

**The Survival of University Spin-offs and
Their Relevance to Regional Development**

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Summary

Spin-off companies that commercialize intellectual property are significant drivers of innovation in Canada, where spin-offs are produced at a much higher rate per research dollar than in the U.S. This has been demonstrated repeatedly via analysis of surveys performed by the Association of University Technology Managers (AUTM). In order for spin-off companies to contribute to economic growth, they must survive and succeed.

This report is based on data from nine Canadian universities active in technology transfer about the spin-offs they created since 1995. Key findings are that the major areas for spin-offs overall are Biotech (52%) and Information and Communication Technologies (ICT) (25%). Biotech companies dominate at the Medical/Doctoral institutions (60%), but not at the Comprehensive institutions (16%). The “survival rate” is 73% overall and is similar at both Medical/Doctoral institutions (72%) and Comprehensive institutions (76%). Overall, 80% of the surviving companies operate in the same region as the university from which they originated and thus are significant drivers of economic activity in the clusters present in those regions.

Background

The presence of a major research university is a huge advantage to the knowledge-based regional economy.¹ In 1994 the University of Calgary reported on a study² that concluded the net benefit to the Alberta economy from knowledge transferred from the University was about \$50 million per year, or about one third of that university’s operating budget that year! This report included all forms of knowledge transfer by faculty and professional staff, not just from businesses (existing or newly formed) using knowledge developed at the University.

In 1999, the federal Advisory Council on Science and Technology (ACST) noted:

“... Canadian universities are well placed to strengthen Canada’s innovative capacity and productivity performance. They are positioned to play a more prominent role in fuelling

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¹ Florida, R., “*The Rise of the Creative Class*,” Basic Books, 2002

² Chrisman, J.J., “*Economic Benefits Provided to the Province of Alberta by the Faculty of the University of Calgary*,” University of Calgary, 1994

*national economic growth and social development than universities in most other G-7 countries, including the United States.”*³

However, the ACST also stated that Canadian universities are far less effective in generating economic benefits than their U.S. counterparts.⁴ One means of generating these benefits is through creation of spin-off companies. Companies spun off⁵ from university research appear to be a particularly effective means of technology transfer out of universities, leading to job creation and wealth creation.⁶ It is clear from previous studies that Canadian universities create spin-offs at a rate far exceeding their U.S. counterparts – on the basis of companies created per dollar of research expenditure.⁷

In order for spin-off companies to contribute to economic growth, they must survive and succeed. Some universities have reported that over 80% of their spin-offs are still in business five years from start-up, while other sources, including the ACST, suggest that Canadian survival rates are low. The present study comprises examination of data from a number of Canadian universities that are active in technology transfer in order to determine actual survival rates, as a function of the companies’ lines of business and the universities from which they originated and to explore their roles in regional economic development.

According to Statistics Canada^{8,9}:

- in terms of expenditures, universities in 2001 performed 33% of all R&D in Canada, of which 10% was funded by industry
- in 1999 there were 44,160 full-time-equivalent researchers in universities, 31% of the national total number of researchers
- in 1999 there were 454 spin-off companies (not including those originating in the hospitals); in 2001 there were 648
- in 1999 royalties to universities totalled \$18.9 million; by 2001 this had increased to \$44.4 million

The ACST used similar figures from previous years to note that universities in Canada perform a larger share of national R&D than in most other G-7 countries, and that the industrial sector in Canada depends more on universities as a source of innovation than in any other G-7 country. It should be noted that the data from Statistics Canada surveys of spin-offs

³ ACST, “*Public Investments in University Research: Reaping the Benefits*,” 1999

⁴ “...if Canadian universities were as effective in generating commercial benefits as their American counterparts, they would have contributed \$1.5 billion more in economic benefits and generated 12,788 more jobs in 1997 than was actually the case.”

⁵ Statistics Canada defined a spin-off as “...a new firm created to transfer and commercialize inventions and technology developed in universities, firms and laboratories,” 1999 Biotechnology Use and Development Survey, 2001

⁶ Rogers, E.M., S. Takegami, and J. Yin, “*Lessons Learned about Technology Transfer*,” in *Systems and Policies for the Globalized Learning Economy*, edited by P. Conçeição *et al.*, Greenwood Publishing Group, Westport, CN, USA, 2003

⁷ Clayman, B.P., “*Technology Transfer at Canadian Universities: Fiscal Year 2001 Update*,” (unpublished, 2003). Available via www.sfu.ca/vpresearch/vprreport.htm

⁸ Statistics Canada reports, Catalogue 88-001-XIB : Vol. 26 No.7 and Vol. 25 No.5; Innovation Analysis Bulletin Vol. 2, No.3

⁹ Survey of Intellectual Property Commercialization in the Higher Education Sector, 2001, Statistics Canada (October 2003) www.statcan.ca/cgi-bin/downpub/listpub.cgi?catno=88F0006XIE2003012

are neither definitive nor precise, since not all universities responded in either year and there are year-to-year differences in responding populations. The 2001 response rate was 72%.

Annual surveys by the Association of University Technology Managers (AUTM) form the basis of the report by Clayman cited⁷ above. A subsequent report¹⁰ traced the creation of university spin-off companies¹¹ over the last decade. Although precise comparison with the results cited above from Statistics Canada is not possible due to the differences in responding institutions (unknown in the case of Statistics Canada) and differences in definitions, it is reassuring that the results are of the same order of magnitude: Canadian universities responding to the AUTM surveys reported creating a total of 409 spin-off companies from 1994 to 2001 versus Statistics Canada's reports that the institutions (universities and hospitals) responding to their 2001 study reported 343 companies created between 1995 and 2001 and 648 created over a longer period pre-1980 – 2001.

The Role of Clusters in Economic Development

The elements that make a national, provincial or regional economy vibrant and prosperous today are fundamentally different from those of the past. There is growing recognition that regional clusters are key to economic development. One useful definition of a "cluster" is:

*"...a geographic concentration of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g. universities, standards agencies, trade associations) in a particular field that compete but also cooperate."*¹²

It is generally recognized that developed countries are moving from economies based on tangible assets to ones based on commercialization of intellectual property and other intangible assets. In these new economies, concepts such as patents, copyrights, customer relationships, brand value, unique institutional designs, the value of future products and services and their structural capital (culture, systems and processes) are critically important to businesses in a region. Economic performance is determined by a region's effectiveness in using its comparative advantages to create and expand knowledge assets and convert them into economic value.

These new "economics of place" are driven by their ability to attract, retain and expand science and technology assets and leverage them for economic development. In practical terms this means the ways in which these assets, usually located in urban areas in the region, are mobilized and how knowledge which is created (often in university facilities) is transferred from the laboratory to production facilities.

While Porter does not suggest that the presence of a large public sector research institution is a necessary condition for the existence of a cluster (a position supported by Rogers⁶), current

¹⁰ Clayman, B.P., "Addendum to Technology Transfer at Canadian Universities: Fiscal Year 2001 Update," 2003 (unpublished). Available via www.sfu.ca/vpresearch/vprreports.htm

¹¹ The AUTM definition of start-ups is more conservative than Statistics Canada's: "Companies that were dependent on a license to the reporting institution's technology for initiation."

¹² Porter, M., "Location, Competition and Economic Development: Local Clusters in a Global Economy," Economic Development Quarterly 14(1), 15 – 34, 2000

research by the Innovation Systems Research Network¹³ (ISRN) is leading to the conclusion that, at least in Canada, a large public sector investment in relevant science and technology is a prerequisite for the creation and sustainability of viable high-tech industrial clusters. ISRN researchers are carrying out studies of a number of high-tech and conventional industry clusters in Canada, including Biotechnology clusters and Information and Communications Technology (ICT) clusters.

Other research to date on innovation in Canada has focused on the need for university research to generate innovations in general, principally for job creation, rather than on cluster development *per se*. The ACST stated:³

“The overriding objective of our recommendations is to increase the return to Canada on the investment in university research made by Canadian taxpayers. That goal is not in dispute. We believe that research-based innovation originating in universities has the potential to contribute much more than it does now in a form that is very important to all Canadians, namely well-paying new jobs.

They noted however:

.....the main goal of the proposed actions (recommendations) is to increase wealth creation in Canada; it is not primarily to produce new revenue streams for universities. The experience in the United States, which we use as a benchmark in this report, is that in the vast majority of research universities the revenues from commercializing research constitute a small addition to university budgets, generally well below 1 percent. It would not be realistic to expect much more in Canada. That amount of incremental income might be sufficient to provide useful incentives to the researchers involved, and to pay some of the cost of managing IP, but it could not be counted on to relieve the financial pressures that Canadian universities face today. Discoveries that produce financial bonanzas are so rare that policies designed to pursue them would almost always lead to failure.”

The Role of Spin-offs in Cluster Development

We wish to determine the role of university spin-offs in cluster development, as well as considering their economic activities. Given the ISRN findings that universities (and/or other public sector laboratories) are necessary, but not sufficient for the creation and sustainability of clusters, it is necessary to link spin-offs to specific clusters. Our first step in pursuing this question was to develop a database of university spin-offs. Using information from university-industry liaison offices (UILOs), a database of spin-offs was developed for a number of universities. They were selected as representative of universities that are active in technology transfer across Canada in both the Medical/Doctoral and the Comprehensive categories (as defined by Maclean’s magazine¹⁴).

¹³ A national research network which brings together researchers studying a number of aspects of innovation .

See www.utoronto.ca/isrn

¹⁴ Maclean's Magazine, Toronto, ON M4Y 2Y5

¹⁵ 1995 was chosen so that the spin-off numbers would not be influenced by the 1991 recession. It also corresponds roughly to the start of the “dot.com” era.

The data gathered comprise:

- year of establishment of the spin-off company
- its general line of business (Biotech, ICT, or other)
- whether it is still in operation
- the location of its place of business.

A spin-off company was judged to be “active” if it is listed as created by the UILO concerned, formed during or after 1995¹⁵ and independently confirmed to exist currently, usually through a web search. A company was deemed to be inactive if it had no web site, and no reference to it could be found on the web using a Google search. Normally, if a firm is absorbed by another, the new firm’s web site will make reference to the fact. However this is not assured and, as a result, our estimates of survival rates will likely be underestimates. Note also that the data gathered from the UILOs on company creation was not all current, so that some spin-off companies that were created recently may not have been included.

Table 1 summarizes the data gathered over the summer of 2003; the Appendix to this report contains a more detailed breakdown.

Table 1: Summary of Spin-offs From Selected Universities Since 1995

University			Line of Business			Location	
	Status	#	Biotech	ICT	Other	In region	Elsewhere
Alberta N = 42	Active	31	20	9	2	26	5
	Inactive	11	9	1	1		
McGill N = 30	Active	19	14	2	3	14	5
	Inactive	11	6	3	2		
Montréal N = 37	Active	27	17	6	4	22	3
	Inactive	10	7	1	2		
Queen’s N = 25	Active	21	14	2	5	12	9
	Inactive	4	1	2	1		
Sherbrooke N = 13	Active	12	7	3	2	8	4
	Inactive	1	-	-	1		
SFU* N = 38	Active	24	5	10	9	23	1
	Inactive	14	2	7	5		
Toronto N = 53	Active	38	23	7	8	34	4
	Inactive	15	9	2	4		
UBC N = 43	Active	27	14	9	4	20	7
	Inactive	16	5	2	9		
Waterloo* N = 20	Active	20	2	10	8	13	5
	Inactive	-	-	-	-		
Totals N = 301	Active	219	116	58	45	172	43
	Inactive	82	39	18	25		

* “Comprehensive” institution

Notes:

- An additional 59 firms were spun off from the University of Waterloo, but their dates of establishment could not be confirmed. Of these 5 were in Biotech, 18 in ICT and 36 in other areas. 19 of the firms were inactive. 19 of the 40 active firms were located in the Waterloo region.
- The location of four active firms - two spun off from the University of Waterloo and two from Université de Montréal - could not be determined
- Lines of business (Biotech, ICT or other) could not be rigorously determined in all cases.

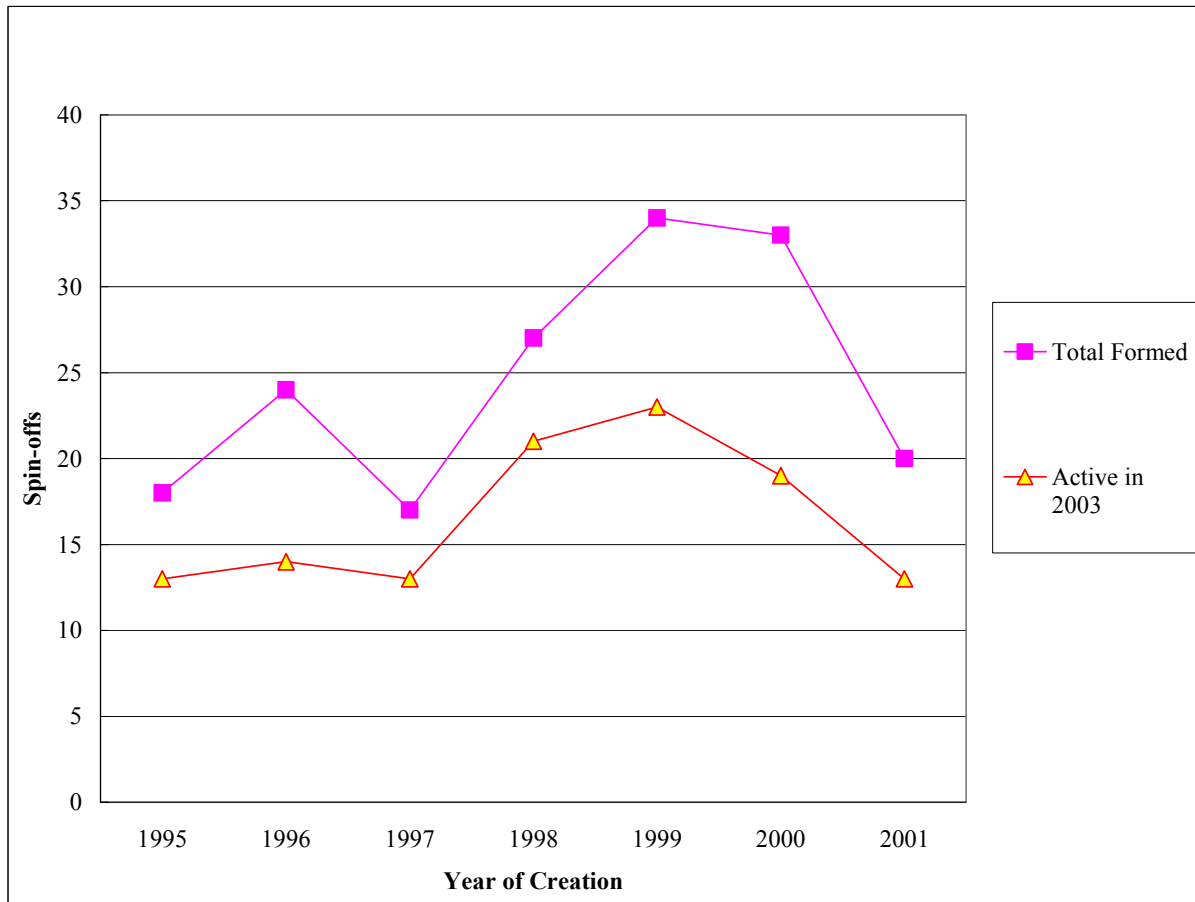
The “survival rate” is the ratio of the firms that are found to be active to the total number that were created. Several observations come immediately from our analysis of these data, recognizing that these results are based on a limited sample:

- Overall, 73% of all spin-offs in the sample are still in existence
- Overall, the survival rate is essentially the same at both Medical/Doctoral (72%) and Comprehensive (76%) institutions, although there are significant differences among reporting institutions
- The survival rate for Biotech companies (74%) is essentially the same as that for ICT companies (78%)
- Biotech (52%) and ICT (25%) are the major areas overall for spin-offs
- Biotech companies dominate at the Medical/Doctoral institutions (60%), but not at the Comprehensive institutions (16%)
- Overall, 80% of the surviving companies operate in the same region as the university from which they originated, with those from Medical/Doctoral institutions at 79% and those from Comprehensive institutions at 86%.

Further analysis was done of spin-offs from five universities (Alberta, Montréal, Sherbrooke, SFU and UBC) where data on company creation were available on a year-by-year basis. Figure 1 shows the survival data by year of creation – i.e. the number of companies formed each year and the number of them that were found to have survived to summer 2003. It is interesting to note that when the data are aggregated over three-year periods (1995 – 1997 and 1998 – 2000), the survival rate for each period of company creation is 67%. This suggests that if a spin-off survives for a relatively short period, there is a greater likelihood that it will continue operating.

Comparisons with Statistics Canada’s 2001 results are useful. Their methodology of determining survival differed from ours – they used data held by the Canada Customs and Revenue Agency and did not depend on searches of the internet for reference to the companies that were reported by the responding institutions (universities and hospitals), although web searches were sometimes employed. Of the 664 companies whose status could be determined, they found that 80.4% were either “active,” “merged,” or in early stages of development – companies our approach would consider to be surviving. Of the 655 whose line of business could be determined, 46% were in fields that our approach would classify as Biotech. For the 62 companies reported to have been created in 2000 and 2001, 48% were in Biotech. Considering differences in methodology, definitions and responding institutions, their results are in quite reasonable agreement with ours, especially considering the superior sources of information available to Statistics Canada on company status and remembering that we consider our survival rates to be underestimates.

Figure 1: Spin-offs by Year of Creation



Discussion

The fact that over two thirds of university spin-offs created since 1995 are still in existence is remarkable, the more so since ICT, part of the “dot.com” bubble, are a significant portion of the whole. The fact that most spin-offs stay close to home means that they contribute directly to regional industrial strengths. The fact that the large majority of university spin-offs (79%) are in Biotech and ICT suggests that university spin-offs play no small role in supporting these regional development objectives.

Biotech clusters

Bibliometric data indicate that the impact of papers published by Canadian researchers in the health sciences is above the world average.¹⁶ Our national expertise has been fuelled by a long and generally beneficial relationship between university health research facilities (often funded by the federal government through the Canadian Institutes for Health Research (CIHR) and its predecessor, the Medical Research Council) and the large teaching hospitals

¹⁶ The “revealed world impact factor” of Canadian papers in the health sciences, 1997 – 2000, was 110% of that expected for the world average of papers (the same was also true of all natural sciences in Canada): Benoit Godin, Canadian Science and Innovation Indicators Consortium, 2003

(funded by provincial health care systems), that are affiliated with university medical schools. Our results show that universities without medical schools also spin out Biotech firms, albeit at a lower rate. Statistics Canada has noted in the previously cited report on its 1999 survey of biotechnology “...(*Biotech*) spin-offs are, generally, at the early stages of development and their progress will mirror that of the sector as a whole.”

The Biotech sector varies widely across the country: each metropolitan area has its strengths, and there is, in general, relatively little competition in terms of overlapping research projects or industrial activity. Each has an “orientation”: for example, while Vancouver is noted mainly for its basic research activities and exploitation via small and medium enterprises (many of which are university spin-offs), the Biotech sector in Montreal is closely integrated with very large, multinational pharmaceutical companies. Biotech companies are not confined to the large metropolitan areas, however: concentrations of Biotech firms can be found in regional centres such as Sherbrooke.

ICT clusters

In many ways, ICT clusters can be considered to be the “textbook” cases of clusters in Canada. The original ICT cluster developed in Ottawa, through the wartime (WW II) activities of the National Research Council and the Defence Research Telecommunications Establishment. Bell Telephone established its Canadian research facilities in Ottawa, primarily because of the proximity of government laboratories. When spun off by Bell for regulatory reasons, Northern Electric (today Nortel) invested further in its Ottawa laboratories.

The subsequent role of the public sector has been complex, since it has involved not only support for basic research in universities and, upon occasion, directed procurements, but also regulatory activities and their consequences. The regulation of the regional telephone monopolies and their subsequent deregulation have been factors in the growth of ICT clusters across the nation and in the development of specific niche markets attractive to regionally based entrepreneurs.

In general, the Canadian federal granting agencies have invested far less in academic research in ICT than in Biotech. This may be due to a number of factors, such as the presence of mature ICT enterprises with their own in-house research facilities, and the government’s own in-house ICT research facilities. Furthermore, health is regarded as a social good in Canada, and it is thus regarded as the public sector’s responsibility to ensure that Canadians have access to leading edge health technologies – which stem from leading edge research. ICT technologies are also much easier to exploit – the cost barrier to entry into the market for ICT firms (and, indeed, commercial ICT research as well) is also much less for ICT than for Biotech.

In many ways, ICT is a combination of several industrial sectors, since it comprises not only telecommunication and electronic data processing, but also the development of software for various applications and the multimedia/entertainment sector. A few years ago these might have been regarded as separate sectors, but the boundaries have become blurred and the fields have grown together, often in synergistic ways, to become a whole. Thus ICT clusters are

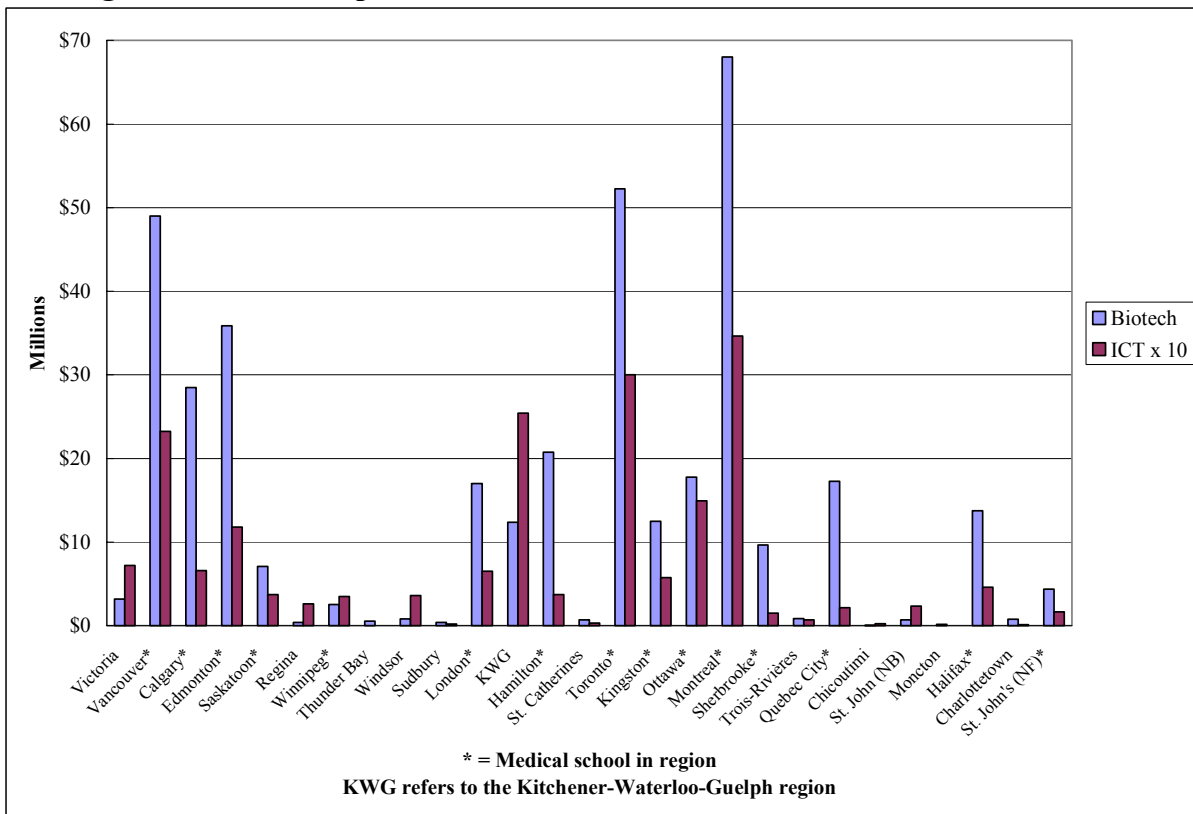
diverse, ranging from photonics to multimedia and, like Biotech, are found in regional centres in Canada such as Calgary and Waterloo, as well as in the larger metropolitan areas.

Biotech and ICT spin-offs as indicators of cluster success

Although it is argued that most university research is driven primarily by intellectual curiosity, it could also be argued that research in universities (and so their spin-offs) also follows the success of local clusters established for other reasons. But if this latter view were the case, most ICT spin-offs in Canada would be in Ottawa and most Biotech spin-offs would be in Montreal. The demands for new technologies in order to maintain the competitiveness, and thus the existence, of the clusters can be satisfied only by research at the basic levels and the commercialization of that research. The fact that most of the spin-off companies are still in existence suggests that these firms have contributed and continue to contribute to the competitiveness of their clusters. Indeed, there are examples in Canada where university spin-offs have fostered the development of clusters, such as the Waterloo ICT cluster.

Our data show that there is a good correlation between investments in Biotech by the federal granting agencies and the existence (and/or development) of Biotech clusters in Canadian cities. There is less correlation when it comes to ICT expenditures. Figure 2 presents the sum of CIHR expenditures plus NSERC expenditures in the biological sciences (“Biotech”) compared with NSERC ICT expenditures (note that ICT expenditures in Figure 2 are multiplied by 10 for visibility). The existence of significant provincial matching funds for health and Biotech in Alberta may explain the relatively large expenditures in Edmonton and Calgary in comparison with other cities.

Figure 2: Federal Expenditures on R&D in Biotech and ICT in Selected Cities



Conclusions

The data suggest that federal spending has been a factor in creating and sustaining Biotech clusters in major centres across the country. The data also suggest the role that provinces have to play in that the availability of significant matching funds for health research attracts federal funding although, according to ISRN studies, it may not have resulted yet in the creation of mature clusters (as in the case of the relatively large Biotech investments in Alberta).

There is a major role for universities in the generation of innovations and intellectual property for existing clusters. Thus the relatively low level of funding for ICT research might be of concern. This is funding that cannot be “downloaded” onto industry – industrial research, of necessity, is more applied than basic; it rarely generates the next generation of inventions. A good example of this is in the photonics sector: many of the innovations that created the industry came from universities and federal laboratories. The presence of a strong, existing cluster gave Canada a major competitive advantage in this area.

The new technologies, the “killer apps,” rarely come from established companies. Those enterprises that have succeeded in disrupting their own sectors, such as Bell Labs and Xerox, did it mostly by establishing arm’s length subsidiaries. For the most part, in a commercial sense this is not worthwhile – it is usually easier (and cheaper) to acquire intellectual property from the publicly funded university system which, by definition, is interested in new knowledge and new technologies.

Finally there is the question of the relatively few “other” spin-offs. Biotech and ICT make up most of the spin-offs. Why are there not more in the other areas? One explanation, particularly in engineering and in the social sciences (including law, economics and business administration), is that many faculty have independent consulting practices that are not recognized as spin-offs by UILOs (or by AUTM and Statistics Canada). The conclusions from the previously cited University of Calgary report tend to bear this out. But the fact remains, university spin-offs are concentrated in Biotech and ICT and some policy analysis should be directed at finding the reasons for this.

Acknowledgements

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Appendix Spin-Off Report Data

University / Number of Companies	Active	Line of Business						Total % Surviving	Location of Surviving Company *			
		Biotech	ICT	Other	Total	% ICT	% Biotech		In Region	Else-where	Total	% in Region
Alberta N = 42	Yes	20	9	2	31	29.0%	64.5%	73.8%	26	5	31	83.9%
	No	9	1	1	11	9.1%	81.8%					
McGill N = 30	Yes	14	2	3	19	10.5%	73.7%	63.3%	14	5	19	73.7%
	No	6	3	2	11	27.3%	54.5%					
Montréal N = 37	Yes	17	6	4	27	22.2%	63.0%	73.0%	22	3	25	88.0%
	No	7	1	2	10	10.0%	70.0%					
Queen's N = 25	Yes	14	2	5	21	9.5%	66.7%	84.0%	12	9	21	57.1%
	No	1	2	1	4	50.0%	25.0%					
Sherbrooke N = 13	Yes	7	3	2	12	25.0%	58.3%	92.3%	8	4	12	66.7%
	No	0	0	1	1	0.0%	0.0%					
Toronto N = 53	Yes	23	7	8	38	18.4%	60.5%	71.7%	34	4	38	89.5%
	No	9	2	4	15	13.3%	60.0%					
UBC N = 43	Yes	14	9	4	27	33.3%	51.9%	62.8%	20	7	27	74.1%
	No	5	2	9	16	12.5%	31.3%					
Medical/Doctoral Universities Totals N = 243	Yes	109	38	28	175	21.7%	62.3%	72.0%	136	37	173	78.6%
	No	37	11	20	68	16.2%	54.4%					
	% Yes	74.7%	77.6%	58.3%	72.0%							
	All	146	49	48	243	20.2%	60.1%					
SFU N = 38	Yes	5	10	9	24	41.7%	20.8%	63.2%	23	1	24	95.8%
	No	2	7	5	14	50.0%	14.3%					
Waterloo N = 20	Yes	2	10	8	20	50.0%	10.0%	100.0%	13	5	18	72.2%
	No	0	0	0	0	0.0%	0.0%					
Comprehensive Universities Totals N = 58	Yes	7	20	17	44	45.5%	15.9%	75.9%	36	6	42	85.7%
	No	2	7	5	14	50.0%	14.3%					
	% Yes	77.8%	74.1%	77.3%	75.9%							
	All	9	27	22	58	46.6%	15.5%					
All Universities Totals N = 301	Yes	116	58	45	219	26.5%	53.0%	72.8%	172	43	215	80.0%
	No	39	18	25	82	22.0%	47.6%					
	% Yes	74.8%	76.3%	64.3%	72.8%							
	All	155	76	70	301	25.2%	51.5%					

*Note: The location of four surviving firms - two spun off from Waterloo and two from Montréal – could not be determined