

HD
3626
.C2C3
no. 4

Plant Efficiency and Competition Policy in Canada:

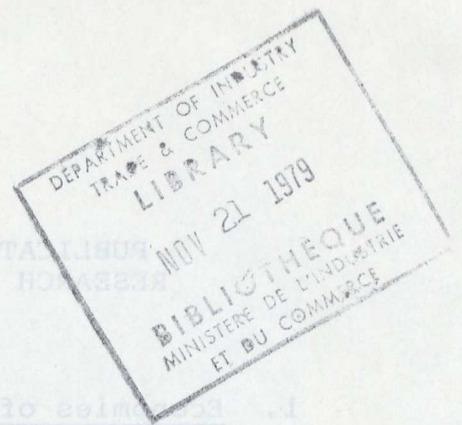
a study of the pulp and paper
and wire rope industries

Isaiah A. Litvak and
Christopher J. Maule



Consumer and
Corporate Affairs
Canada

Consommation
et Corporations
Canada



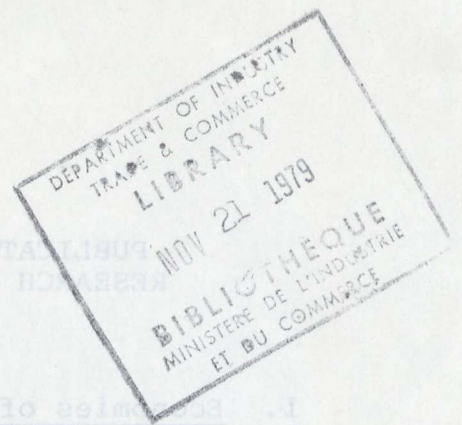
Plant Efficiency and Competition Policy
in Canada: A Study of the
Pulp and Paper and Wire Rope Industries

Isaiah A. Litvak
York University

and

Christopher J. Maule
Carleton University

Research Monograph Number 4
Research Branch
Bureau of Competition Policy



Plant Efficiency and Competition Policy
in Canada: A Study of the
Pulp and Paper and Wire Rope Industries

Isaiah A. Litvak
York University

and

Christopher J. Maule
Carleton University

Research Monograph Number 4
Research Branch
Bureau of Competition Policy

PUBLICATIONS IN THE MONOGRAPH SERIES OF THE
RESEARCH BRANCH, BUREAU OF COMPETITION POLICY

1. Economies of Scale and Efficient Plant Size in Canadian Manufacturing Industries by P.K. Gorecki (1976)
2. Shipping Conferences in Canada by I.A. Bryan and Y. Kotowitz (1978)
3. Electronic Funds Transfer Systems in Canada: Emerging Issues and Recommendations by J.W. Lambie (1979)
4. Plant Efficiency and Competition Policy in Canada: A Study of the Pulp and Paper and Wire Rope Industries by I.A. Litvak and C.J. Maule (1979)

FORTHCOMING IN 1979

5. Professional Licensing, Earnings and Rates of Return Differentials and Competition Policy by T.R. Muzondo and B. Pazderka

ACKNOWLEDGEMENTS

The authors wish to acknowledge the kind cooperation and assistance given to them by the many company executives, government and association officials both in Canada and the United States who were interviewed in connection with the study. Mr. Adam Zimmerman was particularly helpful in providing an overview of the general issue areas related to plant efficiency in North America. Expertise in the area of production management was provided by Dr. John R.M. Gordon. This input was a vital ingredient in the analysis of the manufacturing systems. Throughout the study we benefited from discussions held with officials of the Bureau of Competition Policy, Consumer and Corporate Affairs Canada. In particular, we would like to thank Dr. D. McKinley and Mr. Shyam Khemani for their helpful comments and support throughout the study. Ms. Norma Rankin, as ever, provided invaluable assistance in expediting the completion of the study.

FOREWORD

In addition to studies conducted within the Research Branch, the Bureau of Competition Policy contracts research externally to researchers with special interest in Canadian industrial organization and antitrust policy. This enables the Bureau to draw on the experience of recognized experts and to take into account their views on the content and implementation of competition policy. In addition, the related interaction that typically occurs between outside researchers and Bureau staff has a number of salutary effects: it creates a basis for better understanding and appreciation of the 'real world' problems confronting competition policy; it allows for support and funding of research which otherwise might not be undertaken; and it gives rise to research likely to be more directly relevant to policy formulation.

This study by Professor I.A. Litvak of York University and Professor C.J. Maule of Carleton University is a particularly good example of the achievement of the above-mentioned objectives. The authors, in their previous consulting assignments, have had wide exposure to problems confronting Canadian industry. They are familiar with the complex environment in which Canada's industrial and competition policies must be framed. And they have extensive research and teaching experience in the field of industrial organization. As a result, their highly readable analysis makes a contribution to existing knowledge that is likely to be of interest to both businessmen and professional economists in the public and private sectors of the Canadian economy.

In keeping with the Bureau's policy of extending researchers the widest possible latitude in presenting their conclusions, it may be noted that the views presented are those of the authors and are not necessarily held by the Bureau of Competition Policy.



D.F. McKinley,
Director, Research Branch.
August 6, 1979

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION AND SUMMARY	
INTRODUCTION	1
SUMMARY	4
Factors Affecting Plant Efficiency and Costs	4
Competition Policy Implications	8
CHAPTER I - SURVEY OF LITERATURE	
COMPETITION POLICY AND EFFICIENCY	13
REVIEW OF PRODUCTIVITY STUDIES IN CANADA	15
Product Specific Economies	24
Economics of Multiplant Operations	31
THE LEARNING CURVE	33
THE MANUFACTURING SYSTEM	41
Continuous Flow and Intermittent Systems	41
Equipment and Process Technology	42
Productivity and the Focused Factory	45
CHAPTER II - THE PULP AND PAPER INDUSTRY	
INDUSTRY OVERVIEW	49
INDUSTRY DEFINITION	51
PRODUCTION PROCESS	54
Technology	60
INDUSTRY PROFILE	62
Global Position and Growth	62
Concentration and Product Differentiation	65
Costs - Production	67
Costs - Investment	74
Productivity, Profitability and Prices	79
Entry Barriers and Tariffs	84
Corporate Landscape	87
CASE EXAMPLES	94
Northwood Pulp and Timber Ltd.	96
Brunswick Pulp and Paper Company	98
Canadian International Paper Company	101
British Columbia Forest Products	105
CHAPTER III - WIRE ROPE INDUSTRY	
INDUSTRY OVERVIEW	107
PRODUCTION PROCESS	108

	<u>Page</u>
Wire Rod	108
Wire Rope	110
The Manufacturing System	113
INDUSTRY PROFILE	119
The Producers	119
Ownership and Competition	122
The U.S. Wire Rope Manufacturers	127
Imports, Pricing and Industry Growth	128
Market Segmentation and Product Differentiation ...	137
Regional Industry Characteristics	141
CASE EXAMPLES	143
Wire Rope Industries of Canada Ltd.	143
Bridon-American Corporation	148
Greening Donald	153
Summary	155
CHAPTER IV - FACTORS AFFECTING EFFICIENCY AND COSTS	
PRODUCTION PROCESS	161
LEARNING PROCESS	165
OTHER FACTORS	167
MINIMUM EFFICIENT SIZE	169
CANADA AND UNITED STATES COST FACTORS	174
CHAPTER V - COMPETITION POLICY IMPLICATIONS	
PULP AND PAPER	177
WIRE ROPE	180
INFRASTRUCTURE FACILITIES AND THE FOCUSED FACTORY ...	183
BIBLIOGRAPHY	191
CASES AND ENQUIRIES UNDER THE COMBINES	
INVESTIGATION ACT	207

TABLES

	<u>Page</u>
1. Canada: Top 50 Per Cent Plant Sizes as a Percentage of the Minimum Optimal Scales	21
2. Learning Curve Improvement	35
3. Pulp and Paper Industry in Canada, 1974	50
4. Rank of Pulp and Paper Industry out of 87 Canadian Manufacturing Industries	50
5. World Position of Canada's Pulp and Paper Industry	64
6. Pulp and Paper Industry Growth in Canada, 1950-1975	64
7. Share of Production of Leading Five Firms, Canadian Pulp and Paper Industry	68
8. Average Cost of Pulpwood used by Pulp and Paper Mills in Canada, 1961-1974	68
9. Comparative Regional Wood Costs, 1976	70
10. Distribution of Costs and Profits for Softwood Bleached Kraft Pulp, 1976	71
11. Distribution of Costs and Profits for Newsprint, 1976	71
12. Comparison of Profitability and Costs of Softwood Bleached Kraft Pulp in Eastern Canada and the U.S. South, 1976	72
13. Comparison of Profitability and Costs of Newsprint in Eastern Canada and the U.S. South, 1976	72
14. After-Tax Profits as a Percentage of Capital Employed and Shareholders' Equity: Pulp and Paper Industry, Canada, 1965-75	81
15. After-Tax Profits as a Percentage of Shareholders' Equity: Forest Products Industry, Canada and the United States, 1970-75	82

	<u>Page</u>
16. Profitability of Major Canadian Pulp and Paper Companies, 1965-74	82
17. Canadian, U.S. and EEC Tariffs on Selected Pulp and Paper Products	86
18. Distribution of Firms and Capacity by Number of Plants per Firm, 1975	89
19. Distribution of Firms by Number of Plants and Number of Pulp and Paper Products Produced, 1975 .	89
20. Distribution of Firms and Capacity by Major Product Categories, 1975	90
21. Distribution of Plants and Capacity by Major Product Categories, 1975	90
22. Distribution of Plants and Capacity of Plants Producing Newsprint, by Size, 1975	92
23. Distribution of Plants and Capacity of Plants Producing Pulp Only, by Size, 1975	92
24. Distribution of Basic Manufacturing Costs for Northwood Pulp, B.C. and Brunswick Pulp, Georgia, 1976	100
25. Canadian Wire Rope Market, 1965-76	109
26. Wire and Wire Products Manufacturers, 1974	109
27. U.S. Wire Rope Market	130
28. Wire Rope Imports into Canada	130
29. Canadian Wire Rope Markets: Effect of General Preferential Tariff	132
30. Import Prices Example	132
31. Exports of Wire Rope and Strand by Canadian Manufacturers	136
32. Comparison of Manufacturing Plants, 1976	147
33. Wire Rope Industries Ltd. 1976	147
34. Wire and Cable Plant Cost Comparisons	159

EXHIBITS

	<u>Page</u>
1. Learning Curve Example	36
2. Learning Curve Example	36
3. The Influence of an EPT on an Operating System ...	43
4. Production Flow of Canadian Pulp and Paper Industry, 1975	52
5. Forest Products Industry - Production Stages	55
6. Chemical Pulp-Paper Making Process Flow Chart	58
7. Average Machine Capacity of Newsprint, Wood- Containing Printing and Writing Paper, and Kraftliner in 1960-76	77
8. The Structure of Newsprint Capacity	78
9. Different Types of Steel Wire Rope	112
10. The Manufacturing Process	114

INTRODUCTION AND SUMMARY

INTRODUCTION

This study is concerned with the implications for competition policy of the cost and productivity performance of a select number of Canadian plants in the pulp and paper industry and the wire rope industry, with comparisons made to selected plants in the United States.

A major purpose of the study is to determine what aspects of competition policy significantly influence the cost and productivity performance of Canadian industries. Instead of taking the highly aggregative, macro approach to productivity analysis, this study deals with productivity at the product and plant floor levels. In so doing, it draws on literature in the fields of industrial engineering and production management, and provides a view of how the corporation is structured. This literature has been noted in other studies of competition policy but has generally not been incorporated in the analysis of public policy.

The study involves case examples, and the findings will be used to suggest what areas of competition policy need to be modified. This approach, analysing specific industry, firm and plant situations, is particularly appropriate because many aspects of competition policy are already administered on a case-by-case basis. The case approach will be reinforced with the passage of the Second Stage Amendments to the Combines Investigation Act and the establishment of a Competition Board.

The pulp and paper industry and wire rope industry were selected for study because they offer contrasts and problems of particular relevance for competition policy in Canada. The pulp and paper industry is a substantial sector in the Canadian economy. There are both Canadian and foreign-owned firms -- primarily with U.S. and U.K. ownership. There is a government record of mergers in the industry and a history of combines issues. Proposals have been made for industry rationalization, and a number of federal and provincial studies of the industry are available.

The pulp and paper industry raises questions for competition policy in areas of mergers and diversification (horizontal, vertical and conglomerate); specialization and export agreements; interaction with provincial government policies; tariffs, in the case of fine papers; and informal cooperative arrangements between firms. In addition, international aspects of industry structure in terms of both ownership and markets affect the application of competition

policy. At present the industry is experiencing fundamental problems which will also condition the application of competition policy.

The wire rope industry is, by contrast, small in terms of both sales volume and number of producing firms. These firms tend to be foreign-owned with mostly U.K. and German ownership. The industry is a consumer of steel and the supplier to a wide range of important industries in Canada, such as construction, engineering, mining, logging and fishing. The production process is more intermittent than continuous-process oriented, and a wide range of products are produced in each plant, giving rise to the noted problem of short production runs and changeover costs. The industry has adjusted to a dispersed geographical market by locating warehouses across the country. Imports of wire rope are an important competitive element.

The pulp and paper industry is based upon a renewable resource and is integrated forward into manufacturing. The wire rope industry uses non-renewable resources and is a non-integrated (in Canada) manufacturing industry facing large firms as both suppliers and customers. While the four producing firms in the Canadian wire rope industry are small, the two principal manufacturers are subsidiaries of large vertically integrated multinational enterprises.

These two industries display a wide variety of organizational characteristics which are common to other industries, such as vertical integration, product diversification, tariff protection, domestic and foreign ownership, different combinations of domestic and foreign sales, batch versus continuous-flow production processes, different transportation and distribution attributes, and variations in plant and firm sizes within an industry. While it is not suggested that the pulp and paper and the wire rope industries are typical of all manufacturing industries in Canada, they do provide illustrations of the kinds of industrial organization issues which arise for analysing competition policy, and how the issues might be approached in the context of particular industries.

It is interesting to note that while government policies such as competition policy, taxation and tariffs are often discussed as general framework policies for industry, they are in fact frequently administered on an individual basis. For example, competition policy involves court cases and hearings before the Restrictive Trade Practices Commission involving individual firms; Revenue Canada has to deal with individual taxpayers as well as

administer the general collection of taxes; and the Tariff Board and Anti-Dumping Tribunal examine the circumstances of individual firms and industries. Consequently, the issues examined in these case studies do provide an input into the administration of framework policies, such as competition policy.

Chapter I presents a survey of the literature, including an examination of the relevant material in production management as well as in economics. Chapters II and III provide an examination of the pulp and paper and wire rope industries respectively, including their economic characteristics, the production processes and technology employed, and case studies of individual plants. An assessment of the efficiency and competitiveness of the two industries is contained in Chapter IV, and the implications for competition policy are presented in Chapter V.

The data examined in Chapters II and III have been collected from a variety of sources. It should be noted, however, that both industries have long been established in Canada, so that there is considerable general knowledge about them. Much has been published about the pulp and paper industry, and industry executives, suppliers and customers have substantial information about the wire rope industry. Both industries are in part foreign-owned, which presents some difficulties in data collection since wholly-owned subsidiaries do not have to disclose much information. However, presentations to governments in the light of proposed policy changes tend to elicit facts as well as views from industry representatives.

The sources used in this study include: (a) federal and provincial government studies including royal commission reports, Statistics Canada data, Department of Industry, Trade and Commerce reports, Canadian Forest Services reports, hearings before bodies such as parliamentary committees, tariff and anti-dumping tribunals and royal commissions; (b) industry studies and reports made by the Canadian Pulp and Paper Association, by investment analysts, and by individual firms in their presentations to governments; (c) company financial reports, including Form 10-K filed with the Securities and Exchange Commission in the United States; (d) Canadian, U.S. and U.K. court cases involving companies; and (e) interviews with Canadian and U.S. government and business officials, academics, investment analysts and engineering consultants familiar with the industry. Because of the variety of data sources used, some figures do not correspond exactly. For example, Statistics Canada and the Canadian Pulp and Paper Association define the pulp and paper industry slightly differently.

The approach taken in this study required information at the micro or plant level, which necessitated cooperation on the part of the firms and plants examined. The executives interviewed in Canada and the United States responded positively to the case study format. As expected, their concern was over the release of confidential material, specifically the cost structure of plant operations in absolute figures. Agreement was reached for cost data to be provided as averages, and the distribution of costs to be shown as percentages. However, as confidence developed some of the specific cost figures were made available to the researchers and are included in their assessment of the two industries. Numerous plants were approached in the course of the study before the selection of six plants for in-depth study was made, three in each industry. There were more plants from which to choose in the pulp and paper than in the wire rope industry. The final selection was made on the basis of comparability of products between plants and agreement of executives to assist in the provision of information.

The format of Chapters II and III differs slightly. In the case of wire rope, the two leading firms in effect constitute the industry, and for this reason the examination of the companies is the vehicle for studying the industry. For pulp and paper, because of the nature and size of the industry and the number of firms, the study begins with a general industry survey and then focusses on selected plants.

The general approach taken is similar to that discussed by Professor W.G. Shepherd in which he argues the need for understanding both the "context" and "content" of the firm in the analysis of aspects of economic performance.¹

SUMMARY

Factors Affecting Plant Efficiency and Costs

The main problems faced by plants and firms in the pulp and paper industry vary by segment of the industry--pulp producers, newsprint producers, and producers of fine papers. In the case of plants producing pulp only, the main concerns center around the cost of pulpwood delivered to the

1. W.G. Shepherd, The Treatment of Market Power (New York: Columbia University Press, 1975), p. 23.

plants. Affecting these costs are the quality of wood and the transportation costs of having the wood delivered to the plant, especially in parts of eastern Canada. Again there are regional differences to consider, because in western Canada the supply of fibre as a by-product of sawmills alleviates this problem. All plants are concerned with the rising costs of capital equipment, and environmental controls create cost problems, especially for plants producing pulp using the sulphite process.

Most plants producing pulp or newsprint tend to be of a scale where minimum efficient scale (MES) is reached according to available engineering estimates. The main problem faced by newsprint producers and pulp producers that supply newsprint plants is the growing competitiveness of plants located in the southern United States. In particular, the supply of wood is becoming increasingly attractive in the southern United States, both in terms of the shorter growth period for trees and the cheaper access to lumber. Tree farming and harvesting in accessible areas in the United States has to be contrasted with logging operations in remote terrain, requiring the building of special roads, which is often the case in Canada.

Plants producing fine papers experience the small scale operations and short production runs which typify much of tariff protected secondary manufacturing industry. Production often takes place in old plants utilizing old equipment, where modernization is a clear need. The geographic spread of the market also presents problems of distribution costs for small producers.

In contrast to pulp and newsprint production, which involves continuous process operations, the production of wire rope, especially from the stage of wire drawing, tends to require batch processing, at least in Canada where the demand is for different types of rope in different regions for different end uses. Consequently, the problems of short production runs are experienced in the wire rope industry. Unlike some of their U.S. counterparts, Canadian plants do not produce their own wire, but either purchase it from the major steel producers or import it from Europe or Japan. Competition in this industry comes from imports, so that despite the high degree of concentration in the industry, there is considerable actual and potential competition on the supply side.

A major problem in the wire rope industry is that the plants producing wire rope have often been designed for other purposes. (A major exception to this is the Wire Rope Industries plant in Pointe Claire, Québec.) In some plants, equipment and machinery also require modernization, but the major improvement to efficiency could arise from improving the corporate infrastructure in terms of production management, in order to deal with the problem of short production runs. The wire rope industry has to cater to a number of different markets such as logging, construction, mining and marine, and within each market there is a demand for different sizes and types of wire rope. The importance of production management for efficient operation results from the fragmented nature of wire rope demand.

Foreign ownership is also an element in the wire rope industry, requiring companies to source some of their steel rod and wire requirements outside of Canada because of excess capacity available in offshore plants. This is one reason why Canadian firms have not integrated backwards into wire drawing, as is the case in a number of larger U.S. plants.

The optimum scale of wire rope plants is more difficult to determine, but the reason for the difficulty is revealing. Some firms do not look at plant size in static terms, but in terms of tactical and strategic considerations such as collective bargaining.

The common features of these two industries are the short production runs in the fine paper segment of the pulp and paper industry and in the wire rope industry, both of which are characterized by a batch process of operation. Fine paper plants are typically integrated with pulp production, whereas wire rope plants purchase steel wire from both related and independent sources of supply. Both the pulp and paper and wire rope industries have supply and output relationships with foreign firms which present both opportunities and problems for the plants in Canada.

In contrast to previous studies, the present study has attempted to work up from the level of the plant floor and the production process, in order to determine the meaning of data presented at the industry level. From this approach it has been possible to show that presenting one figure for the MES of a plant in some industries can be highly misleading, because an industry can include a number of different segments, each with a different MES estimate.

In addition, firms view optimum plant size in terms of dynamic and tactical considerations as well as in static terms, so that what is observed may reflect factors other than scale economies. Differing estimates of MES are often observed when calculated on the basis of engineering estimates and the survival techniques.

The present study suggests considerable caution in using published industry statistics for estimating scale economies, because the data may be affected by the variety of products manufactured within the industry and the variety of production techniques used. One alternative approach is to determine the plant circumstances under which a particular type of product is produced and then to determine from a variety of sources, including engineering estimates and information collected from the firm, what appears to be the range of plant sizes that correspond to MES. In sum, it is suggested that the concept of MES of plant is much more difficult to operationalize and estimate than has been recognised in some studies.²

Previous studies have emphasised the structure of industries as determining aspects of performance. The present study emphasises the parallel importance of the structure of firms for performance. There are two characteristics of firm structure to be considered, first the organizational structure of firms as discussed by O.E. Williamson³ (and not considered in this study), and second the importance of the firm's infrastructure for performance. The ability which firms have in different functional areas must be recognized. In the case of short production runs, a critical function is production management.

The fragmented nature of Canadian secondary manufacturing industry has been a continuing theme in Canadian industrial policy debates, with U.S. industries often held up as models for Canadian industries to match. It was therefore important to learn that a detailed study of U.S. manufacturing plants observed conditions within these plants that have typically been thought to apply to

-
2. This view coincides with that of L.W. Weiss, "Optimal Plant Size and the Extent of Suboptimal Capacity," in R.T. Masson and P.D. Quails, eds., Essays in Industrial Organization in Honor of Joe S. Bain, (Cambridge, Mass.: Ballinger, 1976) p. 126.
 3. See O.E. Williamson, Corporate Control and Business Behavior, (Englewood Cliffs, N.J.: Prentice-Hall, 1970.)

Canadian and not to U.S. industries. The study concluded that corporate infrastructure improvements were needed.⁴ Most of the proposed remedies in Canada to date have centred on altering the structure of industries. An alternative and complementary approach is to focus on improving the internal management of production, and thus the emphasis on the corporate infrastructure in this study.

Competition Policy Implications

In recent years a variety of policies has evolved to promote Canadian industries in ways such as research and development, export marketing, and regional development. Competition policy, as traditionally conceived, has been viewed as a means of ensuring a fair functioning of market forces by establishing certain framework rules, but rules which have often been adjudicated on a case-by-case basis before the courts, and more recently before the Restrictive Trade Practices Commission. Competition policy, industrial policy, regulation and public ownership are converging on the same set of players, namely firms and industries, and in so doing they pose the problem of imposing a set of conflicting requirements on the players. For example, regional incentives may conflict with the objective of competition policy to bring about a structural rationalization of industries; the promotion of export consortia may permit agreements covering export sales which would not be permitted in domestic markets; and financial incentives may be more easily obtained by larger firms, thus promoting industry concentration. At the very least, it can be said that competition policy now has to work in conjunction with an expanded number of industrial policies. This requires consideration of two sets of issues, the extent to which competition policy can be administered to promote industries and industrial efficiency, and the extent to which industrial policies may involve aspects restrictive of market forces.

The proposed Competition Board can be viewed as entry by competition policy into the field of general industrial policies, especially with its mandate to evaluate mergers, specialization agreements, and export agreements. This evaluation will be undertaken on a case-by-case basis, necessitating a detailed understanding of the relevant

4. W. Skinner, "The Focused Factory," Harvard Business Review (May-June 1974), p. 116.

industry and the firms involved. On the basis of the study of the pulp and paper and the wire rope industries, it is suggested that cases will have to be examined at three levels, the plant or firm, the industry, and the international context. In the case of horizontal mergers, consideration will have to be given to production economies (product and plant), firm economies, the extent of import competition, the preferences of buyers for several sources of supply and the extent to which the merger may lead to intrafirm specialization.

The present study suggests that specialization agreements may be difficult to make and to sustain. In the case of foreign-owned firms, there may be a reluctance to have their subsidiaries cooperate. Even without foreign ownership, specialization may involve firms being assigned different product lines, some of which are financially more rewarding than others. Moreover, firms are reluctant to become dependent on one product line, in the event that it loses its market acceptance or becomes obsolete. Some cases of specialization, especially in Western Canada, can probably only work if the firms have access to the U.S. market, in order to sell the volume of product that is required for scale economies. This type of specialization would involve north-south rationalization as opposed to east-west rationalization, and thus has to involve some element of trade negotiations.

The issue of foreign ownership is relevant in north-south rationalization because where foreign-owned firms are involved, production rationalization tends to remove decision-making powers from the subsidiary operations in Canada and to concentrate them in the United States. This has been the impact of the automotive agreement on the major U.S. automobile manufacturing subsidiaries in Canada, and is certainly contrary to the intent of the Foreign Investment Review Act. A distinction can be made between rationalizing component production and end-product production. In the latter case, decision-making power is more likely to be removed from the foreign subsidiary operation in Canada.

In the context of current discussions of Canadian manufacturing industries, the work of the industry sector task forces of the Department of Industry, Trade and Commerce and the multilateral trade negotiations are important for the administration of competition policy. While the trade negotiations may result in increasing competitive forces, the task forces are likely to propose measures which are restrictive of competition by arguing for

higher tariffs, or such items as preferential government procurement practices for Canadian-based firms.

In general, a concern of competition policy is that other government policies are drawing more companies away from its scope, especially where regulation occurs, where public ownership exists, and where government itself becomes a party to cartel agreements. A further concern relates to the existence of other industrial policies which may conflict with competition policy. A period of recession tends to aggravate these concerns as industry argues for special treatment and government becomes more receptive to proposals which may be anti-competitive. Industry may then turn to departments of government, other than the Department of Consumer and Corporate Affairs, in order to assist them to bring about structural change, and the challenge for competition policy makers will be to indicate the relevance of their review procedures. In fact, competition policy has to be sold to other government departments as well as to industry. Much of the criticism from industry of the Stage II proposals for amending the Combines Investigation Act arises from the perception of industry that the Act has tended to deal with issues which are critical of business behavior. The realisation that the Competition Board may assist in the reorganisation of industry and may in fact promote it is difficult for industry to appreciate, despite the wording of the Act, because of the image which business has of this area of policy. Nowhere is this clearer than in the case of fine papers, where the firms have been involved in combines cases in the past and find it difficult to adjust to the idea that cooperation between them may be supported by a government department which has previously been critical of their conduct. The foregoing suggests that the revised competition policy will have to be administered in a new environment requiring cooperation between government departments and an understanding by industry of the new rules of the game.

The present study suggests that the corporate infrastructure of the firm was important to consider in examining the performance of firms. At present, governments have policies that assist the infrastructure of firms in terms of finance, research and development and marketing (domestic and foreign). The wire rope industry indicates a case where plant efficiency could be improved by measures taken in the area of production management (scheduling) and industrial engineering. It is probable that other industries, characterised by small scale and wide product mixes, would also benefit from measures introduced to

improve the corporate infrastructure in the area of production management. A related concern is the improvement of labour-management relations, which is required not so much at the firm level but at the plant level. It was revealing to discover that a study of U.S. industry identified production management as a deficiency in many U.S. manufacturing plants. Given the nature of Canadian manufacturing industry, this issue is certainly worth examining in the context of other Canadian industries.

CHAPTER I

SURVEY OF LITERATURE

COMPETITION POLICY AND EFFICIENCY

The rationale for competition policy according to the Economic Council of Canada is that competitive market forces are a more efficient way of allocating resources in most parts of the economy than is public ownership, government regulation or self-regulation of firms in a corporate state.¹ This view is reflected in the preamble to the proposed Competition Act.² Both statements imply that a system of resource allocation can only be evaluated fairly by comparing its performance to alternative systems, recognizing that each system has advantages and disadvantages.

The objective of competition policy is not to compare economic systems but to be supportive of the market system, recognising that problems, sometimes referred to as market failures, can occur. The support which competition policy can provide must be based on a thorough understanding of the process of competition, which itself is multidimensional. For example, competition can occur as price and non-price competition between firms producing the same product and selling to a common group of buyers, as a result of bargaining between buyer and seller (vertical competition as highlighted in discussions of countervailing power), through the capital market as one group of owner/managers attempts to displace another group of owner/managers; and in a Schumpeterian sense through innovation involving new products, processes and forms of organization.

All these dimensions of competition relate to the performance of markets and industries, which is the ultimate concern of competition policy. One critical aspect of performance is the technical (productive) efficiency with which firms operate, which will depend in part on the economies of scale open to a firm and the extent to which firms realise these economies. At the same time, the more important such economies of scale are in a given market, the more highly concentrated the industry is likely to become, with the potential for resource misallocation to occur

-
1. Economic Council of Canada, Interim Report on Competition Policy (Ottawa: Queen's Printer, 1969), p. 8.
 2. Bill C-42, An Act to Amend the Combines Investigation Act, Ottawa, 16 March 1977.

external to the firm.¹⁰ From the manager's point of view, measures of real productivity are important to the extent that they assist in reducing the costs of production. It is production costs rather than real production efficiency that will determine where goods are produced. For example, labour productivity could be higher in Canada than in the United States, but this could be offset by higher labour costs in Canada. Some of the most detailed studies of productivity in individual industries have been undertaken by Professor B. Gold, who also discusses the conceptual problems involved in such analysis.¹¹

Studies of productivity performance in Canada have been concerned with explaining changes in productivity over time and with comparing productivity in Canada with that in other countries, especially the United States. These studies have dealt with productivity at the macro level as well as for individual industries. To date, there has been little in the way of published studies of firm-to-firm, plant-to-plant, or product-to-product productivity comparisons, which is the focus of the present study.

Much of the concern over Canada's productivity performance has been linked to policy questions concerning the international competitiveness of Canadian industries; the role of Canadian tariffs, foreign tariffs, and foreign investment; and the implications for combines policy of the size of the Canadian market and the structure, conduct and performance of Canadian industries. A view of Canadian industry, developed and documented during industry studies made for the Royal Commission on Canada's Economic Prospects, pervades much of the subsequent research and writing--that productivity performance is poor in Canada due to the small size of the Canadian market, short production runs, sub-optimal scale plants and the use of less-efficient machinery.¹²

-
10. I.H. Siegel, "Measurement of Company Productivity," in Improving Productivity Through Industry and Company Measurement, Series 2, Oct. 1976. (Washington: National Centre for Productivity and Quality of Working Life) pp. 20-22.
 11. See S. Eilon, B. Gold and J. Soesan, Applied Productivity Analysis for Industry (Toronto: Pergamon Press, 1976).
 12. S. Stykolt and H.C. Eastman, "A Model for the Study of Protected Oligopolists," Economic Journal, Vol. 70, (June 1960), pp. 336-347.

Comparisons at the aggregate level of output per person employed show lower figures for Canada than for the United States, with the gap closing over time but with very little movement in the last decade. Canadian output per person employed was 40.3 per cent below the United States in 1953, 31.5 per cent below in 1963, and 29.6 per cent below in 1973.¹³ From the outset of such studies, the analysis explaining these differences has noted that:

. . . the difference is due not to significant differences in the quantities of labour and capital used in Canada, but rather in the way we have used these basic resources.¹⁴

This comment strongly suggests the need for in-depth analysis of the way in which resources are actually combined and organised to produce specific products within plants, firms and industries. Studies using partial productivity comparisons (labour or capital inputs only) and studies using total factor productivity comparisons come up with the same type of results, showing productivity to be lower in Canada than in the United States. In terms of lower labour productivity, the actual problem faced by firms has been that their costs were higher because the lower hourly earnings were not sufficient to offset the lower productivity levels. Comparative costs, as opposed to comparative real productivity, affect the competitive position of firms. In the 1970s, the situation for Canada has worsened as the productivity gap persists while the wage gap is closing.

Two follow-up studies were published by the Economic Council of Canada in 1971 to explore some of the productivity issues identified earlier. One study compared the productivity performance of a sample of 30 Canadian manufacturing industries with comparable U.S. industries and concluded that (a) net output per employee was on average

13. D.J. Daly and S. Globerman, Tariff and Science Policies: Applications of a Model of Nationalism, Ontario Economic Council, Research Studies, 1976, p. 27.

14. D.J. Daly, B. Keys and E. Spence, Scale and Specialization in Canadian Manufacturing (Ottawa: Economic Council of Canada, 1968), p. 3. [Underlining added.]

one-third lower in Canada, but there were wide variations between industries; (b) when other inputs were included, productivity was still lower in Canada - labour and capital productivity were 20 per cent lower than in the United States, and materials and fuel productivity were 12 per cent lower; (c) about one-third of the variation in productivity performance between industries was due to a scale effect which was measured in a way which suggested that the economies of scale realized with large-volume output most likely emanated, not from differences in size of establishment, but from greater specialization within particular establishments; and (d) industries with a low level of productivity relative to the United States tended to have a higher proportion of nonproduction workers.¹⁵ This last finding reinforces the view that the productivity performance of Canadian industry could be improved through increased specialization.

The second follow-up study developed a general model and methodology capable of identifying and measuring the sources of productivity growth for an industry, in order to compare differences in productivity growth rates between industries in the Canadian manufacturing sector.¹⁶ This study recognised the importance of applying industrial engineering and psychology concepts to questions of productivity, but did not include them in the analysis.¹⁷ Important aspects of industrial engineering mentioned are methods and time analysis, work simplification, materials handling and flow process analysis. The field of industrial psychology includes supervisory methods, incentive systems, team size and organization, and labour-management relations. This study concluded that differences in industry labour productivity growth rates were due primarily to the quality of labour, the capital intensity of production, the size of representative establishments and the total level of industry output.¹⁸

15. E.C. West, Canada-United States Price and Productivity Differences in Manufacturing Industries, 1963 (Ottawa: Economic Council of Canada, 1971).

16. H.H. Postner, An Analysis of Canadian Manufacturing Productivity (Ottawa: Economic Council of Canada, 1971).

17. Postner (1971), p. 1.

18. Postner (1971), pp. 4-5.

The Conference Board in Canada has published a further study comparing productivity in Canada and the United States, in which it concludes that:

Relative labour productivity levels have risen about 15 percentage points to about 80 per cent of the U.S. level over the period 1967 to 1974 for the selection of 33 manufacturing industries.

Labour productivity in durable goods industries is approximately 95 per cent of the level in the United States.

Labour productivity in non-durable goods industries is approximately 70 per cent of the level in the United States.

Canada has more capital per worker than the United States so that the relative labour productivity levels overstate the levels of total factor productivity.¹⁹

The 33 industries studied consisted of matched pairs of Canadian and U.S. industries.

Conflicting data have been published on the average size of plant or establishment in Canada in comparison with the United States. The Economic Council of Canada stated that for about 50 industries "the average size of plant or establishment is actually larger in the U.S."²⁰ A more recent study provides different evidence.²¹ In part the difference is due to the measure used. However, it indicates the need for caution even in measuring plant size.

The extent to which Canadian production occurs in plants of suboptimal size has been estimated in a recent

19. J.G. Frank, Assessing Trends in Canada's Competitive Position: The Case of Canada and the United States, (Ottawa: Conference Board in Canada, Nov. 1977), p. ix.

20. Daly (1976) p. 153.

21. Gorecki (1976), p. 14.

study, which also measures, for 12 industries, the extent to which unit costs rise with production when the plant is one-third of optimal size. (See Table 1.) The work of Professors Eastman and Stykolt and the industry studies made for the Royal Commission on Canada's Economic Prospects²² have provided a launching pad for further study of production at the micro level. The principal hypothesis tested by Eastman and Stykolt was that the determinants of the productive efficiency of an industry (X_1) are market size (X_2), the capital requirements for entry into or expansion in a market (X_3), product differentiation (X_4) and the rate of growth of the market (X_5). The dependent variable, the productive efficiency of an industry (X_1) was concerned with the total output of the industry, and was measured by the actual share of the market which was accounted for by plants of optimum size, where optimum size was based on engineering estimates of how large plants had to be to enjoy minimum average costs of production. Market size (X_2) was measured by the ratio of market size to minimum efficient plant size (or the maximum number of efficient plants that the industry can sustain), so that the larger X_2 is, the larger is the number of efficient size plants that can operate in an industry.

A positive relationship was expected between X_1 and X_2 on the grounds that the larger X_2 is, the greater the number of efficient-size plants the industry can accommodate and consequently the more competition there is likely to be. Conversely, the smaller X_2 is, the more monopolistic the industry is likely to be, with less pressures for firms to be efficient. In addition, a small value for X_2 suggests high entry barriers, because of the price repercussions expected from new entry with a large relative market share, thus there will be less pressure to be efficient from potential as well as from actual competition when X_2 is small. In those cases where foreign firms were present in the Canadian industry, the problem of a low value for X_2 was felt to be compounded, because of the difficulty of getting foreign parent firms to allow their subsidiaries in Canada to merge in order to obtain greater efficiency. The results of applying this analysis to sixteen industries showed that market size was the major factor in explaining the level of efficiency in particular industries.²³

22. Eastman and Stykolt (1967) and Daly and Globerman (1976).

23. Eastman and Stykolt (1976) p. 79.

TABLE 1

CANADA: TOP 50 PER CENT PLANT SIZES AS A PERCENTAGE
OF THE MINIMUM OPTIMAL SCALES, AND COST PENALTIES
WITH SUBOPTIMAL SCALE OPERATION

Industry	Top 50 percent plant sizes as percentage of minimum optimal optimal scales*	Percentages by which unit cost rises, building at 1/3 minimum optimal scale
Beer brewing	26	5.0
Cigarettes	31	2.2
Fabrics	187	7.6
Paints	32	4.4
Petroleum	38	4.8
Shoes	110	1.5
Bottles	118	11.0
Cement	83	26.0
Steel	92	11.0
Bearings	97	8.0
Refrigerators	13	6.5
Batteries	63	4.6
Mean value	74	
Median value	73	5-6.5

* Top 50 per cent plant size is the average plant size of those plants which account for 50 per cent of industry output. For example, in beer brewing the average plant size of the largest plants (producing 50 per cent of industry output) is 26 per cent of the minimum optimal scale of plant, estimated from company interviews on the basis of engineering estimates assuming 1965 "best practice" technology.

Source: F.M. Scherer, "The Determinants of Industrial Plant Size in Six Nations," The Review of Economics and Statistics (May 1973), Tables 2 and 3, pp. 137 and 138.

In focussing on market size as an explanation of production efficiency in industries, Eastman and Stykolt argue that a small market leads to inefficiency by not allowing for the presence of enough firms to generate the competitive pressure (actual or potential) which will lead to productive efficiency. The analysis then leads to a discussion of the cost associated with operating plants which would be of efficient size if they produced only one or a few products, but which in fact produce a wide range of products, often with dated technology and equipment. Observing plants at a point in time will not capture changes that are taking place, nor will it be easy to determine whether the efficiency conditions identified in one country are appropriate for evaluation of efficiency in another.

The question of suitable production techniques for Canadian industry is identified by Eastman and Stykolt as a case of the technology tending to be developed in the United States suitable for relative factor prices in the United States, which are usually different from Canadian relative factor prices. Moreover, as new techniques are developed and U.S. relative factor prices change, Canadian industry faces the following alternatives:

The first is to incur the fixed costs of designing based on present knowledge and appropriate to Canadian relative factor prices. The second is to adopt the new United States techniques even though they are not exactly suited to domestic factor prices owing to the higher price of labour relative to capital in the United States. The third is to adopt the old techniques of the United States which are appropriate to present relative factor prices, but are based on a backward state of knowledge.²⁴

In sum, the works of Eastman and Stykolt focus on the issue of productive efficiency of Canadian industry in terms of market size as influenced by both Canadian and foreign tariffs, and emphasize the need to understand product-specific economies or economies associated with producing a range of products within one plant. The next step is to appreciate exactly what those product-specific economies are in the light of current technology.

24. Eastman and Stykolt (1967), pp. 44-45.

One area in which the analysis of Eastman and Stykolt is not satisfactory is an understanding of why firms in Canada which could have lower costs by being less diversified, nevertheless choose higher costs and apparently lower profits. The prevailing situation is described as one in which protected Canadian markets have allowed for higher prices to be charged in Canada than in the United States. At first, higher prices allow higher profits, but these attract new entry and the addition of new product lines by existing firms, which fragments the market, resulting in a situation of more sellers than are required to service the market with efficient producing plants, but still not enough to generate competitive pressures (i.e., markets are oligopolistic and over-populated). Possible reasons why producers do not rationalize their production have been suggested as follows:

1. Insufficient price competition and the ability to pass on increased costs as increased prices. Moreover, cost savings if realised would have had a minor impact on total costs and demand for the product may have been elastic.
2. Oligopolists substitute product competition for price competition, and in the case of foreign (U.S.) subsidiaries repeat the same product lines that are produced in the United States and promoted by nationwide media.
3. Oligopolists feel that buyers demand a full product range and that it is more rewarding to offer a wide range with higher prices than a narrower range and lower prices.
4. The alternative strategy -- producing one product in Canada for sale in Canada and abroad and importing the other products in the product range -- may not be worthwhile if the cost of Canadian and foreign tariffs more than offsets the savings of a longer production run.
5. Dependency on one product (or a narrow product range) as in 4, increases marketing vulnerability and the threat of government intervention if output and employment fall off.²⁵

25. Some of these issues are discussed in connection with the automobile industry in R.J. Wonnacott and P. Wonnacott, Free Trade Between the United States and Canada (Cambridge: Harvard University Press, 1967), Ch. 13, pp. 226-247.

The significance of the foregoing issue is that there may be circumstances in which firms in Canada, both domestic-owned and foreign-owned, may resist engaging in specialization agreements for several reasons. They may fear to lose some marketing advantage connected with having a wide product range. They may feel that plants which are too product-specific are too vulnerable if market conditions alter. They may believe that government policies could change and leave them owning a plant which is uneconomical to operate. A firm may decide to engage in a specialization agreement and lose some flexibility only if it is reasonably certain that the market is going to continue to absorb its specialized product, and if it believes that government policy in other areas will not undermine the product. A situation of rapidly changing federal and provincial policies, often working at cross purposes, is not conducive to specialization agreements.

Two conditions required for specialization agreements are of primary importance. There must be product-specific economies to be gained from specialization, and firms must feel that these savings more than offset the disadvantages of plants becoming more specialized. These disadvantages may relate to the firm's view of its competitors and of the total market in which it operates, as well as its view of the stability of government policies in support of specialization agreements. For example, if tariffs are likely to be changed to the detriment of the specialized product, if federal or provincial governments may enter the industry with a crown corporation to compete with the specialized product (e.g., Sidbec-Dosco and Sysco in steel) or if subsidies are made available to new producers (e.g., Michelin for tires), then firms will be reluctant to engage in specialization agreements.

Product-Specific Economies

A series of brief industry illustrations were published by the Economic Council of Canada in 1968 to show the problems associated with limited product specialization in Canadian manufacturing plants. The factors suggested as leading to this situation were:

Canada's commercial policy, which was historically designed, to a considerable extent, to foster a wide diversity of manufacturing activity in Canada;

tariffs and other trade barriers in foreign countries which have inhibited greater speciali-

zation in Canadian manufacturing on the basis of larger markets (foreign plus domestic);

fears and risks, even in situations in which greater penetrations of foreign markets would have been economically feasible on the basis of greater specialization under existing conditions, that foreign trade barriers would be raised to prevent successful expansion of sales to these markets;

various factors inhibiting flows of products within Canada, including some policies and practices of provincial and municipal governments having "compartmentalizing effects" on the production and marketing of various goods;

production and marketing conceptions and practices, at least in some areas of production, favouring a relatively wide diversification of product lines rather than greater specialization of production;

uncertainty about the applications of restrictive trade practices policies, tending to restrain greater rationalization and specialization in Canadian manufacturing; and

factors tending to limit the infusion of new initiatives towards greater specialization in the economic system via the activities of smaller and newer firms (such firms, for example, encounter relatively much greater difficulty in getting access to financial resources in Canada than in the United States, especially in the form of long-term funds and equity resources).²⁶

This study also reported that the stock of capital in Canadian and U.S. manufacturing indicates about the same quantity of machinery and equipment per employed person in Canada and the United States, and a larger quantity of construction per employed person in Canada. The age and efficiency of the capital was not considered. A comparison made of 31 items produced in Canada and the United States showed that for 18 the total costs were 20 per cent or more higher in Canada (eight cost 35 per cent more to produce in Canada)

26. Daly, Keys and Spence (1968), pp. 23-25.

and five were produced at less cost in Canada. The reasons given for the higher Canadian costs were the Canadian tariff, product diversification, size of equipment and size of plant, seasonality of production, level of formal education of managers, morale and attitude of labour, less mechanization and inferior technology, and higher costs of physical distribution and promotion in Canada.²⁷

Reference was also made in the study to the literature on the economies of accumulated experience or learning-by-doing as an important factor in explaining high costs in Canada. In view of the size of the Canadian market, especially where there is limited access to foreign markets, the opportunities for accumulated experience for any given product will be limited. Moreover, if plants are producing a wide product range, the accumulated experience and lower costs will relate to producing the range rather than an individual product, and it is the latter which will allow the firm to compete internationally with other firms that can engage in plant specialization by product.

On the issue of product diversification in Canada, a study published by the Economic Council of Canada in 1975 noted that at the enterprise level, U.S. subsidiaries in Canada are less diversified than their parent companies in the United States.²⁸ In the same industry at the plant (establishment) level, of three types of plants, U.S. subsidiaries in Canada are most diversified, U.S. parent plants are least diversified, and the plants of independent Canadian firms fall in between. The reason that U.S. subsidiaries in Canada are more diversified than plants of Canadian firms is probably that the U.S. subsidiaries' diversified product range is supported by access to parts and technology from the parent, while Canadian firms have to be self-sufficient in order to produce an equivalent product range.

The study examined differences in plant diversification between industries in the following terms: differences in opportunities for diversification, complementarity of production process, complementarity of

27. Daly, Spence and Keys (1968), pp. 9-61.

28. R.E. Caves, Diversification, Foreign Investment and Scale in North American Manufacturing Industries, (Ottawa: Economic Council of Canada, 1975).

the non-production process, and opportunities for or restrictions on foreign trade. None of these factors provided a good explanation, although the second and third factors were shown to be somewhat related to diversification and it was found that the more diversified plants had more non-production workers. An attempt was also made to explain the differences in diversification of U.S. subsidiaries between industries in Canada. None of the following factors were found to be significant: domestic market (U.S.) saturation, complementarity of production and non-production processes, small market for primary products produced, products being bulky with high freight costs, high Canadian tariffs, and the extent to which vertical integration competes with diversification.

An earlier study had shown that foreign subsidiaries in Canada that produced a narrower product range than their parents (there were a few) and those that produced different products tended to export more from Canada and do more research.²⁹ Overall, Canadian firms appeared to have a less impressive performance than both foreign subsidiaries and foreign parents. A major difficulty in measuring performance of foreign subsidiaries is that their performance can be influenced by parent company policies, where there are intracompany transactions involving goods and services.

The most recent research related to the question of the productivity of establishments in Canada was undertaken for the Royal Commission on Corporate Concentration.³⁰ This study calculates value-added per worker as an indicator of industrial efficiency in Canada, and then uses this measure of productivity to compare the same industry in Canada and the United States. Establishments in each country are divided into two groups, large and small, based on the median size of U.S. establishments, and comparisons are made between the small and large establishments in the same industry.

29. A.E. Safarian, The Performance of Foreign-Owned Firms in Canada (Montreal: Canadian-American Committee, 1969).

30. R.E. Caves, Studies in Canadian Industrial Organization (Ottawa: Royal Commission on Corporate Concentration, July 1976.)

Productivity in small Canadian plants is found to be negatively related to the minimum efficient scale of plant in the U.S. industry, i.e., the larger the plant has to be to operate efficiently, the lower the productivity in Canada (for reasons similar to those advanced by Eastman and Stykolt). In addition, the higher the Canadian tariff and the greater the advertising intensity, the lower the productivity in the small Canadian plants. Among the group of large plants, productivity is greater where there are important diseconomies of small size, i.e., where there are severe penalties in terms of higher costs of being small by U.S. standards. This finding is reinforced by the fact that a higher percentage of Canadian industry output (value-added) comes from plants of minimum efficient size or larger, where there are large cost penalties for being small.

Individual industry studies have noted that production efficiency has increased with greater within-plant specialization. Prior to the U.S.-Canadian automotive agreement, Canadian automotive plants produced a wide range of models. Labour productivity in Canadian plants was substantially lower than in U.S. plants, and there were more non-production workers per production worker in Canada. The latter point reflects the need for a greater number of persons to cope with product line changes for different models. The companies reacted to the automotive agreement by reducing the number of vehicle lines produced in Canada, obtaining higher volumes for each line produced, exporting the models produced in Canada and importing those models not produced in Canada. The improvement in productivity through specialization was translated into lower costs of production. Whether these lower costs are passed on to the consumer is another question and is affected by other terms of the agreement which will not be discussed here.³¹

Similar advantages of greater specialization have been noted in an in-depth industry study dealing with the production of pleasure craft.³² These boats are custom

31. C.E. Beigie, The Canada-U.S. Automotive Agreement: An Evaluation (Montreal: Canadian-American Committee, 1970).

32. Report by the Tariff Board re Pleasure Craft, Ref. no. 149. (Ottawa: Information Canada, 1976).

built and learning-by-doing was particularly important in reducing the costs of production of a specialized product line.³³ In this case the firm concerned, Shepherd Boats Ltd., had plants in both Canada and the U.S., and duty draw-back provisions were important in encouraging the firm to engage in cross-border specialization. This example suggests that the cost advantages from specialization are especially large where the product is custom built as opposed to a more routine operation. That is to say, custom building operations tend to be expensive per se, but dividing them between plants is very costly because of the need to duplicate both human capital expertise and the plant set-up for custom operations. More routine manufacturing operations appear to be less costly to duplicate, in part because the process is less complex and requires supervision with a lower level of expertise.

A further study applied the product cycle theory of international trade and investment to the production of household appliances in Canada, in order to examine the corporate readjustment that would likely take place in the event of the reduction of U.S. and Canadian tariffs.³⁴ It was noted that new products in the industry have been introduced into the Canadian market by subsidiaries of large U.S. companies, usually as a second-best alternative to exporting to Canada. Competing Canadian firms have usually delayed their entry into the market until it has grown and stabilised, and even at this stage Canadian firms have difficulty in competing with the research and development and marketing services made available to the subsidiaries in Canada by the U.S. parent companies.

The study concludes that in the case of household appliances, the lowering of Canadian and U.S. tariffs would lead both U.S. subsidiaries and Canadian firms to rationalize their production and use plants in Canada to service larger markets with fewer products. Canadian firms were felt to be at a disadvantage in that they would tend to produce mature products and, to compete in the larger U.S. market with these products, they would still have to overcome the brand preferences of consumers for the widely

33. Tariff Board (1976), p. 90, 91 and 93.

34. H. Crookell, The Role of Product Innovation in Trade Flows, (London; School of Business, University of Western Ontario, 1970).

advertised products of U.S. firms. In sum, the study confirms the existence of unrealised product-specific economies in Canadian plants, but notes the difficulties associated with realisation of such economies where new products are continually being introduced.³⁵

The Canadian tire industry provides an example of an industry where product-specific economies might be realised through greater specialization within plants and firms. The Canadian tire industry in 1977 had 14 plants with an average daily output per plant of 5400 tires, compared to 62 plants in the U.S. tire industry and an average daily output of 16,500 tires per plant. In the Canadian industry, 913 different tire sizes were produced.³⁶ In an earlier study of the Canadian tire industry,³⁷ it was noted that the industry had higher costs in Canada, in large part due to the excessive number of tire sizes produced. The same conclusions are contained in a 1976 report of the industry made by the Automotive Parts Division of the Transportation Industries Branch, Department of Industry, Trade and Commerce. However, this study recommended against promoting rationalization on the grounds that the firms did not want it.³⁸

-
35. Further evidence of adjustment to lower tariffs is found in the Canadian packaging industry, where a representative of the industry argues against specialization, even though it would mean access to a larger market:

Mr. Morris, president of DRG Packaging Ltd. of Toronto, said his firm, a subsidiary of a large multinational company, would be forced to specialise in product lines that could be sold to the entire North American market, while marginally profitable lines would be dropped and probably imported. (Toronto Globe & Mail, March 22, 1977, p. B1)

36. Data supplied by the Department of Industry, Trade and Commerce, Ottawa, March 1977.
37. Eastman and Stykolt (1967), pp. 365-380.
38. Published in a summary of the study circulated to the industry. The complete study is confidential and is not publicly available.

Economics of Multiplant Operations

The foregoing comments suggest some difficulties associated with implementing structural rationalization in circumstances which would seem to warrant such treatment. Clearly a detailed appreciation of an industry situation is required before recommendations can be made.

In examining the economics of multiplant firms, F.M. Scherer identifies the following factors, based on actual industry observations, as affecting product-specific economies:³⁹ (a) the extent of fixed set-up costs required for each production run; (b) the down-time required to reset a machine from producing one product to producing another; (c) the cost of holding in-process and end-product inventories--there is a trade-off between longer production runs and larger inventories and shorter runs and smaller inventories; (d) the extent to which production of large lots promotes learning-by-doing; (e) the extent to which large lots justify the use of engineers spending more time to develop or adapt techniques of production; (f) the ability of managers to plan and to cope with the complexity of short runs, i.e., cost control and quality control; (g) the extent to which production of various types of products under one roof affects labour attitudes and morale where some jobs are continuous flow and others stop-start. These factors were found to be important considerations in the following industries: fabric weaving and furnishing, shoemaking, bottle blowing manufacture, cigarettes, paint and refrigerators.

Scherer suggests a number of ways that a multiplant firm, as opposed to a single plant firm, can overcome some of the cost disadvantages of small lot size (i.e., can realise product-specific economies): when it can specialize the production of one product in one plant; when it cannot specialize production but there are management-overhead economies of multiplant operation; when all low-volume production can be concentrated in one plant and the specialization savings in other plants more than offset the higher costs of the low-volume plant; when inventory holding costs can be reduced by pooling inventory requirements; and when transportation costs are low relative to product value so that advantages of specialization are not offset by increased transportation costs (both in-bound and out-bound).

39. F.M. Scherer, The Economics of Multi-Plant Operation, (Cambridge: Harvard University Press, 1975).

Scherer's work provides the most complete survey, including actual industry examples, in the economics literature of the factors to examine in determining the nature and extent of product-specific economies. It is interesting to note that Scherer, working with a large team of highly qualified researchers, considered that the case study approach was the best way to elicit the type of information which is needed to get at the heart of the issues of productivity and economies of scale. While more aggregate studies can provide clues, further understanding will only come from detailed knowledge of individual industries and their techniques of production, and from an understanding of the specific conditions under which each product is produced. What has been considered micro-economic analysis to date is too macro for the type of issues to be understood concerning productivity, so that the level of analysis now has to go to the plant floor and the production line. In essence, micro-economic analysis has to be brought into contact with the study and approach of industrial engineering so that the determinants of the costs of production can be understood.

In pointing to failures in U.S. antitrust policy, Scherer concludes that:

The economic theory underlying United States antitrust policy has in our judgment been overly simplistic, tending to deny categorically that real benefits can come from concentration-increasing mergers or cartels. This oversimplification appears to have two main roots: inadequate insight into the determinants of plant size decisions, plus an almost total preoccupation with plant-specific production economies and concomitant neglect of product-specific economics.

Failing to recognize the existence of a phenomenon is no serious sin if the phenomenon is quantitatively unimportant. The crucial policy questions are therefore: How often can concentration-increasing mergers or rationalization cartels lead to production efficiency gains? How large are the gains? What are the side costs? And how can one distinguish the cases in which benefits will exceed costs from cases of the oppose genre?⁴⁰

40. Scherer (1975), p. 389.

Apart from the general concern of improving the performance of Canadian industry, the special mandate of competition policy includes the administration of policies towards mergers, specialization agreements and export agreements. There is no way to evaluate effectively the costs and benefits of mergers, specialization and export agreements without an in-depth knowledge of individual industries, firms and production processes. The current Stage II amendments to the Combines Investigation Act recognise that simple rules for deciding whether a particular merger should be allowed, e.g., a market share test, are not suitable because of the range of factors which require consideration. If this is true for mergers, it is doubly true for specialization agreements where, as Scherer has shown, we are only dimly aware of the particular items that require evaluation.

In sum, the evolution of economic research and analysis to date and the concern and approach of Canadian competition policy both point in the same direction, namely to be skeptical of broad generalisations about factors affecting productivity and efficiency, and to pursue in-depth analysis of individual products, plants, firms and industries. With this in mind, the approach taken in this study is to start at the plant floor and to place the case example within the context of the industry. In order to make progress in this analysis, some familiarity with the literature in production management is necessary, so as to appreciate the engineering considerations which lie behind the layout of a plant, the technology used in production, and the impact of the learning curve on the costs of operations.

THE LEARNING CURVE⁴¹

The phenomenon of the learning curve was first documented in airframe manufacturing in the 1930s in the United States, where it was shown that the number of man-hours taken to produce an airplane decreased at a regular rate--specifically, that the direct labour input per airplane declined with a high degree of predictability as more planes were manufactured:

-
41. Learning curves are also referred to as improvement curves, experience curves, cost curves and industrial progress curves. The following three Harvard Business Review articles provide excellent background reading to the topic: Frank J. Andress, "The Learning Curve as a Production Tool" (Jan.-Feb. 1954); Winfred B. Hirschmann, "Profit from the Learning Curve" (Jan.-Feb. 1964); and William J. Abernathy and Kenneth Wayne, "Limits of the Learning Curve" (Sept.-Oct. 1974).

The basic theory of the learning curve is simple: a worker learns as he works; and the more often he repeats an operation, the more efficient he becomes, with the result that the direct labour input per unit declines. This holds true whether the industry is aircraft, metalworking, textile, or candy-making.⁴²

Studies involving the fabrication of missile hardware, weapons and commercial products indicate that the learning curve effect is especially significant on jobs with high labour content and is least significant on jobs which are largely machine controlled.

The general mathematical expression describing the learning curve may be stated as,

$$Y = AX^B \text{ where:}$$

Y -- manhours to produce a selected unit
A -- manhours to produce the first unit
X -- cumulative units to and including a selected unit
B -- exponent of learning curve slope =
$$\frac{\log (\% \text{slope}) - 2}{.30103} \text{ where:}$$

$$\% \text{ slope} = 100 - \% \text{ decrease}$$

The precise percentage decrease depends upon the item manufactured and the type of work performed. The appropriate percentages for various classes of work are usually developed from historical cost accounting data. In this instance, time elements other than direct labour are not included in the learning curve.

In the case of the aircraft industry, for example, it was shown that in the production of a particular model of aircraft, the second unit produced needed about 80 per cent of the time required to manufacture the first unit, the fourth unit required about 80 per cent as much direct labour as the second, the eighth unit, 80 per cent as much as the fourth, and so forth. Thus, an 80 per cent learning curve means that a 20 per cent reduction in time occurs for doubled quantity outputs. This rate of improvement has

42. Andress (1954), p. 87

since been applied "in analyzing a variety of procurement, production, and costing problems within the industry (aircraft) and within particular companies."⁴³

Table 2 provides an example of the foregoing relationship in which 2000 manhours are required to manufacture the first unit of a product.

TABLE 2
LEARNING CURVE IMPROVEMENT

Unit	Manhours
1	2000
2 2000 x 80% (constant rate of improvement)	1600
4 1600 x 80%	1280
8 1280 x 80%	1024
16 1024 x 80%	819

The units produced and manhour time relationship can be easily depicted on graph paper. Exhibit 1 shows how the rapid initial decline tapers off with subsequent units manufactured. The relationship drawn is for a representative 85 per cent learning curve which was the experience of Douglas Aircraft in the 1950s and early 1960s. The manufacturing process at Douglas reduced labour costs around the 85 per cent level during the production of the first 40 or 50 planes.⁴⁴ The rate of improvement in relation to time declines dramatically at first, and then drops more slowly.

Exhibit 2 plots the same data on log-log paper. In this case the learning curve follows a straight line, since the distance between doubled quantities is equal. Industrial engineers contend that the Log-Log Graph Paper Plot is easier to interpret and project than the Arithmetical Graph Paper Plot.

43. Andress (1954), p. 88 and John Mecklin, "Douglas Aircraft's Stormy Flight Path," Fortune, Dec. 1966.

44. John Mecklin (1966), p. 258.

EXHIBIT 1

LEARNING CURVE EXAMPLE

85% Learning Curve

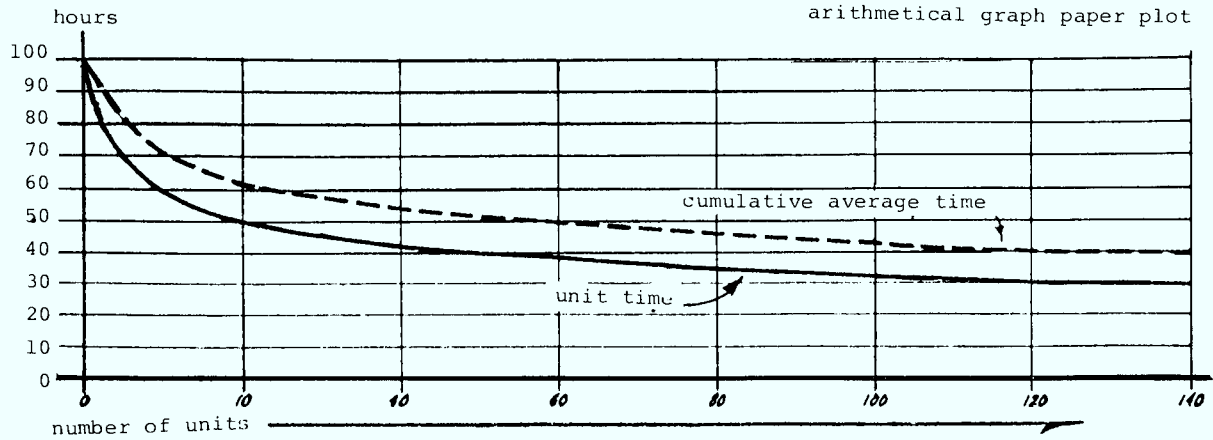
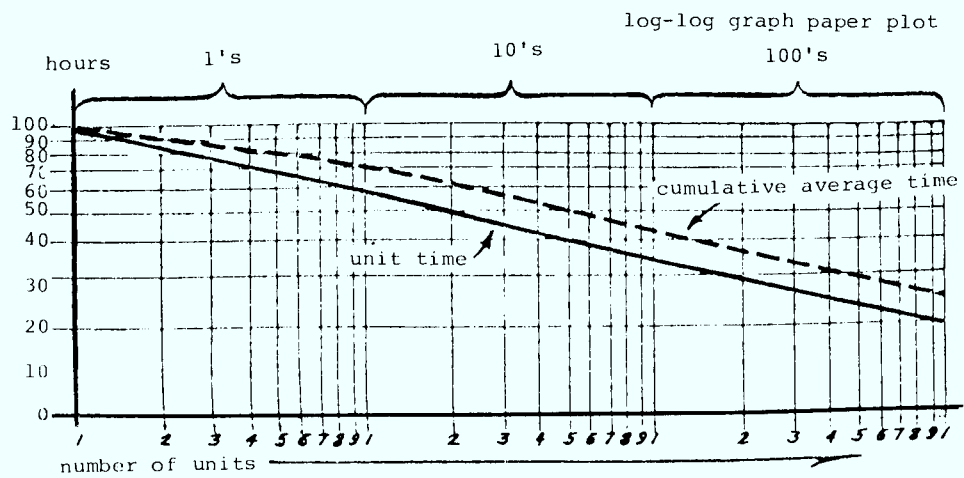


EXHIBIT 2

LEARNING CURVE EXAMPLE



Both exhibits plot two lines. The unit time curve, the solid line, represents the time to produce a single unit for each individual unit considered. The cumulative average time curve, the broken line, represents the average time per unit to manufacture the total number of units up to the unit under consideration. This curve is helpful in estimating the total direct labour time necessary to manufacture the output under consideration. The mathematical expression for this curve is described as follows:⁴⁵

$$\bar{Y} = \frac{\sum_{1}^N AX^B}{N}$$

- \bar{Y} -- average manhours to produce a unit
- X -- number of units under consideration
- A -- manhours to produce the first unit
- N -- serial number of the unit being considered
- B -- exponent of learning curve slope

When a product model is significantly altered or a new model is introduced, the direct labour time required to manufacture the first unit will revert back to approximately the time consumed to manufacture the preceding model's first unit. This relationship is predicated on the assumption that the new line of units is similar in size and configuration to the old product line and, therefore, that the learning process follows the pattern of the old learning curve. If, on the other hand, the modified or new product uses a different manufacturing process, then a new slope may develop because of different learning characteristics.

The improvement ratio may range from approximately 60 per cent, when the benefits in reduced labour time are exceptionally significant, to 100 per cent when no improvement is realized. A variety of factors will determine the improvement ratio:

45. U.S. Department of Defense, Principles and Applications of Value Engineering, Vol. 1 (Washington, D.C.), pp. 4-15.

Generally, as the difficulty of the work decreases, the expected improvement also decreases and the improvement ratio that is used becomes greater. On the other hand, as the difficulty increases, we have a greater opportunity for improvement; therefore, the improvement ratio that is used will be a lower percentage. The proportion of the labor content in an operation also affects the improvement ratio: lower percentages occur in operations with higher labor content. Moreover, operations having similar proportions of labor-paced to machine-paced work tend to have similar improvement ratios.

Some other factors which have an important effect on determining the rate of improvement are:

1. Familiarization with the job by both workers and supervisors.
2. Length of service on the job of workers and supervisors.
3. Improvement in organization and procedures which improve the flow of work and availability of materials.
4. Design and engineering change in the product.
5. Improvement in tooling used to produce the product.
6. Expectation of improvement by workers and management.⁴⁶

46. Richard A. Johnson, William T. Newell and Richard C. Veigin, Production and Operations Management: A Systems Concept (Boston: Houghton Mifflin Co. 1974), p. 429. The authors note that their list is not comprehensive, and that much work remains to be done to define and quantify the impact of the contributing factors. The following articles illustrate some quantitative applications of the learning curve theory: S.N. Goel and R.H. Becknell, "Learning Curves That Work," Industrial Engineering, Vol. 4, No. 5 (May 1972), pp. 28-31; and Richard J. Alden, "Learning Curves: An Example," Industrial Engineering, Vol. 6, No. 12 (Dec. 1974), pp. 34-37.

The early literature about the learning curve focussed largely on individual performance. However, it does describe group performance as well, and includes direct labour and indirect labour -- tool engineers, for example, who design jigs and fixtures, and other technical specialists who concern themselves with improving performance in such areas as maintenance and construction.

The industrial learning curve thus embraces more than the increasing skill of an individual by repetition of a simple operation. Instead, it describes a more complex organism - the collective efforts of many people, some in line and others in staff positions, but all aiming to accomplish a common task progressively more efficiently.⁴⁷

While the original learning curve theory stressed that the time needed to perform a task on the shop floor decreases as a constant percentage the more often it is done, the Boston Consulting Group (BCG), through its own research, tested the hypothesis that "overall unit costs" as well as unit labour costs decline by fixed percentages each time the number of units produced doubles. And the learning curve became the experience curve to the BCG. The range of industries studied included integrated circuits, electric power, television receivers, and facial tissues. BCG's major finding is that the decline in unit costs results from the combined effect of learning, specialization, investment and scale.⁴⁸

Economists writing on the learning curve suggest a number of important issues in comparing costs between plants. First, the impact of cumulative production on lowering costs may result from either lower costs due to the experience gained by doing the same job more often, or lower costs due to using a different technique of production, i.e., more capital or more experienced workers, because it is known that more production will be undertaken. The latter point reflects the fact that planned or scheduled production is for a larger volume of output, whereas the former point reflects lower costs from cumulative

47. Winfred B. Hirschman, "Profit From the Learning Curve," Harvard Business Review, (Jan.-Feb. 1964), p. 128.

48. See Perspectives on Experience (Boston: The Boston Consulting Group, Inc., 1970).

production, regardless of whether the facilities were planned for a larger or a smaller output level. There exists the possibility of rising costs with cumulative output, in the event larger production facilities are planned due to anticipated demand, but demand is not realised. A distinction can be made between the rate of output and volume of output:

With Alchian's model, the business economist can grasp the essentials of the problem of economies of scale: marginal costs are a rising function of rate of production, a declining function of scheduled volume of production. He can thus fruitfully separate the problems hitherto confounded, of responding to accelerations of demand (rate increased, for given volume), extensions of demand (volume increased, for given rate), and expansions of demand (rate and volume increased, in proportion).⁴⁹

Hirschleifer makes a further distinction between vertical (length) and horizontal (width) dimensions of orders, where the width of orders depends on the number of different types of orders. In general, the wider the order the higher the costs, because of the set-up (start-up) costs of each type and because of the transaction costs of interacting with each purchaser. However in certain cases the transactions costs can be reduced, as when numerous customers buy electricity from a public utility or when customers group to purchase as for package tours and airline travel.

Companies which manufacture products that require frequent major and minor design alterations, where production is characterized by short runs at well-spaced intervals, and whose operations tend to be assembly, and not machine, time-oriented, can be potentially major beneficiaries of the learning curve phenomenon.

49. J. Hirschleifer, "The Firm's Cost Function: A Successful Reconstruction?" Journal of Business, Vol. 35, No. 3 (July 1962), p. 253. See also A. Alchian, "Costs and Outputs," in Moses Abramovitz, ed., The Allocation of Economic Resources (Stanford: Stanford University Press, 1959), p. 35.

The electronics industry, which includes the characteristics of rapid product change and assembly orientation, is an excellent example where the economic effects of the learning curve are discernible. "The price of ferro-magnetic memory cores for computers plunged from 5 cents per bit (units of memory) in 1965 to less than a half cent in 1973, thereby significantly reducing the costs of computers."⁵⁰ In the case of the semi-conductor industry, the combination of learning-by-doing, management experience, and economies of scale appear to underly the unit cost decline associated with the learning curve phenomenon. The earlier example of Shepherd Boats Ltd. illustrates the way in which costs fall from repeated production of labour-intensive custom manufactured pleasure craft.

THE MANUFACTURING SYSTEM

Conceptually, the function of the manufacturing system is to produce a product or service. It is the operations phase of the corporate organization which combines materials, labour and capital resources in order to produce the product or service. To effectively perform its production function, the manufacturing system relies on and draws inputs from other subsystems of the corporate organization such as maintenance, supervision, plant layout design, data processing, order and sales information processing. These inputs, most of which are of a service nature, are part of the corporate infrastructure.

The nature of the manufacturing system will differ depending upon the combination of inputs to be processed and the series and sequence of operations required to process each input. It is necessary to describe the nature and characteristics of the manufacturing system (determine the boundaries of the system) if one is to identify and study the performance issues related to productivity. For example, in some industries, the warehouse is viewed as an extension of the factory, which in turn is part of the manufacturing system. In other cases, the factory and warehouse are seen as two separate systems within the larger manufacturing system.

Continuous Flow and Intermittent Systems

There are basically two types of manufacturing systems, continuous flow and intermittent. The former system is one in which the facilities are standardized in terms of routings and flows. Since the inputs are standardized, the system is characterized by a standard set

50. Abernathy and Wayne (1974), p. 110.

of processes and sequence of processes. Examples of this system are to be found in the automotive industry where the production operations are placed in sequence and are largely interconnected by conveying equipment. A high volume, standardized production and assembly line configuration tends to characterize the continuous flow system where the decisions rules are "first in - first out."

The intermittent system is a more complex manufacturing system. Here, the facilities have to be sufficiently flexible to manage a larger assortment of products and sizes. The basic nature of the manufacturing activity may also impose change in the characteristics of the input (change in product design). Firms that are involved in custom- or job-order manufacturing situations employ the intermittent system.

Examples of the two systems can be readily found in the chemical industry--e.g., "continuous flow of chemical operations" versus "batch chemical operations." The layout of the manufacturing system is critical for the efficiency of the operation, and its design will be affected by whether the system is continuous or intermittent.⁵¹

Equipment and Process Technology

Selecting the appropriate equipment and process technology (EPT) for the manufacturing system is one of the most critical areas for corporate decision-making, since it will generate demands on, and requirements of, the other elements of the system. To gain maximum operating efficiency, all parts of the manufacturing system must be designed and managed so that they are congruent and compatible with the chosen EPT.

Products can generally be manufactured in a number of ways. Each EPT selection will impose its particular demands and requirements. "The effect of an EPT may be seen as taking place on three levels: primary-direct effects on the product, costs, investment, and basic requirements; secondary-demands on the operating system infrastructure; and tertiary-effects on the performance ability of the operating system."⁵² (See Exhibit 3.)

51. See Elwood S. Buffa, Operations Management: Problems and Models (New York, John Wiley & Sons, 1972).

52. Technology and the Manager - Part I, Working Paper, Harvard Business School, Intercollegiate Case Clearing House, Soldiers Field, Boston (9-671-060), p. 6.

EXHIBIT 3

THE INFLUENCE OF AN EPT ON AN OPERATING SYSTEM

operating system elements INFLUENCES	COSTS	QUALITY	INVESTMENT	FLEXIBILITY product change volume change	CUSTOMER SERVICE
<u>Primary</u> direct effects	operator skills labor labor & material costs set-up & change - over supervision maintenance skills	precision reliability appearance maintenance	capacity original cost economic life inventory utilities & building certainty- stability of technology	product range producible set-up & change over time lead times	cycle time total lead time
<u>Secondary</u> system require- ments	purchasing sys- tem burden rates cost control system work force management mfg. eng. reqs. mfg. organiza- tion structure	maintenance system QC system supervision mfg. eng. reqs.	inventory control system capacity planning system capital budgeting system	production planning & scheduling system new product capacity & lead times	customers promise system orgn. for new product in mfg. introduction
<u>Tertiary</u> performance	total costs cost flexibility with volume change pdt. change	quality per- formance reliability	return on investment	ability to compete on pro- fitable basis with change in volume & products	ability to compete

SOURCE: Technology and the Manager - Part I, Working Paper, Harvard Business School,
Intercollegiate Case Clearing House, Soldiers Field, Boston (9-671-060), p. 7.

Any given EPT will perform certain physical activities in terms of the materials it will handle, the production output per hour, the range of product variations which can be manufactured, and the qualities of the product manufactured. However, regardless of the EPT choice, the final decision will have to take into account the following four EPT characteristics:⁵³

1. Size and Capacity - for example, investment in one large machine as opposed to a few smaller ones, and the design of extra capacity for contingency, growth, and flexibility.
2. General Purpose vs. Special Purpose - the use of a technology which can handle a broad range of products and/or materials with a simple changeover from one to another, instead of a special purpose technology which will handle one product or operation exceptionally well but will be limited in its flexibility, e.g., an automatic screw machine vs. a simple engine lathe.
3. Precision and Reliability - the degree of precision of product specification that the technology will have to meet, as well as the probabilities of meeting those specifications.
4. Degree of Mechanization - the more mechanized and automatic the EPT, the greater the capital investment at the time of its acquisition. In addition, while the dependence on operator time, skills and judgment will be less in the case of the more mechanized EPT, dependence on the infrastructure will be greater, i.e., maintenance, engineering and supervision re the care, adjustment and repair of the EPT.

From a corporate standpoint, the evaluation of the EPT characteristics will involve trade-offs between operating costs and different performance capabilities, as well as in the design of the operating system infrastructure. The quantity and quality of labour employed, for example, will be directly affected by all four EPT characteristics, which in turn will condition the wage system, labour agreements, recruiting, and supervision

53. Technology and the Manager, p. 11.

arrangements and activities of the firm. Similar effects and trade-offs would materialize, affecting cost controls, production planning, scheduling and quality controls, plant engineering and every other element in a factory system.⁵⁴ Moreover, because each of the EPT characteristics generates its own demands on the various elements of the infrastructure, problems often arise as to how best to satisfy the conflicting demands.

The design of the manufacturing system requires decisions concerning both its facilities and infrastructure.⁵⁵ Obviously, a continuous flow system and an intermittent manufacturing system will involve different facilities and infrastructure decisions. "For example, an assembly line is highly interdependent and inflexible, but generally promises lower costs and higher predictability than a loosely coupled line or batch flow operation or a job-shop."⁵⁶

Productivity and the Focused Factory

The National Commission on Productivity, formed in 1971 in the United States, has drawn attention to concern over the decline of productivity in the United States relative to other industrialized countries. In part, the Commission attributed the problem of higher cost and lower efficiency to "internal problems, such as assimilating new technology, the will to work, and shortages of highly skilled workers".⁵⁷ Professor Skinner of Harvard University analysed the cause of this problem in terms of the "piecemeal syndrome" approach taken by U.S. manufacturing executives - e.g., introducing new automated, highly mechanized machines without making the necessary changes in plant layout and materials handling. By not anticipating and adjusting for the impacts of a modified or new EPT on

54. Technology and the Manager, p. 11.

55. From Robert H. Hayes and Roger W. Schmenner, What's the "Right" Manufacturing Organization, Working Paper, Harvard University, Graduate School of Business Administration, 1977, p. 9.

56. Hayes and Schmenner (1977), p. 9.

57. Wickham Skinner, "The Anachronistic Factory," Harvard Business Review (Jan.-Feb. 1971), p. 62.

the total factory system, U.S. firms experience absenteeism and problems in workmanship, effort and morale on the factory floor.

The "infrastructure problem" is identified by Dr. Skinner as a major reason for declining productivity. Organizational levels, wage systems, supervisory practices, production control and scheduling approaches, and job design and method concepts are among the key elements of a factory's infrastructure. The problem with many U.S. firms is that while they may be quick to invest in new technology to combat competitive disadvantage, they often fail to recognize that this investment will not pay off unless similar attention and care is directed to the infrastructure. For example, the potentially positive results of automation and computer technology can be quickly nullified if the factory work force is not adequately counselled and prepared in advance of its introduction.

Skinner contends that U.S. productivity suffers from the fact that too many firms try to do too many conflicting manufacturing tasks with one plant and one organization. For example:

Most of the manufacturing plants in my study attempted a complex, heterogeneous mixture of general and special-purpose equipment, long- and short-run operations, high and low tolerances, new and old products, off-the-shelf items and customer specials, stable and changing designs, markets with reliable forecasts and unpredictable ones, seasonal and nonseasonal sales, short and long lead times, and high and low skills.⁵⁸

Consequently, the firm cannot develop a consistent, task oriented manufacturing policy. Instead, it is stuck with an assortment of policies designed to execute a variety of manufacturing tasks, sometimes conflicting, and often in one plant. Skinner includes the following elements in a manufacturing policy: size of plant and its capacity; location of plant; choice of equipment; plant layout; selection of production process; production scheduling system; use of inventories; wage system; training and supervisory approaches; control systems; and organizational structure.⁵⁹

57. Wickham Skinner, "The Focused Factory," Harvard Business Review, (May-June 1974), p. 116.

58. Skinner (1974), p. 117.

The inconsistencies in manufacturing policy which arise from the pursuit of different manufacturing tasks in one plant result in high cost performance. Tasks become exaggerated and when the plant design is overly complicated, the plant operation can be easily overstaffed and mismanaged. Skinner's "study shows that the chief negative effect is not on productivity but on ability to compete."⁶⁰

While the obvious solution to the problem is to engage in major investments in new plants, new equipment, and new tooling, Skinner suggests that the practical solution for most firms would be to adopt the "plant within a plant" (PWP) approach. This approach would allow each PWP its own facilities in which it can focus its particular work force, management orientation, production control techniques, etc.

The economic significance of a discussion of the manufacturing system, equipment and process technology and the focused factory is that it provides substance to the term "x-efficiency" in the economic literature. X-efficiency has been used as a catch-all for all forms of organizational slack that may appear within firms as a result of the absence of competitive pressures:

... management may eat into part or all of its potential monopoly profits - i.e., its "organizational slack" - by tolerating inefficiency and sheer waste. That is, it operates completely off the production function surface to which profit-maximizing enterprises adhere. Production and office staffs may become bloated and obsolete equipment may be retained in use long beyond the proper time for modernization.⁶¹

The particular type of manufacturing system employed in a plant may not be the most efficient one, not because of organizational slack due to the absence of competitive pressures, but due to the fact that it is not known what manufacturing system is the most efficient,

60. Skinner (1974), p. 117.

61. F.M. Scherer, Industrial Market Structure and Economic Performance (Chicago: Rand McNally, 1970), p. 405.

especially in a dynamic setting where technology is changing, and plants of different ages co-exist in an industry. Moreover, plants within an industry may differ in numerous respects, including something as intangible as management style, so that the manufacturing system suitable for one may not be suitable for another. Widespread discussion of manufacturing systems may provide some of the missing information necessary to improve internal efficiency.

CHAPTER II

THE PULP AND PAPER INDUSTRY

INDUSTRY OVERVIEW

The pulp and paper industry in Canada consists of about 145 plants owned by 75 enterprises, which produced shipments of \$5.7 billion in 1974.¹ The level of shipments, value-added and wages and salaries paid accounts for about seven to nine per cent of total Canadian manufacturing activity, as indicated in Table 3. The industry is a major employer in Canada, accounting for over 66,000 employees directly, and associated with an almost equal number in the logging and wood products industries. The livelihood of numerous Canadian communities is dependent on this industry.

Industry exports are a major contributor to Canadian exports, and while imports are small overall, they are significant in that they are concentrated in the segment of the industry which produces processed paper products, especially fine papers, where imports provide competition despite Canadian tariff protection.

An indication of how the pulp and paper industry compares with 86 other Canadian manufacturing industries is shown in Table 4. These data show that pulp and paper is a large Canadian industry with a small number of establishments and a high level of capital intensity, when compared to other manufacturing industries. The industry ranked low in terms of payroll as a per cent of shipments and value-added, as might be expected in a capital intensive industry. The same study also provides some relative performance indicators which suggest room for improvement in the industry. Profitability performance showed the industry to be 60 to 75 per cent of the average profitability for all manufacturing industries in Canada.²

-
1. The actual number of establishments and enterprises in the industry depends on the data source. Several sources will be used and identified in the study.
 2. Department of Industry, Trade and Commerce, Statistical Handbook on Canadian Manufacturing Industries (Ottawa, 1975).

TABLE 3

PULP AND PAPER INDUSTRY IN CANADA, 1974

		Per cent of total Canadian manufacturing
Number of establishments	147	0.47
Value of shipments (\$million)	5,703	6.9
Value-added (\$million)	3,034	8.6
Exports (\$million)	4,003	12.0 ^a
Imports (\$million)	206	0.7 ^a
Number of employees	66,584	5.1
Wages and salaries (\$million)	803	6.9
Cost of materials and supplies (\$million)	2,307	4.9
Cost of energy (\$million)	409	25.2
Capital employed (\$million)	9,866	-
Annual capital expenditure (\$million)	469	9.4

^a Per cent of total Canadian exports and imports.

Note: 1974 is a year which was not affected by a large number of strikes.

Sources: Statistics Canada and the Canadian Pulp and Paper Association.

TABLE 4

RANK OF PULP AND PAPER INDUSTRY
OUT OF 87 CANADIAN MANUFACTURING INDUSTRIES, 1970

	Rank out of 87 Canadian manufacturing industries
Number of establishments	53
Value of shipments	2
Value-added	2
Total employees	1
Net capital stock	1
Net capital stock per employee	6
Employee per establishment	2
Value-added per establishment	2
Value-added per employee (1968-1970 average)	17
Value-added per manhour	24
Value-added per labour and capital	53
Value-added per \$ of net capital stock	83
Productivity increase index	68

Source: Department of Industry, Trade and Commerce, Statistical Handbook on Canadian Manufacturing Industries, Ottawa, 1975.

The Canadian pulp and paper industry can be divided into several dimensions. On a regional basis, there is a western and eastern Canadian industry, with almost 30 per cent of the pulp making capacity in British Columbia, and 50 per cent in Ontario and Québec. Production and marketing characteristics vary between the two regions. All firms in the industry produce either pulp or paper products, some produce timber for pulp, and some are integrated with timber harvesting operations and may produce lumber as well. The three principal paper products are "newsprint," "other paper" and "paperboard," with newsprint having by far the largest value of shipments in the group.

Industry Definition

The Canadian pulp and paper industry consists of those enterprises and establishments producing pulp and paper as their principal products. Because timber is the resource common to wood products such as lumber and plywood as well as to pulp and paper, the pulp and paper industry is one part of the forest products industry and many of the producing firms operate in both segments of the industry.

The principal outputs of the forest products sector are softwood lumber, softwood plywood, pulp, newsprint, other paper and paperboard. The pulp and paper industry segment of this sector (SIC 271 according to the Standard Industrial Classification) produces pulp, newsprint, other paper and paperboard. Annual average production, 1973-1975, was 6,956,000 tons of pulp, 8,841,000 tons of newsprint and 4,821,000 tons of other paper and paperboard, for a total of 20,618,000 tons.

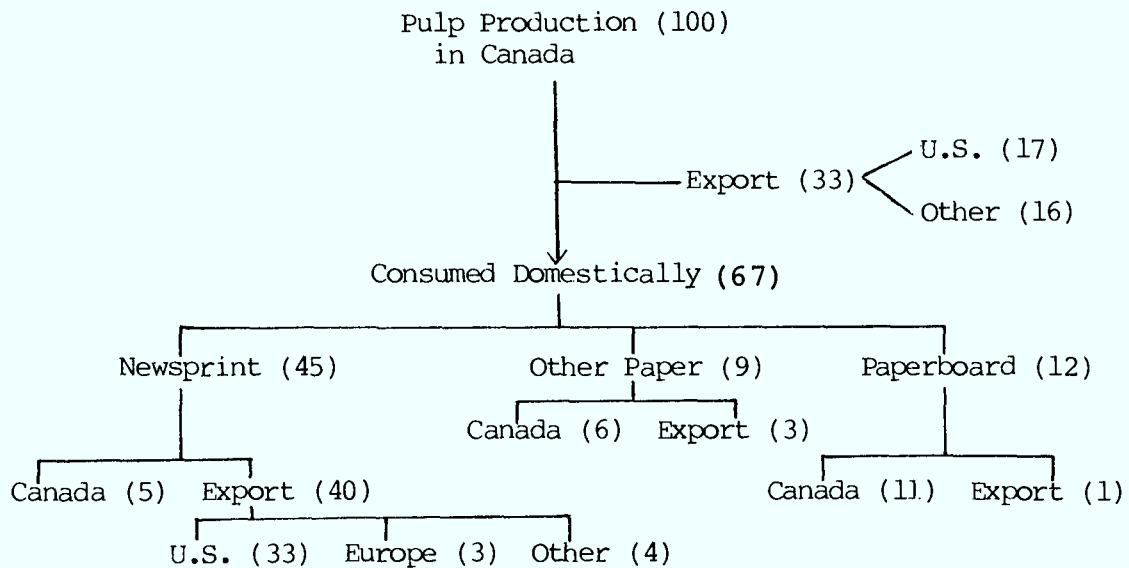
The production process for pulp and paper involves timber harvesting, pulp making, paper making, and paper converting and packaging. The Canadian pulp and paper industry produces pulp from timber, exports part of the pulp directly and converts the remainder into newsprint and into other paper and paperboard products. About 90 per cent of the newsprint is exported, with most of the exports going to the United States. Most of the "other paper" and paperboard is consumed in Canada together with a small amount of imported paper.

The production flow of the industry is shown in Exhibit 4. About 73 per cent of production is exported, primarily as pulp and newsprint, mostly to the United States. Canada is a major supplier of raw and semiprocessed materials to the United States, with a major involvement of

EXHIBIT 4

PRODUCTION FLOW OF CANADIAN PULP AND PAPER INDUSTRY, 1975

Based on data for production and shipments for 1974-75, the following diagram shows the approximate flow of pulp to different markets and principal end uses. Figures show the percentage of pulp production (100) going to each category (major end product and region)



Almost 80 per cent of pulp produced is exported either as pulp, newsprint, paper, paperboard and building board. In excess of 50 per cent of the pulp produced is exported to the United States in one form or another, but mainly as pulp or newsprint. Canada consumes about 20 per cent of pulp produced in the form of newsprint, other paper, paperboard and building board.

SOURCE: Canadian Pulp and Paper Association.

subsidiaries of large U.S. firms in this process. Almost all the fine papers produced in Canada are produced on a small scale by Canadian-owned firms and are sold in Canada behind tariff walls.

The principal end users of pulp are in the communications industry (newsprint, books, letters, forms, etc.), in the sanitary tissue industry, in the packaging industry (from wrapping paper to heavy cardboard containers), and in the building industry (products such as hardboard and insulating board). Thus competition for the pulp and paper industry results from different forms of communications such as radio, television, telex, computer networks and telephones; from different types of packaging such as plastic, glass, various metals and wood; and from a variety of materials used by the building trades.³

In terms of raw materials, the pulp and paper industry competes for the use of wood both with the wood products industry (lumber and plywood) and through it with the building industry, as well as with recreational uses of standing timber. Technological developments, with respect to both the pulp and paper industry and industries competing for inputs and outputs, affect the competitiveness of the pulp and paper industry. Thus, to some extent the definition of the industry, SIC 271, is too narrow in that there are some firms in other industries which produce reasonably close substitute products. In another sense, the industry is defined too broadly, because the market is regionally segmented, with transportation costs reducing the ability of firms in one part of the country to compete with firms in another part. In addition, some firms in Canada are locked into long-term supply contracts with certain buyers, especially subsidiaries of U.S. firms with associated plants in the United States, so that they do not compete on a day-to-day basis with other producers in Canada.

As noted, the industry is regionally segmented, the two principal segments being British Columbia and Eastern Canada. These segments differ not only in location, but also in terms of the type of production process used. For example, wood residue is a much more important input for pulp making in the West than in the East, so that the economics of the industry varies between the two regions.

3. The Canadian Pulp and Paper Association lists 24 product categories produced by member firms.

In addition, firms in the West tend not to produce in the East and those in the East tend not to produce in the West, although they may sell in each other's markets.

PRODUCTION PROCESS

A general view of the production process for the forest products industry is shown in Exhibit 5. The two segments of the industry, wood products and pulp and paper, are shown in terms of their end products. The segments interact in terms of a common raw material, timber, and the fact that waste from wood products becomes input for pulp making. Companies in the industry embrace different degrees of vertical integration (timber, pulp and paper) and of horizontal integration (wood products and pulp and paper products).

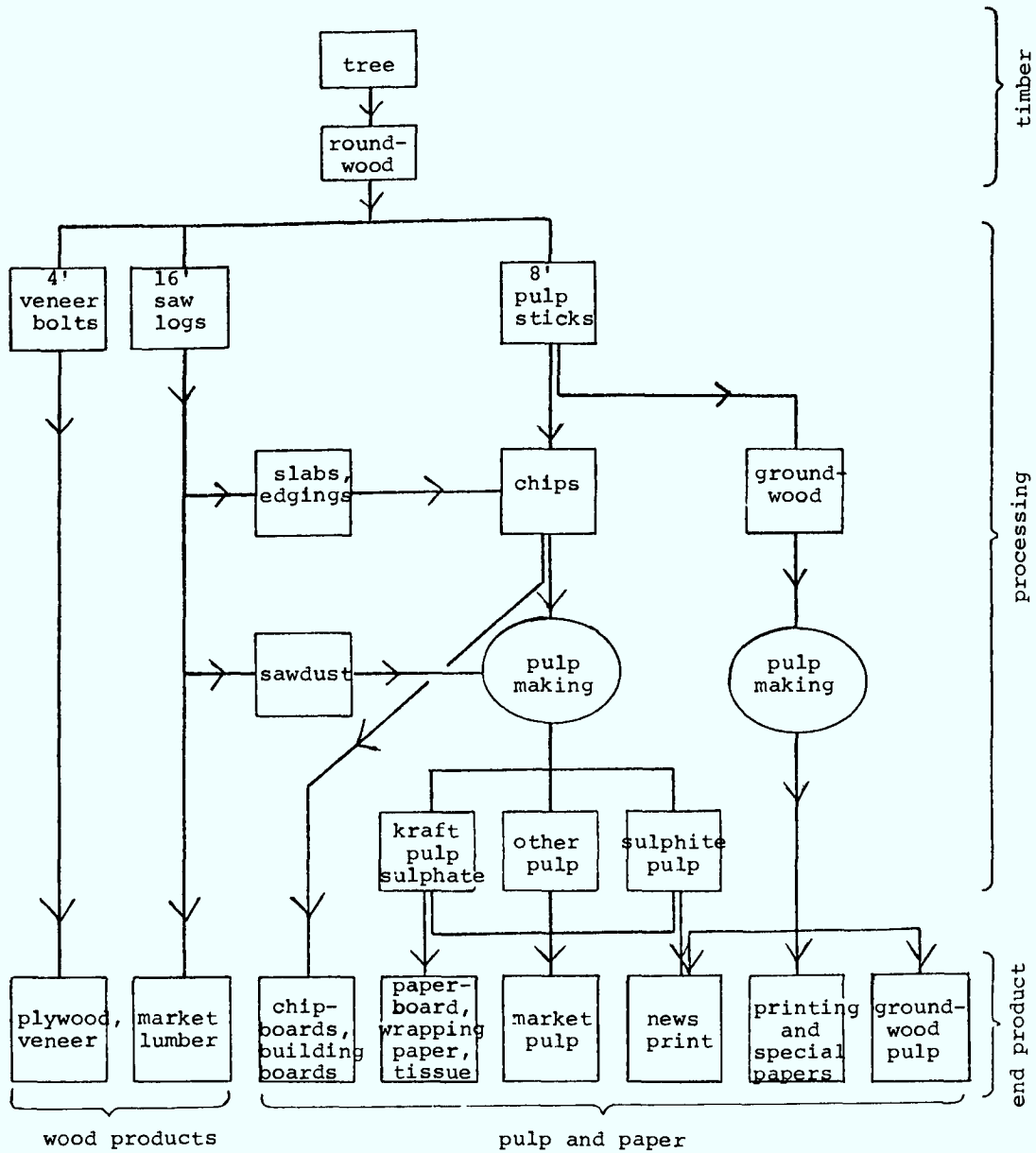
Most paper production begins with the harvesting of trees, as 95 per cent of the raw material for paper making is wood, with the remaining 5 per cent coming from rags, cotton linters, hemp, flax, and other fibres. In recent years pulp mills have developed means of making efficient use of chips left over from sawmill and plywood plant operations. Some argue that the best way to run a pulp mill is to use chips from a sawmill operation and no round wood.⁴ The feasibility of this procedure depends on having access to timber which can be cut for the lumber market so that the waste is available for chipping and thus for pulp and paper. Timber located in genetically old forests is often not suitable for lumber.

In addition, millions of tons of waste paper, including bond and writing paper, old magazines, old newspapers, used boxes, and other paper and paperboard products, are collected each year and routed back to the mills. These reclaimed materials are re-pulped and used in the production of paperboard and paper. There are limits to re-pulping because of damage sustained by the fibres in the process. In Canada, the recovery rate for waste paper is 12 per cent, compared to 6 per cent for Portugal and 46 per cent for the Netherlands.

4. Testimony by I. Barclay, British Columbia Forest Products, to Canadian Senate Committee on Foreign Affairs, 2 Dec. 1976, pp. 6-20 and 6-21. British Columbia Forest Products has two mills (MacKenzie and St. Felicien) which use only chips.

EXHIBIT 5

FOREST PRODUCTS INDUSTRY - PRODUCTION STAGES



Wood is made of billions of small cellulose fibres, bound together by a glue-like substance called lignin. Through these fibres flow the tree's sap and resins. A tree is approximately 50 per cent lignin and 50 per cent cellulose, and the chemical production of pulp and paper involves the separation of lignin from cellulose in order to use the cellulose for paper making. The lignin has little value and involves costs in disposing of it. Research is being conducted to see whether industrial chemicals or protein can be produced from it. When the sap, resins, lignin and other matter in the tree have been separated from the cellulose fibres by chemical means, the remaining fibres are called chemical pulp.

When the wood is reduced to small particles by friction using rotating grindstones or diskers revolving at high speeds, the resulting product is called mechanical pulp. This lacks the strength of most chemical pulps but has qualities found useful in high speed printing. Newsprint, for example, uses mechanical pulp.

The "mechanical" and the "chemical" methods of pulping wood are the two major pulping processes. However, research is underway to find more economical means of producing pulp for paper making from all kinds of vegetation. In addition, variations of pulp making are the chemigroundwood process, sulphate (or kraft), soda, semi-chemical, sulphite, and cold soda processes.

Mechanical pulping has traditionally involved either stone grinding methods (groundwood pulp) or refiner groundwood using revolving disk plates. The introduction in recent years of thermomechanical pulping has involved the heating of chips which are then fed with steam into a pressurised refiner at the first stage. The steam is then released before passage to the second stage of refining. An alternative method involves heating the chips, adding steam and then releasing the steam and feeding the chips to atmospheric refiners (not under pressure) at the first and second stages. A further development involves adding a chemical to the steam while heating the chips. This is called chemithermomechanical pulp.

Significant aspects of these techniques are first that mechanical pulping is cheaper to install and operate and causes less pollution than chemical pulping; second, there is a higher recovery of pulp from wood (95 per cent)

in mechanical than in chemical pulping (30 per cent);⁵ and third, the thermomechanical techniques result in longer fibres in the pulp, which raises the pulp quality, than when using the groundwood technique.

Fibre length is a critical ingredient in paper making. In general, softwoods produce longer fibres than hardwoods, and chemical pulp produces longer fibres than mechanical pulp. Thus Canadian softwoods and the greater use of thermomechanical pulping can provide an advantage for the Canadian industry, and this pulping process can be done on a smaller scale. This may be especially important in newsprint production which is increasing the proportion of mechanical pulp used, because of the thermomechanical techniques. U.S. southern softwoods may also benefit for similar reasons, but the fibres in the U.S. South, though long, tend to be fatter than in Canadian softwoods, which reduces their quality for paper making.

In pulp making by chemistry (see Exhibit 6), fibre separation is accomplished by cooking the wood in one of the several different methods, depending on the kind of pulp desired. The sulphate solution, for example, is especially used for making kraft (a Swedish word for "strength") papers for use as grocery bags and wrapping for packages.

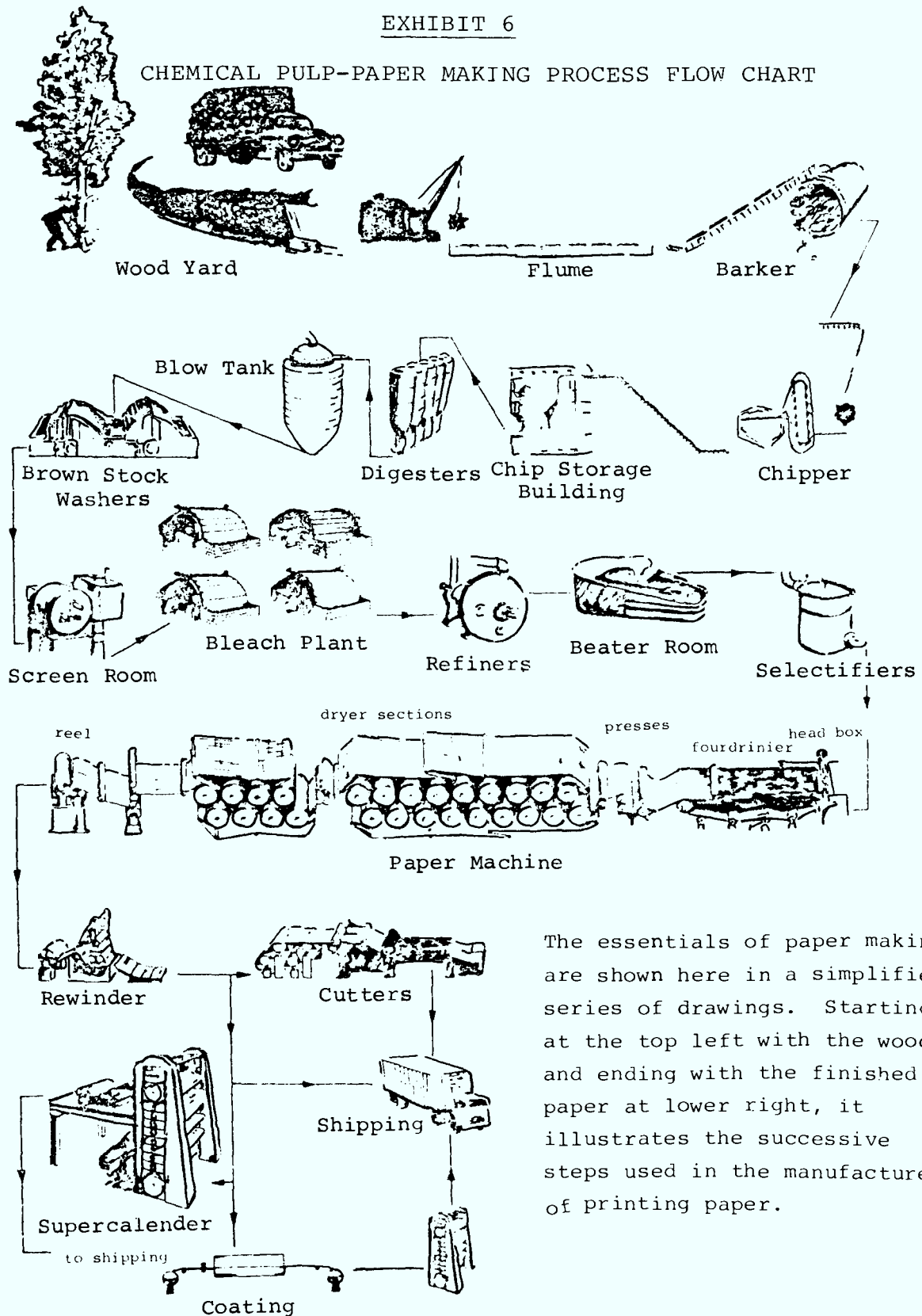
Pulpwood is first sliced into small chips, about an inch square and one-eighth inch thick, and is then fed into large vats, called "digesters," designed on the same principle as a kitchen pressure cooker. These digesters are three to four stories high. The chips and chemicals are steamed until the mixture is reduced to a wet, oatmeal-like mass. It is this cooking that dissolves the lignin and frees the fibres, suspending them in water.

The pulp is blown from the digesters under pressure to separate the fibres, washed to remove the chemicals and other materials from the fibres, and then sent to the beaters. On the way bleaching may be undertaken. The most common form of beating consists of passing the

5. The higher recovery of wood in mechanical pulp is due to the pulp containing the cellulose fibres and lignin, while in chemical pulp the lignin is removed and only the cellulose fibres remain. Removal of the lignin is not necessary for newsprint but is necessary for fine papers.

EXHIBIT 6

CHEMICAL PULP-PAPER MAKING PROCESS FLOW CHART



The essentials of paper making are shown here in a simplified series of drawings. Starting at the top left with the wood and ending with the finished paper at lower right, it illustrates the successive steps used in the manufacture of printing paper.

suspended pulp between sets of metal bars or knives that complete the separation, reduce the fibres to proper length, and fray their edges so that they will cling together when formed into a sheet. Added during the beatings are color, if desired, size (which makes finished paper water resistant) and whatever other chemicals are required to make a specific type of paper. At the refining stage, the fibres are cut to uniform size and brushed to further improve their ability to cling together in the sheet. The pulp - at this point 99 per cent water - is run onto an endless mesh screen at the "wet" end of the paper machines. This screen is called the Fourdrinier wire. Through a constant side-to-side vibration of the screen, the fibres are interlaced and much of the water extracted, leaving a sheet of paper which is quickly shunted through rollers for further drying.

Travelling at speeds sometimes faster than 3,000 feet per minute, the paper winds through a long series of steam-heated cylinders called "dryers," some wide enough to handle sheets 25 feet across. Here the last of the water is removed by heat, pressure and suction.

After drying, the procedure again differs according to the end product desired. Many papers go through a process called "calendering," which provides a glass-smooth finish by ironing the sheets between heavy, polished rollers. Others pass through tubs of chemicals that furnish additional coating. But however finished, the product that comes from the dry end is paper in large rolls which are then sent to converting areas to be made into many products. If the end product is dried pulp or paperboard, the process is similar but the end product is cut rather than rolled because of its thickness.

The total sequence of pulp and paper making has characteristics of both a continuous (flow) and an intermittent (batch) process. Timber harvesting has become increasingly capital intensive with the use of mechanical tree harvesters. The product, timber, is transported principally by water or truck in a batch operation to a pulp mill. Chips may be transported as a substitute input. The pulp making process is essentially a flow process, although digesters have to be filled and emptied in a batch operation. Paper making (head-box to reel) is itself a continuous process but the pulp input at the head box may consist of pulp from different sources, e.g., hardwood chemical pulp, softwood chemical pulp and groundwood pulp, and involve a batch process. Certainly, as different types of paper are made in the same machines, the operation

becomes more of an intermittent type. The final stage, cutting and packaging, is relatively more labour intensive and tends to be more of a batch operation, because of the variety of end products produced from paper. An exception to this would be in the case of mills which are specialized to producing one product, e.g., newsprint for one customer's paper. Overall, the production process is of an intermittent nature, but within the production stages there are examples of continuing processes. In part the ability to operate a continuous process will depend on the end product produced. The fewer the end products, the easier it will be to operate paper making as a continuous process.

The economics of paper making suggest that feeding the wood input into the pulp mill, the maintenance of machinery, and the cutting and packing of the end product are labour intensive operations. Continuous processes tend to be capital intensive, requiring labour at the start and end and in maintaining machinery and equipment. Visual evidence of good total factor productivity is when there are few machine operators who are doing nothing, indicating that the machinery is working well. Productivity declines and there is evidence of more labour when the machinery breaks down, when maintenance is underway or when machines have to be adjusted to new products. Even a crude partial productivity measure (output per unit of labour) is deficient if only direct labour is included, because it is both direct and indirect labour (e.g., maintenance) which will influence the output of paper.

Scale and specialization have to be viewed in terms of each of the stages of production as well as for the integrated process. Principal determining factors for scale and specialization will be the geographical location of timber and the characteristics and location of the market for the product. These features of the Canadian pulp and paper industry have to be put into perspective before issues of competition policy can be discussed. For example, scale can relate to type of wood, type of pulp, type of paper and packaging. Both scale and specialization can then be related to a single plant or to a multiplant operation, where different types of economies may be applicable.

Technology

The technology utilised by the pulp and paper industry can be examined in terms of the stages of production: timber harvesting, pulp making, and paper making. Much of the traditional technology is embodied in

machinery and equipment and in methods of organization which are widely known because of the mature nature of the industry. New technology has been developed because of rising labour and capital costs, the need to meet pollution standards and the pressure of energy costs. The maturity of the industry also means that the industry's cumulative learning experience is available through machinery manufacturers, consulting engineers and management consultants, so that access to technology is not a formidable barrier to entry. It should also be noted that the technology associated with organising and managing production, marketing and distribution may be as critical for productivity as the technology associated with machinery and equipment. Organisational technology may involve the relationship which the administrative functions of the firm may have to each other, as well as the layout of the equipment and machinery on the plant floor. Because plants are built at different times and because additions are often made to existing plants, a wide variety of plant layouts are found in practice.

The need to meet pollution standards has meant higher capital costs for new plants and increased capital expenditure for older plants which have to adapt to the standards of air and water pollution. The technology appears to exist to meet the standards. Costs vary between plants and firms.

New technology is being developed in the following areas. First, for the timber stage, science is being applied to the problem of harvesting and reforestation. Short-run productivity has been improved by increasing the capital intensity of logging operations, especially through the use of the tree harvester. A major problem is how to reduce the cost of transportation from forest to pulp mill. Various schemes are being tried including balloon logging and helicopter logging. Second, increased fibre yield from wood is being developed by work being undertaken on thermomechanical groundwood pulp making which reduces energy costs, reduces water pollution as well as increasing fibre yields. This process may displace sulphite mills, which produce a type of pulp required for newsprint⁶ and which tend to be heavy polluters.

A third area involves the use of waste paper in the recycling and making of new paper. Here, the technology exists, although de-inking is a problem, and there is a wide

6. Barclay (1976), p. 6-46.

variation between countries concerning the extent to which waste paper is recycled. In the Canadian case, it is argued that the cost of organising collection of waste paper over a wide geographical area discourages a greater use of recycled paper in current production.

Many of the paper making machines installed in plants are old in the sense that they were originally installed many years ago. However, the basic machines have usually been modernized through capital expenditures to improve their productivity in terms of speed of operation, drying capacity, and reliability through the use of computers in quality control systems. Thus, in a sense a new plant can replace an old plant through modernization expenditures made on existing basic machinery and equipment. In addition, entry can occur in the industry by increasing the output from existing machines, by adding new machines in old plants, as well as by building completely new plants.

Knowledge of the technology of production and organisation and the costs associated with the technology is a critical ingredient in an evaluation of the possible cost savings associated with a proposed merger or specialization agreement. For example, the merging of two firms leading to a high degree of concentration in sulphite pulp production may be of declining competitive significance if this process is being replaced by a new process of pulp making which will compete with the merged firm.

Factors which will affect the pulp and paper industry in the future include: the renewable nature of wood; the substantially longer tree regrowth period in Canada and Scandinavia than in the southern United States, where tree farming is undertaken as opposed to reforestation further north; the importance of forests for soil conservation and watershed management and their influence on climate; the reduction of waste problems because of the biodegradable nature of wood; the lower energy requirements for producing wood products relative to steel and aluminum; and the substitution of mechanical for chemical pulp.

INDUSTRY PROFILE

Global Position and Growth

The Canadian pulp and paper industry's share of world production and consumption of pulp and newsprint is shown in Table 5. The industry's share of wood pulp production has declined since 1950 from 22.2 to 16.4 per

cent, and its share of newsprint production has fallen from 53.4 to 34.7 per cent. In foreign trade, the industry's share of world pulp exports has increased, while its share of the more processed product, newsprint, has declined from 81.9 per cent in 1950 to 67.7 per cent in 1975.

The world position of Canadian firms in the pulp and paper industry reveals that the eleven largest firms by gross sales are in either the United States (9) or the United Kingdom (2).⁷ The four largest Canadian firms rank 12, 16, 19, and 33, but the largest Canadian firm, MacMillan Bloedel, is less than half the size of International Paper, the world's largest firm.

Between 1950 and 1974 (a relatively strike-free year), the industry grew in real terms (tons) as follows:

Wood pulp production	+154.0%
Newsprint production	+ 80.9%
Other Paper and Paperboard production	+264.2%
Pulp and Paper exports	+149.3%

Over the same period, the number of mills increased by 18.7 per cent (23 mills), and the labour input increased substantially less than the increase in production, again indicating the capital intensity of the industry. (See Table 6.) By 1974, there were an average of 590 employees per establishment compared to 425 per establishment in 1950.

The industry has become less export oriented in the sense that exports as a percentage of production (in value terms) has fallen from 75 per cent in 1950 to 70 per cent in 1974. The overall increase in exports of 91 per cent from 1960 to 1974 is broken down in terms of a 39.0 per cent increase in newsprint exports and a 143 per cent increase in other paper and paperboard exports. The international position of the industry has declined in the sense that Canada is now a less important supplier of pulp and paper to its major markets in the United States and Western Europe, as well as being a less important world producer of pulp and newsprint.

7. See Pulp and Paper International, Sept. 1975.

TABLE 5

WORLD POSITION OF CANADA'S PULP AND PAPER INDUSTRY,
1950-1970

Canada's share of	1974	1970	1960	1950
(in percentages)				
World production of wood pulp	16.4	15.9	17.5	22.2
World consumption of wood pulp	11.1	11.1	13.5	17.4
World export of wood pulp	35.6	30.3	24.2	29.4
World production of newsprint	34.7 ^a	38.3	45.1	53.4
World consumption of newsprint	3.9 ^a	3.1	3.2	3.7
World export of newsprint	67.7 ^a	69.9	76.1	81.9

^a For 1975.

Source: Canadian Pulp and Paper Association, Montreal,
Reference Tables 1976.

TABLE 6

PULP AND PAPER INDUSTRY GROWTH IN CANADA, 1950-1975

	1975	1974	1970	1960	1950
Gross production (\$million)	5351	5700	2851	1583	954
Pulp and paper share of GNP (%)	3.46	4.05	3.34	4.36	5.30
Establishments (nos.)	147	146	139	126	123
Employees (nos.)	73625	86203	80371	65772	52343
Wages & salaries (\$million)	1067	1097	701	345	169
Capital employed (\$million)	10700	9852	6942	3142	1350
Capital employed per employee (\$'000)	145	118	86	48	26
Pulp & paper exports ('000T)	13500	17366	14692	9088	6965
Pulp & paper exports (\$million)	3861	4011	2063	1124	714
Pulp & paper exports share of total Canadian exports (%)	12.03	12.77	12.51	21.38	22.89
Wood Pulp Production	16500	21518	18308	11461	8473
NEWSPRINT					
Capacity ('000T)	10165	10038	9845	7611	5227
Production ('000T)	7679	9548	8719	6739	5279
Operating Ratio (%)	75.5	95.0	88.6	88.5	101.0
Shipments to Canada ('000T)	864	886	717	487	355
Exports ('000T)	6863	8711	7988	6265	4956
Total Shipments ('000T)	7727	9597	8704	6752	5311
Other paper & paperboard ('000T)	3875	5438	3960	2234	1493
Exports of other paper ('000T)	661	867	538	195*	
Exports of paperboard ('000T)	295	589	384	245*	
Imports of paper, paperboard and paper products (\$million)	385	306	125	68	23

* 1965

Source: Canadian Pulp and Paper Association, Reference Tables, 1976.

Canada's share of the U.S. market for pulp and paper has declined. Canada supplied 80 per cent of the U.S. newsprint supply in 1950 and 72 per cent in 1960. In 1975, the share dropped to 61 per cent as a result of increased production in the United States. This has resulted in part from increased pulp supplies coming from U.S. sources, and in part from imported pulp, including pulp from Canada. In 1950, Canada provided 10 per cent of the U.S. wood pulp supply (1.7 million tons). By 1975, this share had fallen to 7.3 per cent although the tonnage had increased to 3 million tons. The Canadian industry is now described as a marginal supplier to non-Canadian markets.⁸

Concentration and Product Differentiation

From an economic viewpoint, overall concentration figures are less meaningful than concentration in the main product categories, which are shown in Table 7 for 1964 and 1974. Only in the case of newsprint production has there been a significant increase in concentration in recent years. The high level of concentration for printing and writing paper is associated mainly with a few Canadian-owned firms which produce a wide range of these products on a small scale with high unit costs and tariff protection, a typical "miniature replica effect" situation, but without a high level of foreign investment.

The term "specialization" relates to two characteristics of the industry - the extent to which firms are specialized in the production of pulp and paper products as opposed to other products, and the extent to which firms and plants specialize in the production of particular pulp and paper products. The latter characteristic is discussed in the section dealing with the corporate landscape. On the former point, aggregate industry enterprise statistics for 1970 show that 53.5 per cent of industry value-added comes from establishments coded to the pulp and paper industry (SIC 271) and 46.5 per cent from establishments coded to other industries. Pulp and paper is shown to be unspecialised relative to other industries.⁹ According to

8. Barclay (1976), p. 6-36; and developed during discussions with Department of Industry, Trade and Commerce, Ottawa.

9. See Statistics Canada, Industrial Organization and Concentration in the Manufacturing, Mining and Logging Industries (Information Canada, 1975), p. 116.

this set of data, there are 46 enterprises in the SIC 271. Thirteen are single plant enterprises producing pulp and paper, two have two plants, each producing pulp and paper, and 31 are multiplant enterprises with 101 plants producing pulp and paper and 510 plants producing other products. Thus, a total of 118 plants were associated in 1970 with the pulp and paper industry.

However, the low level of industry specialization in pulp and paper is somewhat misleading, since firms operate plants in other branches of the forest products industry, such as sawmills (SIC 251), veneer and plywood mills (SIC 252), and logging (SIC 031), as well as in the chemical industry and transportation industry, which provide products and services required in pulp and paper production. The low level of specialization in the pulp and paper industry should not necessarily be regarded as firms straying very far from forest related activities.

Product differentiation is significant in the industry with respect to the production of tissues, especially sanitary tissue products, which are heavily advertised. Newsprint and papers do vary in quality but differentiation tends to be more in the form of services which each firm can give to its customers, usually through the activities of its sales force. Printers and converters do specify both quality and particular companies in ordering paper.

According to CALURA (Corporations and Labour Unions Return Act), the extent of foreign control of the paper and allied industries, of which pulp and paper is one part, was around 45 per cent in 1974. About 75 per cent of this total was U.S. owned and 7 per cent was U.K. owned.

Foreign control of different segments of the pulp and paper industry is as follows:¹⁰

	<u>Canadian controlled</u>	<u>U.S. controlled</u>	<u>Other foreign controlled</u>
Pulp capacity ^a	59%	29%	12%
Newsprint capacity	62%	28%	10%
Other paper and paperboard ^b capacity	72%	19%	9%

^a Excluding mechanical pulp for building board and paper.

^b Excluding building paper and board, but including ground-wood printing papers.

10. CPPA Brief to Royal Commission on Corporate Concentration, Nov. 1975, p. 10.

The eleven largest international pulp and paper companies, which are all non-Canadian, have operations in Canada. For example, Canadian International Paper, a wholly-owned subsidiary of International Paper, the largest pulp and paper company in the world, has six plants and produces a range of pulp and paper products.

Costs - Production

The average cost of pulpwood used by pulp and paper mills in Canada 1961-1974 is shown in Table 8. From the 1950s to 1965 the cost of roundwood altered very little. Between 1965 and 1972 pulpwood costs rose at an annual average rate of less than 3 per cent, while the annual increase in 1973 was 10.3 per cent and in 1974 18.6 per cent. The major increase in the cost of pulp chips came in 1974 with an increase of 35 per cent. Pulp chips have become a more important source of wood in recent years. Second, the cost of pulpwood has increased faster in Canada than in the United States, especially the southern U.S., which now provides a major competitive factor for the Canadian industry.

The regional cost differences in Canada and the United States are due to the physical characteristics of the wood, to its location and accessibility, as well as to the cost of the principal inputs such as labour and capital. Essentially it is the fibre content of timber which is required for pulp and paper, which in turn is dependent on the density of the wood, so that information on the volume of wood cut has to be combined with data on density before the value of wood for pulp and paper can be calculated. For example, advantages which the U.S. South has over eastern Canada are the higher density of wood cut in the South, as well as the easier access to woodlands requiring less infrastructure costs such as roads. Density will vary not only with the type of wood cut, but with its age, such that a genetically mature forest will tend to have a higher proportion of trees with low fibre content because of aging. In sum, comparisons of cost per cunit of wood are incomplete cost comparisons without further information on wood density.¹¹

11. It is estimated that 1 ton of bleached kraft pulp requires 1.8 cunits of eastern Canada softwood compared to 1.36 cunits of southern U.S. pine.

TABLE 7

SHARE OF PRODUCTION OF LEADING FIVE FIRMS,
CANADIAN PULP AND PAPER INDUSTRY

		1964		1974
Newsprint	(22)	54%	(21)	62%
Pulp for sale	(35)	44	(39)	30
Paperboard	(19)	67	(21)	60
Printing and writing paper	(7)	80	(7)	79
Wrapping paper	(12)	77	(13)	73

() shows total number of firms

Source: Canadian Pulp and Paper Association, Brief to Royal Commission on Corporate Concentration, 1976.

TABLE 8

AVERAGE COST OF PULPWOOD USED BY PULP AND PAPER MILLS
IN CANADA, 1961-74

(\$ Per Cunit)

Roundwood	Canada	British Columbia	Ontario	Québec	Other provinces
1961	29.77	20.08	33.52	31.86	27.95
1965	29.64	21.12	33.05	32.16	27.90
1970	34.11	25.15	38.61	37.65	30.89
1971	34.	26.22	40.16	38.11	30.97
1972	35.66	28.80	40.17	39.23	31.64
1973	39.33	32.90	42.23	43.14	37.58
1974	46.64	38.73	49.44	51.72	43.34
<u>Pulp chips</u>					
1961	20.25	17.66	29.32	26.47	28.74
1965	25.32	24.34	31.08	30.02	28.52
1970	24.79	21.92	35.27	35.38	27.90
1971	25.63	21.12	37.87	36.54	33.79
1972	26.40	22.30	35.98	36.35	33.87
1973	26.69	22.35	35.30	37.58	36.26
1974	36.11	33.94	39.73	47.85	39.29

Source: Developed during discussions with Department of Industry, Trade and Commerce, Ottawa.

It is also the case that pulp chips are obtained as a by-product of sawmills, and thus are in joint supply with lumber. Consequently, those firms which operate both sawmills and pulp and paper mills are able to set pulp chip prices at the desired level within the firm on the basis of transfer prices. Thus, a firm integrated backwards into sawmills may have greater commercial flexibility to determine where its profits are taken, than a firm which has to buy pulpwood or chips on the open market. In British Columbia, wood residues constitute a much higher percentage of total fibre supply than in eastern Canada.

In recent years capital has been substituted for labour in logging operations, with a greater use made of heavy machinery and equipment. In part, this has been a response to problems of a regular supply of labour and rising labour costs. However, it is estimated that direct labour still accounts for 40 to 60 per cent of total wood costs. For Ontario, the approximate distribution of wood costs is suggested as follows:¹²

	<u>per cent</u>
Cutting and skidding roadside	30
Slashing	10
Total delivery (roadside to mill)	25
Overhead costs	25
Stumpage and scaling	10
	<hr/>
Total delivered cost	<u>100</u>

Obviously this distribution will vary with the delivery distances, with labour and capital costs and with stumpage payments. The last are set by governments in the case of crown owned land. The major areas for cost reductions are for labour and capital. Labour productivity has increased in logging operations but this has been offset by rising wage costs and the cost of depreciation, repair and maintenance expense associated with the mechanization of operations. This provides a good example of a real partial productivity measure, labour productivity, providing a poor indicator of the cost efficiency of an activity.

12. Developed during discussions with Department of Industry, Trade and Commerce, Ottawa.

Allowing for all the foregoing caveats, one estimate of comparative wood costs for 1976 between regions of Canada, the U.S. South and Sweden suggests that the highest wood costs are in Sweden, Newfoundland, Ontario and Québec and the lowest are in British Columbia and Alberta. (See Table 9.)

TABLE 9
COMPARATIVE REGIONAL WOOD COSTS, 1976

(\$ per unit)

<u>CANADA</u>	<u>1976</u>
British Columbia Coast	32-40
British Columbia Interior	35-44
Alberta	30-35
Ontario	70-80
Quebec	65-75
Maritimes	45-55
Newfoundland	70-80
<u>U.S. SOUTH</u>	45-55
<u>SWEDEN</u>	76-86

Source: Developed during discussions with Department of Industry, Trade and Commerce.

Estimates of production costs related to pulp and newsprint mills with 1000 tons per day (350,000 tons per year) capacity using softwoods are shown in Tables 10, 11, 12, and 13. These estimates assume the following:

The new newsprint mills use refiners for the production of mechanical pulp. The 10 year old mills have not undergone any basic changes since their inception....The new mills are costed at 1976 levels for all cost elements. The 10 year old mills are costed at 1966 levels for annual capital, interest and depreciation costs and at 1976 levels for all other cost elements.

The capital cost per annual ton takes into consideration all normal capital cost elements including pollution control, but does not take into consideration such capital cost elements as forest land and infra-structure.

TABLE 10
DISTRIBUTION OF COSTS AND PROFITS FOR
SOFTWOOD BLEACHED KRAFT PULP, 1976

	U.S. South New mill	Eastern Canada New mill	10-year-old
Selling price (third quarter 1976)	100%	100%	100%
Manufacturing costs			
Wood	20.8	31.9	31.9
Labour (incl. fringe)	6.4	6.9	7.2
Energy	7.8	6.4	7.0
Other	12.5	13.9	14.4
Sub-total	47.5	59.1	60.5
Overhead, selling & admin.	4.4	5.0	5.0
Transportation	4.2	8.3	8.3
Capital related	23.9	29.2	6.7
Gross before tax	20.0	(1.6)	19.5

Source: Developed during discussions with Department of Industry, Trade and Commerce.

TABLE 11
DISTRIBUTION OF COSTS AND PROFITS FOR NEWSPRINT, 1976

	U.S. South New mill	Eastern Canada New mill	10-year-old
Selling Price (third quarter 1976)	100%	100%	100%
Manufacturing costs			
Wood	14.0	24.6	24.6
Purchased chemical pulp	12.6	13.0	13.0
Labour (incl. fringe)	7.4	9.1	9.8
Energy	15.8	14.0	13.3
Other	5.6	7.0	7.3
Sub-Total	55.4	67.7	68.0
Overhead, selling & admin.	5.6	6.3	6.3
Transportation	5.3	12.3	12.3
Capital related	20.4	24.9	8.1
Gross before tax	13.3	(11.2)	5.3

Source: Developed during discussions with Department of Industry Trade and Commerce.

TABLE 12

COMPARISON OF PROFITABILITY AND COSTS OF SOFTWOOD BLEACHED
KRAFT PULP IN EASTERN CANADA AND THE U.S. SOUTH, 1976

	U.S. South New mill	Eastern Canada New mill 10-year-old	
Capital costs			
per annual ton	100	105	30
working	100	120	130
Manufacturing costs			
Wood	100	153	153
Labour (incl. fringe)	100	108	113
Energy	100	82	90
Other	100	111	115
Overhead, selling & admin. costs	100	113	113
Transportation costs	100	200	200
Interest on debt (40% equity)	100	140	25
Depreciation (5% annum)	100	105	30
Total del'd cost	100	126	101
Gross before tax	100	negative	95
Equity	100	105	30
ROE before tax	100	negative	320

Source: Developed during discussion with Department of Industry
Trade and Commerce.

TABLE 13

COMPARISON OF PROFITABILITY AND COSTS OF NEWSPRINT IN
EASTERN CANADA AND THE U.S. SOUTH, 1976

	U.S. South New mill	Eastern Canada New mill 10-year-old	
Capital costs			
per annual ton	100	105	42
working	100	125	133
Manufacturing costs			
Wood	100	175	175
Purchased chemical pulp	100	103	103
Labour (incl. fringe)	100	123	132
Energy	100	88	84
Other	100	125	130
Overhead, selling & admin. costs	100	113	113
Transportation costs	100	230	232
Interest on debt (40% equity)	100	140	35
Depreciation (5% annum)	100	104	43
Total del'd costs	100	128	110
Gross before tax	100	negative	40
Equity	100	105	40
ROE before tax	100	negative	95

Source: Developed during discussion with Department of
Industry, Trade and Commerce.

The working capital cost for all mills is based on 1976 levels of cost and mainly reflects the higher wood inventory essential in Canadian mills and the more distant wood likely for the 10-year old mills.¹³

In terms of pulp production, wood costs and capital related costs account for from 38.6 to 61.1 per cent of the selling price of pulp, while direct labour amounts to only 6 to 7 per cent. The principal cost differences for the three mills relate to the higher wood costs and transportation costs in Eastern Canada and the higher capital costs for the new mill in Eastern Canada. Not only are interest costs higher in Canada but the cost of machinery is also higher. In the case of the ten-year-old mill, there are lower capital costs due to the use of book value for measuring capital, however working capital costs are higher for the ten-year old mill than either of the other two mills. Thus, old eastern Canadian mills can compete with new southern U.S. mills providing book value of assets is used for valuation purposes. The ability of old eastern Canadian mills to compete in the future will depend on the extent to which they update their existing equipment. This will require replacement at current costs for which insufficient allowance out of depreciation is made, if firms only set aside allowances based on the book value of assets.

The principal cost elements in newsprint production are capital, wood and pulp, and energy which constitute from 59 per cent to 77 per cent of total selling price. Energy is a major cost element because of the energy requirements of mechanical pulping, and labour accounts for 7 per cent to 10 per cent of selling price. Similar comparisons tend to apply for newsprint production as for pulp production, namely, that wood/pulp costs and transportation costs are considerably higher in Canada; capital costs are also higher in Canada except in the case of a 10-year-old mill.

These data have led analysts to argue that existing mills have an advantage over new mills because of the high cost of building new mills, and that this represents the principal entry barrier to new firms in North America. This entry barrier is even higher in Canada

13. Developed during discussions with Department of Industry, Trade and Commerce.

because the cost of capital, machinery and equipment is higher in Canada than in the United States. A study prepared by Environment Canada notes that Canadian producers pay on average 15.5 per cent more for the same "basket" of forest machinery and equipment than their competitors in the United States and 37 per cent more than the Finns.¹⁴ The same type of cost differential probably relates to machinery and equipment used in pulp and newsprint manufacturing.

An engineering estimate of the relationship between unit manufacturing costs and mill capacity for the manufacture of sack paper and newsprint,¹⁵ based on 1972 Swedish conditions, are considered in general to have global validity. For example, minimum optimum scale of newsprint production in Canada is now estimated at 1000 tpd. Unit costs according to the Swedish data increase about 10 per cent for an integrated newsprint mill of about half the minimum optimum size.¹⁶

The Swedish study also shows the cost savings associated with various degrees of vertical integration. For example, the minimum optimum scale of a non-integrated mill has average costs which are about 13 per cent higher than for an integrated groundwood pulp and newsprint mill, with most of the higher average costs associated with capital and direct labour.

Costs - Investment

The same engineering source has estimated the economies associated with investment requirements per ton of pulp and paper capacity for integrated and non-integrated

14. Barclay (1976), p. 6A-15.

15. Jaako Poyry & Co., JP Publication No. 8, 1972 (P.O. Box 20, Helsinki, Finland, 38).

16. Minimum optimum scale for an integrated pulp and newsprint plant in Sweden ranges from 250,000 to 350,000 tons per annum. The estimates of a recent Canadian study range from 165,000 to 250,000 tons per annum. The differences are due to different time periods and different methods of estimation being used. See R. Schwindt, The Existence and Exercise of Corporate Power (Ottawa Royal Commission on Corporate Concentration, March 1977), pp. 79-108.

mills. The general relationship shows that the investment requirements (\$ per ton of annual capacity) decline with increases in capacity up to about 800 tpd (300,000 tons per year) for pulp and paper mills. Different types of pulp mill operations are shown to have different levels of investment requirements, e.g., a bleached sulphate pulp mill has investment requirements which are nearly four times higher per ton than for a groundwood mill where both mills have a capacity of 180,000 tons per annum. In general, the investment requirements for a groundwood pulp mill are much lower than for other types of pulp mill, and there are no substantial investment savings to building a groundwood pulp mill in excess of about 140,000 tons per annum. Similarly, the investment requirements for an integrated paper and board mill are higher than for a non-integrated mill with investment savings occurring as capacity increases.

This information is also used to contrast various countries. If the investment information for pulp mills is shown as 100 for Sweden, then British Columbia is 115, Brazil 110, the U.S. South 105, and Finland 95. Thus, British Columbia is shown as the high cost region from an investment viewpoint. An analysis of the capital cost structure of building mills in different parts of the world suggests that infrastructure costs (roads, railways, etc.) are highest in developing countries, lower in British Columbia and lowest in Scandinavia; labour costs are lower in Scandinavia and in developing countries than in British Columbia. This results in lower capital costs in Scandinavia and in some developing countries than in British Columbia, with the developing country's lower labour costs more than offsetting the higher infrastructure costs.

The large scale of pulp mills encouraged by economies of scale based on existing technology may be altered in the future by developments in thermomechanical and chemithermomechanical pulp based paper plants. For developing countries this may permit the construction of integrated pulp and paper plants with capacities of 50 to 150 tpd.¹⁷ Mechanical pulp is increasingly being substituted for chemical pulp in newsprint, printing and writing papers. Since mechanical pulp can be produced economically on a smaller scale than chemical pulp, this may also permit smaller scale operations to be undertaken in the future.

17. Jaako Poyry & Co., JP Publication No. 48 (P.O. Box 20, Helsinki, Finland, 38), p. 9.

At present, there are freight advantages to shipping pulp as opposed to chips or waste paper. For example, by ocean transport, it would cost about twice as much to ship the chip equivalent of a ton of pulp, and about two and one-quarter times as much to ship the baled recycled fibre equivalent of a ton of pulp, than it would a ton of pulp.¹⁸ Pelletized recycled fibre however may not be at a transport cost disadvantage to pulp. Thus, while transport costs may not favour further integration forward, they do not encourage less backward integration, i.e., selling chips as opposed to pulp.

International differences in plant size and machine capacities actually utilised make an interesting comparison. For example, in the case of newsprint, average machine capacity is higher in the Nordic countries than in North America, although the opposite is true in the case of linerboard, Exhibit 7. Until the early 1960s average machine capacity for newsprint and paper was very similar in North America and the Nordic countries and it is only in recent years that the latter have drawn ahead. The percentage distribution of machine size (by capacity) for the newsprint industries of the Nordic countries, North America and the EEC countries is shown in Exhibit 8. In 1976, the EEC had no newsprint machines with capacities in excess of 120,000 tons per annum, while for North America and the Nordic countries 30 per cent and 48 per cent total newsprint capacity came from machines with annual capacity in excess of 120,000 tons per annum.

Further analysis needs to be undertaken of the age of machinery and equipment as well. Those countries with larger average machine sizes tend to have newer machines which are wider and faster. However, age is not everything since old machines can be modernized, especially in terms of speed if not width. For example, the U.K. paper industry competes with machinery which was mostly installed prior to World War I.¹⁹ Future technological developments may not all favour increasing size.

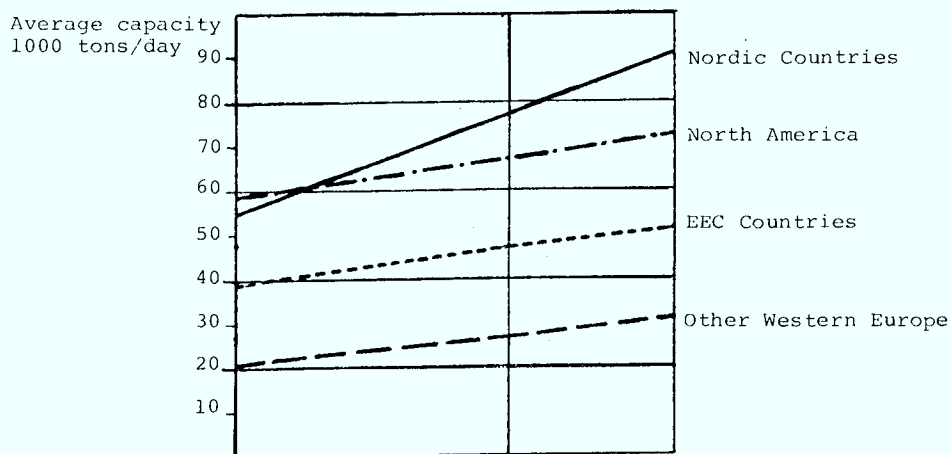
18. Poyry, No. 48, pp. 14-19.

19. Jaako Poyry & Co., JP Publication No. 17, (P.O. Box 20, Helsinki, Finland, 38), p. 4.

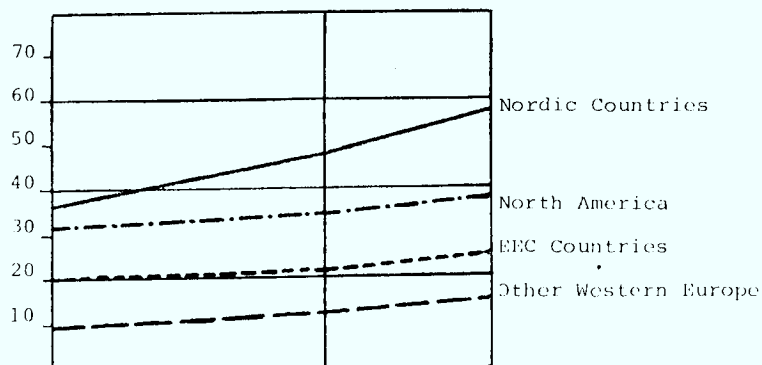
EXHIBIT 7

AVERAGE MACHINE CAPACITY OF NEWSPRINT, WOOD-CONTAINING
PRINTING AND WRITING PAPER, AND KRAFTLINER IN 1960-76

NEWSPRINT



WOOD-CONTAINING
PRINTING AND
WRITING PAPER



LINERBOARD

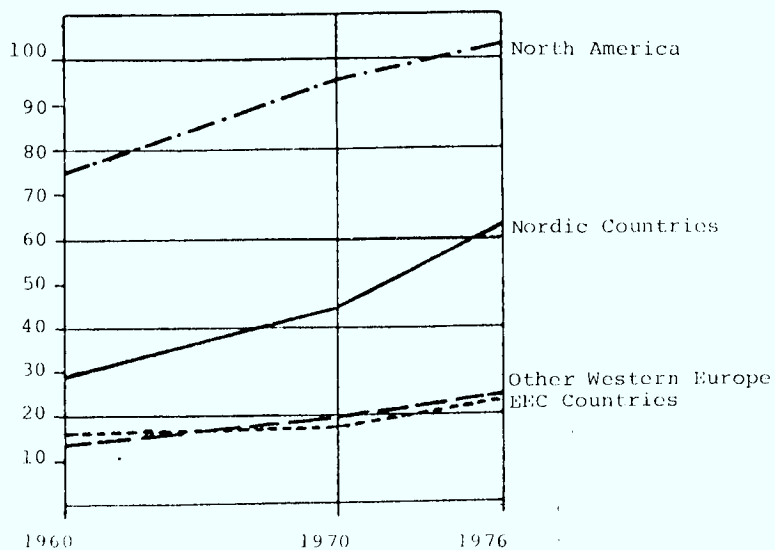
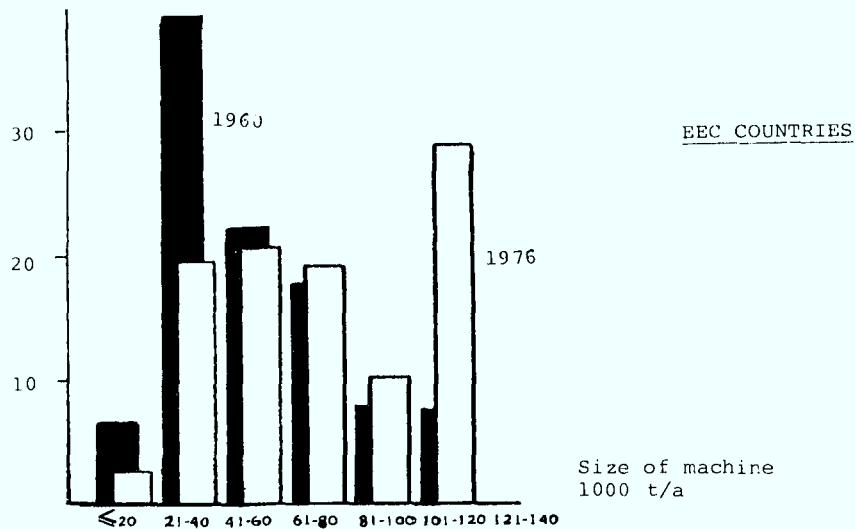
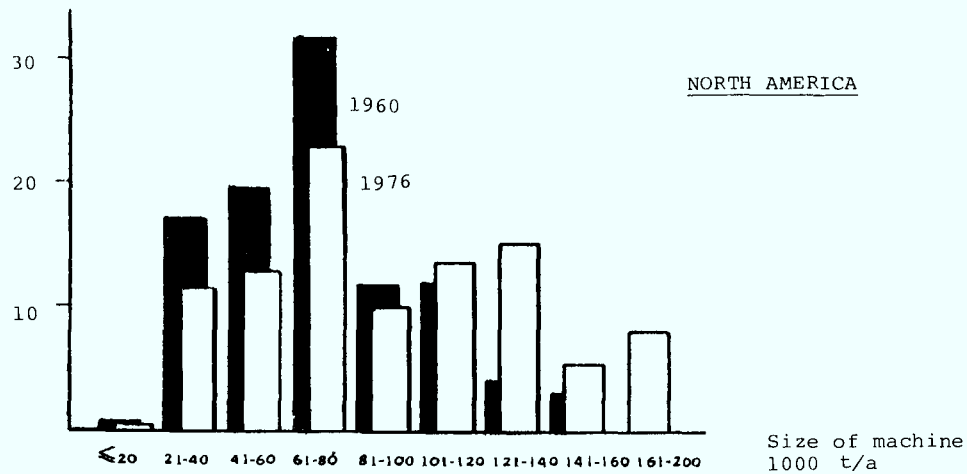
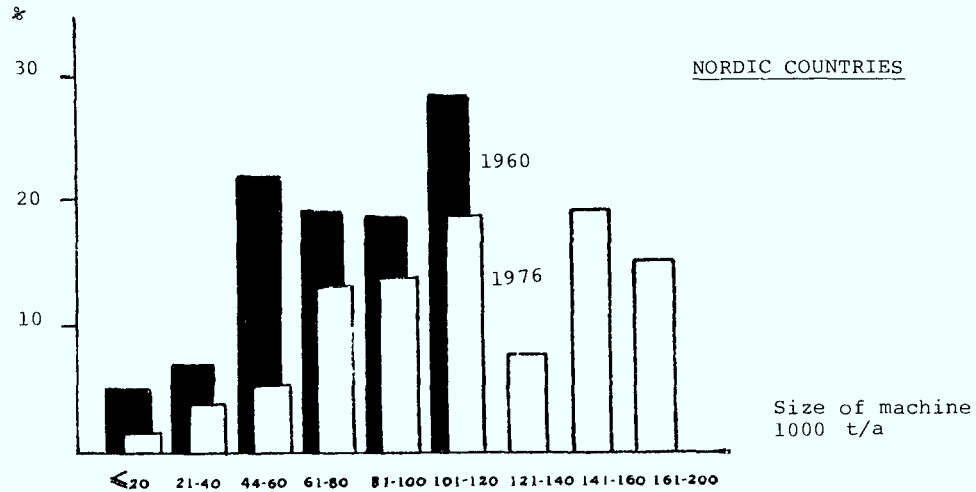


EXHIBIT 8

Share of
total capacity

THE STRUCTURE OF NEWSPRINT CAPACITY



Source:

Jaako Poyry, JP No. 48, p. 28.

Productivity, Profitability and Prices

For 1972, the following productivity data have been reported for the "Paper and Allied Products" sector of Canadian manufacturing, one of 20 such sectors:²⁰

- Value-added per production worker was 18.2 per cent lower in Canada than in the United States.
- Value-added per person employed was 7 per cent lower in Canadian controlled establishments than in U.S. controlled establishments in the pulp and paper industry.
- Value-added per combined unit of labour and capital: the sector ranked 16 out of 20 Canadian manufacturing sectors.
- Value-added per dollar of gross capital stock (at replacement cost) was 75.4 per cent lower in Canada than in the United States.
- Value-added per combined unit of labour and capital was 94.7 per cent lower in Canada than in the United States.
- Capital stock per production worker was 3.3 times higher in Canada, and on this measure the Canadian "Pulp and Allied Products" sector was the third most capital intensive sector of the 20 Canadian manufacturing sectors.

These data show the comparative productivity performance of the "Paper and Allied Products" sector in Canada and the United States and the high level of capital intensity of the industry, in both Canadian terms and comparative U.S. terms. The latter aspect is of particular

-
19. Jaako Poyry & Co., JP Publication No. 17, (P.O. Box 20, Helsinki, Finland, 38), p. 4.
 20. Department of Industry, Trade and Commerce, Discussion Paper entitled, "Productivity and Competitiveness in the Canadian Economy", (Ottawa Office of Policy Analysis), 28 Oct. 1976, pp. 19-33.

concern because of the stated need for the industry to modernise its machinery and equipment.

The profitability of the industry has been considerably below the average profitability of all Canadian manufacturing industry, and this situation has persisted for a number of years, as indicated in Table 14. One bright spot in recent years was 1974. A comparison with the U.S. industry, Table 15, shows a fairly persistent lower level of profitability in Canada in recent years.

Table 16 presents financial statements for Canada's leading pulp and paper companies. For the 1970-74 period, the 100 largest Canadian companies had a return of 18.4 per cent, and the long term corporate bond yield ranged from 8.5 to 10.5 per cent for the forest industry compared to the major pulp and paper companies' returns of 8.6 per cent. Thus not only has the industry been losing world markets, but it has shown a poor profit performance, and is now faced by substantial costs for modernization and pollution abatement.

The following prices are published by the Paper Trade Journal, and indicate the general level and movement of prices for certain types of pulp and paper in recent years. This information has to be placed in the context of the long term sales contracts which characterise the industry and which allow for price changes, as well as for discounts given for various reasons including quantity purchases. The long term contracts are usually very flexible, allowing for adjustments of both volume and price as market conditions alter. For the buyer, the contracts often reserve a certain share of the output of a supplier, and for a supplier there is an agreement that in times of cutback all suppliers will be subject to an equal proportional reduction of supply.

TABLE 14

AFTER-TAX PROFITS AS A PERCENTAGE OF CAPITAL EMPLOYED
AND OF SHAREHOLDERS' EQUITY: PULP AND PAPER
INDUSTRY CANADA, 1965-75

Per cent of capital employed

Year	Pulp and paper	Total all manufacturing	Pulp and paper as per cent of manufacturing
1965	7.1	8.0	89
1966	7.4	7.7	96
1967	3.6	6.2	58
1968	3.4	6.7	51
1969	5.5	6.9	80
1970	2.4	4.9	49
1971	1.5	6.4	23
1972	1.1	7.5	15
1973	4.7	10.0	47
1974	11.4	11.8	97
1975	5.2	9.4	55
Period Average	4.8	7.8	62

Per cent of shareholders' equity

Year	Paper and allied industries	Total all manufacturing	Pulp and paper and allied ind. per cent all manufacturing
1965	10.5	11.1	95
1966	11.6	11.0	105
1967	6.1	9.2	66
1968	5.8	10.0	58
1969	7.8	10.2	76
1970	4.3	7.4	58
1971	3.0	9.5	32
1972	2.0	11.1	18
1973	8.5	14.5	59
1974	20.5	16.7	123
1975	9.1	13.5	67
Period Average	8.1	11.3	72

Source: Developed during discussions with Department of
Industry, Trade and Commerce, Ottawa.

TABLE 15

FOREST PRODUCTS INDUSTRY,
CANADA AND UNITED STATES, 1970-75
AFTER-TAX PROFITS AS A PERCENTAGE OF SHAREHOLDERS' EQUITY

Year	Canada	United States	Canada as per cent of United States
1970	3.0	6.6	45
1971	3.2	7.0	46
1972	4.0	11.0	36
1973	12.4	16.0	78
1974	18.7	14.6	128
1975	8.7	10.6	82
Period Average	8.3	10.9	76

Source: CPPA Brief to Royal Commission on Corporate Concentration

TABLE 16

PROFITABILITY OF MAJOR CANADIAN
PULP AND PAPER COMPANIES, 1965-74

Company	OPERATING INCOME AS A PERCENTAGE OF TOTAL ASSETS	
	1965-69	1970-74
MacMillan Bloedel Ltd.	13.7	9.9
Abitibi Paper Co. Ltd.	10.4	6.4
Domtar Limited	7.4	10.8
The Price Co. Ltd.	6.1	6.0
B.C. Forest Products Ltd.	9.6	9.7
The Fraser Companies Ltd.	<u>5.4</u>	<u>4.5</u>
Average	9.3	8.6

Source: Developed during discussions with Department of Industry, Trade and Commerce, Ottawa.

		Groundwood (Canada)	Kraft Bleached Softwood (Canada)	Newsprint (30 lb. E. Coast)	Register Bond	No. 1 News Waste
1977 2nd Q.		175-200	370-372	305	523	35
1977 1st Q.		225	370-372	285	517	35
1976 4th Q.		225	365-372	285	515	38
1976 3rd Q.		225	365-372	285	500	35
1976 2nd Q.		225	365-372	285	500	32
1976 1st Q.		175-225	364-369	285	500	32
1975 4th Q.		175-225	365-372	260	490	18
1975 3rd Q.		175-225	365-372	260	480	18
1975 2nd Q.		175-200	295			
1974 3rd Q.		N.A.	325-330			
1974 2nd Q.		120-135	295			
1973 Sept.		115	210			
1973 Aug.		95	210		N.A.	
1973 Jan.		90-95	169-172			
1972		90-95	169-172			
1971		90-95	169-172			
1970		90-95	169-172			

The pricing of newsprint has been fairly intensively studied and has been characterised in a recent study as a situation of price leadership, with movements in prices taking place as a result of changes in cost conditions and the rate of operating capacity. Existing firms are sensitive to the strength of buyers, to the cost conditions facing new entrants and to the pressure to reduce prices by existing firms when the rate of operating capacity falls. Price reductions do take place with lower operating capacity and constant costs. If costs are rising then the increase in prices will be lower than they would otherwise be if firms have excess capacity.²¹ There has also been an enquiry initiated by the Director of Investigation and Research in September 1976 on the pricing of newsprint by MacMillan Bloedel, Crown Zellerbach, Domtar, Consolidated Bathurst, Abitibi and the Canadian Pulp and Paper Association.²²

Some estimates of price elasticity of demand have been made:

Attempts to compute coefficients of price elasticity of demand in the pulp and paper industry have produced disappointing results; the principal reason being that demand in the industry

21. M.G. Dagenais, "The Determinants of Newsprint Prices," Canadian Journal of Economics, IX, No. 3 (Aug. 1976), pp. 442-461; and R. Schwindt, pp. 91-108.

22. Vancouver Sun, 30 Sept. 1976, p. 1

is influenced much more by changes in incomes, tastes, and technology than it is by price²³

The general conclusion is that the market demand for wood pulp, newsprint and other pulp products is price inelastic because of the difficulties of substitution in the short run in the cases of pulp and newsprint, and because newsprint and paper are a small proportion of the final cost of newspapers and books. In the case of sanitary papers and tissue, demand is probably less price inelastic, and for paperboard used in containers, substitute containers are available which make this product less price inelastic as well.

Entry Barriers and Tariffs

The foregoing description of the pulp and paper industry indicates that barriers to entry will likely vary with the segment of the industry which is being considered. At an industry level, the equipment and process technology used in the industry is widely known, and much of it can be found either published or in the hands of consulting engineers who specialize in the industry. In addition, the major equipment manufacturers are familiar with the process technology, so that technology should not pose an entry barrier. New technology is being developed with respect to pollution control systems and the construction of larger mill operations, so that at any time one firm may gain an advantage. However, research on pollution control is undertaken collectively and with government assistance, so it is likely to become available to outsiders if the government wants to diffuse the information.

Product differentiation, another potential entry barrier, has not been considered significant at the industry level, except for sanitary and tissue papers and for fine papers. Marketing arrangements and service differentiation may deter entry where existing firms have long-term contracts with customers. These contracts are, however, less binding than is sometimes implied, so that a new entrant could break in, but with some difficulty.

23. J.A. Guthrie, An Economic Analysis of the Pulp and Paper Industry (Pullman: Washington State University Press, 1972), pp. 68-72.

The main entry barrier appears to be the fact that economies of scale, especially for an integrated mill, require a large capital investment on the part of a new entrant. Entry into the industry is difficult unless the firm has substantial borrowing capacity from its operations in another industry, a good independent credit rating, or substantial government assistance. This is true generally, but may not apply to situations involving mechanical pulp making and special segments of the market which can be served by a smaller operating entity. For example, some firms now operate as captive suppliers of packaging materials to affiliated firms.

The industry tends to be characterised by new entry via the expansion of existing firms or new corporate arrangements involving groupings of firms with some government involvement. The pulp mill under construction at St. Felicien in Québec is a joint venture between British Columbia Forest Products (controlled by Noranda and Mead Corporation) and Donohue (controlled by GIC, a Québec government corporation). Financing for this mill came from equity purchased by the parent companies, a loan from the federal government through the Department of Regional Economic Expansion, and debt financing. A part of the debt financing was arranged on the basis of sales contracts for pulp which were taken up by the Mead Corporation.

There are no Canadian tariffs on pulp, newsprint and coated and uncoated paper for publication. Canadian, U.S. and EEC tariffs for six groups of paper and board other than newsprint are shown in Table 17, together with the relative capacity of the industry for each product in Canada and in the United States. Canadian capacity ranges between 8 and 11 per cent of U.S. capacity. These tariff protected items account for approximately 20 per cent of Canadian pulp and paper industry output.

For each product category in Table 17, the CPPA argues that under favourable conditions Canadian tariffs could be adjusted downward on kraft linerboard, kraft papers and semi-chemical corrugating medium, but that no adjustment should be made on boxboard, printing and writing (fine) papers, and sanitary tissues. The reasons given for the need for continued Canadian tariff protection are:

1. The small scale of Canadian mills producing these products relative to the scale necessary to be internationally competitive. For example, in the case of fine papers, two U.S. companies each

TABLE 17
CANADIAN, U.S. AND EEC
TARIFFS ON SELECTED PULP AND PAPER PRODUCTS

	Kraft Linerboard	Kraft Papers	Semi-chemical Corrugating Medium	Boxboard	Printing & Writing Papers	Sanitary Tissue
Canadian capacity (s.t.)	1.3M	0.7M	0.4M	0.9M	0.8M	0.4M
U.S. capacity (s.t.)	14.1M	6.2M	5.2M	11.1M	10M	4.4M
Canadian tariff	15%	15%	15%	15%	12.5-15%	15-17½%
U.S. tariff	3%	4.6%	10%	Free	2.8%	11.7%
EEC tariff	8.5%	8.5%	12%	12%	12%	12%

Source: Submission by Canadian Pulp and Paper Association to Canadian Trade and Tariffs Committee, September 1975.

produce an output equal to the entire Canadian industry, where output is split between six companies and thirteen mills.

2. Rail freight rates per ton-mile are 20 per cent higher in Canada than in the United States for fine papers; labour costs are 15-20 per cent higher in Canada.
3. Corporation taxes for the forest products industry are higher in Canada.
4. Machinery and equipment costs are higher in Canada, in part due to tariffs.
5. Wood costs are higher in Canada due to higher labour costs, increased provincial stumpage and more difficult access to wood.
6. Competition policy in Canada to date has been felt to impede moves by firms entering specialization agreements.
7. U.S. producers are integrated forward into converting and marketing, which tends to foreclose these outlets for suppliers from Canadian firms.

In terms of specialization agreements, the most interesting possibility occurs in the case of fine papers, which is discussed in a later section.

Corporate Landscape

The following examination of the corporate landscape of the Canadian pulp and paper industry, in terms of the characteristics of the individual firms and plants operating in the industry, is based on data collected from a variety of sources about those firms which are members of the Canadian Pulp and Paper Association. The data show the extent to which firms in the pulp and paper industry engage in multiplant operations, in product diversification and integration within the industry, and the extent to which firms and plants are specialized to one or more products. Product diversification refers to different pulp and paper product categories and not to diversification outside the industry; integration refers to two stages only, first, pulp, and second, products made from pulp. The data relate to 61 firms and 125 plants with a total capacity of 75,281 tons per day.

The number of plants per firm ranged from one to 16, with 37 single plant firms accounting for 32 per cent of industry capacity. The remaining 24 firms have 68 per cent of the capacity and 14 of these have only two plants. Firms with eight or more plants have about 24 per cent of industry capacity, as indicated in Table 18. Thus, within the pulp and paper industry, single plant and multiplant firms operate side by side. However, a range of products is produced by firms in the industry, and so firms and plants can be more or less product specific. The average size of firm increases with the number of plants per firm.

The CPPA identifies 24 pulp and paper product categories, which can be used to indicate both vertical integration (pulp plus further processing) and diversification in the sense of the range of paper products produced by firm and plant.

Fifteen firms with about 20 per cent of capacity produce in only one product category, two firms with about 8 per cent of capacity produce in sixteen or more product categories and forty firms with about 50 per cent of capacity produce in two to ten product categories. Again a range of product diversification is found in the group of firms, with specialized firms operating alongside diversified firms but with most firms producing more than one product.

From Table 19 it can be seen that the multiplant firms tended to be the multiproduct firms, such as Domtar with 12 plants producing in 11 to 24 product categories. In contrast, 12 of the 15 single plant firms produced in only one product category and the other three in only two product categories. Thus, multiplant firms may be specialized by product categories, as may single plant firms.

The size distribution of firms and plants is shown in Tables 20 and 21. About 70 per cent of the capacity is controlled by firms which produce only newsprint or newsprint and other pulp products. Most of these firms have pulp as well as newsprint capacity. The average total firm size is in excess of 1200 tons per day (tpd) with firms ranging in size from Abitibi-Price with 6955 tpd to Bennett Ltd. with 45 tpd.

The 61 firms have 125 plants ranging in size from 35 tpd to 2700 tpd, with an average plant size of 602 tpd. Thirty plants produce pulp only and have a quarter of the total productive capacity, while another quarter is held by 24 newsprint producing plants, most of which are integrated backwards into pulp but do not sell it as market pulp.

TABLE 18

DISTRIBUTION OF FIRMS AND CAPACITY BY NUMBER OF PLANTS
PER FIRM, 1975

Number of plants/firm	Number of firms	Capacity tons/day	Per cent of total capacity	Average capacity
1	37	24,395	32.4	659.3
2	14	15,440	20.5	1102.9
3	3	3,615	4.8	1205.0
4	1	1,765	2.3	1765.0
5	2	6,601	8.8	3300.5
6	1	5,180	6.9	5180.0
7	0	-	-	-
8	1	5,865	7.8	5865.0
9	0	-	-	-
10	0	-	-	-
12	1	5,465	7.3	5465.0
16	1	6,955	9.2	6955.0
	<u>61</u>	<u>75,281</u>	<u>100.0</u>	<u>1234.1</u>

Source: Firms listed with the Canadian Pulp and Paper Association. Data were collected from company reports, trade journals and interviews.

TABLE 19

DISTRIBUTION OF FIRMS BY NUMBER OF PLANTS AND NUMBER OF
PULP AND PAPER PRODUCTS PRODUCED, 1975

Number of plants	Number of products				
	<u>1</u>	<u>2-5</u>	<u>6-10</u>	<u>11-24</u>	
1	12	21	4	0	37
2	3	9	1	1	14
3			2	1	3
4			1		1
5			2		2
6				1	1
7					0
8				1	1
9					0
10					0
12				1	1
16				1	1
	<u>15</u>	<u>30</u>	<u>10</u>	<u>6</u>	<u>61</u>

Table reads that, for example, 12 firms which produced one product only had one plant, and three had two plants; and that one firm produced from 11-24 products and had 12 plants.

Source: Firms listed with the Canadian Pulp and Paper Association. Data were collected from company reports, trade journals and interviews.

TABLE 20
DISTRIBUTION OF FIRMS AND CAPACITY BY MAJOR PRODUCT
CATEGORIES, 1975

Product category ^a	No. of firms	Capacity tons/day	% Total capacity	Average size
1	17	12,960	17.2	762.4
2	4	2,590	3.5	647.5
3	4	1,030	1.4	257.5
4	10	3,120	4.1	312.0
1,2	8	11,400	15.1	1425.0
1,3	3	1,771	2.4	590.3
1,4	2	1,830	2.4	915.0
1,2,3	1	1,390	1.9	1390.0
2,4	1	1,980	2.6	1980.0
3,4	3	2,585	3.4	861.7
2,3	1	1,765	2.3	1765.0
1,2,3,4	7	32,860	43.7	4694.3
	61	75,281	100.0	1234.1

^a1 - pulp; 2 - newsprint; 3 - other paper; 4 - board.

Source: Firms listed with the Canadian Pulp and Paper Association. Data were collected from company reports, trade journals and interviews.

TABLE 21
DISTRIBUTION OF PLANTS AND CAPACITY BY MAJOR PRODUCT
CATEGORIES, 1975

Product category ^a	No. of plants	Capacity tons/day	Per cent of total capacity	Average size
1	30	18,770	24.9	625.7
2	24	18,170	24.1	757.1
3	20	3,771	5.0	188.6
4	20	5,855	7.8	292.8
1,2	6	8,255	11.0	1375.8
1,3	5	3,265	4.3	653.0
1,4	1	510	0.7	510.0
1,2,4	1	1,240	1.7	1240.0
2,3,4	1	1,765	2.4	1765.0
2,4	4	3,265	4.3	816.3
3,4	5	3,790	5.0	758.0
2,3	7	4,925	6.5	703.8
1,2,3,4	1	1,700	2.4	1700.0
	125	75,281	100.0	602.2

^a1 - pulp; 2 - newsprint; 3 - other paper; 4 - board.

Source: Firms listed with the Canadian Pulp and Paper Association. Data were collected from company reports, trade journals and interviews.

Plants producing only newsprint or newsprint and market pulp or other pulp products total 44 and account for over half the total industry capacity. These plants average 894 tpd and range in size from 150 to 2700 tpd. Almost 80 per cent of capacity is in plants with capacity in excess of 750 tpd. (See Table 22.)

Another 25 per cent of industry capacity is in 30 plants which produce pulp only. These plants have an average capacity of 626 tpd and range in size from 70 to 1350 tpd. Over 80 per cent of this capacity is in plants with capacity of more than 500 tpd, and 46 per cent in plants with more than 750 tpd. (See Table 23.)

Vertically integrated plants (pulp plus one or more pulp products) account for about 70 per cent of industry capacity, averaging 787 tpd and ranging in size from 150 to 1900 tpd. Over 50 per cent of the capacity of integrated plants is in plants which produce pulp and newsprint only.

The 22 largest plants, with capacity of 1000 tpd or more, have 40 per cent of industry capacity and range up to 2700 tpd. Plants producing pulp only or pulp and newsprint have almost 60 per cent of the capacity of this group.

The smallest plants, those with capacities of less than 200 tpd, have 3 per cent of industry capacity and range from 35 to 180 tpd, averaging nearly 100 tpd. Most (85 per cent) of this capacity is associated with plants producing paper other than newsprint or board products. Plants which use waste paper as their source of fibre tend to be among the smaller plants in the industry. There are 16 such plants, with 4 per cent of industry capacity, averaging 190 tpd and ranging between from 40 to 550 tpd.

Minimum optimum scale of a new kraft pulp mill is estimated by engineering consultants at around 800 tpd. This is the approximate size of the new plant now being built in St. Felicien, Québec, for opening in 1978. For newsprint production, minimum optimum scale is estimated to be about 1000 tpd.

In the case of existing plants producing pulp only, 80 per cent of capacity is in plants which can produce more than 500 tpd, and 46 per cent is in plants able to produce over 750 tpd (present minimum optimum scale). For newsprint, 79 per cent of capacity is in plants capable of producing 750 tpd or more, and 54 per cent is in plants able to produce 1000 tpd or more (present minimum optimum scale).

TABLE 22

DISTRIBUTION OF PLANTS AND CAPACITY OF PLANTS PRODUCING
NEWSPRINT, BY SIZE, 1975

Size distribution tons/day	No. of plants	Capacity tons/day	Per cent of total capacity	Average size
0 - 249	1	150	0.4	150.0
250 - 499	8	2,945	7.5	368.1
500 - 749	9	5,195	13.2	577.2
750 - 999	11	9,640	24.5	876.4
1000 - 1499	10	11,625	29.6	1162.5
1500 - 1999	4	7,064	18.0	1766.0
2000 +	1	2,700	6.8	2700.0
	44	39,320	100.0	893.6

Total industry 35.2% 52.2%

Source: Firms listed with the Canadian Pulp and Paper Association. Data were collected from company reports, trade journals and interviews.

TABLE 23

DISTRIBUTION OF PLANTS AND CAPACITY OF PLANTS
PRODUCING PULP ONLY, BY SIZE, 1975

	No. of plants	Capacity tons/day	Per cent of total capacity	Average size
500	11	3,910	20.8	355.5
500 - 749	10	6,210	33.1	621.0
750 - 999	6	4,750	25.3	791.7
1000+	3	3,900	20.8	1300.0
	30	18,770	100.0	625.7

Total industry 24.0% 24.9%

Source: Firms listed with the Canadian Pulp and Paper Association. Data were collected from company reports, trade journal and interviews.

The production of fine papers has been identified as one segment of the Canadian pulp and paper industry in which specialization could reduce the costs of short production runs. The capacity of the fine paper industry is 768,000 tons per annum, divided between six firms and fourteen plants as follows: Domtar - 284,000 tons per annum (five plants with capacities of 150,000; 87,000; 21,000; 14,000; and 12,000): Abitibi - 150,000 (two plants, 87,000; and 63,000): Eddy - 131,000 (three plants, 85,000; 43,000; and 3,000): Rolland - 117,000 (two plants, 97,000; and 20,000): Reed - 51,000 (one plant): and MacMillan Bloedel - 35,000 (one plant). Within each plant other paper products besides fine papers may be made, and each plant may contain a number of paper making machines. For example, the two Eddy plants in Ottawa-Hull produce fine papers with six machines which range in size from 35 to 175 tpd and produce paperboard and tissues as well. Thus productspecific economies may be obtained from making machines specific to particular products and/or products specific to plants.

In contrast, the U.S. fine paper industry, with a total capacity of 9.6 million tons per annum, has many small plants as well as a number of large plants and firms equipped with machines having a capacity of up to 500 tpd. International Paper has plants with two such machines. Another company produces one million tons per annum (nearly 3000 tpd). The larger U.S. plants tend to produce the high-volume grades of fine paper, while the smaller plants supply the low-volume specialties.

The cost of production run changes for different fine papers depends on the nature of the change. For example, weight and moisture changes tend to be computer controlled and lead to minor downtime for machines. Major changes occur with colour changes and changes in the composition of pulp used. A finishing change may be less costly in terms of downtime.

The Canadian fine paper industry has rationalized, in part due to firms such as Rolland deciding to produce fewer paper types. The industry has not specialized further by way of agreements, because tariff protection has allowed the existing situation to persist and because there is a reluctance on the part of firms to become specialized in lines of fine paper which may not have market acceptance in the future.

If specialization is to occur, it must either involve firms having access to export markets, especially the U.S. market, or firms becoming specialized within the much smaller Canadian market. Assuming lower U.S. tariffs, Canadian producers of fine papers would still have difficulty selling in the United States, because paper merchants (wholesalers) tend to act as exclusive agents to U.S. fine paper producers. The area for possible penetration would be the specialty fine papers, which are presently produced in small plants in the United States. Since western Canada has only one producer, specialization could only occur in eastern Canada. At present, however, the existing producers do not appear to view the possible cost advantages of longer runs as sufficient to offset the commercial risks associated with becoming less diversified.

In sum, the opportunities exist for production cost savings in fine paper production through machine, plant and firm specialization, but there are also some impediments to specialization in terms of factors relevant to both the United States and the Canadian market.

CASE EXAMPLES

The Mead Corporation, with headquarters in Dayton, Ohio, is ranked as the eighth largest pulp and paper company in the world. In 1976, it had sales of \$1.6 billion, assets of \$1.2 billion and 26,200 employees. Mead is the sixth largest pulp and paper company in North America and is about half the size of the world's largest company, International Paper.

Mead's operations are divided into three main sectors, forest products (56 per cent of sales and 72 per cent of pretax earnings), consumer and distribution sector (30 and 14 per cent) and industrial products (14 and 14 per cent). The forest products sector produces and sells pulp, lumber, paper and paperboard, mainly in North America but with smaller operations in Spain, West Germany and Holland. The forest products division is subdivided into three parts, paper, paperboard, and pulp and lumber. Mead's production facilities in Canada exist through Mead's partial ownership of Northwood Pulp and Timber Ltd. in Prince George, British Columbia and British Columbia Forest Products Ltd. with mills in Mackenzie and Crofton, British Columbia.

Mead Pulp and Forest Products is headed by a corporate executive vice president who is responsible for:

1. Brunswick Pulp and Paper Company -- a pulp mill and two sawmills headquartered in Brunswick, Georgia. The company is owned 50-50 by Mead and Scott Paper Company. The pulp mill has a capacity of 1600 tpd and produces bleached kraft pulp and board.
2. Northwood Pulp and Timber Ltd. -- a pulp mill, four sawmills and logging operations, headquartered in Prince George, B.C. The company is owned 50-50 by Mead and Noranda Mines Ltd. The pulp mill has a capacity of 800 tpd and produces bleached softwood kraft pulp.
3. British Columbia Forest Products Ltd. -- two pulp mills, eight sawmills, logging operations, a newsprint mill, a shingle mill, a veneer plant, and two plywood plants, headquartered in Vancouver, British Columbia. The company is 15 per cent owned by Mead, 27 per cent by Brunswick (of which 30 per cent is owned by Mead) and 28 per cent by Noranda. The pulp mills have capacities of 925 tpd at Crofton and 580 tpd at Mackenzie, while the newsprint operation has a capacity of 765 tpd at Crofton. The pulp mills produce bleached softwood kraft pulp.

Hardwood and softwood pulp is also produced at Mead's Escanaba, Michigan mill. This mill produces paper as well, but the plant falls under the responsibility of the Mead Paper Group.

Mead's pulp mills adjacent to its paper mills and the pulp mills of Brunswick, Northwood and BCFP have the capacity to produce nearly all the pulp required for use in the paper mills. The affiliated Canadian operations of Mead are used principally to supply pulp both to Mead operations and to third parties as market pulp. The Crofton mill of BCFP consists of two plants which produce market pulp, pulp for other Mead operations, and semi-unbleached pulp for on-site conversion into newsprint. Mead's pulp mill operations vary in size as follows:

	<u>tons per day</u>
Brunswick (Georgia - pulp)	1600
BCFP (Crofton - pulp)	925
BCFP (Crofton - pulp and newsprint)	765
BCFP (Mackenzie - pulp)	580
Northwood (Prince George - pulp)	800

Northwood Pulp and Timber Ltd.

Northwood is 50 per cent owned by Noranda and 50 per cent by Mead. It is managed by a managing director who reports to an operating committee with representatives from Noranda, Mead and the Northwood management, as well as to the company's board of directors. The owners maintain close managerial control of Northwood. The mill was built in 1966 for a cost of \$56 million. Estimated replacement cost in 1977 is \$240 million. The mill, with a pulp capacity of 800 tpd (one-third larger than BCFP-Mackenzie), employs about 450 persons (350 hourly and 100 salaried) and pays salaries in excess of \$10 million per annum.

Wood may be supplied in the form of logs which are processed in an on-site chipper, and directly as chips from local sawmill operations. Chips are purchased at about \$30 per cunit plus transportation up to \$14 per cunit paid by Northwood. The mill has access to road and rail transportation, the latter being the B.C. Railway, whose labour disputes have resulted in high costs of transportation for Northwood. As a result, Northwood is considering building a bridge to link up with the Canadian National Railway system.

At present the surplus of chips available in the province has resulted in a larger than desired on-site inventory of chips and an inventory of logs which at present are not used as input. Consequently, the chipper facility is idle.

The output of the plant is dry pulp in 500 lb. bales, of which about 65 per cent is sold as market pulp to the United States, Europe and Japan, 25 per cent to the Mead Corporation and 10 per cent to the Fraser Companies.

Apart from external factors of availability of wood supply and cost of transportation, the equipment and process technology influences the optimum scale of plant. Northwood incorporates a single-line continuous process operation. Two of the critical pieces of equipment in the plant are the digester and the recovery furnace (for recovering chemicals).

The technology associated with this equipment favours a pulp mill of about 800 tpd in the sense that a continuous digester and a recovery furnace of this capacity fall in the range of optimum plant size. However, optimum size is an elusive concept. If the plant is built as a

continuous process plant, there are advantages in digesters and furnaces of 800 tpd capacity, but there are disadvantages in that breakdowns in a continuous process operation can be costly if the whole operation has to stop when there is a defect at one point in the process. In order to overcome this difficulty, flexibility is built into the continuous process at Northwood by building storage tanks at different stages, to allow the process to continue even if there is a stoppage at one point. Additional costs of storage tanks are thus added to the continuous process operation. Another way in which flexibility can be built into the production process is through the use of a series of batch digesters and more than one recovery furnace, allowing for machinery stoppages without closing down the plant.

A plant of twice the capacity of Northwood could be built in one of two ways, either by building a second pulp line parallel to the first, twinning the existing operation, or by building a plant of twice the size. In the case of Northwood, constructing a parallel plant would require almost doubling the capacity of equipment used in the digester, bleaching, washing, and pulp drying operations, but would lead to economies of scale (less than doubling) for such operations as administration, transportation (road and rail system), water treatment, wood handling and chipping, chemical recovery, maintenance, and laboratories and engineering. Economies of scale at the plant level thus require an examination of economies with respect to individual machine operations and functional activities.

The reasons why Northwood may not want to commit itself to a larger facility at this time even if significant plant economies of scale exist are: (1) the cyclical market conditions for pulp; (2) the high capital cost of new capacity (\$300,000 per daily ton in 1977 compared to \$100,000 in 1972); (3) the risks associated with operating in a fairly remote location, with the possibility of labour problems and high cost of transportation in and out; and (4) the increasing cost of obtaining a fibre supply when greater distances to the mill are required (not a problem at present because of a surplus of chips in B.C.).

An interesting feature of the Northwood mill is its extent of self sufficiency. In terms of energy, 80 per cent is generated on site by steam driven generators using heat from the chemical recovery furnace and from a furnace burning log fuel supplied by Northwood's sawmills. Only

20 per cent of energy requirements are purchased from outside as gas and electricity, and management is working to reduce this external dependency. Much of the chemical requirement of the mill is recycled through the chemical recovery process, which also generates steam for energy, though some topping up of chemicals is required as in the case of caustic soda. B.C. Chemicals Ltd., an associate company of Northwood, supplies other chemicals needed in the manufacturing process. These chemicals are also supplied to the two other pulp mills in Prince George (Prince George Pulp and Paper and Intercontinental Pulp Co.).

Brunswick Pulp and Paper Company

Brunswick is owned 50 per cent by Mead and 50 per cent by Scott Paper Co. The mill was built in 1937 with a pulp capacity of 150 tpd, producing market pulp for use in fine paper and tissues. The present capacity of 1600 tpd has come about as a result of both modernization and addition to the plant. The plant consists of a wood handling area with facilities for pine logs, hardwood logs and chips; 17 batch digesters ranging in capacity from 3800 to 6100 cu. ft.; a bleach plant with three bleach lines, one with 300 tpd capacity and two with 600 tpd capacity each; and a pulp drying machine. In addition to producing paper grade hardwood and softwood market pulps (1050 tpd capacity), the plant produces tissue and bleached paperboard (550 tpd capacity).

The pulp mill is specialized to hardwood and softwood pulp making. Although there is interchangeability between the digesters, the small digesters are used mostly for hardwood and the large digesters for pine. Subsequently, there are two processing lines (blow tank to bleach plants) which specialise in hardwood and pine, and there is specialization in the bleach plant. Mixing of the two types of pulp then takes place before the pulp is fed onto the pulp machines, with the mixture depending on the end use to which the pulp is to be put.

The equipment and process technology in the Brunswick mill illustrates the areas in which specialization can take place in pulp production. The wood handling area may be specialized to handle logs and/or chips, depending on their availability in the area. The wood or chips may be softwood and/or hardwood, depending on the type of pulp and pulp products to be made, and the digesters and subsequent production process including the bleach plant may be specialized according to softwood and hardwood requirements.

This specialization can be carried on in a mill which is integrated forward into paper making (Brunswick is only to a limited extent), either with a number of paper making machines each making one type of paper product or with machines which can make several products. In the latter case higher downtime and changeover costs will be experienced.

Brunswick's wood supply is about 80 per cent softwood and 20 per cent hardwood, with about 35 per cent delivered as chips and 65 per cent as logs. Approximately 28 per cent of total wood supply comes from company owned or controlled timberlands, with the balance purchased from local independent wood producers. The mill employs about 1000 persons, one-third of whom are salaried and non-unionized and two-thirds hourly paid and unionized. Net capital invested (31 Dec. 1976) was \$141 million plus about \$52 million for timberlands supporting the operation. Most of the pulp output is used by the paper and tissue-making operations of Mead and Scott, with the excess marketed in the United States and Europe. Bleached board is distributed mainly in the U.S. market.

A breakdown of the production costs for softwood pulp in the Northwood and Brunswick mills of the Mead Corporation is shown in Table 24. Brunswick has double the capacity of Northwood. However, total unit costs are approximately the same, suggesting that there are no significant economies of scale in production above a capacity of 800 tpd. Variable costs are a lower percentage of total costs in Northwood than in Brunswick, while both direct labour and indirect costs are higher in Northwood. In both plants raw materials constitute about half the cost of manufacturing pulp, with fibre cost being by far the most important raw material cost. Labour, depreciation and energy are the three most important items of non-material costs.

Because total costs per ton are approximately the same, the percentage comparison of the cost data shows where absolute costs of each item are higher or lower. For example, fibre costs are slightly lower in Northwood. However, problems of comparison occur for a number of reasons. First, fibre may be purchased from and transported by affiliated company operations, in which case the transfer price charged may not reflect the costs of an arm's length transaction. At Northwood, 54 per cent of output was sold to non-Mead, non-Noranda customers, 31 per cent to Mead and 15 per cent to the Fraser group of companies in which

TABLE 24

DISTRIBUTION OF BASIC MANUFACTURING COSTS FOR
NORTHWOOD PULP, B.C. AND BRUNSWICK PULP, GEORGIA, 1976

(in Percentages)

	Northwood		Brunswick	
Raw materials		46.7		54.8
Fibre	37.3		39.9	
Other	9.4		14.9	
Conversion costs		29.9		29.3
(Bleached sheet, drying, baling)				
Labour	11.6		9.9	
Energy	8.6		9.0	
Other	9.7		10.4	
Total variable costs		76.6		84.1
Indirect and overhead costs		15.3		8.7
Depreciation		8.1		7.2
TOTAL		100.0		100.0

Noranda has an interest, so that 46 per cent of sales were made on the basis of transfer prices. Second, energy in one form or another is an important cost element, but much energy is generated internally within the plant as a by-product of the production process, and the accounting procedure used to record this item will result from internal company directives. Third, the comparison of Northwood to Brunswick is based on a year in which capacity utilization was 91.0 per cent for Northwood and 102.0 per cent for Brunswick (because actual days worked exceeded days scheduled for work). Unit labour costs (wages per hour, including overtime and excluding benefits) in 1976 were \$9.10 at Northwood compared to \$6.65 at Brunswick (both in Canadian dollars), or 37 per cent higher in Canada. Capital per unit of output was Canadian \$289 at Northwood, and U.S. \$309 at Brunswick (capital in both instances includes the historic cost of assets less depreciation for machinery, equipment, land and inventories, but excluding purely financial assets). Because the capital was acquired over a period in which the Canadian-U.S. exchange rate fluctuated, an approximation is made of a one-to-one exchange rate, and thus capital cost per unit of output was about seven per cent higher at Brunswick in 1976. Caution is thus advised in using the data other than for general comparative purposes.

Canadian International Paper Company

The International Paper Company (IPC) is the world's largest producer of paperboard, paper and pulp products, with 1976 sales of \$3.5 billion, assets of \$3.6 billion, earnings of \$253.6 million and 52,000 employees. Sales and production by products were as follows:

	<u>Sales</u> \$ million	<u>Production</u> '000 tons
Paperboard, paper and pulp	\$1840.5	6,830
Packaging	\$1092.6	2,273
Wood products	\$ 387.1	-
Crude oil and natural gas	\$ 126.7	-
Other products	\$ 93.7	-
	<hr/>	
TOTAL	\$3540.6	
	<hr/>	

Outside of the United States and mainly in Canada, IPC's sales were \$826.4 million and assets \$721.6 million. In Canada, IPC operates through a wholly-owned subsidiary,

Canadian International Paper Co. (CIP) which in turn wholly owns International Paper Sales Co. Inc. and British International Paper Ltd. CIP employs 8700 workers mainly in six pulp and paper mills (four in Québec, one in Ontario and one in New Brunswick). The products and capacity of the six mills are as follows:

	<u>Capacity tons/day</u>	<u>Product</u>
Dalhousie, N.B.	800	Pulp and newsprint
Matane, P.Q.	230	Paperboard
La Tuque, P.Q.	1500	Pulp, paper and paper-board
Trois Rivières, P.Q.	975	Pulp, newsprint and paper
Gatineau, P.Q.	1400	Pulp and newsprint
Hawkesbury, Ontario	275	Pulp

The Canadian plants are major producers of newsprint, accounting for 82 per cent of IPC's newsprint production, most of which is sold in the United States.

The Gatineau newsprint mill was constructed in 1926 and started operation in April 1927. Average daily production rates on the original four 270-inch wide Dominion Engineering paper machines increased from 400 tons of 32 lb. newsprint in 1927 to 1000 tons in 1966, when the decision was made to add a fifth newsprint machine. This 380-inch Black-Clawson machine started up in 1969. The five newsprint machines are currently producing approximately 1400 tpd of 30 lb. newsprint for use on letter press, offset and direct printing presses.

The mechanical pulping facilities were expanded during 1946 to 1956 by adding 12 hydraulic grinders to the original 24 grinders in the stone groundwood mill. In 1968 a 450 tpd refiner groundwood plant was erected. In 1972, the sulphite chemical pulp operation was closed down completely, and the additional mechanical pulp requirement was met by increasing the refiner groundwood capacity by 225 tpd and installing equipment to handle purchased semi-bleached kraft chemical pulp.

A management team of 90 personnel from foreman to manager direct the work of 1350 tradesmen and operating personnel. Wood requirements for mechanical pulp production amount to 370,000 cunits annually. River wood is received from May to November and during this period winter wood

requirements are stored in eight wood piles of approximately 25,000 cunits each. Ninety-five per cent of the wood requirements are floated down the Gatineau and Ottawa Rivers from timber sources 40 to 200 miles north of the mill. The balance of wood received is in the form of trucked roundwood and purchased chips. All wood is cut into four foot lengths as it is removed from the river and then debarked in rotary barking drums, since bark is unacceptable for the manufacture of quality newsprint. The bark is dewatered and used as fuel in boilers to produce steam.

The newsprint is a blend of two pulps, 17 per cent chemical and 83 per cent mechanical. The mechanical pulp is supplied 50 per cent by the stone groundwood plant and 50 per cent by the refiner groundwood plant. The chemical fibre, semi-bleached softwood kraft, is purchased in bale form, principally from CIP's La Tuque kraft mill. It is repulped at the mill, refined and then blended with the mechanical pulps for metering to the paper machines.

The refiner groundwood plant produces an average of 600 tpd of pulp, making it the largest installation of its kind in the world. The plant contains four lines of refiners each line containing three refiners. The original nine refiners installed in 1968 are rated at 5000 hp each, and the three refiners installed in 1973 are rated at 7500 hp each. The stone groundwood plant produces an average of 600 tons of pulp per day.

The four Dominion Engineering paper machines vary in equipment configuration at both the wet and dry ends. The most interesting feature, however, is the Black-Clawson Vertiforma on the Number 2 machine. This twin wire former produces an exceptionally high quality sheet of offset newsprint. The Number 2, 4 and 6 machines have dedicated computer control of basic weight and moisture. The Number 6 380-inch Black-Clawson machine is one of the largest modern high-speed newsprint machines in the world.

PAPER MACHINE OPERATIONS DATA

<u>Machine Number</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>6</u>
Average daily Production (Tons)	185	260	235	300	490
Speed (Feet/Minute)	1540	2050	1875	2225	2560
Trim (Inches)	255	255	255	255	362

Each roll of newsprint is carefully inspected for paper defects, roll structure and damage. In addition to the visual inspection given the paper by the inspector, quality is monitored by a continuous paper testing program carried out at the mill and with the technical support of the research group.

Following inspection, the rolls are sent to one of three semi-automatic Williams & Wilson finishing lines used to wrap the 2600 rolls produced every day. On each of these lines, the rolls are marked with a number identifying each customer, weighted and wrapped. The rolls are then moved by clamp truck either to storage or directly into waiting freight cars and trucks for shipment to the customer.

Newspaper is sold to customers by International Paper Sales Company Inc. Five per cent of Gatineau's production is shipped overseas, 10 per cent is sold in Canada, and 85 per cent is exported to the United States. Eighty per cent of U.S. shipments go to the northeast area and 20 per cent to the midwest. Sixty per cent of shipments are by rail. The majority of the freight cars used in this service are hydrocushioned to prevent damage. The remaining 40 per cent of shipments are by truck.

The distribution of manufacturing costs for the Gatineau mill of CIP is as follows:

	<u>%</u>
Wood and wood handling	36
Purchased dry pulp	33
Fuel and power	8
Labour direct	11
Labour maintenance	4
Materials maintenance	3
Miscellaneous	<u>5</u>
Total Cost	<u>100</u>

As for the Northwood and Brunswick cost comparison, the CIP cost distribution data result from internal accounting procedures used by the firm, and in particular the fact that much of the fibre input is purchased as dry pulp from an affiliated firm in La Tuque, P.Q.

British Columbia Forest Products

The two pulp mill operations of British Columbia Forest Products (BCFP) are illustrative of the variety of production set-ups which are found in the industry. The Mackenzie pulp mill of BCFP has a capacity of 600 tpd. The chemical pulp production process is designed as a single-line continuous process using a continuous, as opposed to a batch, digester. Fibre is supplied in the form of chips from nearby BCFP sawmills by a chip conveyor system and from independent sawmills. Chips bought on an arm's length basis cost \$30 per cunit, plus the cost of transport to the mill, which is up to \$14 per cunit. The price of chips bought from BCFP sawmills is established on the basis of a company transfer price.

Both supplies and pulp shipments use the services of the B.C. Railway, which has been plagued with labour disputes, necessitating the use of higher cost truck transportation. The Mackenzie mill is below the size considered optimal by the industry for technical efficiency. There are three reasons for its small size. There is significant risk associated with the operation of a mill in a remote area, where the options for alternative transportation facilities and the cost of such alternatives discourage a larger investment in physical plant and equipment. The cost of acquiring wood supplies rises at greater distances from the mill. Optimum size at the time of mill construction was smaller than it is to-day, and on an historic book value basis the mill can be operated efficiently.

The Crofton pulp and newsprint mill, with a capacity of 1690 tpd, is comparable only in part to Mackenzie. Crofton consists of two plants, one producing pulp and one producing pulp and newsprint. The two plants are interrelated in terms of common administrative services, energy sources, water pollution systems, transportation systems, and the provision of kraft pulp to the newsprint operation. The pulp plant is larger than the Mackenzie pulp plant, but comparable in basic layout. It uses chips from BCFP sawmills and plywood plants on Vancouver Island as well as from independent suppliers. The pulp and newsprint plant uses a mixture of three fibre sources -- stone groundwood, refiner groundwood and semi-bleached kraft pulp. Stone and refiner groundwood are produced in the newsprint plant and are mixed with kraft pulp produced in the pulp mill. Thus the two plants at Crofton differ in terms of size, type of end-product produced, type (mix) of pulp used and type of equipment and process technology used in the plant.

In contrast to Mackenzie, the Crofton complex appears to be twice the estimated optimum size for a pulp complex. Closer examination reveals that Crofton is really a two-plant operation, with the newsprint plant vertically integrated backward into pulp for its own use, and the pulp plant single stage and only partly integrated forward with the newsprint complex.

CHAPTER III

THE WIRE ROPE INDUSTRY

INDUSTRY OVERVIEW

There is a clearly defined wire rope industry in Canada which consists of seven plants and four enterprises. The industry produced approximately 32,000 tons of wire rope in 1976, plus an additional 10,000 to 12,000 tons of wire strand. The domestically manufactured wire rope shipment figure has been relatively constant in recent years, as indicated in Table 25, which shows market growth over 1965-1976. The four enterprises and the geographic location of their seven manufacturing establishments are as follows:¹ Wire Rope Industries Ltd. (WRI) -- two plants, Pointe Claire, Québec and Vancouver, British Columbia; Greening Donald Ltd. -- two plants, Hamilton and Midland, Ontario; Martin Black Wire Ropes of Canada Ltd. -- two plants, Pointe Claire, Québec and Edmonton, Alberta; Wrights Canadian Ropes Ltd. -- one plant, Vancouver, British Columbia.

WRI is the leading manufacturer and accounts for approximately half of the wire rope produced in Canada, followed by Greening Donald (25 to 30 per cent), with the remainder split between Martin Black and Wrights Canadian (20 to 25 per cent). The industry employs some 1400 people in Canada and has an annual sales volume of about \$60 million.

For statistical purposes, the wire rope industry is included in SIC 305, which is entitled Wire and Wire Products Manufacturers and is described as follows:

the operations of establishments primarily engaged in drawing wire from rods and in manufacturing nails, spikes, staples, bolts, nuts, rivets, screws, washers, wire fencing, screening, wire cloth, barbed wire, tire chains, uninsulated wire rope and cable, kitchen wire goods and other wire products.

-
1. Industry sources report that Martin Black Wire Ropes of Canada Ltd. opened a third small plant in Truro, Nova Scotia in 1977, and that Tree Island Steel, in British Columbia, acquired some wire rope manufacturing machinery and plans to produce a limited wire rope line.

The economic importance of SIC 305 is highlighted in Table 26. The wire rope segment accounts for approximately five per cent of the total value of shipments and seven per cent of the number of employees. Although many establishments produce goods under the SIC 305 designation, the bulk of economic activity is concentrated in the hands of a few establishments which employ in excess of 200 persons. For example, 20 such establishments account for 54 per cent of the total value of shipments, 54 per cent of the value-added, 48 per cent of the labour force employed, 52 per cent of the wage and salary bill, and 53 per cent of the materials and supplies consumed.

Three of the four wire rope producers have multiplant operations. The size distribution of the plants based on employment is as follows:

<u>Number of Employees</u>	<u>Number of Plants</u>	<u>Enterprise and Location</u>
0 - 19	Nil	-
20 - 49	1	Martin Black - Edmonton, Alberta
50 - 99	3	Martin Black - Pointe Claire, Québec Wrights - Richmond, British Columbia Greening Donald - Midland, Ontario
100 - 199	Nil	-
200 - 499	3	WRI - Vancouver, British Columbia WRI - Pointe Claire, Quebec Greening Donald - Hamilton, Ontario
500+	Nil	-

The three plants each with more than 200 employees account for approximately two-thirds of the Canadian output of wire rope.

PRODUCTION PROCESS

Wire Rod

The raw material used for the manufacture of wire rope is wire rod, produced by steel mills in Canada and abroad. Since the grain structure of the rod is not uniform

TABLE 25

CANADIAN WIRE ROPE MARKET, 1965-1976

Growth Indices (1965 = 100)

Year	Total Market (Tons)	Canadian Manufacture (Tons)	Imports (Tons)	Imports as % of Market	Total Market	Canadian Manufacture	Imports
1965	44,430	33,555	10,875	24.5	100	100	100
1966	46,326	35,250	11,076	23.9	104.3	105.1	101.9
1967	41,308	31,115	10,193	24.7	93.0	92.7	93.7
1968	41,425	30,721	10,704	25.8	93.2	91.6	98.4
1969	45,280	32,458	12,822	28.3	101.9	96.7	117.9
1970	46,359	32,327	14,032	30.3	104.3	96.3	129.0
1971	45,495	32,183	13,312	29.3	102.4	95.9	122.4
1972	44,103	33,091	11,012	25.0	99.3	98.6	101.3
1973	50,722	35,721	15,001	29.6	114.2	106.5	137.9
1974	51,484	34,653	16,831	32.7	115.9	103.3	154.8
1975	50,288	34,186	16,102	32.0	113.2	101.9	148.1
1976	43,787	31,901	11,886	27.1	98.6	95.1	109.3

Source: Company data.

TABLE 26

WIRE AND WIRE PRODUCTS MANUFACTURERS, 1974

	Classified by total employed in size group establishments of over 200		Per cent of total
Number of establishments	282	20	7
Value of shipments (\$ thousands)	960,342	514,109	54
Value-added (\$ thousands)	445,576	242,282	54
Number of employees	19,535	9,310	48
Wages and salaries (\$ thousands)	200,100	103,726	52
Cost of materials and supplies (\$ thousands)	524,711	277,584	53
Cost of energy (\$ thousands)	10,064	5,949	59

Source: Statistics Canada, Wire and Wire Products Manufacturers, Cat. No. 41-216 (October 1976), pp. 4 and 5.

it cannot be properly drawn until it has been heat treated as patented. Patenting involves heating the material to a temperature slightly above its transformation point and soaking for a period of time followed by a controlled cooling process, either in air or in a molten lead bath at a constant temperature.

After patenting, the surface scale of oxides is removed either by acid "pickling" or mechanical cleaning. The rod is then cold-drawn, with intermediate patenting and cleaning operations as required, to achieve the necessary physical properties (i.e., diameter, tensile strength, fatigue strength, etc.) of the finished wire. Wire to be used in corrosive atmospheres is usually galvanized, either by passing the wire through a molten zinc bath or by electroplating after the cold drawing operation is completed.

Wire Rope

Wire rope is a flexible tension member used to transmit a force over any reasonable distance. Because of its flexibility, the path may be either straight or irregular. A solid steel rod is very stiff and will withstand very limited flexural bending or torsion. An equivalent cross-sectional area of steel wires formed into a rope has significantly greater flexibility and fatigue life. In addition, there is usually an increase in tensile strength, since wire rope has a tensile strength ranging from 85,000 to 300,000 pounds per square inch or higher, depending on the wire grade.

Once the wires of the required physical properties are obtained, they are passed through to the rope-making operation, which uses specially designed equipment. The rope-making operation is divided into three distinct phases.

Phase 1. Spooling (winding)

Spooling consists of transferring the wire from coils or other package form, as received from the wire drawing operation, to bobbins of the type and size suitable for mounting in the stranding machine in which the strand is made (Phase 2). The spooling operation allows the wire to be wound onto the bobbins under constant tension, providing a more uniform finished product. It measures the wire wound onto each bobbin in order to reduce or eliminate the joints in the wire.

Phase 2. Stranding

Stranding consists of bringing the required number of wires together in a predetermined pattern and twisting or "stranding" them uniformly in concentric layers about a central wire to form the completed strand. This is normally done in a single operation.

There are many types and geometrical patterns of strands, each with its own particular advantages. Most strands fall into three classifications or basic types: 7-wire, 19-wire, and 37-wire. The 7-wire strand is made by covering a center wire with a layer of 6 wires twisted about it in uniform helices (Exhibit 9: 6 x 7). A strand in the 19-wire classification may have from one to 26 wires in various arrangements; for example, 12 wires over six wires over one wire, or nine wires over nine wires over one wire (Exhibit 9: 8 x 19). A strand in the 37-wire classification could be made from 31 to 49 wires. One such configuration is 14 wires over seven wires, each of two different sizes laid alternately over seven wires over one wire (Exhibit 9: 6 x 36).

It should be noted that for a given strand diameter, as the number of wires increases, the diameter of the individual wire must decrease. Thus, flexibility of the strand increases as the number of wires per strand increases. On the other hand, as the diameter of the outer wire decreases, the area of contact between each wire and the sheave decreases, and this results in an increased wear rate.

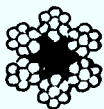
Phase 3. Closing

The final operation in rope making is the twisting or closing of the strands around a core. Most wire ropes are composed of six strands, with the 6 x 19 and 6 x 37 classifications being the most common. However, ropes may consist of as few as three or as many as 36 strands. Where more than one layer of strand is closed over the core, the layers can be closed in opposite directions, reducing the tendency of the rope to rotate during use (Exhibit 9: 18 x 7 and 34 x 7).

The core around which the strands are closed is usually either a synthetic or sisal fibre core but may also be wire. Fibre cores are standard for wire ropes which are not subjected to heat, crushing and/or heavy loads. Wire cores, usually independent wire rope cores, are employed where greater strength or greater resistance to distortion and heat are required but result in reduced flexibility of the rope.

EXHIBIT 9

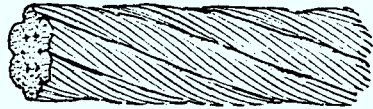
DIFFERENT TYPES OF STEEL WIRE ROPE



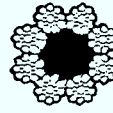
6 x 7 Right Regular Lay, Fibre Core



6 x 25 Filler Right Lang Lay, LWRC



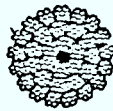
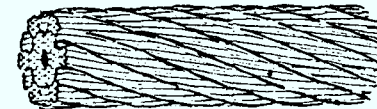
6 x 36 Warrington Seale Right Regular
Lay, Fibre Core



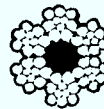
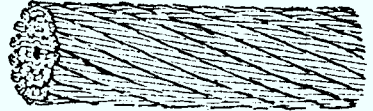
8 x 19 Seale Right Regular Lay,
Fibre Core



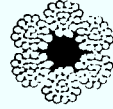
18 x 7 Non-Rotating, Fibre Core



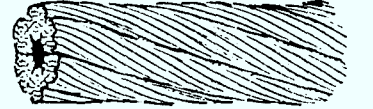
34 x 7 Non-Rotating, Fibre Core



6 x 8 Right Lang Lay, Fibre Core



6 x 27 Right Lang Lay, Fibre Core



The direction or lay of a wire rope may be either right or left, although practically all wire ropes are right lay. In a right lay wire rope, the strands form a helix about the core similar to the threads on a righthand screw. If the direction of the lay of the wire in the strands is opposite to the direction of lay of the strands in the rope, the rope is regular lay. If the lay of the wires in the strands and the strands in the rope are of the same direction, that rope is Lang lay. Regular lay ropes have a wider range of application than Lang lay ropes because they have lesser tendency to rotate. Lang lay ropes, however, possess greater flexibility and resistance to abrasion than regular lay ropes.

With the combinations of number and pattern of wires in strand, strands in the rope, types of core, direction of closing, regular or Lang lay, wire grade and rope diameter, the number of possible wire ropes becomes legion. However, a very small fraction of these combinations satisfy most industrial applications.

The Manufacturing System

The wire rope manufacturing process from rod to wire, to strand and rope is depicted in Exhibit 10. Since none of the wire rope producers in Canada manufacture rod or draw wire for wire rope, the manufacturing system employed in their plants is limited to the bottom part of the illustration in Exhibit 10 (spooling, stranding and closing).

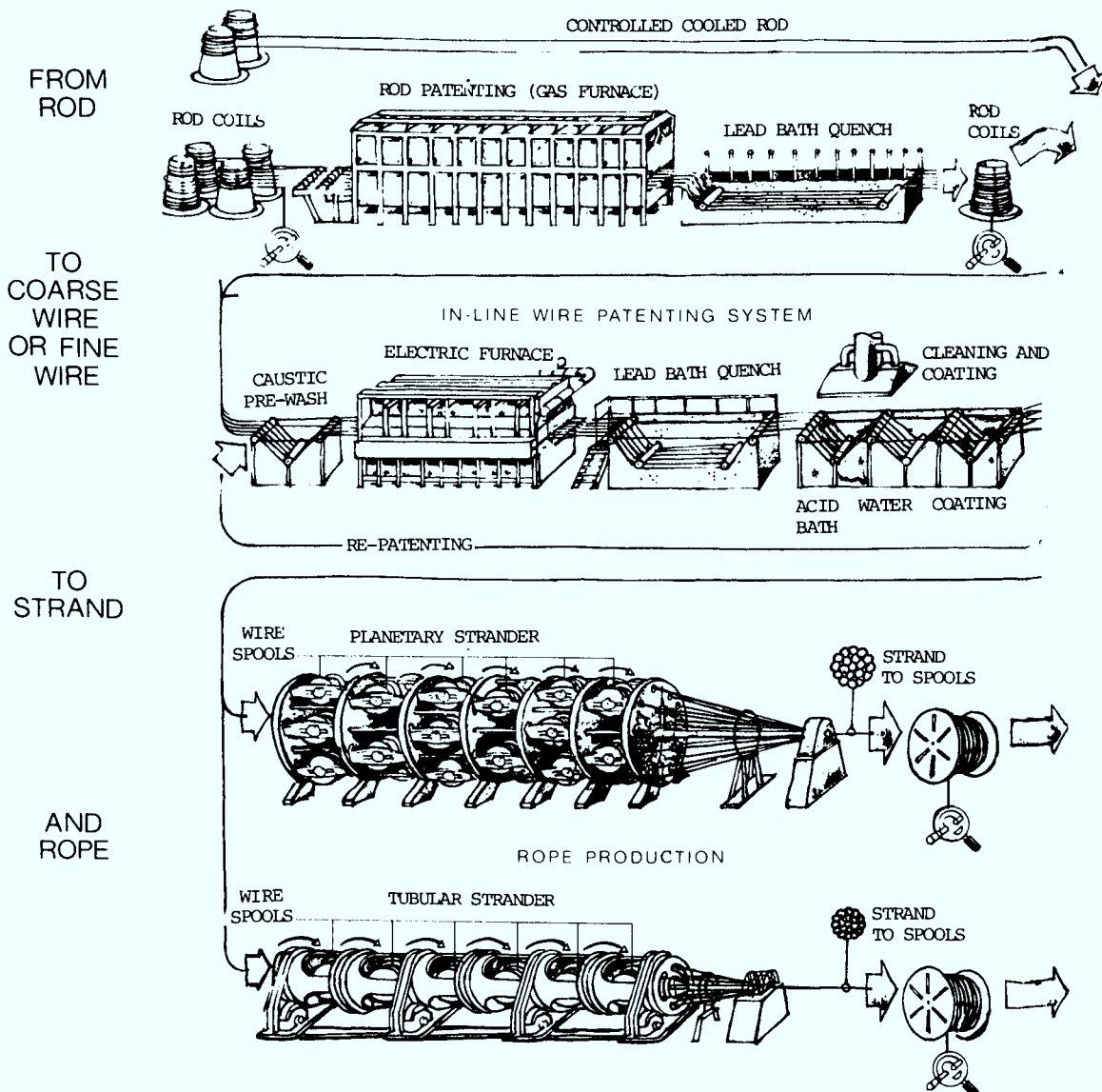
As previously noted, there are two types of manufacturing systems, continuous flow and intermittent. Some elements of the former system are employed when the ropes produced are of the standard variety, usually in the diameter range of $\frac{1}{4}$ " to $1\frac{1}{4}$ ". The high volume requirements of such ropes allow the producer to use a standard set of processes and sequence of processes. This has prompted some manufacturers to have multiplant operations, in order to specialize along product-specific lines.

For example, Greening Donald has two plants in Ontario, one in Hamilton and the other in Midland. The latter plant primarily produces the standard variety of ropes, and its manufacturing system exhibits certain characteristics of the continuous flow model. The Hamilton plant, on the other hand, produces the larger diameter ropes, and here the manufacturing facilities have to be flexible enough to manage a larger assortment of products

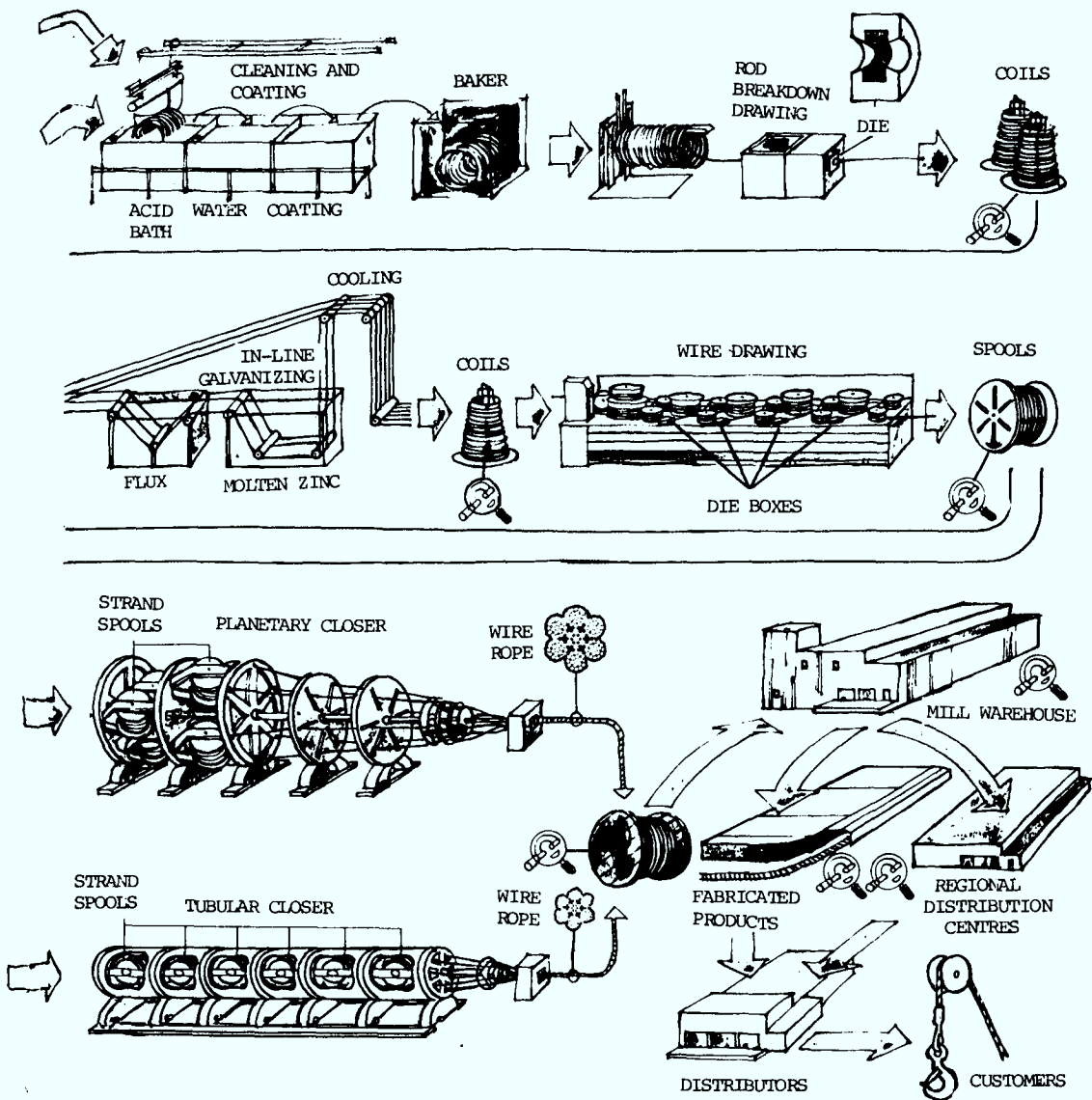
EXHIBIT 10

THE MANUFACTURING PROCESS

Fully-integrated manufacturing provides close quality control at



every production step...with continuous  inspections at every critical point



and sizes. Custom or job orders tend to characterize much of the output in the Hamilton plant; hence, the use of the intermittent system. Although the technical and economic benefits of specializing along product-specific lines are significant, the small size of the Canadian market influenced the largest wire rope producer, WRI, to manufacture both standard and specialty ropes, employing both types of manufacturing systems in a hybrid fashion, under one roof in their Pointe Claire plant in Québec, while producing largely standard types of wire rope in their Vancouver plant.

The manufacture of rope for a wide variety of uses involves many technical complexities. The quality of wire, the choice of sizes to be used, the number and arrangement of strands in the rope all vary according to the initial use of the end product. Nonetheless, there are only three relatively simple basic manufacturing processes.

Roping wire is usually purchased in catch weight coils or as packaged prewound (spoolless) wire. In the case of the former, the coils are placed on swifts and then spooled or wound on bobbins. This is Phase 1, the first and least costly process, usually referred to as spooling. While pre-packaged wire can be used directly for stranding, this does not always happen, because of the need to fit the wire to the various stranders (machine sizes).

The second basic process, Phase 2, stranding, involves loading the bobbins of wire on a stranding machine to produce strand. At present there are two types of stranders -- planetary and tubular. The strands are then loaded on a closing/finishing machine, the third basic process, Phase 3, which produces the wire rope. As in the case of the stranding machinery, there are two types of closer machines -- planetary and tubular. The amount of manufacturing involved in the production of strand from the wire stage is proportionately smaller; in essence, strand is closer to wire than it is to wire rope.

The wire rope plants in Canada are equipped with stranders and closers in a variety of sizes. Light ropes can be made most economically on light machines, while large machines are required for the production of heavy ropes. The planetary machines are used for the manufacture of heavy strands and ropes, i.e., diameter in excess of $1\frac{1}{4}$ ", while the tubular machines produce the lighter ropes, i.e., diameter less than $1\frac{1}{4}$ ".

The ability to produce different sizes and types of rope varies with the machines employed, e.g., the number of bobbins and the size of the tube. The size of the machine will affect the foregoing considerations. Machine speed is also an important variable in the manufacturing process. While faster machines are more efficient than slower ones, they require more frequent loading of bobbins, so that ease of loading becomes a critical element in the system. The faster machines also tend to be newer, and while they require less maintenance in the early years of their operation, the high speed at which they operate may result in significantly higher maintenance costs in later years.

Some of the machinery employed possess a degree of adaptability in that for some sizes of ropes, the stranding and closing operations can be performed on the same machinery. The extent to which the closing machinery can be used to manufacture different size ropes is determined by the number of bobbins it can hold and the size of its tube. Many machines, however, operate in a narrow range of rope production. Consequently, the more varied the ropes, the more frequently the machines have to be stopped for resetting.

Partly in response to these and related problems, Canadian wire rope manufacturers invest more money in the acquisition of adaptable machinery than do their U.S. counterparts. The scope for specialization in Canada is not as great as in the United States, and thus engineers request the design of machines that can be better adapted to produce a broad product mix. This often adds 25 to 30 per cent in capital costs over those of U.S. manufacturers, who can segment markets and invest in single-purpose versus multi-purpose machines. Higher transportation expenses and those related to the Canadian climate are other added costs.

Plant capacity is generally calculated on what the existing machinery could produce, given the firm's product mix, on a three-shift, five-day-a-week basis. Because Canadian producers are called on to manufacture a wide range of sizes, types and complexity of wire rope construction, they invest in and employ many different types of machines. Theoretically, their potential plant capacity figure is high, but in fact it cannot be realized.

The plant cannot operate at a high capacity level because the manufacturing system has to be continually geared for change in response to different customer-product

requirements. For example, what is the economical production run on some standard diameter rope? The answer will depend on the type of machine used. The most economical run may necessitate not filling up that machine to maximum capacity of its bobbins, but having a large enough order of the one size so that it can be continually reloaded to the same specifications, to the same lays, to the same diameter and to the same settings.

Executives of the wire rope industry contend that the product-specific scale economies enjoyed in U.S. plants are not achievable in Canadian plants. The problem in Canada is that after a run of one or two machine loads of one diameter, customer requirements demand a switch to another diameter, which entails a higher labour cost because of the need to change the machines to the new construction in diameter of strand or roping.

Measuring capacity in terms of footage is impossible because it depends on the size of rope construction and type of machine employed. High capacity is realized when the machine is run without any change in the settings. This is done at some plants in England and the Continent where there is a substantial domestic demand for specific types of rope. In a country where there is a very large demand for rope, there is by the same token a large demand for each individual size. In Canada, for example, one may have a demand for 100 tons of $\frac{1}{2}$ " scraper cable, while in some European countries that demand could be 1000 tons, and that $\frac{1}{2}$ " scraper cable is laid in the same fashion on the machine.

If a sales order calls for a multiplicity of diameters, many of which have to be processed on the same machine, then considerable labour is involved in changing the machines over. The stranding and closing machines, for example, must be adjusted to new settings, and this cannot be done in the course of running, but only after each job is finished.

It is most economical to produce a length of rope equivalent to the maximum carrying capacity of the bobbins in terms of wire. However, if the producer is faced with demands for shorter length ropes which are not stocked, then to satisfy such orders the machines will run on short lengths requiring changes and loadings in each shift, thus raising labour costs.

In brief, local producers experience a number of competitive disadvantages in their attempt to reduce the costs of manufacturing wire rope in Canada. Specifically, there is the combined problem of operating below capacity and producing short runs. The most economical type of operation is one where a machine can be left for long periods in the production of one product. In such an operation, the refilling of the bobbins and other servicing functions are reduced to an efficient routine. In the absence of sufficient volume to permit such an operation, it is highly desirable that volume be at least large enough to permit the bobbins on a closing machine to be completely filled, even though the machine will have to be adjusted each time to produce a different kind of rope. The most costly type of operation is the setting up of a machine to produce an order too small to justify fully loaded bobbins. It is estimated that Canadian manufacturers exhaust full bobbins on only about 60 per cent of their production.

A number of the Canadian wire rope executives emphasized that the longer and more standardized runs produced in the United States meant that the manufacturing system employed in U.S. plants tended to exhibit more of the "continuous flow" characteristics and less of the "intermittent" than is the case in Canada. The savings which result from using different manufacturing systems can be quite substantial. "Manufacturing cost savings as high as 50 per cent can be gained by shifting from job-shop methods (intermittent) to a straight line (continuous flow) operation. Large lots and long runs may permit the realization of 'learning by doing' economies, for instance, as workers develop dexterity in carrying out intricate assembly tasks."²

INDUSTRY PROFILE

The Producers

The "SIC 305" group of manufacturers may be conveniently considered in two groups. There are three integrated firms which are engaged in all stages of the steel wire production process. There are also 25 unintegrated firms which purchase wire rod and manufacture wire products.

2. Scherer (1975), p. 50.

The three integrated producers are the Steel Company of Canada Ltd. (Stelco), Canada's largest and most vertically integrated steel producer; Sidbec-Dosco, the Québec-government-controlled steel producing enterprise; and Ivaco, the smallest but most internationally oriented of the firms. All three firms produce primary steel and manufacture wire rod as a semifinished, rolled steel product. Wire rod is drawn down into wire, which in turn is used in the manufacture of wire products, the principal ones being fencing, mesh, netting, screening and rope.

Stelco, Sidbec and Ivaco account for almost all of Canada's output of steel wire rod.³ In 1976 their combined output was approximately 800,000 tons. Stelco accounted for about two-thirds of this figure, with the remainder split between Sidbec and Ivaco. Imports for the year were in the range of 160,000 to 200,000 tons, approximately half from Japan and the rest from Europe. The three Canadian producers normally retain all of their output of rod for processing into wire. They account for at least three-fourths of total Canadian production of wire, and they also retain a considerable proportion of their output of wire for processing into a variety of wire products.

Of the three producers, Ivaco is the only substantial importer, because its rod mill cannot produce all the grades it requires. The imports come largely from France, Belgium and Eastern Europe, and in certain years account for as much as 25 per cent of Canada's wire rod imports. Ivaco, unlike Stelco and Sidbec, has wire and wire related manufacturing facilities outside of Canada, in the United States. A substantial part of its rod is shipped to its U.S. subsidiaries where it is drawn and converted into wire products.

These three firms account for more than half the Canadian output of wire manufactured products, but none of them produce wire rope. They are the pre-eminent producers of nails, spikes, staples, bolts, nuts, washers, wire fencing and barbed wire. Of the three producers, Stelco is the largest and most diversified manufacturer of wire and bolt products. Stelco has four wire mills in the Hamilton and Montreal areas which produce a wide range of wire and

3. Atlas Steels Co. Ltd. produces a stainless steel wire rod, but the market for this product is extremely small in relation to that of other grades.

wire products. Its Parkdale Works in Hamilton include the largest nail manufacturing operation in Canada, and its plants in Edmonton, Hamilton, Brantford, Toronto and Montreal produce screws, bolts, nuts, rivets and other fastener products. Stelco does not produce small volume products such as screening and wire cloth.

The second group in "SIC 305" includes some 25 manufacturers which are unintegrated in the sense that they must obtain their wire rod or wire from Stelco, Sidbec, Ivaco, or abroad. Some of these firms compete with the integrated producers in manufacturing nails, bolts, nuts, fencing and other products, while others produce wire rope and other products not made by them. In recent years, an increasing number of the unintegrated manufacturers have installed wire-drawing equipment, e.g., Lundy Steel Ltd. However, they retain the wire they produce for their own use in the manufacture of such products as wire cloth and wire screen.

The corporate motivation for developing a wire drawing capability is to reduce dependency on the integrated producers and the foreign suppliers of steel wire. Greening Donald is the only one of the four rope manufacturers that draws wire. It has been in the wire drawing business for more than 50 years. However, it draws wire for stainless steel production, half of which is internally consumed but none in the manufacture of wire rope.

The manufacture of much of the wire produced from wire rods requires relatively little capital investment. The value-added varies greatly with the type of wire produced; it is considerably less than 50 per cent of the cost of the rod in the case of many uncoated wires, and in only a small percentage of total wire production would it exceed 100 per cent. The virtually duty-free entry of wire rod and the relatively high rates of duty on wire result in high effective rates of duty on the value-added--hence, the incentive to draw wire in Canada.

The four firms in the wire rope industry account for virtually all Canadian factory shipments of wire rope, but less than half of strand. The principal use of strand is in the manufacture of wire rope, but there is also a market for strand as such; e.g., guy and prestressed concrete strand. "Guy wire" is a form of strand used principally to support communications and power line poles. Stelco is the largest producer of strand for guy wire, concrete reinforcement and other purposes.

WRI is the only wire rope manufacturer that produces a substantial volume of both guy strand and prestressed concrete strand. While Greening Donald produces some guy strand, the volume is not significant. WRI, on the other hand, ranks second to Stelco as a producer of the two strand products. In 1976 approximately one-quarter of WRI's Pointe Claire plant output (in tonnage) consisted of guy strand, and one quarter of its Vancouver plant's output was made up of prestressed concrete strand.

Of all the products included under SIC 305, wire rope and strand are the most technically complex. The quality and size of the wire, the number and arrangement of wires in a strand, and the number and arrangement of strands in wire rope all vary according to the end use for which the wire rope is intended. Because of the variations possible in the end product, and the diversity of customer requirements, this industry grouping appears to be more subject to the economic problems related to short production runs and excess capacity.

Ownership and Competition

The production of wire rope in Canada was initiated during the last quarter of the nineteenth century. Great Britain, because of its heavy involvement in shipping and mining throughout the world, was a major force in developing wire rope technology.⁴ U.K. wire rope expertise spread into the areas of logging, commercial fishing, elevators, materials handling and other areas of manufacturing activity, especially those related to resource industries.

Canada's mining, fishing and logging industries presented British wire and rope manufacturers with an export market opportunity and a commercial rationale for having subsidiaries in Canada. By the mid-1960s, the Canadian wire rope industry was largely foreign owned or controlled, by companies based in the United Kingdom and Germany. For example, WRI, until recently, was controlled by its major

4. See The Monopolies Commission, Wire and Fibre Ropes, A Report on the Supply and Exports of Wire Rope and Fibre Rope and Cordage, Presented to Parliament in pursuance of Section 9 of the Monopolies and Restrictive Practices (Inquiry and Control) Act 1948, (London: Her Majesty's Stationery Office, 20 Nov. 1973).

shareholder, Bridon Ltd., formerly British Ropes; Greening Donald is still controlled by German interests (Thyssen Westfaelische Union); Martin-Black Wire Ropes Canada Ltd. is a subsidiary of Martin, Black & Co. Ltd., Coatbridge, Scotland; and Wrights Canadian Ropes Ltd., while a Canadian-owned company, has had a contractual arrangement with a U.K. firm covering the transfer of technology and the importation of wire for its British Columbia rope manufacturing plant. In the case of WRI, while Bridon is still a substantial minority shareholder, the majority of its shares are held by Noranda. Effective control is exercised by Noranda's members on the board, and for all intents and purposes, WRI is now a Canadian controlled firm.

Bridon (British Ropes Ltd.) has been a major force in the emergence and development of the wire rope industry in Canada. Its initial overseas investment was made in 1925 in Canada when it acquired a company which it re-named British Ropes Canadian Factory Ltd. Subsequently, it acquired another wire rope subsidiary, Dominion Wire Rope Ltd. These two companies merged with two other Canadian wire rope companies to form Wire Rope Industries of Canada Ltd.⁵

The establishment of WRI in 1963 was made up of an amalgamation of the following four Canadian wire rope operations:

1. Anglo Canadian Wire Rope Company Ltd. Established in 1919 in Lachine, Québec, this company introduced to Canada the manufacture of locked coil rope in 1946. At the time it became one of the group of companies operating under the name of WRI, Anglo Canadian manufactured all types of steel wire rope.
2. British Ropes Canadian Factory Ltd. Dating back to 1918, this Vancouver-based operation first sold rope imported from Great Britain. In 1923, it began to manufacture wire rope for the logging and shipping trade. The company built a new factory in 1953 and became the first Canadian plant to include facilities to prestretch strand and ropes of its own manufacture.

5. The Monopolies Commission, (1973), p. 18.

3. Dominion Wire Rope Ltd. The company's origin dates back to the 1880s, when it acted as an agent for a number of British manufacturers supplying railway, mining and contractors' equipment. Dominion's Lachine factory was the first to manufacture "truly performed" ropes; locked coil ropes for mine shaft hoisting; locked coil ropes of high tensile wires for aerial tram track ropes; and synthetic cordage, particularly nylon, terylene and polypropylene for steel wire rope cores and coverings. At the time of amalgamation, this plant had the most modern types of machinery designed to manufacture the complete range of wire ropes in round strand, flattened strand, and locked coil types and in sizes ranging from 1/16" diameter to 4 1/4" diameter. A rope and strand prestretching facility was added to the Lachine operations in 1966, making WRI the only company with prestretching capabilities in both eastern and western Canada.
4. Canada Wire Ropes Ltd. First formed in 1911, it was the Wire Rope Division of Canada Wire and Cable Company Ltd., a subsidiary of Noranda at the time of amalgamation. The company's factory was situated in Smiths Falls, Ontario and included some of the group's newest high-speed stranders and closer equipment and machinery.

Noranda's entry into manufacturing commenced shortly after it initiated its mining operations in 1930, when it acquired a substantial interest in Canada Wire and Cable Company Limited. The move to integrate forward vertically was precipitated by Canada Wire and Cable's decision to build a copper rod mill in Montreal, adjacent to Noranda's new copper refinery. The copper rod mill has since become a substantial outlet for Noranda's copper production. Canada Wire and Cable is Noranda's most important manufacturing subsidiary, and in turn has become a dynamic force for Noranda's expansion and diversification into manufacturing. One such area of activity is related to WRI.

Bridon Ltd. ranks as a leading world company in steel wire, fibres, plastics and engineering products. In fact, the U.K. Monopolies Commission concluded that British Ropes occupied a "monopoly" position in the supply of both wire rope and fibre cordage and a "dominant" position among U.K. producers with regard to exports of both wire rope and

fibre cordage from the United Kingdom.⁶ In 1971, British Ropes accounted for about 55 per cent of domestic wire rope production and its estimated domestic market share was approximately 50 per cent.

It appears that Bridon and WRI occupy positions of comparable importance in the manufacture and sale of wire rope in their respective markets -- the United Kingdom and Canada. Their market pre-eminence differs, however, in one major respect. While approximately 90 per cent of Bridon's requirement of steel wire is produced in company-owned wire mills in the United Kingdom, WRI is totally dependent on external domestic and foreign suppliers for its wire requirements.

The WRI amalgamation move was an important one for Bridon. The merger of the four companies paved the way for the establishment of a single management group through organizational rationalization, allowing WRI to supply and service more efficiently and economically the wire rope requirements of the Canadian market. At present, WRI is the wholly owned subsidiary of Leaworth Holdings Ltd., which is controlled by the Noranda Group of Companies with a large minority interest held by Bridon Ltd. of Doncaster, England. WRI gross sales in 1976 were approximately \$50 million, and only \$6 million was realized through the sale of non-wire rope and strand products.

Prior to the formation of WRI, the Canadian wire rope industry was relatively fragmented and the manufacturing plants were small. It was largely in response to two key amalgamations in the 1960s, involving the WRI complex and the amalgamation of Donald Ropes and Wire Cloth Ltd. and Greening Wire Rope and Cable Company into Greening Donald Ltd., that the industry developed modern facilities. These two amalgamations produced some rationalization of wire rope manufacturing facilities in Canada, and improved the overall efficiency of the industry. The present seven plants have been built since the mid-1950s and have incorporated many of the new technological developments in wire rope manufacture in order to increase their productivity and to improve their product and associated technical service.

6. The Monopolies Commission, (1976), p. 97.

The competitive relationship between the integrated steel producers and non-integrated wire rope producers includes characteristics which are both vertical and horizontal in nature. This is particularly so in the case of Stelco and the two major wire rope manufacturers. Approximately half of the wire requirements of the four rope manufacturers is obtained from domestic sources, primarily from Stelco and Sidbec. Of the four rope manufacturers, the two major buyers are WRI and Greening Donald, both in absolute and relative terms vis-à-vis imports. Wrights Canadian Ropes Ltd. is the most heavily dependent on wire imports, largely from Japan and the United Kingdom. This firm is the smallest of the four, the only single plant enterprise in the group, and the most regional in its production and marketing orientation in western Canada.

The vertical competitive relationship is not just one way, namely Stelco as a supplier of wire. WRI and Greening Donald are also major suppliers of wire rope to Stelco. There is also a horizontal competitive relationship because Stelco and WRI compete in the field of prestressed concrete and guy strand. Greening Donald has announced its intention to increase its production of guy strand in 1977, further promoting the elements of horizontal competition between the two major wire rope manufacturers and Stelco.

The vertical relationship implies interdependency between large and small, with the small often on the dependent end of the transaction. Theoretically, this would be the case with the wire rope group if there were no import alternative to purchasing the wire from Stelco and Sidbec. Similarly, if WRI and Greening Donald were not subsidiaries of large multinational enterprises, Stelco could conceivably exercise much greater financial and technical pressure over the activities and strategies of these two leading rope manufacturers. For example, WRI gross sales in 1976 were approximately \$50 million, which included strand, rope, fencing and related products. Stelco's sales, on the other hand, were about \$1.36 billion. A comparison of commercial power based on these figures would be meaningless since WRI's sales are consolidated with those of Noranda Mines' other companies. Noranda's sales in 1976 were \$1.23 billion, a sales figure which is comparable to Stelco's.

In a horizontal relationship, the dependency of the small firms rests much more on whether the large firm allows the small firm to exist when it could drive it out of business. The strength of the small firm in this situation depends on whether it produces an identical product to the

large firm or can differentiate its product or service to gain a measure of independence. A small firm promotes its own independence when it develops a new product or process which cannot be easily copied; provides personalized service; operates in an area where economies of scale are not important, the market is small, transportation costs are high and adequate sources of finance are available. Many of these factors are apparent in the wire strand and rope segments of the industry. So far, Stelco does not compete in the wire rope market. However, as WRI and Greening Donald increase their marketing efforts with respect to guy strand and prestressed concrete strand, horizontal competition between them and Stelco will intensify.

The competitive relationship between Stelco and the wire rope manufacturers is an interesting one. Some of the executives interviewed readily agreed that Stelco has deliberately refrained from entering the wire rope industry. Concern with Canada's competition policy was one of the principal reasons put forward. Stelco's market dominance in SIC 305 is real and visible, so that any additional integration, vertical and/or horizontal, might precipitate "unwanted" government scrutiny. Coupled with this is the fact that WRI and Greening Donald, which together account for more than three-quarters of the domestically produced wire rope, obtain a substantial part of their wire requirements from Stelco.

There also appears to be an understanding that Stelco stands ready to meet the "offshore prices" quoted on wire to enable the domestic rope manufacturers to compete against wire rope imports. From the standpoint of Stelco, there is little reason to produce wire rope so long as the rope manufacturers purchase a significant part of their wire requirements from them. On the other hand, the rope manufacturers, who do not wish to encourage Stelco's entry into their industry, find that refraining from drawing their own wire or increasing imports is a small price to pay, particularly since they are assured a reliable supply of competitively priced wire.

The U.S. Wire Rope Manufacturers

The wire rope industry in the United States consists of 17 enterprises with 23 plants located in 13 states.⁷ The industry produced approximately 182,000 tons

7. United States Tariff Commission, Steel Wire Rope from Japan, Determination of Injury in Investigation No. AA1921-124 under the Antidumping Act, 1921, as amended (Washington: TC Publication 608, Sept. 1973), p. 3.

of wire rope in 1976. Between 1968 and 1976, the annual domestically manufactured wire rope shipment figure has hovered around the 200,000 ton level. (See Table 27.)

The U.S. wire rope industry differs from its Canadian counterpart in three important respects. With the exception of Bridon-American Corporation, an affiliate of WRI, all major U.S. wire rope producers are American-owned and controlled. The two largest steel producers -- United States Steel Corporation and Bethlehem Steel Corporation -- are also the two largest wire rope producers in the United States. The major U.S. wire rope producers draw their own wire.

In recent years, the U.S. market consumed around 250,000 tons of wire rope a year, approximately five times the total consumed in Canada. Imports account for about 20 per cent of domestic consumption in the United States, while in Canada it is closer to 30 per cent. Although foreign market penetration is substantially lower in the United States than in Canada, it is viewed with equal concern by the domestic manufacturers.

U.S. wire rope executives estimate that the combined wire rope output of U.S. Steel and Bethlehem Steel accounts for approximately 40 per cent of U.S. manufacturers' shipments of wire rope. In 1976, U.S. Steel produced approximately 40,000 tons of wire rope, while Bethlehem Steel produced approximately 35,000 tons. The output of each of the two firms was greater than the output of the entire Canadian wire rope industry. In fact, U.S. Steel's wire rope output exceeded Canada's 1976 domestic consumption of wire rope. There are ten other wire rope producers of note, but none occupies a position to rival the leading two firms.

Imports, Pricing and Industry Growth

The growth and threat of imports has been a major concern for the industry. The import share of the Canadian market for steel wire rope has grown from 15 per cent in 1956 to about 25 per cent in the late 1960s, and has fluctuated between 27 and 32 per cent since 1970. Another way of highlighting the rise in imports is to note that while the total available wire rope market has grown by 13.2 per cent between 1965-1975, the portion supplied by Canadian manufacturers has increased by only 1.9 per cent, while imports have risen by 48.1 per cent, as noted in Table 25.

The year 1976 was a poor one for the industry, because demand for wire rope fell significantly as the pace of economic activity slackened in Canada. The economic situation had a similar impact on imports, which were at their lowest since 1968. Industry spokesmen are not optimistic about future Canadian prospects for wire rope. In terms of real growth in tonnage, they see little upward movement in the next five years (1977-1981) with projections indicating an average annual consumption figure in the range of 48,000 - 52,000 tons, with imports servicing about a quarter of total domestic requirements.

Between 1965-1975, the Canadian market share steadily declined despite rationalization and modernization activities undertaken by the four Canadian based producers. Increased imports, according to the Canadian firms, are due largely to tariff reductions under the "Kennedy Round" of 1968, and more recently the General Preferential Tariff of 1974. The introduction of the General Preferential Tariff (GPT) in mid-1974 was followed by the importation of approximately 2000 additional tons of wire rope from Korea, Colombia and India, which now enjoy the low rate of duty applied previously only to Commonwealth countries.

Table 28 provides a breakdown of wire rope imports by country. Imports from the three GPT countries -- Korea, India and Colombia -- increased from 7.5 per cent of total imports in 1973 to 29.4 per cent in the first half of 1975, and from 2.2 per cent of the total Canadian market to 9.4 per cent for the same period, as noted in Table 29. These imports were brought into Canada under tariff item 40113-1. The GPT rate for wire rope is 10 per cent and applies primarily to imports from countries that are classified as being part of the Third World. The most favoured nation (MFN) tariff is 15 per cent and it applies largely to the industrialized West, which includes the United States, Germany and France, but not members of the Commonwealth. The current general tariff (GT) is 25 per cent and covers imports from all countries which do not fall in the GPT, MFN and British Preferential groupings. Most of these countries are either viewed as "not friendly" or "commercially distant" such as Albania and Libya.

Two other tariff categories are worth noting in terms of wire imports. They are tariff item 40114-1, which covers wire rope for fishing, and 40115-1, which covers wire rope used in logging machinery. Most imported wire rope products are of the general purpose category used in the fishing and forestry industries. Generally speaking, that class of wire rope does not require a high technology input

TABLE 27
U.S. WIRE ROPE MARKET

Year	Total market (tons)	U.S. manufacture (tons)	Imports (tons)	Import as per cent of market
1968	234,503	211,526	22,977	9.8
1969	234,525	207,711	26,814	11.4
1970	226,647	197,577	29,070	12.8
1971	218,391	189,845	28,546	13.1
1972	231,892	189,965	41,927	18.1
1973	256,482	208,324	48,158*	18.8
1974	294,743	230,629	64,114*	21.8
1975	262,111	209,711	52,400	20.0
1976	220,984	181,626	39,358	17.8

* Includes brass-plated tire cord.

Source: Compiled from data in Brief of Amsted Industries Incorporated, Before the United States Tariff Commission, Investigation No. AA1921-124, 20 Aug. 1973, p. 12; and Request for Investigation by Broderick & Bascom Rope Company, Before the Secretary of the Treasury in the matter of Steel Wire Rope from the Republic of South Korea, 19 Sept. 1977.

TABLE 28
WIRE ROPE IMPORTS INTO CANADA (TONS)

COUNTRY	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Australia			52	180	13	-	-	-	46	110	53	27
Austria			77	56	44	32	38	20	50	1	-	-
Belgium			720	712	786	336	381	340	46	346	77	21
Columbia			-	-	-	-	-	-	-	195	74	-
Denmark			20	29	33	15	13	5	12	1	138	1
France			35	49	33	48	126	347	563	361	628	856
Greece			-	-	-	-	-	-	-	-	325	-
Germany (W)			598	996	1433	1081	741	851	1431	2261	2475	984
Hong Kong			44	-	-	-	-	-	-	-	-	-
India			-	11	-	4	96	60	79	938	1263	227
Italy			433	326	222	183	4	52	12	118	6	11
Japan	Details not		1702	1771	2976	2878	3341	3231	4223	3756	2380	2267
Korea	Available		162	59	455	1435	1216	707	1052	2406	2714	2887
Netherlands			922	1012	764	875	1023	1216	1452	990	1075	713
New Zealand			-	2	-	-	-	-	-	166	-	-
Norway			189	234	212	236	461	479	376	369	259	235
Poland			-	-	-	-	-	-	-	248	58	2
South Africa			-	-	-	-	-	-	-	-	60	-
Spain			-	-	1	-	-	-	-	10	22	20
Sweden			-	-	3	7	32	25	3	56	26	18
Switzerland			46	-	13	2	25	1	-	1	32	56
Taiwan			242	117	245	570	238	205	29	248	77	7
Turkey			-	-	-	-	-	-	-	-	19	-
United Kingdom			2753	3565	3014	3350	3401	1921	2845	1638	2189	1863
United States (new)			2198	568	1038	596	667	870	1086	1111	1322	875
United States (used)			-	1017	1537	2384	1509	676	1696	1501	830	816
	10875	11076	10193	10704	12822	14032	13312	11012	15001	16831	16102	11886

Source: Company data.

or technical support service. Standardization, expendability and low price are three key characteristics associated with many of the imported ropes from the GPT countries.

Steel wire rope is manufactured in a great number of countries. It has become a basic commodity since it is essential to most phases of commerce and industry, and it is therefore manufactured by hundreds of companies in industrialized and semi-industrialized countries. Most of the manufacturing techniques, specifications and standards are well established. Even the latest technology is made available to firms in the Third World via turnkey projects and contractual arrangements, particularly technical licensing agreements involving leading European producers of wire rope.

Canadian executives allege that governments in many of the exporting countries pursue policies which favour firms that export, and this puts the Canadian manufacturer at a disadvantage even in his home market. These countries offer lower corporate tax rates on profits earned through exports; more advantageous capital cost allowance incentives for equipment and machinery designed and used to increase exports; payment of direct subsidies, such as concessional financing, for firms actively involved in exporting; and preferred treatment on obtaining raw materials for the manufacture of goods for export.

In recent years, Japan has displaced the United Kingdom as Canada's leading source of imports (Table 28), much of which finds its way to the West Coast where import competition is fiercest. Canadian wire rope manufacturers have traditionally argued that Japan's pricing policies smack of unfair trade practices. The recent willingness of the Japanese to match almost immediately the prices offered by the GPT countries to Canadian customers has been singled out as further evidence of unfair pricing and trade practices. Table 30 compares a Japanese exporter's price list for a group of wire rope products with a Canadian manufacturer's raw material costs for similar products (using domestic sources), before and after the initial impact of the Korean imports. The Canadian manufacturer's raw material costs exceed the Japanese finished product price quotation in every case but one, Product E, and here the difference is one of 37 cents or about one per cent.

This situation appears to be unchanged, and during the summer of 1977 one of the two key Canadian manufacturers

TABLE 29

CANADIAN WIRE ROPE MARKETS:
EFFECT OF GENERAL PREFERENTIAL TARIFF

Year	Total market (tons)	Total imports (tons)	Imports as per cent of market	*Imports from G.P.T. countries	G.P.T.. as per cent of imports	G.P.T. as per cent of market
1967	41,308	10,193	24.7	162	1.6	0.4
1968	41,425	10,704	25.8	70	0.7	0.2
1969	45,280	12,822	28.3	455	3.5	1.0
1970	46,359	14,032	30.3	1,439	10.3	3.1
1971	45,495	13,312	29.3	1,312	9.9	2.9
1972	44,103	11,012	25.0	767	7.0	1.7
1973	50,722	15,001	29.6	1,131	7.5	2.2
1974 (1st half)	22,883	6,321	27.6	1,388	22.0	6.1
1974 (2nd half)	28,601	10,510	36.7	2,151	20.5	7.5
1975 (1st half)	29,875	9,590	32.1	2,815	29.4	9.4

* G.P.T. countries shown are Korea, India, and Colombia.

Source: Company data.

TABLE 30

IMPORT PRICES EXAMPLE

Price quoted by Japanese supplier			Canadian manufacturer raw material cost		
per 100 ft.			per 100 feet		
Prod.	Dec. 1974	Sept. 1975	<u>1</u>	<u>Difference</u>	<u>Cost</u>
A	\$ 9.25	\$ 4.80	- 48.1%	\$ 5.86	
B	12.00	8.60	- 28.3%	11.73	
C	18.20	15.20	- 16.5%	17.35 ²	
D	26.80	21.50	- 19.8%	23.10 ²	
E	40.80	32.70	- 19.9%	31.33 ²	
F	47.40	39.50	- 16.7%	41.82 ²	
G	61.60	51.50	- 16.4%	52.64 ²	

1. Japanese supplier advises "we have recently reduced our prices considerably so that we may compete with Korean mills."

2. Canadian raw material prices for these items is for slightly different, but comparable, construction.

Source: Company document.

of wire rope lodged dumping charges with the Department of National Revenue against "certain wire rope products from Asian countries." These documented charges contend that the aforementioned pattern persists; namely, that Canadian manufacturers' raw material costs exceed the prices quoted on imported wire rope products. In August 1977, the Deputy Minister of National Revenue agreed that there was sufficient evidence of dumping, and possibly injury, to warrant an investigation under the Anti-Dumping Act, and ordered such an investigation with reference to imports from Japan and Korea.

The criticism made of Japanese imports is not unique to wire rope, as similar complaints are levelled against many other Japanese imports, particularly in secondary manufactures. A word of explanation about the Japanese ability to meet competition is in order. There are a number of factors underlying Japanese corporate decision-making behaviour that enable them to engage in "excessive competition" resulting from pre-emptive capital investment and pricing.

First, Japanese firms are less reluctant to employ price cutting tactics than either North American or European producers. Second, Japanese firms are willing to operate less profitably in terms of after-tax return on sales than their North American counterparts (less than three per cent versus more than six per cent), although it should be noted that executives of the Canadian wire rope industry contend that their margin is comparable to the Japanese. This low return makes Japanese firms particularly vulnerable to the dynamics of their manufacturing organisation and the marketplace. If a firm is run inefficiently it will not be able to meet price competition, and if this results in a loss of market share then the Japanese firm's ability to meet price competition is further eroded because of its increased cost disadvantage. Third, the Japanese system permits its firms to operate on an extraordinary level of debt financing for corporate growth. But in order to pay for the seemingly high interest costs (servicing its high debt level), producers are obliged to compete on price in order to hold market share.

These and other reasons have motivated Japanese producers to pursue "the full capacity pricing policy." Messrs. Abegglen and Rapp of the Boston Consulting Group note that:

The high fixed costs of a typical Japanese company result in what might be called a "full- capacity policy." That is, since most costs are fixed, there is considerable incentive for the Japanese firm to operate at full capacity so long as the product can be sold at prices that are somewhat above variable costs -- in fact, somewhat above the cost of raw materials. Since the breakeven point is high and cannot be significantly reduced in the short run, management is constantly pressed to lower prices as necessary to ensure continued full operations as long as these prices do not drop below variable costs.⁸

The drive to rationalize production facilities, to upgrade and replace existing wire rope machinery and equipment, and to develop technical skills to assist Canadian users of wire rope, has been spurred by import competition. The actions taken by the Canadian producers reflect a defensive marketing strategy. This does not mean, however, that they refrain from importing wire rope.

The four Canadian wire rope manufacturers, collectively, account for about 20 per cent of total wire rope imports. Martin Black is the most active importer. A subsidiary of a U.K. wire rope producer, it imports primarily from the United Kingdom. Imports account for approximately half of its wire rope sales in Canada. This firm was originally established as a sales agency by its foreign parent. Most of the imports consist largely of standard types of wire rope which are produced in large quantities, e.g., ropes used by trawl warps in trawling and slusher hoists in mines.

Industry sources estimate that the total Canadian market for wire rope will average an increase of between 2 and 2.5 per cent per year in real growth terms between 1977 and 1981. Imports are expected to account for about one-quarter of domestic consumption and are not expected to make further substantial inroads at the expense of the domestic producers. This view is related to the fact that while the demand for general purpose ropes (standard) has softened significantly, the demand for the larger size

8. "Japanese Managerial Behaviour and 'Excessive Competition,'" International Business - 1973 (East Lansing: Michigan State University, Graduate School of Business Administration, 1973), p. 69.

(diameter) and specialty ropes remains strong. Both WRI and Greening Donald are well equipped to supply these classes of wire rope. Moreover, industry spokesmen contend that current governmental hearings and investigations in Canada and the United States concerning low-priced imports from Japan and Korea should result in decisions which will dissuade these countries from continuing to "dump" their wire rope products in North America, especially on the West Coast.

Two further factors limit the growth potential for standard (general purpose) wire ropes. First, hydraulic systems are replacing wire ropes in an increasing number of machine related systems. And secondly, wire rope manufacturers have been producing better quality ropes that last longer and are easier to maintain. For these reasons, Canada's two major wire rope producers are aggressively exploring export markets as well as opportunities to diversify into related wire and fibre rope and cordage manufacturing operations such as fencing and synthetic rope manufacture. WRI appears to have embarked on a substantial diversification program in 1977.

As previously noted, WRI and Greening Donald possess certain technological and marketing strengths in some wire rope product lines. Apparently, the Canadian market for these products was sufficiently large to justify the initial investment to establish a productive capacity and capability which is now used as the basis for promoting an export thrust into the U.S. market. This is particularly so in the case of Greening Donald, which has a technological advantage in the area of splicing. The U.S. Navy is its major customer.

The Canadian-U.S. joint defense production arrangement, according to executives of Greening Donald, has helped to promote a favourable attitude towards buying Canadian-made goods on the part of the U.S. military, even though the product is not covered under the agreement. In 1976, Greening Donald's exports of wire rope accounted for about 25 per cent of domestic output, sold primarily to the U.S. Navy.

Since 1971, exports of wire rope have ranged between eight and ten per cent of total Canadian production, of which at least 80 per cent was shipped to the United States, as shown in Table 31. Industry spokesmen contend that the scope for exporting outside of the United States is limited, because they are in direct competition with the low

TABLE 31

EXPORTS OF WIRE ROPE AND STRAND BY CANADIAN MANUFACTURERS (TONS)

COUNTRY	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Australia	62	46	20	37	21	-	10	-	-	-
Barbados	-	4	8	10	2	11	-	8	-	-
Bolivia	24	67	22	20	34	40	13	41	20	8
Brazil	-	11	-	-	2	-	-	-	-	9
Chile	1	41	2	-	-	-	16	-	3	17
Colombia	11	30	12	6	14	28	-	-	22	22
Costa Rica	-	-	-	7	-	-	-	-	-	-
Cuba	-	-	15	1	-	-	-	-	-	-
Dominican Republic	-	-	-	-	-	1	2	-	-	-
El Salvador	-	11	13	2	12	5	-	-	2	-
France	-	-	-	4	-	-	33	39	-	-
Greenland	-	-	-	-	-	-	3	5	21	18
Guyana	79	137	94	56	8	103	1	2	53	12
Haiti	5	8	1	3	6	-	-	-	-	-
Honduras	2	2	4	4	5	4	6	6	-	2
India	-	3	1	156	-	-	1	242	-	-
Jamaica	88	27	12	23	1	-	-	31	-	-
Japan	-	41	84	94	-	-	-	18	-	-
Malaysia	-	-	-	16	14	35	-	-	-	-
Nicaragua	-	12	9	4	7	3	5	8	3	17
Nigeria	8	-	-	-	-	-	-	-	-	-
Pakistan	227	119	45	153	1	-	298	-	36	-
Peru	36	240	114	70	121	51	8	-	7	10
Philippines	95	67	69	9	37	25	20	-	30	55
Puerto Rico	-	-	-	-	-	1	6	36	118	14
South Africa	-	-	-	73	-	-	8	2	24	7
Sri Lanka	38	-	-	2	-	-	-	14	-	9
Tanzania	-	-	-	-	-	-	-	-	28	193
Taiwan	47	29	35	-	84	-	11	16	13	-
Trinidad	10	105	5	20	15	11	13	-	9	-
United Kingdom	-	14	-	15	-	10	-	31	45	31
United States	1266	1325	1755	1434	1430	1493	2533	2391	2233	2855
Venezuela	69	19	25	11	40	28	-	-	-	-
Sundry Countries ¹	9	-	-	-	-	-	83	141	40	44
Miscellaneous	7	5	11	4	8	24	27	26	67	18
TOTAL	2084	2363	2356	2234	1862	1873	3097	3057	2774	3341

Source: Company data

1. Burma, Korea, Spain, Turkey, Morocco, Iran.

cost producers. U.S. wire rope executives are even more vocal on this point, since their exports have ranged only between 1 and 2½ per cent of total U.S. production since 1971.⁹

Market Segmentation and Product Differentiation

Whenever a market for a product or service consists of two or more buyers, a potential exists for market segmentation. The rationale behind segmentation is to define differences among buyers which may be critical in marketing to them. Most manufacturers do not find it profitable to "customize" their product mix to satisfy each buyer's individual needs. Rather, the manufacturer tries to search for broad classes of buyers who differ in product interests and marketing susceptibilities. A few of the larger users of wire rope are the construction, oil, mining, elevator, logging, marine, commercial fishing, and material handling industries.

Wire rope manufacturers differentiate their products in four fundamental ways: convenience of location, services offered, physical characteristics of products, and brand images created through promotion.

The location of plants and service centers is designed to promote convenience and economy for customers in terms of quick delivery, warehouse support and lower transportation costs. WRI, the largest manufacturer, has the most extensive company-owned network aimed at servicing its customers. Besides its two manufacturing plants, it has 14 service centers across Canada which stock its products.

Virtually every manufacturing facility in Canada and the United States has a material handling system utilizing a variety of wire rope sizes and constructions. For this reason, WRI and Bridon-American service centers are stocked with hoisting ropes, slings, and load handling rope assemblies. The selection includes O.E.M. and replacement ropes for overhead cranes and hoists, ladle cranes, and gantry cranes. Each service center is also stocked to meet

9. Compiled from data in Brief of Amsted Industries Incorporated, Before the United States Tariff Commission, Investigation No. AA1921-124, 20 Aug., 1973, p. 12; and Request for Investigation by Broderick and Bascom Rope Company, Before the Secretary of the Treasury in the matter of Steel Wire Rope from the Republic of South Korea, 19 Sept., 1977.

rope requirements for any number of conveyer, towing, and lifting applications.

In addition to the warehousing function, the service centres have some machinery and equipment to enable them to perform certain manufacturing and quality control activity in preparing the ropes for immediate use by their customers, e.g., testing product quality and reliability, and splicing and fitting wire rope assemblies. In this instance, the service centre functions as an extension of the manufacturing plant. Thus, any examination of the economic benefits of multiplant operations in the wire rope industry would have to take into account the role of the service centre in both manufacturing and marketing. Firm economies in sales and distribution of wire rope are a critical factor in the cost structure of wire rope, accounting for about 20 to 25 per cent of total cost.

At the field sales level, a certain minimum sales volume is required to justify a geographically dispersed field sales force, to generate the cooperation of a distributor organization, and, when necessary, to provide a product service function. The degree of dispersion or concentration of customers, their individual market potential and the technical requirements of selling to them will influence the manufacturer's size of field sales and service resource support group.

The three smaller wire rope manufacturers cannot justify investment in an extensive company-owned distribution network. The small size of their markets has prompted them to make greater use of wholesale distributors and consignment sales agents. For example, in the case of Greening Donald with six service centres, approximately 60 per cent of domestic sales is handled through the indirect route, i.e., distributors and agents. Direct sales, by the manufacturer to the user, would involve such customers as Stelco and Inco. Volume of business and technical service requirements conditions the manufacturers' decision either to merchandise their product lines through their own sales organization or through independent middlemen.

In the case of the indirect sales route, the distributor is the dominant middleman. He takes title to the product and generally specializes in terms of a geographic area and the industry requirements in that region. Some of his customers will also buy directly from the wire rope manufacturers when volume and technical specifications justify it. The distributors tend to

function as hardware wholesalers, stocking a wide line of related products. Most of the imported wire rope is sold through distributors in Canada who, rather than handling the wire rope products of more than one domestic manufacturer, handle a few imported lines.

Another point to note is that Canadian corporate distribution networks are usually organised along regional lines. This is evident in the case of the wire rope industry. For example, a senior WRI marketing executive made the following points regarding distribution in British Columbia:

Marketing the full product range over a region with problems of distance and inaccessibility requires a highly developed distribution network. This is finely balanced between direct shipments to customers from the plant or via the region's five service centers or through WRI-accredited agents and distributors which have grown up with a valuable and specialised knowledge of a particular area. An agent is able to set up in areas which are too small for us to service. It allows us to concentrate on moving the rope in volume. The proportion of deliveries direct from the plant to customers or via distributors varies from area to area, from as high as 100% direct deliveries in parts of Vancouver Island to only 40% in, say, northern B.C. All except one of WRI's 12 sales representatives in the region operate from the Vancouver office or from service centers.

British Columbia has always been a fiercely competitive market. Japanese wire rope in particular has been imported in large quantities. Each new generation of buyers tries to buy more cheaply. But they look only at the initial dollar cost and not at the final cost. Our initial price is often higher but it includes quality and service.

The point about service introduces the second important way of differentiating a company's product line. The wire rope industry is frequently described as one involving a homogeneous product or little product differentiation. This description appears plausible at the outset but has to be modified in a number of ways. A critical modification is that the marketing of wire rope gives rise to the provision of a range of services on the

part of the wire rope manufacturers, so that service differentiation undermines the homogeneity of the product and indicates the nature of and scope for non-price competition in the industry. Service differentiation takes the form of shorter delivery times, continuity of supply, quality of product, credit terms, transportation and availability of technical and consulting services. Service differentiation is viewed as a critical element of the marketing strategies employed by the Canadian producers, because they cannot compete with imported wire ropes on price alone.

The physical characteristics of the rope products manufactured differ in construction, and this is a third way of differentiating an essentially homogeneous product. The design of steel wire ropes are influenced by such key factors as breaking load, flexibility, resistance to abrasion and crushing, and spin resistant properties. The relative importance of these factors affects the design of the rope, and hence its physical characteristics. While the manufacturers produce hundreds of different types of ropes, the bulk of their sales revenue is realized from only a few product lines.

WRI and Greening Donald have pursued product differentiation tactics by specializing in the manufacture of wire ropes for different markets, thereby developing unique technologies as a means of limiting the scope for comparison and price competition. For example, Greening Donald is particularly strong in the area of open pit mining (i.e., large drag line rope types, and splicing and fittings), while WRI emphasizes its strength in deep shaft and open pit mining (i.e., high strength hoist rope types).

Finally, products are differentiated in terms of the subjective image they impress on the customers' thinking. Whether the product is a consumer or industrial good, manufacturers tend to employ brand promotion as a means of generating strong and saleable images for their product lines. All four Canadian producers use brand names; for example, WRI brand names include "Blue Strand," "Hydraloc," and "Blu-Loc;" Greening Donald uses "Orange Strand;" Martin Black uses "Duoflex" and "Silver Strand;" and Wrights uses "Greenheart" and "Bulldog." The extent to which brand images succeed in promoting the sale of industrial products, however, is affected by the performance of the company's total service mix.

There is quite a psychological dimension to promoting the sales of wire ropes. As previously noted, different product lines stress different characteristics. Promotion of elevator ropes stresses safety, life and "smoothness of operation," while that of hoist ropes tends to emphasize safety, life and "endurance." The difference between the smoothness and endurance features reflects the different uses of the rope, passenger vs. industrial. The smoothness factor is so important that rope manufacturers' engineers work closely with engineers of firms such as Otis Elevators in order to design the ideal product to approximate the "smoothest" impact possible.

A further point should be noted. The wire rope manufacturers' salesmen work closely with the original equipment manufacturers (OEM) to get their products specified in the original design of the machinery. A product named in a machine's specification book is ensured a long-term future. Since wire rope must be replaced at intervals while the machine is in use, having the product written into the OEM specifications is of great advantage. In many cases, the replacement rope named in the specification is supplied by the OEM. In others, it is supplied directly by the wire rope producer or by one of its authorized distributors.

Regional Industry Characteristics

The substantial weight of steel wire rope and its related freight cost has prompted Canadian and U.S. wire rope manufacturers to establish "marketing regions" which are serviced either by a regional manufacturing plant or service centre facilities. These plants/service centres provide local stocks and service as they relate to regional user and distributor requirements. A key point to note is that separate and distinct pricing and discounting levels appear to be in effect in certain regions because of their unique market characteristics and nature of competition.

On the West Coast, for example, the major volume user is the logging trade, involving important high-volume products. Import competition from Japan and Korea is so fierce in this region that Canadian wire rope manufacturers insist that many of the foreign-made products are being "dumped." This view is shared by the U.S. wire rope industry with respect to their Pacific Coast. They contend that individual prices encountered in competition in the marketplace were indeed so low that they appeared to be below the cost of production in Japan, thereby giving rise

to the suspicion of imports at less-than-fair value. MacWhyte Company, a division of Amsted Industries, Inc., provided confidential data before the Secretary of the Treasury in 1972-73 which indicated that Japanese "steel wire" sold at or near the price of Japanese "steel wire rope" and that the margin of difference was insufficient to cover the cost of conversion.¹⁰

The sale of a number of the currently imported wire rope products, particularly those which are high volume, standardized and largely service-free, are considered critical to the ability of Canadian wire rope manufacturers to realize an adequate return on their investment. Canadian manufacturers are forced to match import price levels which they feel are unrealistic, making the Japanese and Korean exporters the price leaders on the West Coast.

The marketing situation is quite different when wire rope sales are made to major users such as elevator manufacturers, where service differentiation is a key element in the marketing strategy and price competition alone is no longer the issue. For example, the provision of engineering staff services "in the design or recommendation of wire rope for a specific application important to a customer, for guidance in safety and maintenance, and to render follow-up services after the sale."¹¹

In summary:

the regionality of the industry is defined both in terms of the geographic locations of the facilities, by the predominance of certain wire rope products and their uses, and by economic factors such as weight and cost of shipments, ability to provide services and, indeed, by the regionality of competition of imports.¹²

10. Noted in Brief of Amsted Industries Incorporated, Before the United States Tariff Commission, August 20, 1973. pp. 11-14.

11. Amstead Industries Brief (1973), p. 9.

12. Amstead Industries Brief (1973), p. 6.

Of the four Canadian wire rope producers, only Wrights Canadian Ropes Ltd. with one plant in British Columbia can be considered a regional producer. The other three producers, each with two plants, including Greening Donald Ltd. with both of its plants in Ontario, consider themselves national manufacturers, serving regional needs through regional plants/service centre establishments.

CASE EXAMPLES

Wire Rope Industries of Canada Ltd.

The company employs some 750 people in 13 cities across Canada. Corporate headquarters are in Montreal, and the company's two principal manufacturing plants are located in Pointe Claire, Québec and Vancouver, British Columbia. The company maintains service centres (sales offices combined with warehouses) at Dartmouth, Nova Scotia; Toronto, and Thunder Bay, Ontario; Québec City, Québec; Winnipeg, Manitoba; Saskatoon, Saskatchewan; Regina, Saskatchewan; Calgary, and Edmonton, Alberta; Nanaimo, Port McNeill, and Prince George, British Columbia. In addition to warehousing, the service centres perform certain pre-production activities for WRI customers such as cutting and coiling. These centres are largely supplied from the two main warehouses at Pointe Claire and Vancouver.

The Pointe Claire Plant

The plant was specifically designed to produce steel wire rope. The plant layout was completed before land for the site was purchased. Previously, the industry approach was to buy or rent space and then install the machinery and equipment. A 28-acre plant site was purchased in Pointe Claire, 15 miles west of the Montreal city centre on the Trans Canada Highway. The site has ideal soil conditions for machine bases and pre-stretch anchorages. It is close to a large and highly skilled labour area, and its proximity to the Trans Canada Highway makes it ideal for material and product handling requirements. In addition, the location of the plant provides excellent advertising exposure, which is particularly helpful in industrial marketing.

The manufacturing plant, erected in 1973, has 285,000 square feet of floor space. The cost per sq. ft. of plant was approximately \$10. In 1977 the price quoted is \$15/sq. ft. Land cost was about 65¢ per sq. ft. -- the figure for 1977 is \$1.65. The plant and site have ample

space for future expansion. The Pointe Claire plant replaced a combined 300,000 sq. ft. configuration of five separate factory facilities located in Lachine and Smith Falls.

The major difficulties encountered in moving to the Pointe Claire plant were not technical but personnel problems. Only six of the 160 people who worked at Smith Falls transferred to Pointe Claire, in spite of many company efforts to ease transfer problems. These six individuals are supervisors who are now part of a total complement of more than 230 plant employees.

In 1974, almost two-thirds of the Pointe Claire production personnel had less than two years service with the company. This has meant that planned productivity levels have not been achieved as soon as expected. Absenteeism and a high labour turnover were other unexpected problems. At one point labour turnover rose as high as 24 per cent. The present monthly rate average is 2.4 per cent and the absenteeism rate also has dropped significantly. Nonetheless, production personnel problems are a continuing concern because of the difficulties of recruiting, motivating and retaining competent operators and plant supervisory personnel.

The approximate full capacity figure for the Pointe Claire plant is 22,000 tons a year, based on a product mix of wire ropes which covers a broad diameter range, $\frac{1}{4}$ " to 6". Production in 1976 was approximately 60 per cent of capacity. About a quarter of this tonnage consisted of 7-wire strand output (e.g., guy strand). The low capacity utilization figure is in part attributed to a major production slow-down and six-week work stoppage (lock-out) at the plant in 1976. Otherwise, the tonnage output would have been closer to the 70 to 75 per cent capacity utilization level.

The Vancouver Plant

WRI's western plant is situated on 13 acres of land on Grandview Highway, Vancouver. This relatively modern plant of 116,000 sq. ft. manufactures a full range of steel wire rope and also produces wire strand for use in the manufacture of prestressed concrete. The Vancouver office administers all western regional sales activities. However, the wire rope range produced is less varied than the Pointe Claire product mix. Western wire rope requirements are more limited and basic than that of the East and this allows for greater standardization of production. The Vancouver plant,

however, produces a broader line of ancillary products, the most important being prestressed concrete strand.

The Vancouver plant has a full capacity figure of about 16,000 tons a year, based on a product mix of wire ropes which ranges up to a diameter of $2\frac{1}{2}$ ", although most of the ropes produced are in the $\frac{1}{4}$ " to $1\frac{1}{4}$ " range. Production in 1976 was approximately 60 per cent of capacity. About a quarter of the tonnage consisted of prestressed concrete strand. Import competition and moderate demand among customers in the West were two of the key reasons cited for not operating at a higher capacity utilization level. Table 32 provides a comparison of the two plants in terms of space, location, capacity and utilization, personnel and product mix manufactured.

Costs

Approximately 40 per cent of WRI's wire requirements is imported, the bulk from Bridon-U.K., its former parent. The import figure for WRI's sister affiliate in the U.S., Bridon American, was 70 per cent. However, once its wire mill is in full operation, it will be moving towards self sufficiency. In the case of WRI's Vancouver plant, a substantial part of the wire requirements used in the manufacture of round strand (guy strand and rope) is purchased from Titan Steel and Wire Co., Ltd. This company was founded in 1963 and is jointly owned by Mitsui & Co. Ltd. and Kobe Steel Ltd. of Japan. It processes both high and low carbon wire from imported steel rod.

Wire accounts for about 60 per cent of the sales value of wire rope. Since general price levels are effectively determined by import competition, the cost of wire to the domestic manufacturer is a crucial factor affecting his final cost performance. Although the wire rope producers purchase a substantial portion of their wire requirements from domestic sources, they insist that any tariff increase on imported roping wire would result in a ruinous cost increase to the wire rope industry. This is particularly the case for firms which have plants in British Columbia and Alberta, with their added burden of high freight costs from domestic steel wire suppliers, many of whom are located in eastern Canada.

The average price of wire used in the manufacture of wire rope in Canada in 1974 was \$573.00 per ton. Labour, overhead, packaging and administrative costs in Canadian factories added another \$313.00 per ton, resulting in an average cost of approximately \$886.00 per ton for Canadian manufactured rope. These cost figures are averages, and

include all wire ropes produced in Canada. The average entered value of wire rope imported in 1974 was \$783.00 per ton from all sources and was as low as \$633.00 per ton in the case of imports from Korea.

In 1976 the average cost of manufacturing wire rope at the WRI Pointe Claire plant was \$880.00 per ton, made up of \$560.00 for wire, and \$320.00 for labour, overhead, packaging and administrative costs. Labour, both direct and indirect, accounted for a little more than half of the \$320.00 figure. The average selling price per ton of wire rope is normally taken to be twice the average cost of producing a ton of wire rope; for example, $\$880 \times 2 = \1760.00 . The selling price covers all other expenses such as marketing and administration, and incorporates the company's estimate of a normal return, i.e., profit. In 1976 WRI's average sales price per ton of wire rope ranged from approximately a low of \$1400.00 to a high of \$2200.00. The type of rope produced and the element of competition, especially import, are two of the major factors which influence the sales price.

Table 33 provides a breakdown of costs in percentages for the two WRI plants which also function as profit centers. A profit is obviously being made, but it is a low one. The profit of the Vancouver plant is significantly lower than that of Pointe Claire. Higher costs of freight (inbound and outbound which on the average account for about 6-8 per cent of net sales), labour (\$8 an hour vs. \$5.75 per hour), and, generally speaking, a lower productivity performance on the plant floor are the major reasons why the Vancouver cost performance is relatively weaker. It should be noted, however, that the profit figures for the two profit centers include the plants' total output, whose product mix is made up of profitable and unprofitable wire rope lines, as well as strand and fittings. For this reason, WRI executives contend that the (low) profit figures are inflated, since profit on fittings and splicing is higher than on the manufacture and sale of wire ropes, though the volume of business in this category is small in relative terms.

A number of steps have been taken by WRI to reduce its costs of manufacturing in Canada. For example, it is "batching" as many of its orders as possible, i.e., "grouping" orders so that it can minimize the number of changeovers, and maximize the scope for production runs. This produces savings in all three phases of manufacturing--spooling, stranding and closing. Economies of volume and

TABLE 32
COMPARISON OF MANUFACTURING PLANTS, 1976

	Pointe Claire	Vancouver
Space and Geographic Location	285,000 sq. ft. 28-acre site Excellent highway location Access to skilled labour pool	116,000 sq. ft. 13-acre site Excellent highway location Access to skilled labour pool
Capacity Utilization level	22,000 tons a year 1976 output - 13,000-14,000 tons	16,000 tons a year 1976 output - 9,500-10,500 tons
Personnel	Production workers: 205 Ropery: winding/stranding /closing (for 3 shifts) - 140 Warehouse including spinning/cutting/rigging (3 shifts) - 49 Maintenance - 16 (includes foreman, lab and testing: 2 shifts)	Production workers: 154 Ropery - 112 Warehouse - 23 Maintenance - 19
Product Mix	Round, flat and lock coil (Large rope up to 6" diameter)	All round (Large rope up to 2½" diameter) Prestressed concrete strand - a specialty product used in beams and bridges

TABLE 33
WIRE ROPE INDUSTRIES LTD. - 1976

	Pointe Claire (in percentages)	Vancouver
Net sales	100.0	100.0
Cost of sales	<u>69.0</u>	<u>65.2</u>
Gross profit	31.0	34.8
Less: operating expenses		
marketing	15.6	23.1
administration	3.9	6.4
Other expenses	<u>.1</u>	<u>(1.6)</u>
Operating profit	11.4	6.9
Interest on L.T. debt	1.2	-
Corp. H.Q. charge	<u>2.8</u>	<u>3.6</u>
Profit before taxes	7.4	3.3
Income taxes	<u>3.3</u>	<u>.7</u>
Net profit	<u>4.1</u>	<u>2.6</u>

Source: Company data.

capacity are realized in this case, and according to the manufacturing executives interviewed, the savings can amount to as much as five per cent of total cost.

The approach to batching in production is closely linked to the plant's inventory policy--specifically, deciding between the cost of ordering and the cost of carrying inventory. A major goal here is to achieve the best possible balance between holding orders until a mix is obtained for minimizing costs and maximizing manufacturing efficiency, and/or anticipating future requirements by batching the production of potential orders which are held in stock until they are required by customers.

Some linear programming work in the area of production and inventory planning is being done by WRI in order to gain greater economies of volume and capacity. In fact, management believes that the key to increased productivity is through production planning and management. Through judicious planning (execution of orders), maximum utilization can be made of the plant's machinery to ensure fewer "stop-go" routines and longer production runs. The "learning experience" comes into play when the production planner can anticipate and group the orders in line with sales requirements and the time it takes to make each type of rope.

Stranding, according to the production supervisors, is the heart of wire rope manufacturing. By reducing and preferably eliminating spooling, the cost associated with wire rope manufacturing can be reduced. At this time WRI is experimenting with new stranders that embody a new process technology which allows them to strand at higher speeds and to replace bobbins without having to shut the machines, i.e., economies of process technology. The design of this machinery and the experimentation currently conducted at the level of the plant have been spurred by, and incorporate the learning experience of, the production planning personnel.

The Canadian wire rope plants largely embody elements of the intermittent system. However, with the introduction of new technologically advanced stranders, more elements of the continuous flow pattern should emerge.

Bridon-American Corporation

Bridon-American was originally a wholly owned subsidiary of Bridon Ltd. (U.K.). In 1941, British Ropes

Ltd. (Bridon Ltd. - U.K.) established a New York based sales and distribution outlet to handle wire rope imports from the United Kingdom. In 1953, this outlet was transformed into a full-fledged sales subsidiary, British Ropes New York Inc., to merchandise wire ropes and related products. In addition, some manufacturing activity was initiated in New Jersey.

In order to grow in the U.S. market, a manufacturing operation had to be established. British Ropes' management decided not to start from scratch, but rather to acquire an existing operation. When the wire rope division of American Chain and Cable (ACCO) became available for purchase in early 1972, Bridon purchased the principal assets of that division. The ACCO acquisition made available 10,000 tons of domestic business, an operating sales and distributor organization, the experience of ACCO employees, and a fair manufacturing capability. The acquisition enabled British Ropes to offer a complete range of wire rope products to the U.S. market, except for locked coil rope. The name of Bridon's U.S. operation was changed to Bridon-American Corp. from Bridon Industries in March 1972.

Three years after the ACCO acquisition, a similar opportunity emerged. The wire rope division of the Jones & Laughlin Steel Co. (J.&L.) became available and was purchased by Bridon-American in January 1975. The J.&L. acquisition gave the company the following benefits: a direct link with a major domestic steel manufacturer, additional business tonnage, an increase in manufacturing capacity, capabilities up to 3½-inch diameters, special products in high demand, the experience of J.&L. employees, and an expanded sales and distribution network.

The J.&L. acquisition included a 148,000 sq. ft. wire rope manufacturing plant located in Muncy, Pa., close to the former ACCO plant which by then had in place new machines designed and built by Bridon-U.K. The proximity of the two plants presented some distinct advantages for Bridon-American in terms of specialization of manufacturing and centralization and co-ordination of corporate staff services.

In order to finance the Bridon acquisitions in the United States, the British parent company invited its Canadian partner, Noranda, to participate in its U.S. venture. In 1974, Noranda Inc. obtained an interest in

Bridon-American Corporation which in 1976 amounted to 49 per cent of equity. In addition to being part owners of Bridon American and WRI Inc. of Canada, Bridon-U.K. and Noranda share active directing roles in the two companies; however, as of December 1977, Bridon-American reports to Leaworth Holdings Ltd., a Noranda management dominated holding company. Thus, while Bridon-U.K. holds a majority equity position (51) in Bridon-American, Noranda through Leaworth will direct the commercial future of both WRI and Bridon-American.

When Bridon-American Corporation acquired the Wire Rope Division of ACCO in 1972, the company represented one of about 15 wire rope manufacturers in the United States. Initially, the total tonnage produced at the Exeter, Pa., plant represented less than five per cent of the total production of all U.S. wire rope manufacturers. However, with the acquisition, Bridon-American had a firm base upon which to build. It is estimated that by 1977 Bridon-American was the fifth U.S. producer in order of market importance, whose share appears to be in the six to eight per cent range.

Unlike the other major U.S. wire rope manufacturers, Bridon-American did not draw its own wire until October 1977, and had to rely on outside suppliers for its raw material. Management argued that this placed the company at a competitive disadvantage because of its dependence on foreign imports and wire supplies from some of its major domestic competitors, namely, the integrated producers. In 1976 Bridon-American launched an expansion program which included a new wire mill designed to provide it with 40 per cent of its roping requirements by 1978. In addition to the wire mill, the company has two wire rope plants and a sling and assembly facility all within a 50 mile radius in Pennsylvania. The proximity of the plants and head office will allow Bridon to achieve certain multiplant economies, particularly with reference to corporate infrastructure services such as engineering, product design, research and development, and production planning and control.

Bridon-American's two wire rope plants have a combined potential capacity of approximately 25,000 tons--10,000 tons at Exeter and 15,000 tons at Muncy. The 1976 output for the two plants was about 8000 and 11,000 tons respectively, or approximately three-quarters of the total potential capacity. While the capacity utilization figure was higher than that of the two WRI plants, the net profit performance was substantially lower.

The Exeter Plant

The average cost of producing a ton of wire rope in 1974 at the Exeter plant was \$842.00. Raw materials consisting of wire, rope core and lubricants amounted to \$561.00 per ton, leaving the balance of \$281.00 for labour, overhead, packaging and administrative costs. By 1976, the average costs of production had risen to \$1,039.00, with a breakdown of \$685.00 for raw materials and \$354.00 for other production costs. The average cost of production at the Muncy plant was slightly lower at \$946.00 per ton, made up of \$653.00 for materials and \$293.00 for the remaining manufacturing costs.

The cost of goods manufactured in the United States was appreciably higher than at the two WRI plants because Bridon could not obtain its wire requirements in the United States at competitive prices. Hence the decision to build its own wire mill. Approximately 70 per cent of the wire used at the two plants is presently imported, but dependence on imports will drop as wire is drawn at the newly constructed company mill.

The labour component, both direct and indirect, is less costly in the United States. Average hourly wages at Exeter and Muncy are \$5.20 and \$6.20 respectively, compared to \$5.75 and \$8.00 at Pointe Claire and Vancouver. Once the wire mill is on stream, it is expected that the two U.S. plants will generate a slightly higher profit return than their Canadian plants.

There are three shifts at the Exeter plant when it operates at full production, 7 a.m. to 3 p.m., 3 p.m. to 11 p.m., and 11 p.m. to 7 a.m. The first shift is the most important one and is staffed by the full complement of wage and salaried personnel. For example, the Exeter plant has 73 persons working in ropery (bobbin boys, spoolers, stranders and closers) and the breakdown by shift is 30, 25 and 18 for a total of 73 hourly wage earners. There are 13 people in the maintenance group, six in the ancillary section (stores, scrap and miscellaneous loaders--i.e., indirect support personnel), two in quality control, four in shipping and three in cutting. The distribution by shift again favours the first shift.

In addition, there are 20 salaried people at the plant, the so-called administrators, which include eight foremen, the plant manager, the production planning manager, other plant executives and the secretarial support staff. In all, the Exeter plant employed approximately 131 persons in 1977.

The Exeter plant, unlike the plant at Muncy, is not unionized. Three attempts have been made to organize the workers at Exeter. The union lost the first vote by a small margin and the following two attempts by a landslide. The employees feel that there would be more to lose than to gain if they were to join the union, as they feel that company conditions and benefits are good.

Wire rope manufactured at the Exeter plant is in the 3/64"-1" range. The Muncy plant produces a much broader product-mix, in 3/64"-3½" range, but primarily produces ropes over the 1" diameter size.

The output of the two plants differs considerably in terms of strand footage. The weekly output at Exeter is six million feet of strand, while at Muncy it is only one million feet. However, the average product weight per foot at Exeter is .40 lbs., while it is 1.16 lbs. per sq. ft. at Muncy. These differences are explained in terms of the types of ropes produced at the two plants (e.g., diameter of rope) and the extent to which "special" ropes are produced at Muncy, versus the more standardized, popular and hence longer production runs at Exeter.

Since many of the ropes produced at the Exeter plant are of the standard variety, management has tried to integrate production planning and inventory control in response to market requirements in order to gain maximum scale economies in manufacturing. To this end, management has designed an inventory replenishment program for certain popular wire rope items, especially seven-day stock items, which service centres and distributors can draw on with confidence.

Similar production planning and inventory control analysis has been undertaken for the other wire rope products manufactured at Exeter. The scope for batching is greater in Exeter than in the Muncy plant, the inventory turnover is quicker, and the carrying costs are consequently lower.

Minimum Efficient Scale

Interviews with wire rope executives and an examination of some of their corporate studies involving new capital projects indicate that any MES plant estimate will be conditioned by the proposed product mix to be manufactured. The product mix determines the machinery and equipment requirements as well as the ideal size and design of the plant.

Is there an MES plant? There is no simple answer to the question and there are no studies to refer to. Greening Donald and WRI executives, however, did try to answer the scale question, based on their extensive operating experience in Canada and knowledge of the industry in the United States and United Kingdom. The specific question posed was, "What is the minimum size of an efficient plant in relation to the size of the Canadian market?"

Greening Donald

Senior management felt that their present two-plant operation could be viewed as the minimum in scale and efficiency for producing wire rope for the Canadian market. Some of the key characteristics of the two Greening Donald plants and the 1977 dollar estimate to replicate them is as follows:

Hamilton Plant

This plant produces large diameter ropes and customized rope products. Full capacity is measured at approximately 7000 tons a year, and the output in feet is approximately 8.6 million. In 1974, the plant ran at full capacity. Since then, it has been operating at about 90 per cent of capacity. The year 1974 was unusual because of wire rope shortages. At full capacity, the occupational breakdown and numbers of the plant labour force would be as follows:

Ropery and splicing	- 60	(splicing is 17)
Stores (warehousing, etc.)	- 15	
Machine shop	- 9	
Building maintenance	- 3	
Hourly wage earners	87	
Salaried	18	(foreman, supervisors, secretarial, etc.)
TOTAL	105	

MES = 7000-ton plant for large diameter rope. Duplicating the Hamilton plant in 1977 (173,250 sq. ft.)

Land	\$ 960,000	(8%)
Building and building services	3,600,000	(30%)
Machinery and equipment	7,440,000	(62%)
TOTAL	\$12,000,000	(100%)

Midland Plant

This plant produces smaller diameter ropes, largely in the $\frac{1}{4}$ " to $1\frac{1}{4}$ " range (standard type rope products). The plant's capacity is approximately 4600 tons a year; output in feet is about 18.5 million. The plant personnel mix at full capacity would be as follows:

Ropery	- 40	
Stores	- 10	
Machine shop	- 7	
Building maintenance	- 3	(maintenance, quality control)
	—	
Total hourly	60	
Salaried	7	(1 plant supt. 4 foremen, 2 secretaries)
	—	
TOTAL	67	

MES = 4000-ton capacity plant for $\frac{1}{4}$ " to $1\frac{1}{4}$ " rope production. Duplicating the Midland, Ontario plant in 1977 (80,000 sq. ft.)

Land	\$ 162,500	(2½%)
Building and building service	2,275,000	(35%)
Machinery and equipment	<u>4,062,500</u>	<u>(62½%)</u>
TOTAL	\$6,500,000	(100%)

The president of Greening Donald made the following key comments in connection with the MES discussion:

1. Wire rope plants which manufacture the small diameter standardized ropes are less costly to design and build. Greening Donald tries to realize a 9 per cent ROI, and by operating at near full capacity at each of its two wire rope plants, it can achieve this target objective.
2. Greening Donald is cost competitive with WRI. It operates two considerably smaller scale plants, but at near full capacity. Although WRI has a much larger market share and maintains two considerably larger plant operations, plant facilities in the wire rope industry can easily be scaled down.

3. If Greening Donald had the opportunity to start afresh, management would still opt to have two plants that are geographically separate, even though some argue that it is more efficient and economical to concentrate the manufacturing operations under one roof or on one site. The justification for this view is based on the industrial relations environment in Canada. By maintaining separate contracts, timed differently, even with the same union but different locals, Greening Donald feels itself less vulnerable because it cannot be shut down by a single local union action. In short, it is buying insurance by maintaining two separate plants. Furthermore, smaller plants are easier to manage.

Summary

WRI is the dominant wire rope producer in Canada. To compete profitably, management insists that it has to service the nationwide market. However, some WRI executives no longer believe that to do so optimally requires the operation of multiple, geographically decentralized plants. Although regional specialization has certain advantages such as geographic decentralization and product segmentation specialization, these benefits also can be achieved by having a large, single plant operation supported by a decentralized network of company-owned service centres.

If the design of the large single plant conforms to the "plant within a plant" concept, then a broad range of wire ropes can be produced under one roof. This is the case with the Pointe Claire plant. The costs of running the Vancouver plant appear to exceed the benefits of regional specialization, prompting some of the WRI executives to lament that the manufacturing part of the Vancouver operation was not consolidated with the eastern factories at the time management made the decision to build the Pointe Claire plant.

Labour problems and their related costs in the Vancouver plant loom large in the minds of the WRI executives, but they are only one of the key management tasks performed in the course of running either a single or multiplant operation. The problems of multiplant operations are more complex and demanding.

Running a multi-plant production network efficiently requires a more effective managerial information and control system than operating a single plant enterprise. Many multi-plant firms

failed to realize their potential because they were unable to cope with the managerial challenges.¹³

Another important consideration is that of transportation costs. Prices are generally quoted F.O.B. destination. The manufacturers are usually faced with the absorption of the freight costs. Since the geographic territory serviced is large, this might suggest that it would be more profitable to run a number of dispersed plants instead of a large centralized facility. This argument failed to impress the WRI executives because of the difficulties associated with achieving satisfactory sized production runs in Canada, i.e., small market and broad product-mix requirements.

Although WRI has two plants, given the present market circumstances, the engineering and manufacturing group would opt for a one-plant operation in Canada. In essence, this "new plant" would be designed to produce a broad product mix along the lines of the Pointe Claire operation--standard ropes, large diameter ropes and specialty/custom rope orders. The small size of the Canadian market, poor future growth prospects, market acceptance of wire rope exports, and the higher profitability associated with producing larger and more complex rope products were some of the reasons given for the single plant preference.

The estimated costs of constructing a new MES plant, designed to produce a broad range of wire rope products, based on the Pointe Claire plant location, with plant space of 250,000 square feet and an estimated potential capacity of 18,000 tons and a minimum output of 12,000 tons, is as follows:

Land (Montreal)	\$ 1.0 million	5%
Building and building services	4.5 million	23%
Machinery and equipment	<u>14.0 million</u>	<u>72%</u>
APPROXIMATE TOTAL	\$19.5 million	100%

Two specific reasons were offered for arguing the single plant preference. First, the industrial relations

13. Scherer (1975), p. 387.

advantage of having separate plants will be short-lived because different locals of the same union will be increasingly conditioned by union headquarters to bargain as one unit. Second, service centres perform certain manufacturing activities, i.e., customizing the wire rope product to meet local (regional) requirements. In essence, these service centres function as "partial regional manufacturing plants," and thereby become part of a multiplant configuration even in those cases where the firm has but one major plant operation. A multiplant operation, consisting of one plant and a number of service centres which perform some manufacturing activities such as splicing and fitting wire rope assemblies, may provide for product and plant specific benefits. In the case of the former, transportation and inventory are two of the key areas where savings can be realized through the deployment of regional service centres.

One of the WRI engineers who visited and studied a number of foreign wire rope plants believes an MES plant might be one that produces exclusively 3/8"-3/4" wire rope in a volume range of 8000 to 9000 tons per annum. This is the case with one of U.K. Bridon plants. No such plant exists in Canada or could be justified as an investment at this time. The important qualifier in determining the MES configuration is the product mix which conditions capacity utilization.

Both WRI and Bridon-American executives agree that the present potential capacity of the Exeter and Muncy plants compare favourably with MES calculations for the U.S. market, providing capacity utilization for each of the two plants is in excess of 85 per cent and that the bulk of their wire requirements is satisfied from the company's own wire mill. In short, to be competitive in the United States, Bridon has to be nearly self sufficient in wire. In addition, the size of the U.S. market allows for a higher degree of specialization along product-specific lines than in Canada. There are some real technical and economic benefits which arise from having a multiplant operation in the United States, and Bridon hopes to realize them in the near future.

As for cost calculations, Canadian executives argue that any comparison employing a similar MES model would be less costly to design and build in the United States. Although no such comparison has been made by WRI or Greening Donald, a sufficiently relevant example can be found in a comparative plant cost study undertaken by Canada Wire and Cable Ltd., the manufacturing division of

Noranda Mines. In 1976, this company launched a study that compared the costs of construction and added value of a new wire and cable plant in Ontario and a new plant in the southern United States. A major assumption underlying this comparison was that the equipment and process technology were identical for both plants. Table 34 provides a summary of the cost findings, indicating that Canadian costs exceed those for the United States. Moreover, the executives interviewed contend that since completion of the study, the difference has widened in favour of the U.S. site because the assumption that Canadian and U.S. labour productivity are similar is more questionable in late 1977 than it was in 1976.¹⁴

At present, in the Canadian context, the cost increases at less than MES are difficult to estimate because of lack of information. Wire rope executives indicate that producing a broad product range in volumes of less than 10,000 to 12,000 tons a year would result in a significant increase in costs.

14. Department of Industry, Trade and Commerce, Productivity Analysis Branch, Comparative Tables of Principal Statistics and Ratios, (Ottawa, 1975).

TABLE 34
WIRE AND CABLE PLANT COST COMPARISONS

	Canada (Québec/ Ontario)	U.S.A. (Southern U.S.A.)	Difference
Capital Requirement			
Land, building, equip- ment, working capital	\$18,000,000	\$16,500,000	\$1,600,000
Basic Raw Materials	(internationally available at similar cost)		--
Output	same	same	--
Major Cost Differences			
Cost of capital	1,793,000	1,130,000	663,000
Labour			
Direct	529,000	397,000	132,000
Indirect	1,122,000	842,000	280,000
Fringe	333,000	150,000	183,000
Packaging and shipping	419,000	377,000	42,000
Production supplies	335,000	302,000	33,000
Special materials A	2,194,000	1,975,000	219,000
Special materials B	1,530,000	1,377,000	153,000
Miscellaneous material	73,000	66,000	7,000
Energy	174,000	174,000	--
Total	\$8,502,000	\$6,790,000	\$1,712,000

Source: Company data.

CHAPTER IV

FACTORS AFFECTING EFFICIENCY AND COSTS

This chapter examines the factors which affect efficiency and costs in the Canadian pulp and paper industry and wire rope industry, with comparisons made to these industries in the United States. The discussion draws on the material presented in Chapters II and III and relates it to the literature highlighted in Chapter I. The main problems faced by plants in these two industries are summarized and comparisons are made with previous studies.

PRODUCTION PROCESS

Pulp and paper can be made by using either a chemical or a mechanical process. Research is presently underway to develop thermo-mechanical processes.¹ The scale of efficient operation required for the chemical process is greater than that for the other processes, because of the requirement to use large recovery furnaces. Chemical and mechanical pulp are suited for different types of products. Thus efficient size in the pulp and paper industry depends upon the type of product.

The chemical process is primarily a continuous process operation which favours larger scale for efficient operation. However, the continuous process can lead to higher costs of maintenance because the total process is disrupted if one part breaks down. For example, a continuous digesting operation requires that the subsequent production stages run smoothly. As a result, some plants use batch digesters and some insert storage tanks in the continuous process operation to allow for possible stoppages. Industry opinion differs on the issue of whether a continuous chemical process is more efficient than an intermittent process and, if so, how the continuous process should be constructed. Another key piece of equipment in the chemical process is the recovery furnace, where there are economies of large scale operation.

The production of pulp requires inputs of logs, chips and secondary fibre or some combination of these items. Accordingly, the production process must accommodate various types of input and allow for switching between them. For example, the Northwood mill uses chips and logs because it is located near sawmills, some of which are company

1. See Chapter II.

owned, and because chips are in plentiful supply in British Columbia. Mills near densely populated areas make use of secondary fibre from recycled products because the collection costs are low. Since wood costs are a major element in the cost structure of plants--almost 40 per cent for Northwood and Brunswick--efficiency will depend in part on having the facilities to handle the least costly type of wood inputs.

The efficiency of the production process is also affected by the type of pollution abatement equipment required. For example, a sulphite pulp mill tends to generate more pollution than a sulphate or a mechanical process mill. As a result, in recent years sulphite mills have been converted or are being phased out of operation.

In sum, in order to discuss efficiency at the plant level in the pulp and paper industry, it is necessary to specify at the outset the type of production process, chemical or mechanical, to be used; the nature of the equipment and process technology employed, continuous or intermittent; the type of fibre input, logs, chips, or secondary fibre; and the nature of the pollution abatement requirements.

The pulp and paper industry includes plants producing a variety of products and plants which are integrated to different degrees, i.e., pulp alone (Northwood), pulp plus one or more pulp products (British Columbia Forest Products at Crofton) or pulp products using pulp produced elsewhere (Island Mills of MacMillan Bloedel). The different production configurations indicate that the factors affecting efficiency are likely to vary according to the type of products.

Engineering estimates suggest that an integrated pulp and sack paper mill and an integrated pulp and newsprint mill have lower unit manufacturing costs at all levels of output than do unintegrated mills.² Northwood, for example, is an unintegrated pulp mill, but part of its output is sold to a paper mill belonging to its U.S. co-owner, the Mead Corporation, and its market pulp is sold through the Mead sales organisation, so that it cannot be viewed entirely as a non-integrated mill from a marketing standpoint. In fine papers, an estimated \$40 per ton is saved in an integrated mill.

2. See Chapter II, pp. 74 to 76.

Some of the same considerations prevail in the wire rope industry in terms of the production process and the range of products. The wire rope industry, with annual shipments of \$60 million, is a fraction of the size of the pulp and paper industry, which has shipments in excess of \$5 billion. A description of the operations of four firms describes the Canadian wire rope industry. However, many of the problems experienced by Canadian manufacturing industries can be seen in the production of wire rope.

The production process for wire rope involves a series of stages which starts with the production, usually by primary steel producers, of wire rod from which wire is drawn. Wire is then spooled and the spooled wire is used in wire rope manufacture which involves first stranding and then closing. Various fittings are then added to the wire rope depending on its end use. Distribution of the rope is the final stage and is viewed by some industry executives as a partial extension of the manufacturing process, since it often involves the addition of fittings.³

Wire rope is produced by firms which experience different degrees of vertical integration. In Canada, wire rope manufacturers purchase either domestically produced or imported wire, while in the United States the two largest producers of wire rope are major steel companies which are integrated forward into rope manufacture. There appear to be cost advantages for a rope manufacturer to draw his own wire, as evidenced by recent moves on the part of non-integrated firms such as Bridon. Otherwise, Canadian firms are dependent on a relatively small number of wire suppliers, who may be competitors in the production of wire rope.

Canadian steel rod and wire producers, especially Stelco and Sidbec-Dosco, have not integrated forward into wire rope production.⁴ It appears that these firms have been satisfied to remain as suppliers of wire to the rope manufacturers. One reason for this may be that the manufacture of wire rope in Canada only consumes about 32,000 tons of production a year, of which half the wire is imported. The tonnage has not changed for the past decade,

3. See Chapter III, pp. 156 and 157.

4. See Chapter III, pp. 126 and 127.

and future growth prospects are not encouraging. Another reason is that the major steel producers are concerned about the attitude of the competition policy authorities to further forward vertical integration in steel related products. Furthermore, the owners of the small wire rope manufacturers are large firms, namely Noranda for Wire Rope Industries and Thyssen Steel for Greening Donald, so that any competitive response would be backed by large firms. Finally, the market in Canada is viewed as being increasingly competitive, as evidenced by the share of the market supplied by imports. The U.S. market of 250,000 tons of wire rope per annum, compared to 44,000 tons in Canada, is a more attractive market for some multinational steel producers to integrate forward into wire rope manufacture.⁵

The production process for wire rope involves both intermittent and continuous flow processes. Discrete machines are used at each stage of spooling, stranding and closing, and these machines have to be loaded and reloaded in the course of production. As long as one type of wire is being produced, the machine settings remain the same and the machine downtime occurs as bobbins are reloaded. However, as the type of wire produced changes, the machines have to be reset and different size wire loaded onto the machines, necessitating longer downtime. Machines tend to be specific to different types of wire rope--planetary machines are used for thicker rope and tubular machines for thinner rope. The speed of operation and therefore the size and capacity of a plant will depend in part on the type of rope to be produced and the number of machines used. The equipment and process technology in a wire rope plant consists mainly of a series of spooling, stranding and closing machines. Wire rope machinery has been operated in a number of general purpose buildings.

A variety of types of wire rope is produced in Canadian plants, with the output supplying users in engineering, construction, mining, logging, marine, fishing and other industries. While it would be desirable from a production efficiency viewpoint to produce one kind of wire rope in one plant, this is not possible given the demand characteristics of the Canadian market. However, a number of adjustments can be made to offset some of the disadvantages of short runs and product variety. First, in multiplant operations plants can be more or less specific

5. See Chapter III, pp. 127 and 128.

to particular rope types. Second, within plants particular machines can be made specific to the production of particular rope types. And third, machinery can be designed to embody features which allow it to be switched more efficiently between types of rope production.⁶

Thus, like pulp and paper, a discussion of efficiency in wire rope production requires specifying the type of wire rope to be produced. Scale and vertical integration are factors which aid efficiency but which are discouraged by characteristics of the Canadian market, especially its size, geographic dispersion and the ownership of the producing firms. The wire rope industry can be subdivided into a number of industries for purposes of analysing both efficiency and competition.

LEARNING PROCESS

The phenomenon of cumulative experience illustrates the dynamic aspects of efficiency, or the extent to which the learning gained from cumulative production tends to increase the efficiency of the plant operation.⁷ In the pulp and paper industry, while there are examples of learning by doing in a number of areas, this factor seems to be particularly important in the process of adjusting to a larger scale of operation. The minimum efficient size of mills has increased over time. At present, engineering estimates put the figure at 800 tpd for pulp mills and 1000 tpd for an integrated pulp and newsprint plant. A few years ago, these figures were considered too large for efficient operation, but management has learned to cope with this scale of operation and it is felt that larger plants will be built in the future and that management will learn to administer these. Already, in Brazil a pulp mill of 1400 tpd capacity is being built, which many engineers would consider, for technical reasons, to be too large to operate.

A second area where the learning process is important is in handling the changeover of product lines in a fine paper plant. In the Island Mills of MacMillan Bloedel, about 110 grades of paper are made in a 100 tpd plant. The experience of machine operators used to be

6. See Chapter III, p. 117.

7. See Chapter I, p. 33.

critical in the cost of changeover between grades. However, this procedure has been sharply reduced. Short production runs are less of a problem because the learning process has become mechanised.

This example illustrates a further aspect of the learning process. The pulp and paper industry is a mature industry in Canada. Information about production and organisation is widely disseminated and some research is undertaken collectively. In this instance, the learning process as a factor affecting efficiency may be less important than in those industries where knowledge is rapidly evolving, is often proprietary, and is not disseminated, as in the case of chemicals and electrical products.

At the present, the learning process needs to be applied more to the external environment of the firm than to the internal production process. Government policies, federal, provincial and international circumstances, are having an increasing impact on the pulp and paper industry, and it is these factors which firms need to understand and attempt to influence and to forecast.

In wire rope manufacturing in Canada, economies of cumulative production are important in learning to cope with short production runs. Firms have attacked the problem from two angles. First, an attempt has been made to design flexibility into machinery in order that the cost of machine changes can be reduced. This has required working with machinery manufacturers as well as adapting machines on the plant floor. One reason found for higher machinery costs in Canada is the need for design changes on imported machinery, especially where tariffs are applied to the increased price of the machine.

The second approach has been to organise production so that more of the same type of wire rope can be produced at one time. Wire Rope Industries and Greening Donald are batching their orders as much as possible in order to minimize the number of changeovers and maximize the scope for production runs. This produces savings in all three phases of manufacturing--spooling, stranding and closing. Economies of volume and capacity are realized and, according to the manufacturing executives interviewed, the savings can amount to as much as five per cent of total cost.

The approach to batching in production is closely linked to the plant's inventory policy, specifically,

deciding between the costs of ordering and the cost of carrying inventory.⁸ A major goal here is to achieve the best possible balance between holding orders until a mix is obtained, to minimize costs and maximize manufacturing efficiency, and anticipating future requirements by batching the production of potential orders which are held in stock until they are required by customers. This is one reason why the firms consider inventory management critical to the manufacturing process of wire rope.

In sum, the learning process is involved both in the design and adaptation of machinery, as well as in the organisation and administration of the production-distribution process.

OTHER FACTORS

In terms of other factors affecting efficiency at the plant level, the age, speed and capacity of pulp and paper making and wire rope machinery are considered crucial by industry executives. Much equipment, especially in eastern Canadian pulp and paper mills, is considered too old for efficient production. Newer machines tend to be wider and faster and thus show greater direct labour productivity, although maintenance costs may increase. The ability of plants with older machines to compete with plants having newer machines is in part due to the lower depreciation costs of older machines, when they are costed on an historical rather than replacement cost basis, thus allowing both types of plants to record positive returns on assets.

In pulp and paper, the initial age of machinery is not as critical to efficiency as the extent to which machines have been modernised in subsequent years. While a new machine is generally more efficient than an old machine, an old machine which has been modernised may not be at as great a disadvantage. New machines tend to have greater capacity and require less labour input, as in the case of the largest newsprint machine in the CIP Gatineau mill, but the maintenance and operation of the machines require more highly skilled labour. Industrial relations become a more critical issue as major disruptions can be caused by a small number of key workers.

8. Scherer (1975, p. 49) discusses this trade off.

The set-up costs of short production runs are illustrated in the case of fine paper production at the Island Mills of MacMillan Bloedel. Product diversification exists in that about 110 grades of paper are made with grades varying by the base or pulp composition, by weight (20 to 150 lb. per 3000 sq. ft.) and by colour. In addition to these grade differences are differences that occur at the finishing stage in terms of cut paper size and packaging. Because of product diversification, about 70 grade changes per month have to be made on the one paper-making machine, which has a width of 105 inches and a speed of 1600 feet per minute. The grade changes result in the machine operating at about 88 per cent efficiency in the sense that 88 per cent of the available time is used for producing saleable product and 12 per cent involves downtime, which includes scheduled maintenance, changeover time and unscheduled maintenance or stoppages due to breakdowns. It is estimated that if grade changes were reduced to 30 per month (from 70), efficiency would increase by about three percentage points to 91 per cent.

Productivity in the plant has been improved by the use of computers to control the paper-making machine and to change grades while the machine is operating. While grade changes are being made, inferior quality paper is produced until the change is complete, with the waste paper being recycled as "broke." The computerised system of grade changes involves 50 per cent less downtime than when grade changes were made manually.

In wire rope production, efficiency has been improved by the amalgamation of five plants into one in the case of Wire Rope Industries. Here it is possible to show the reduced costs associated with the move from a multi-plant set-up to a central plant. Wire Rope Industries' Pointe Claire plant consisting of 280,000 sq. ft. replaced five plants with a total of 300,000 sq. ft.⁹ The new plant was designed specifically for wire rope manufacture, whereas some of the closed plants were merely buildings in which wire rope machinery had been placed. The main economies resulted from the reduced cost of materials handling within the plants. In addition, management overhead and transportation costs were reduced. The amalgamation took place by relocating the existing machinery, some of it quite

9. See Chapter III, p. 144.

old, to the new plant, so that while the material flow was improved with the new plant layout, the flow involved machines which were not the most modern.

The present two plant set-up of Wire Rope Industries reflects a multiplant firm which sells in both eastern and western Canada, and the product specialization of the two plants reflects this situation. In order to cater to a geographically dispersed market, the distribution network of Wire Rope Industries has to be located to reach the major customers. There are fourteen service centres across the country which, together with the two plants, store wire rope and undertake the operations of cutting the rope and attaching fittings to it according to customer needs.¹⁰ From these service centres, the firm provides technical advice and assistance to customers, as well as the product itself. Thus, in order to cater to the Canadian market, Wire Rope Industries has consolidated the first stages of manufacturing wire rope into two plants, which are in part product and regional specific, and has dispersed the latter stages through the use of service centres for warehousing, fitting, final distribution and technical advice to customers.

One development in the wire rope industry has been the use of prespooled wire, which reduces one stage of the production process. In effect, the wire manufacturer produces wire from rod in such a way that it can be loaded directly onto bobbins on stranding machines, without the wire rope manufacturer having to engage in spooling. The industry expressed differing views on the savings from this development and it was only used for part of the wire input. In one plant prespooling was preferred even though respooling at the plant was undertaken. The reason for this was that prespooled wire is easier to handle and, as was noted, materials handling is a major cost element in wire rope manufacture. A further development has been the use of stranding machines on which continuous stranding can take place, i.e., reloading bobbins without closing down the machinery. This feature can also reduce the costs of machine downtime.

MINIMUM EFFICIENT SIZE (MES)

An estimate of MES of plant for SIC 271 (pulp and paper) is that the plant should be 0.27 per cent of industry

10. See Chapter III, p. 137.

size based on the 1972 employment measure of size.¹¹ This would correspond to a plant with about 240 employees. The Northwood mill employs 450 persons, has a capacity of 800 tpd, and is viewed, on the basis of engineering estimates, as being of MES in 1972.¹² The Island Mills of MacMillan Bloedel has a capacity of 100 tpd, employs 206 persons and is considered to be about one-fifth of MES for a mill producing a high volume grade of fine paper.

If the survival technique is used to estimate MES and evaluate technical efficiency in an industry, the foregoing discussion of factors affecting efficiency, and the comparison of estimates based on survival techniques with engineering estimates, suggest that it can be misleading to present a single figure for the MES of a plant. There are several reasons why this is so in the case of pulp and paper, particularly SIC 271. First, the plants produce a variety of pulp and paper products. Second, the plants are vertically integrated to different degrees and in different ways. Some are vertically integrated on the same site, some with affiliated plants in a different location, and some not at all. Third, plants embody different production processes, depending on the product being produced, and efficient scale of operation varies between processes. Fourth, plants use different sources of fibre input (logs, chips and secondary fibre) depending on their regional location and ownership of sawmills and this will affect efficiency considerations. Fifth, the size of the markets for the products will differ, and transportation costs will affect the size of plants.

Based on the interviews conducted for this study with business executives and engineering consultants, the MES for a chemical pulp mill is about 800 tpd, for an integrated newsprint mill about 1000 tpd. For pulp plants, 80 per cent of Canadian capacity is in plants with capacity of 500 tpd plus, and 46 per cent is in plants with 750 tpd plus. For newsprint, 79 per cent of capacity is in plants with a capacity of 750 tpd plus and 54 per cent in plants with 1000 tpd plus.¹³ Over time, as a result of investment in new machines and modernisation of existing machines, the

11. Gorecki (1978), p. 86.

12. See Chapter II, p. 96.

13. See Chapter II, p. 91.

percentage of plant capacity of MES for these two product categories has increased, although the rate of increase has probably slowed down in recent months. At half the MES (based on 1972 estimates) for newsprint, unit costs increase about 12 per cent.

For other papers, a 1972 study estimates MES at about 500 tpd (175,000 tons per year) with unit costs rising more than 20 per cent at half the MES. The largest Canadian fine paper plant has a capacity of 150,000 tons per year, so that all Canadian fine paper capacity was in plants of less than MES.

These data tend to be consistent with those in a recent study by Weiss, who estimates MES of plant for unbleached kraft paper at 896 tpd, linerboard at 850 tpd and printing papers at 567 tpd. These figures make MES as a percentage of 1967 U.S. shipments of each product as 6.2, 4.4 and 4.4 per cent respectively.¹⁴ In other words, the U.S. market could contain a maximum of about 16 plants of MES for unbleached kraft paper, and 23 plants of MES for both linerboard and printing paper. The Canadian market, at about one-tenth the size and assuming similar conditions, would be satisfied with about two to three plants of MES for each product. Of course, Canadian producers also sell some of these products in export markets, so that these estimates of MES should be used with care.

The foregoing use of several estimates of MES of plants in the pulp and paper industry, depending on product, is felt to provide more reliable findings of efficiency in the industry than the use of one estimate for all plants in the industry. These estimates of MES probably need to be further adjusted to take into account regional factors, ownership characteristics and technological considerations.

Similar considerations prevail in the wire rope industry. Assuming market conditions permitted it, a wire rope manufacturer would produce only a narrow range of wire rope (3/8" - 3/4") in a plant with a capacity of 8000 to

14. L.W. Weiss, "Optimal Plant Size and the Extent of Suboptimal Capacity," Essays on Industrial Organization in Honor of Joe S. Bain (Cambridge, Mass: Ballinger, 1976), p. 130.

9000 tons per annum. In such a plant it would be possible to purchase or produce from an integrated wire mill the exact type of wire required on a reasonably predictable year-round basis. The stranding and closing machines could be set for one size of wire rope and no change of machine setting would be required. Downtime would be required for reloading wire onto machines and capacity utilisation would depend on market conditions. Distribution would take place through company owned outlets or independent dealers, depending on the amount and type of service required by customers.

However, it is clear that the Canadian market for 44,000 tons of wire rope per annum involves a demand for rope of many different types and sizes, so that even if the industry had five plants of MES (8000 to 9000 tons per annum), that would not guarantee technical efficiency, because each plant could not be specialised to the production of one type of rope only. Given the conditions that actually prevail in the Canadian market, especially the variety of rope types demanded and the geographical spread of the market, actual plants in Canada have made a compromise between product specialization within plants and geographic location of plants. For example, Wire Rope Industries, having consolidated its eastern Canadian operations, has two plants, one in the East and one in the West, with each plant being somewhat specialized to particular end users.

Estimates of MES tend to reflect the operating experience of the companies involved. Unlike pulp and paper, wire rope plants tend to be designed and built by or under the direction of industry personnel, so that independent engineering estimates of MES are difficult to obtain. Faced with this question of what constitutes a plant of MES, Wire Rope Industry opted for a single plant with a minimum output of 12,000 tons per annum and the potential for 18,000 tons per annum, which would produce a broad range of wire rope products.¹⁵ The markets would then be serviced through a series of service-distribution centres to undertake the final processing (fitting) of the rope and provide technical advice to the customers. Technical advice is important for some of the specialty uses of wire rope. Another part of the market uses standard types of wire rope, where replacing worn out rope is a routine operation. The present cost of such an operation was estimated to be about \$19.5 million.

15. See Chapter III, pp. 152 to 155.

Greening Donald, on the other hand, opted for a two-plant complex with a combined production of 12,000 tons per annum. The estimated cost of replacing their two existing plants, which have approximately this capacity, was \$18.5 million. The purpose of a two-plant complex would be to specialise production by type of rope within each plant. Although this could be done within one plant by making certain machines specific to one type of rope within the plant, this procedure was not favoured, on grounds of labour relations. Greening Donald found themselves to be vulnerable to the collective bargaining environment in Canada. By maintaining separate contracts, timed differently, even with the same union, the company feels it is buying insurance against a total closedown of its operations in the event of a strike. The point to note is that the factors which influence a firm's plant size and location decisions include not only technology, scale, geographical spread and nature of demand, but also the uncertainty attached to the purchase of inputs, including labour.

The need for a wire rope plant to be integrated backward into wire drawing was examined. At present, about half the wire used by the four Canadian wire rope manufacturers is imported and half is supplied domestically by Stelco and Sidbec. Domestic wire supplies tend to be priced to meet import competition, which enters Canada with a tariff. Cost savings could occur if the tariff were reduced and Canadian suppliers met the reduced wire price. Canadian wire rope producers have argued for lower tariffs on wire but not on wire rope. Vertical integration into wire drawing would produce savings in that wire rod enters Canada virtually duty-free and the domestic price of rod would have to be competitive with the international price, while this is not the case with wire.

Much imported wire is of a type not produced in Canada. The integrated rod-wire producers have followed a live-and-let-live policy by keeping out of wire rope manufacture providing they have a market for the type of wire they produce. If they went into rope manufacture then Bridon and Noranda might be encouraged to expand into the production of other products using wire. To date, Bridon's interest in WRI, as well as in its U.S. operations, has been to provide an outlet for its wire drawn in the United Kingdom. In Canada it has achieved this objective, but in the United States it is finding that, in order to compete with U.S. Steel Co. and Bethlehem Steel in the production of wire rope, it needs to draw at least part of its own wire.

To date, Bridon-American has had to purchase much of its wire from firms with which it competes in the production of wire rope.

CANADA AND UNITED STATES COST FACTORS

There are five major production regions in North America for pulp and paper, the Pacific Northwest of the United States, the southern United States, the interior of British Columbia, the coast of British Columbia, and eastern Canada. Any cost comparisons between Canada and the United States are thus generalizations which may obscure regional differences.

Wood costs in Canada tend to be higher than in the United States for reasons of wood density, access to wood, transportation costs due to greater distances, and higher labour costs. This generalization is truer for the comparison between eastern Canada and the southern United States. Wood costs in British Columbia are at less of a disadvantage because of the greater use of wood residues from sawmill operations. In the Pacific Northwest, stumpage rates are higher than in Canada, but these can be reduced by government policy to allow U.S. industry to compete, whereas reducing higher wage rates in Canada is an unlikely eventuality.

Machinery and equipment costs tend to be higher in Canada, in part because of tariffs on imported items. Rail freight rates, capital costs and corporate taxes are also higher in Canada, while energy costs may be slightly lower.

The cost comparison between a new mill in the U.S. South, a new mill in eastern Canada and a 10-year-old mill in eastern Canada, shows that the 10-year-old eastern Canadian mill can compete with the new mill in the U.S. South, because low capital-related costs in Canada offset the higher fibre and transportation costs. That is to say, if depreciation is charged on the basis of the historical cost of assets in Canada, rather than the replacement costs, then Canadian mills can compete today. The implications for the future are that Canadian mills may not have set aside enough to replace their aging machinery. The urgency expressed for modernising Canadian pulp and paper mills may reflect the fact that the industry is already feeling the effects of inadequate replacement and declining competitiveness of mills versus the United States.¹⁶

16. See Tables 10, 11, 12 and 13, pp. 71 and 72.

The cost data provided by the individual plants are difficult to compare because the categories used by the plants do not correspond to each other or to other published data. The reasons for this include differences in the classification of labour, into direct, indirect, maintenance, hourly, salary; the basis for allocating head office charges, especially when the plant is foreign-owned; the differing equipment and process technology used within a plant, and age of the plant; and the procedures used for handling the costs of pollution abatement. The information obtained from interviews and the views of engineers appeared to be more useful in discussing aspects of plant efficiency than attempting detailed interpretation of cost data. A comparative cost study of fine paper produced by mills in Canada, in which the firms cooperated fully, has run into similar difficulties.

Comparing cost data between individual plants is no less difficult in the case of the wire rope industry. In fact, it is more extreme. In addition to the problems which apply to the pulp and paper industry, there is a lack of information. The four wire rope producers in Canada are all privately held companies. Three firms function as wholly or partially-owned subsidiaries of a Canadian or foreign parent, e.g., WRI (Noranda and Bridon--United Kingdom), Greening Donald (Thyssen--Germany) and Martin Black (Martin, Black & Co. Ltd.--United Kingdom), and one is a privately held Canadian firm (Wrights Canadian Ropes Ltd.). Consequently, there are no public financial reports, and all cost information has to be obtained from the individual firms.

The situation in the United States is equally complicated because the two largest wire rope producers are integrated steel companies which do not separate out the performance of their wire rope division. A similar situation exists for most of the other U.S. wire rope producers which are diversified, privately held companies.

Information drawn from the interviews indicates that the average cost of producing wire rope in Canada in 1976 was about \$890 per ton. Wire rope imported from Japan and the GPT countries was cheaper, while wire rope produced by Bridon-American was significantly higher, averaging about \$1000 per ton. However, Bridon-American in 1976 was not representative of the U.S. wire rope industry since it was the only firm which did not draw its own wire. The cost of wire rope produced by U.S. Steel and Bethlehem was at least 10 per cent lower on average than the Canadian figure. This helps to explain why Canadian wire rope exports to the

United States are minimal, and why Bridon-American is investing in its own wire drawing facility, partly financed by Noranda. Lower U.S. costs are attributed by Noranda to labour, equipment and machinery, and working capital.

Labour productivity based on the three plants studied (WRI--Pointe Claire and Vancouver, and Bridon-American--Exeter) suggests a very similar relationship between output per production employee--65.8 tons per employee at Pointe Claire, 64.9 for Vancouver and 61.1 for Exeter. The comparable figures for Greening Donald's two plants are 60.0 in Hamilton and 61.8 for Midland. Even accounting for differences of product and definition of production employee, the executives confirm that real labour productivity is comparable, although labour costs differ significantly.

CHAPTER V

COMPETITION POLICY IMPLICATIONS

In this chapter the implications of the case findings for competition policy are discussed with reference to the two industries. In addition, some observations are made on the role of competition policy in promoting more efficient operations at the plant level and the relationship of these policies to other industrial policies.

PULP AND PAPER

There is a critical need to modernize the machinery and equipment in existing Canadian plants, especially in eastern Canada, in order to improve their production efficiency. This may require greater allowances for depreciation in order to reflect current machinery replacement values, providing these allowances are used for modernization.

Horizontal mergers are only likely to improve efficiency if accompanied by plant modernization and some rationalization of production within a multiplant firm. The anticompetitive consequences would be conditioned by the fact that the Canadian tariff on pulp and newsprint is zero, and that Canadian firms export 80 per cent of newsprint production and thus have to compete in world markets. Potential competition in the Canadian and U.S. market and actual competition in the United States exists from U.S. producers, who are taking a larger share of their domestic market at the expense of Canadian suppliers. Although there have been cases of collusion in some sectors, the general conclusion is that Canadian newsprint producers engage in price leadership, not usually collusive, and face both potential competition and powerful buyers in the form of newspaper publishers.¹

It is probable that foreign governments may be providing financial assistance to their pulp and paper industries, which provides a particular type of foreign competition for the Canadian industry. For example, it is difficult to explain how the high wood costs in Scandinavia can permit this region to compete with North America unless

1. A list of reports and court cases involving the pulp and paper industry follows the bibliography. See Schwindt, (1977) p. 100; Guthrie, (1972) pp. 167-174; and Toronto Globe and Mail, 29 Dec. p. B4.

some form of assistance is being provided. One technique of Scandinavian governments has been to finance excess pulp inventories held by firms. If this is the case, Canada has the option of providing similar assistance, attempting to negotiate away the foreign assistance, or doing nothing.

The one area where efficiency could be improved through larger scale operations is in the production of fine papers. Canadian tariffs protect fine papers in Canada, and U.S. tariffs discourage their export to the United States. The Canadian market for fine papers is 800,000 tons per annum compared to 10 million tons in the United States. When regional factors are taken into account, Canadian markets are much smaller. To date, rationalization has not taken place, because with tariff protection the firms can make some profit at a small scale, and because there has been concern about the application of the Combines Investigation Act, in part related to earlier prosecutions. In addition, there is a general reluctance to agree to specialize in a particular product line when there is uncertainty about future demand for the product. Product diversification provides a hedge against reduced sales of one product.

The example of Island Mills illustrates some of the difficulties of specialization. In contrast to a paper machine installed in the United States by Weyerhaeuser, which is 320 inches wide and operates at 3000 feet per minute, Island Mills' machine is 105 inches wide and operates at 1600 feet per minute. The ability of a machine of larger size to operate in western Canada is limited by the size of the market both in western Canada and in the Pacific Northwest of the United States, where the market is protected by a tariff. There is little opportunity for specialization agreements to operate in western Canada because Island Mills is the sole fine paper producer in the region (in Canada). Some specialization could occur if U.S. and Canadian tariffs were lowered and Island Mills specialized on a narrower range of grades for sale in western Canada and the U.S. Pacific Northwest. Island Mills might, however, be reluctant to specialize in a few product lines on the understanding that it had access to U.S. markets, since this access might be withdrawn in the future. Future loss of the U.S. market would be more harmful to Island Mills than loss of the Canadian market would be to U.S. producers.

A further avenue for exploration is the development of more joint international ventures, either vertical or horizontal mergers between Canadian and foreign

firms. Northwood and B.C. Forest Products have elements of joint ventures because of their ownership make-up involving Mead Corporation and Noranda. This gives them access to markets in the United States and large international sales organisations.² Such a move could improve the marketing effectiveness of operations for unintegrated pulp mills. Firms which are Canadian-owned such as MacMillan Bloedel have to sell on an arms-length basis, and the formation of joint ventures might improve their marketing position. For example, it would probably be a great deal easier for the Island Mills plant of MacMillan Bloedel to sell in the U.S. market if it had a U.S. partner.³ Economies of distribution would occur with the plant supplying a relatively assured market outlet.

The potential for export agreements was not viewed favourably as far as the U.S. market is concerned, because of U.S. antitrust legislation and existing commercial arrangements between Canadian and U.S. firms, which for structural reasons (ownership and supply contracts) would not be suitable for such agreements. The fact that there was a combines case involving fine paper producers may also complicate the formation of an export agreement, because of concern that such an agreement may have effects in the domestic market.⁴

Newsprint producers in Canada already have an association, the Newsprint Exporters Marketing Association, which deals with the exchange of information on marketing newsprint outside North America. This association is not limited by provisions of the Combines Investigation Act providing no discussion takes place over market shares, no restraint on newsprint production occurs, and no actions taken concerning offshore markets have an adverse effect on domestic competition. At present eleven Canadian newsprint producers belong to the association, although it is open to all of them. In addition, MacMillan Bloedel,

2. See p. 96.

3. A recent example of a Canadian firm linking up with a U.S. firm is the acquisition of the fine paper firm, Blandin Paper Co. of Michigan, by B.C. Forest Products Ltd., which provides long-term access for their pulp.

4. R. v. Howard Smith Paper Mills et al., 1955, 1957.

B.C. Forest Products and Crown Zellerbach Canada, all western Canadian producers, have jointly formed a company, the Export Sales Co. Ltd., for the marketing of newsprint in Southeast Asia.⁵ Further joint cooperation on newsprint may have to await the completion of an enquiry initiated by the Director of Investigation and Research on newsprint production and marketing in September 1974.⁶

WIRE ROPE

The wire rope industry in Canada is a small industry both in terms of sales volume and number of producers. Any reduction in the number of producers would increase concentration in the industry. However, it is unlikely that such a move would either reduce competition or increase production efficiency. The industry is already subject to a substantial amount of foreign competition, especially in western Canada, despite the tariff protection which it receives. In eastern Canada there is also the threat of potential competition in that one of the steel producers could integrate forward into the manufacture of wire rope. This has not been a significant threat on the part of Stelco, the largest wire producer, as long as the wire rope producers have purchased a substantial amount of its wire. To date, Bridon-Noranda has limited its production to wire strand and rope, and Canadian steel companies produce wire but not wire rope. Ivaco is a small entrepreneurially-oriented steel company and may present more of a competitive threat as it attempts to expand into other wire-related product lines. The opportunities for horizontal mergers are therefore limited in the wire rope industry and the net benefits would probably not be great.

Vertical integration backwards into wire drawing would likely generate some cost savings. While domestic wire supplied to wire rope manufacturers is competitive with imported wire, the latter is tariff protected. Wire rod is virtually duty free so that cheaper material costs would likely occur if wire rope manufacturers purchased rod and produced their own wire. This type of situation prevails in British Columbia where Titan Steel imports wire rod from Japan, draws wire in British Columbia and sells it to WRI's Vancouver plant.

5. R. Schwindt, (1972), p. 101.

6. Vancouver Sun, 30 Sept. 1976, p 1.

One reason why WRI does not source as much of its wire requirements in Canada is because Bridon owns wire producing facilities in the United Kingdom and supplies its North American operations with this wire as part of their requirement. Also, Bridon's wire is of a type not produced in Canada to date. However, in the United States, Bridon-Noranda is now establishing wire facilities to supply its wire rope plants.

Greater specialization on the part of individual firms presents problems because of the variety of types of wire ropes demanded. It would not be feasible for a firm to specialize only in one type of rope or in one industry application, because of the number of rope types required by an industry. In general, the standard types of rope which are in demand in reasonable volumes are ones in which import competition is the greatest. These ropes can be delivered to customers by independent suppliers, and customers tend not to need the type of special advice which a wire rope manufacturer is suited to give. Consequently, Canadian wire rope manufacturers tend to have a greater advantage in providing those ropes which have special application and require technical advice that can be given through a service centre operation. These ropes tend to be the ones which are produced in smaller volumes. Thus, the nature of competition tends to push the Canadian wire rope producers into those segments of the market in which large volumes are difficult to achieve.

One further factor which promotes product diversification is the preference on the part of buyers to obtain their rope requirements from a small number of suppliers.⁷ Extreme product specialization assumes that buyers would be willing to deal with a number of suppliers--at the extreme, one for each type of rope. Buyer preference tends to be to have more than one supplier for each product, but with the supplier producing a range of the product-types in order that transaction costs with the supplier can be reduced.

Export agreements in the wire rope industry would only make sense if through such agreements the companies were able to penetrate further export markets. At present, the opposite tends to be the case as the producers attempt

7. F.M. Scherer reached the same conclusion for a number of industries (1970, p. 256).

to ward off imports. In 1974, Canadian producers exported about 10 per cent of production, with 85 per cent of exports going to the United States. This pattern has prevailed in recent years and since Wire Rope Industries has (through Bridon-U.K.) related production facilities in the United States, there would be an additional impediment to further sales to Canada's most prominent export markets. However, the topic of export agreements raises very important issues for Canadian competition policy.

A recent U.K. Monopolies Commission Report⁸ enquired into export agreements involving wire rope manufacturers in the United Kingdom. Twelve of these manufacturers belong to an export association known as the Wire Rope Export Conference (WREC),⁹ which claims that exports have "been kept above that which would otherwise have prevailed."¹⁰ The Monopolies Commission both agrees with WREC and supports the export agreement:

From the evidence we have had, however, we believe that the operation of the agreements is likely to have kept the level of export prices higher than it would otherwise have been without necessarily reducing the volume of exports.

In the light of all these considerations discussed above we do not find, on balance, that the agreements of WREC and the cordage export groups have effects which are identifiable to the public [U.K.] interest.¹¹

How is competition in Canada affected by WREC? From 1965 to 1976, imports of wire rope into Canada accounted for from 24 to 33 per cent of the Canadian market (Table 25), and imports from the United Kingdom from 1967 to 1974 have accounted for from 10 to 33 per cent of total imports (Table 28), so that Canadian customers have, with

8. Monopolies Commission, Wire and Fibre Ropes: A Report on the Supply and Exports of Wire Rope and Fibre Rope and Cordage, (London: HMSO, 20 Nov. 1973).

9. Monopolies Commission (1973), pp. 100-110.

10. Monopolies Commission (1973), p. 92.

11. Monopolies Commission (1973), p. 94 [word in brackets added].

the approval of the U.K. government, paid higher prices than would otherwise have existed. Second, U.K. firms which are members of WREC also have subsidiaries in Canada, namely Bridon and Martin Black, and in the case of Bridon, steel wire is sold from its U.K. to its Canadian operation, which may also be affected by the export agreement. At the very least, the documented activities of WREC could be used to activate those provisions of the Combines Investigation Act which deal with the intrusion of foreign activities that may affect competition in Canada.

The U.K. report also notes the agreements made between U.K. and European wire rope producers with respect to the pricing of wire rope.¹² This situation is significant for Canada in that Greening Donald is owned by Thyssen, a German firm.

Given the forces working against greater specialization, there are, however, measures which can be adopted to improve the productive efficiency of wire rope plants. While mergers and specialization agreements may provide limited opportunities for improvement, greater attention can be given to improving the effectiveness of the production which takes place within the existing plants. Effectiveness can be achieved by measures to modernise the equipment and machinery within given plants. These measures can promote the development of equipment and process technology which will improve the flexibility of plants, so as to reduce the costs of producing a wide range of product types and encourage methods for organising the batching of small orders. In promoting such measures, it should be noted that policy makers are not just dealing with the relatively small firms in the industry, but also with much larger firms which are the owners of firms such as WRI and Greening Donald.

INFRASTRUCTURE FACILITIES AND THE FOCUSED FACTORY

Measures to promote the modernisation of existing plants must take into account the plant infrastructure as identified by Professor Skinner (in Chapter 1) in his work dealing with the manufacturing performance of U.S. industry.

Skinner argues that declining productivity in U.S. industry can be attributed in part to apparent weaknesses in

12. Monopolies Commission (1973), p. 95.

the factory infrastructure. The infrastructure includes "such elements as organizational levels, wage systems, supervisory practices, production control and scheduling approaches and job design and methods concepts." Those U.S. companies which have not anticipated and adjusted for the impact of a modified or new equipment and process technology (EPT) on the total manufacturing system have experienced absenteeism, as well as problems with workmanship, effort and morale on the plant floor.

The problem is no less significant in Canada--in fact, it may be more extreme. Studies undertaken by the Economic Council of Canada and other organizations indicate that a managerial gap exists between Canadian and U.S. executives. U.S. executives tend to be better trained in management practices, including supervisory and interpersonal skills, particularly with reference to the design and management of manufacturing systems.

A major preoccupation of Canadian management, when installing a modified or new EPT in the plant, centers on overcoming the resistance of workers and certain members of the supervisory team to learning new methods and ways of using up-to-date EPT in the manufacture of essentially the same product. While technological innovation can be purchased on the open market, the resistance to its application by plant personnel and the apparent lack of organizational innovation demonstrated by many members of the corporate management team often result in a substantial shortfall of anticipated cost savings. In this instance, the increase in technical efficiencies which one would expect from a new EPT would not materialize, because of a failure in the factory infrastructure. Even if the EPT employed in the Canadian factory is equal to or slightly superior to the one used in the U.S. plant, the latter plant may still be more productive and competitive if its infrastructure provides for superior services in the areas of production control and scheduling, wage systems and motivation. A sufficient number of executives have stressed this point to confirm Skinner's findings and affirm the researchers' perception of the Canadian scene and its comparison with the United States.

A second major problem identified by Skinner is that U.S. productivity suffers from the fact that too many firms try to do too many conflicting manufacturing tasks within one plant and one organization.

As previously noted, Skinner states that:

Most of the manufacturing plants in my study attempted a complex, heterogeneous mixture of general and special-purpose equipment, long- and short-run operations, high and low tolerances, new and old products, off-the-shelf items and customer specials, stable and changing designs, markets with reliable forecasts and unpredictable ones, seasonal and nonseasonal sales, short and long lead times, and high and low skills.¹³

The net result is that firms which have such plants often do not possess the ability to compete in the marketplace. The problem is not one of simple productivity or technical efficiency, but one of flexibility. Preoccupation with the cost of manufacturing has prompted many firms to add new products to their existing line as a means of achieving full utilization of the plant's machinery and equipment. However, this policy normally ignores the demand requirements, specifically, how to improve customer service and thus one's competitive position in the marketplace. In short, these firms employ a product orientation rather than a marketing (customer) orientation.

In Canada this orientation is even more severe. Studies by government and business organisations document numerous cases which illustrate that Canadian firms lack a marketing orientation and that this problem leads them to manufacture costly, non-competitive products.

Skinner's solution to the many product/one plant non-marketing orientation syndrome is to promote the "plant within a plant" (PWP) approach which would allow each PWP its own manufacturing facilities, a separate and identifiable work force, management orientation, production control techniques, etc. The PWP would be guided by a separate market strategy linked to specific markets and would function as a separate profit center. The PWP approach embodies elements of a multidivisional structural model, but at the plant level.¹⁴ One benefit from such an approach is

13. Skinner (1974), p. 116.

14. PWP takes O.E. Williamson's multidivisional hypothesis one step further by applying it within a plant as opposed to a firm. See O.E. Williamson, Corporate Control and Business Behaviour (Englewood Cliffs, N.J.: Prentice Hall, 1970), Part II.

to sensitize the manufacturing organization to the dynamics of the marketplace. Thus, organizational and marketing innovation is a prerequisite to achieving maximum utilization of any technological innovation via a modified/new EPT.

On the basis of the two industries studied, the following observations are made with a view to suggesting considerations which may have to be taken into account by the proposed Competition Board, or by any other policy maker concerned with industrial policies aimed at promoting the efficiency of Canadian manufacturing industries.

The traditional problems of scale and specialization in Canadian manufacturing industry may be alleviated in part by mergers and specialization agreements. This approach assumes increased efficiency through the manufacturing process. The present study suggests that added efficiency may also be gained through the modernization of existing plants and emphasis on technology which favours small scale operation. But to achieve such modernization the plant infrastructure will have to be capable of adapting to the new requirements. A parallel situation may exist for multiplant firms, where a merger may not produce production rationalization but may allow for cost savings through rationalization of corporate infrastructure services such as distribution, transportation, sales and procurement.

The implications of this for the policy maker are the need to have a detailed knowledge of the industry, the firms, the plants, and the production and management process. The approach of the proposed "Competition Board" evaluating individual cases is consistent with this requirement, providing it has access to technical as well as economic-management expertise.

The approach to studying productive efficiency needs to involve three layers of analysis. One layer deals with the industrial organization aspects of the industry, using the traditional structure, conduct and performance approach, but introducing the international dimension of the industry, which may involve trade, investment, technology, joint international ventures or joint ownership, and marketing arrangements. A second layer would provide information on the corporate landscape of the industry--details about the individual firms, the plants, the scale of operation, product mix, sources of inputs and outputs. Details of specialization, diversification, integration and

multiplant operation of individual plants would be collected. And the third layer would identify the nature of the production process with special reference to the equipment and process technology used, alternatives available, plant layouts and the cost structure related to the production process.

The information collected at these three levels would then be related as follows. Information at the plant-product level would show the probable cost savings associated with the manufacturing system in use and the cumulative experience of the plant. The plant's position within its firm (assuming a multiplant firm) would indicate the probable cost savings, given the strategy and structure of the firm including its infrastructure facilities. A single-plant firm will also have a strategy, and the cost savings associated with the manufacturing system will have to be related to the other functional activities of the firm such as marketing, finance, research and development, and industrial relations. Information at the industry level indicates the competitive pressures which would be exerted on the firm. What is suggested here is that there is no one test to determine whether resource allocation will be improved in a particular case but that improvements will depend on the many variables of that case.

Cost data provided by firms are frequently difficult to interpret and even more difficult to use for comparative purposes. Information can be gained as to whether labour rates and the cost of capital are higher in one place or another. Comparing material costs is more difficult if the materials are supplied from an affiliated firm on an intrafirm basis. The division of labour costs between different categories of labour and overhead costs between different products are frequently arbitrary and vary between firms. Information on MES of plants is available from consulting engineers in those industries where engineers are frequently used. The alternative tends to be to rely on industry sources, and to attempt to correct for particular biases that may be introduced.

The significance of understanding the manufacturing system in analysing the performance of individual plants and firms is that it affects the internal efficiency of the plant, not merely in the sense of x-efficiency as that concept has been developed to date, but in terms of the firm knowing what the appropriate system is

for its particular set of circumstances.¹⁵ For example, a wire rope manufacturer in western Canada might employ a different equipment and process technology than a wire rope manufacturer in eastern Canada because of differences in labour market conditions. For a firm in the industry, there is no one obvious "best" way of organising production. Moreover, in the Canadian setting, industries may contain so few plants that generalizations are difficult to make. This is true for wire rope but less so for pulp and paper.

This consideration affects the applicability of the concept of the MES of plant. In a recent article, L. Weiss has emphasised the difficulties associated with the measurement of MES.¹⁶ The difficulties are fully supported by the two industry studies presented here, where there have been wide differences in estimates of MES. These differences are in part explainable because plants within an industry are dissimilar in what they produce, how they produce it and the environment in which they operate. However, even if all these factors could be controlled, firms would still differ in their assessment of, say, the risks associated with having all production in one large plant as opposed to two smaller plants, where closure of one plant by a strike would shut down the whole firm.

Even within giant industries, small plants are often more efficient. Some of the executives interviewed argued that large organizations experience certain increasing costs due to low morale, which is often reflected in industrial stoppages, resistance to improved working methods and a failure to increase the quality of output. In many small companies, the line of command is shorter and the production process employed is usually more flexible. Thus, the higher morale found in smaller plants together with proven technology can result in lower manufacturing costs, while the system as a whole becomes less vulnerable to a breakdown or to industrial disputes. For this reason, more large companies have come to appreciate the advantages of having a number of semi-independent small factories which function as profit centres, in order to secure the psychological commitment found in the smaller firms, but with the financial and management support and assistance that only the infrastructure of a large corporation can

15. See Chapter I, p. 41.

16. Weiss (1976), p. 126.

provide. Consideration of this type of issue does not come from evaluating published data, but from in-depth analysis of industries. The Competition Board and the Department of Consumer and Corporate Affairs are suited to this type of analysis, because of the case analysis which is undertaken by the Department, and because of the mandate for case analysis which is proposed for the Competition Board. Both export agreements and specialization agreements will involve a case approach.

In evaluating the cost performance of individual firms and industries, three further aspects of current economic conditions were noted during the course of the study. First, the cost competitiveness of Canadian versus U.S. industries can be measured at a particular point in time. However, a movement in the exchange rate, as occurred in 1977, can quickly alter that competitive situation.¹⁷ Second, the costs experienced by foreign-owned subsidiaries in Canada are often higher than their U.S. counterparts, because of the way in which the foreign parent allocates costs, especially overhead costs, to the subsidiary. The impression was that the Canadian subsidiary was often as productive as a U.S. plant in real terms, but not in cost terms. Aggregate studies that compare Canadian and U.S. productivity fail to take this factor into account and use published industry statistics when that confidence is not warranted. In fact, there is usually a fundamental problem in comparing industries at the 3-digit level in Canada and the U.S. because they contain such dissimilar entities.¹⁸ And finally, Canadian competition policy will have to be increasingly concerned with the growing interventionism and protectionism of governments of other industrialised countries. The example of steel comes readily to mind and may in fact affect the wire rope industry. Japan is viewed as assisting its firms to dump steel abroad. The United States in response is developing a "trigger" price mechanism which will automatically exclude steel imports below a certain price.¹⁹ The realities of these forms of intervention will

17. See Toronto Globe and Mail, 29 Dec. 1977, p. B4.

18. The Conference Board in Canada study is an example of failure to check the data used for comparative purposes. See Chapter 1, p. 19.

19 See A.M. Solomon, Report to the President, A Comprehensive Program for the Steel Industry, U.S. Treasury Department, 6 Dec. 1977. It is interesting to note that current conditions are forcing more flexible pricing on the part of large U.S. firms as well, see Business Week, 12 Dec. 1977, p. 78.

make it increasingly complicated for competition policy to be administered in harmony with the economic policies of other government departments and agencies, both domestic and foreign. This is a dimension which has not been considered in the development of Canadian competition policy in recent years.

BIBLIOGRAPHY

Abegglen, James C., and William V. Rapp, "Japanese Managerial Behaviour and 'Excessive Competition'," in D.S. Henley (ed.), International Business - 1973 (East Lansing: Graduate School of Business Administration, Michigan State University, 1973).

Abernathy, William J., and Kenneth Wayne, "Limits of the Learning Curve," Harvard Business Review (Sept.-Oct. 1974).

Alchian A., "Costs and Outputs," in Moses Abramovitz, et al., eds., The Allocation of Economic Resources (Stanford: Stanford University Press, 1959).

Alden, Richard J., "Learning Curves: An Example," Industrial Engineering, Vol. 6, No. 12 (Dec. 1974).

Andress, Frank J., "The Learning Curve as a Production Tool," Harvard Business Review (Jan.-Feb. 1954).

Apsey, T.M., M.M. Garton, and C. Hajdu, "Economic Trends in the Canadian Forest Products Industry," American Journal of Agricultural Economics 55 (Dec. 1973).

Barclay, I., of B.C. Forest Products, Testimony to Committee on Foreign Affairs, Senate of Canada, 2 Dec. 1976.

Beigie, C.E., The Canada-U.S. Automotive Agreement: An Evaluation (Montreal: Canadian-American Committee, 1970).

✓ Bernolak, I., "Enhancement of Productivity Through Interfirm Comparisons, A Canadian Experience," in Improving Productivity Through Industry and Company Measurement, Series 2 (Washington: National Centre for Productivity and Quality of Working Life, Oct. 1976).

Bill C-13, An Act to Amend the Combines Investigation Act, Ottawa, November 1977.

* Bridon, The Significance of 50 years, Bridon Group Information Office, 1975.

British Columbia Forest Products, Brief Submitted to the Royal Commission on Forest Resources, Vancouver, Mar. 1975.

Buffa, Elwood S., Operations Management: Problems and Models (New York: Wiley Inc. 1972).

Canadian Pulp and Paper Association, Submission to the Royal Commission on Corporate Concentration, Nov. 1975.

Caves, R.E., Diversification, Foreign Investment and Scale in North American Manufacturing Industries (Ottawa: Economic Council of Canada, 1975).

7 Caves, R.E., et al., Studies in Canadian Industrial Organization, for the Royal Commission on Corporate Concentration, Ottawa, July 1976.

Crookell, H., The Role of Product Innovation in Trade Flows (London: University of Western Ontario, School of Business, 1970).

Crown Zellerbach Canada Ltd., Submission to the Royal Commission on Forest Resources, Vancouver, Nov. 1975.

Dagenais, M.G., "The Determinations of Newsprint Prices," Canadian Journal of Economics, IX, No. 3 (Aug. 1976).

Daly, D.J. and S. Globerman, Tariff and Science Policies: Applications of a Model of Nationalism, Ontario Economic Council, Research Studies, 1976.

Daly, D.J., B. Keys and E. Spence, Scale and Specialization in Canadian Manufacturing (Ottawa: Economic Council of Canada, 1968).

Dean, J., "Pricing Policies for New Products," Harvard Business Review (Nov.-Dec. 1976).

Department of Industry, Trade and Commerce, Discussion Paper entitled, "Productivity and Competitiveness in the Canadian Economy" (Ottawa: Office of Policy Analysis), 28 Oct. 1976.

9 Department of Industry, Trade and Commerce, Statistical Handbook on Canadian Manufacturing Industries (Ottawa, 1975).

Department of Industry, Trade and Commerce, Productivity Analysis Branch, Comparative Tables of Principal Statistics and Ratios (Ottawa, 1975).

Du Pont, Brief to the Royal Commission on Corporate Concentration, 20 Oct. 1975.

Eastman, H.C., and S. Stykolt, The Tariff and Competition in Canada (Toronto: MacMillan Co., 1967).

Economic Council of Canada, Interim Report on Competition Policy (Ottawa: Queen's Printer, 1969).

Eilon, S., B. Gold and J. Soesan, Applied Productivity Analysis for Industry, (Toronto: Pergamon Press, 1976).

Frank, J.G., Assessing Trends in Canada's Competitive Position: The Case of Canada and the United States (Ottawa: Conference Board in Canada, Nov. 1977).

Goel, S.N., and R.H. Becknell, "Learning Curves That Work," Industrial Engineering, Vol. 4, No. 5 (May 1972).

7 Gorecki, P.K., Economies of Scale and Efficient Plant Size in Canadian Manufacturing Industry (Ottawa: Department of Consumer and Corporate Affairs, 1976).

Guthrie, J.A., An Economic Analysis of the Pulp and Paper Industry (Pullman: Washington State University Press, 1972).

Guthrie, J.A., and G.R. Armstrong, Western Forest Industry and Economic Outlook (Baltimore: Johns Hopkins Press, 1961).

Hayes, Robert H., and Roger W. Schmenner, What's the "Right" Manufacturing Organization, Working Paper (4) (Cambridge: Harvard University, Graduate School of Business Administration, 1977).

Hayter, Roger, "An Examination of Growth Patterns and Locational Behaviour of Multi-Plant Forest Product Corporations in British Columbia," unpublished doctoral thesis, University of Washington, 1974.

Hirschleifer, J., "The Firm's Cost Function: A Successful Reconstruction?" Journal of Business, 35: 3 (July 1962).

Hirschmann, Wilfred B., "Profit from the Learning Curve," Harvard Business Review (Jan.-Feb. 1964).

Johnson, Richard A., William T. Newell and Richard C. Veigin, Production and Operations Management: A Systems Concept (Boston: Houghton Mifflin Co., 1974).

MacMillan Bloedel, A Submission to the Royal Commission on Corporate Concentration, Dec. 1975.

MacMillan Bloedel, Brief Submitted to the Royal Commission on Forest Resources, Prince Rupert, Sept. 1975.

Mead, W., Competition and Oligopoly in the Douglas Fir Industry (Los Angeles: University of California Press, 1969).

Mecklin, John, "Douglas Aircraft's Stormy Flight Path," Fortune (Dec. 1966).

* Monopolies Commission, Wire and Fibre Ropes, A Report on the Supply and Exports of Wire Rope and Fibre Rope and Cordage (London: HMSO, 20 Nov., 1973).

Nadiri, M.I., "Some Approaches to the Theory and Measurement of Total Factor Productivity: A Survey," Journal of Economic Literature (1970).

Pemberton Securities, Submission to the Royal Commission on Forest Resources, Vancouver, Dec. 1975.

Perspectives on Experience (Boston: Boston Consulting Group, Inc., 1970).

Postner, H.H., An Analysis of Canadian Manufacturing Productivity (Ottawa: Economic Council of Canada, 1971).

Report by the Tariff Board re Pleasure Craft, Ref. No. 149 (Ottawa: Information Canada, 1976).

Reed, F.L.C., and Associates, The B.C. Forest Industry: Its Direct and Indirect Impact on the Economy (Vancouver: Author, 1975).

Restrictive Trade Practices Commission (RTPC), Report Concerning the Manufacture, Distribution and Sale of Paperboard Shipping Containers and Related Products (Ottawa, Queen's Printer, 1962).

Rich, Stuart U., Marketing of Forest Products: Text and Cases (New York: McGraw-Hill, 1970).

Safarian, A.E., The Performance of Foreign-Owned Firms in Canada (Montreal: Canadian-American Committee, 1969).

Scherer, F.M., et al., The Economics of Multi-Plant Operation (Cambridge: Harvard University Press, 1975).

Scherer, F.M., "The Determinants of Industrial Plant Size in Six Nations," The Review of Economics and Statistics (May 1973).

- Scherer, F.M., Industrial Market Structure and Economic Performance (Chicago: Rand McNally, 1970).
- Schoeffler, S., R.D. Buzzell, and D.F. Heany, "Impact of Strategic Planning on Profit Performance," Harvard Business Review (Mar.-Apr. 1974).
- Schwindt, R., The Existence and Exercise of Corporate Power (Ottawa: Royal Commission on Corporate Concentration, Mar. 1977).
- Shepherd, W.C., The Treatment of Market Power (New York: Columbia University Press, 1975).
- Siegel, I.H., "Measurement of Company Productivity," in Improving Productivity Through Industry and Company Measurement, Series 2 (Washington: National Centre for Productivity and Quality of Working Life, Oct.on, 1976). 036.
- Skeoch, L.A., et al., Dynamic Change and Accountability in a Canadian Market Economy (Ottawa: Department of and Consumer and Corporate Affairs, 1976).
- Skinner, Wickham, "The Anachronistic Factory," Harvard Business Review (Jan.-Feb. 1971).
- Skinner, Wickham, "The Focused Factory," Harvard Business Review (May-June 1974).
- Solomon, A.M., Report to the President, A Comprehensive Program for the Steel Industry (Washington: U.S. Treasury Dept., 6 Dec. 1977).
- Statement made by Du Pont before the Standing Committee on Foreign Affairs, Senate of Canada, 22 Feb. 1977.
- Statistics Canada, Canadian Forestry Statistics, (Ottawa: Information Canada, Catalogue 25-202).
- Statistics Canada, Industrial Organization and Concentration in the Manufacturing, Mining and Logging Industries, (Ottawa: Information Canada, 1975).
- Stykolt, S., Economic Analysis and Combines Policy (Toronto: University of Toronto Press, 1965).
- Stykolt S., and H.C. Eastman, "A Model for the Study of Protected Oligopolists," Economic Journal 70 (June 1960).

Technology and the Manager - Part I, Working Paper, Harvard Business School, Intercollegiate Case Clearing House, Soldiers Field, Boston (9-671-060).

U.S. Department of Defense, Principles and Applications of Value Engineering, Vol. 1, Joint Course (Washington, D.C.).

Weiss, L.W., "Optimal Plant Size and the Extent of Suboptimal Capacity," in Essays on Industrial Organization in Honor of Joe S. Bain (Cambridge: Ballinger, 1976).

West, E.C., Canadian-United States Price and Productivity Differences in Manufacturing Industries, 1963 (Ottawa: Economic Council of Canada, 1971).

Weyerhaeuser Canada Ltd., Supplementary Submission to the Royal Commission on Forest Resources, British Columbia, Vancouver, Nov. 1975.

Weyerhaeuser Canada Ltd., Submission to the Royal Commission on Forest Resources, British Columbia, Kamloops, Sept. 1975.

Williamson, O.E., Corporate Control and Business Behaviour (Englewood Cliffs, New Jersey: Prentice Hall, 1970).

Wonnacott R.J., and P. Wonnacott, Free Trade Between the United States and Canada (Cambridge: Harvard University Press, 1967).

Zimmerman, A.H., "Men, Money and Forests," Weyerhaeuser Lecture Series, Canadian Pulp and Paper Association, Montreal, 24 Nov. 1976.

Annual Reports of companies cited in the two industry studies.

Cases and Enquiries under the Combines Investigation Act
relating to the Pulp and Paper Industry

Rex v. Container Materials Ltd. et al. (1940) 74 C.C.C. 113; 4 D.L.R. 293 (Trial).
Rex v. Container Materials Ltd. et al. (1941) 76 C.C.C. 18; 3 D.L.R. 145 (Appeal).
Container Materials Ltd. et al. v. The King (1942) S.C.R. 147; 77 C.C.C. 129; 1 D.L.R. 529.
Regina v. Howard Smith Paper Mills, Limited et al. (1954) O.R. 543; 663; 19 C.R. 1; 242: 109 C.C.C. 65; 213: 4 D.L.R. 161; 517 (Trial).
Regina v. Howard Smith Paper Mills, Limited et al. (1955) O.R. 713; 22 C.R. 205; 112 C.C.C. 108; 4 D.L.R. 225; 25 C.P.R. 27 (Appeal).
Howard Smith Paper Mills Limited et al. v. The Queen (1957) S.C.R. 403; 26 C.R. 1; 118 C.C.C. 321; 8 D.L.R. (2d) 449.
Regina v. Crown Zellerbach Canada Ltd. et al. (1956) 22 C.R. 1; (1955) 15 W.W.R. 563; 113 C.C.C. 212; 5 D.L.R. 27 (Trial).
Regina v. Crown Zellerbach Canada Ltd. et al. (1957) 25 C.R. 217; 20 W.W.R. 523; 118 C.C.C. 16; 7 D.L.R. (2d) 515 (Appeal).
Regina v. Abitibi Power & Paper Company, Limited et al. (1961) 131 C.C.C. 201; 36 C.P.R. 188.
Regina v. St. Lawrence Corporation Limited et al. (1966) 51 C.P.R. 170 (includes sentence).
Regina v. St. Lawrence Corporation Limited et al. (1969) 2 O.R. 305; 3 C.C.C. 263; 5 D.L.R. (3d) 263; 59 C.P.R. 97 (Appeal).

The Restrictive Trade Practices Commission has published the following reports relating to the Pulp and Paper Industry:

Report Concerning the Manufacture, Distribution and Sales of
Paperboard Shipping Containers and Related Products
(1962).

Report Concerning the Purchase of Pulpwood in Certain
Districts in Eastern Canada (1958).

Report of the Registrar/Special Commissioner, Manufacture and Sale of Paperboard Shipping Containers, (1939).

Report of the Commissioner, Fine Papers ..., (1952).

Report of the Commissioner, Coarse Papers in B.C..., (1953).

RTPC Report, Manufacture, Distribution of Boxboard Grades of Paperboard, (1956).

Purchase of Pulpwood in Eastern Canada, RTPC Report, (1958).

RTPC #6, Specialty Bags, (1960).

RTPC #10, Transparent Packaging, (1960).



INDUSTRY CANADA/INDUSTRIE CANADA



48714

