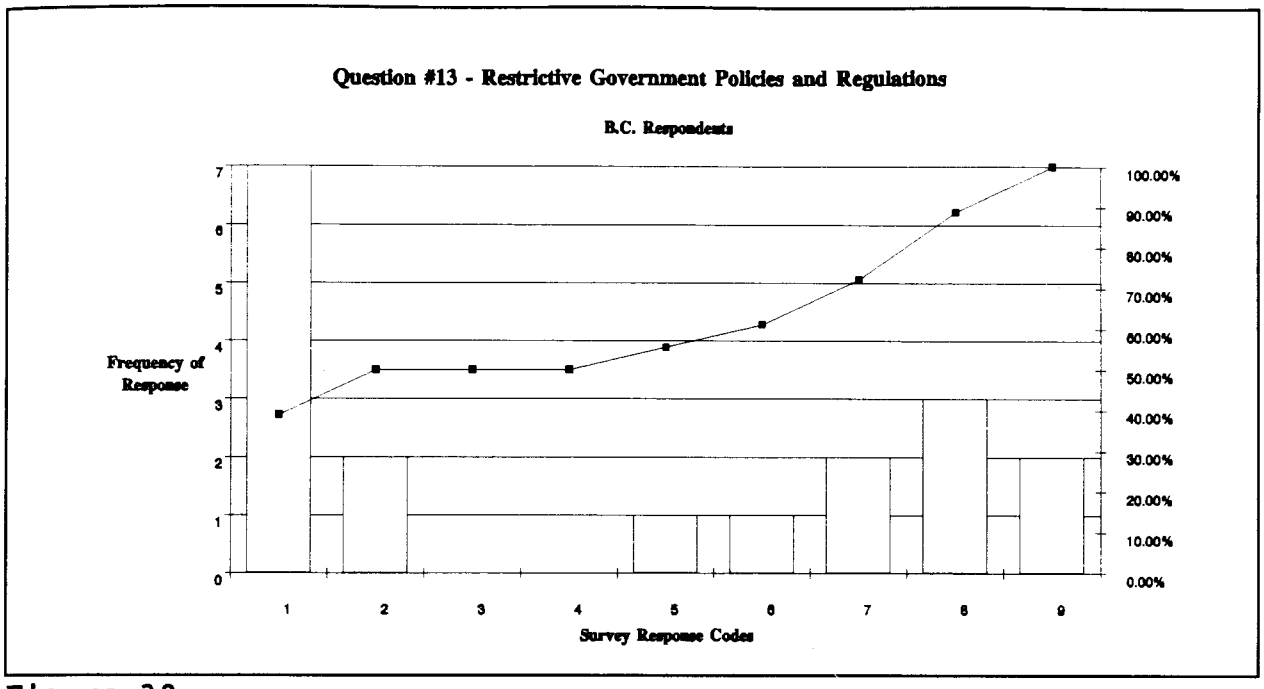

Figure 30

also indicated that the government should focus less on promotion and more on infrastructure (coded as a "3") and that the time lags between the need for policy and the actual implementation were excessive (coded as a "4").

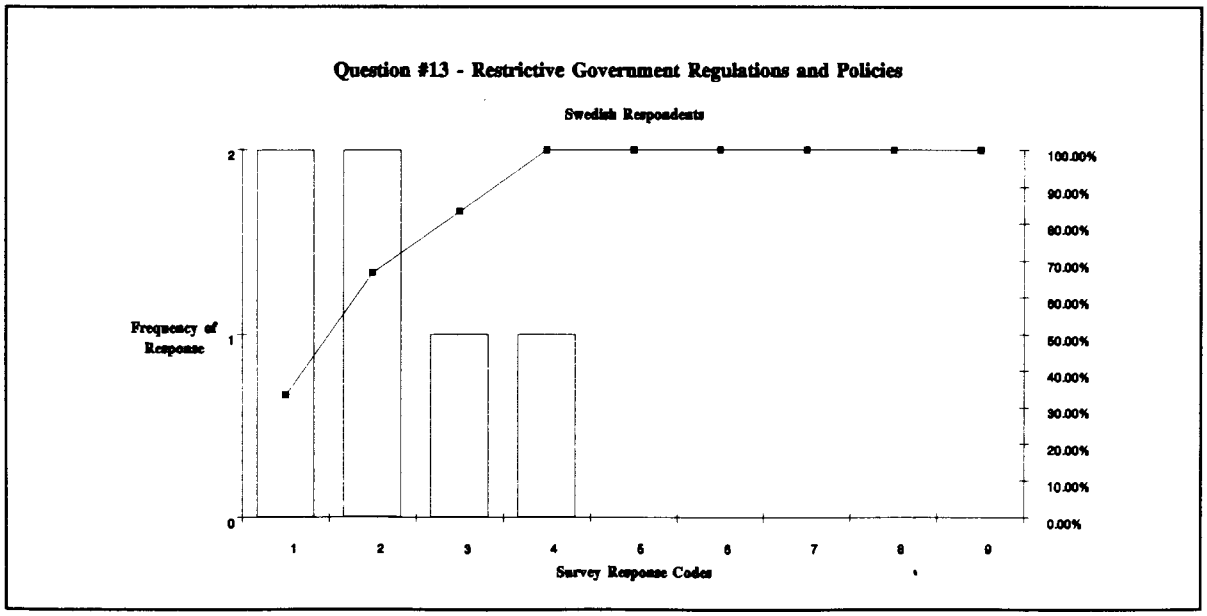

Figure 31

Similar to the strategy questionnaire, the supplier survey prompted B.C. and Swedish supply firms to rate their respective governments contribution in the areas of financial incentives (ie. tax credits, subsidies, depreciation allowances), policy and regulations, and promotional activities. Based on the general findings from the strategy questionnaire, it was assumed that B.C. suppliers, in comparison to Swedish, would perceive public sector activities as being more negative in nature (reflected in the alternate hypothesis). However, both Swedish and B.C. suppliers responded that the public sector is not supportive in the context of financial incentives; B.C. had a mean response of 6.786 and Sweden had an average response rate of 6.500. This difference was found to be statistically insignificant.[19] The same finding held for government contributions in the area of industry promotion; B.C. had a mean response rate of 6.000 while Sweden had an average response of 5.917. Naturally, this difference was found to be statistically insignificant.[20] Thus one can infer that both B.C. and Swedish suppliers believe that the public sector could improve in the context of incentives for investment and in promoting the general industry to consumers (both domestic and foreign).

B.C. suppliers did demonstrate a more negative attitude toward

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[19] Null Hypothesis: H_0: $\mu_{BC} = \mu_{Sweden}$
Alternate Hypothesis: H_a: $\mu_{BC} > \mu_{Sweden}$
$\alpha = 0.05$; fail to reject null ($t_{calc} < t_{critical}$)

[20] Null Hypothesis: H_0: $\mu_{BC} = \mu_{Sweden}$
Alternate Hypothesis: H_a: $\mu_{BC} > \mu_{Sweden}$
$\alpha = 0.05$; fail to reject null ($t_{calc} < t_{critical}$)

governmental regulations and policies; the mean response for B.C. was 6.143 whereas Sweden had an average response of 4.833. This difference was found to be statistically significant.[21] When prompted to indicate which regulations or policies are most restrictive, B.C. suppliers responded with: B.C. labour laws (coded as a "2"), general business taxation policies (coded as a "3"), and the B.C. corporate capital tax (coded as a "4"). Other answers included "general disregard" (coded as a "1"), freight size restrictions (coded as a "5"), and environmental regulations (coded as a "6").

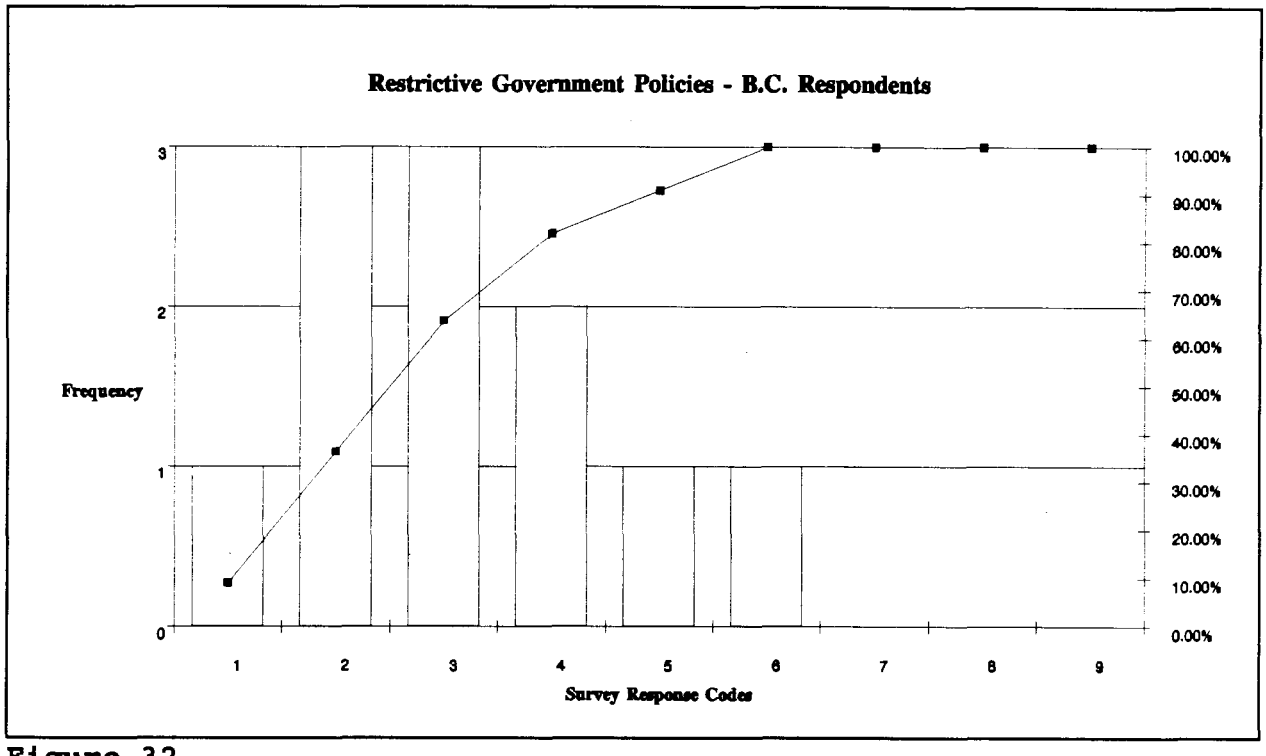

Figure 32

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[21] Null Hypothesis: H_0: $\mu_{BC} = \mu_{Sweden}$
Alternate Hypothesis: H_a: $\mu_{BC} > \mu_{Sweden}$
$\alpha = 0.05$; reject null ($t_{calc} > t_{critical}$)

Swedish suppliers provided three distinct answers in the context of restrictive public policies: trade restrictions with South Africa (coded as a "7"), general export regulations/credits (coded as a "8") and limited financing such as "soft loans" (coded as a "9").

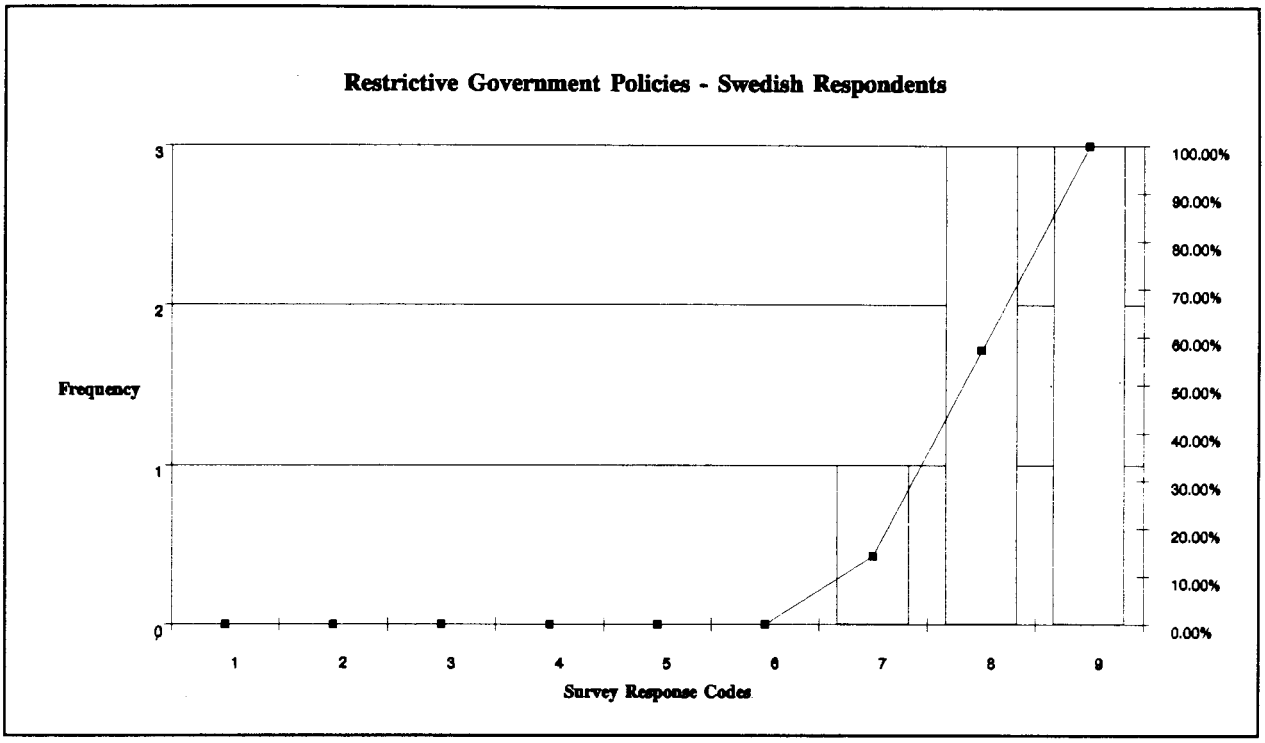

Figure 33

Overall, the contribution of the public sector as perceived by mill management and suppliers tends to be negative. Although Swedish mill managers appear to be less critical of their government, excluding promotional activities, the most "positive" average rating was a 3.333 (on a seven-point scale). Suppliers, both B.C. and Swedish, demonstrate an even greater negative perception of governmental activities. The lowest rating was a 4.833 for Sweden in the context of public policies. The general

finding for supply firms was that both Sweden and B.C. are equivalent in their attitudes, excluding regulations where B.C. demonstrated a more extreme criticism.

6.3 British Columbia Government Policies

As mentioned in the introduction, public policies should promote and facilitate the competitiveness of an industry. But for an industry to be competitive abroad, it must also be exposed to domestic competition. The 1991 "World Competitiveness Report" ranked Canada's government 10th out of 23 countries in this context. One immediate basis for this low rating could be the existence of interprovincial trade barriers. Overall, the Canadian government must examine the existing structure of policies and regulations; "competition policy, incorporation and bankruptcy rules, intellectual property rights, regulatory environment, tax structure, and attitudes toward foreign investment."[70] An example of policies incorporating global trends is the review of the bankruptcy act in June of 1991. The federal government tabled amendments to facilitate the development of entrepreneurship, risk taking behaviour, and overall development of businesses.

For British Columbia, the public sector has announced its continuing effort to diversify the local economy (1992 budget). The need for enhanced research and development has been examined previously in this paper. Towards this end, the government established two venture capital funds (1992); two Vancouver-based

organizations were allocated $10 million each with the requirement that private contributions are sought. Typically such funds would be used to finance emerging companies with the qualifications that the funding organization receives equity participation, a limited investment term of 7-12 years, and active involvement in the firms management. Similarly, approximately $30 million was allocated to the BCTDC (1992) or B.C. Trade Development Corp. for investment in export-oriented companies.

The history of labour-management relations was outlined in the strategy chapter, and the current B.C. Labour code was described as restrictive in this chapter. Employment in pulp and paper tends to be rural, with capital investments in plant and process technology displacing human labour over time. Consequently, labour organizations have developed a negative perception of managerial goals and strategies. Overall, the adversarial labour-management relationship has contributed to a poor international image. Subsequent to a major strike in 1986, where production curtailments and adverse market reactions were prolonged, the federal government and the Canadian Forestry Service initiated a "Forestry Sector Labour Adjustment" study which concluded in 1988. Similarly, in late 1987 the Western Canadian Regional Council of IWA and the Council of Forest Industries of B.C. developed a program to help educate labour leaders and union members on competitive factors underlying the industry. While Industry and Science Technology Canada proposes that such programs have improved labour relations, the strategy questionnaire findings in Chapter five demonstrate a

persistent, negative management-labour relationship. The B.C. labour code, Bill 84, has received extensive criticism from the business sector. Some of the highlights of this bill include:

- anti-scab legislation banning employment of alternate personnel
- certification votes will occur given sign-up rates between 45 - 55%; no fee will be required to join a union
- if one party discontinues a strike/lockout, the other party may continue without serving 72 hours notice
- new procedures handling unfair representation complaints facilitate the rejection of arbitration meetings by unions (based on less costly complaint hearings).

The questionnaire findings also highlighted the B.C. Capital tax as a restrictive and negative policy. Any corporation which has a fixed place of business in B.C. is subject to a levy independent of profit earnings; the 1993/94 exemption limit is $1.25 million (context of paid-up capital and implemented technical changes). Where the tax is applicable, the rate is 0.3% of a taxable base defined as: the sum of capital stock, retained earnings, liabilities (excluding current accounts payable) and deferred credits, less the sum of deferred tax debits, proportion of shares and bonds, research expenditures (eligible) and eligible plant and equipment holdings (acquired after March 31, 1992 and considered "new"). The expected (public sector) revenue for the 1992/1993 fiscal year was $268 million ($288 million is estimated for 1993/94). In 1992, the B.C. government also increased the

general corporate income tax rate to 16% from 15% and the small business rate to 10% from 9%. Subsequently, the 1993 budget increases the corporate income tax rate another 0.5% to 16.5%, effective July 1.

The B.C. government receives substantial revenues from the forest industry. During the recession of the early 1980's, forest firms contributed between $1.1 - 1.5 billion, on an annual basis, to all levels of government (federal, provincial, and municipal). Public revenues peaked in 1989 at almost $3 billion. In late 1987, the B.C. government replaced a softwood lumber export tax (approx. 15%) with increased stumpage costs and other timber fees. Such charges totalled over $650 million in 1989 in comparison to approximately $350 million in 1987. For 1992/93, the B.C. government estimates $690 million was collected from the forest industry, increasing to an expected $913 million in 1993/94. Employee contributions totalled over $1.25 Billion in 1989 and reached approximately $1.3 Billion in 1990.

In 1991, the B.C. Forest Resources Commission completed a report titled "The Future of Our Forests." Approximately 108 recommendations were made in relation to land use, resource management, structure of the public sector, and the existing forest tenure system. As of 1992, none of the recommendations have been integrated into active policies. However, various proposals to alter tenures, stumpage and royalty requirements have been made. For example, announced adjustments to the AAC have ranged from maintaining past levels to reductions of 33% in specific areas.

While a drop in the allowable annual cut will "aggravate" excess processing capacity, one must recall the aforementioned long-run yield and future shortage of wood chips. The B.C. Ministry of Forests is also developing a Forest Practices Code; a legislation package is expected within the next year.

"Policies that convey static, short-term cost advantages but that unconsciously undermine innovation and dynamism represent the most common and most profound error in government industrial policy."[71] Such governmental behaviour may underlie the current problems with specialized research and development among other symptoms discussed in this study. However, as mentioned in the introduction, the environmental policies of the current B.C. government may represent a source of competitive advantage; "when tough regulations anticipate standards that will spread internationally, they give a nation's companies a head start in developing products and services that will be valuable elsewhere."[72] One qualification to this inference, in the context of AOX regulations, is the existence of other standards which are not as stringent, the potential market size for such production, and the presence of countries with no such regulations. The forest renewal program, launched in 1985 at an estimated $300 million cost by provincial and federal governments, may be considered a policy which facilitated industry competitiveness. Approximately 436,000 ha of productive forest, previously classified as NSR, had been re-planted by the time of the termination of the program in 1990.

Liquid effluent falls under the Waste Management Act in

British Columbia (B.C. Reg. 470/90). Recall that on January 17, 1992, the "Pulp Mill and Pulp and Paper Mill Liquid Effluent Control Regulation" was amended by the Ministry of Environment, Lands and Parks. More specifically, mills employing chlorine or chlorine compounds during the bleaching process face new standards concerning the discharge of AOX. Such mills must meet a discharge limit of 1.5 kg per ADt of pulp by December 31, 1995. AOX discharges are to be effectively eliminated by December 31, 2002. Note that the 1.5 kg/ADt limit may have been circumvented if mills submitted a working plan and time schedule, to meet the December 31, 2002 "zero AOX" limit, before June 30, 1992. Schedules are also specified for individual organizations in the context of upgrading/completing secondary effluent treatment and meeting effluent quality requirements. As specified in Section 3 of the Act, sampling of effluent takes place over a 24 hour period, and involves either a continuous sample from each effluent outfall or a composite of samples over 15 minute time intervals. Mills are also required, under section 5, to follow specific sampling frequencies; 5 samples per week must be conducted for TSS, 3 samples/week for BOD, and 1 sample/week for AOX. Penalties for noncompliance with the amended regulation cannot exceed $200,000.

Overall, the degree of effluent toxicity has diminished.[73] In 1959, approximately 600 tonnes/day of TSS (Total Suspended Solids) was discharged as effluent into existing waterways. This decreased to approximately 240 tonnes/day in 1989 (slight increase over 1987 figures). Similarly, the biochemical oxygen demand loss of

effluent (BOD) has decreased from a peak of more than 900 tonnes/day to little more than 400 tonnes/day in 1989. Note that the BOD of effluent has shown increases between 1959-1975 and 1980-1987.

Finally, in 1979 a joint government-industry program was developed to control and collect waterborne debris in British Columbia's lower coastal region. The Debris Control Board collected approximately 140,000 m^3 of debris between 1989 and 1990. Sponsors of this program included: Forestry Canada, Ministry of Forests, Federal Dept. of Fisheries and Oceans, and the Canadian Coast Guard. The following table elaborates on the extent of debris collected between 1982 and 1990.

Table 14: Activities of the Debris Control Board between 1982 - 1990

Source: Council of Forest Industries of B.C.

Year	Disposed Debris*
1982/83	105,600
1983/84	100,500
1984/85	95,300
1985/86	145,000
1986/87	150,500
1987/88	155,500
1988/89	135,000
1989/90	140,100

* Approximations - m^3

6.4 Swedish Government Policies

The Swedish government is built upon an integrated system of social welfare and private enterprise; Sweden has enjoyed essentially full employment, a skilled labour force, extensive compensation for sick and parental leave (90% or more of average income), and a three-month summer slowdown in production. To support such levels of government expenditure, tax rates have reached a high of 84%. Currently, Sweden is in a state of transition; unemployment has increased to 7% (an additional 5% of the workforce participates in government training programs), inflation stands at 4.8% and the GDP growth rate is -1.7%. The on-going integration between Sweden and the EC (based on the June, 1991 application for membership) poses additional problems for Swedish policy makers. Swedish energy and environmental taxes "are at an extremely high level by comparison with every international standard."[74] Consequently, as Swedish economic policy is "steered toward" integration with the EC, maintenance of such high charges may become more unlikely.

For the purposes of this study, the framework of Swedish public policy will be examined in the context of environmental protection and maintenance of natural resources. Both of these issues have been identified as primary concerns in the pulp and paper industry. Similarly, Sweden has been identified as an industry leader; "the Swedish system of legislation and controls means that nobody slips through the net. There are no 'bad' mills

in this country, but unfortunately there are some in many other countries."[75]

Sweden has a history of overexploitation and environmental degradation. In 1810 and 1823, Swedish parliament introduced policies to help remedy overexploitation of forest resources as a result of its common property characteristics. However, the immediate result was an increase in devastation in Southern and Central Sweden. The iron industry was the principal factor underlying this exploitation. In 1860, approximately 600 ironworks were operating in Central Sweden. Overall, Sweden was one of the world's foremost producers of iron, with approximately 40% of the world's iron exports being of Swedish origin. This extensive production of iron consumed tremendous amounts of wood and charcoal, hence the need for comprehensive legislation to help restrict the harvesting of trees.

Sweden enjoys the oldest silvicultural legislation in the world. The "Swedish Silvicultural Act" was implemented in 1903 and since its introduction, "the forest stock has doubled and growth has trebled."[76] The National Board of Forestry is responsible for overall supervision to ensure compliance with the regulations. The County Forest Boards provide a more decentralized method of observation, and advise forest owners on silviculture techniques. Note that the County Forest Boards also provide grants for road-building, drainage and planting. If excessive cutting is observed, the County Forest Boards can order the submission of a regeneration guarantee, and if this is not provided, an order prohibiting any

further forest cutting can be issued. Special monetary charges can also be levied by the government.

Every forest holder must submit a forestry plan which recognizes that cutting can only take the form of cleaning/thinning stands or clear cutting. The latter harvesting method is only granted in cases where the forest is of such age that average annual growth is minimal. In addition, the government regulates the maximum proportion of a stand which can be clear cut, and the portion of harvesting which can be conducted during a specific period. Currently, the National Forest Survey is conducted as a means of monitoring the extent of standing stock, and as a basis for determining the annual increment and cut. Although the increment changes from year to year, the national average is 4.2 m^3/ha. Note that the forest holder is also required to follow criteria concerning the establishing of new stands, the exclusion of specific tree-groupings, and the construction of roads. As an example, most cleaning work (ie. underbrush) is manual and selective in nature as the use of herbicides is prohibited in hardwood stands.

The Swedish government can set aside forest land as protected given: difficulty in regeneration, need to prevent lowering of timber line, and demonstrated soil erosion. As a means of preventing the depletion of nutrients and shelter for the forest stock, regulations limiting the removal of tree tops and branches have been recently introduced. Approximately 10% of Sweden's total land area is protected. Forest reserves account for another 3% of

total productive forest land. In 1990 there were: 135 nature reserves (1.9 million ha), 20 national parks (577 thousand ha), and 746 crown reserves (1.4 million ha). Overall, 4 million ha of forest land is protected as some form of reserve, with any voluntary private reserves being additional.

"Mills which employ the best technology now have such low emission levels that very little more can be demanded of them for environmental reasons. And other mills are well on the way towards similar emission levels."[77] The Swedish government and forest industry has demonstrated a strong commitment toward the reduction of harmful emissions. However, there still exists a need to address such issues as the emissions of nutrient salts and additive chemicals. This is reflected in Table #15 on the following page. While the Swedish government can continue "stepping up" environmental requirements, it must also recognize that "if the requirements in Sweden are appreciably stiffer than in the competing countries, [Sweden is] likely to lose [its] competitiveness very quickly."[78]

Finally, the implementation of Swedish policy in the area of waste paper has been extensive. Compulsory paper collection was introduced as an act of parliament in 1975. Subsequently, the consumption of recycled newspaper by paper mills has increased six-fold. Waste paper can be utilized in two basic forms, as a raw fibre in the production of paper and as a fuel for the production of energy. For the former, the Swedish government is

Table 15: Swedish Environmental Issues

Source: Skogsindustrierna - April/92

	Problem	Current Situation
(a)	Fibre Emissions (fibre banks)	- solved
(b)	BOD Emissions (oxygen shortage in water)	- solved
(c)	Sulphur Dioxide Emissions	- almost solved
(d)	Foul Smells	- not solved; improved
(e)	Oil Consumption	- minimized
(f)	COD Emissions (oxygen consuming substance)	- much accomplished
(g)	Chlorine Emissions (AOX)	- perhaps solved
(h)	Chlorate Emissions	- solved
(i)	Dioxon Formation	- solved

reviewing/preparing legislation which specifies proportions of waste paper to be included in different paper grades. Waste paper also represents a valuable fuel source. However, the dumping and incineration of all unsorted waste is to be eliminated by 1994; the 1991 "Public Cleansing Act" empowers local authorities to require more sorting of various waste materials at the source. This reflects the fact that many paper products contain inks, glues and plastics which may not be suitable for burning.

7. Conclusion

7.1 Implications for British Columbia

International competitiveness is an issue which has moved to the forefront as trade barriers diminish and nations move away from distinct, domestic markets. The general objective for this research paper was to provide a more holistic view of the pulp and paper industry in the context of global competition. More specifically, the extent to which British Columbia is adapting to the dynamics of international trade was questioned and reviewed. Change in the economy of B.C. is inevitable. However, the response of the pulp and paper industry to such pressures is not so certain. Dr. Michael Porter contends that a nation should focus primarily on productivity, and consequently should facilitate the upgrading of industries, labour skills and education, research and development, and the sophistication of domestic demand.

Canada and British Columbia have relied to a great extent on natural resource industries. British Columbia is fortunate in that it enjoys an abundance of natural forest; approximately two-thirds of the province is covered with forest, with six of the eleven major forest regions of Canada being found in British Columbia. Between 1986 - 1990, British Columbia contributed to approximately 50% of the Canadian harvest of hardwood and softwood stocks. However, with past reforestation techniques, harvesting methods and an Allowable Annual Cut exceeding long-run sustainable yields, the

B.C. pulp and paper industry faces a potential wood fibre deficit of approximately 5 million m^3 per year, ceteris paribus.

Coupled with a change in natural resource conditions has been a weakening in the performance of newsprint, paper and allied product sectors. Paper production has declined since 1990 and the ARIMA analysis of paper and allied products shows a continuing fall in shipments since 1989. The increased likelihood of waste paper requirements in exports to the U.S. and current regulations concerning AOX discharges may exacerbate the performance of paper products and negatively impact the production of pulp.

Consequently, the B.C. pulp and paper industry must begin to analyze its comparative advantages and disadvantages, addressing the latter through innovative strategies and policies. British Columbia enjoys a substantial competitive advantage in the context of fibre supply. However, as predicted by H.A. Simons, this advantage could disappear over the next decade if the industry remains static in its approach toward natural resource management.

Based on cost efficiencies, the industry will most likely continue to rely on clearcut harvesting methods. But as demonstrated by Sweden, such practices can be applied in a manner which recognizes the need for enhanced forest stewardship. More specifically, the use of smaller clearcuts; "shelterwood systems" where a series of cuts provides cover for new growth; the retention of old-growth stands to facilitate regeneration; and an increase in the use of selective harvesting methods can help the B.C. industry maintain its factor advantage. This is supported by the Carmanah

Valley Forest Management Advisory Committee which recommended that patch clearcutting be implemented in place of the traditional, progressive clearcutting technique.

Similarly, the B.C. industry should review Swedish practice and legislation in the context of maximizing the silvicultural potential of the land. Only recently has the level of net reforestation surpassed the level of net harvest. This may draw from the fact that provincial law did not require firms to reforest harvested areas until 1987. Coupled with this has been a demonstrated use of short time horizons by B.C. management. With an average 80-120 year time lag between the time a forest is replanted and the time it is ready to harvest, an increase in reforestation must be maintained to enhance the productivity of forest land.

Suppliers are an important factor underlying the competitiveness of an industry. Pulp and paper suppliers appear to be less innovative, in the context of developing new technologies, in British Columbia. Based on survey findings, B.C. suppliers tend to focus more on "importing" and adapting existing technologies. This in itself may be a factor inhibiting competitive ability given that B.C. mills may be unable to match competing mills in terms of new technology (as produced by domestic suppliers). The crosstab analysis highlighted that B.C. mills consider new technology to be an important criteria for competitive advantage.

A strategic implication may be found in the degree of interaction between suppliers and pulp & paper firms. Currently

there appears to be a constrained flow of information between these two parties. Dr. Michael Porter contends that technological innovation is only maintained through demanding, sophisticated consumers. Clark (1989) estimated that the Japanese advantage in engineering can be attributed, in part, to the level of interaction between suppliers and producers. Hence mills and suppliers should develop or expand existing channels of communication. This would facilitate understanding of market supply and demand trends, creating a synergy effect in the context of R/D.

H.A. Simons predicted that pulp and paper mills in B.C. will see an erosion in their cost competitiveness. Overall, the B.C. interior is expected to become a "medium-cost" competitor in the softwood kraft pulp market, whereas the B.C. coast will most likely become a "high-cost" producer before the year 2000. This prediction is reinforced by current industry trends, with a 1992 first-quarter return on assets of -2.0% and a 1991 cumulative industry loss of $363.6 million.

On the cost side, B.C. management has demonstrated a trend toward displacing labour with capital. However, the acceptance of supplier bids with fixed cost targets does not appear to have been addressed. While a study of U.S. suppliers found that competitive bidding forced supply firms to lower prices, wage and other cost increases were passed back to the buyer. Consequently, B.C. pulp and paper mills should consider adopting a practice similar to the Japanese method of "target pricing", where buyers set a target price and then negotiate periodic reductions in factor input costs.

The latter process draws on the fact that suppliers should be able to reduce their costs based on experience and technological improvements. Survey findings which suggest that mills and suppliers tend to have long-term relationships support the feasibility of implementing new supplier-management practices in British Columbia.

The relationship between labour and management in B.C. has been shown to be negative in nature. Pulp and paper organizations should consider the use of education and incentives to help forge a stronger bond. For the former, organizations can review and modify previous governmental programs aimed at educating labour and labour leaders on the competitive factors facing pulp and paper mills. An industry-adopted program, with management and labour interacting on an informal basis, may help overcome the negative attitudes that both sides seemed to have developed. More specifically, such a program would help counter the tendency for both labour and management to focus upon short-term issues; typically, management views labour as "a short-run variable cost" while labour leaders perceive "that management is unwilling to consult openly with them on issues affecting long-term corporate strategy."[79]

In the context of incentives, one can draw from Sweden's use of combined fixed wages and performance-related bonuses. A predominant proportion of the Swedish labour force has opted for such combinations. However, B.C. unions appear reluctant to adopt or sanction changes that are developed to improve productivity and

profitability. For example, unions tend to negate the need for wages that reflect changes in productivity; over the past ten years, major wage settlements in Canada have followed the trend in the Consumer Price Index.[80] Thus the B.C. pulp and paper industry is constrained in it's ability to be innovative and profitable by the nature of it's management - labour relations.

B.C. firms should also adopt more focused marketing strategies. There has been an increase in the substitution of both lower-cost paper and fibre (i.e., eucalyptus and southern pine) from the U.S. South, Brazil and Chile. Consequently, B.C. management must rationalize product offerings and concentrate on differentiated products. For example, Sweden has focused on developing paper which is both thinner and of higher quality. This allows Swedish mills to differentiate themselves from lower-cost producers of kraft pulp and standard newsprint.

There has been a demonstrated need to improve technology development within British Columbia. While improving communication channels between mills and suppliers is an important strategy, mills should also become more active in research being conducted at universities and educational institutions. Such participation could take two forms. Firms can become more involved by offering both sessional employment opportunities and financial incentives for students entering forest technology programs. Firms can also examine funding and/or contracting out of basic research and development to universities or colleges with related in-house facilities. There are tangible benefits to the firm; recall that

Canada does not compare favourably with Japan and other countries in terms of overall numbers of research and engineering scientists. Consequently, by developing dynamic strategies and incentives, the firm can improve the factors influencing its competitiveness.

The pulp and paper industry in British Columbia has relied to a great extent on the United States as an export market. This may have contributed, in part, towards management decisions which emphasize short-term gains and are focused on the North American market. However, with the inclusion of Mexico into the North American free trade bloc, and the move toward more open global trade, British Columbian management must adopt more long-term, global oriented strategies. There are a myriad of strategic implications, one being the need to examine and satisfy the needs of foreign buyers (e.g., EEC represents the second largest export market for B.C. pulp and paper industry). Dr. Porter maintains that firms will benefit the most by targeting the most sophisticated and demanding buyers in foreign countries. The advantage of such a strategy may be seen in Sweden, where the capability to produce TCF pulp far exceeds that of Canadian firms. One can infer that strict German policy on environmental requirements for pulp and paper imports, and the heavy reliance on Germany as a market for Swedish production, has had a beneficial impact on Sweden's long-term competitive ability.

Government policy is another factor that influences the competitive ability of an industry or nation. While it is important for the government to encourage industrial adjustment and

upgrading, it is also important to consider the scope and form of such interventions. It can be argued that the historic application of tariffs and other trade disincentives to protect Canada's domestic economy ultimately undermined it's ability to compete on a global scale. Similarly, political involvement spurred by interest groups and constituencies has been linked in part to the current overcapacity in the pulp and paper industry. A third consideration is the need to minimize direct subsidization of an industry. The application of subsidies creates an environment where there is less pressure to innovate and which facilitates the development of a dependent relationship.

Consequently, the public sector should concentrate on the use of targeted incentives (ie. tax & depreciation allowances) and "matched-funding" grants to encourage private sector investment in training, research & development and specialized infrastructures (eg. TCF production facilities). While Canada does offer a capital gains tax regime which encourages investment in firms, there is no distinction between long-term and short-term capital gains. By taxing short-term gains at a higher marginal rate, it is possible to foster an environment which facilitates long-run decision making by both investors and firms. There also exists a federal and provincial system of tax incentives for research & development. However, poor coordination among federal and provincial authorities may inhibit the effectiveness of such incentives by increasing the level of complexity involved.[81]

The use of clearcut harvesting techniques has implications

beyond the natural resource conditions of British Columbia. Old-growth forests in B.C. have become a high profile, international issue. This draws upon a change in public views, with recreational and environmental values conflicting with beliefs that a forest is simply a timber resource. The Ministry of Forests has attempted to incorporate the recreational aspects of forests through its "Visual Quality Objectives". More specifically, the "Forest Practices Code" initiative outlines that harvest plans must ensure the maintenance of forest characteristics which are an integral component for specific recreational experiences. The degree to which such initiatives address timber and non-timber demands for forest resources is an ongoing debate.

A related issue which must be dealt with by the public sector is the integration of public involvement with policy planning. The channels through which "stakeholders" (e.g., environmental groups, first nations) can influence policy decisions at the "operational" stages must be clearly defined. These operational strategies involve the management and planning of forest protection, recreational management, harvesting and silviculture.

Finally, the public sector must move toward improving interprovincial relationships. Industry, Science and Technology Canada highlighted the impact that interprovincial trade barriers have on trade, investment and the mobility of labour. The burden on the pulp and paper industry can be seen in the area of innovation and technology. Barriers within the Canadian economy have encouraged fragmented markets, resulted in firms which are

unable to achieve economies of scale and created a duplication of services. By allowing suppliers to forge stronger links (e.g., strategic alliances), expand and to specialize on a national basis, B.C. and Canada can improve its competitive position.

7.2 Future Research Considerations

The theoretical structure for this analysis was based upon Dr. Michael Porter's "diamond of national advantage", a paradigm which incorporates: natural factor conditions, demand conditions, supporting industries, firm strategy, and government. This system of factors is interdependent, and a deficiency in any one determinant will diminish the synergistic contributions of the system.

By examining issues which are either addressed or downplayed by Dr. Porter's paradigm, one can discover avenues for future research. One of the major strengths of Dr. Porters theory is the stress placed on linkages within the diamond structure. Cohen and Zysman (1987) argued that services can be "tightly linked" to manufacturing, and that competitive problems in one sector will likely undermine the competitive ability of the other. Government policy linkages reflect the need, as put forth by Laura D'Andrea (1987), for a "national competitiveness policy" which promotes enhanced research and development, improved quality and flexibility of the work force, increased industrial investment, and increased resource mobility (from declining sectors to firms and sectors with

a high potential for growth). Dr. Porter's paradigm also reflects the fact that competitiveness is not an issue solely based on exchange rate fluctuations and trade balances; "they do not tell the whole story and taken in isolation they can be misleading."[82]

However, Dr. Porter's theory is very introspective in its nature and application. More specifically, while linkages are stressed within a national diamond, linkages between national diamonds do not receive the same emphasis. Thus it could be argued that Dr. Porter's paradigm minimizes the importance and extent of economic interdependence among nations. David Hume argued in the 18th Century that such linkages are important, and not necessarily to be feared; the latter comment is salient given the prevalence of fears that third-world countries will "leap-frog" ahead of industrialized countries (i.e. through cheap labour and resource availability). More specifically, David Hume stated that even if another nation ("poorer nation") was successfully competing in specific sectors, the "richer" nation could adjust its allocation of resources (assuming proper conditions existed) and target sectors where an advantage could be maintained. Such a strategy was demonstrated by Sweden, where the paper industry targeted innovative applications for paper to avoid competition with more cost-effective producers in Brazil & Chile. Peter Jones and David Teece (1987) stated in their paper, "The Research Agenda on Competitiveness", that "it is increasingly apparent that spillovers & interdependencies in the international economic system are now enormous".[83] Consequently, while Dr. Porter's theoretical structure

does recognize the existence of such linkages, it may not be the optimal choice for an analysis of the dynamics in trade and relations between nations.

An alternative may be found in an adaptation of the "Geobusiness model". This model examines a number of factors in both a country-specific and inter-nation context. Specifically, there are three basic variables: conditioning, motivation and control. *Conditioning variables* focus on the conditions within which an industry must operate; product-specific factors include technological and production capabilities. Country-specific issues include domestic market demands, natural resources and the political environment. Inter-nation factors include financial, trade and communication systems. *Motivation variables* account for the factors which drive firms to take advantage of a change in business patterns. Specifically, they examine the firm's ability to evaluate opportunities and threats, and translate them into effective strategies. This includes a review of competitive position vis a vis other producers, and strategic advantages and disadvantages. Finally, *Control variables* examine the laws and regulations of governments. This can be country-specific in the form of domestic policies and incentives, or inter-nation in the form of international agreements and treaties. Overall, by adapting this theoretical structure, one could account for the global aspects which impact the pulp and paper industry.

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Appendix #1: Traditional Kraft Pulping Process

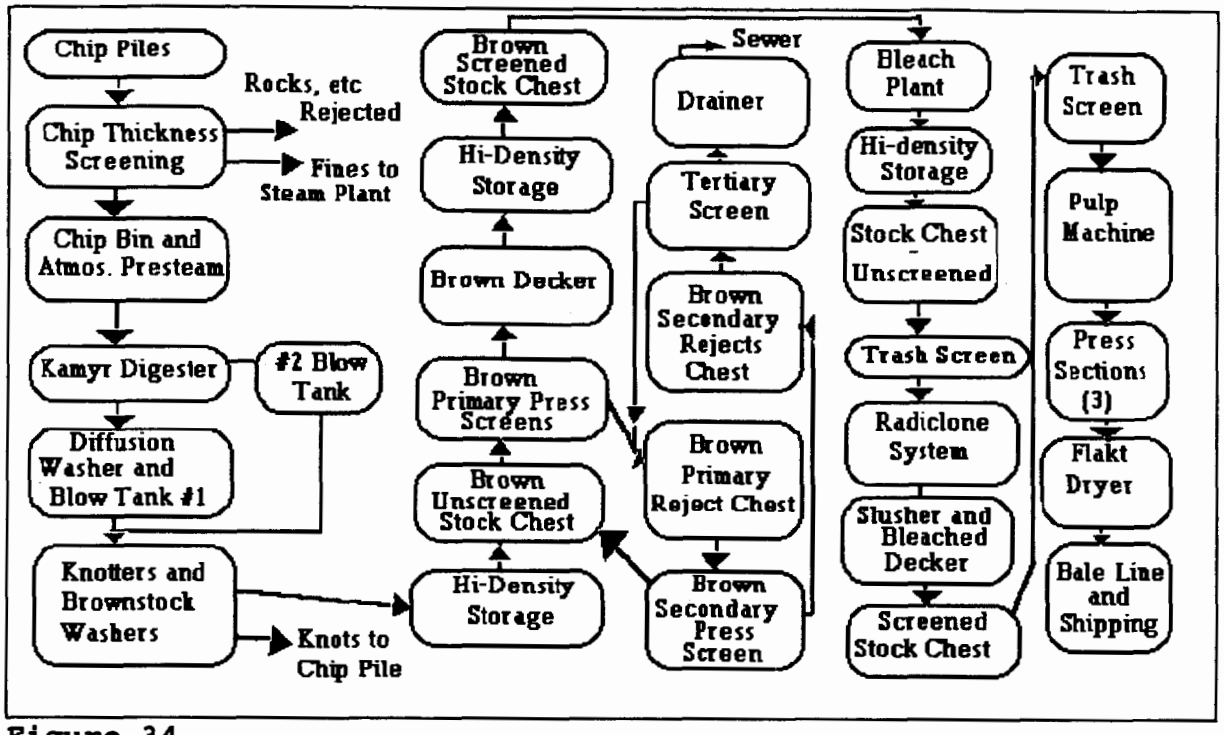


Figure 34

The following is a brief overview of a traditional, Kraft pulping process. This overview is based on the Intercon mill in Prince George, British Columbia. Overall, cellulose fibres are separated from the wood chips by a continuous cooking process with chemicals, elevated temperatures, and high pressure:

(a) wood chips are screened to attain uniformity and freedom from sawdust, other fine particles and wood knots.

(b) chips are then "cooked" in a solution called white liquor which consists of sodium hydroxide and sodium sulphide (temperature is elevated through the application of direct steam). In terms of the flowchart, this process is conducted in a "Kamyr Digester". Most of the non-essential factors dissolve in this cooking solution,

freeing the desired cellulose fibres.

(c) the chip mass is removed from the "digester" and fed into a high pressure "diffusion washer" which causes the chips to explode, separating the individual fibres. This diffusion washer also removes spent chemicals and impurities from the pulp mass.

(d) the pulp then undergoes "brown screening" where screens remove large fibre bundles and rejects are sent for reprocessing.

(e) at this point, the "brown decker" thickens the mass and prepares it for bleaching.

(f) the bleach process removes coloured impurities, or converts them to a colourless compound, through a "C Eo D E D" process:

(i) bleaching with chlorine

(ii) extraction of chlorinated lignin - the glue which binds fibres - with sodium hydroxide and oxygen

(iii) bleaching with chlorine dioxide

(iv) extraction of remaining chlorinated lignin with sodium hydroxide

(v) final bleaching with chlorine dioxide.

Note that in the first bleaching stage (chlorine), chlorine dioxide can be used as a substitute ranging from 50% - 100% of the required bleaching input.

(g) bleached pulp is then fed to a trash screen to remove any coarse material and then to a "radiclone system" where

dirt and impurities are removed by centrifugal force.

(h) accepts from stage (g) are washed, and fed into a final pulp process which removes water by:

(i) drainage ("Pulp Machine")

(ii) mechanical force ("Press Sections")

(iii) heat ("Flakt Dryer").

The cooled sheet is then cut and formed into bales. These bales can then be wrapped together and transported to customers. Note that in this specific context, the majority of pulp shipments are transported by BCR and CNR to Vancouver where freighters then deliver the pulp to overseas markets.

To help provide a general reference for the review of environmental aspects, the recovery of waste chemicals will be included in this kraft pulp overview. On completion of the pulping process, residual chemicals and dissolved substances form a solution referred to as "black liquor". This solution is removed from the digester by the washers. Turpentine, methanol and sulfur gases are other common by-products. The former can be recovered while the latter are normally incinerated for odour control. The black liquor must be concentrated prior to firing in a recovery boiler, hence the use of evaporators which remove water until the liquor is approximately 65-70% dry solids. From here it is burned in the recovery boiler (any remaining water is evaporated by the hot gases in the boiler) to remove organic matter, generate steam to help power the mill and to recapture sodium sulphide & sulfur. The latter melt and are retrieved as "smelt", a mixture of molten salts which is dissolved in water to produce a solution called

"green liquor". This is then reacted ("clarified and causticized") with lime to produce "white liquor", the chemical used in the digester. A by-product of this step is lime mud, which is washed

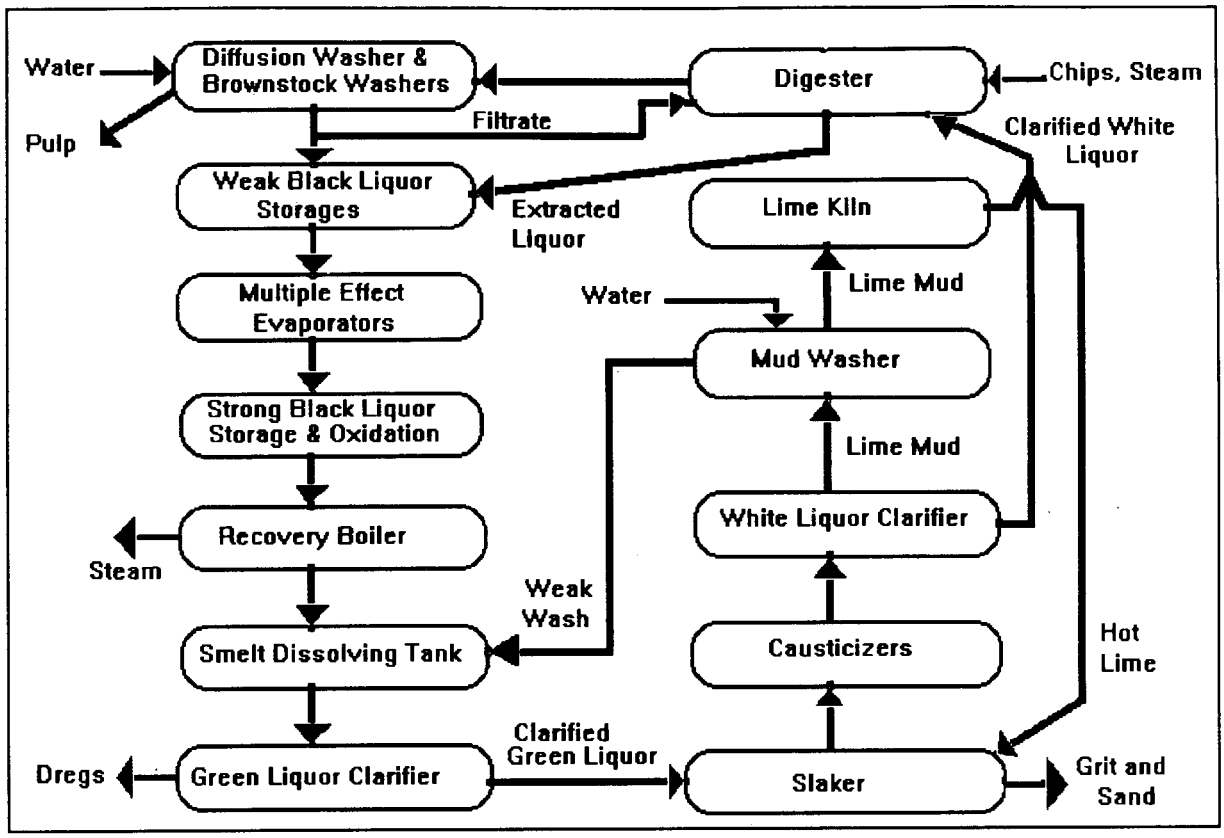


Figure 35

and regenerated into lime in the "lime kiln". There are three other general processes which are frequently carried out in the recovery of waste chemicals: soap skimming, oxidation and waste gas incineration. Soap skimming is the removal of fatty and resin acids from the black liquor. These acids are then processed into "tall oil", which has a commercial value. Oxidation prevents odorous emissions from emerging while the black liquor is being concentrated in the evaporators. Finally, odorous sulfur gases are collected and incinerated as a waste.

Appendix #2: ARIMA Paper Shipments Analysis

Prior to the ex-poste forecasts, the model had to be identified based upon the characteristics of the original data set. For this section of the analysis, the following notation is used:

ARIMA (p, d, q) (P, D, Q)

where:

p = order of nonseasonal AR (Auto Regressive) process

d = order of nonseasonal differencing

q = order of nonseasonal MA (Moving Average) process

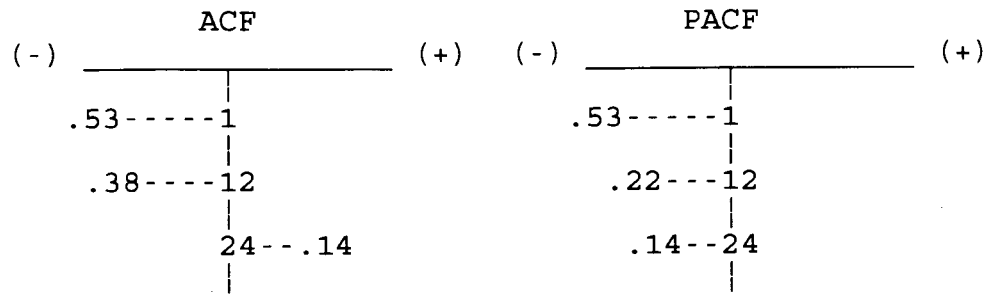
P = order of seasonal AR process

D = order of seasonal difference operator

Q = order of seasonal MA process

The original series demonstrated a strong upward trend from observations #1-46 (approximately) and then a downward trend from observations #47-73. A first check for stationarity subjectively showed a strong likelihood of a nonstationary series, which was supported by the estimated autocorrelation function (ACF) which demonstrates a slow decay to zero. First differences (nonseasonal) were taken, and although the differenced series showed no trend, the estimated ACF had significant spikes (in relation to zero) at lags: 1, 3, 4, 12, 13, & 24. I assumed that a strong seasonal pattern may explain the large autocorrelations surrounding and at fractional multiples of the seasonal lag (s = 12). Consequently, this indicated the need for seasonal differencing. A plot of the seasonally differenced series indicated a strong downward trend. The estimated ACF showed slow decay to zero, hence first order differencing was necessary to obtain a stationary series. At this point, the ACF suggested an $MA(1)_{12}$ process, supported by the PACF

which showed slow decay, versus a cutoff, to zero on the negative side at lags 1, 12 & 24.



Thus the first process used was an ARIMA $(0,1,0)(0,1,1)_{12}$ which can be stated as:

$$(1-B)(1-B^{12})\ \text{paper} = C + (1 - \Delta_1 B^{12})\ a_t$$

However, the residual ACF had significant spikes at lags 1 and 3, with the autocorrelation at lag 1 being the largest (-0.49 versus 0.46). This implied an MA(1) nonseasonal process should be added given the assumption that the residual autocorrelations at lags 1 and 3 could be correlated. The second process, ARIMA $(0,1,1)(0,1,1)_{12}$, can be stated as:

$$(1-B)(1-B^{12})\ \text{paper} = C + (1 - \Delta_1 B^{12})(1 - \theta_1 B)\ a_t$$

The coefficients showed no correlation (an indication of stability in the model), but the residual autocorrelation function (ACF) demonstrated one significant spike at lag 3. An AR(3) nonseasonal process was then added to the model; ARIMA $(1,1,1)(0,1,1)_{12}$. The model can be expanded as:

$$(1 - \Phi_1 B^3)\ \text{paper}\ (1-B)(1-B^{12}) = C + (1 - \Delta_1 B^{12})(1 - \theta_1 B)\ a_t$$

None of the coefficients demonstrated any strong correlations, a general indication of a stable process. The constant was insignificant (absolute t-value less than 1.25), but each of the

coefficients were significant. Both the residual ACF and PACF showed no significant values, implying that the model left only (did not account for) random disturbances or "white noise". In terms of the AR coefficient, stationarity conditions are met (which implies a constant mean and variance of the process):

$$| \Phi_1 | < 1$$

For the MA coefficients, the invertibility conditions are satisfied (ensuring that heavier weighting is placed on more recent observations):

$$| \theta_1 | < 1 \qquad | \Delta_1 | < 1$$

As highlighted prior, this final process was used to perform 12 ex-poste forecasts. Note that ARIMA forecasts are said to be "optimal" where optimality refers to the average of squared forecast errors.

Appendix #3: Supplier Mail Questionnaire

Mr. William R.K. Reid

Suite A - 119 Superior Street, Victoria, B.C., Canada, V8V 1T2

Please Note: If the person to whom this letter was addressed is the "wrong" person, would you please give the letter and questionnaire to the individual who is best able to respond to the questions, and ask him or her to complete the survey.

In todays evolving marketplace, competitiveness is becoming more and more an international consideration. Coupled with growing awareness of environmental concerns, natural resource-based industries must consider new technologies, strategies, and markets to survive.

Your organization has been selected, on a non-random basis, to describe it's operational aspects as a supplier for pulp and paper mills. You may be assured of complete confidentiality. The questionnaire has an identification number for mailing purposes only. Your name, and that of the firms, will never be placed on the questionnaire.

The results of this research will be made available to academics, officials in government, and all interested citizens. You may receive a copy of the results by writing "copy of results requested" on the back of the return envelope, and printing your name and address below it. Please do not put this information on the questionnaire itself.

I would be happy to answer any questions you might have. Please write or call. The telephone number is (604) 380-0139.

Thank you very much for your assistance and consideration! It is sincerely appreciated.

William Reid

Supplier Relations Questionnaire

The following questionnaire pertains to a graduate thesis being conducted by William R.K. Reid. The intent of the study is to better understand supply firm management and relationships with pulp and paper mills. The questionnaire will take only 5 to 10 minutes to fill out at your convenience. Please let me assure you once more that your name and that of the firms will in no way be connected with this survey.

---

1. Please indicate the home country (or nationality) for your organization.

Canada	[ ]
Europe	[ ]
United States	[ ]
Japan	[ ]
Australia	[ ]
Other (specify)	_____

2. Is your firm a subsidiary or "in-house" division with respect to a pulp and paper organization (mill)?

Yes	[ ]
No	[ ]

If you answered "No" to the above question, is your firm affiliated with a pulp and paper organization (ie. a pulp and paper company holds a minimum 20% equity ownership)?

Yes	[ ]
No	[ ]

3. Which of the following would best describe the pricing practices of your company? Check the box which best matches your description.

Competitive Bidding with flexible cost targets	[ ]
Competitive Bidding with fixed cost targets	[ ]
Initial contract price with future renegotiations	[ ]
Other (specify)	_____

4. How long would a typical contract to supply a buyer with machinery or parts be? Check the box which best matches your description.

Less than 1 year	[ ]
1 - 2 years	[ ]
3 - 4 years	[ ]
5 years or more	[ ]

5. Please indicate, by checking one of the boxes below, the degree to which your firm and buyers exchange information during various phases of product development. If buyers (mills) actively participate in product (machinery) development, check a box closer to the left end of the line; if buyers (mills) are not active participants, check a box closer to the right end of the line.

Frequently [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] Infrequently

6. Of the following criteria, which best distinguishes your company from potential competitors? Rate each on a five-point scale as to their importance to your firm in the context of competitive advantage (circle the relevant number).

5 = "very important" ..... 1 = "not important"

Initial Price offered to buyers (mills):	5	4	3	2	1
Cost-reduction capability:	5	4	3	2	1
Quality (context of industry standards):	5	4	3	2	1
Delivery capability:	5	4	3	2	1
Design/Engineering capability:	5	4	3	2	1
Technological capability:	5	4	3	2	1
Past business relations with buyers:	5	4	3	2	1

7. With respect to reducing costs or improving efficiency, would (or did) your firm consider any of the following options? Check those boxes which seem appropriate.

Production process changes	[ ]
Changes in quality control	[ ]
Cost reduction	[ ]
Design changes	[ ]
Material changes	[ ]
Equipment changes	[ ]
Inventory control changes	[ ]
Other (specify)	_____

8. Please rate your governments contribution in the following areas. If you feel that government has been supportive, check a box closer to the left end of the line. If you feel that government has not been supportive, check a box closer to the right end of the line.

Government Financial Incentives
(eg. tax credits, subsidies, depreciation allowances)

Positive [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] Negative

Government Regulations and Policies

Positive [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] Negative

Government Promotional Activities
(eg. trade shows, conferences)

Positive [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] Negative

9. If you felt that government was not supportive, please indicate below (or attach a sheet) what regulations, policies, or other aspects are the most restrictive.

_____

_____

_____

_____

Thank you very much for your time and patience.

Open-Ended Question Codebook

Question #1:
6 - Germany
7 - Sweden

Note: Question #1 should have used more specific options than simply "Europe".

Question #3: 4 - Fixed Price Lists

Question #4: 5 - Not Applicable

Note: I specified machinery/parts and neglected to include chemical or service suppliers.

Question #7: 9 - Missing information (no answers provided)

Question #9:
1 - General disregard of Western (BC) suppliers (vs. East)
2 - B.C. Labour law (specifically related to small business)
3 - General business taxation policies and procedures
4 - B.C. corporate capital tax
5 - Freight size restrictions
6 - Environmental regulations on mill effluent discharge
7 - Restrictions on trade with South Africa
8 - General export regulations and credits
9 - Limited financing possibilities (eg. "soft loans")

Appendix #4: Environmental Technologies

The following are some of the technologies that are being examined in the context of reducing or eliminating AOX compounds:

(1) Modified Cooking - recall that traditional cooking processes dissolve lignin (an organic compound that functions as a glue) to isolate the cellulose fibres, and that any remaining lignin has to undergo a bleaching process. Modified cooking removes approximately 38% more residual lignin and hence reduces the extent of bleaching required. Note that processes such as modified continuous cooking (MCC) and modified batch cooking (MBC) reduce to even a greater extent the residual lignin which must be processed in the bleach plant.

(2) Oxygen Delignification - a technology adopted by Sweden and Japan in the later 1970's, oxygen delignification removes approximately 40 - 50% of residual lignin (after the cooking process). More recent adaptations have increased the ability to remove residual lignin without losing pulp strength (specifically the two-stage system).

(3) High Chlorine Dioxide Substitution - recall that chlorine (with chlorine dioxide) is effectively used to remove residual lignin during the bleaching process. However, chlorine produces more AOX compounds whereas chlorine dioxide utilizes a different chemical reaction and hence reduces the production of chlorinated organic compounds. More

specifically, chlorine dioxide has approximately 2.6 times the oxidizing power of chlorine, which according to H.A. Simons leads to a reduced chemical input and only 28% of the AOX level as produced by chlorine. Note that there are disadvantages, foremost being the inability of this technology to satisfy a "zero AOX" regulation. There is also an overall increase in cost for bleaching chemicals and a loss in finished pulp brightness.

(4) Hydrogen Peroxide - by adding this chemical to the sodium hydroxide and oxygen delignification stage, an improvement in residual lignin removal and a consequent reduction in the use of "active" chlorine (chlorine and chlorine dioxide) is seen. A related benefit is that by reducing the degree of "active" chlorine needed, a mill can substitute more chlorine dioxide relative to chlorine. Once again, this process only reduces the generation of AOX compounds.

(5) Biological Bleaching - special enzymes (Xylanase) can be used to facilitate the removal of lignin and hence reduce the need for bleaching chemicals.

(6) Ozone - a bleaching agent for cellulosic material which, when coupled with modified cooking and oxygen delignification, can be used to remove residual lignin without detrimental effects on the "strength" of the pulp fibre. However, the pulp

must still bleached for colour, possibly with hydrogen peroxide.

Appendix #5: Strategy Mail Questionnaire

Mr. William R.K. Reid

Suite A - 119 Superior Street, Victoria BC, Canada, V8V 1T2

Please Note: If the person to whom this letter was addressed is the "wrong" person, would you please give the letter and questionnaire to the individual who is best able to respond to the questions, and ask him or her to complete the survey?

In todays evolving marketplace, competitiveness is becoming more and more an international consideration. Coupled with growing awareness of environmental concerns, pulp and paper mills must consider new technology, strategies, and markets to survive.

Your firm (mill) has been selected, on a non-random basis, to outline it's strategies based on such issues. You may be assured of complete confidentiality. The questionnaire has an identification number for mailing purposes only. This is so I may check your name off the mailing list when your questionnaire is returned. Your name will never be placed on the questionnaire.

The results of this research will be made available to academics, officials in government, and all interested citizens. You may receive a copy of the results by writing "copy of results requested" on the back of the return envelope, and printing your name and address below it. Please do not put this information on your questionnaire itself.

I would be happy to answer any questions you might have. Please write or call (the telephone number is 604 380-0139).

Thank you for your assistance and consideration.

William Reid

Strategy Questionnaire:
Pulp and Paper Mills

The following questionnaire pertains to a graduate thesis being conducted by William R.K. Reid. The intent of the study it to better understand the competitive strategies and attitudes of organizations that supply pulp and paper. The questionnaire will take only 10 to 15 minutes to fill out at your convenience. Your name and that of the firms will in no way be connected with the questionnaire.

---

1. Please indicate the home country (or nationality) for your organization.

Canada	[ ]
United States	[ ]
Japan	[ ]
Europe	[ ]
Australia	[ ]
Other (specify)	_____

2. How would you describe your mills advantage over competitors? Check those boxes which best match your description.

Lower Cost	[ ]
Higher Product Quality	[ ]
Customized Products	[ ]
Advanced Technology	[ ]
Other (specify)	_____

3. With respect to reducing costs or improving efficiency, would (or did) your firm consider any of the following options? Check those boxes which seem appropriate.

Cross Training of Labour	[ ]
Upgrade Workers Skills	[ ]
Adopt New Technology	[ ]
Upgrade Existing Machines	[ ]
Other (specify)	_____

4. Has your firm, in the past or recently, provided any incentive or investment towards employee training?

Yes	[ ]
No	[ ]
No Opinion	[ ]

5. In terms of your experience, how would you rate the worker-management relationship? Check a box closer to the left end of the line if you feel labour and management cooperate, or check a box closer to the right end of the line if you feel that management and labour do not cooperate.

Partnership [ ] [ ] [ ] [ ] [ ] [ ] [ ] Adversaries

6. Please indicate, by checking one of the boxes below, how important customer satisfaction is to your firm. If you believe customer satisfaction is important, check a box closer to the left end of the line; if you feel customer satisfaction is not important, check a box to the right end of the line.

Crucial [ ] [ ] [ ] [ ] [ ] [ ] [ ] Irrelevant

7. If you felt it was necessary, how would you monitor customer satisfaction? Check the box(es) which best represents your choice.

Company Phonenumber	[ ]
Postal Reply Form	[ ]
Company Follow-up	[ ]
Other (specify) _____	

8. How would you describe your firms competitive advantage? Check the box which best matches your description.

Long-term planning with fixed goals	[ ]
Long-term planning with changing goals	[ ]
Short-term planning with fixed goals	[ ]
Short-term planning with changing goals	[ ]

9. How do you select the firms which supply your mill with machinery and materials? Check those boxes which match your criteria.

Initial Price Offered	[ ]
Quality (Standards)	[ ]
Delivery Capability	[ ]
Design/Engineering Capability	[ ]
Manufacturing Capability	[ ]
Past Business Relations	[ ]
Other (specify) _____	

10. If appropriate, how much involvement does a supplier have in new technology or product development? Check those boxes which best match your understanding.

Help develop initial concepts/ideas	[ ]
Develop initial models or formulas	[ ]
Develop detailed drawings/plans	[ ]
Develop the first prototype	[ ]
Install or supply the new technology	[ ]

11. How would you describe the background of suppliers (majority) used by your organization? Check those boxes which best match your understanding.

Independent, Foreign Firms	[ ]
Independent, Domestic Firms	[ ]
Affiliated, Foreign Firms	[ ]
Affiliated, Domestic Firms	[ ]
In-house Operations	[ ]

12. Please rate your governments contribution in the following areas. If you feel that government has been supportive, check a box closer to the left end of the line. If you feel that government has not been supportive, check a box closer to the right end of the line.

Government regulations and policies.

Positive [ ] [ ] [ ] [ ] [ ] [ ] [ ] Negative

#12 Continued: Rate your governments contributions in the following areas.

Government Infrastructure.
(eg. roads, railways, water)

Positive [ ] [ ] [ ] [ ] [ ] [ ] [ ] Negative

Government promotional activities.
(eg. trade shows, industry conferences)

Positive [ ] [ ] [ ] [ ] [ ] [ ] [ ] Negative

13. If you felt that government was not supportive, please indicate below (or attach a sheet) what regulations, policies, or other aspects are the most restrictive.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Thank you for your cooperation and time.

Open-Ended Question Codebook

Question #1:

6 - Finland
7 - China

Note: B.C. Respondent #6 has a 50/50 joint venture with Finland

Question #2:

5 - Flexibility; ability to run short orders
6 - Knowledge of domestic/local market conditions/participants
7 - Service

Question #3:

5 - Lower level of stock; faster rotation of goods
6 - Trade flexibility

Question #7:

4 - "local knowledge" of key players at customers organizations
5 - Personal visits to customer sites
6 - Additional sales to original customer
7 - Technical assistance with products

Question #9:

7 - Flexible; fulfil organizations needs
8 - Assistance; service with problems

Question #13:

1 - Environmental (pollution standards, high cost of permits)
2 - Energy taxes; power costs (rising or "very high")
3 - Focus on industry infrastructure, not promotion of industry
4 - Government bureaucracy; unnecessary policy lags
5 - Rail costs (relative to competitors)
6 - Lack of R/D support or incentives for new technology
7 - B.C. Labour relation laws
8 - Land usage policies (stumpage, allowable annual cut)
9 - Taxation on capital (B.C.)

Note for #8: stumpage system viewed as inflexible; annual allowable cut is viewed as arbitrary and too dynamic

Note for #9: refer to Price Waterhouse publication on B.C.'s new capital tax