

# **The Impact Of Outside Technological Services On Enterprise Performance In A National Systems Of Innovation**

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## **Abstract**

This study investigates qualitatively and quantitatively the effect of innovation networks as defined by the external acquisition of technological services on the performance of enterprises. We assume that the outside acquisition of the technological services in a national system of innovation is a more significant indicator to evaluate innovative inputs than R&D for small and medium enterprises. Descriptive results show that successful and less successful enterprises have the same pattern in their process of externalisation of resources. However, statistical correlations show mixed findings from which arises the question: why do not innovation networks always positively affect the performance of enterprises?

## Introduction

In this article we explore the impact of innovation networks on the performance of enterprises and look at the external linkages to resources for learning about new technologies. In this case innovation networks are described by the external acquisition of technological services. Because the accumulation of know-how and technologies in enterprises is a constant interactive learning process which occurs with their specific environment, the external acquisition of technological services contribute to the transfer of knowledge and technologies from providers to users (Dodgson, 1991; Lundvall, 1992).

External acquisition of resources then becomes a useful indicator of innovation especially for small and medium enterprises, which do not have resources for R&D activities (Kelly and Brooks, 1991; Cutler, 1991). Analysing this process implies that we examine the process of access to knowledge by enterprises and look at one of the aspects of the distributive power of Canadian NSI (flows of resources between producers and users). At the same time, by evaluating the effect of

Access to knowledge on the performance of enterprises, we can observe the absorptive capacity of Canadian enterprises. It is assumed that enterprises involved in outside acquisition of diverse resources will be more successful than those who are not because there is a strong relation between access to knowledge and the flow of innovation. The innovative capacity of enterprises depends on public availability of knowledge and infrastructure and the "distribution power" of available resources (David and Foray, 1996: 91). According to Roelandt and Hertog (1996), the notion of distribution power conceptualises two ideas. First of all it is not simply the creation of knowledge which matters but also the flow of knowledge from producers to users. Secondly the distribution power refers to the capability to ensure timely access to the stock of existing knowledge.

Bearing in mind that national institutions are important in shaping the process of innovation, we analyse the process of resource networking between providers of technological services and users in enterprises in the context of the concept of a national system of innovation (NSI). The objective is to understand the transfer of resources from producers to consumers in the Canadian system of innovation. Comparing the process of acquisition of external technical support by industrial sector and by level of performance of the enterprise enables the analyst to identify and evaluate factors that inhibit the transfer of knowledge. This approach can help policymakers to formulate policies promoting distribution and improving access to existing resources for a more efficient Canadian NSI.

## Conceptual Framework

Recent studies have demonstrated the key role of the circulation of knowledge and technologies among socio-economic actors in the process of innovation (Nelson, 1993; Lundvall, 1992; OECD, 1997). Quantitative models emphasise R&D in the process of innovation and give little attention to exploring how access to external resources can be an indicator of adoption and implementation of innovations (Kelly and Brooks, 1991: 107; Mackun and MacPherson, 1997; MacPherson, 1997). It is known that for many small and medium enterprises external technical support is central to their process of innovation. A number of factors induce enterprises (especially small and

medium enterprises) to purchase technical services externally (Cutler, 1991; Kelly and Brooks, 1991; Hagedoorn and Schakenraad, 1994). In doing so, they are seeking to access new technologies and process development while setting in place cost-cutting strategies.

There is a broad range of sources of external technical services, which include universities, technical colleges, consulting firms, industrial associations etc. At the same time, enterprises use different methods to acquire technical services from outside providers. This strategy is known under different categories (collaborative strategy, partnership, alliance, innovation networks) with some particularities (Planque, 1991; Callon, 1992).

Many scholars have shown that the national context is still significant in production, mobilisation and diffusion of resources of innovation despite the globalisation of production and markets (Amsden, 1989). To that extent concepts of NSI and innovation networks are pertinent to the analysis of the process of innovation. On one hand they help describe the transfer of resources from producers to consumers in a national economy and identify the importance of government intervention in supporting this transfer of knowledge and the linkages between elements of NSI. On the other hand, they are useful because they help to identify the resources transferred and their effect on the performance of enterprises.

The approach of describing the innovative capacity of enterprises in terms of the access to external resources emphasises the idea of the circulation of knowledge between providers and users. This is more relevant than measuring R&D activities for small and medium enterprises, which do not have the resources to internalise the production of their technology development (Kelly and Brooks, 1991). In fact actual indicators of innovative process emphasising on R&D activities can not capture the flows of knowledge, finance, information and technology between producers and users. They also cannot show how the availability of resources is not sufficient for the flow of innovation in small and medium enterprises but that innovation is supported by the flow of knowledge from providers to users (Roelandt and Hertog, 1996: 4). In this perspective the external acquisition of technological services becomes an indicator of the flow of innovation because it helps small and medium enterprises, which do not have R&D activities to innovate.

The modern economy is complex; demanding specialisation thus there is a diversity of institutions that can offer the technological services enterprises need. The diversity of effective technological institutions providing services affects technical and institutional learning (Johnson, 1992; Foray, 1994; Saviotti, 1995). In other words enterprises that are involved in acquiring a variety of technical resources can increase their learning possibilities, which can affect their performance.

It is difficult to evaluate the performance of enterprises because concentrating on one measure implies missing on others and each performance measure conflicts with others (Doyle, 1994; Osland, 1994). In this study, performance was measured by the rate of sales growth and the growth of exports.

Studies conducted on the effects of externalization of resources on enterprise performance have shown mixed results. For example, a study conducted by Farrell and Doutriaux (1995) on high-tech enterprises in the region of Ottawa demonstrated a strong

correlation between externalization of resources and performance of enterprises. Studies done by Roberts (1991) and Shapira (1992) on American enterprises show similar results. By contrast, the results of a study done by McCann (1991) show a positive strong association between a strategy of internalization and performance of enterprises, as opposed to the strategy of externalization of resources. This debate continues and this work attempts to provide a quantitative answer.

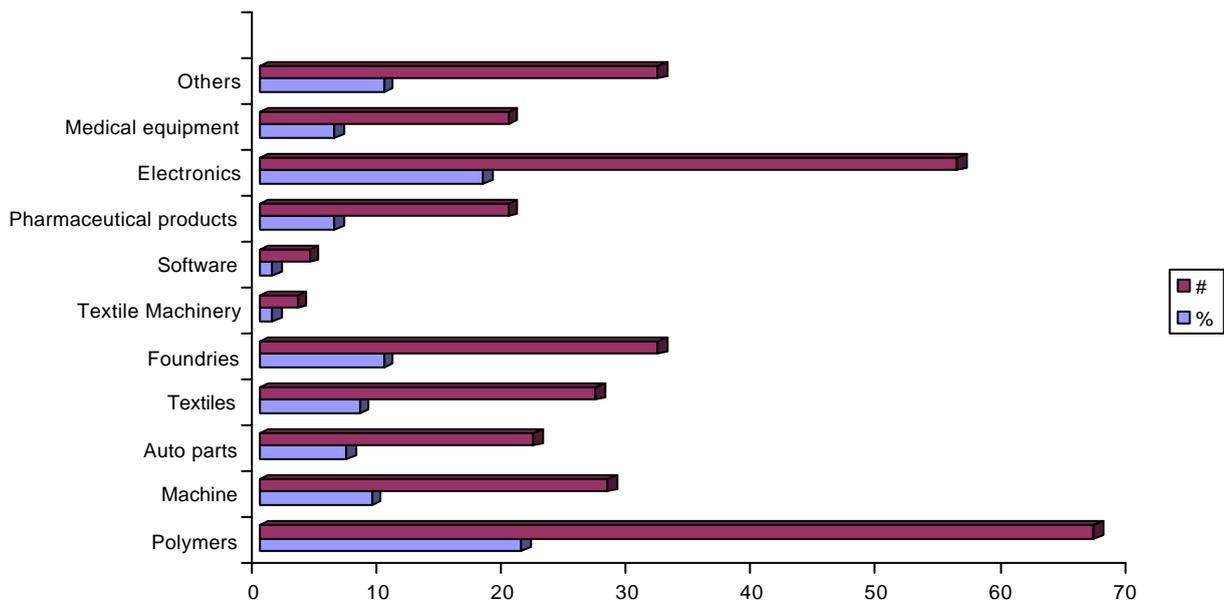
## Research Methodology And Findings

### Research methodology

The study investigates the process of technical resource externalization in ten industrial sectors: polymers, machine, auto parts, textiles, foundries, textile machinery, software, pharmaceutical products and medical equipment. It includes different aspects of the innovation process such as the resources acquired outside of enterprises, technological service providers, problems faced and governmental intervention to support transfer of resources to enterprises. The survey questionnaire was administered by mail to a sample of 3000 enterprises. The response rate was 10%. The data are based on 311 respondents in the ten industrial sectors as shown in Figure 1.

The success of an enterprise depends on a combination of different factors, which includes access to resources, the perception of the importance of available resources and the design of governmental programs. This questionnaire focused attention on these factors and sought to find out problems faced by enterprises in acquiring resources from outside.

**Figure 1: Distribution of Enterprise by Industrial Sector**



We used a qualitative methodology to analyse the transfer information, ideas, technologies and financial flows. Three measures were used. The first gives a picture of the diversity and frequency of recourse to technological service providers incentives/programs and problems faced by enterprises. It also divides responses by successful and non-successful enterprises. The second measures the importance attached to technological service providers or problems faced in the process of resource externalisation. The third measure calculates the Spearman correlation coefficients to capture the association between independent with dependant variables. Performance of enterprise is measured by rate of sales growth and growth of exports.

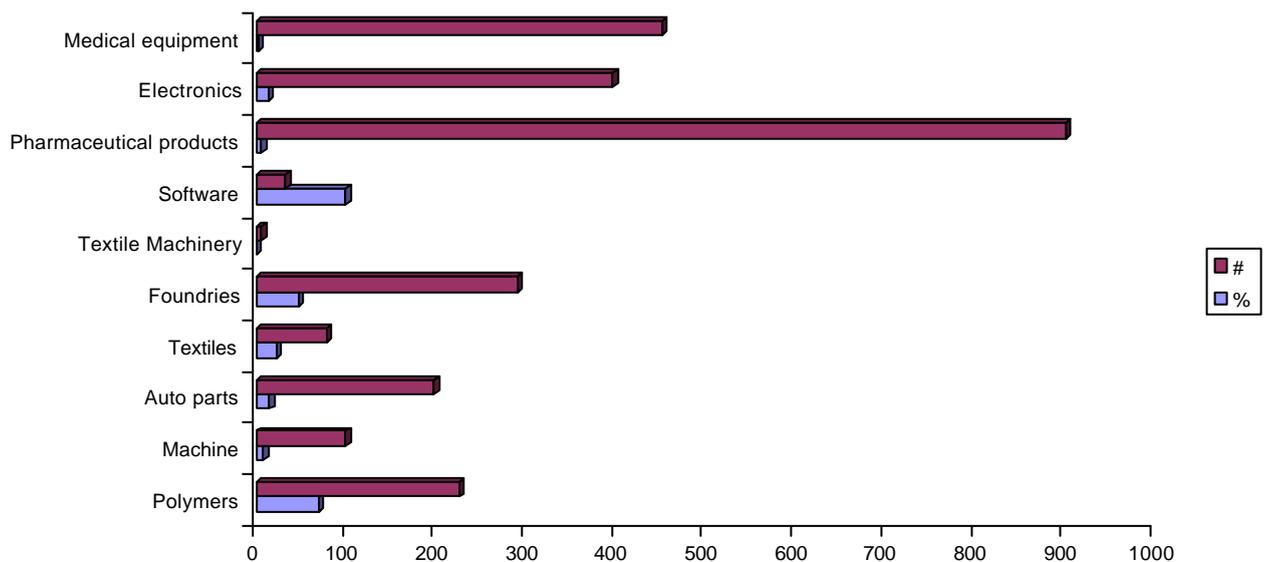
### Findings

Findings are presented on three levels. The first and second are dedicated to the process of resource externalization by industrial sector and by level of performance. The third presents the statistical correlation of the sixteen variables selected with the performance of enterprises.

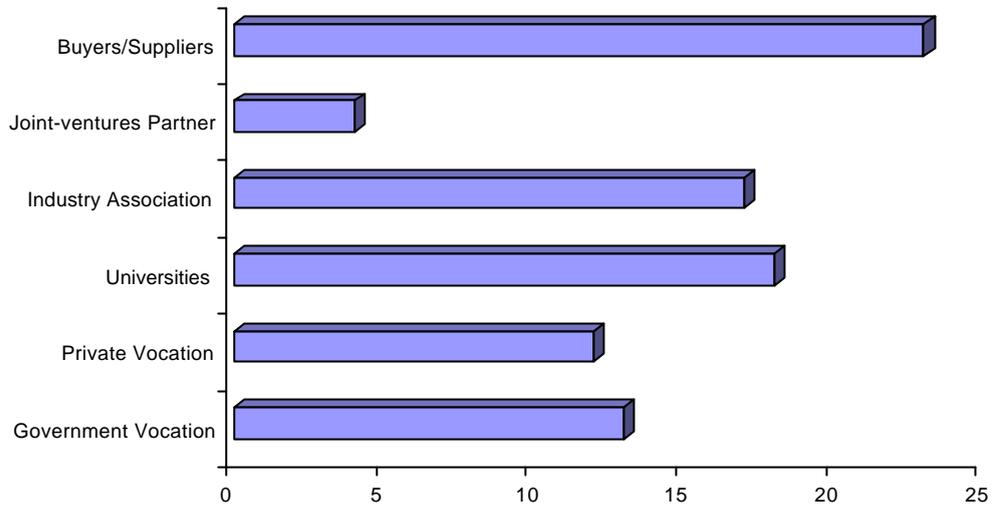
#### The resources externalization by industrial sector

The accumulation of technological capacities is usually a process of acquisition of knowledge from outside the enterprises. The continuing training of technical employees is one of the multiple ways of externalization of resources. Figure 2 shows that industrial sectors with a high number of technical employees – pharmaceutical products, electronic and medical equipment - are not those that have a high rate of continuing technical training. The industrial sector of software is highest with a 100% rate of continuing training, followed by polymers with 69% and foundries with 47%.

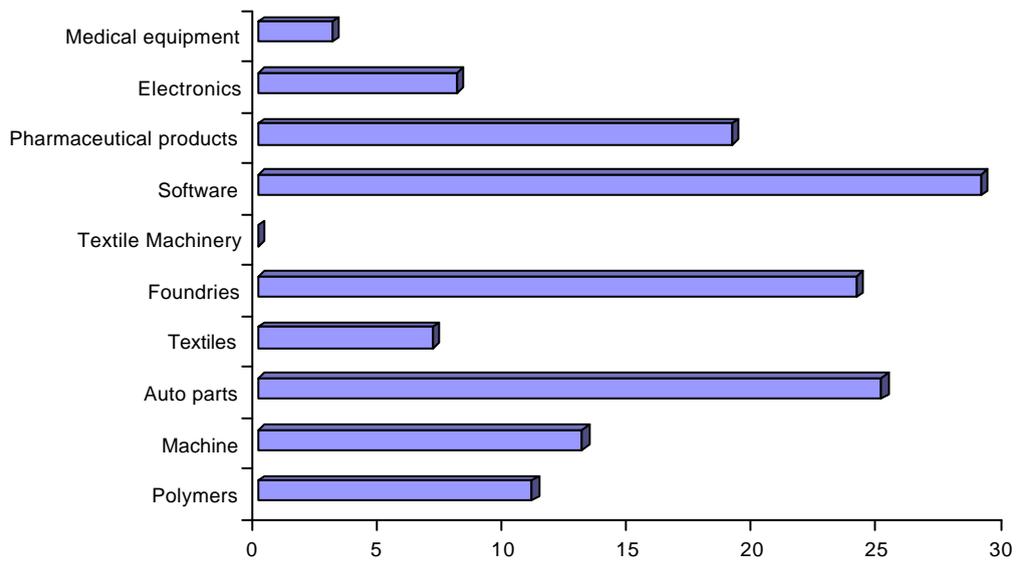
*Figure 2: Rate of Continued Technical Training*



**Figure 3: Recourse Frequency of Institutional Education/Training**



**Figure 4: Recourse Frequency to Educational/Training Institutions by Industrial Sector (%)**



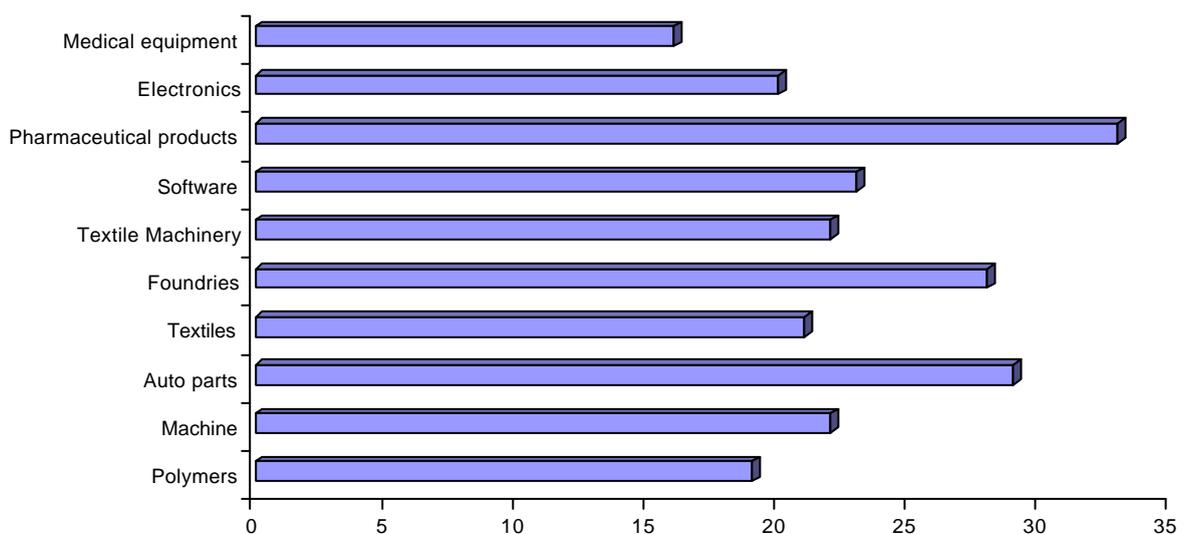
It is well known that small and medium enterprises do not have enough resources to train their employees themselves. Figure 3 shows that customers/suppliers and universities are the institutions frequently used by enterprises to training their employees. Figure 4 shows that software enterprises are those that have the most frequent recourse to educational institutions (29%), followed by auto parts (25%) and foundries (24%). Enterprises of all industrial sectors claim that vocational public and private schools are more important for the technical training of their employees.

By externalisation of resources, enterprises gain various benefits the improvement and development of their technologies. For all enterprises, the solution to specific problems is the benefit most frequently acquired (25%), followed by quick access to information (19%) and reduction of production and operating costs (12%). They claim that the most important benefit they get from technological services are quick access to information, help for new product development/design and improved quality and reliability respectively (score of 4,1 to 5).

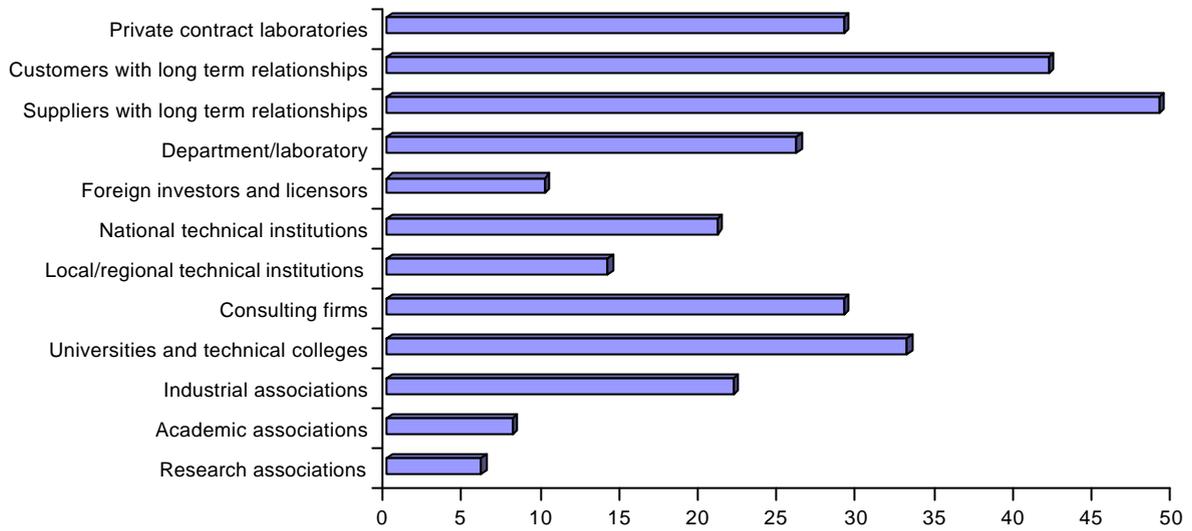
The transfer of resources from suppliers to customers is one of the important access routes to new ideas and technologies. Figure 5 indicates that enterprises that have frequent recourse to external technological services are pharmaceutical products (33%) followed by auto parts (28%) and foundries (23%). When we observe Figure 6, it indicates that the technological service providers frequently used by enterprises are suppliers (49%) and customers (42%). Universities and public vocational colleges were third (33%).

The importance attached to technological service providers differs from sector to sector. When asked to evaluate the technological service providers, auto parts fabrication enterprises attribute to them high importance with a score of 3.7 to 5 followed machinery and foundry enterprises respectively with scores of 3.6 and 3 to 5.

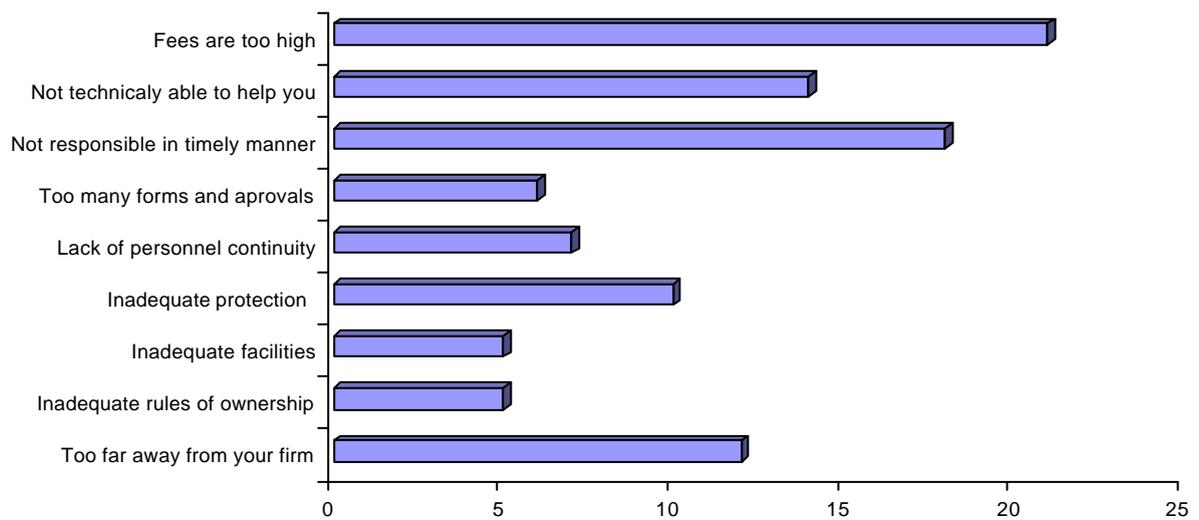
**Figure 5: Recourse Frequency to Providers of Technological Services by Industrial Sector**



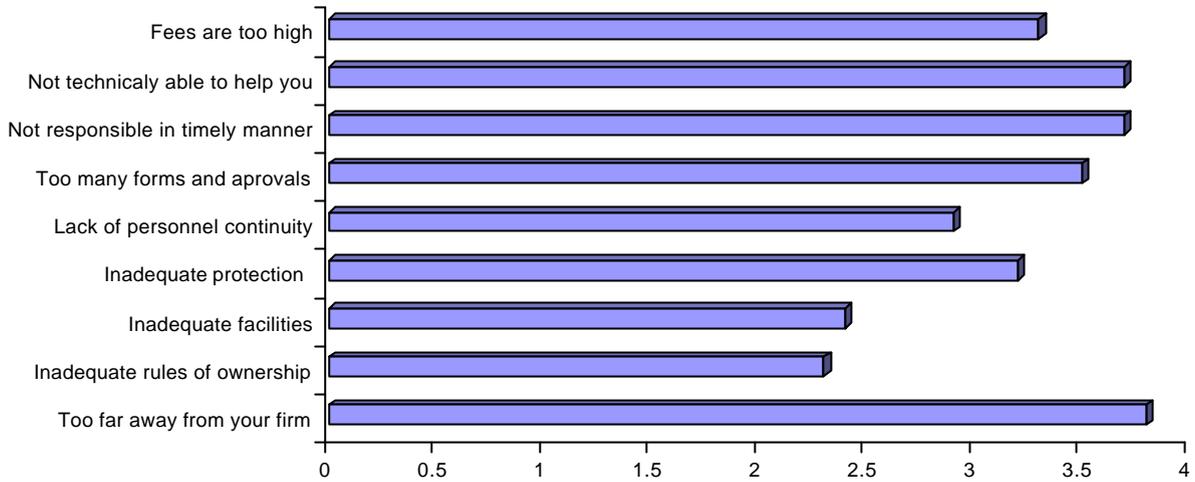
**Figure 6: Recourse Frequency to Providers of Technological Services by %**



**Figure 7: Frequency of Problems Faced by Enterprises**

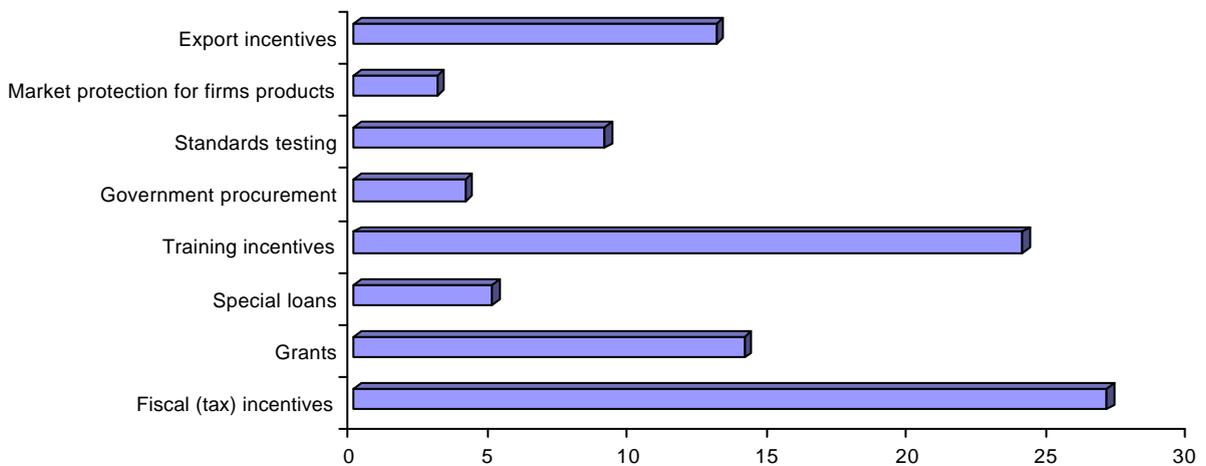


**Figure 8: Importance of Problems Facing Enterprises (Score 1 - 5)**

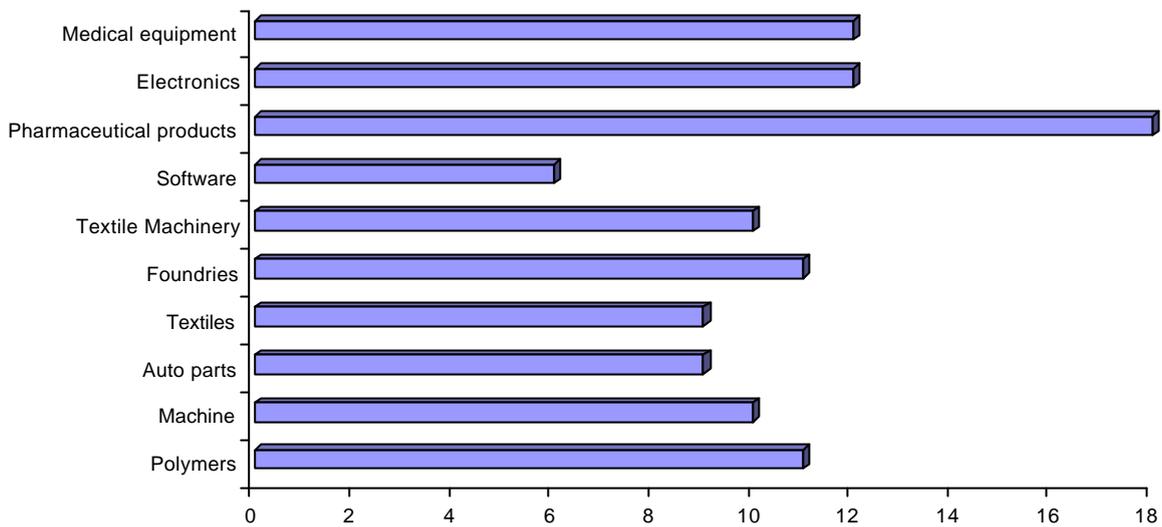


Enterprises face problems in their process of external resources utilisation. Figure 7 indicates that problems faced by most enterprises of all industrial sectors were: high fees (21%), the inability to help technically (18%), the inability to offer the service required in time (14%) and the location far away from the enterprises (12%). When enterprises are asked to evaluate the problems faced in their resource networking, the most important are distance from the enterprise with a score of 3.8 out of 5 and the inability to respond to technical needs and the inability to offer the service required in time with scores of 3.7.

**Figure 9: Frequency Utilization of Incentives and Governmental Programs (%)**



**Figure 10: Frequency Recourse of Incentives and Programs by Industrial Sector (%)**

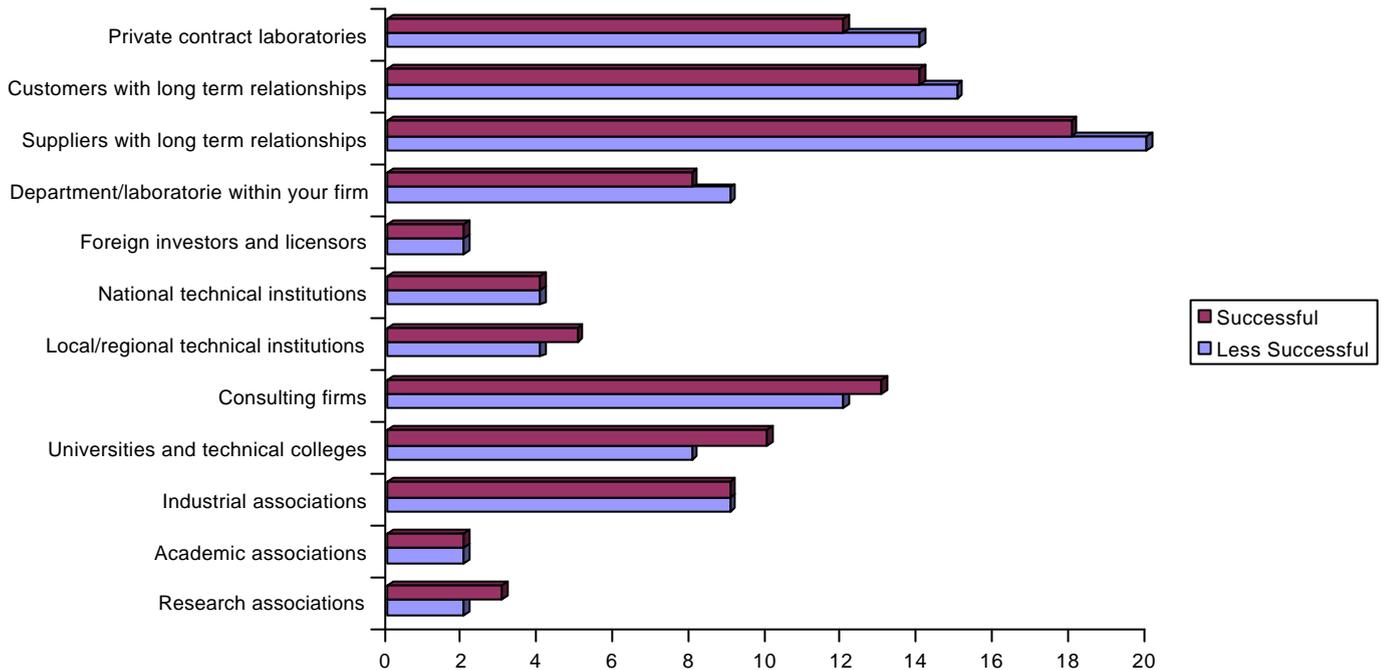


Developed countries often have incentives and programs devoted to promotion of technological innovation. Figure 9 shows that the most frequently used government incentives and programs are financial intervention (27%), followed by training incentives (24%), grants (14%) and export incentives (13%). Figure 10 shows, by industrial sector, that pharmaceutical products (18%), medical equipment (12%) and electronics (12%) are the sectors that frequently use the incentives and government programs. Enterprises of all sectors attach high importance to fiscal incentives with a score of 3.3 out of 5 and training incentives with score of 3.2.

Resources externalisation by level of performance

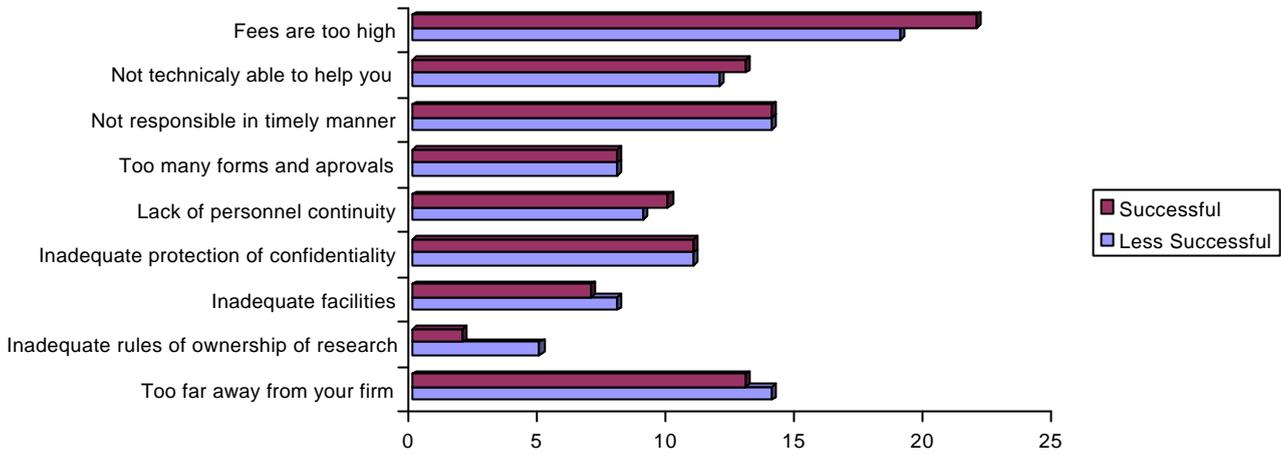
The survey data were used to measure the externalisation of resources by enterprises according to their level of performance. Findings indicate that successful enterprises are more likely than the less successful to externalize their resources. Figure 11 indicates that successful enterprises used in order suppliers (18%) and customers (14%) with whom they have long-term relationships as technological services providers. Then follow consulting firms (13%) and private laboratories (12%). Figure 11 shows that successful and less successful enterprises have almost the same patterns. In order, there are successful enterprises used suppliers (20%), private laboratories (15%) and suppliers (14%) with long-term relationships.

**Figure 11: Frequency Recourse to Providers of Technological Services by Successful and Less Successful Enterprises (%)**



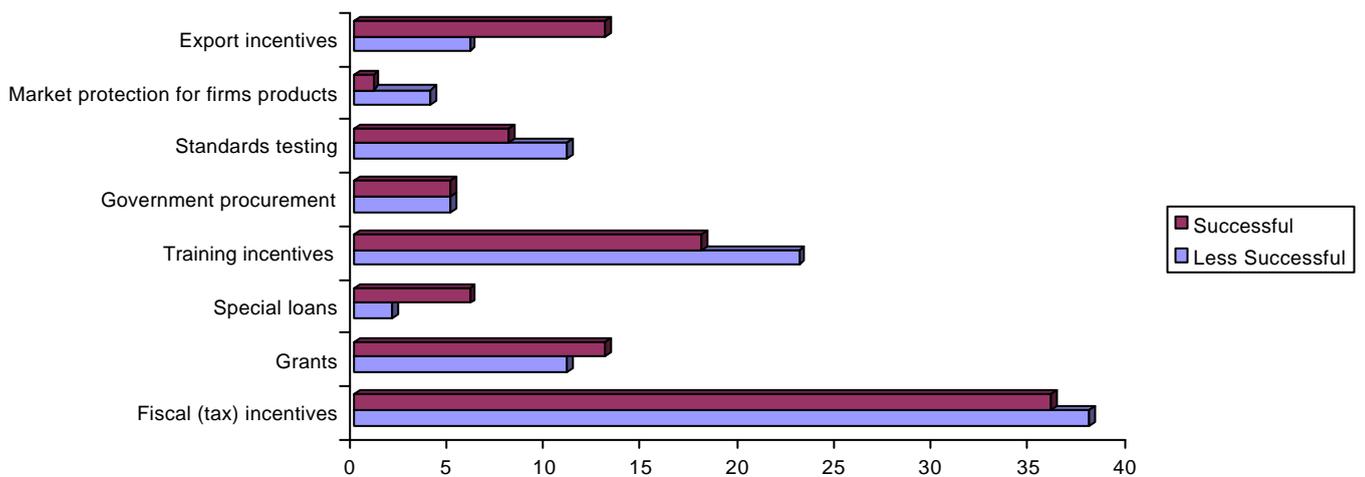
Successful and less successful enterprises attach the same importance to the technological service providers. Even successful enterprises are more likely to be involved in the resources network. At the same time, when enterprises are asked to identify problems they face in their external acquisition of resources, Figure 12 indicates that problems frequently faced by successful and less successful enterprises are the high cost of technical services, the inability to respond to technical needs, their inability to offer the service in time and their distant location. In the same way, successful enterprises are more likely to have recourse to incentives and programs to promote their acquisition of outside resources.

**Figure 12: Frequency of Problems Faced by Successful and Less Successful Enterprises (%)**



But Figure 13 shows that the level of use of government incentives and programs is about the same for successful and less successful. Fiscal incentives, training incentives and grants are seen as the appropriate type of governmental intervention for both types of enterprises for the acquisition of external resources.

**Figure 13: Frequency of using Incentives and Governmental Programs by Successful and Less Successful Enterprises (%)**



### 11.3.3 Correlation test

As shown in Table 14, of sixteen variables selected, six present a high positive correlation with high rate of sales growth and growth of exports.

- High diversification of educational and training institutions is highly correlated with a high growth of exportations and not with high rate of sales growth. Findings also indicate that a high importance attached to education/training institutions is highly correlated with the rate of sales growth. The diversification use of incentives and programs is strongly correlated with a high rate of sales growth and growth of exports. The higher importance attached to incentives and programs is highly correlated with a high growth of exports. The high number of benefits gained from technological services is highly correlated with a high growth of exports. Finally, a high diversification of information networks is also highly correlated with a high growth of exports.
- Six variables have a positive low correlation with the performance of the enterprise. The high importance attached to technological services providers, the high diversity of technological services, the high importance attached to the benefits gained from technological services and the high diversification of information networks have a low correlation with a high rate of sales growth and exports.
- The high number of problems faced and the importance attached to them have negative low correlation with the rate of sales growth and exports.
- Four variables have a low anti-correlation. It is surprising to observe that the high rate of continuing technical training, the high diversification of technological service providers and the high importance attached to technological services acquired are negatively correlated with high rate of sales growth and growth of exports.

**Table 1: Statistical Tests using the Spearman Correlation Coefficient**

Hypothesis/Variables	Measures	Performance of Enterprise	
		Rate of sales growth = or > to 20%	Growth of Exportations = or > to 5%
1. High rate of continuing technical training	Ratio between skilled workers/engineers trained and total number of skilled worker and engineers x 100 =or> to 20%	-109,609	-0,11257
2. High diversification recourse to education/training institutions	Enterprise that have recourse to a number at least 4 to 8 educational/training institutions	0,07171	0,12718**
3. High importance attached to educational/training resources	Importance attached to educational/training is scored at least 3 to 5	0,14825*	0,09681
4. High diversification recourse to technological service providers	Enterprise have recourse at least to 6 to 12 technological service providers	-0,00988	0,09881
5. High importance attached to technological service providers	Score attached to the importance of technological services providers is at least 3 to 5	0,02191	0,03073
6. High importance attached to technological services acquired	Score attached to technological services acquired is at least 3 to 5	-0,00825	0,01538
7. High diversification of technological services acquired	Enterprise that have acquired at least 4 to 8 technological services	0,05644	0,08326
8. High diversification recourse to incentives and programs	Enterprise that have recourse to at least 4 to 8 incentives and programs	0,17018***	0,13454**
9. High importance attached to incentives and programs	Importance attached to incentives and programs is scored at least 3 to 5	-0,2851	0,16567**
10. High number of problems faced by enterprise	Enterprise have faced at least 4 to 8 problems	-0,06277	0,04456
11. High importance of problems faced by enterprise	Importance attached to problems faced is at least 3 to 5	-0,07501	0,10228
12. High diversification of benefits from technological services acquired	Enterprise that have gained at least 4 to 8 benefits from technological services acquired	0,09082	0,09822**
13. High importance attached to benefits from technological services acquired	Importance attached to benefits from technological services acquired is at least 3 to 5	0,05138	0,13206
14. High diversification of information networks	Enterprise that have acquired information service, advice in commerce and management	0,01259	0,12296**
15. High diversification of personnel networks	Enterprise that have recourse to R&D in collaboration, education/training and the creation of business affairs and technology networks	0,07241	0,08371
16. High diversification of technology networks	Enterprise that have recourse to resolution of specific problems, contract of R&D and test/standard	-0,09242	-0,02821

## Conclusion (With A Second Glance At The Theory Of Innovation)

The findings show mixed answers to the question of impact of the externalisation of resources by enterprises to their performance. What lesson can we get from these results? Perhaps some of the dogma found in the literature of innovation should be taken with caution.

We have tried to capture the impact of resource externalisation to the performance of enterprises and an explanation model of the performance of enterprises measured by the rate of sales growth and growth of exports. The comparative analysis of the externalisation of resources by industrial sector and by performance shows two clear results. First, enterprises attach to innovation networks different levels of importance according to sector and level of performance. Second, successful enterprises are more likely to be involved in innovation networks than the less successful ones.

At the same time, enterprises of all industrial sectors both less and more successful, present some common trends in their process of acquisition of external technical services. They face the same problems and all have recourse to the same technological service providers and government financial programs. The question is why are some more successful than others? What can be said about postulates such as the access to a variety of socio-economic institutions to help enterprises be more effective, accumulate and develop new organisational and technical capacities?

There is no easy answer to this question. Two general answers can be taken into account: the collective incapacity of enterprise to integrate specific assets acquired from outside and the cumulative, or long term effects of, externalities of innovation networks on performance.

The first of general explanation probably results from the lack resources to absorb resources acquired from outside. Technologies are more and more complex and oblige enterprises to have a high level of knowledge and qualified employees to respond to change, to absorb new ideas. It is known that small enterprises do not invest in R&D and do very little continuing training. It may be that internal incapacity that explains the difference between high performance and low performance of enterprises. The inability to co-ordinate transformative capacity (Garud and Nayyar, 1994) and absorptive capacity that is the ability of enterprise to identify adopt and absorb external resources (Cohen and Levinthal, 1990). It is clear that it is important to be involved in external acquisition of resources and that enterprises must master the absorption of resources acquired outside.

The second explanation can be that the effects of the external resources can take a long time to show. Technologies and knowledge acquired from outside invisible or intangible products that are difficult. Quantitative methods may not capture the whole innovation (Hagedoorn and Schakenraad, 1994; Crozier, acquisition of their effects. may produce to measure. complexity of 1994).

This study investigated enterprises located in Quebec and Ontario. They may be part of a specific, single regional system of innovation in Canada because of the economic links between these two provinces and the high concentration of high-tech industries. This suggests that the spectrum of the technological service providers may be different from others regional systems of innovation in the country. The variety of technological service

providers, the pattern of externalisation of resources and the problems of innovation faced by enterprises may differ in the various Canadian regional systems of innovation, because of the geographic influences on innovation (Malecki, 1995; Storper and Scott, 1995). In addition, Holbrook (1997) has suggested that in some Latin American economies technological service providers are important building blocks in the national system of innovation, possibly because they employ the recent (and presumably better trained) individual in these economies. These questions might serve as a starting point of future empirical research in order to understand more the role that technical service providers can play in innovation process of small and medium enterprises.

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