NOTICE

The quality of this microfcrm is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us an inferior photocopy.

Reproduction in full or in part of this microform is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30, and subsequent amendments.

AVIS

La qualité de cette microforme dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

S'il manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de qualité inférieure.

La reproduction, même partielle, de cette microforme est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30, et ses amendements subséquents.

Canada

The Nature of Cooperation Between Pharmaceutical Firms in the Greater Montreal Area: A Descriptive Study

Caroline Trudeau

A Thesis

in

The Faculty

of

Commerce and Administration

Presented in Partial Fulfilment of the Requirements
for the Degree of Master of Science in Administration at
Concordia University
Montreal, Quebec, Canada

September 1993

ISBN 0-315-87337-X

Canada

ABSTRACT

The Nature of Cooperation Between Pharmaceutical Firms in the Greater Montreal Area: A Descriptive Study

Caroline Trudeau

This study describes the Montreal pharmaceutical industry from the theoretical perspectives of industrial districts and regional networks. The reason for this study stems from the fact that the recent Quebec government strategy, based on the industrial district approach that aims to reinforce the province economic wealth, has identified the pharmaceutical industry as a key focus of development. This research describes the various inter-organizational agreements taking place in a sample of pharmaceutical firms mostly grouped in the West Island of Montreal. The data, which consisted of 40 interviews conducted in 25 different organizations, revealed that firms mostly deal with each other for production needs: 37 per cent of these contracts involved firms located in the Greater Montreal area, including pharmaceutical firms and specialized subcontractors. The results also showed that multinational companies prefer to deal with other multinational firms for production contracts and marketing alliances, and moreover, there is no synergy between biotechnology start-ups and Montreal pharmaceutical firms.

Always in comparison with other studies of industries, i.e. the Third Italy and the Silicon Valley regions, this research emphasizes the creation of a production network caused by the overcapacity problem of plants, the support of industry associations in making the link with governments, and the presence of governmental centres offering various services to firms, such as contractual research. The intention of pharmaceutical firms to reinforce their research partnerships with universities in the future is a clear indication that the government should elaborate a specific program to increase R&D in Quebec universities.

A mes parents

ACKNOWLEDGEMENTS

The author wishes to express her gratitude and appreciation to Dr. Mick Carney for his support in conducting this study.

Special thanks are also extended to Drs. Lea Katsanis and Rick Molz for their contribution to this paper, and also to the members of the Concordia Pharmaceutical Management Centre for their assistance during this research.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ACRONYMS

BRI: Biotechnology Research Institute

CRIQ: Centre de Recherche Industrielle du Quebec

GC: Generic company

IRPI: Institute for Research in Industrial Pharmacy

MICT: Ministry of Industry, Commerce and Technology (Quebec)

MNC: Multinational company

PMAC: Pharmaceutical Manufacturers' Association of Canada

SU: Start-up (biotechnology firm)

INTRODUCTION

The spatial clustering of related industries has often been discussed in the literature. For instance, the Emilia-Romagna region in Italy shows a high concentration of small craft firms (ceramics, clothing) grouped in industrial districts according to the outputs produced (Best, 1990b; Brusco, 1982; Powell, 1990). Silicon Valley, a high-technology agglomeration of firms in California, is the North American version of a regional network (Saxenian, 1990, 1991).

The definition of an industrial cluster, according to the Quebec Ministry of Industry, Commerce and Technology (MICT), "is a group of industries in the same sector of activity that interact, come together and compete with each other in order to accelerate their growth" (Gagné and Lefèvre, 1993a). This definition clearly communicates that the advantages provided by spatial clustering is a way to build a regional economy. M. Porter (1990) argues that a critical mass of local specialized suppliers, links between related industries (such as pharmaceutical and biotechnology in this research), a high-quality demand in the country itself, and public sector organizations adjusting to the research needs of private firms, are key factors that support the development of industrial clusters. Moreover, when firms are closely localized and cooperate in projects leading to mutual

dependency, inter-organizational relationships are strengthened by personal contacts, trust and solidarity (Bianchi and Bellini, 1991; Larson, 1992; Lorenzoni and Ornati, 1988; Powell, 1990; Pyke, 1988).

The Quebec government has recently adopted a strategy that aims to reinforce the presence of such industrial districts, in order to assure wealth for future generations by creating jobs and encouraging entrepreneurial activities. An industrial district is defined in this research as a geographically concentrated industry, including firms of various sizes, that is characterized by particular inter-organizational relationships. Spatial clustering plays a crucial role in industrial districts, since firms can easily find the various factors of production they need in their external environment, such as specialized subcontractors, relevant knowledge from local universities and public research centres, and skilled labour force. Firms located inside an industrial district then have the advantage of having access to various factors they would otherwise have to develop in-house, at a certain cost, if they were located outside the district. Apart from formal agreements between firms, geographical proximity might also stimulate the creation of informal contacts, bringing together people to solve problems. There is a collective learning effect which contributes to economies of scale external to the individual companies, but

internal to the industrial district itself (Bianchi and Bellini, 1991). Various resources are gained by firms, while they avoid the capital investments and bureaucratic inefficiencies of vertical integration. This situation is particularly attractive for entrepreneurial companies that usually do not have a strong financial position to integrate all critical functions in-house (Larson, 1992).

The dynamics resulting from the industrial district approach then help firms to reduce their costs of information and coordination (transaction costs), remain competitive, and be better prepared to face market globalization. This explains why the Quebec government encourages the development of such industrial districts. The importance of regional governments in fostering the development of industrial districts has been emphasized in many situations, such as in the Third Italy (Sabel, 1989) and in the Denmark national network effort (Hatch, 1991). M. Best (1990a), in his discussion of industrial restructuring, stresses the fact that governmental implications for regions should carefully consider how to preserve inter-firm dynamics, by formulating policies that stimulate firms to reinforce their positions.

The purpose of this research is to describe the Montreal pharmaceutical industry from a comparison based on two well-known models of regional networks: the Italian industrial

district and the American technopole (Silicon Valley region). These models will be discussed in depth in the review of literature. In this context, this research addresses the following questions:

1) What is the role of the provincial government?

Apart from formulating policies, the government should be involved directly with firms, for instance consult them to know their needs and take actions to help them grow. In other studies of industries (Best, 1990a; Hatch, 1991; Sabel, 1989), the presence of regional governments is crucial to stimulate the development of industrial districts and more importantly, to assist the small entrepreneurial firms that have less resources. This question will determine to what extent the provincial government adopts such a role.

2) What is the role of universities?

The industrial district strategy of the Quebec government is based on Porter's study (1990) stating that public sector organizations adapting to the needs of firms reinforce the links inside a local industry. By determining the functions universities perform for pharmaceutical firms and also the intentions of these firms toward universities as partners, it is possible to formulate suggestions that aim to reinforce the actual position of universities to support the local industry. This can benefit both universities and private firms.

3) What attitude have pharmaceutical firms adopted toward the fiscal incentives offered by the government to conduct R&D in Quebec?

This question is essential to verify if this policy corresponds to the needs of all categories of firms that are part of the pharmaceutical industry: subsidiaries of multinational companies, generic companies and biotechnology start-ups. One can make the assumption that fiscal incentives oriented toward R&D might not be interesting for all types of firms, especially if they are not extensively involved in R&D activities. If these fiscal incentives are more or less efficient, some recommendations can suggest how the government could re-adjust its policy to stimulate firms.

4) What are the roles of industry associations and research centres?

The reason for asking this question is similar to the one mentioned for the second question, i.e. public sector organizations adapting to the needs of private firms reinforce the links inside a local industry. However, associations and research centres are included in this question since the literature on the models of regional networks that will be used to analyze the Montreal pharmaceutical industry, insist on the importance of such organizations to bring support to private firms.

5) What are the relationships we find between firms of different sizes?

An industrial district will reinforce its competitive position if firms of different sizes get involved with each other. To succeed, firms need to combine a range of complementary assets. One can make the assumption that small firms can bring their expertise in a particular field, for instance a specialized service or a new technology, and large firms provide their financial support and administrative know-how. This question will determine to what extent Montreal-based firms of different sizes cooperate with each other to accelerate their growth.

6) What types of agreements do Montreal-based firms enter into?

The industrial district strategy of the Quebec government aims to reinforce links between customers and specialized suppliers of related industries. An answer to this question is the best way to find out what is occurring in the industry and to determine if there are some barriers that prevent these links from happening. Also, in the industrial district approach, firms should take advantage of geographical proximity by using the resources available on their territory.

In reference to the last question, the following objectives were set: a) conduct an inventory of the investigated firms'

cooperative involvements and contracts - a cooperative involvement is defined here as two organizations executing well-defined tasks in order to reach a strategy jointly elaborated, and a contract as a task executed by one firm in exchange for a payment; b) distinguish between in-house and external activities of the firms; c) ascertain the geographical location of the external activities, and d) explore the nature of the agreements to which the firms are involved.

The first chapter reviews the literature on flexible specialization, regional networks and industrial districts, and examines more closely the Italian and Silicon Valley models that will be used to discuss and compare the actual situation of the Montreal pharmaceutical industry. The second chapter deals with the evolution of the pharmaceutical industry in Quebec and Canada, and will address in more depth the role of the Quebec government. The last three chapters concern the research methodology, the results, and the discussion and implications, respectively.

CHAPTER I: REVIEW OF LITERATURE

Flexible Specialization

Since the 1970s, several forces have contributed to the restructuring of firms: globalization of markets, introduction of revolutionary technologies (computer integrated manufacturing, genetic engineering), increased foreign competition, and market instability often caused by the rapid changes in technology (Best, 1990a; Bianchi and Bellini, 1991; Contractor and Lorange, 1988). From the perspective of technology strategy, a number of authors (Friar and Horwitch, 1985; Hagedoorn, 1990; Hamilton, 1985) have mentioned the wide range of agreements, from a research contract to a joint venture, that firms might use to facilitate the transfer and commercialization of new technologies. For instance, in biotechnology, start-ups usually provided technological innovation (R&D), while large scale corporations provided the financial, marketing, and distribution power (Forrest and Martin, 1992; Hamilton, 1985; Langowitz and Graves, 1992). D.J. Teece (1987, 1992) has also emphasized the fact that successful innovations require the combination of a range of complementary assets that can be reached through various inter-firm agreements.

The combined forces previously stated have required firms to

become more flexible and specialized to respond to new environmental conditions, and to do this, they must rely increasingly on cooperative strategies of one sort or another. C.F. Sabel (1989) uses the term "flexible specialization" to represent: (1) the production of specialty goods, as opposed to mass manufacturing, by highly skilled labour force using flexible multi-purpose machinery, and (2) the fact that firms have to collaborate with their subcontractors in order to know what to produce and vice-versa. Gradually, a complementary division of labour becomes visible in an industrial district, since producers decide what functions to integrate in-house and what activities will be subcontracted to local firms. Regional networks are then created, and innovations are transferred to manufacturing applications (Bianchi and Bellini, 1991).

This concept of flexible specialization, which has been associated with local networks in several European countries, can apply to both small and large firms. The vertically integrated firm of Chandler (1992), fit for mass manufacturing, probably has an easier access to support services and financial resources, but might not be flexible enough to react quickly to the changing demands of consumers or new technology. To become flexible, large firms can decentralize some of their activities and recentralize others, and at the same time, achieve external growth by forming

alliances with other firms (Bianchi and Bellini, 1991). Large firms can develop an expertise in the assembly of final products, and delegate the production of parts to carefully chosen subcontractors (Sabel, 1989). On the other hand, small specialized firms with fewer employees can structure themselves to become "lighter organizations" and act as subcontractors for other firms, sometimes larger, so that a certain interdependency develops between firms (Szarka, 1990). Flexible specialization then creates a favourable environment for the development of networks.

Regional Networks and Industrial Districts

In the literature, various meanings and usages are made of the term "network", that will be introduced here as a set of inter-organizational relationships (DeBresson and Amesse, 1991). According to the Storper and Harrison (1991) classification, networks can differ along several variables, for instance the territorial configuration of the industrial system: networks may be dispersed over wide territories ("dispersed network production"), or they may be agglomerated ("agglomerated network production"). Networks can be made up of both small and large firms, where large firms may set the operational environment for small firms (Smith et al., 1991), or networks can be constituted of small entrepreneurial firms

involved in a sophisticated subcontracting relationship, such as the case in the Italian industrial district model, which will be reviewed in the following section. Network firms can also be linked by a range of formal and informal agreements.

Relationships among firms are then taken as a key linkage mechanism of network configurations. Although a network consists of two or more firms, it can also include their linkages with suppliers and other organizations; in fact, the environment in which they operate. C. Freeman (1991), in his synthesis of research issues on networks, identifies all the categories of networks that are relevant from the standpoint of innovation (Figure 1), and adds that all these "modes of networking" are not mutually exclusive. Large firms may be involved in several of these modes of networking at the same time, and reciprocally, the same situation might apply for small firms.

FIGURE 1 - Modes of Networking According to Freeman (1991)

(1) Joint ventures and Research Corporations
(2) Joint R&D agreements
(3) Technology exchange agreements
(4) Direct investment (minority holdings) motivated by technology factors
(5) Licensing and second-sourcing agreements
(6) Subcontracting, production-sharing and supplier networks
(7) Research Associations
(8) Government-sponsored joint research programmes
(9) Computerized data banks and value-added networks for technical and scientific interchange
(10) Other networks, including informal networks

Source: Research Policy 20 (1991), p.502.

Freeman (1991) concludes that a regional network should not be classified as a separate category, but rather, be considered as an *environment* which may include any type of agreement between firms listed in Figure 1.

Although a number of authors (Dorfman, 1983; Florida and Kenney, 1990; Sabel, 1989; Saxenian, 1991) have reported that the following relationships between firms are observed in their studies of industries, i.e. (1) subcontracting relationships, (2) production-sharing, and to a certain extent, (3) interdependency towards certain local suppliers and subcontractors that have adapted their products or services (flexible specialization) to the needs of their customers, a complete understanding of the phenomenon of regional networks should not focus exclusively on production-related issues. As also reported in studies of industries in Europe or in the United States, the role of local organizations, such as associations and governmental centres, is included in regional networks of firms. We will then define a regional network as an agglomeration of production and services organizations, public or private, based around a core industry. Due to the emphasis some authors have placed on subcontracting and production relationships, the three elements enumerated above will constitute the definition of a "production network."

The interest in this review is to distinguish between two types of regional networks, both characterized by informal and subcontracting relationships, the Italian industrial district model and the American version, the technopole model. In the literature on the Italian districts, the growth of regional industries is based around dense transactional relations between firms (Sabel, 1989). These so-called industrial districts are based on traditional production, such as textiles, clothing, and non-electrical machinery (Bianchi and Bellini, 1991). These craft-based industries are characterized by extensive subcontracting and production-sharing activities between firms mostly situated in the same region. According to Storper and Harrison (1991), where "functional inter-relations between units are dense and localized," we can find an industrial district. For historical reasons, these districts have been supported by associations (trade unions) and government-sponsored programmes. In fact, when using Freeman's modes of networking (refer to Figure 1), the Italian industrial districts would be best described by using categories (6), (7), (8), and (10).

However, how can we define an industrial district as such? Although the typical industrial district of Italy is based mostly on production systems, other studies, as we will see soon in the case of Silicon Valley, demonstrate that other industrial districts can include a variety of inter-firm

agreements in R&D, product development, marketing, and others. Based on these findings, we will define an industrial district as a geographically concentrated industry, including firms of various sizes, that is characterized by particular inter-organizational relationships. Figure 2 summarizes the theoretical concepts of networks (including pro ıction network and regional network) and industrial districts (including technopole) that are discussed in this review.

FIGURE 2 - Summary of the Concepts of Networks and Industrial Districts

CONCEPT	DEFINITION	AUTHORS
Network	Set of inter-organizational relationships.	DeBresson & Amesse (1991); Freeman (1991).
Production network	If emphasis is placed on production relationships between firms, the term "production network" is used.	Dorfman (1983); Florida & Kenney (1990); Sabel (1989); Saxenian (1990, 1991).
Regional network ↓ Two types: 1. Italian industrial district 2. American technopole	An agglomeration of production and services organizations, public or private, based around a core industry; an environment which may include any type of inter-organizational relationships.	Florida & Kenney (1990); Freeman (1991); Storper and Harrison (1991); Saxenian (1990, 1991).
Industrial district	A geographically concentrated industry, including firms of various sizes, that is characterized by particular inter-organizational relationships.	Bianchi & Bellini (1991); Sabel (1989); Storper & Harrison (1991).
Technopole	High-technology industrial districts; group of firms or industries that rely on scientific developments and applications to create innovations.	Amesse et al. (1989); Business Week (October 1992); Dorfman (1983); Florida and Kenney (1990); Piore (1990); Saxenian (1990, 1991).

American researchers have extended the analysis of European industrial districts to high-technology industries often called technopoles, defined by Amesse et al. (1989) as a group of firms or industries that rely essentially on scientific developments and their applications to create innovations that will have a major economic impact. The most studied technopoles are Route 128 and Silicon Valley region, although a recent article in *Business Week* (October 1992) briefly describes 15 other emerging high-technology industrial districts, such as the Golden Triangle near San Diego with biotechnology and communications as major industries, Minnesota's Medical Alley with 500 health-related companies, and Ceramics Corridor with its ceramics and electronics packaging industries in Corning.

An analysis of the literature (Dorfman, 1983; Florida and Kenney, 1990; Saxenian, 1990, 1991) reveals that these high-technology industrial districts are characterized by joint product development agreements, investments motivated by technology factors, and, of course, extensive subcontracting relationships. Using Freeman's modes of networking (refer to Figure 1), these technopoles would be best described by referring to categories (2), (3), (4), (6), and (10). Figure 3 summarizes the typical inter-organizational relationships described in the case of the Italian industrial district model and the American technopole model.

FIGURE 3 - Summary of the Inter-Organizational Relationships Described in Two Types of Regional Networks

TYPE OF REGIONAL NETWORK	INTER-ORGANIZATIONAL RELATIONSHIPS
Italian industrial district	- Production relationships (subcontracting) - Relationships with industry associations (trade unions) - Government-sponsored programs (trade unions' funds are used as a source of capital) - Informal relationships
American technopole	- Production relationships (subcontracting) - Joint product development agreements - Technology exchange agreements - Investments motivated by technology factors - Informal relationships

In each type of industrial district discussed above, it was emphasized that particular inter-organizational relationships or agreements characterize firms within each district. These agreements such as the ones shown in Figure 1, have been widely used to study how firms improve their competitive position through collaborative arrangements with other organizations. The terms "strategic alliance", "exchange" and "collaborative relationship", can be found throughout the literature, especially in the context of emerging technologies (Forrest and Martin, 1992; Hagedoorn, 1990; Hamilton, 1985; Teece, 1992). In this research, the term "cooperative involvement" is used to describe a case where two organizations execute a well-defined task in order to accomplish a strategic plan, jointly elaborated. For each organization, the task might be the same or different, but it remains that both organizations have planned a strategy and

meet periodically to review their activities. On the other hand, in a contract, only one of the two organizations in the agreement executes a specific task for the other organization, in exchange for a payment. The literature on regional networks and industrial districts mentions a division of labour between firms, as a result of a decentralization of activities caused by some environmental conditions. In order to better illustrate the distribution of tasks between organizations of the public or private sector localized within the same industry, inter-organizational agreements are described in this way.

To continue this review on the nature of networks from a transaction cost approach, networks have been defined to be a distinctive form of coordinating economic activities, as opposed to an intermediary form that combines markets and hierarchies (Powell, 1990). In the transaction cost theory, markets usually rely on price for control (Larson, 1992), and their participants are totally free of any future commitments. Markets offer choice, flexibility and opportunity, but they are inappropriate for learning and the transfer of specialized knowledge (Powell, 1990). On the other hand, hierarchies rely heavily on administrative authority and formal decision-making procedures that are well suited for mass production and distribution, but useless for unpredictable changes (Powell, 1990). Networks are then more flexible than hierarchies, and

transactions occur through collaboration, complementary interdependence, a reputation and relationship basis for communication (Johanson and Mattson, 1987; Larson, 1992; Powell, 1990). The difference can be found in the nature of the relationships: firms can more easily access assets in other firms, promote knowledge development, and reduce costs of production and exchange, since the participating firms are characterized by flexibility and specialization (Jarillo, 1988). The transfer of knowledge and collaboration through networks has proven to be efficient for the development of new products and processes, bringing an important advantage to the participating firms (Freeman, 1991; Saxenian, 1991).

However, several authors (Freeman, 1991; Powell, 1990) stress that networks should not be perceived strictly in terms of costs (such as transaction costs), but also combined with social factors such as inter-personal relationships of trust and confidence, reciprocity and solidarity, and professional ethics of cooperation. On this issue, A. Larson (1992) argues that while economic control is present, social control is essential to the creation and maintenance of networks in entrepreneurial settings. Personal reputations, information exchange, and trust replacing formal contacts were the components of this social control.

To summarize this section, one should keep in mind that a

regional network is probably not a synonym of technopoles, or industrial districts, but that in either type, some inter-organizational relationships take place. Although J. Szarka (1990) argues that for a regional network to develop, companies need not be localized within a geographical area, other authors (DeBresson and Amesse, 1991; Pyke, 1988) argue that firms situated in close proximity have a better chance of developing a sustaining relationship, since personal contacts, and shared cultural values reinforce inter-firm relationships.

Regional networks present the advantages of pooling information, evaluating each other's technologies while ensuring non-cash payments of technical know-how (DeBresson and Amesse, 1991), and gaining access to complementary assets through a range of inter-firm agreements, but at the same time, can this situation be applicable to the pharmaceutical industry where intellectual property protection is so crucial? The Teece (1987) framework suggests that if the innovative firm is confronted by weak intellectual property protection but needs complementary capacities, it is preferable for the firm to expand its activities through vertical integration. On this issue, G.P. Pisano (1991) reported that biotechnology firms have a tendency to integrate forward from R&D into manufacturing, to avoid losing some know-how in the process technology.

In order to better illustrate the applications of regional networks, the two following sections describe in depth the Italian industrial district model and the American technopole model (Silicon Valley region), including their strengths and weaknesses.

The Italian Industrial District Model

The Third Italy, located in the North Central part of Italy, corresponds to groups of small, entrepreneurial firms using flexible production methods. In Emilia-Romagna (in Bologna), the fastest growing region which has become the highest per capita income region in the country, there are 90,000 small manufacturing firms, with fewer than 50 employees each, for a population of approximately four million (Gagné and Lefevre, 1993b). To illustrate the economic success story of this region, the per capita income of the province of Modena (the manufacturing centre of Emilia-Romagna) jumped from 17th place in Italy in 1970 to 2nd place in 1979 (Brusco, 1982). P. Gagné and M. Lefèvre (1993b) report a precise description of how a network of firms operate: in Modena, there is a company producing robots for the diesel engine industry. This company does the design, the assembling, the testing, and the commercialization, while five other local enterprises supply various electronic and hydraulic components, as well as the welding services. All these firms have no more than 20

employees. The only large firm that is part of this network supplies the electric motors.

Of course, this example deals with only one network in one specific province, but in this whole region of Italy, other examples demonstrate that small firms are grouped in sectors according to their outputs (leather, ceramics, clothing), leading to the creation of industrial districts where production is organized through extensive, cooperative subcontracting agreements (Brusco, 1982; Powell, 1990). The success of the Italian model is not linked to massive investments in high-technology equipment, but to the constant addition of new firms to a local network. Best (1990b) reports these industrial districts as groups of design-dependent firms providing some components for other firms doing the design of products and taking care of the final assembly, or groups of design-independent firms and subcontractors having a greater power of collectively reacting to markets, from where originates Best's (1990a) concept of an industrial district behaving like a collective entrepreneur.

At first glance, the organization of these districts is perceived as an adaptation to changing tastes and technology, but also, there are political and historical factors unique to the context of Emilia-Romagna. The Confederazione Nazionale dell' Artigianato (CNA), a powerful association (a trade

union), was the result of socialist and communist parties in Italy, and is still related to the political Left In Emilia-Romagna (Best, 1990b). This association offers to craft firms a wide range of shared services, such as quality control, marketing, materials purchasing, bookkeeping, as well as guaranteeing loans to entrepreneurs (Best, 1990b; Brusco, 1982; Hatch, 1991). Moreover, the CNA can work in participation with universities. The role of this association in supporting the growth of agglomerations, if not of a whole region, is well illustrated here.

However, even if some authors (Lorenzoni and Ornati, 1988) have elaborated on the strengths of the Italian entrepreneurial firms, such as: (1) they can make decisions quickly, (2) economies of scale are realized by dealing with many clients, and (3) they have the capacity to innovate in many phases of a product, Best (1990b) argues that small firms are not capable of competing on the basis of price with vertically integrated firms. A solution to this problem has been the creation of collective services centres to provide technological information to craft firms. The most popular of these centres is probably CITER, a textile and clothing industry information centre for Emilia-Romagna, offering three support services to firms: fashion information, market analysis, and technologies (Best, 1990b).

The role of the government in stimulating and supporting the growth of regional economies is also obvious in the case of Denmark, the first country to apply the Italian experience. In 1988, the Denmark trade deficit was growing, investments were low, and unemployment high. C.R. Hatch (1991) then proposed to the Danish government a plan to encourage network cooperation in small and medium-sized firms. Denmark had very few large firms, and it was believed that the country did not have the "critical mass" to build a strong industrial system. However, Hatch (1991) did not perceive any barrier in the small size of firms, but in the fact that they were isolated. Hatch, who had previously studied how operate the Italian industrial districts, attributed several advantages (listed in Figure 4) to networks. The Danish Ministry of Trade and Commerce then offered network grants, additional subsidies for the first two years of operations, and also funded a technology research and development program. Eighteen months after, more than 3,000 of Denmark's 7,300 manufacturing firms were part of an active network, made of a minimum of three firms.

To come back to the Italian model (the Third Italy), we can say it consists of districts of small, specialized firms integrated in local networks, where the capacity of firms to develop new products and manufacturing processes is reinforced by the proximity of entrepreneurs involved in complementary

FIGURE 4 - Advantages of Networks Among Small Firms According to Hatch (1991)

(1) Permits the aggregation of isolated firms capabilities to meet the requirements of corporate customers.
(2) Enables complementary firms to jointly manufacture components and finished products, in order to add value in the production process.
(3) Simplifies the shifts from one market to another by organizing the networks to include the required capabilities.
(4) Stimulates firms to learn from one another.
(5) Provides valuable economies of scale since several assets are shared (marketing, R&D, training).

Source: Entrepreneurial Economy Review, 9 (1991), p.14.

activities, but also by the cooperation existing between workers (Brusco, 1982). G. Lorenzoni and O.A. Ornati (1988), in their study of textile firms, report non-conventional mechanisms, such as mutual adjustment, trust, and reciprocity. However, Sabel (1989) argues that it is not all the regional economies that possess the complete range of the aforementioned collective services. In this case, craft firms are vulnerable and have to find larger partners, inside or outside the district, in order to have access to new production technology, marketing knowledge, capital, and other essential assets they can not afford or generate in-house.

An important factor that caused the decentralization of the production system in the Third Italy is linked to the fact that the technology of mass production could no longer satisfy the rapidly changing demand for more customized and diversified products. Therefore, flexible machinery (rather than product specific machines) even though less productive,

was more compatible with small firms. Moreover, workers were trained to perform many different tasks and develop cooperative industrial relations (Brusco, 1982; Sabel, 1989). To summarize, it is the combination of flexible manpower, the use of multi-purpose equipment, the existence of associations offering collective services and the participation of small firms - although the integration of larger firms is not impossible - to local networks of production, that has enabled the Third Italy to resist foreign competition and the invasion of expensive computer integrated manufacturing.

The American Technopole Model (Silicon Valley Region)

Silicon Valley, which is situated in California, is viewed as the North American version of the European industrial districts. In this region, small- and medium-sized firms gain external economies[1] through sophisticated supplier and subcontracting relationships, resulting in a decentralized system that is more flexible than the vertically integrated corporation (Saxenian, 1990, 1991). It appears that the dynamics of this region are associated with a high number of start-ups that were formed during the 1980s, during which the

[1] External economies refer to various factors of production firms have access by geographical proximity, such as specialized subcontractors available in the district, that otherwise firms would have to develop in-house at a certain cost.

region experienced massive overcapacity and declining profits, caused by the increased Japanese competition in the semiconductor industry. While local producers of chips were massively laying off personnel and sales had plummeted by 35 per cent, A.L. Saxenian (1990) reports that the presence of the start-ups is linked to the creation of 25,000 jobs and to $2 billion in annual sales.

The literature on Silicon Valley compares with the Italian model on the aspect of the extensive and cooperative subcontracting relationships between specialized firms of the region. Start-ups apply a very focused strategy, for example, specializing specifically on the chip design, and often subcontracting the manufacturing of their chips to local foundries, which specialized themselves in manufacturing, but might also assist their customers in the initial design of the chips. Moreover, the start-ups have emphasized on producing custom and semi-custom chips, as well as parts designed for specific niche markets, instead of solely producing standard parts as done by the established firms of the region, performing all their activities in-house. Aside from the specialization, the flexibility of the start-up firms is one of the mentioned characteristics. For instance, a specialist can produce 75 different products by using the same flexible manufacturing line (Saxenian, 1990).

However, R. Florida and M. Kenney (1990) reveal a weakness in this model, by arguing that firms are not necessarily flexibly specialized, but overspecialized. The tendency of firms to specialize in a narrow segment of high-tech products or components (overspecialization) makes it impossible to combine one or more technologies into what is called a hybrid innovation. An example of a hybrid technology is the combination of the mechanical and computer technologies into new applications. In fact, the products or components made by some firms are not always made to fit those of other high-tech firms. The overall result is that small high-technology firms and large companies' activities do not always create a synergy in the same region.

The reasons for extensive subcontracting can be attributed to the pressures created by the rapidly changing designs and technologies of the semiconductor industry. Firms can react more quickly to the demand of the market by relying heavily on upgraded subcontractors for most components (Freeman, 1991; Saxenian, 1990, 1991). This situation has the following advantage: the technical competence of the subcontractors gradually increases, so they can provide a product tailored to the requirements of their customers who consider them as long-term partners, instead of easily replaceable, low-cost suppliers. Saxenian (1990, 1991) reports that some of these customer-subcontractor relationships improved through joint

investment in new equipment, joint problem solving, and technical exchanges. A more equal relationship then developed between large and small firms, with several alliances forming in the 1980s between regional firms. However, the participation of foreign firms was not excluded. Figure 5 outlines some of these partnerships. It seems that geographical proximity of firms had a role to play in several partnerships, making it easier to solve unexpected problems of a technical nature.

FIGURE 5 - Examples of Partnerships Formed in Silicon Valley During the 1980s According to Saxenian (1990, 1991)

Type of Partnership	Firms Involved
(1) Joint product development	Two start-up firms OR One start-up and one large firm
(2) Technology licensing and manufacturing agreement	One start-up and one large firm
(3) Manufacturing agreement and technology transfer	One start-up and one large firm
(4) Minority investment and technology transfer	One large firm and one start-up
(5) Minority investment and joint product development	One large firm and one start-up firm

Again, a number of authors (Florida and Kenney, 1990; Sabel, 1989) disagree on the portrait Saxenian draws of Silicon Valley. Firms are not always loyal to and cooperative with

their subcontractors, as price, not proximity or quality, is the rule in this competitive-driven industry. Also, regional suppliers do not always provide high-quality products, so customer firms must rely on foreign competitors, instead of investing time and capital in neighbour firms. In Silicon Valley, innovation is driven by the potential for profits, and contrasts with the Third Italy craft firm, which has remained a source of livelihood for generations of Italian families (Florida and Kenney, 1990).

Another dimension of Silicon Valley that compares with the Italian model is the role played by trade associations in offering some services, such as lobbying the government, although no other precise description is made on other existing services. Other factors that complete the profile of this model show similarities with another American high-technology sector, Route 128 near Boston, Massachusetts (Dorfman, 1983; Piore, 1990): (1) a diverse mix of consulting, market research, public relations, venture capital firms that offer specialized services to the industry, in particular for start-ups that cannot afford all these resources in-house, and (2) a major research university, which encourages linkages between the academic and business community. However, the Silicon Valley literature does not spell out an agreement between a local university and a private firm. This last factor offers a contrast with the Italian model, where

universities do not play a crucial role in the business community, although the Third Italy associations and collective services centres might be in contact with local universities. This situation can be explained by the fact that Italian firms concentrate on crafts (leather, ceramics, clothing), where basic research is not a key factor such as in the case in high-technology industries.

Regarding the links existing between universities and private firms, it seems that in the emerging technopoles of the United States (Golden Triangle, Medical Alley, Ceramics Corridor), local universities play a more important role, as opposed to the "traditional" Silicon Valley region. For example, technology transfers take place between the University of Minnesota Medical School and Minnesota's Medical Alley health-related companies (*Business Week*, October 1992).

Although Silicon Valley remains popular for its expertise in the management of start-ups and entrepreneurial tradition, which may be attributed to the presence of academic centres (Stanford and Berkeley Universities) known for their spirit of entrepreneurship (Dorfman, 1983), this model presents some weaknesses. First, the creation of Sematech, a collaborative manufacturing consortium that could help in preserving the position of the U.S. semiconductor industry by stimulating joint research projects, has been criticized. The expensive

membership fees restrict access to all but the largest firms (Saxenian, 1990). A consortium that excludes the innovative producers of the industry - the start-ups - is not a collaboration.

Secondly, there is no institution or local agency to look after the coordination and strategic planning of the region. Such an institution could have provided various information and consulting services, fostered exchanges between firms of all sizes, performed an analysis of the changes in the industry, and organized forums to address the needs of firms (Saxenian, 1990). A statement by the chairman of a public-private group that recently conducted a report on the region, confirms this situation: "This valley grew so quickly and had so much success, that there wasn't a sense of continuity and community" (*The Montreal Gazette*, March 1993). As opposed to Silicon Valley, in the 15 emerging technopoles briefly described in a recent article in *Business Week* (October 1992), it is mentioned that local and state governments, in conjunction with business leaders, design policies to encourage the growth of regions.

This ends the review on the applications of regional networks and industrial districts. Figure 6 summarizes the Italian industrial district and the American technopole (Silicon Valley) models discussed in this section. The next chapter

introduces the strategy of the Quebec government to create a regional economy similar to the models just described. The remainder of the chapter reviews the evolution of the Canadian pharmaceutical industry, provides a profile of the industry, and more importantly, outlines the role of the provincial government in the context of this industry.

FIGURE 6 - Summary of the Italian Industrial District and the American Technopole (Silicon Valley) Models

DIMENSIONS	THIRD ITALY	SILICON VALLEY
Types of firms	Craft-based; family enterprises.	High-technology start-ups; profit-oriented.
Sources of capital	Family savings and associations (trade unions) programmes.	Venture capital firms and minority investments motivated by technology factors (large firms into start-ups).
Role of associations	Trade unions are highly involved (the CNA).	No important role for any local association.
Inter-firm agreements	Production-sharing.	Joint product development agreements and technology transfers.
Relationships with universities	Basic research is not a key factor in craft-based industries.	Not extensively discussed for Silicon Valley, although existing links in the emerging technopoles.
Role of regional governments	Achieved through the associations (trade unions).	No role adopted by the regional governments in Silicon Valley, although reported for the emerging technopoles.

CHAPTER II: THE PHARMACEUTICAL INDUSTRY IN QUEBEC AND CANADA

The Industrial Cluster Strategy in Quebec

In December 1991, the Quebec MICT announced an industrial cluster strategy, the goal of which was to move quickly from a mass production economy to a value-added economy (Tremblay, 1991). This strategy is based on Porter's (1990) industrial clusters study that states that the competitive industries of a country are always supported by a network of suppliers, subcontractors, and services firms, competitive themselves (Gagné and Lefèvre, 1993b). The aim of the government is to better prepare firms to face market globalization and accelerate the growth of all industrial sectors, in order to create permanent, quality jobs for Quebecers.

The MICT defines a cluster as a group of interdependent firms that stimulate the growth of their own industrial sector by taking collective actions in several fields, such as the acquisition of new technologies by forming alliances, the training of the labour force, or the reinforcement of their subcontracting relationships (Gagné and Lefèvre, 1993b). Furthermore, the strategy states that enterprises must take advantage of the resources available on their territory, and rely on interactions that can be stimulated by geographical proximity. But, in order to be able to pass from an economy

based on natural resources to an economy based on innovation, the government has defined seven principles that each company should carefully apply (Tremblay, 1991): (1) ensure capitalization, (2) encourage continuous training to have a qualified personnel, (3) develop a favourable labour climate, (4) make total quality a reality, (5) make technological development a priority, (6) respect the environment, and (7) adopt exportation as a strategy.

In this strategy, the government has adopted the role of organizing specific committees for each industrial cluster. Each committee is led by a coordinator appointed by the Ministry, whose mandate is to gather information from several representatives and experts of the industry, such as presidents of companies, in order to establish strategic plans for the years to come (Gagné and Lefèvre, 1993a). So far, Quebec has 13 industrial clusters, of which eight are called *strategic* since they offer potential in regional development. The remaining five are classified *competitive*, meaning they already compete at the international level and have a good synergy within their networks. The pharmaceutical industry is one of these competitive clusters, and a few suggestions on how to increase synergy in this sector have already been formulated. For instance: (1) increase fundamental research in universities that should form more partnerships with the industry, in order to ensure technology transfers to private

firms, (2) promote education in specialized fields such as pharmacology and molecular biology, in order to fulfil the growing needs of the industry, (3) find ways to ensure a better complementarity between specialized suppliers of goods and services and pharmaceutical firms, and (4) create more partnerships between large firms and small- and medium-sized companies (Gagné and Lefèvre, 1993a).

Historical Background

The Canadian pharmaceutical industry began to expand, during World War I, in order to supply the drugs that Canadian soldiers needed, but could not obtain from some European countries. Canada had already made important contributions, such as the production of insulin by Connaught in 1922, and the synthesis of vitamin D by Frosst in 1928 (La PME Pharmaceutique Québécoise, 1989). During the 1920-1940 period, several multinationals opened branches in Canada. It seems that American companies preferred to establish themselves in Ontario and European companies preferred Quebec. Figure 7 illustrates this situation.

After the Second World War, small- and medium-sized firms appeared in the Canadian pharmaceutical industry. These firms were established by entrepreneurs who had previous experience

with large multinationals. But gradually, several foreign companies that wanted to expand in Canada acquired these small- and medium-sized enterprises, which were Canadian-owned. Some examples are: Ayerst, acquired by American Home (U.S.) in 1943; Frosst, acquired by Merck (U.S.) in 1965; and Pentagone, bought by Schering A.G. (Germany) in 1973 (La PME Pharmaceutique Québécoise, 1989).

FIGURE 7 - First Site of Foreign Pharmaceutical Companies

QUEBEC		ONTARIO	
Rhone Poulenc (France)	1920	Mead Johnson (U.S.)	1923
Ciba (Switzerland)	1922	Squibb (U.S.)	1925
Schering (Germany)	1926	Abbott (U.S.)	1929
Sandoz (Switzerland)	1927	Upjohn (U.S.)	1935
Organon (Holland)	1930	Miles (U.S.)	1936
Roche (Switzerland)	1931	Scherer (U.S)	1936
		Eli Lilly (U.S.)	1938

Source: La PME Pharmaceutique Québécoise, Ministère de l'Industrie, du Commerce, et de la Technologie, Gouvernement du Quebec, 1989, p. 50.

Other foreign companies created a Canadian subsidiary that led to the establishment of 13 pharmaceutical companies in Quebec between 1949 and 1983, such as Hoechst from Germany, Pharmacia from Sweden, and Servier from France (Trépanier, 1992).

The Evolution of the Industry

The pharmaceutical industry is centered in Mississauga, Ontario and the West Island of Montreal. During the 1950s, pharmaceutical activities were equivalent in both provinces, but suddenly, in 1976, the role of Montreal in the industry began to be less important. In 1982, the proportion of pharmaceutical activity in Quebec, in terms of shipments and number of employees, showed a decrease compared with Ontario (La PME Pharmaceutique Québécoise, 1989). Some factors have been attributed to this situation: for instance, the development of Toronto as the primary financial centre of Canada and the increase of salary taxation in Quebec.

However, 1990 statistics showed that the Quebec pharmaceutical industry, mostly concentrated in the Greater Montreal area, was represented by 50 enterprises, corresponding to 46 per cent of the total Canadian pharmaceutical industry (Trépanier, 1992). This situation indicates an increase in the activities in the Quebec industry, since 1986 statistics reported 40 enterprises located in the Greater Montreal area (of a total of 45 for Quebec). Moreover, employment in this industry stocd at 5,854 in 1986, as opposed to 8,000 in 1990, representing almost 36 per cent of the Canadian total in this sector (Trépanier, 1992). This increase can be attributed to the role played by the Quebec government in promoting the

development of the pharmaceutical industry in its economic strategy, which will be emphasized in the following section. This might explain the companies' preference for Quebec.

The evolution of the Canadian pharmaceutical industry is also closely linked to the patent laws. In the 1970s and at the beginning of the 1980s, the amount of money spent by pharmaceutical companies on research and development in Canada was very limited, compared with Europe or the United States. This situation was attributed to the poor intellectual protection provided by the Canadian Patent Act. In 1969, Bill C-102 was amended to provide for compulsory licensing to import patented pharmaceutical products. Consequently, during the 1970s, the R&D expenses increased by only 2.6 per cent each year (Trépanier, 1992) and several companies decided to concentrate their investments in countries offering a better patent protection. In order to reverse this situation, the government introduced Bill C-22 in 1987, restoring the patent protection to seven years of exclusivity for the introduction of new drugs on the market. The multinational innovative companies (i.e. firms producing new, original drugs as opposed to generic manufacturers that reproduce a "copy" of a drug), committed to boost research in Canada, then showed an increase of 3.4 per cent in 1987 to 9.7 per cent in 1991 in their R&D investments (Gagné and Lefèvre, 1993a). Consequently, the federal government did not wait until 1996 to revise the

impact Bill C-22 would have on the companies' investments, such as it had been planned in discussions before the adoption of C-22. In December 1992, it enacted Bill C-91, which offered an additional protection of three years of exclusive rights.

The Role of the Provincial Government

In order to make Quebec one of the most attractive places in the world to conduct R&D, the government has offered major tax incentives to stimulate research in the universities, as well as in the industry. These fiscal advantages include (Focus on the Pharmaceutical Industry, 1993): (1) a 20 per cent provincial tax credit of the wages paid with respect to scientific research done in the province (adding to the 20 per cent federal tax credit for current or capital expenditures related to R&D); (2) moreover, the Quebec government increased the tax credit to 40 per cent if the research is executed by a small Canadian-owned firm; (3) if the research is contracted with a Quebec university or certain public research centres, a tax credit of 40 per cent of all R&D expenses is offered; and finally, (4) there is a 24-month personal income tax exemption for foreign researchers moving to Quebec. Apart from these fiscal incentives offered in the case of R&D, the Quebec government also offered refundable tax credits for

manpower training.

Quebec has contributed to the creation of a favourable environment for the pharmaceutical industry in other ways, including its support for the improvement of the Canadian laws dealing with the intellectual property protection, Bills C-22 and C-91 previously described (Gagné and Lefèvre, 1993a; Trépanier, 1992).

This positive attitude adopted by Quebec has resulted in an increase in innovative firms' R&D expenditures in Quebec since 1989, giving Quebec first place in 1991, accounting for 46 per cent of the Canadian pharmaceutical research (this situation is shown in Figure 8). The comments of a company's vice-president of corporate affairs published in *The Toronto Star* of March 1992 confirms this statement: "We consider the environment for our industry is better in Quebec than in Ontario (...) taxes are lower (...) specific programs in Quebec, incentives for capital investment and equipment improvement, that don't exist in Ontario."

It is also worth mentioning that the Quebec government also lent its financial support to the creation of the Institute for Research in Industrial Pharmacy, which will be officially inaugurated in Laval in September 1993 (Trépanier, 1992). This research centre will conduct research for the industry on

FIGURE 8 - R&D Spending by Innovative Firms
(in millions of dollars)

Province	1989	1990	1991
Atlantic Provinces	3.1	3.4	3.8
Quebec	98.3	127.4	163.9
Ontario	106.7	135.2	156.5
Western Provinces	20.5	22.4	30.8
Canada	228.6	288.4	355.2

Source: Patented Medicine Prices Review Board, 1991 Annual Report.

new dosage forms. Also, since January 1 1993, Quebec reimburses the price of innovative drugs to pharmacists, as opposed to Ontario which encourages the substitution by a cheaper, generic drug (Gagné and Lefèvre, 1993a).

Industry Profile

In Quebec, such as the rest of Canada, the industry is dominated by the presence of multinational companies (MNCs). A close examination reveals the presence of about 26 MNCs, mostly located in the West Island of Montreal. In Canada, the MNCs employ directly about 6,000 people and their R&D expenditures surpassed over $164 million in 1991 (Focus on the Pharmaceutical Industry, 1993). Most of these firms are involved in the commercialization of innovative drugs based on the traditional medicinal chemistry research. Few of them, such as Merck-Frosst and Boeringer Ingelheim (Bio-Méga) are

involved in biotechnology research (Trépanier, 1992).

Although, these MNCs manufacture a wide range of drugs in various therapeutic fields for the Canadian and sometimes, foreign markets, very few of them have established R&D programs of sufficient size to engage in long-term drug discovery (Industry Profile 1990-1991, by Industry, Science and Technology Canada). The introduction of new products is often the result of the fundamental research done by the head office in Europe or in the United States. Their R&D efforts are essentially oriented toward clinical research, since the therapeutic efficiency of a new drug has to be determined in university hospitals of the country where the product will be launched.

A second group of firms consists of small- and medium-sized enterprises that manufacture drugs under the classification "generic" or "sole source" products (Focus on the Pharmaceutical Industry, 1993). These companies copy products on which patents have expired (generic) or add original features or other changes to existing products (sole source products). Mostly located in the Greater Montreal area, this group of approximately 30 firms employ 1,000 employees and hold 5 per cent of the Quebec market (Trépanier, 1992). A report on the Quebec-owned small- and medium-sized pharmaceutical enterprises classified these firms in three

categories according to their main activity: (1) integrated firms that manufacture and market their products, (2) firms that market products manufactured by another company, and (3) contractors that manufacture on demand (La PME Pharmaceutique Québécoise, 1989).

Although these firms are mainly involved in pharmaceutical activities, they might also depend on cosmetics and nutrition related products. Moreover, in the past few years, some of these firms have adopted the strategy of investing in R&D that would lead them to the discovery of innovative drugs. M. Trépanier (1992) reports that in 1987, 13 of these 25 firms had R&D activities.

The last group of firms that are part of the Montreal pharmaceutical industry are the ones making use of biotechnological processes to develop new therapeutic products, vaccines, or diagnostic tests. Biotechnology has been defined as a set of techniques, methods and processes that once applied to micro-organisms, plant, animal or human cells, can produce new cells and molecules having commercial applications, or create new processes that can be used in industries (Conseil de la Science et de la Technologie, 1992a). This definition is broad enough to understand the multidisciplinary nature of biotechnology, since it has specific applications for different fields: agriculture and

food, waste treatment, forestry, and of course, human biopharmaceuticals.

L. Orsenigo (1989), who studied the evolution of biotechnology in six major industrial countries, gives a definition that better illustrates the strong scientific foundation of biotechnology: "A body of knowledge and techniques involving the integrated use of biochemistry, microbiology, genetics, and engineering sciences to achieve the technological applications of the capabilities of micro-organisms, cultured tissue cells and parts thereof." Although the aforementioned sciences are linked to the expansion of biotechnology, Orsenigo (1989) argues that contemporary biotechnology emerged principally from one discipline, molecular biology, that includes DNA recombinant techniques, cell fusions, and the production of monoclonal antibodies.

The applications of biotechnology to the discovery of new drugs, vaccines, or diagnostic tests are often called biopharmaceuticals. Actually in Quebec, the government estimates the number of jobs associated with this sector, in the private industry, to be 250 (Focus on the Pharmaceutical Industry, 1993). The 1992 Directory of Quebec Biotechnology companies (published by the Ministry of Industry, Science and Technology) lists 15 dedicated biotechnology firms located in the Greater Montreal area, 11 of which have been founded

between 1985 and 1991. Most of them have roughly 20 employees or less (with the exception of Biochem Pharma which has 300 employees).

Actually, the biotechnology sector in Quebec mirrors what was the case in the United States a few years ago: an industry mostly composed of start-ups devoted to research, hoping to commercialize some products in the near future, although these start-ups are very few in number compared to the United States (Conseil de la Science et de la Technologie, 1992a). Unlike the United States, in Quebec such as in Canada, there is a lack of financial resources to support the R&D efforts of these start-ups. The National Biotechnology Advisory Committee (1991) reports that Canadian biotechnology companies have been established either with venture capital investments alone, or with a combination of government assistance for some projects.

In addition to these three groups of firms, the branches of multinational companies, the small- and medium-sized generic companies and the biotechnology firms, the Montreal pharmaceutical industry is supported by various firms offering specialized services. An example is Médis Services, a wholesaler specializing in the distribution of drugs at the national level (Léger, 1989). Also, three Montreal firms are specialized in contractual pre-clinical or clinical research,

which are essential phases of the development of a new drug.

The profile of the Montreal pharmaceutical industry would not be complete without mentioning the existence of two research institutes. The first, the Biotechnology Research Institute (BRI), was founded by the federal government's National Research Council in 1987. Depending on the needs of the firm with which it interacts, the BRI can adopt several positions. Large pharmaceutical firms will contract research in a specific area from a research team (employees of the Institute) to complete their in-house research, or they might contract the BRI to produce some material in the pilot plant.

On the other hand, start-ups might ask the BRI to assist them more closely in the production of a component already discovered by researchers of the small firms, and subsequently require the synthesis of such products for pre-clinical trials in the pilot plant. Some start-ups also lease some space in the BRI, so they can have easier access to the expertise of the research teams of the BRI.

Apart from these contractual services, the BRI concentrates on building collaborative research agreements with firms. When the in-house research teams of the BRI also identify drug targets, it is the role of the Institute to find interested partners of the industry and negotiate a collaborative R&D

agreement with them. In these formal agreements, the National Research Council and the collaborating party agree to participate jointly in the cost sharing and the conduct of the research project. And at the same time, the private firm gets a licensing agreement with the existing technology discovered by the BRI.

The second research centre is the Institute for Research in Industrial Pharmacy (IRPI), which is a good example of cooperation between government, industry, and the university. The federal and provincial governments brought subsidies for the construction of the building and the acquisition of equipment, the University of Montreal its expertise, and affiliated members of the industry (MNCs) their support to the Institute for the developmental role it will play. Opening next September, the purpose of the IRPI is to conduct contractual research for industry firms in the field of pharmaceutical technology, meaning the formulation of drugs[2]. Although the role of innovative companies, the MNCs, is emphasized here for the support they gave to this project, the Institute offers its services to all categories of firms of the industry, where applicable.

This section ends the review on the evolution and description

---

[2] Drug formulation refers to delivery drug systems and dosage forms.

of the pharmaceutical industry in Quebec and Canada. The next section explains the methodological approach used in this research.

CHAPTER III: RESEARCH METHODOLOGY

Methodological Approach: Overview

Qualitative research is attractive in the sense that it provides rich descriptions and explanations of processes happening in local contexts. M.B. Miles and A.M. Huberman (1984) state that "words, especially when organized into incidents or stories, have a concrete, vivid, meaningful, flavour that often proves far more convincing to a reader - another researcher, a policymaker, a practitioner - than pages of numbers". R.K. Yin (1989) refers to case studies as the preferred methodology when the researcher wants to investigate a real-life phenomenon that cannot be manipulated, such as "how do firms cooperate with one another in a local context?" Qualitative research offers two techniques to collect data: observation and systematic interviewing (Strauss and Corbin, 1990; Yin, 1989). There are many reasons for conducting qualitative research, one of them being to help researchers go beyond initial preconceptions and frameworks (Miles and Huberman, 1984). The use of an ethnographic record, such as interviews, links discovery and description into a single process (Spradley, 1979).

Sampling Framework

Qualitative research deals with purposive rather than random samples, for the reason that the definition of the universe is more limited (Miles and Huberman, 1984). In this research, the universe refers to the pharmaceutical and biotechnology firms situated in the Greater Montreal area. Qualitative research is not based on the premise that a larger sample size is always better, such as the traditional survey approach used to achieve representativeness, since depth of understanding is given priority (Belk and al., 1988). Although Larson (1992) states that the use of qualitative research involving only a few cases is limited in terms of generalizability, she mentions that the value of this approach lies in its capacity to provide rich details of a phenomenon and to produce a grounded model. However, the use of a multiple-site study of carefully chosen cases is the way to enhance external validity (Miles and Huberman, 1984; Yin, 1989). To ensure representativeness of the population of firms constituting the Montreal pharmaceutical industry, a certain number of each category of firms was included in the sample: multinational companies (MNCs), generic companies (GCs), and biotechnology start-ups (SUs). Moreover, a number of private firms offering specialized services and governmental research institutes were included in the sample, in order to obtain various perspectives. A description of the sample is provided in

Figures 9, 10, and 10a. For reasons of confidentiality, the names of the participating private firms will not appear throughout the research and the codes given in Figure 10 will be used for future references to firms in the results and discussion sections.

FIGURE 9 - Distribution of the Sample of Firms

Category of Firms	Number of Firms
Multinational Companies (MNCs)	9
Generic Companies (GCs)	4
Biotechnology Start-Ups (SUs)	4
Specialized Services Firms	3
Specialized Supplier	1
Research Institutes	2
Industrial Research Centre	1
Private Sector Initiative Centre	1
Total	25

Data Collection and Analysis

Individual, in-person interviews with members of firms were conducted, using a structured questionnaire as a guide (this questionnaire is available in Appendix I). Arguments support the use of pre-developed instrumentation: it emphasizes external validity and if interview schedules are not focused enough on the constructs the researcher wants to investigate, data overload will compromise the analysis. Moreover, a multiple-site study will provide a cross-site comparison,

FIGURE 10 - Information on the Sample of Firms

Firm	Number of employees	Year of foundation	Revenues in millions ($)	Ownership
MNC1	50	1973	27	(S)
MNC2	13	1983	45	(S)
MNC3	350	1971	226	(S)
MNC4	200	1958	111	(S)
MNC5	500	1947	268	(S)
MNC6	800	1965	416	(S)
MNC7	10	1951	67	(S)
MNC8	115	1983	59	(S)
MNC9	800	1925	260	(S)
GC1	225	1901	8	(C)
GC2	146	1974	14	(C)
GC3	12	1946	1	(C)
GC4	70	1973	9	(C)
SU1	25	1989	< 1	(C)
SU2	23	1991	< 2	(S)
SU3	6	1988	unknown	(SC) at 77%
SU4	10	1985	unknown	(SC)
Contractual pre-clinical research firm	450	1965	24	Caisse de depôt et de placement du Québec at 30%; Canadian investors.
Marketing services agency	10	1991	unknown	(C)
Clinical trial management services firm	6	1992	unknown	(C)
Supplier of plastic bottles	40	1972	5-10	(C)

Notes: 1) In the case of MNCs, the number of employees is for the branch in Montreal. It does not include the sales representatives.

2) The revenues represent the Canadian sales, drugstores and hospitals (December 1992). For MNCs and GCs, the data is from IMS.

3) For the ownership, the following codes apply:
(S) Subsidiary of a foreign-owned company, at 100 per cent.
(C) Canadian-owned private company, at 100 per cent.
(SC) Subsidiary of a Canadian-owned company.

FIGURE 10a - Information on the Sample of Firms (Continued)

Firm	Number of employees	Year of foundation	Ownership
Biotechnology Research Institute (BRI)	233	1987	Created by the National Research Council of Canada to promote the development of biotechnology.
Institute for Research in Industrial Pharmacy (IRPI)	20 (when the Institute will operate at full capacity)	1990 (official opening in September 1993)	Established by Université de Montréal, CRIQ, and initially supported by 15 pharmaceutical firms of Montreal and Toronto. Financially supported by the federal and provincial governments for the construction of the building.
Centre de Recherche Industrielle du Quebec (CRIQ)	25-30 (group for automation of machinery)	unknown	Created by the Quebec government to support various industrial sectors.
Centre d'Initiative Technologique de Montreal (CITEC)	9	1987	Created by industry; is a non-profit private-sector centre whose goal is to increase R&D in the region. Financially supported by federal and provincial governments, and the municipalities of Montreal and St-Laurent.

which requires some standardization of instruments, so the results can easily be contrasted during the analysis (Miles and Huberman, 1984). In order to build an inventory of cooperative involvements and contracts, open-ended questions were asked, but also a list of 11 types of partnerships the firm can potentially be involved in, was presented to the interviewees. This list of various agreements (joint venture,

manufacturing agreement, etc.) was taken from Forrest and Martin (1992), which reported the experiences of 70 North American firms with strategic alliances in the biotechnology industry (this list of agreements refers to question NO 3, page 4 of the questionnaire in Appendix I).

Triangulation within sites, meaning the possibility of interviewing several interviewees within the same organization, was done when possible. The issue of construct validity in case study data collection can be addressed by the use of multiple sources of evidence that essentially provide multiple measures of the same phenomenon (Yin, 1989). The data collection resulted in 40 interviews (36 in-person and four on the phone) conducted between February and June 1993 in 25 different organizations, all located in the Greater Montreal area.

The principal steps of the data collection were done in the following order: 1) a letter of introduction was first sent to the potential interviewees of several firms. The letter included a short description of the research project and an invitation to participate in the study. Letters were sent to several potential interviewees of a same firm, in order to increase the rate of participation. Letters were sent to presidents, general directors, vice-presidents (or directors) of technical operations, marketing, scientific affairs. Names

and addresses were taken from Scott's Directory of Quebec Manufacturers 1992-1993, the Quebec Biotechnology Companies Directory 1992 (Ministry of Industry, Science and Technology), and also, personal contacts were used. 2) One week after the mailing, the potential interviewees were contacted and asked if they were willing to participate in the study.

The analysis of naturalistically obtained data is part of the data collection process (Belk et al., 1988). New data was always compared to prior interpretations as new interviewees were met. A permanent database (field notes, tapes, transcripts of interviews) was created to increase reliability, since the evidence could be reviewed and also made available to another researcher (Yin, 1989).

In building an inventory of inter-organizational agreements, the agreements were first classified as a cooperative involvement or a contract on the basis of the division of the tasks between the two organizations: an agreement was deemed a cooperative involvement if the two organizations have well-defined tasks, (that might be the same or different for each organization) planned to fulfil a strategy jointly elaborated, or a contract if only one of the two organizations in the agreement executes a certain task at the request of the other organization, in exchange for a payment. A contract also includes a situation whereby one organization receives a right

from another organization in exchange for a fee (licensing).

Secondly, in a cooperative involvement, the frequency of interactions and communications between the two organizations is usually done on a periodic basis (to review the activities in progress and to make decisions on further tasks to be achieved), as opposed to a contract where the interactions between the organizations are less regular. In a contract, the organizations usually meet at the beginning to set the terms of the agreement, but as time progresses, the frequency of communications declines between the two parties.

Thirdly, the time frame is different in the two types of agreements: the tasks to be executed in a cooperative involvement are planned on a more long-term perspective, as opposed to a contract where the tasks are more short-term in nature.

The analysis was first done by classifying the content, meaning the various cooperative involvements and contracts with which each individual firm was involved, by referring to the descriptions given by the interviewees. Secondly, each firm with its own inventory of agreements was compared to other firms of the same category (within-category analysis) to determine the role of each category of firms (MNC, GC, or SU) in the local industry. At a third level, results were

compared and contrasted across categories of firms (cross-category analysis), in order to gain a better understanding of how the industry operates.

Research Limitations

Despite the fact that the research sample included pharmaceutical firms of various categories (MNCs, GCs, SUs), private firms supplying specialized services to the industry, and governmental research centres, so as to provide a representative sample of the actual industry, the following limitations of this research should be considered:

1) Triangulation of methods since only in-depth interviews were conducted;

2) The nature of the interviewees and sometimes their skepticism toward the research project;

3) Time constraints;

4) Confidentiality issues concerning the agreements with which firms are involved, probably caused by the nature of the industry where intellectual property plays an overriding role.

The next section deals with the results obtained for each category of firms (MNC, GC, SU). An introductory paragraph summarizes the findings that will be presented, and several sections that include tables showing the inventories of

cooperative involvements and contracts for each firm, discuss in more depth the inter-organizational relationships and other findings for each category of firms.

Some characteristics of the four investigated specialized services firms are also described following the three categories of pharmaceutical firms. The discussion will then move to an analysis of some of the patterns revealed in the results section, by comparing some aspects with the two models of regional networks introduced in the review of literature, but also by understanding some factors unique to the context of the Montreal pharmaceutical industry.

CHAPTER IV: RESULTS

Multinational Companies

The first three sections for this category of firms will describe the production contracts, the overcapacity problem and the cooperative involvements in marketing found for MNCs. This research showed that MNCs mostly deal with each other for production issues, and also, MNCs join forces for marketing purposes. Usually, MNCs do not contract out manufacturing to firms specialized in custom manufacturing and prefer to perform in-house all the quality control procedures pertaining to the manufacturing of their drugs. However, in a few cases, it was found that MNCs deal with firms specialized in packaging or quality control services. The research also revealed the overcapacity situation of Canadian plants, leading MNCs to offer contract manufacturing services. In reference to the research questions asked in the introduction, the three following sections answer *"What types of agreements do Montreal-based firms (MNCs) enter into?"*

The Production Contracts

The first aspect worth mentioning for this category of firms, is the amount of contracts involving pharmaceutical multinational companies (MNCs): of a total of 32 cases (inter-firm agreements) classified as contracts, 11 involved two

pharmaceutical MNCs. Moreover, seven of these 11 contracts were dealing with technical operations (or production) issues, meaning manufacturing, quality control, and packaging contracts. For instance, MNC3 (refer to table 1a) and MNC9 were manufacturing products for five other MNCs, two located in Montreal and at least two in the Toronto area.

TABLE 1a[3] - Cooperative Involvements and Contracts for MNC3

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
CI	Fundamental research projects (11)	Canadian universities	Across Canada (two in Montreal)
CI	Fundamental research project	Biotechnology Research Institute	Montreal
CI	Fundamental research project	Institut de Recherches Cliniques	Montreal
C*	Manufacturing agreement	MNC8	Toronto
C*	Manufacturing agreement	MNCa	Montreal
C*	Manufacturing agreement	MNCc	Toronto
C	Packaging agreement	Firm specialized in the packaging of pharmaceuticals	Toronto
C	Packaging agreement	Firm specialized in the packaging of pharmaceuticals	Montreal
C	Manufacturing agreement	Candy factory that has a section for "pharmaceuticals"	Eastern Townships (East of Montreal)

[3]Notes: 1) A cooperative involvement is indicated by CI and a contract by C.

2) In the case of a contract (C) where a service is received, the firm supplying the service is described under "type of organization involved." If it is the firm mentioned in the title that executes the service, then the contract will be designated by an asterisk (C*). The firm contracting the service is described under "type of organization involved."

3) Montreal refers to the Greater Montreal area (includes Laval and the South Shore).

4) These tables exclude the clinical studies done in hospitals that are always conducted in various locations across the country.

5) The above notes apply to all tables in the results section.

Also, three other MNCs (MNC1, MNC2, and MNC6) were contracting out production to three Montreal MNCs, including MNC9. The four remaining contracts involving two MNCs on a total of 11, were licensing agreements (inward or outward) involving three Montreal MNCs (including MNC9 twice, another Montreal MNC, and the German head office of a last MNC).

It is important to notice that none of the investigated MNCs were contracting out manufacturing of products to small custom manufacturers. They might contract out packaging or quality control of finished products to specialized firms offering these services (as in the case of MNC1, MNC2 and MNC3 in tables 1b, 1c and 1a, respectively), but it is not often the case. MNCs usually prefer to perform in-house all of the technical operations pertaining to the production of drugs, for a better control of the quality of the processes. Members of MNC3 and MNC9 admitted that they have contracted out manufacturing, but only for temporary capacity reasons. The extensive subcontracting of MNC1 and MNC2 for manufacturing and quality control of finished products (refer to tables 1b and 1c) is explained by the fact that both of them do not have any production facilities in Montreal or in the rest of Canada, as opposed to all other investigated MNCs.

TABLE 1b - Cooperative Involvements and Contracts for MNC1

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
CI	Technology licensing (outward) + Co-marketing	MNC9	Montreal
CI	Fundamental research projects (10)	Canadian universities	Across Canada (one in Montreal)
C	Quality control inspection + Packaging agreement	MNCa	Montreal
C	Packaging agreement	Multidivisional company with a branch specialized in packaging for pharmaceuticals	Montreal
C	Quality control inspection	Small company specialized in contractual quality control for pharmaceutical firms	Montreal
C	Manufacturing agreement	Firm specialized in the production of medical devices	Finland

TABLE 1c - Cooperative Involvements and Contracts for MNC2

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
CI	Joint venture involving: 1) Co-marketing; 2) Collaborative R&D; 3) Technology licensing (Inward) + Marketing agreement (Joint venture is international)	MNC9	Head office in U.S.; the Montreal subsidiary is involved in 1) and 3).
C	Quality control inspection	Small company specialized in contractual quality control for pharmaceutical firms	Montreal
C	Manufacturing agreement	MNCb	Montreal
C	Distribution agreement	Company specialized in distribution; one division for pharmaceuticals	Montreal
C	Research contract	Company specialized in contractual pre-clinical research	Montreal

The Production Overcapacity Problem

Recently, Canadian pharmaceutical plants have been faced with an overcapacity problem created by the presence of multiple plants of their respective parent companies located in Europe, Asia, United States and Latin America. Realizing that it was not profitable to serve only the Canadian market, and under the constant threat of shutting down operations if they were not cost-efficient compared to the other subsidiaries, Canadian plants adopted two strategies. The first strategy was to acquire global mandates for the manufacturing of some products that would fill a part of this overcapacity. The acquisition of some mandates for the United States or some European countries is the case for MNC3, MNC4, MNC6, MNC7 and MNC9 (the plant of MNC4 and MNC7 is located in Ontario).

Canadian plants have been successful in attracting these mandates because they are flexible and are capable of quickly adapting to low volumes. The second strategy to solve the overcapacity problem was the result of collective actions of MNCs taken through their association, the Pharmaceutical Manufacturers' Association of Canada (PMAC), which groups the innovative manufacturers of drugs, as opposed to generic companies, which sell "copies" of drugs. MNCs decided to offer contract services in some areas that might interest other members of the same association. A directory, titled "Pharmaceutical Contract Manufacturing Services Offered by the

PMAC Members", was published and sent across the country to all members at the end of 1992. Aware that several of their colleagues were experiencing the same difficulties, MNCs took collective actions to improve their situation. This strategy might also explain why contract manufacturing is rarely given to firms other than PMAC members. However, it seems that this collective strategy went a step further, with MNCs now willing to offer their services to generic manufacturers and small firms (this is already the case with MNC9 manufacturing for GC4; refer to table 1d). More details on the creation of such a production network is left for the first section of the discussion.

TABLE 1d - Contracts for MNC9

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
C*	Manufacturing agreements (8)	2 MNCs (including MNC6); 6 non-PMAC members (including GC4).	2 in the U.S.; 3 in Toronto; 3 in Montreal.

The Cooperative Involvements in Marketing

From the perspective of agreements classified as cooperative involvements, there were only six cases in 55 involving two MNCs. MNCs join forces for marketing purposes, although a joint development process or some collaborative R&D might also

be included in the agreement.

In the case of MNC4, which is involved in a joint development and co-marketing process with MNCd (refer to table 1e), it must be noted that the agreement was initially set up by the respective headquarters of the two MNCs and consequently, all the worldwide subsidiaries participated. Following the joint strategy elaborated first by the two headquarters, MNCd and MNC4 in Montreal have set up their own joint strategic plan, which also specifies the tasks attributed to both MNCs concerning the development and marketing of one product. This situation is also the case for MNC2 and MNC6 (refer to table 1c), where the joint venture was initiated by the two respective headquarters, but involves all the subsidiaries at the international level. But even if these two MNCs are involved in a joint venture, implying collaborative R&D, there is no R&D undertaken at the local level; it is done in their respective facilities in the United States. Only the joint strategy concerning the co-marketing of certain products is achieved locally.

The situation of MNC1 and MNC9, both involved in a co-marketing process (refer to table 1b), probably represents a special brand of a cooperative involvement. Although the joint strategic plan was also elaborated by the two respective headquarters, the two Montreal subsidiaries rarely interact to

TABLE 1e - Cooperative Involvements and Contracts for MNC4

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
CI	Joint development + Co-marketing (Agreement is done at the international level)	MNCd	Head office in U.S.; the Montreal subsidiary is involved.
CI	Fundamental research projects (8)	Canadian universities	3 in Montreal; 3 in Ontario; 1 in B.C.; 1 in Alberta.
CI	Joint venture *	MNC	Montreal
CI	Co-marketing	MNC	Montreal
C	Research contract	Company specialized in contractual clinical laboratory testing	Toronto
C	Research contract	Company specialized in contractual pre-clinical research	Montreal
C	Technology licensing (Inward)	MNC9	Montreal
C	Technology licensing (Outward)	MNCe	Montreal

(*): For confidentiality reasons, it was impossible to determine if this joint venture implied some marketing or R&D.

review their activities and to take decisions on further steps to be followed. The two Montreal subsidiaries strictly follow the instructions they receive from their respective headquarters. In other words, they execute the tasks dictated to them to fulfil a plan jointly elaborated by the two headquarters.

These three cases discussed above reflect well the role of the MNCs, which are "branches" in the respect that the decisions to enter an agreement are not necessarily taken locally, but

at the level of the headquarters.

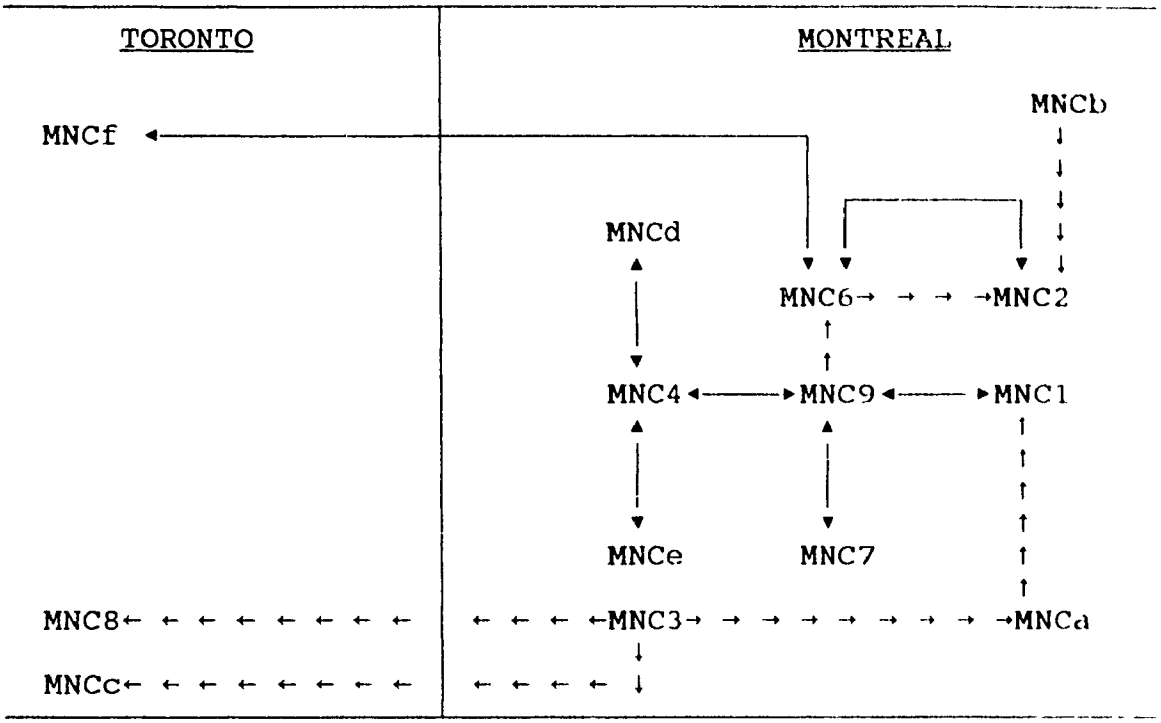
The three remaining cooperative involvements in marketing (including MNC4 in table 1e and MNC6 in table 1f) have MNCs formulating a joint strategic plan locally, or at least at the Canadian level, since two of these cases involved Toronto-based companies. Moreover, we must keep in mind that MNCs have functions performed by the Toronto and Montreal branches.

TABLE 1f - Cooperative Involvements and Contracts for MNC6

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
CI	Co-marketing	MNCf	Toronto
CI	Co-marketing	Generic Company	Toronto
CI	Joint venture (refer to MNC2)	MNC2	Montreal
C	Manufacturing agreement	MNC9	Montreal subsidiary is involved
C	Research contract	Biotechnology Research Institute	Montreal

This section ends the description on the production and marketing agreements Montreal-based MNCs enter into. Figure 11 presents a summary of the agreements found between MNCs.

FIGURE 11 - Summary of the Agreements Between MNCs



Notes: 1) A one-sided arrow (→) means: this MNC produces a service (quality control, packaging, or manufacturing) for the indicated MNC. Example: MNC9 produces a service for MNC6.
2) A double-sided arrow (←→) indicates any other type of agreement between the two firms (licensing, joint venture, co-marketing, or joint development).
3) MNCs other than the ones investigated, had their names coded MNCa through MNCf for confidentiality reasons.
4) Other agreements also involving two MNCs could not be shown in this summary; they remain unidentified for confidentiality reasons. These unidentified MNCs are shown in tables 1d and 1e.

The following three sections present some R&D issues particular to MNCs. The first section describes the importance played by Canadian universities in conducting fundamental research projects with MNCs; in fact, most of the agreements classified as cooperative involvements for MNCs are undertaken with universities and research institutes. The second section describes the biotechnology research conducted by MNCs and once again, it was found that MNCs deal with

universities and research institutes (including the BRI) for their R&D needs. In only one case two MNCs collaborated on a joint R&D project. The research showed that although MNCs are involved in several research projects with universities and institutes, MNCs are dependent on their respective headquarters for the orientation taken in R&D. In reference to the research questions asked in the introduction, the two following sections then answer *"What is the role of universities?"* in the case of MNCs.

The third section that follows will answer the research question *"What attitude have pharmaceutical firms (MNCs) adopted toward the fiscal incentives offered by the government to conduct R&D in Quebec?"* The findings show that MNCs are not primarily motivated by the fiscal incentives in their R&D decisions, but rather by the expertise of the researchers. Furthermore, MNCs argue not to find this expertise in Quebec for all their research needs.

The Cooperative Involvements with Universities for R&D

Most of the cooperative involvements of MNCs are undertaken with universities and research institutes (i.e. 48 of a total of 55). This can be explained by the fact that most of the Canadian MNCs do not have an in-house unit to conduct fundamental R&D (i.e. research linked to the discovery of new molecules having new therapeutic effects) and moreover, the

innovative industry (PMAC members) promised to increase their Canadian investments in R&D when Bill C-22 was enacted in 1987. The MNCs lend their financial support and execute administrative tasks (for instance, help researchers to acquire a patent), while researchers bring their expertise and make available their laboratories to conduct experiments on a topic that is of crucial interest to both parties. Universities and institutes' researchers will periodically exchange with the scientific affairs department in Montreal, and in some cases, with researchers of the MNCs based mainly in Europe or in the United States.

Although some R&D efforts are made through local universities and research institutes, MNCs are heavily dependent on their respective headquarters for the orientation taken in R&D. Almost all research projects undertaken in universities and institutes are done to support on-going projects in Europe or in the United States. Although this makes sense to a certain degree, otherwise R&D efforts would not be focused enough across worldwide subsidiaries, the other extreme is that not many of these projects are undertaken with the idea of trying a new field or orientation with which the headquarters are not already involved. On this matter, a scientific affairs manager says: "Although it would be very interesting to get started in promising projects we see, we must carry on the guidelines established by the most recent developments of the

niche research in Europe." This behaviour adopted by MNCs might explain why none of the cooperative agreements involved any local start-up.

The Biotechnology Research of MNCs

Biotechnology seems to be selectively included in the R&D of MNCs. At least five of the investigated MNCs revealed that they have on-going projects involving aspects of biotechnology. MNC6 and MNC8 contract out some research from the BRI (refer to tables 1f and 1g), i.e. the production of materials in the BRI pilot plant, or contractual research on a precise topic done by one of the research teams of the BRI.

TABLE 1g - Cooperative Involvements and Contracts for MNC8

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
CI	Fundamental research project	Institut de Recherches Cliniques	Montreal
CI	Fundamental research projects (7)	Canadian universities	Across Canada (three in Montreal)
C	Research contract	Biotechnology Research Institute	Montreal
C	Research contract	Company specialized in contractual pre-clinical research	Montreal

Also, MNC3 and MNC5 are involved in research projects with different institutes (refer to tables 1a and 1h). MNC4, which was mentioned earlier, is involved in a joint development

agreement with MNCd, but for a biotechnology product. At least three of these five agreements are done to complete a facet of the R&D efforts usually conducted in European or American subsidiaries, as previously explained, and especially in the case of biotechnology, MNCs seem to concentrate their R&D efforts in one or two locations in the world.

TABLE 1h - Cooperative Involvements and Contracts for MNCs

CI or C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
CI	Fundamental research projects (4)	Canadian universities	Across Canada (one in Montreal)
CI	Fundamental research project	Research Institute	Toronto
C	Distribution agreement	Generic company	Toronto

The Attitude Adopted Toward the R&D Fiscal Incentives

From the perspective of the fiscal policy adopted by the Quebec government to stimulate firms to increase R&D in the province, it can be concluded that at least in six of the nine MNCs investigated, the decisions to invest in fundamental R&D are motivated essentially by the expertise of the researchers, wherever they are located in Canada, and not primarily by the fiscal advantages offered for conducting research in Quebec. The typical answer that would be obtained from a scientific affairs vice-president was: "Our mandate is to be a research-oriented company and not a company driven by fiscal credits."

Scientific affairs directors of MNC1 and MNC3 even admitted that they prefer to spread out research across Canada (refer to tables 1a and 1b), to make sure they do not miss the opportunity to cooperate with talented researchers working in different, reputable research centres. However, the general manager of MNC2 argues that "the reason to transfer a part of our research activities form the United States to Quebec relates to the generous fiscal policies that are not found anywhere else." MNC2, from an American background, is the only firm of this category that offered such a contrast in its attitude toward the fiscal incentives.

Although members of MNCs admit that they are conscious of the efforts made by the Quebec government to support R&D, they argue that the research teams corresponding to their needs might not necessarily be in Quebec for all the topics in the various therapeutic fields they need to investigate. Table 1i, referring to MNC7, illustrates this aspect: two research projects on four are conducted in locations other than Quebec. On the other hand, several MNCs emphasize that doing research in Quebec is attractive because of the dynamic interactions existing between researchers and members of MNCs, made possible by the geographical proximity to the Montreal office, and also because of the frequent contacts made by members of firms with local universities. Of course, we should keep in mind that these research projects conducted with Quebec

TABLE 1i - Cooperative Involvements and Contracts for MNC7

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
CI	Fundamental research projects (4)	Canadian universities	2 in Quebec; 1 in Alberta; 1 in Ontario.
C	Technology licensing (Inward) + Manufacturing agreement	MNC	Germany
C	Technology licensing (Inward)	MNC9	Montreal

universities are only feasible when MNCs fulfil their most important criterion for selecting a research partner, *expertise*, MNCs claim not to find in Quebec for all their research needs.

To conclude, the reason why MNCs choose to invest in Quebec seems to be more the consequence of the support of the provincial government in the enactment of Bills C-22 and C-91, rather than the fiscal incentives offered for attracting more R&D in Quebec. Members of a number of MNCs (MNC5, MNC6, MNC9) reported that the patent laws had a direct influence on the expansion of the infrastructure of their respective firms in R&D laboratories or manufacturing facilities, including the production of experimental drugs tested in worldwide clinical studies. This last option seems to be particularly attractive to MNCs with American headquarters (MNC5 and MNC9), since the Canadian regulations are more flexible than those of the

Federal Drug Administration. Canadian law states that a pharmaceutical product manufactured in Canada may be exported even before it has been approved for sale, provided, of course, that it complies with the regulations of the country where the product is sent. One can conclude that the relocation of the production of experimental drugs for worldwide clinical trials can easily be relocated to Montreal. This observation can be linked to the argument of B. Kogut (1985), who states that MNCs design flexible strategies to permit the firm to exploit valuable options through their subsidiaries, in order to avoid uncertainties, such as exchange rates and government policies.

This ends the description on the R&D issues found for MNCs, including the role of universities in conducting research with MNCs, and also the attitude of MNCs toward the R&D fiscal incentives. The next section concludes on a review of the reasons that motivate MNCs to choose partners in Montreal.

The Reasons why MNCs Select Partners in Montreal

In tables 1a through 1i, the organizations involved with MNCs are often also based in Montreal. Are there any particular reasons that motivate MNCs to enter into agreements with other Montreal-based organizations? First, for research projects with universities and institutes, as stated previously, the research partners are selected for their expertise in a

certain therapeutic field, not for the fiscal incentives offered by the provincial government, or their physical proximity, although several members of MNCs admitted this last factor was appreciated when research can be done in Montreal.

Secondly, MNCs deal with several Montreal-based specialized services firms[4] "that have demonstrated to have requirements that satisfy the needs of MNCs, since these services firms have simply evolved over the years as a result of the requests coming from the local pharmaceutical companies." Since these services firms have the reputation of dealing with other MNCs, members of MNCs admit that they have confidence in their services.

Thirdly, some members of MNCs admitted that geographical proximity had a role to play to solve unexpected problems of a technical nature that could happen in the manufacturing of their product(s) by another MNC. In many cases, i.e. for some licensing, manufacturing, and co-marketing agreements, members of MNCs have developed contacts with other Montreal-based MNCs, sometimes leading to links with them in more formal agreements. These relationships have developed as a result of informal contacts through the PMAC meetings or other opportunities (conferences) MNCs have to interact with other

---

[4] Contractual pre-clinical research, quality control services, distribution and packaging firms.

MNCs.

Generic Companies

Generic companies (GCs) are characterized by the fact that they are Canadian-owned, usually by a small group of individuals often including a chemist, a pharmacist, or a former sales representative from a local branch of a MNC. The strategy of these GCs is usually to exploit a niche of products such as vitamins, sterile products for hospitals, syrups, and dermatological ointments and creams. Apart from improving the existing formula of these products whereby the patents have expired, the strategy of two of the visited GCs (GC1 and GC2) is to manufacture over-the-counter (or self-medication) products for Canadian drugstore chains. This strategy enables GCs to occupy more shelf space in drugstores with their own products, labelled under the private trademark of the corresponding drugstore.

The two following sections describe the production and marketing contracts found for the GCs. As opposed to MNCs, most of the GCs (three on four) contract out a more important part of their production to firms specialized in custom manufacturing and quality control services. This research also showed that marketing agreements are not frequent among GCs. In reference to the research questions asked in the introduction, the two following sections answer *"What types of agreements do Montreal-based firms (GCs) enter into?"*

The Production Contracts

On the four GCs investigated in this study, three (GC1, GC2, GC4) are integrated enterprises, meaning they manufacture all of their products, or a certain part, and market them. GC3 relies entirely on custom manufacturers for the production; they only market and distribute their products. However, apart from GC1, which confirms that they contract out manufacturing for a very small amount of their products (less than one per cent of their revenues) and quality control services only on an irregular basis, GC2 and GC4 contract out an important part of their manufacturing and quality control activities (refer to tables 2b and 2d). In particular, GC2 contracts out its entire production of solid dosage forms (tablets) to a local custom manufacturer, as well as the fabrication of gelatin capsules to a firm in Ontario. The reason? GC2 believes no local firm has the equipment to do so. GC4 also contracts its production of liquids and solid dosage forms to another Ontario firm. It contends that "local custom manufacturers do not achieve a high level of quality, such as what we find in Ontario. Otherwise, we would encourage a local producer without any hesitation." GC2 and GC4 are also dependent on local firms specialized in contractual services for quality control of raw materials or finished products.

Contracting out quality control operations was never done with

MNCs, (with the exception of MNC1 and MNC2 that do not have any in-house manufacturing facilities in Canada) which always prefer to closely supervise these crucial operations. However, GCs do not see any disadvantage in subcontracting these activities, since they claim local small firms have developed customized techniques to service them.

The Marketing Contracts

GCs are involved in very few marketing agreements with other firms: only two contracts of a total of 29. As opposed to MNCs that joined forces to market and promote some of their products according to a plan jointly elaborated (cooperative involvements), GCs get involved on a contractual basis with other firms. This is the case of GC2 which the sales representatives promote the product of a Swedish company, and also the case of GC3, but this time for another Montreal-based GC (refer to table 2a).

TABLE 2a - Contracts for GC3

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
C	Marketing agreement	Small generic company	Montreal
C	Manufacturing agreements (5)	5 custom manufacturers	2 in Ontario; 3 in Montreal.

This ends the description on the production and marketing agreements GCs enter into. The next section describes other types of agreements GCs are involved in, such as product development contracts performed for MNCs, but more specifically, this section answers another research question, i.e. *"What are the relationships we find between firms of different sizes?"* in the case of GCs and MNCs.

The Relationship Between GCs and MNCs

Even if GCs seem to have developed their own production network through a combination of Montreal and Ontario custom manufacturing firms (19 contracts on a total of 29 were related to production issues for these GCs), this research shows that GCs have more interactions with MNCs than one might suspect. Although no agreement between a MNC and a GC was classified as a cooperative involvement, GC2 (refer to table 2b) holds three product development contracts for three different MNCs (two in Montreal and one in Toronto). As these MNCs' do not possess the facilities in-house to develop the formulation for a new product to be launched on the Canadian market, they have to contract out this development process to this medium-sized GC that has developed the expertise to do so for their own products. Moreover, for intellectual property reasons, MNCs prefer not to contract out this service to

---

' Similar to most of the MNCs located in Montreal and in the rest of Canada.

TABLE 2b - Contracts for GC2

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
C	Marketing agreement	Pharmaceutical company	Sweden
C*	Product development contracts (3)	3 MNCs	2 in Montreal; 1 in Toronto.
C	Quality control inspection agreements (4)	Small companies specialized in contractual quality control for pharmaceutical firms; Chemistry department of one university.	Montreal
C	Clinical research contracts (2)	2 firms specialized in contractual pre-clinical and clinical studies	Montreal
C	Manufacturing agreement	Company specialized in the production of injectables	Ireland
C	Manufacturing agreement	Custom manufacturer	Montreal
C	Manufacturing agreement	Custom manufacturer specialized in the production of gelatin capsules	Windsor (Ontario)
C	Manufacturing agreement	Custom manufacturer specialized in the production of creams	Montreal

another MNC, but to a GC that is not a direct competitor. This example illustrates how competition can be heavy on the R&D side of this industry, while on the production side, cooperation was obvious between MNCs, as previously discussed for their overcapacity problem.

Another role a GC can play in the industry is the case of GC1 doing contractual manufacturing on a regular basis for three MNCs, two of them located in Toronto (refer to table 2c). Although GC1 is a medium-sized enterprise, it owns specialized

TABLE 2c - Cooperative Involvements and Contracts for GC1

CI or C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
CI	Fundamental research project	2 Montreal universities	Montreal
C*	Manufacturing agreements (3)	3 MNCs	1 in Montreal; 2 in Toronto.
C	Manufacturing agreement	Custom manufacturer	Montreal
C	Quality control inspection agreements (2)	2 small firms specialized in contractual quality control for pharmaceutical firms	Montreal

equipment that would be a major investment for these three MNCs, which each produce only one drug requiring the use of that equipment. That's why these MNCs prefer to go where the expertise already exists. Although these contracts represent less than one per cent of the manpower activities of GC1, the loss of one of these manufacturing contracts would be considerable in terms of revenues generated.

But GCs have another way of attracting MNCs: the results of their cooperative involvements with universities or rather, the outcomes of their unique fundamental research project. For instance, GC4 is looking forward to creating the first local cooperative involvement between a small enterprise and a MNC. The motivation for this partnership: a new molecule isolated by a researcher of a local university in a project of GC4 (refer to table 2d). Moreover, GC1 will soon be the

TABLE 2d - Cooperative Involvements and Contracts for GC4

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
CI	Fundamental research project	University	Montreal
C	Manufacturing agreement	Custom manufacturer	Toronto
C	Manufacturing agreement	MNC9	Montreal
C	Quality control inspection	Small company specialized in contractual quality control for pharmaceutical firms	Montreal

exclusive manufacturer of a patent controlled release agent discovered in a joint project with two local universities (refer to table 2c). Bound with a particular active ingredient that has therapeutic applications, the resulting compound will have the controlled release effects given by this agent. Who are the potential "buyers" of this new excipient? Three Montreal MNCs have already approached GC1. A member of GC1 admits that the informal contacts made in local conferences and meetings had a role to play in the establishment of more formal links with MNCs.

The previous section has described not only the product development and manufacturing contracts GCs perform for MNCs, but also the research projects of GCs with local universities, which the outcomes interest MNCs. Although there was not a section titled the *Relationship of GCs with Universities*, this research showed that the role of universities is less

important in the case of GCs as opposed to MNCs. However, the next section that answers the research question *"What attitude have pharmaceutical firms (GCs) adopted toward the fiscal incentives offered by the government to conduct R&D in Quebec?,"* also mentions the role played by universities in the case of GCs. Following this, a last section will then conclude on the reasons that motivate GCs to choose partners in Montreal.

The Attitude Adopted Toward the R&D Fiscal Incentives

From the perspective of the fiscal policy adopted by the Quebec government to increase R&D, three of the four investigated GCs respond that they appreciate what the government has done, but given the financial resources of these GCs, they cannot get involved in multiple fundamental research projects with universities as MNCs do. As seen, GCs usually have only one research project, which is always conducted with a university located in Quebec. GC2 actually maintains contacts with several Quebec universities, such as supplying samples of some compounds to researchers so they can pursue their investigations, in the hope of soon finding a project where they can get involved more formally.

The Reasons why GCs Select Partners in Montreal

In the case of the agreements set up with several Montreal-based specialized services firms (for instance, contractual

quality control services and clinical research) and subcontractors (custom manufacturers), GCs deal with these firms since "they have customized their services to the needs of GCs over the years." Like the MNCs mentioned earlier, for the choice of their own services firms, these specialized companies have developed appropriate services over the years as a result of dealing with the local pharmaceutical industry. In the case of research projects with Montreal-based universities, GCs do not have the financial resources to get involved with multiple universities across the province or the country. Moreover, these R&D projects were always initiated by personal contacts between a member of a GC and a researcher.

Start-Ups (Biotechnology)

The first two sections for this category of firms describe R&D issues particular to SUs. The first section answers the research question *"What attitude have pharmaceutical firms (SUs) adopted toward the fiscal incentives offered by the government to conduct R&D in Quebec?"* by explaining that SUs depend heavily on fiscal credits for the financial support it brings them. The second section that answers the question *"What is the role played by universities?,"* reveals that SUs frequently interact with universities as it was the case for MNCs. However, while MNCs got involved in joint research projects with universities, SUs rely on universities for the short-term contractual research they need.

The third section will then present the findings for another research question, *"What are the relationships we find between firms of different sizes?"* in the case of SUs and MNCs. The research showed that there is no agreement existing between these two categories of Montreal-based firms, although SUs have approached foreign-based companies in order to build formal agreements.

The Attitude Adopted Toward the R&D Fiscal Incentives

This category of firms is, without hesitation, the one where the fiscal advantages play the most crucial role, given the

fact that venture capital is scarce in Montreal such as in the rest of Canada. On this issue, the corporate affairs director of SU1 says: "Fifty per cent of our revenues come from the R&D fiscal credits; of course, we occasionally go outside of the province to find the scientific expertise we need to pursue our R&D activities, but the bulk of our research (in-house or with universities for contractual services) will always be done in Quebec for the unique fiscal advantages we get." Of course, each SU has its own history linked to its foundation, but the interviewed members of the four investigated SUs agreed that the existence of such fiscal credits were seriously considered for the financial support of the starting company, aside from the private investments made by the owners.

Three of the SUs are owned by Canadians, but SU2, which is a subsidiary of a New Jersey-based company, has an additional reason to be here: aiming to serve the North American and European markets, the exportation from Canada was easier because the law states that a product may be exported even before it has been approved for sale. In the United States, the Federal Drug Administration requires the product to be approved, even if it is to be exported; this results in a delay of two to three years for the company. Established in Montreal, SU2 is in essence a plant which produces the results of successful research done in the R&D facilities in New

Jersey. This situation is similar to the case of two American-based MNCs, discussed in a previous section, which find it attractive to locate in Montreal the production of experimental drugs dedicated to worldwide clinical studies, in order to avoid the rigid regulation imposed by the Federal Drug Administration.

All these SUs then have a team of scientists in-house, with the exception of SU2, which is a production facility. The formation of each of the three remaining SUs was the result of contacts existing between scientists and people already working in local pharmaceutical companies. For instance, since its inception, GC4 has been the host of SU4, which now has a fully equipped laboratory inside the premises of GC4. The owner of GC4 knew a university professor who proposed that GC4 hire one of his graduate students. SU1 decided to establish its laboratories inside an independent research centre of a local university, after being told by the general director that the centre had a sufficient amount of space to do so. Now, SU1 is looking forward to a formal collaborative R&D agreement involving a researcher of the same centre.

The Relationship Between SUs and Universities

SUs have stayed in close contact with universities, in particular for the short-term contractual research they need (refer to tables 3a to 3c). As opposed to MNCs, which

contract out pre-clinical tests (by that, is meant toxicology tests dealing with the development stage of a new drug) to a large Montreal company specialized in this field, SUs prefer to use the expertise of local universities for certain stages of the development of their products (i.e. pharmacokinetics and toxicology tests) or for the analytical testing of their equipment. Of a total of 11 contracts found for the four investigated SUs (SU2 is not involved with any external organization at the moment), nine were university contracts of that type.

TABLE 3a - Cooperative Involvements and Contracts for SU1

CI OR C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
C	Marketing agreement	Medium-sized company specialized in medical devices	Pennsylvania
CI	Collaborative R&D	Independent research centre linked to a university	Montreal
C	Research contract	Independent research centre linked to a university	Montreal
C	Research contract	University	Montreal

An interview with three account managers of a large Montreal company specialized in pre-clinical research confirmed that no local SU has dealt with them, at least on a regular basis. This situation differs greatly from the way MNCs operate, since they usually contract out the needed pre-clinical

research to private contractual firms, for the development of their products to be launched on the Canadian market.

TABLE 3b - Contracts for SU3

CI or C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
C	Manufacturing agreement (only for the last stage of production of the finished product)	Custom manufacturer	Montreal
C*	Distribution agreement	Dermatological products company	Switzerland
C	Research contracts (6)	Universities	Quebec (one in Montreal); Toronto; Maritimes.

TABLE 3c - Contracts for SU4

CI or C	TYPE OF AGREEMENT	TYPE OF ORGANIZATION INVOLVED	LOCATION OF THE ORGANIZATION INVOLVED
C	Contractual services (testing of equipment)	University	Sherbrooke

The Absence of Relationship Between SUs and MNCs

Regarding links with other organizations, aside from universities, this research shows that SUs are not involved with any local MNC. Members of SUs explain that at the beginning of their operations, they had very little to offer

to MNCs. But that situation has changed. Three SUs are now at the stage where the development of promising products is almost completed or even ready to market products, so these SUs are actually involved in negotiations for marketing agreements with established companies. However, very few MNCs located in Montreal seem to be interested in forming such agreements. Members of SUs explain that their products belong to a niche that was not "compatible" with the existing product lines marketed by local MNCs, so the latter did not make a move. A member of SU1 explains that their production technology is so different from the processes used by MNCs that it would be impossible to contract out the manufacturing of a finished product to a local MNC. In this sense, SU1 and SU3 plan to integrate forward into larger production facilities in the near future; moreover, SUs prefer to do as much as they can in-house to avoid information leaks.

The strategy of two of the SUs (SU1 and SU3) has been to approach American or European companies that have products fitting with their niche and offer to promote or distribute their products in Canada on a contractual basis, in order to bring in revenues, build a product line, and more importantly, establish contacts for potential collaborative R&D agreements in the future. This is the case with a marketing contract for SU1, in which the sales representatives promote the product of an American-based company, and a distribution contract, which

is performed by SU3 for a Swiss company.

The Reasons why SUs Select Partners in Montreal

To conclude, since the R&D fiscal incentives play a crucial role for this category of firms, it is not surprising to observe a high concentration of research contracts in Montreal-based universities, or at least in Quebec. Occasionally, SUs will also deal with university researchers outside of the province for a particular expertise they need.

In one case, i.e. SU3 dealing with a custom manufacturer, the choice of a Montreal-based firm was motivated by the previous experience of a member of SU3 with this specialized subcontractor.

This section ends the results obtained for the three categories of pharmaceutical firms. The next section describes a different category of firms offering specialized services to the pharmaceutical industry. As mentioned in the research methodology section, these firms were investigated to provide a representative sample of the actual industry.

Specialized Services Firms

Contractual Pre-Clinical Research Firm

This large firm has built itself a worldwide reputation by offering a range of pre-clinical research services that are customized to the needs of their customers. Even in the case of some biotechnology products that they might never test again, the researchers of this firm are willing to develop particular testing procedures to answer the needs of their customers. Of 13 different areas of services the firm can currently perform, roughly half of them have been developed over the last 10 years, as a result of customer demand. Actually, 80 per cent of their customers are pharmaceutical firms, 10 to 15 per cent are biotechnology firms (mostly from the United States, but also from Canada), and the rest of their customers are from the chemical industry. Even if more than 90 per cent of their pharmaceutical customers are from the United States, the firm has dealt with 10 Montreal-based firms over the last five years, eight of them MNCs. For instance, MNC2 (refer to table 1c) is currently involved in a contract with this specialized firm. Of the three categories of firms previously reviewed (MNCs, GCs, SUs), we can then conclude that this firm deals mostly with MNCs.

The interviewed members of this firm agreed that since the enactment of Bill C-91 in late December 1992, they have seen

an increase in the demand for their services, of an average of about 20 per cent per month, for the first three months of 1993. Although it might be too early to appreciate the full impact Bill C-91 will have, this statement is interesting, as it relates to the previously described attitude of some MNCs that seem to be more motivated in their investments by the patent laws than by the R&D fiscal incentives.

This specialized firm occasionally interacts with universities, based mainly in Montreal, to give them contracts asking for a very specialized technique that requires some equipment the firm does not have. Although this subcontracting with universities represent less than 5 per cent of all the firm's contracts, it enables the researchers of this firm to keep in touch with the academic community and its latest applications in terms of equipment. The interviewed members also believe that the firm's researchers will be performing more work in the future with universities, because of the increasing demand for specialized techniques and machinery.

Marketing Services Agency

This small firm, founded by two members who originally worked in Montreal-based pharmaceutical firms (including MNC6), specializes in providing marketing research to the industry. Ninety per cent of their customers are MNCs, roughly half of

which are located in Montreal. The remainder of their customers are marketing agencies, usually European, giving them contracts that will complete the Canadian facet of their own worldwide research.

Since the beginning of the recession, many consumer research firms have been trying to increase their business in other areas, such as the pharmaceutical field, where they usually have less expertise. Consequently, the market is actually getting saturated by the presence of several marketing research agencies. But a member of this agency argues that MNCs do not hesitate to request the services of his firm, since MNCs trust them for their significant in-house experience in MNCs. Having this unique point of view, the members of this agency can approach the market differently for each MNC, which has its own corporate culture.

Although some pharmaceutical companies admitted that the physical proximity to some of their suppliers was an asset, for example, in the case of manufacturing contracts, the proximity between customer and supplier is less important in the case of marketing services.

Clinical Trial Management Services Firm

Clinical trial management refers to several tasks performed during a clinical study, such as the recruitment of qualified

investigators, the writing of the clinical plan at the beginning of the study and the final clinical report, the preparation of the documentation to be submitted to the Health Protection Branch (regulatory affairs), and the statistical analysis of the data obtained during the study.

Two experts, who have previously worked for pharmaceutical firms, perform these tasks. Seventy per cent of their customers are biotechnology firms. The rest are large pharmaceutical firms. Even if most of their customers are American-based firms (they also deal with a few Canadian based firms located in the Western region of the country), the members of this small firm hope to gain more Canadian customers in the coming year, especially Montreal-based firms. Founded only a year ago, this firm is one of the first in Canada to offer such a complete range of services dealing with the clinical studies done in the industry. Local SUs are a good target for them, since their strategy is to offer the services of trained people to companies that otherwise would have to hire and train the people themselves. Some of their biotechnology customers are very dependent on their services, as they have no expert in-house for opinions on some stages (i.e. clinical trials) of their product developments.

Using the argument that conducting clinical research in Canada is cheaper than in the United States, this firm also wants to

sell their services to American companies.

Supplier of Plastic Bottles

For more than 20 years, this family enterprise has been involved in the commercial molding of plastic bottles. Because the company made contacts early with Montreal-based pharmaceutical firms, the founder could design some molding tools exclusive to them, and the expertise to do so progressed to the point of attracting more pharmaceutical customers, whom now represent 80 per cent of the firm's customers.

This firm builds the molding tools for the plastic bottles, by using a prototype reproducing the exact dimensions of the bottles. A lot of engineering is involved since each bottle must weigh the same. Aside from all these specifications, pharmaceutical customers insist that the materials used should have specific physical and chemical properties. The owner of this bottle business comments that he has learned a lot from pharmaceutical MNCs (especially MNC3) on the quality control procedures needed to ensure that the finished products are reliable and reproduce all the criteria required by the industry: the stability of the materials used, the exact dimensions, and sometimes, the functional properties of the bottles.

Because this supplier has worked in close collaboration over

the years with his customers to develop the design of the bottles, a new supplier trying to produce the same bottles would not be able to survive, because customers, especially MNCs, prefer to stay with their suppliers who have proven to be reliable.

CHAPTER V: DISCUSSION

Comparison Between the Montreal Pharmaceutical Industry and the Italian Industrial District and the American Technopole (Silicon Valley) Models

As mentioned in the introduction section, the purpose of this research is to describe the Montreal pharmaceutical industry from a comparison based on the Italian industrial district and the American technopole models. The four sections included in this discussion each present a dimension where the Montreal pharmaceutical industry shows some similarities or differences with the two well-known models of regional networks.

The first section, the creation of a production network, is based on some findings mentioned in the results section, i.e. the production contracts of MNCs and GCs, the overcapacity problem of MNCs, and also, the relationships described with some specialized services firms, for instance the supplier of plastic bottles. The second section describes the role of industry associations, research centres and provincial government, two research questions that have not been really answered in the results section. The third section, the relationship between private firms and universities, refers to some aspects mentioned for each category of firms (MNCs, GCs, SUs), but also suggests a model of cooperation for all

pharmaceutical firms that want to increase their R&D with local universities. The fourth and last section, the relationship between firms of different sizes, also refers to some aspects of the results section but always in comparison with the two models of regional networks. This last section also summarizes the characteristics of the three industries.

The Creation of a Production Network and the Relationship With Local Suppliers

If we recall the Italian and Silicon Valley models, subcontracting relationships between local firms were described as extensive, to the extent that some firms would specialize in the production of certain items to supply regional firms (Italian model), and other firms would subcontract all their manufacturing to other firms specialized in fabrication, while the other firms would concentrate on certain activities such as the design of products (Silicon Valley model). These relationships led to a regional system whereby firms, with a less rigid structure, could react more quickly to the fluctuations in demand.

Although the subcontracting of production is certainly not as extensive in the case of the Montreal pharmaceutical industry, since firms do not contract out *all* their manufacturing

activities, the "skeleton" of a production network is still visible. GCs are already flexible enough to contract out work, as three out of four investigated GCs contract out completely, or an important part of their manufacturing and\or quality control, through contracts with custom manufacturers and small firms specialized in quality control services. For instance, GC4, which specializes in manufacturing a wide range of different volumes for its niche market, contracts out other forms of products that are not part of its core business. Similar to Silicon Valley, this behaviour represents a shift from the vertically integrated approach.

On the other hand, as introduced in the results section, MNCs took collective actions to solve their overcapacity problem, leading to a restructuring of the large firms, which up until a few years ago, would never have had their products manufactured by an external firm. To become flexible, MNCs have decided to continue to manufacture certain products when the cost-efficiency would justify it, but at the same time, contract out the production of other products when "someone else" of their industry association (PMAC) could do it more efficiently for them. Let's take the case of MNC6 to illustrate this argument. The production of only one drug required a separate facility to avoid cross-contamination. The renovation of a whole facility to produce one drug does not make economic sense, but MNC6 was aware that MNC9 had a

surplus of capacity in that precise type of manufacturing it required. The result: MNC9 now manufactures this product for MNC6.

The above observations certainly have similarities with the flexible specialization concept stating that large firms can centralize some of their activities, while decentralizing others by subcontracting (Bianchi and Bellini, 1991). Even though these subcontracting activities represent only a small amount of their products, local MNCs made a collective effort to resist the threat they were facing from their respective parent companies.

Local plants of MNCs, knowing they were in a highly flexible position due to the fact they had been producing for years a broad product line for a relatively small market (the Canadian market), could attract external business by promoting their expertise. This flexibility refers to the capacity of producing small batches on demand or big batches, quick set-up times of machinery to pass from one product to another, and also the rotation of manpower from one assembly line to another, sometimes on a daily basis.

While in Silicon Valley, firms relied on subcontracting to be able to introduce quicker new product generations (Saxenian, 1991), in the context of the Montreal pharmaceutical industry,

MNCs decided to contract out manufacturing or offer such services to solve their overcapacity problem, in order to collectively resist the competition felt by other subsidiaries, which were cost-efficient because they could service bigger markets than Canada.

As stated earlier, it is true that this initiative was taken through the industry association of the MNCs, the PMAC, but all interviewed members of MNCs agreed that there has always been an atmosphere of informal cooperation existing between all Montreal MNCs at the level of technical operations. It is not uncommon for a production director to visit another plant and ask his colleague questions about the efficiency of the new machines. But what is most interesting about this collective initiative is the fact that MNCs are now willing to offer their services in the near future to firms that are non-members of their association, including American and European firms that have already shown some interest: of its eight "clients," MNC9 actually manufactures for six non-member firms, including two American pharmaceutical firms and Canadian small- and medium-sized GCs. This year, these contracts of small volumes for external companies will reach 10 to 15 per cent of the entire production of a specialized area of manufacturing of MNC9.

The creation of a production network leads to some assets

being "shared" by companies. For instance, three MNCs (two from Toronto and one from Montreal) that did not want to invest in specialized equipment to produce creams and ointments, asked MNC3, which had an overcapacity in that area of manufacturing and also trained manpower to do so, to take up their production. This year, these contracts will represent 40 per cent of the entire production of the creams and ointments department of MNC3. Moreover, one MNC for which GC1 manufactures one product, has been ready to make a joint investment to acquire state-of-the-art equipment with GC1, since this MNC needs an important volume of this product. If GC1 considers to start manufacturing products of the same type, the equipment is already available in-house, a major advantage for GC1.

The situation just mentioned compares with the description made by Saxenian (1990, 1991) of Silicon Valley firms that are ready to invest in their suppliers they consider long-term partners. On the issue, not only the MNCs, but also GCs that contract out to custom manufacturers, have insisted on the fact that geographical proximity (and quality) had a role to play in the choice of local suppliers, since problems of a technical nature are always easier to solve. Also, suppliers and customers can work closely together in order to develop specific requirements, another way firms can invest in their long-term suppliers. For example, 15 years ago, MNC3 started

a relationship with a local candy factory that supplies them a finished product containing a medication provided by MNC3. At the beginning, MNC3 had to send some of its employees on site to help them develop the quality control standards required by the pharmaceutical industry. Now, this factory has created a department specialized in "pharmaceuticals" with skilled employees to better serve MNC3. Both organizations are now very dependent on each other: high revenues are generated for the candy factory and MNC3 never found a second supplier that was ready to do the equivalent work.

Another example of a typical initiative taken in this industry is the case of a supplier of plastic bottles. Eighty per cent of the supplier's customers are local pharmaceutical firms, mostly MNCs. In the case of MNC3, this supplier invested in his technology in order to be able to supply a particular type of bottle MNC3 requested, and build a long-time partnership with MNC3. But at the same time, MNC3 spent time to help develop the quality control processes of its supplier. With the same supplier, MNC9 invested in the acquisition of a molding tool exclusive to them, otherwise, MNC9 would have been obliged to buy from Ontario and build a bulky inventory of bottles. Moreover, this would not result in the best situation to solve unexpected problems of a technical nature, as the president of the bottling business reports: "They (the pharmaceutical companies) like to be able to go down the

street and talk to suppliers; they are interested in looking that you do well, and at the same time, they really invest in you."

To summarize, one can see from these cases that production links have evolved between pharmaceutical firms themselves, and with their subcontractors and suppliers. However, the decentralization of production of MNCs will certainly never reach the point of contracting out *all* their manufacturing, since the aim of these plants is to survive in a global world and for some of them, that means offering their services. Also, the sequential nature of the manufacturing activities, but mostly the crucial quality control tests that must be applied "in process", are serious limitations to the capacity of contracting out pharmaceutical manufacturing extensively, since some production stages are hardly dissociable. This comment applies to both MNCs and GCs. In contrast, in the semi-conductor industry (Silicon Valley), it was easily feasible for a firm to subcontract all the fabrication of components, and concentrate only on the final assembly in-house. The same situation applies in the Italian industrial district, where craft firms could provide specialized services for other firms taking care of the design.

If we refer to the arguments made in the review of literature, it was emphasized that: (1) subcontracting relationships, (2)

production-sharing, and (3) interdependency towards local suppliers and subcontractors that have adapted their services to the needs of their customers, were typical relationships observed in a production network (Dorfman, 1983; Florida and Kenney, 1990; Sabel, 1989; Saxenian, 1990, 1991). Although it is hard to put numbers on the third and last element of this definition, examples mentioned throughout the results section and in the three previous pages - the candy factory, the supplier of bottles, the firms specialized in quality control services - refer to this fact. For elements (1) and (2) of the definition, we can point to the fact that 53 per cent of the contracts in the sample dealt with production activities, meaning manufacturing, quality control, or packaging activities. Specifically, 37 per cent of these contracts involved two firms located in the Greater Montreal area, and 16 per cent of them involved one firm located in Ontario (the Toronto area mostly) and one firm of the Greater Montreal area. All these production contracts involved a combination of two of the following organizations: MNC, GC, SU, custom manufacturer, quality control services firm and packaging services firm.

The Role of Industry Associations, Research Centres and Provincial Government

In the Italian model, the role of one association (a trade union), the CNA, was emphasized for the shared services it organized for small firms, such as marketing, quality control, and bookkeeping. In the case of the Montreal pharmaceutical industry, the purpose of industry associations is primarily for governmental relations and information on regulatory issues, since the patent laws and regulations are the driving forces behind the industry.

In addition, in the Third Italy, the existence of collective services centres (such as CITER) could provide technological information to firms. This wide range of services was offered in the context that the small craft firms of the Third Italy were not structured with all the functional and administrative departments usually found in an integrated enterprise. In some of these craft firms, the level of vertical integration was practically non-existent. However, this situation is usually not applicable to pharmaceutical firms, especially in the case of MNCs and GCs, where the functional structure is always present. One can start with the assumption that pharmaceutical firms will be less inclined to need the broad range of services offered by collective centres as in the case

of the Third Italy.

Nevertheless, some firms of the sample occasionally request the services of CRIQ (Centre de Recherche Industrielle du Québec), an organization created by the Quebec government that offers the following services on a contractual basis: market analyses, automation of machinery, consulting services on productivity issues (MRP, TQM, JIT), and information on existing patents and on certain technologies, such as the slow and controlled release technologies used in the production of drugs. Some GCs deal with CRIQ, but mostly for patent information and consulting services mentioned above. It seems that CRIQ is also open to the idea of finding business partners, although it is not the centre's primary goal. A member of CRIQ revealed that pharmaceutical firms do not represent a high percentage of their overall activities.

Although CRIQ was created to assist small- and medium-sized firms of different industries (Gagné and Lefèvre, 1993b), one MNC investigated in this research has shown some particular interest in the expertise provided by its automation of machinery department. This department of CRIQ can design and build equipment and machinery customized to the needs of the client firms. To reinforce the subcontracting linkages in Quebec, CRIQ members deal with regional firms for the fabrication of the components and parts that they will

assemble. Contrary to what one might suspect, CRIQ usually assembles machines at the request of MNCs, and not small- and medium-sized enterprises of the pharmaceutical industry.

On the issue of industry associations, there exists a strong association, the PMAC, which groups the innovative firms of the industry, the MNCs. Although this association played an overriding role in lobbying the federal government for better patent protection (Bill C-22 and C-91), as seen in a previous section, it is through the PMAC that collective actions were suggested to solve the overcapacity problem of plants. The PMAC has an Administration Board formed of 15 company presidents, through which decisions are taken. All members of firms meet periodically with other members of their respective section (for instance, marketing, scientific affairs, plants operations). On the other hand, GCs are members of a different association, the CDMA (the Canadian Drug Manufacturers Association), which has the same objectives as the PMAC: governmental relations and information.

Members of MNCs as well as a member of a marketing services agency reported that innovative firms might also meet through a separate association on a monthly basis, a pharmaceutical marketing research group, where agencies present their work and discuss the firms' needs and at the same time, marketing members of firms discuss with suppliers how their services can

be improved. Several members of firms admitted that trust and mutual exchange are essential to maintain a good relationship with suppliers, as described in the Italian and Silicon Valley models.

In the case of SUs, they report thac they have never dealt with a particular biotechnology industry association. Instead, SUs directly interact with regional representatives of the MICT to discuss their needs in terms of potential business partners. Members of SUs agree that the MICT is extremely efficient in terms of promoting them to foreign investors. This situation indicates that apart from formulating specific policies, the government also takes concrete actions to assist the growth of SUs. Moreover, the existence of a provincial governmental program managed by a crown society, has been of particular help to several SUs. The SDI (Société de Développement Industriel du Québec) offered participative loans to SUs, meaning that when this society participates in a venture, it is entitled to a certain percentage of the ownership, usually 10 per cent (Gagné and Lefèvre, 1993b).

In fact, members of SUs gave the impression that they do not require a formal association since there are very few SUs and their members all know each other in Montreal, and general managers of SUs usually have worked in Montreal pharmaceutical

firms, so they know how the system works. Through this informal network made of personal contacts, the MICT, BioCapital[6] (a venture capital firm based in Montreal), and CITEC (Centre d'Initiative Technologique de Montréal), SUs regularly interact to discuss their needs in terms of business partners.

CITEC, the last organization mentioned above, is a non-profit private-sector centre whose purpose is to contribute to the long-term economic growth of the Montreal region, by attracting investment in the following high-technology sectors: information technology, electronics, aerospace, and biotechnology. Each one of these sectors is sponsored by a president of a Montreal company: for biotechnology, it is the president of a pharmaceutical MNC. Apart from finding business partners for Montreal-based companies, CITEC also makes the links with the four Montreal universities for technology transfers and research contracts. Actually, CITEC is working with various levels of government and universities to develop high-technology parks in Montreal (*The Montreal Gazette*, June 1993).

In the field of biotechnology, CITEC has created an

---

[6] The most important shareholder of BioCapital is le Fonds de Solidarité des Travailleurs du Québec (Lefèvre and Gagné, 1993a). The purpose of such a fund is to help businesses that have financial difficulties or are starting, in that they secure existing jobs or create new jobs for Quebec workers.

information bulletin devoted to promoting Montreal SUs. Distributed in 20 countries, the bulletin has the support of the MICT, the private industry, and the municipalities of Montreal and St-Laurent. Another aspect of CITEC that is worth mentioning is its cooperation with the Quebec government to produce a report assessing the scientific and technological activities in the Greater Montreal area, in 17 different sectors (Conseil de la Science et de la Technologie, 1992b). The objective of this report was to bring recommendations that would help the government in its strategic planning of the Montreal region. The presence of such an organization in the Montreal pharmaceutical industry is a strength that the Silicon Valley model lacked, as there was no local agency to coordinate the strategic planning of the region.

In terms of centres offering services to the industry, as in the case of the Italian model, two research centres have adopted this position in the Greater Montreal area. The first one, the BRI, takes different roles depending on the type of firm with which it interacts, as explained in the Industry Profile section. Although the position of the BRI brings exceptional advantages to Montreal firms, some SUs investigated in this research revealed that they preferred not to be located inside the premises of the BRI. The reason? Their production technologies were not compatible with the applications the BRI emphasizes on, namely genetic engineering

and fermentation processes. It is then a weakness that such a public institute does not adapt to the needs of SUs, since its mission is to help firms in their growth.

The second research centre that plays a role in the Montreal industry is the IRPI. The MNCs were particularly attracted to the existence of such an Institute, seeing as they are actually rationalizing their manufacturing facilities, and they have to compete with other worldwide subsidiaries to obtain global mandates of production. In order to do so, MNCs need some technical support to reformulate drugs because getting a world mandate means adapting the dosage forms to the requirements of all countries. For instance for one drug there might exist five or six different formulations around the world. Moreover, very few MNCs are equipped with such research facilities. The IRPI provides shared assets, something individual firms probably could not otherwise invest in.

But what is special in the case of this Institute, is that it really is a local initiative. Members of MNCs immediately showed some interest when the IRPI was mentioned. Interviewed members of at least three MNCs (MNC6, MNC7, MNC9) said they knew its Director well, from the University of Montreal environment, or from the presentations he made at the PMAC meetings, and their respective firms would certainly contract

some services from the Institute. The vice-president of technical operations of a MNC said: "We have a good project to start IRPI; a good project as far as our company is concerned, but also to help the industry." As in the creation of the production network, collective actions are again taken by MNCs to improve their situation and become more competitive with other subsidiaries.

What is important to emphasize in the Montreal pharmaceutical industry is the presence of "pre-existing networks" as reported in other studies of industries, meaning that informal and personal contacts among the members of the industry become key factors in the creation of cooperative links (Smith et al., 1991) As demonstrated above, in the IRPI project, but also in the development of a production network, the existence of personal contacts among industry members were often the basis for cooperation.

The Relationship Between Private Firms and Universities

While the relationships with universities were not extensively discussed in the Italian model, and although associations and collective services centres might be in contact with them, it is never stated that firms had direct links with universities. One can assume that given the nature of the work performed in

the craft firms (clothing, ceramics, leather), it does not require frequent interactions with university researchers, unlike the case in technology-related sectors. On the other hand, Silicon Valley literature outlines the importance of universities in the business community, even though no agreement between a private firm and a university is described. A recent article on the Silicon Valley region now confirms that "the industry failed to reinvest in the community, government became hostile to the needs of industry," and with the increased foreign competition, executives now wished they had got involved in "greater cooperation between the private and public sectors" (*The Montreal Gazette*, March 1993). However, we should keep in mind that other emerging American technopoles seem to have important links between universities and private firms (*Business Week*, October 1992).

Therefore, a description of the Montreal pharmaceutical industry would not be complete without mentioning its important relationships with universities across Canada. This dimension offers a contrast with the Italian model and a strength compared to the Silicon Valley model, if we take into account the comments reported above. Technology-related industries have the reputation of keeping a close contact with scientists in universities (Dorfman, 1983; Kenney, 1986; Piore, 1990). Several interviewed members of firms (MNCs

mostly) admitted that the best researchers are found in universities and that they will increase their collaborative R&D with universities in the years to come, even though firms already have an R&D unit in-house or would develop one in the future. Since conducting fundamental research is extremely complex and expensive, firms (MNCs mostly) would prefer to increase their collaborative research with several university researchers to spread the risk, rather then creating an R&D unit or forming R&D alliances with other pharmaceutical firms, which they claim, makes them too vulnerable.

From the inventories of inter-organizational agreements shown in the results section, 88 per cent of the cooperative involvements in the whole sample of firms were done with universities, for research purposes always, and 16 per cent of the overall contracts were dealing with short-term research services, evaluations, or certain stages of the research that cannot be performed in-house given the lack of equipment or the need for a particular opinion on a topic. These numbers also include the contracts performed by public sector organizations, for instance the BRI, although these percentages mainly take into account universities in Quebec and Canada.

The aim of this section is to stress the fact that although intellectual property is an overriding factor that makes pre-

competitive research very difficult to realize in this industry, the creation of shared assets is still possible between universities and private firms, bringing advantages to both parties. On this issue, one case is discussed here in that it should serve as a model for all Montreal pharmaceutical firms wanting to increase their competitiveness in research and their synergy with local universities.

To avoid duplication of costly equipment, SUs admitted that they first looked at what they could find in their environment. This is why they often contract short-term analytical tests to local universities, as previously stated in the results section. SU1, which established its laboratories inside an independent research centre of a local university, had the advantage of contracting out short-term tests to the university researchers located in the same premises. Also, these university researchers could use the equipment bought by the SU. In the near future, this symbiosis will go a step further: a "joint laboratory" will be built so that researchers of both organizations can use it for certain biochemical applications. This example is not unique: GC1 had equipment in its plant laboratory, where researchers of a joint project with two local universities used to conduct some analytical tests. Although this equipment is part of GC1 routine work, universities do not always possess these expensive tools.

The Relationship Between Firms of Different Sizes

While in the Third Italy production networks were mostly made up of small firms, although the inclusion of a larger firm was also possible, in the Montreal pharmaceutical industry, large firms (MNCs) rarely deal with firms other than their category for production issues (refer to Figure 11). Similarly, GCs mostly deal with other small- and medium-sized firms, i.e. custom manufacturers and quality control services firms. However, this research has shown, in a few cases, that this is changing, and we might see more subcontracting relationships developing between large and small and medium-sized firms in the future, at least for production issues. In the Silicon Valley model, a more equal relationship between small and large firms was described, and agreements dealing with manufacturing, but also joint product development agreements were more frequent throughout the industry (refer to Figure 5). The Montreal pharmaceutical industry then offers a variation of the Silicon Valley and Italian models. The characteristics of the three industries on the dimensions introduced in the review of literature, the results section and in this discussion are outlined in Figure 12.

In this research, MNCs and SUs showed no synergy in the aspect of transferring new technologies by forming alliances. Given the following factors, i.e. 1) the attitude of MNCs that

prefer to rely on research done in other subsidiaries for biotechnology; 2) the fact that MNCs might also get involved in selective projects mostly with university researchers; 3) the fact that SUs prefer to conduct research as much as possible in their laboratories (besides short-term research and tests they contract to local universities) for intellectual property reasons; and also 4) the issue that SUs integrate forward for production, the large pharmaceutical firms and the small biotechnology firms seem to evolve like two parallel lines. This situation confirms the following thesis: when intellectual property is at threat, innovative firms prefer to pursue their R&D activities through vertical integration (Pisano, 1991; Teece, 1987).

For the moment, this portrait is far from what was found about 10 years ago in the biotechnology industry in the United States: MNCs would give R&D contracts to SUs, or MNCs would purchase equity in SUs (Kenney, 1986; Orsenigo, 1989). Again, this might be explained by the fact that the Canadian subsidiaries of MNCs are dependent on their headquarters for R&D orientations, and subsequently, take very few local initiatives, apart from their commitment to increase fundamental research through Canadian universities since the enactment of Bill C-22.

To summarize, like in the Third Italy and Silicon Valley

models, the Montreal pharmaceutical industry receives comparable support for various services from the presence of governmental research centres: contractual research, automation of machinery, information on patents, consulting services on productivity issues. As seen in each model of regional network, there were different reasons for the existence of a production network (refer to Figure 12), but in each case, it was an adaptation of an industry to some changes in the environment.

As a technology-related industry, the Montreal pharmaceutical industry can take advantage of the existence of several links with universities, multiplying chances of not missing opportunities in discoveries. Investing back in institutions is also a way of reinvesting in the community, and contributing to the training of graduate students in the scientific field. Moreover, what is interesting here, is the existence of a non-profit centre (CITEC) acting as a coordinator between the private sector and local universities.

On the other hand, if we return to the definition of the MICT that describes an industrial cluster as a "group of firms (...) coming together and competing with each other to accelerate their growth," it is obvious that the Montreal pharmaceutical industry suffers from a lack of effort to create links between established firms and biotechnology

FIGURE 12 - Summary of the Comparison Between the Montreal Pharmaceutical Industry and the Italian Industrial District and the American Technopole (Silicon Valley) Models

DIMENSIONS	THIRD ITALY	SILICON VALLEY	MONTREAL PHARMACEUTICAL
Production network	Extensive subcontracting relationships between specialized firms.	Extensive subcontracting relationships between specialized firms.	Limited subcontracting relationships.
Reasons leading to the formation of a production network	Rapidly changing demand for more customized and diversified goods	Pressures created by changing technologies; capability to introduce quicker new product generations.	Solve overcapacity problem; resist the competition felt by other worldwide subsidiaries (MNCs).
Relationship between firms of different sizes	Networks constituted mostly of small firms; larger firms can be included.	Agreements between small firms; or between small and large firms.	Agreements between large firms; or between small\medium firms.
Role of industry associations and other collective centres	Associations (trade unions) and collective centres offering a wide range of shared services, such as marketing, bookkeeping, quality control and technological information.	Industry associations offering some services, such as lobbying; no local agency for strategic planning of the region.	Industry associations primarily existing for governmental relations; governmental centres offering contractual research; initiative centre for regional planning of high-tech industries.
Relationship with universities	No direct links with universities; associations (trade unions) can work in collaboration with universities.	No description made of a formal agreement between a firm and a local university.	Extensive research agreements with universities, locally, and across the country.
Sources of capital	Family savings; trade union funds (CNA).	Venture capital firms; minority investments of large firms into SUs.	Trade union funds (FTQ); governmental program (SDI); MNCs investments.
Predominant types of agreements	Production-sharing.	Joint product development agreements and technology transfers.	Production contracts; research projects between universities and firms.

start-ups. These comments lead us to the implications section.

Implications and Future Research Needs

For Firms

1) Even though MNCs have current research projects with university researchers, and also have the autonomy in deciding which projects they should get involved in, the choice of these research projects is almost always done in line with the completion of some aspects dealing with the niche research done in the European or American subsidiaries. If more discretion in R&D was undertaken by local MNCs, they could become more competitive with the other subsidiaries, and initiate some projects with some promising local SUs. For instance, minority equity investments can be a way to keep an open window on new technologies, and stimulate the growth of SUs that suffer from a lack of capital. Future research should monitor how Montreal pharmaceutical firms have integrated biotechnology in their activities. If GC1 created facilities with some help of the government to welcome a biotechnology team, a MNC can certainly bring support of some kind to a SU.

In the near future, SUs will need some assistance to market

and distribute their products, since they do not have the "critical mass" to concentrate on these aspects. This is another way MNCs could cooperate with SUs, as this kind of agreement could be advantageous to both parties. For instance, one local MNC has not launched a new ethical product in five years; their sales representatives would be stimulated by a new product, and the SU could continue to concentrate on R&D and production.

2) GCs should increase their research and product development activities in the future, in-house or with university teams, since it reinforces their presence in the industry and has led to the creation of some links with MNCs that were attracted by their discoveries with universities teams, or in-house expertise in manufacturing or product development.

3) If local branches of MNCs want to survive in a global world by attracting external business in manufacturing, they should focus on manpower training and continuing education. Some MNCs already have a Quality Management system in place, and others have started to get in touch with local CEGEPs to cooperate in the creation of a formal program, since many workers need to be retrained in several areas, such as computerized machinery.

4) If R&D increases in GCs and SUs in the years to come, there

will be a growing need for more specialized firms offering regulatory affairs services and clinical trial management services, since the above firms do not always have the critical mass to do it in-house. One member of a GC reported he had to go to Ontario to find better services than the ones found in Montreal, in the area of regulatory affairs.

For Universities

1) Several MNCs have revealed their intention to increase their research with universities in the future, because it gives them more choice and flexibility than creating a R&D unit in-house. Quebec universities should prepare to respond to this trend by investing more in equipment and facilities. If there is a high-quality demand for research, Quebec universities should be the first ones to attract MNCs, in order to increase R&D in the province, and create more jobs for scientists in the future.

2) University researchers should adopt the model of a "joint laboratory" already described in the section on the relationships with universities, and promote this concept to all private firms of the industry. This concept brings some funding in state-of-the-art equipment for universities, and advantages for industry researchers who could interact

frequently with other researchers, and even conduct collaborative projects with university researchers.

Since members of MNCs find it attractive to have research in Quebec, because of the geographical proximity to the Montreal office, the two suggestions made above should be particularly appealing to them.

For the Government

1) From this research, we have seen that GCs and SUs are usually interested in the fiscal policies and respond well by conducting most of their research projects with Quebec universities. But MNCs argue that their research choices are motivated by the expertise that might not be found in Quebec, or they prefer to spread the risk by investing across the country rather than "putting their eggs in the same basket." What can be done to increase the investments of MNCs in Quebec is to bring their attention to the fiscal incentives offered (tax credit of 40 per cent) for conducting research in small Canadian-owned enterprises. This could create more links with local SUs. Future research should examine to what extent the fiscal advantages mentioned for the above case are used by MNCs, to see if it yields any results.

2) If the government and other initiative groups want to bring more foreign investors to Quebec to boost the growth of high-technology sectors like biotechnology, such as the creation of high-tech parks by CITEC, the government should keep in mind its objective of creating high-quality jobs for the local people. If Quebec has a shortage of researchers and has to recruit from other countries, all the created jobs that can be performed by competent local people, i.e. administrative functions, support staff, and laboratory technician positions, should be reserved for Quebec residents.

3) In order to increase the number of joint research projects between Quebec universities and industry firms, and to reinforce the intentions of firms to do so, the government should create a program encouraging such alliances. For instance, university researchers (or research teams) teaming up with a private firm and having a joint proposal to conduct research on a precise topic, would receive some subsidies for the acquisition of equipment that would remain part of the universities. This could also give graduate students much needed experience.

4) The government should publish and distribute to all industry firms a regional directory listing all the small firms specialized in various services, such as clinical trial management services, regulatory affairs, consulting services,

to reinforce the links between firms of the Montreal industry.

5) Many GCs have emphasized the problem of quality with some local custom manufacturers, and in one instance, forcing one firm to deal with an Ontario supplier. In order to reinforce links between customers and suppliers in the local industry, the government should encourage manufacturers to get involved in quality management programs.

Limitations of the Quebec Industrial Cluster Strategy

1) The overriding role of intellectual property in the pharmaceutical industry means that the key tasks of R&D will essentially remain in-house, i.e. within the MNCs and the SUs. Even if the provincial government has a policy oriented toward increasing R&D in the province (R&D fiscal incentives), more partnerships involving R&D activities are not likely to occur. However, the strong links already existing between universities and the industry might be the only option where R&D will increase in the future, if expertise can be developed.

2) Based on the arguments of Porter (1990), a high-quality demand in the country and public sector organizations adjusting to the needs of firms, reinforces the links inside

an industry. Although there is a demand for competent researchers from local MNCs, the expertise to satisfy these needs is not always found in Quebec. Even if the government wants to promote education in the scientific fields to fulfil the needs of the industry, it takes a reasonable amount of time to train some researchers at the university level. This recommendation should be followed by the future government, as it will pay off eventually.

3) The fiscal incentives offered to conduct more R&D is not a policy adapted to the needs of some small- and medium-sized enterprises, where R&D is neither their interest, nor their actual strategy. The role of the government is to encourage these firms to perform better in the activities they are already involved in, or in other words, help firms upgrade their actual expertise. For instance, during this research, some members of firms admitted that they are not satisfied with the services they receive from local custom manufacturers, to the extent of switching to an Ontario supplier. The government policy could be refocused by offering some subsidies to these custom manufacturers for the creation of a MRP system, a TQM program, or an improved quality control system.

Extent to Which the Research Answers the Questions Asked

1) What is the role of the provincial government?

This research has revealed the fact that the government not only elaborates some policies, but also works closely with some firms, namely the SUs, to help them grow. Future research could include the arguments of a regional representative of the provincial government involved in dealing with these SUs.

2) What is the role of universities?

Although this research has emphasized the crucial importance of universities for R&D purposes, since in almost all the investigated firms (MNCs, GCs, SUs) there was a contract or a cooperative involvement currently undertaken with one or several universities, future research could include the opinions of some university researchers involved in agreements with firms.

3) What attitude have pharmaceutical firms adopted towards the fiscal incentives offered by the government to conduct R&D in Quebec?

Triangulation across sites within a same category of firms (MNCs, GCs, or SUs) and also a comparison across these categories, have clearly demonstrated that fiscal incentives are not considered the same way by the three categories of

firms. They are of less importance to MNCs, crucial to SUs, and interesting to some GCs, but to a lesser degree than SUs, as GCs already exploit some particular niches. We can say this question has been answered with a high level of confidence.

4) What are the roles of industry associations and research centres?

By triangulation across three research centres (BRI, CRIQ, IRPI), and also from the perspectives of members of several firms across categories, this research has extensively reviewed the role of centres. It was demonstrated that the above centres offer different services to the industry, and for the associations, all the interviewed members of firms unanimously agreed that their industry associations (CDMA, PMAC) play the role of making the link with the several levels of government. The associations take care of governmental relations and also inform their members of regulatory affairs.

5) What are the relationships we find between firms of different sizes?

By having identified the partners (MNC, GC, or SU) with whom each firm investigated is involved, via the cooperative involvements and contracts, we can confirm the following situation with a high level of confidence: very few agreements involve firms of different sizes or categories (MNC, GC, or

SU).

6) What types of agreements do Montreal-based firms enter into?

The inventories of cooperative involvements and contracts in the results section precisely report the types of agreements, although these lists of agreements should not be considered exhaustive for all the investigated firms. Moreover, the cases of the research contracts sometimes present variations from the criteria of a contract presented in the methodology section. The execution of the task, the research, is sometimes more long-term than short-term, and the communication between the organization executing the research and the other party might be intense from the beginning of the agreement to the end, as some specifications need to be progressively re-adjusted.

CONCLUSION

If models of industrial districts have shown that restructuring is a phenomenon reaching collective actions of organizations (Best, 1990a), two situations need to be outlined in the case of the Montreal pharmaceutical industry. First, the creation of a production network where the dominating firms of the industry, the MNCs, cooperate to solve their overcapacity problem and now offer their contract services to firms that are not part of their industry association. Secondly, the cooperation of the governments (federal and provincial), the industry, and a regional university on a very focused goal: the foundation of an institute dedicated to conduct contractual research for private firms. In the objective of MNCs to try to acquire global mandates in manufacturing, the technical support of such an institute is unquestionable since it creates a "tool" that each individual firm could not afford to keep going, from where originates such a strong interest from the industry. These two collective projects, often strengthened by personal contacts and solidarity, demonstrate that Montreal pharmaceutical firms reacted to the competition felt by other subsidiaries, restructuring their production activities.

If links at the level of production will multiply between Montreal pharmaceutical firms in the future, and this

production network might also include firms located outside the Montreal region, we certainly cannot expect a similar situation in the case of R&D activities. Intellectual property is the major barrier to the cooperation between firms of this industry, and the possibility of evaluating each other's technologies, like DeBresson and Amesse (1991) claim in their discussion of networks, is certainly not the case here. Intellectual property is the reason to integrate vertically, rather than growing by alliances with other firms (Teece, 1987; Pisano, 1991). This argument has been confirmed by MNCs, but also by SUs that prefer to conduct R&D as much as possible inside their facilities and integrate forward into production.

The last hope to increase R&D cooperative involvements in this industry is to reinforce the intentions of firms to multiply their partnerships with public sector organizations, namely universities. This is where the government should orient its industrial cluster strategy through a program stimulating the linkages between universities and the private industry. The role of the Quebec government has already been obvious in the elaboration of fiscal policies to increase R&D, but this research has revealed that the dominating firms of the industry, the MNCs, are the ones that are the least responsive to these fiscal incentives, as opposed to the Canadian-owned GCs and SUs. If the government does not react quickly to this

situation, it might result in the creation of jobs in production in the Montreal pharmaceutical industry, but not necessarily in R&D as first intended.

Almost no synergy exists between SUs and other firms in Montreal. Whatever the reasons for this situation, i.e. the lack of autonomy in R&D for the large firms of the industry, or the lack of "compatibility" of the new biotechnology products with the existing product lines of firms, if firms do not take advantage of their geographical proximity, we might see the biotechnology industry evolve separately from pharmaceutical firms. If, in the Italian model, isolated small firms were vulnerable and not capable of competing with large-scale firms, but that the presence of collective services centres made them strong, then the solution for the Montreal SUs might be to receive some support from the network to which they belong, i.e. governmental representatives closely working with them, the existence of an initiative centre making the link with regional universities, and other contacts helping them to find the partners they need.

Based on the comparison made with the two models of regional networks, we can conclude that the Montreal pharmaceutical industry offers some similarities, such as the existence of associations and centres offering services like in the Third Italy, but also some differences, such as the research

agreements that take place between universities\institutes and private firms, as opposed to Silicon Valley, where the technology-related agreements usually involved two private firms. But what is important to notice, is that each regional network is shaped by some factors unique to its environment. In Montreal, an overcapacity problem leads to the creation of a production network, intellectual property reasons restrict the formation of R&D agreements between private firms and some governmental programs support the activities of small, intensive R&D firms.

BIBLIOGRAPHY

Amesse, F., Lamy, P., Tahmii, B. 1989. L'axe 40/401: Notre "Silicon Valley" du Nord. *Revue Internationale de Gestion*, 14 (1), 15-22.

Belk, R.W., Sherry, J.F., Wallendorf, M. 1988. A Naturalistic Inquiry into Buyer and Seller Behavior at a Swap Meet. *Journal of Consumer Research*, 14 (March), 449-470.

Best, M. 1990a. The New Competition: Interpretations and Challenges. In: Best, M. (ed.), *The New Competition: Institutions of Industrial Restructuring*, Harvard University Press, Cambridge, Massachusetts, pp.251-277.

Best, M. 1990b. The Third Italy: Regional Cooperation and International Competition. In: Best, M. (ed.), *The New Competition: Institutions of Industrial Restructuring*, Harvard University Press, Cambridge, Massachusetts, pp.203-226.

Bianchi, P., Bellini, N. 1991. Public Policies for Local Networks of Innovators. *Research Policy*, 20, 487-497.

Brusco, S. 1982. The Emilian Model: Productive Decentralisation and Social Integration. *Cambridge Journal of Economics*, 6, 167-184.

Business Leaders in Silicon Valley Want to Remodel its Economy. 1993. *The Montreal Gazette*, March 31, p.F3.

Chandler, A.D. 1992. Organizational Capabilities and the Economic History of the Industrial Enterprise. *Journal of Economic Perspectives*, 6 (3), 79-100.

Conseil de la Science et de la Technologie. 1992a. *Avis\Les Biotechnologies: Un Choix Stratégique pour le Québec*. Gouvernement du Québec, premier trimestre.

Conseil de la Science et de la Technologie. 1992b. *Rapport du Comite du Bilan de l'Activité Scientifique et Technologique de la Region de Montreal*. Coordonné par le

Centre d'Initiative Technologique de Montreal (CITEC), Gouvernement du Québec, quatrième trimestre.

Contractor, F.J., Lorange, P. 1988. Why Should Firms Cooperate? The Strategy and Economics Basis for Cooperative Ventures. In: Contractor, F.J. and Lorange, P. (eds.), *Cooperative Strategies in International Business*, Lexington Books, Lexington, Massachusetts, pp.3-30.

DeBresson, C., Amesse, F. 1991. Networks of Innovators: A Review and Introduction to the Issue. *Research Policy*, 20 (5), 363-379.

Dorfman, N.S. 1983. Route 128: The Development of a Regional High Technology Economy. *Research Policy*, 12 (6), 299-316.

Florida, R., Kenney, M. 1990. Silicon Valley and Route 128 Won't Save Us. *California Management Review*, 32, 68-87.

Forrest, J.E., Martin, M.J.C. 1992. Strategic Alliances Between Large and Small Research Intensive Organizations: Experiences in the Biotechnology Industry. *R&D Management*, 22 (1), 41-53.

Freeman, C. 1991. Networks of Innovators: A Synthesis of Research Issues. *Research Policy*, 20, 499-514.

Friar, J., Horwitch, M. 1985. The Emergence of Technology Strategy: A New Dimension of Strategic Management. *Technology In Society*, 7 (2\3), 143-178.

Gagné, P., Lefèvre, M. 1993a. *L'Atlas Industriel du Quebec*, Publi-Relais, Montréal, Québec.

Gagné, P., Lefèvre, M. 1993b. *L'Entreprise a Valeur Ajoutee: Le Modèle Québécois*. Publi-Relais, Montréal, Québec.

Hagedoorn, J. 1990. Organizational Modes of Inter-Firm Co-Operation and Technology Transfer. *Technovation*, 10 (1), 17-30.

Hamilton, W.F. 1985. Corporate Strategies for Managing Emerging Technologies. *Technology In Society*, 7 (2\3), 197-212.

Hatch, C.R. 1991. The Ties that Bind: Networks and the Making of Denmark's Competitive Edge. *Entrepreneurial Economy Review*, 9 (3), 13-18.

Hot Spots: America's New Growth Regions Are Blossoming Despite the Slump. 1992. *Business Week*, October 19, 80-88.

Industry, Science and Technology Canada. 1990-1991. *Industry Profile: Pharmaceuticals*. Ottawa, Ontario.

Industry, Science and Technology Canada, Quebec region. 1992. *Quebec Biotechnology Companies Directory*. Ottawa, Ontario.

Jarillo, J.C. 1988. On Strategic Networks. *Strategic Management Journal*, 9, 31-41.

Johanson, J., Mattson, L.G. 1987. Interorganizational Relations in Industrial Systems : A Network Approach Compared With the Transaction-Cost Approach. *International Studies of Management & Organisation*, 27 (1), 34-48.

Kenney, M. 1986. *Biotechnology: The University-Industrial Complex*. Yale University Press, New Haven.

Kogut, B. 1985. Designing Global Strategies: Profiting from Operational Flexibility. *Sloan Management Review*, 27 (1), 27-38.

Langowitz, N.S., Graves, S.B. 1992. Innovative Productivity in Pharmaceutical Firms. *Research Technology Management*, 35 (2), 39-41.

Larson, A. 1992. Network Dyads in Entrepreneurial Settings: A Study of the Governance of Exchange Relationship. *Administrative Science Quarterly*, 37, 76-104.

Léger, C. 1989. *Etude de la Concentration du Secteur de Commerce et de Distribution Pharmaceutique au Quebec.* Maîtrise en Sciences de la Gestion. École des Hautes Études Commerciales, Montréal, Québec.

Lorenzoni, G., Ornati, O.A. 1988. Constellations of Firms and New Ventures. *Journal of Business Venturing*, 3, 41-57.

Major Drug Firm May Quit Ontario Unless NDP Offers New Incentives. 1992. *Toronto Star*, March 11, p.D1.

Miles, M.B., Huberman, A.M. 1984. *Qualitative Data Analysis: A Sourcebook of New Methods.* Sage Publications, California.

Ministère de l'Industrie, du Commerce et de la Technologie. 1989. *La PME Pharmaceutique Quebecoise.* Gouvernement du Québec, premier trimestre.

Ministère de l'Industrie, du Commerce et de la Technologie. 1993. *Focus on the Pharmaceutical Industry.* Gouvernement du Québec, premier trimestre.

National Biotechnology Advisory Committee. 1991. *National Biotechnology Business Strategy: Capturing Competitive Advantage for Canada.* Industry, Science and Technology Canada, Fifth Report.

Orsenigo, L. 1989. *The Emergence of Biotechnology: Institutions and Markets in Industrial Innovation.* Pinter Publishers, London, England.

Piore, M.J. 1990. United States of America. In: Sergenberger, W., Loveman, G., and Piore, M.J. (eds.), *The Re-Emergence of Small Enterprises: Industrial Restructuring In Industrialised Countries*, International Labour Organization, Geneva, pp.261-308.

Pisano, G.P. 1991. The Governance of Innovation: Vertical Integration and Collaborative Arrangements in the Biotechnology Industry, *Research Policy*, 20, 237-249.

Porter, M. 1990. The Competitive Advantage of Nations. *Harvard Business Review*, March-April, 73-93.

Powell, W.W. 1990. Neither Market Nor Hierarchy: Network Forms of Organization. In: *Research in Organizational Behavior*, JAI Press, Greenwich, pp.295-336.

Pyke, F. 1988. Co-Operative Practices among Small and Medium-Sized Establishments. *Work, Employment, and Society*, 2 (3), 352-365.

R&D Gets Concrete Results. 1993. *The Montreal Gazette*, June 17, pp.C1-C2.

Sabel, C.F. 1989. Flexible Specialisation and the Re-emergence of Regional Economies. In: Hirst, P. and Zetlin, J (eds.), *Reversing Industrial Decline*, St. Martin's Press, New York, N.Y., pp.17-70.

Saxenian, A.L. 1990. Regional Networks and the Resurgence of Silicon Valley. *California Management Review*, Fall, 88-111.

Saxenian, A.L. 1991. The Origins and Dynamics of Production Networks in Silicon Valley. *Research Policy*, 20, 423-437.

Smith, H.L., Dickson, K., Smith, S.L. 1991. There Are Two Sides to Every Story: Innovation and Collaboration Within Networks of Large and Small Firms. *Research Policy*, 20, 457-468.

Spradley, J.P. 1979. *The Ethnographic Interview*, Holt, Rinehart & Winston, New York.

Storper, M., Harrison, B. 1991. Flexibility, Hierarchy and Regional Development: the Changing Structure of Industrial Production Systems and their Forms of Governance in the 1990s. *Research Policy*, 20 (5), 407-422.

Strauss, A., Corbin, J. 1990. *Basics of Qualitative Research.* Sage Publications, California.

Szarka, J. 1990. Networking and Small Firms. *International Small Business Journal*, 8 (2), 10-22.

Teece, D.J. 1987. Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy. In: Teece, D.J. (ed.), *The Competitive Challenge: Strategies for Industrial Innovation and Renewal*, Ballinger, Cambridge, Massachusetts, pp.185-219.

Teece, D.J. 1992. Competition, Cooperation, and Innovation: Organizational Arrangements for Regimes of Rapid Technological Progress, *Journal of Economic Behavior and Organization*, 18 (1), 1-25.

Tremblay, G. 1991. *Moving Toward a Value Added Society*. Text of a speech given at a press conference at l'École des Hautes Études Commerciales, Montreal, December 2nd.

Trépanier, M. 1992. *L'industrie Pharmaceutique*. Étude Sectorielle préparée à l'intention du Comite du Bilan de l'activité scientifique et technologique de la région de Montréal. Conseil de la Science et de la Technologie, Sainte-Foy, Québec, troisième trimestre.

Yin, R.K. 1989. *Case Study Research: Design and Methods*. Sage Publications, California.

APPENDIX I:

Questionnaire Used in the Interviews

Mick Carney, Ph.D.
Caroline Trudeau, Research Assistant

CONCORDIA UNIVERSITY
Management Department
1550 de Maisonneuve Blvd. W.
Montreal, Quebec

INTERVIEW QUESTIONNAIRE

Name _____
Position _____
Company _____
Division or
Subsidiary _____
Address _____
_____
_____
Telephone _____
Date of the
interview _____

SECTION ONE: CHARACTERISTICS OF THE FIRM

NOTE: during the interviews, specify that the word FIRM refers to the UNIT localized in MONTREAL.

(*) : the questions marked by an asterisk should be asked only if previous research in directories and publications has been unsuccessful.

1. Size of the firm

* a) What were the revenues of your firm for 1992?

* b) What was the average number of employees in this firm for 1992?

2. Domain of the firm (products and markets)

a) What is/are the major output(s) in your firm?

Probe:
- Products?
- Laboratory testing?
- Other? Please describe.

b) Who are the major customers for the output(s) of your firm?

Probe:
- A parent company? An associated company? (Name and location)
- Industrial clients? (Name and location)
- Dealers? (Name and location)
- Other? Please describe.

3. Age of the firm and background history

* a) When was this firm founded?

b) Who founded this firm (in Montreal)?

Probe:
- Another organization?
- An independent researcher?

* c) Can you tell me something about the way your firm has developed over the past 5 years? What were the key events?

SECTION ONE: CHARACTERISTICS OF THE FIRM (CONTINUED)

4. **Ownership**

a) To whom does the senior manager/CEO of this firm report?

Probe:
- A government unit?
- Is this firm a subsidiary of ... ?
- Is it an independent firm? Who are the main shareholders?

5. **Organizational structure**

a) Do you have an organizational chart of your firm (here in Montreal)? If not, could you please briefly describe it?

SECTION TWO - COOPERATIVE INVOLVEMENTS AND CONTRACTS OF THE FIRM

1. **a)** What do you feel are the most important functional areas in your firm? Why?

Probe and check the following items:

- R&D? ____
- Manufacturing? ____
- Marketing? ____
- Distribution? ____
- Other function (s)? Please describe.

b) What other functions does your firm perform?

Probe and check the following items:

- R&D? ____
- Manufacturing? ____
- Marketing? ____
- Distribution? ____
- Other function (s)? Please describe.

SECTION TWO - COOPERATIVE INVOLVEMENTS AND CONTRACTS OF THE FIRM (CONTINUED)

2. How does your firm handle the activities/functions not performed by itself? (see 1 on previous page).

Probe:

Factual data:
- Who performs these activities for your firm? (Name and location)

- Can you describe the way the two firms communicate? ("faxes", telephone, mail, face to face conversations) How often? (more than once a week, more than once a month, occasionally).

Qualitative data (nature of the relationship):
- Can you describe the relationship your firm has with this other firm? (contractual versus informal)

- How hard/easy would it be to replace this relationship?

- Can your firm count (rely) on this relationship?

- How did this relationship begin?

- Do you have any other comments on this relationship?

3. Can you tell me if your firm is involved in any of the following activities with other pharmaceutical firms or biotechnology firms?

Check the following items:

___ Operating Joint Venture
- An independent third enterprise formed by the company with another firm. Assets are contributed by both parties, who also share the risks.

___ Equity Investment
- An investment by a large established company in the second or smaller firm.

___ Client Sponsored Research Contract
- The small company is paid to conduct research on particular products or processes for another organization.

SECTION TWO - COOPERATIVE INVOLVEMENTS AND CONTRACTS OF THE FIRM (CONTINUED)

___ Marketing/Distribution Agreement
- Agreements whereby another company will market and distribute the firm's product(s).

___ Manufacturing Agreement
- An agreement whereby another company agrees to manufacture products for other firms.

___ University Agreement
- An agreement with a university whereby the firm pays the university to conduct research on its behalf.

___ Research Institute Agreement
- Similar to the university agreement but with a research institute.

___ Collaborative R&D
- An agreement between the firm and another company to collaborate on the development of specific products or processes.

___ Research and Development Limited Partnership (RDLP)
- A tax advantage investment vehicle which provides funding for new product R&D at no cost to the company.

___ Technology Licensing (Inward)
- A contractual arrangement by which the firm is granted access to another company's patents or technology for a fee.

___ Technology Licensing (Outward)
- The reverse of the above. In this case, the firm receives the fee.

___ Other? Please describe.

Probe:

Description of the relationship:

Factual data:
- Can you name this firm? Is it a multinational or a small firm?
- Where is this firm located?
- Is there a written contract?
- Can you describe the way the two firms communicate? ("faxes", telephone, mail, face to face conversations) How often? (more than once a week, more than once a month, occasionally).

SECTION TWO - COOPERATIVE INVOLVEMENTS AND CONTRACTS OF THE FIRM (CONTINUED)

Qualitative data (nature of the relationship):
- How formal are your dealings with the other side?

- Can your firm count (rely) on this relationship?

- How hard/easy would it be to replace this alliance?

Probe: *Product/service exchanged:*

Factual data:
- What is the product or service exchanged? Describe.

- What percentage of sales or cost of goods sold does this represent?

Qualitative data (nature of the relationship):
- How would you describe the benefits your firm derives from this arrangement? Are they only economic or there are also strategic contributions?

- If other advantages than economic, were they always present or did they evolve?

- How important is the exchange for your firm?

Probe: *History of the relationship:*

Qualitative data (nature of the relationship):
- How did this relationship begin?

- How did people in your firm hear about the alliance partner? Were personal contacts a factor?

- What factors caused your firm to enter into the partnership? Are they the same factors that keep the firm involved today?

- Has the relationship helped your firm to grow? How?

SECTION TWO - COOPERATIVE INVOLVEMENTS AND CONTRACTS OF THE FIRM (CONTINUED)

4. Can you think of any other organizations (private firms, universities, hospitals, research institutes) on which your firm is dependent to accomplish its activities/functions (R&D, Manufacturing, Marketing, Distribution)?

Repeat the probes of the previous question.

5. Does your firm have a critical supplier? Please describe.

Repeat the probes of the previous question.

6. Does your firm have any other external links? Subcontractors? Creditors? Banks? Government grants? Please describe the relationship.

7. To what extent does your firm informally cooperate or exchange ideas with other pharmaceutical or biotechnology firms? Please describe.

Probe: *Factual data*:
- Can you name this organization? Is it a multinational or a small firm?
- Where is this organization located?
- Describe the way the two organizations communicate? ("faxes", telephone, mail, face to face conversations) How often? (more than once a week, more than once a month, occasionally).

Qualitative data (nature of the relationship):
- What is the purpose of this exchange?
- How would you describe the benefits your firm derives from this exchange?
- How did this relationship begin?
- How important is the exchange for your firm?

SECTION THREE - INNOVATION IN THE FIRM

1. "Innovation" has been identified as a central feature of gaining a strong competitive position. What does innovation mean to you?

2. Can you describe some of the major innovations - both successful and unsuccessful - that have been developed in your firm?

Description	When?	Who innovated?*
1.		
2.		
3.		
4.		
5.		

(*) Who do you think was the innovator?
- Individual within your firm?
- Individual from another company?
- Other? Please describe.

(*) Which innovations came out of partnerships? Please describe.

3. From where does the innovative idea originate for the product you consider the most important in your firm?
   - Individual within your firm?
   - Individual from another company?
   - Other? Please describe.

4. Do you think cooperative involvement is associated with innovation in your firm? How? Please describe.