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INNOVATION AND EXPORT PERFORMANCE OF HIGH-TECHNOLOGY MANUFACTURING ESTABLISHMENTS IN WESTERN NEW YORK

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ABSTRACT. This paper describes the recent corporate performance of high-technology manufacturing companies in the Western New York region of the United States. Survey data from a sample of manufacturers across a wide range of industry-groups are presented. Particular attention is focused upon the impact of technological innovation upon the recent performance of local manufacturing companies, particularly in the areas of new product development, local linkages, and export behavior. Attention is also given to the role of external technical services in the internal innovation processes of the surveyed firms.

The survey provides evidence that the Western New York region possesses a significant population of high-technology manufacturing firms in many industrial sectors. A substantial segment of the region's manufacturing base is rooted in several technology-intensive subsectors that are quite distinct from the traditional notion of manufacturing activities in primary sectors. The high-technology establishments in the region demonstrate superior innovative behavior. A major finding is that innovation-intensity of the manufacturing firms is a good predictor of their export behavior. The high-technology establishments place greater emphasis on the export function and exhibit a much broader range of export destinations. A further finding is that the manufacturing establishments create inter-firm linkages with local as well as distant organizations for sourcing a wide range of technical inputs. These external organizations play an important role in the commercial and/or technical efforts of the region's high-technology companies. The paper concludes by discussing some of the main corporate and public policy issues that flow from the empirical results.

INTRODUCTION

Recent research on industrial restructuring suggests that high-technology companies are of strategic importance to the economic welfare of urban and regional economies (Phillips et al, 1991). High-technology manufacturing is recognized as a key to innovation and competitiveness, and is essential for the sustained industrialization of both large and small cities alike (Phillips et al, 1991). Many scholars believe that high-technology manufacturing assists in the restructuring of developed economies (McDonald, 1987), as well as in the diversification of stagnant or declining regions (Oakey and Cooper, 1991). Despite a large and growing body of scholarly research on this theme, however, hard empirical evidence on the performance of high-technology industries in their local settings is not widely available. Moreover, many academic studies have produced only partial results, leaving comprehensive accounts rather sparse (Hall, 1987).

The present study was motivated by a general lack of micro-level empirical knowledge about the position and performance of high-technology establishments in the Western New York region. According to a recent report in Business First (Houchens, 1990), efforts to gather research for developmental purposes have been hampered for want of a workable definition of high-technology industries. An earlier study by the Erie County Industrial Development Agency (1985) of local technology-intensive companies was not updated (despite a need for such an update), partly because no tractable method of tracking down the companies was available.

Identifying high-technology or technology-intensive companies is problematic because many people perceive these industries to be related only to micro-electronics and computers, aerospace, and robotics (among other things). While several other industries exist that are technology-intensive (Landau, 1986), including, for example, metal

fabricating and food processing, the perceived lack of output sophistication among these industries often leads to misconceptions regarding the technical complexity of the production process and the broader process of product design. In reality, the spectrum of high-technology manufacturing is very diverse and encompasses a wide range of industries, many of which belong to the so-called traditional or sunset industrial categories.

Recently, it was reported that Buffalo's high-technology sector witnessed significant growth from the mid- to late 1980s. Although the birth rate for new firms has levelled off over the last year or so, it is believed that a steady growth in employee numbers and company expansions is occurring in the high-technology sectors (Houchens, 1990). Another recent report said that "providing access to high-technology is the key to making New York companies more competitive and saving jobs statewide" (Madore, 1991). The quality of employment in New York is widely believed to be deteriorating because more than 86 percent of the State's new jobs are being created in the trade and service sectors.

In the case of the Western New York region, however, recent analyses of the local manufacturing inventory provide some useful correctives regarding the overall condition of the goods-producing sector. Table 1 shows that some 20 percent of the 1410 manufacturing establishments in the eight counties of Western New York belong to the technology-intensive manufacturing group, employing approximately 27 percent of all manufacturing jobs in the area. Also, Figure 1 demonstrates that the majority of the high-technology establishments are in the chemical and non-electrical machinery sectors. The sectoral and total distributions of high-technology establishments noted above were determined using a broad definition of high-technology industries, based on the 4-digit SIC (Standard Industrial Classification) taxonomy, proposed by Markusen et al (1986). Using this typology, technology-intensive industries include 100 sub-sectors in the following two-digit Standard SIC categories: SIC 28 (chemicals), 29 (petroleum refining),

30 (rubber and plastic products), 34 (fabricated metals), 35 (machinery), 36 (electrical equipment), 37 (transportation equipment), and 38 (scientific and medical instruments).

Table 1: Sectoral Distribution of Manufacturing Establishments in Western New York in 1990

SIC CODE	DESCRIPTION OF SECTOR	HIGH-TECH INDUSTRIES		LOW-TECH INDUSTRIES	
		Number	Employment	Number	Employment
20	FOOD & KINDRED PRODUCTS	0	0	114	10,113
21	TOBACCO PRODUCTS	0	0	0	0
22	TEXTILE MILL PRODUCTS	0	0	7	592
23	APPAREL & TEXTILES	0	0	33	2,761
24	LUMBER & WOOD	0	0	68	2,368
25	FURNITURE & FIXTURES	0	0	49	4,311
26	PAPER & ALLIED PRODUCTS	0	0	45	4,539
27	PRINTING & PUBLISHING	0	0	156	5,775
28	CHEMICALS & ALLIED PRODUCTS	70	7,544	4	363
29	PETROLEUM REFINING, RELATED	1	11	10	894
30	RUBBER, MISC. PLASTICS	0	0	59	4,955
31	LEATHER, LEATHER PRODUCTS	0	0	10	763
32	STONE, CLAY, GLASS, CONCRETE	0	0	56	5,583
33	PRIMARY METAL INDUSTRIES	0	0	61	5,164
34	FABRICATION METAL PRODUCTS	0	0	199	10,963
35	NON-ELECTRICAL MACHINERY	130	9,446	127	5,400
36	ELECTRICAL, ELECTRONIC M/C	36	4,239	38	3,303
37	TRANSPORTATION EQUIPMENT	5	1,355	31	2,341
38	MEASURING, ANALYZING, CONTROLLING, MEDICAL EQUIPMENT	43	4,145	10	1,613
39	MISC. MANUFACTURING	0	0	48	1,976
	TOTAL	285	26,740	1,125	73,777
	Total employment in all manufacturing		100,517		
	High-technology proportion by number of firms		26.60%		
	High-technology proportion by employment		20.21%		

Source: The basic data was derived from the Commerce Register,1990: Upstate New York Directory of Manufacturing Firms. The separation of the data into high- and low-tech categories was done by this author.

The data in Table 1 indicate that the Western New York region contains a significant population of technology-intensive manufacturers. Further, analysis of local time-series data in Table 2 reveals that this population increased by approximately six percent over 1988-1990, while the population of low-technology establishments actually declined (Commerce Register, 1989, 1990). An analysis of this data (see Table 2) suggests that the population of low-technology firms in Western New York fell by 14.8 percent between 1988 and 1990, while the number of high-technology firms increased by 6.3 percent during the same period. Similarly, employment fell by 22.8 percent in low-technology firms and increased by 15.8 percent in high-technology establishments. This analysis supports the central findings of several other studies, in that high-technology firms generate larger increases in employment than their low-technology counterparts (Browne, 1983, 1986; Phillips et al, 1991).

Figure 1: SECTORAL DISTRIBUTION OF MANUFACTURING FIRMS IN WESTERN NEW YORK

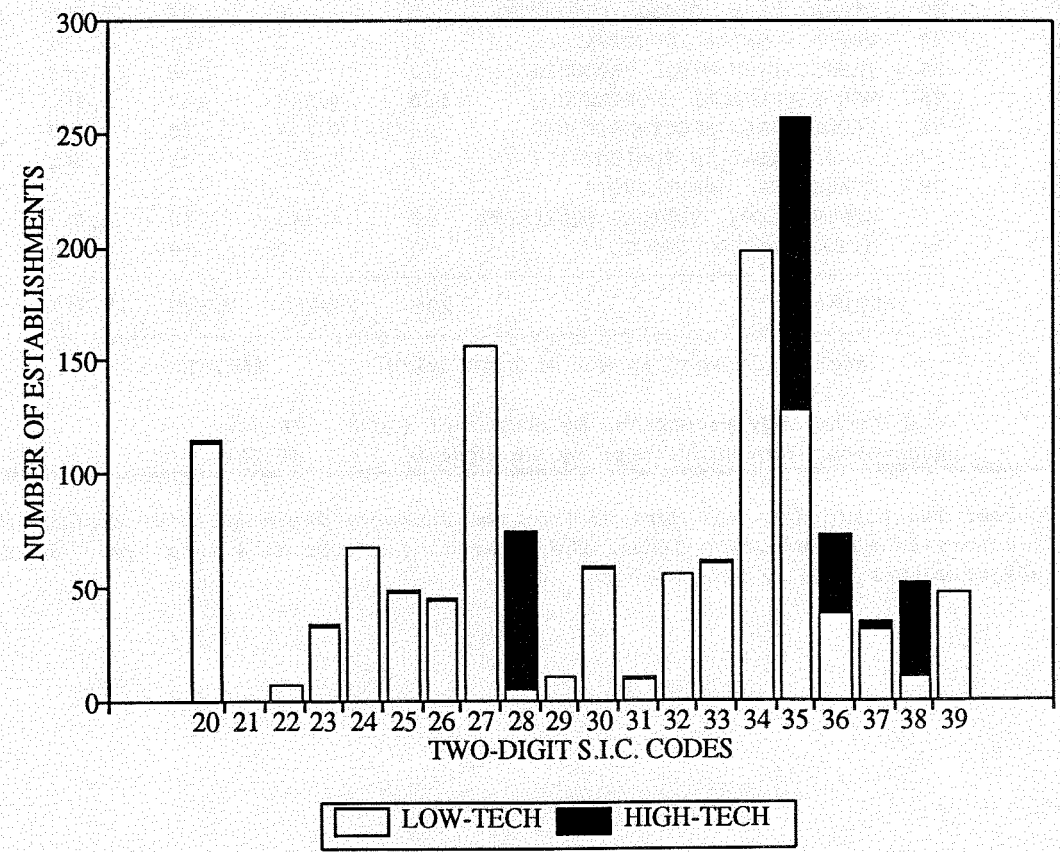


Table 2: Manufacturing Establishments in Western New York

BY NUMBER OF ESTABLISHMENTS

	1988	1990	Difference 1990-1988	Percent Change
Low-technology Establishments	1,321	1,125	-196	-14.84
High-technology Establishments	268	285	17	6.34
Total Manufacturing	1,589	1,410	-179	-8.49

BY NUMBER OF EMPLOYEES

	1988	1990	Difference 1990-1988	Percent Change
Low-technology Establishments	95,622	73,777	(21,845)	-22.85
High-technology Establishments	23,087	26,740	3,653	15.82
Total Manufacturing	118,709	100,517	(18,192)	-7.02

Source: The basic data at the four-digit SIC level were derived from Commerce Register databases for the 1988 and 1990 years. Manufacturing establishments were segregated into low-and high-technology types by this author using Markusen et al's (1986) list of 100 high-technology industries.

SURVEY METHODOLOGY

One of the main procedural problems encountered in this study lay in the construction of an accurate sampling frame. The task of securing a reliable and comprehensive list of manufacturing firms in Western New York proved rather difficult. Several available data sources were surveyed, but varying degrees of incompleteness or data-redundancy were noticed in each.

The Commerce Register (1990) database was found to be the best available choice for obtaining basic company information. The geographic coverage of the database extends to the entire Upstate New York region. This database gives information on the company's name, address, primary SIC class, other SIC classes, name of the president, product description, and approximate annual sales. The sales data provide a range rather than just a single figure. The product classification information is available at the four-digit SIC level.

The master company list was re-organized on the basis of primary SIC membership at the four-digit level. A subset of manufacturing firms was extracted from the Upstate data using geographic ZIP codes as division criteria for Western New York. This method yielded a separate list of 1,410 manufacturing establishments for the eight counties of Western New York.

Using the list of 100 high-technology industries suggested by Markusen et al (1986), the set of 1,410 manufacturing establishments in Western New York was classified into high- and low-technology categories. This procedure yielded 285 high-technology establishments in the region. Table 1 shows the sectoral distribution of the 285 high-technology establishments at the two-digit SIC level.

The initial sample consisted of 100 high-technology establishments, randomly selected from the Commerce Register database. However, because the purpose of the study was to evaluate the performance of the high-technology establishments relative to low-technology establishments, the creation of a control group was necessary. Therefore, a control group was designed to include 100 low-technology manufacturing establishments from the remaining 1125 manufacturing plants in the study area.

A 7-page, multi-dimensional, postal questionnaire was distributed to company presidents and/or CEOs in March of 1991. The survey instrument included categorical, ordinal, contingency, opinion, and attitude questions. It was divided into four different modules, consisting of basic company information and strategic philosophy, technological development, international business orientation, and management attitude toward various policy issues. A total of 74 companies (40 high-tech and 34 low-tech) completed the survey in all respects. Based on the number of survey instruments successfully mailed, a final response rate of 41 percent was achieved.

SUMMARY OF MAIN RESULTS

In terms of establishment age, the survey did not find any significant differences between high- and low-technology companies. The high-technology companies in the sample generally possess long standing business experience. A vast majority of these companies are US-owned and are independently controlled, single or multi-plant organizations, with headquarter locations in the Western New York region (see Figure 2). Their average size, both by number of employees (see Figure 3) and annual total sales, is larger than the low-technology companies. The only significant difference is that the major customers of the high-technology companies are other industrial firms and/or health/educational agencies, in contrast to the retail/consumer markets served by the low-technology companies.

Figure 2: TYPES OF MANUFACTURING ESTABLISHMENTS IN WESTERN NEW YORK

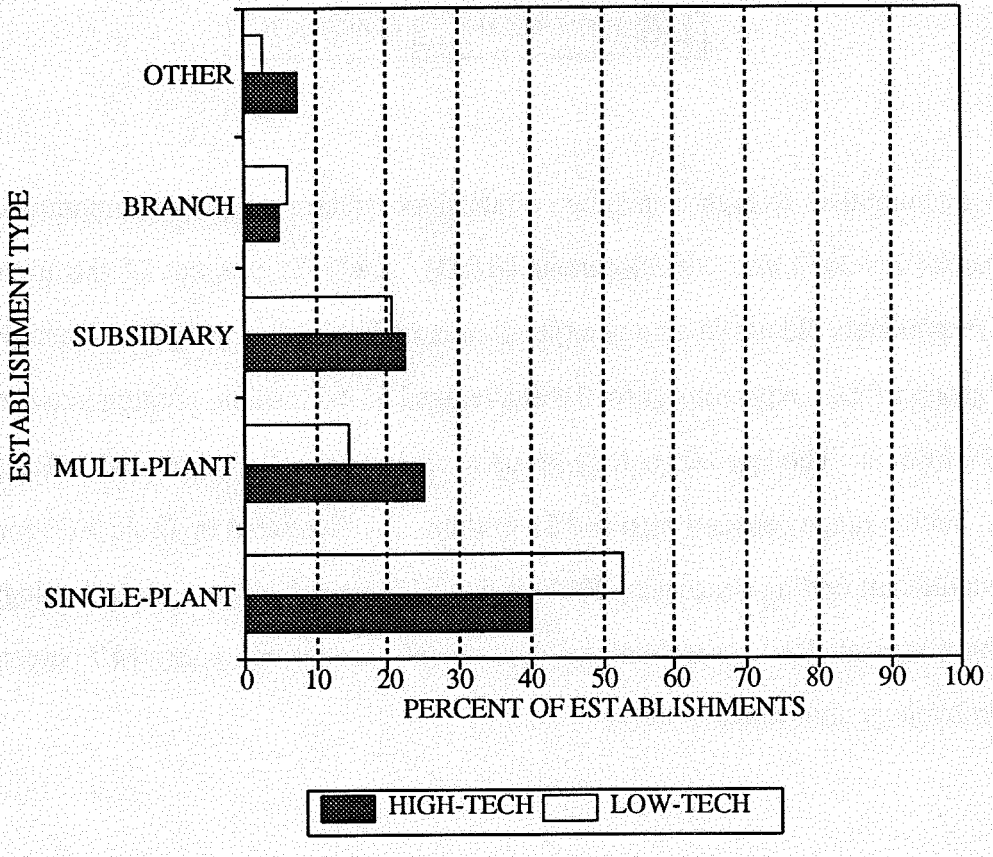
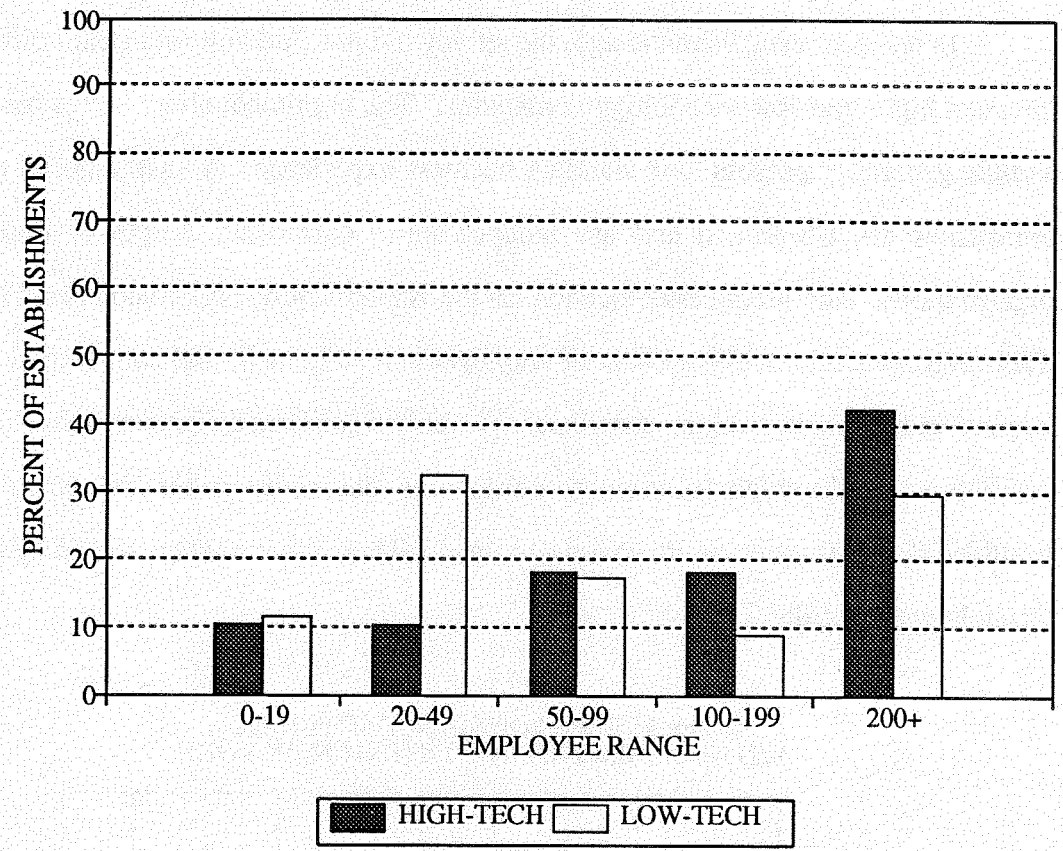


Figure 3: SIZE CLASS OF MANUFACTURING ESTABLISHMENTS IN WESTERN NEW YORK



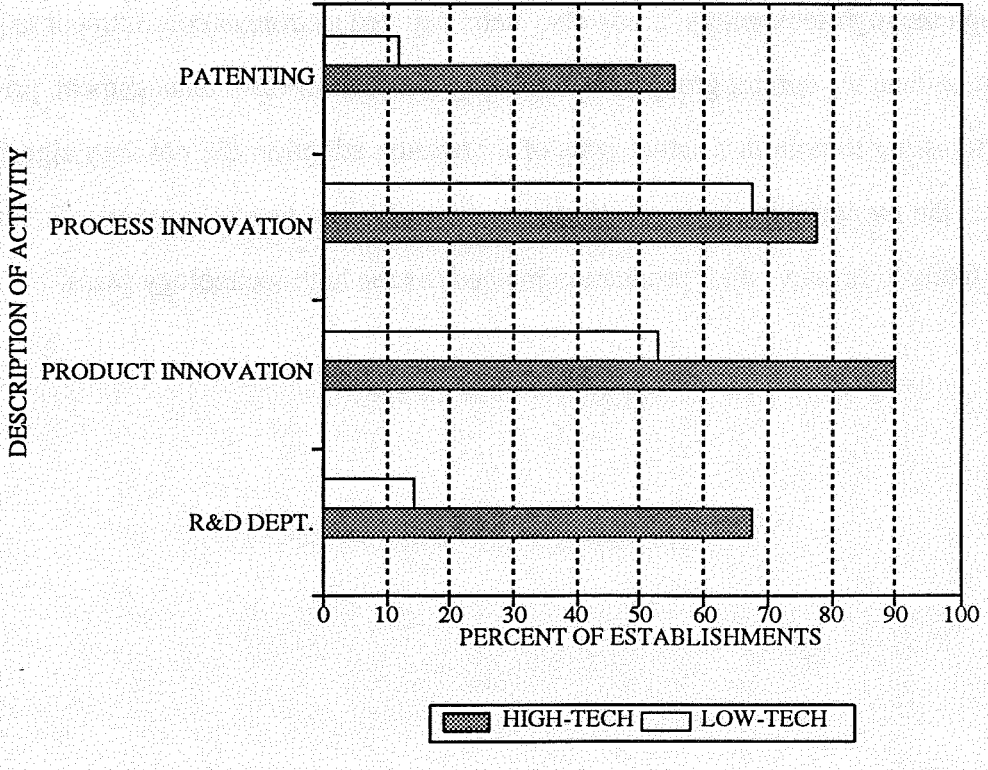
There is no doubt that the high-technology establishments have a superior commitment toward in-house research and development (R&D). Only 21 percent of the high-technology respondents did not incur any expenditures on R&D during 1990. The high-technology group's R&D expenditures for 1990 averaged $1.66 million, ranging between zero and $20 million. The low-technology group averaged only $192 thousand in R&D expenditure, with a range between zero and $1 million. As illustrated in Table 3 (Figure 4), another significant finding concerning R&D is that 67.5 percent of the high-technology companies have separate R&D or technology departments, compared to only 14.7 percent of the low-technology companies.

Table 3: R&D activity, product and process innovation measures

PERFORMANCE INDICATORS		HIGH-TECH MEAN	CONTROL MEAN
SEPARATE R&D DEPT. (Percent of firms)	**	67.50	14.70
R&D INTENSITY (R&D EXP./TOTAL SALE)*100	**	4.04	.74
PRODUCT INNOVATION (Percent of firms)	**	90.00	52.90
NUMBER OF NEW PRODUCTS		11.33	7.50
PROCESS INNOVATION (Percent of firms)		77.50	67.60
PATENTING ACTIVITY (Percent of firms)		55.00	11.80
NUMBER OF PATENTS/YR.		7.50	3.00

Note: * Significant at p =< 0.10 ** Significant at p =< 0.05

Figure 4: R&D AND TECHNOLOGICAL INNOVATION IN MANUFACTURING FIRMS



INNOVATION IN LOCAL MANUFACTURING COMPANIES

Evidence from the study suggests superior innovative performance among the high-technology establishments. What is distinctive in these firms is that there is a high priority for new product development, process innovation (the adoption of improved manufacturing techniques), patenting activity, domestic strategic alliances, and market leadership. In statistical terms, the main factors that were found to influence innovation performance included recent R&D expenditures (1986-1990), employment and sales growth (indicating a size and market-dynamics effect), and the scale, growth, and geographical diversification of existing export markets.

A distinct emphasis on product innovation was evident in the high-technology companies. Particular emphasis was placed on the introduction of new and/or substantially modified products using existing technology. According to the survey results, the crucial significance of product innovation originated from the impact it had on domestic sales and overall business competitiveness. The majority of the companies also reported a medium to high impact of product innovation on their export performance. Although the high-technology group also demonstrated a stronger commitment to process innovation than the control group (measured in terms of immediate management priorities), it is interesting to note that actual rates of innovation adoption did not vary significantly between the two groups. In empirical terms, then, the low-technology manufacturers are just as likely to improve their production methods as the high-technology firms.

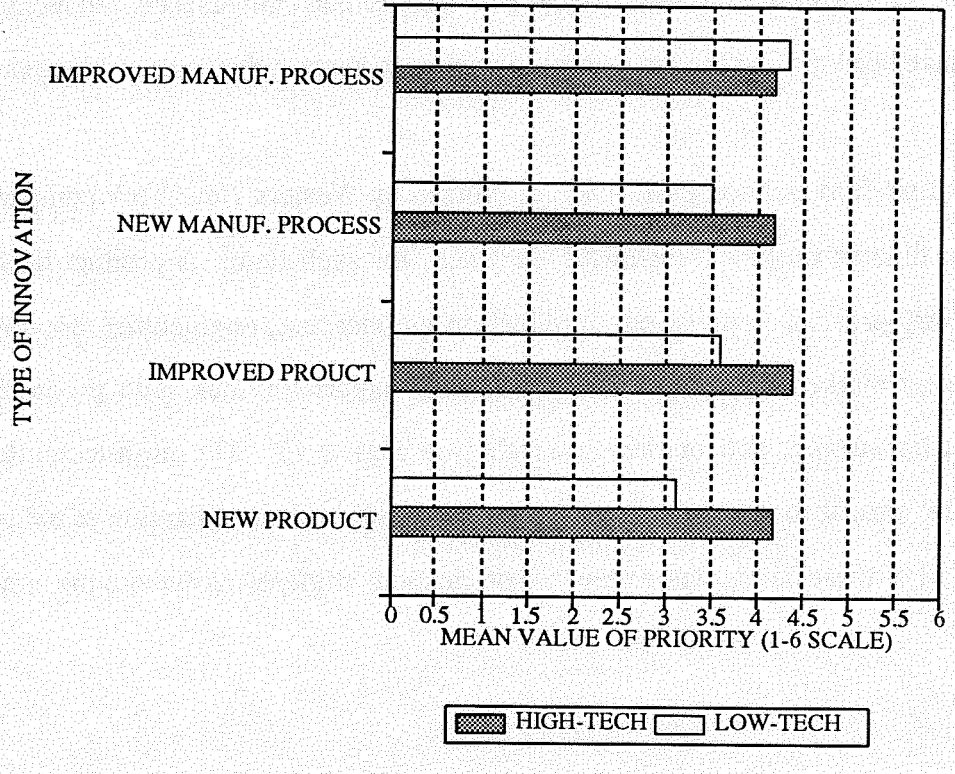
Table 4: Corporate Priority for Innovation in the Establishments

Type of Innovation	Mean Value of Priority (On a scale of 1 - 6) HIGH-TECH	LOW-TECH
New Product Development (N.P.D.) **	4.20	3.12
New Manufacturing Methods (N.M.M.) *	4.18	3.50
Improved Product Design (I.P.D.) **	4.40	3.59
Improved Manuf. Methods (I.M.M.)	4.20	4.32
INNOVATION INDEX *	23.60	19.52

* Significant at p =< 0.10 ** Significant at p =< 0.05

Note: The INNOVATION INDEX variable comprises of the sum total of organizational priorities such as new product development, new manufacturing methods, improved product design, improved manufacturing methods, technology licensing and technological leadership. Each dimension was measured on a scale of 1 - 6. 1 -2 denoted low, 3 - 4 medium, and 5 - 6 high priorities.

Figure 5: PRIORITIES FOR INNOVATION IN MANUFACTURING FIRMS



It is also noteworthy that no evidence of superior employment performance by high-technology companies was uncovered. If anything, in fact, the recent record of the low-technology group has been brighter. Even so, this finding must be tempered by the fact that productivity among the high-technology establishments has generally been higher. At the same time, it should be recognized that firms in the technology-intensive group are more likely to create highly skilled jobs in precisely those occupational categories that are of interest to industrial regions like Western New York. Not surprisingly, the current scientific, technical, and engineering employment performance of the high-technology group was overwhelmingly superior.

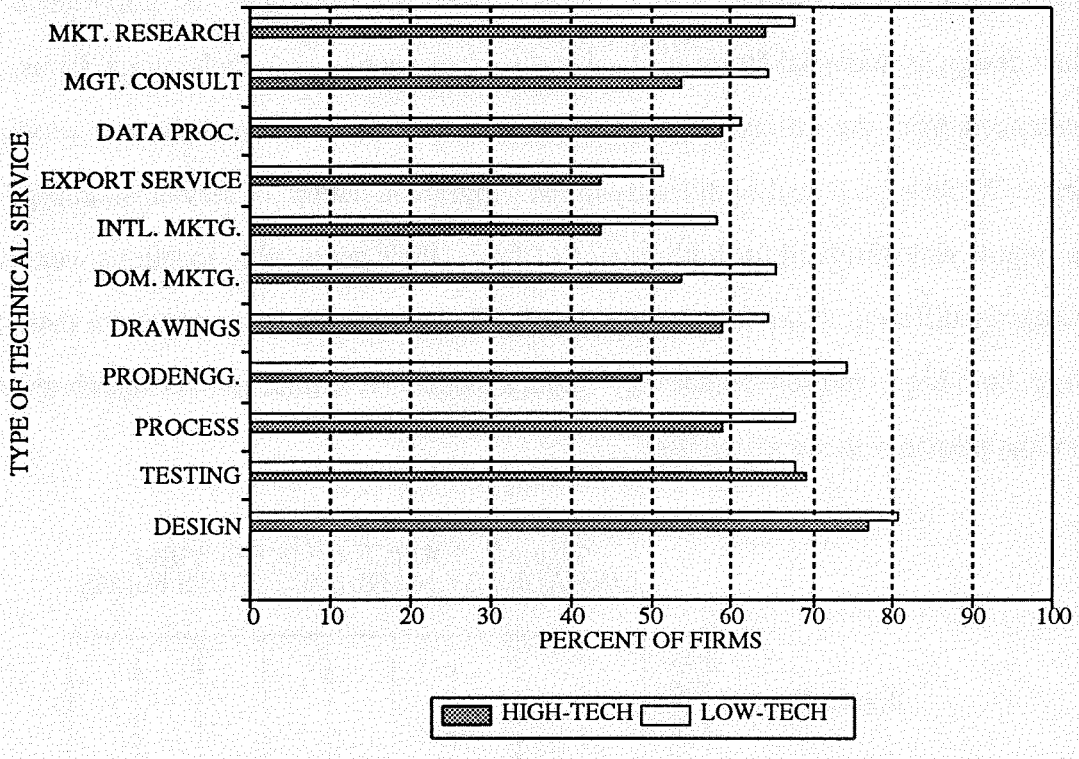
INTER-FIRM TECHNICAL LINKAGE

We saw earlier that the high-technology group was technologically more advanced than the control group. Therefore, a major expectation was that the two groups would differ in their utilization of external technical inputs. In this regard, a central finding of the study was that high-technology establishments are not significantly different from the control group in the utilization of external technical services through inter-firm transactions. These results, presented in Figure 6, suggest that companies of all technical intensities have been turning toward external expertise to support their internal innovative capabilities.

The inter-firm technological linkages utilized by Western New York companies encompass a diverse range of technical services for such items as product design, product testing, process innovation, production engineering, engineering drawings, R&D, domestic marketing, international marketing, export services, data processing, management consulting, and market research (see Figure 6). The high-technology companies are similar to the low-technology companies in their utilization of external linkages for all of these categories, except for production engineering (where the control

group exhibits a significantly higher utilization propensity). This may reflect a product-cycle effect, in that low-technology companies that deal with mature outputs typically require external assistance for process-related purposes (rather than new product development).

Figure 6: USE OF INTER-FIRM TECHNICAL LINKAGES BY MANUFACTURING FIRMS



There is another surprising finding. This study has documented that 67.5 percent of the high-technology firms in the sample have their own, separate R&D or technology departments. Also, 40 percent of the high-technology companies have separate formal exporting departments. But, external linkages in R&D and international marketing were the two categories that had the maximum impact on the augmentation of the internal innovative capability and subsequently on the business performance of high-technology companies. The maximum impact of the external technical linkages on business

performance was observed on the export sale indicator. The message is very clear. High-tech companies do not leave any stone unturned to achieve top-level innovativeness.

In sum, evidence has been found in this study that the development of new or substantially improved products (or for that matter, process innovation) is not wholly internalized in high-technology establishments. These companies adopt an outward sourcing strategy for technical inputs for both product and process innovation. The significance of external linkages for product innovation highlights the importance of product design as a crucial factor for business performance in high-technology firms, as is evidenced from the utilization of multiple external sources for their new product strategy. While a good deal of diversity in the geographic pattern of service sourcing for these inputs was observed for both groups of firms, their geographic locations were not significantly different at the inter-group level. Figures 7a and 7b demonstrate that, on average, both high- and low-technology groups evidenced similar market search space, which was primarily in the region itself.

Figure 7: SOURCE OF INTER-FIRM LINKAGES BY MANUFACTURING FIRMS

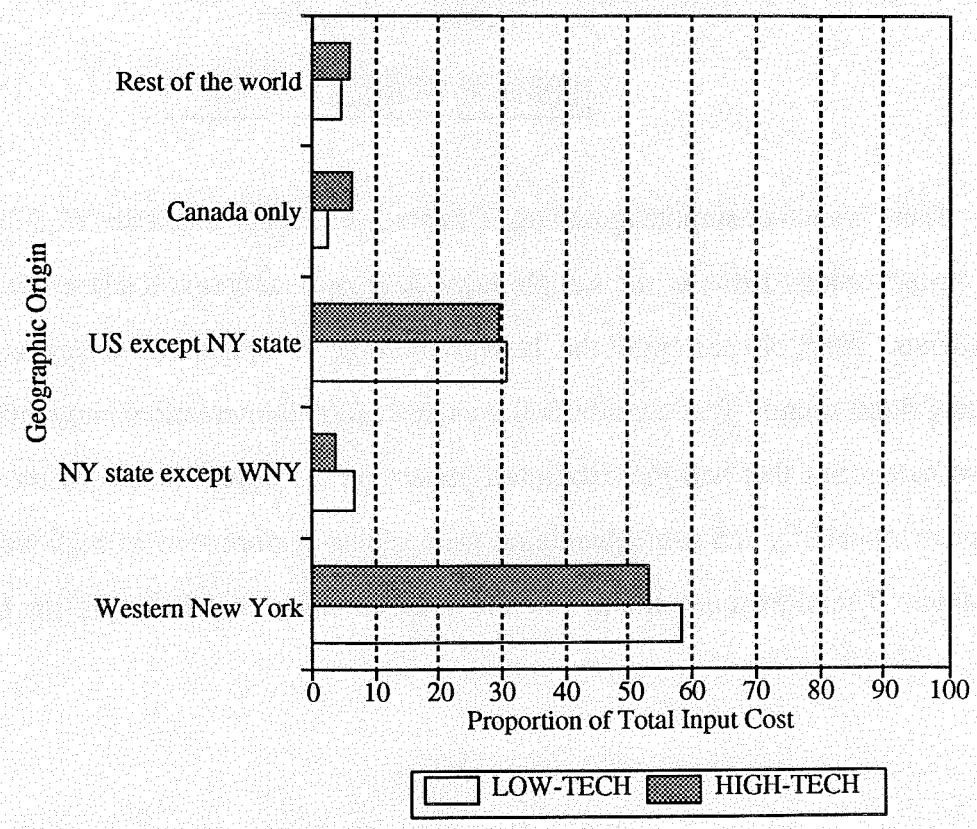


Figure 7A: SOURCE OF INTER-FIRM
LINKAGES BY HIGH-TECHNOLOGY FIRMS

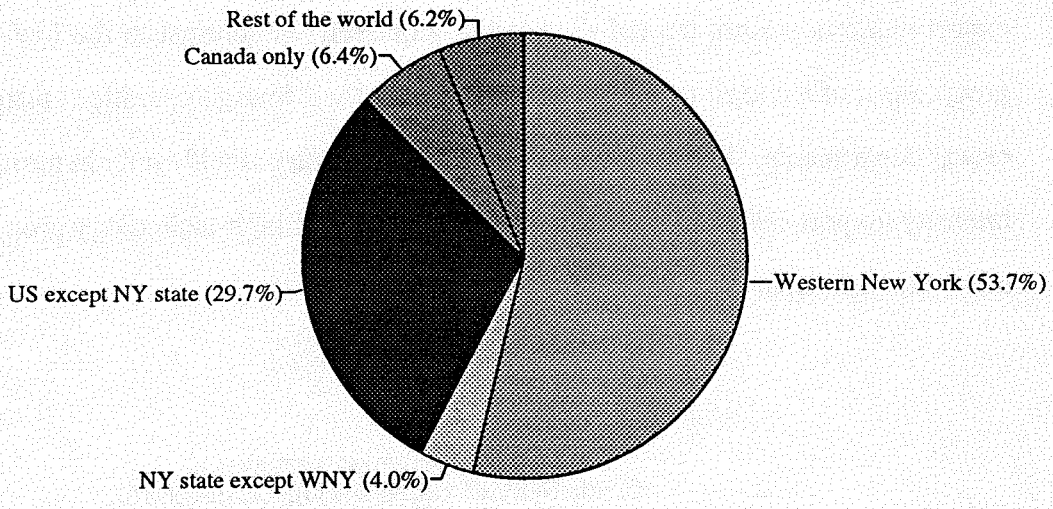
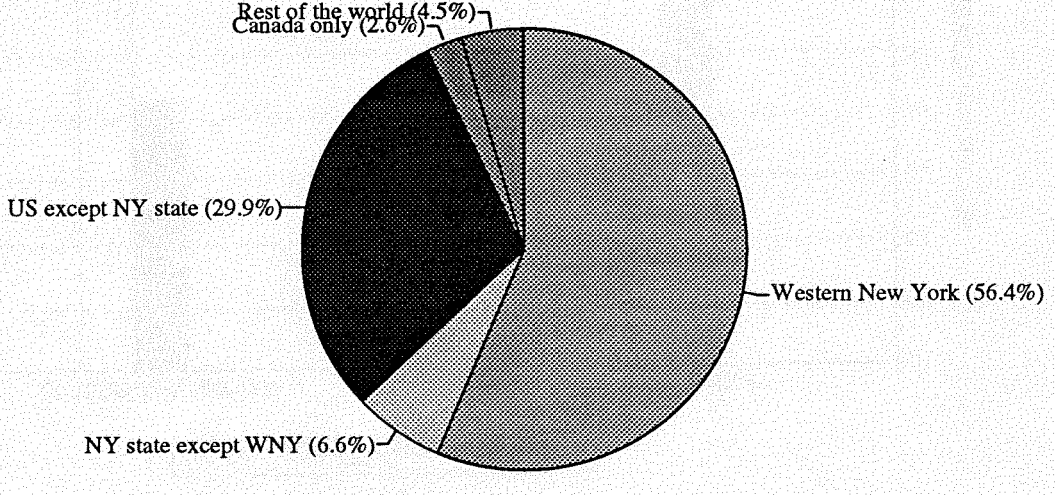


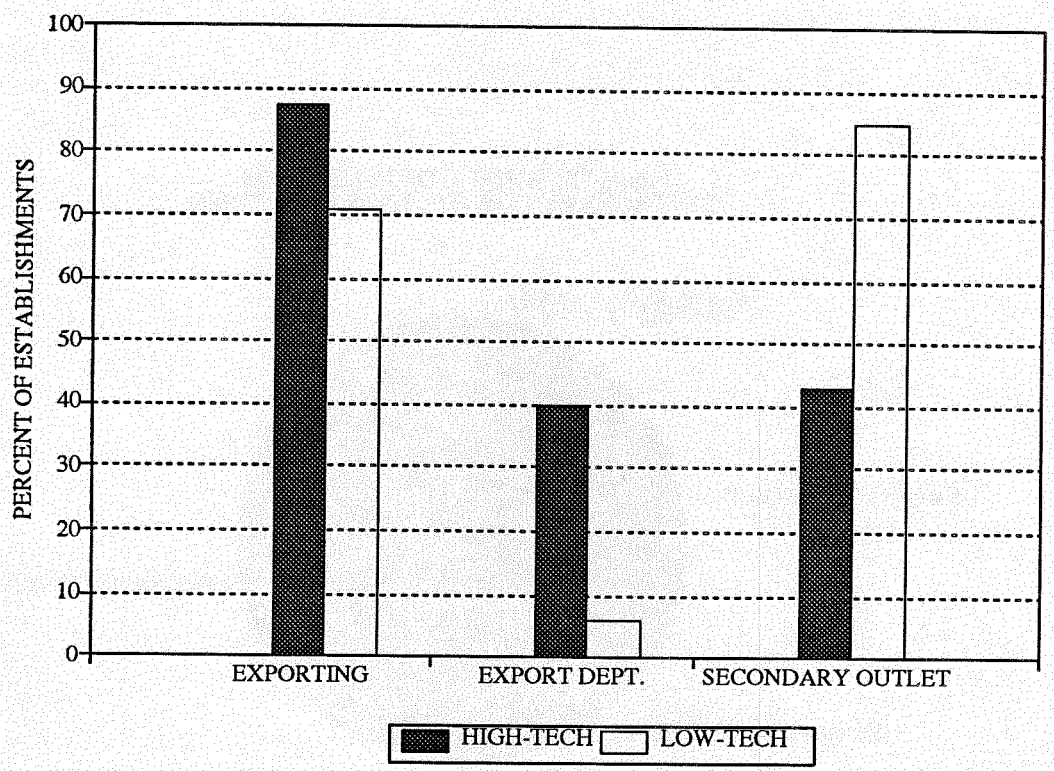
Figure 7B: SOURCE OF INTER-FIRM
LINKAGES BY LOW-TECHNOLOGY FIRMS



EXPORT PERFORMANCE

On the export front, it is clear that the high-technology establishments place greater emphasis on foreign customers. From the data presented in Figure 8, it would appear that export markets are not treated as secondary outlets. In contrast to the low-technology group, most of the high-technology firms manage their foreign operations through formal export departments. Although the two groups do not vary significantly in terms of export-intensity (export sales as a proportion of total sales), the high-technology group exhibits a much broader range of export targets.

Figure 8: EXPORT ORIENTATION
OF MANUFACTURING ESTABLISHMENTS



From an international perspective, the high-technology group is clearly more diversified. Based on a choice of nine different geographic regions, a larger proportion of the high-technology establishments was involved in exporting to Latin America, Western Europe, and Japan (see Figure 9). According to Figure 10, while the percentage of high-technology firms with Canadian export markets is similar to the low-technology group, the high-technology establishments exhibit a sharper interest in Western Europe and Japan (measured in terms of export proportions).

Figure 9: UNWEIGHTED EXPORT INVOLVEMENT
BY CURRENT EXPORT DESTINATION

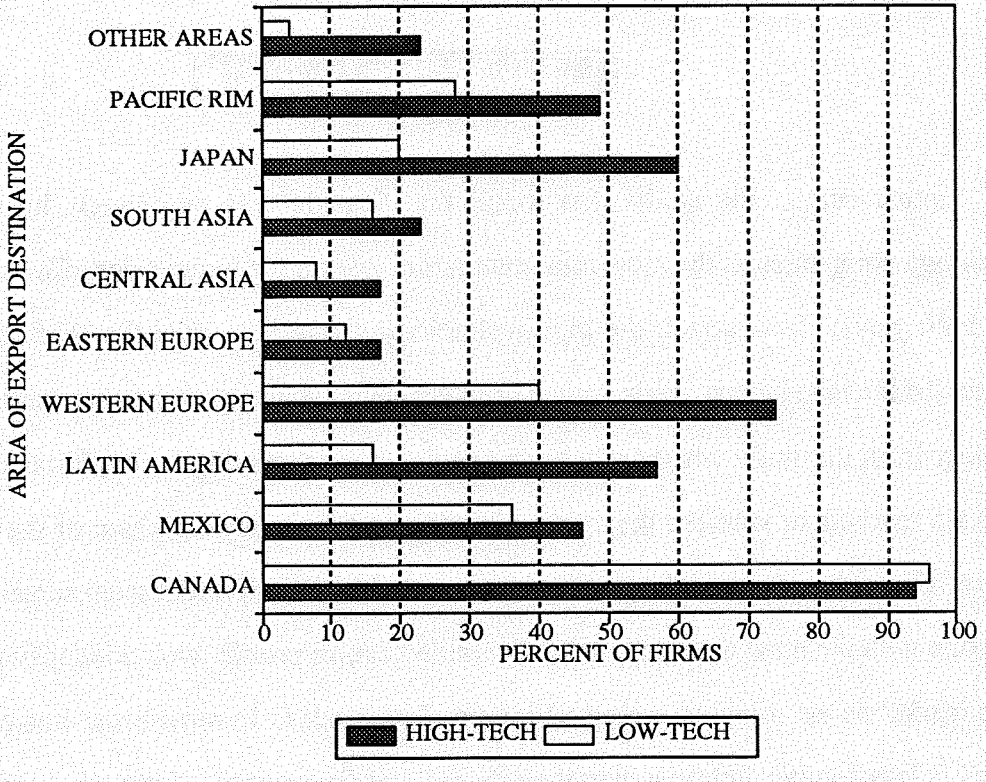
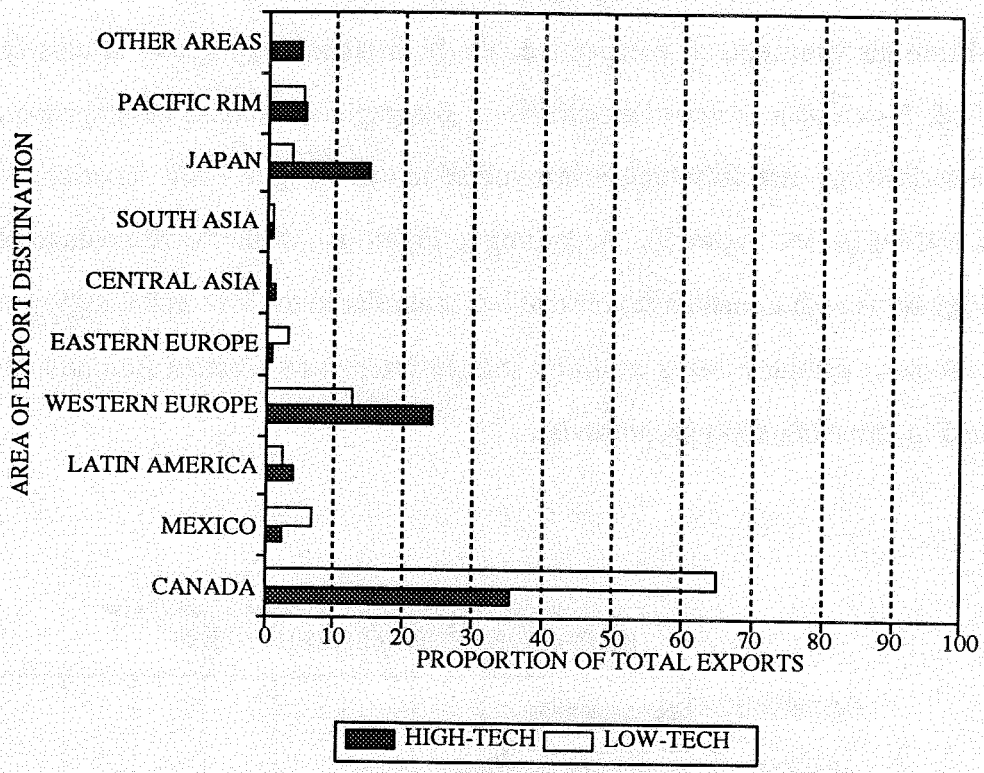


Figure 10: WEIGHTED EXPORT INVOLVEMENT
BY PROPORTION OF TOTAL EXPORTS



Interestingly, the study also found that Canada was perceived by the low-technology companies as the most important target market for future sales efforts over the next 5-10 years. In contrast, the high-technology group identified the U.S. domestic market itself as the largest single source of likely sales growth over the near-term. It was not clear from the study whether these companies were expecting to exploit totally new domestic markets or whether they were planning to seize a greater share of the existing market. Given the nature of the findings documented earlier, it might seem surprising that the group with the most internationally diversified export profile would identify the U.S. home market as the principal expected source of new sales. In retrospect, however, this finding is less counter-intuitive than it might seem at first glance. After all, some of the fastest consumption rates for high-technology products (both intermediate and final) are to be found within the U.S. itself. Moreover, as several authors have shown, high-

technology firms that are actively involved in the development of entirely new products often prefer to target the home market first (as a testing ground). From this perspective, export markets are initially of secondary importance to innovators (Linder, 1961; Vernon, 1977).

One of the most striking contrasts between the two groups is that their innovation-intensity ratios have dissimilar effects upon two aspects of export behavior. Overall, an explicit link is evident between innovation-intensity on the one hand, and export-intensity/diversification on the other. The low-technology establishments achieved greater export intensity, but lower geographic diversity. In contrast, the high-technology establishments accomplished greater export diversity, but lower export intensity. In retrospect, however, it is possible that this contrast reflects the fact that many of Western New York's low-technology manufacturers serve only two markets; local markets in Western New York, and geographically-close export markets in the urban core of southern Ontario (which is only a driving distance of about 2 hours from Buffalo, Niagara Falls, and Rochester) and Quebec. High-technology establishments, in contrast, serve distant markets within the United States, as well as offshore markets in several foreign countries.

CORPORATE POLICY IMPLICATION

Some of the results summarized above suggest that local companies ought to carefully analyze their commercial options before making strategic decisions regarding innovation and export planning. These strategic decision-making processes may affect a whole range of performance parameters, ranging from the selective externalization of technological innovation to the identification of appropriate export markets. As Dvir and Shenhar (1990) suggest, the long-run success of a high-technology focus should not be measured in short-run financial terms alone.

An outward-looking orientation for technology sourcing could lead local

establishments to adopt externally generated innovations, perhaps along the lines already followed by successful and highly progressive companies in Japan. The study also implies that the introduction of new or improved products is very important for the overall domestic and export business performance of manufacturing companies. New product development will continue to remain indispensable for higher performance, although successful efforts in this direction may require high-risk endeavors of the sort suggested by Cooper and Kleinschmidt (1987). Despite the finding concerning lack of sufficient priority for process innovation in comparison to product innovation, this study implies that process innovation can have important repercussions for the competitive position of high-technology companies. Therefore, these companies need to examine closely the current policy regarding the adoption of process change or of simultaneous product and process innovation (Calantone et al, 1988).

The level of satisfaction of the manufacturing companies with factors that support their overall marketing operations was investigated in the original version of this study. These factors included government support measures, the availability of resources and infrastructure, and other types of public and private assistance. The evidence implies a need for new policy initiatives. The mean overall level of satisfaction with government support measures falls within the lower range for the high- as well as low-technology companies. Thus, there is a need to re-evaluate some of the existing industrial initiatives and policies, particularly those regarding support for innovation, technical infrastructure development, training of workers, and export assistance.

Local and State-wide policies for the development of an improved technical infrastructure carry a special meaning in the present research context. The development of enhanced technical service supply in the region to cater to the intermediate demands of local industry is especially important. This study calls for the need for a better infrastructure consisting of higher-level producer services. Such a measure is expected to

augment the internal innovative capabilities of the high-technology industries, particularly in terms of accelerated product innovation.

In this regard, a case can be made for import substitution or regional self-sufficiency in technical services, even to the extent that such services could be exported from the Western New York area to other regions or countries. While the region's ongoing switch from industrial to service employment is generally described in terms of commonly-known services such as banking, retailing, and real estate (to mention a few), this study shows that high-technology companies (as well as their low-technology counterparts) generate demand for specialized technical services as well. At present, almost half of these services are procured from within the Western New York region, while the remainder comes primarily from other parts of the nation and/or Canada. Since more than 50 percent of this technical service demand leaks beyond the boundaries of Western New York, the development of a high value-added technical service industry deserves a good deal of policy attention.

On a related note, the existence of inter-firm strategic alliances has been found to be significantly related to employment and sales growth among the survey firms. Therefore, another public policy issue concerns the need to create dedicated information networks to facilitate the formation of mutually beneficial partnerships with other companies. This study suggests that the high-technology companies will be more likely to form strategic alliances with foreign firms in view of the superior geographic diversity of their markets, the new product focus of their R&D departments, and their tendency to operate with a greater level of outward orientation overall.

The export needs of high-technology companies is yet another domain that has implications for public policy. This study suggests a direct relationship between a firm's technological-intensity (on the one hand) and the geographic diversity of its export markets (on the other). The antithesis of this conclusion is that lower technical intensity

has been found to be positively associated with export intensity. The implication is that the high-technology companies can export their products to a more diverse international market, but their export intensity, as measured by the ratio of export to total sales, is not as significant in comparison to the low-technology companies. This finding suggests a need for the re-design of public policy for export development. Accordingly, the high-technology companies will be suitable candidates for export incentives for entering a larger number of new international markets. If the intention of the policy is to increase the proportion of exports alone, it is implied that the high-technology companies are less likely to benefit from such measures. On the other hand, the low-technology companies also can increase the spatial extent of their export markets if their innovative activities receive a thrust from public policies.

Industry-university collaboration for innovation does not seem to be widespread in Western New York. Although a large number of high-technology companies in the study have built external linkages for R&D and product innovation, it is surprising that only 12 percent of the high-technology companies reported a high level of satisfaction with local as well as other universities and colleges. Public policy attention should, therefore, be focused on the development and implementation of effective outreach programs to encourage and involve the high-technology companies in building better research and development linkages with the universities.

CONCLUSION

Western New York is widely perceived as a declining industrial region with a distinctly Rustbelt image. This perception does not withstand empirical probing on a systematic basis. While it would be misleading to compare this region with the silicon landscapes of high-technology America, the fact remains that a substantial proportion of the local industrial base is rooted in subsectors that are far removed from primary steel,

metal fabricating, or grain elevators. Recent employment gains in the region's manufacturing sector have been concentrated in specializations that emphasize exports, innovation, and technical competence. In order to fully capitalize upon these modest gains, it is necessary to create a local technical infrastructure that can support the needs of the region's surviving industrial firms. The potential for very low cost public intervention is substantial, ranging from information brokerage and technical counselling to networking strategies for connecting different interest groups together.

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