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# Characteristics of Growth Firms, 2004/2005

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- . not available for any reference period
- .. not available for a specific reference period
- ... not applicable
- 0 true zero or a value rounded to zero
- 0<sup>s</sup> value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- <sup>P</sup> preliminary
- <sup>r</sup> revised
- x suppressed to meet the confidentiality requirements of the *Statistics Act*
- <sup>E</sup> use with caution
- F too unreliable to be published

### Note

Due to rounding, components may not add to the totals.



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# Characteristics of Growth Firms 2004/2005

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## Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses and governments. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

## The science and innovation information program

The purpose of this program is to develop **useful indicators of science and technology activity** in Canada based on a framework that ties them together into a coherent picture. To achieve the purpose, statistical indicators are being developed in five key entities:

- **Actors:** are persons and institutions engaged in S&T activities. Measures include distinguishing R&D performers, identifying universities that license their technologies, and determining the field of study of graduates.
- **Activities:** include the creation, transmission or use of S&T knowledge including research and development, innovation, and use of technologies.
- **Linkages:** are the means by which S&T knowledge is transferred among actors. Measures include the flow of graduates to industries, the licensing of a university's technology to a company, co-authorship of scientific papers, the source of ideas for innovation in industry.
- **Outcomes:** are the medium-term consequences of activities. An outcome of an innovation in a firm may be more highly skilled jobs. An outcome of a firm adopting a new technology may be a greater market share for that firm.
- **Impacts:** are the longer-term consequences of activities, linkages and outcomes. Wireless telephony is the result of many activities, linkages and outcomes. It has wide-ranging economic and social impacts such as increased connectedness.

The development of these indicators and their further elaboration is being done at Statistics Canada, in collaboration with other government departments and agencies, and a network of contractors.

Prior to the start of this work, the ongoing measurements of S&T activities were limited to the investment of money and human resources in research and development (R&D). For governments, there were also measures of related scientific activity (RSA) such as surveys and routine testing. These measures presented a limited picture of science and technology in Canada. More measures were needed to improve the picture.

Innovation makes firms competitive and we are continuing with our efforts to understand the characteristics of innovative and non-innovative firms, especially in the service sector that dominates the Canadian Economy. The capacity to innovate resides in people and measures are being developed of the characteristics of people in those industries that lead science and technology activity. In these same industries, measures are being made of the creation and the loss of jobs as part of understanding the impact of technological change.

The federal government is a principal player in science and technology in which it invests over five billion dollars each year. In the past, it has been possible to say only *how much* the federal government spends and *where* it spends it. Our report **Federal Scientific Activities, 1998** (Cat. no. 88-204) first published socio-economic objectives indicators to show *what* the S&T money is spent on. As well as offering a basis for a public debate on the priorities of government spending, all of this information has been used to provide a context for performance reports of individual departments and agencies.

As of April 1999, the Program has been established as a part of Statistics Canada's Science, Innovation and Electronic Information Division.

The final version of the framework that guides the future elaboration of indicators was published in December, 1998 (**Science and Technology Activities and Impacts: A Framework for a Statistical Information System**, Cat. no. 88-522). The framework has given rise to **A Five-Year Strategic Plan for the Development of an Information System for Science and Technology** (Cat. no. 88-523).

It is now possible to report on the Canadian system on science and technology and show the role of the federal government in that system.

Our working papers and research papers are available at no cost on the Statistics Canada Internet site at <http://www.statcan.ca/cgi-bin/downpub/research.cgi?subject=193>.

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# Characteristics of Growth Firms, 2004/2005

## 1. Highlights

The objective of this study was to continue the investigation into growth factors initiated by the previous project: *The characteristics of firms that grow from small to medium size* (Bordt, et al., 2004) in collaboration with the National Research Council — Industrial Research Assistance Program (NRC-IRAP).

Twenty five additional interviews augmented the original 25 with a more heterogeneous mix of Canadian technology-based firms led to the development of a framework for assessing the technology phase of small companies (or business lines in larger companies).

Furthermore, the interviews led to the following additional insights:

- R&D, alliances, expertise in funding, IP protection and a non-competitive market are important in establishing the technology; they also need business advice, formal organization, formal business planning, access to business development funding, incrementally-innovative products and adaptability to rapidly-changing conditions.
- Growth firms were generally unwilling to build new products for new clients; growth was maintained by developing new product lines for existing clients.
- Firms often wanted a “big client” to champion their product.
- Growth firms also faced people-related challenges: finding the right people but also firing employees and managers who are no longer needed.
- The original location may hinder the firm’s plans to grow.
- Alliances based on trust require nurturing and shared goals.
- Firms develop cultures early in their development and these are difficult to change.
- Small firms can attract large clients with new solutions.
- One challenge is not to lose their creativity at the expense of efficiency.

## 2. Overview

### 2.1. Phase one (September 2003 to March 2004)

The first phase combined interviews and analyses of existing data on high-growth technology-based Canadian companies. The study focussed on the transition from small to medium size and provides several useful insights:

- Previous studies had suggested that to grow, technology businesses required R&D, alliances, expertise in funding, IP protection and a non-competitive market. The interviews indicated that many businesses could still make the transition even if they had none of these characteristics. The interviews suggested additional growth factors: access to business advice, formal organization, formal business planning, access to business development funding, incrementally innovative products and adaptability to rapidly-changing conditions.
- The growth factors need to be viewed in context of the company’s stage in its lifecycle, industry and “management style”.
- The statistical analysis of existing data demonstrated that:
  - Between 1995 and 2000, 1.4% of all Canadian small businesses increased their employment by 100% or more. Of all the size classes, firms with 1-99 employees were less likely to double in size than larger businesses. In contrast, 3.9% of businesses with 100-499 employees managed to double

their employment over the period. Concentrations of high-growth small firms were found in industries such as plastic products and electronic products. Geographic concentrations were found in cities such as Kitchener, Calgary, Halifax, Oshawa, Sherbrooke, Ottawa-Hull and Toronto.

- When compared to other small firms, small high-growth firms were more likely to use R&D tax credits, more likely to engage in confidentiality agreements and more likely to engage in collaborative arrangements.
- Small high-growth firms and small growing firms were more likely to engage in R&D and to use government innovation programs than stable and declining small firms.
- Small and medium size manufacturing firms tend to increase their use of advanced technology as they increase in size. Amongst larger SMEs with 50 to 99 employees, high-growth firms were consistently more likely to report adoption of advanced manufacturing technologies than non-high-growth firms.
- High-growth R&D-performing firms reported the highest levels of R&D performance whether measured per firm or per employee. Their high employment growth was paralleled by high growth in revenues, which indicates that their growth appears balanced and sustainable.

## 2.2. *Phase two (September 2004 to March 2005)*

The main characteristic of this, the second phase of the study, was that the specific transition from small to medium was dropped in favour of looking at growth in a more general sense.

In other aspects, the selection of interview candidates was intended to complement the previous study:

- To concentrate in regions not previously covered (Halifax, St. John's, Quebec City, Calgary);
- To cover other industries (less biotech and IT, more services, chemical, traditional manufacturing, etc.);
- To cover larger firms (not only medium that were once small, but to include large that may have been medium or small);
- To refocus on the overall growth phase: growth strategies, business advice and business funding;
- To position the firm's growth phase into a specific growth model;
- To cover a broader range of ages of firms (for example, focussing on a growth phase allows us to include older firms that had experienced recent growth or crises);
- To better understand adaptability (risk), management capacity, entrepreneurship and control; and
- To adapt the interview process and guides to teleconference and videoconference.

The *Interviewer Guide* and survey description are available online (see Statistics Canada, 2005).

## 2.3. *Analytical objectives*

In addition to the expanded scope of the project, the objectives of the analysis were expanded:

- To better determine which factors were important at which stages, and
- To try to frame the results in terms of a growth framework based on a combination of existing models (Goldberg, 1995 and Greiner, 1998).

### 3. Main findings

#### 3.1. *Sources of technology, R&D and innovation*

Twenty one out of the 23 firms interviewed conducted R&D. This is similar to the proportion obtained from the first set of interviews. This set of respondents tended to be quite independent in terms of technology. Few licensed technologies or engaged in partnerships simply to gain access to another firm's technologies.

The objective of most small technology firms that were interviewed was to develop a world-first product. A substantial proportion developed innovations that were new to the market (12) and world firsts (17); several claimed "disruptive" innovations (8). Most claimed product innovations (20) while fewer reported innovations in process (10), organization (5) or marketing (8). The proportion of world-first innovators was similar to the first set of interviews.

Firms with very cutting-edge world-first innovations generally wanted a customer, in many cases more than they want more government funding for R&D. Many companies preferred dealing with NASA and the US Defence Department rather than the Canadian government. Some firms have even begun to tailor their product line to appeal to these US clients only. They like them because their process is transparent; they pay for the R&D up-front, 100%. One quoted "As long as you can deliver the technology, the rest falls into place." For the firms we interviewed, delivering technology is the easy part, even though they are much smaller than the big defence contractors. The smallest firms will partner with larger US firms, while some of the more well-established will seek to get special dispensations to compete on their own as approved non-American suppliers of unique products which are vital to US defence. One firm we spoke to attempted to grow by broadening their customer base but found that the competition for cost was fierce. They have reconfigured themselves to focus on the key client, even so far as entering areas which relate to the firm's mandate but are radically new in terms of the technology supporting the mission.

The most important distinction between firms is in the nature of their product (or market). Do they have a world first that is a radical innovation? Those that have a genuinely unique product are in a different situation to other firms. They must focus on building credibility and getting the first customer to buy in to their concept.

Those firms that have a better way of doing something that has been done before must focus on differentiating their products and simultaneously building a perception of value for money amongst clients.

Those firms that do not have a particular edge must distinguish themselves by other means.

#### 3.2. *Intellectual property (IP)*

In terms of intellectual property, a few claimed to have no IP or conducted no IP protection activities (5); of the remainder, most conducted formal (16) and informal (13) IP protection activities. In comparison with the first group of interviews, the second group showed a greater preference for exploiting their IP by patenting and licensing it.

There is an overall impression that protecting intellectual property while very important, perforce protection is almost impossible. Patents serve some value, but have disclosure risks and can be costly (although not patenting your IP can lead to lawsuits or mergers to regain control over IP). Trade secrets are important, but many manufacturers recognise that competitors can and will reverse-engineer technology. This means that the firm must make constant incremental changes to their technology and products to stay ahead while at the same time some will attempt to develop, new markets for current technology and new technology. The latter case of developing new technology is not as often sought unless there is a crisis in the firm (crash of the market or the technology sector) and the R&D is conducted for the firm to survive.

#### 3.3. *Leadership and formal planning*

Most of the firms interviewed were still led by their original founders or partners (22); Overall, 11 had boards of directors but only two were led only by their boards. Changing leaders can be seen as a positive move towards growth by founders acknowledging that their capacities may not march the skills required to manage growth. However, finding leaders that do not overly disrupt the firm's harmony and can gain the trust and acceptance of the original employees is also very difficult. Firms founded by multiple partners seem to suffer from leadership crises



caused by trying to manage consensus and internal politics. This could hamper growth potential when alliances within the partnerships for in favour or against a new vision.

Some of the firms had developed decentralized management structures but one cautioned that decentralizing too early (that is, when the firm is too small, under 100 in this case), could lead to inefficiencies.

Most of the firms interviewed conducted formal planning activities: 22 produced formal annual business plans; 14 produced formal strategic plans; only two reported only informal business and strategic planning. All firms mentioned that if you were looking for capital that the major requirement was a well-presented formal business plan covering growth, market, environmental research and financing. Although the degree to which the planning looked into the future (e.g., one-year plans, five-year plans) was not specifically assessed, the majority of formal plans were revised annually.

#### 3.4. *Access to highly qualified personnel*

Only six respondents found access to HQP as a limiting factor in their growth although many quoted challenges in finding the appropriate people.

On the opposite extreme of hiring highly-qualified personnel is what to do with them when they are no longer needed. Dealing with “legacy hires” is a common issue. Legacy hires are people who were hired when top people were hard to get. Their experience with the firm means they have some value to the firm, but they can fill a place that could be filled by a top hire available when times get better (from the perspective of the hiring firm). How to deal with these people is complex and usually involves a triage process where the really weak are dismissed and the mediocre are kept on, particularly if they have built expertise in a rare area. Also, some firms have individuals who have mastery of a particular technology but are socially inept and as such, cannot be sent to deal with clients. Knowing the “when, how and which ones” of dismissing or demoting people is one of the most difficult things to do, particularly if you were the one who promoted them in the first place.

Not just legacy hiring issues are of concern. Some firms, especially smaller mid-sized firms realise the needs of maintaining their experts in times of restraint. This is only manageable when the skilled experts also some other “soft-skills” such as the ability to work well in teams, market themselves and their companies, and have cross-disciplinary skills that they can apply. New employees straight from university are preferred as they don't bring with them bad habits (this highlights a possible policy-issue: what to do with mid-career skilled employees) and the other sought after skills are the world-recognised experts. This suggests that in times of economic downturns, experienced skilled workers, although available, may face adversity getting jobs.

#### 3.5. *Competitiveness and markets*

In term of competitive environment, only four firms interviewed were in highly competitive markets and 11 were considered in “monopolistic” markets, that is few competitors. The remainder (10) were considered to be in moderately competitive markets. In general, the firms in the second set of interviews had a much more international perspective than the first. Since the second set was more likely to seek a single client, it is reasonable that they are less concerned whether their clients are local or international. In the current group, nine had clients in the US but had not expanded beyond the US and Canada. Another 14 had clients in countries other than the US and Canada.

The US market was seen as difficult to access if the firm does not have:

- American partners, or
- American subsidiaries / manufacturing plants, or
- American ownership.

US defence and space agencies are major players in high technology markets, these provide R&D funding up-front, but small players find it difficult to access these clients. Canadian government agencies do not provide the same level of support. Firms are selling-off control (51%) to US firms in order to get easier access to NASA and US defence contracts. Part of the original sales agreements include keeping R&D operations in Canada (change in

ownership will be reflected in R&D data). This business strategy has serious policy implications. NAFTA was mentioned by many of the interviewees as not evidently opening the border for business; especially post 9/11.

The small firms interviewed that remained small were as likely to be in niche or speciality markets as they were to be in moderately competitive markets (Table 1). Of the firms that grew to medium size, most had moved into moderately competitive markets.

For those purchasing from the US, the Canadian dollar was seen to hamper competition on the margin with US as high exchange rates can cut into profits. These firms are very focussed on routines, ensuring that process improvements are constantly being sought. International accreditation for quality standards is also essential for to compete globally; if these standards are too difficult to obtain, firms will look to professional accreditation as an alternative. The need for a high-profile Canadian client became apparent. The Canadian military has sometimes purchased technologies without applying them. This inhibits other countries from investing in the technology (stifling growth).

Of interest, many of the larger mid-sized firms stated that they would not be able to break into their market now. The reasons included clients (mainly large firms) that were not willing to take a risk on small firms without an established history with the technology; consolidation of small firms to take advantage of more mass production; and perceived necessary rationalisation of the market niche (too many players). It appears that small firms are more likely to break into a market when they are championing new technology or processes to fill client needs. Breaking into an established market with neither of these innovations would be perceived as very difficult. They also mentioned that recent changes to federal purchasing routines have been detrimental to the success of small business with new products.

Finally, China and India are perceived as both end-markets and as threats.

**Table 1 Current size by competitiveness of markets**

Size of firm (after growth)	Degree of competitiveness of market		
	Competitive	Moderate	Monopolistic
Large (500+)	2	0	1
Medium (100-499)	0	5	2
Small (<99)	2	6	7

### 3.6. Growth strategy and barriers to growth

Almost all those interviewed were considered to put growth (16) above control (7) or simply survival (2). This is a sharp contrast to the previous study wherein many of the firms were reluctant to seek external funds or advice for fear of the loss of control.

Growth can be limited by company structure, particularly partnerships. "Too many partners" and the need for consensus were seen as barriers to growth for some firms. Some firms bought-out and otherwise dissolved partnerships in order to focus on growth. A common theme from the Atlantic Provinces and Québec was that firm growth was stifled to a certain extent by the local economy. The locals were also unwilling to re-locate and there appeared to be a lack of trust factor inhibiting the setting-up of offices staffed by non-partners outside the region. Of interest, one Ontario firm set-up offices in the US that were managed by members of the family. Another Ontario based firm had been originally started in Nova Scotia, by an immigrant, the entrepreneur re-located to the US and then returned to Ontario. He opened a manufacturing plant, run by family, in his country of origin.

### 3.7. Sources of business and technical advice

Sources of business advice included internal (22), board of directors or advisory board (15), external coach (3), business consultant (9). The respondents also mentioned other sources of business advice including banks (2), trade associations, angel financiers and informal networks (4). The combinations of sources of business advice are shown in Table 2.

**Table 2 Sources of business advice – combinations**

Internal	Board	Coach	Consultant	Other	Number of companies
Yes	Yes	Yes	Yes	Yes	1
Yes	Yes	Yes	No	No	1
Yes	Yes	No	Yes	Yes	1
Yes	Yes	No	Yes	No	2
Yes	Yes	No	No	Yes	3
Yes	Yes	No	No	No	5
Yes	No	No	Yes	No	3
Yes	No	No	No	Yes	3
Yes	No	No	No	No	3
No	Yes	Yes	Yes	Yes	1
No	Yes	No	No	No	1
No	No	No	Yes	Yes	1

Oftentimes, the most important thing a firm with radical technology can do is to bring it to the attention of the world expert. You may have to pay them to attend as a consultant, fly them in, do the demonstration, pay their way, but you have to get them inside. Several firms did this and they got them to sit on their boards. The expert then worked as a broker between the firm and the clients.

Clients, suppliers, government agencies, universities and other businesses are also important sources of business and technical advice. These sources were sometimes viewed as providing project-level inputs rather than ongoing, general business and technical advice. They are discussed in more detail below.

### 3.8. Relationships with clients

In contrast to the previous set of interviews, this group viewed the clients almost uniquely (21/25) as individual clients rather than a mass market. **One of the consistent messages was that these firms had grown by developing custom products for known clients.** Only four respondents were developing products for a mass market. This may seem counterintuitive considering that some of the respondents became medium and large over their growth stage. In fact, when the client is a government department or a firm, even a large firm can focus on a limited set of clients.

Relationships with clients ranged from none (3) and “advisory” (10) to more “collaborative” (12). This is also a change from the previous set of interviews where a majority of the firms were targeting a mass market and were less likely to engage in collaborative arrangements.

Respondents mentioned that many industries are closed loops and just getting noticed is difficult. The up-side is that once you’re in, you’re in. Working with the US defence department is similar. It can be difficult to get in, to get noticed. Sometimes it requires partnering; sometimes it requires having a radical solution to a pressing problem. One firm we interviewed had a radical new product which was still in development but they are doing field tests in war zones because there is a pressing need and others are not able to provide the level of quality and reliability that is required.

One advised to “get as close as you can to customers to find out exactly what they want to accomplish, that way you can ensure that your product meets their needs”.

### 3.9. Relationships with suppliers

Relationships with suppliers were more distant than their relationships with clients: 7 claimed no close relationship with suppliers while 8 reported advisory relationships and 8 collaborated closely with suppliers. **This is likely as much a feature of the industries as the characteristics of the business (in some businesses suppliers are anonymous by nature).**

### 3.10. *Relationship to government*

Almost all (20) of the respondents had some advisory or financial relationship with the federal government; only 6 reported similar relationships with the provincial governments and only one worked closely with the municipal government. Eleven respondents were, at some time in their past, IRAP clients.

The Atlantic Canada Opportunities Agency (ACOA) is very popular. This program has enabled firms to survive through rough times when their income stream took a hit (post 911 for a number of firms) and to hire a few extra people who then pushed the capacity of the firm forward.

IRAP is generally well-regarded but a few clients and potential clients mentioned the paperwork required to obtain government funding. This sentiment was also expressed in the previous set of interviews. In that group, several had mentioned that IRAP funding was not only an important source of research support but a milestone that proved to investors that they had a viable product.

Only two of the 25 firms interviewed mentioned having collaborated with government laboratories.

The government is not only a supporter of business development but also a large client. Several companies mentioned that when they cannot sell to the Canadian government, other governments are reluctant to purchase their products.

### 3.11. *Relationship with universities*

In terms of their relationship with universities, 14 used universities as a source of graduates (this is with respect to specific skills); 3 used universities to train staff; 3 used universities for business advice; 9 reported that universities were an important source of technical advice or collaboration.

Awareness and education of the entrepreneurs may impact the use of government programmes. Firms which closely collaborate with universities, spin-offs in particular, are also more likely to use a variety of government programmes and services, above and beyond "funding" programmes such as IRAP, BDC, ACOA and SR&ED. Other services include using the Canadian embassies to locate clients. This may be an awareness issue. All firms are looking for business advice whether through consultants, business schools, financiers, and government.

### 3.12. *Alliances*

Fifteen respondents were engaged in alliances during their growth. Alliances were particularly important to firms attempting to open new geographic markets such as in Europe or Australia. This could be due to a need to better understand local conditions. Overall, this group was much more likely to engage in alliances than respondents to the previous set of interviews. The main difference is likely the industry of the respondents. The first set was dominated by biotechnology and ICT. This set of interviews has more firms that develop specialized manufactured goods for specific clients in a largely monopolistic market. The priority, in these cases, is to bring the world-first technology to the client before someone else solves the problem in a different way.

### 3.13. *Source of funds*

The source of funds for growth that were most frequently reported (20) were "own/private". Since the companies were generally more established than those in the last round of interviews, many could finance their growth from revenues. Nine did report taking advantage of venture capital, only four were financed by angel investors, four were public companies and two obtained funds from family and friends. Respondents also reported important funding contributions from banks (9) and government development programs (11).

VCS are not popular for a variety of reasons but if you must have them, find one that will provide more than money (i.e., advice, networking). Several firms with VCs involved said that they tried to maintain communications in a way that they not only kept them up to date (and therefore relatively happy) but they also were able to get value based on business knowledge of the VCs. Business knowledge includes both general business knowledge and highly specific industry network knowledge.

Going public too early was perceived as a risk not only due to the loss of control and organizational structure but also due to the expenses of operating a public business and the associated reporting obligations.

### 3.14. *Adaptability and approach to risk*

Adaptability was determined by assessing the extent of the most serious crisis the company had to overcome during their growth stage. At least 15 were considered to have survived a major crisis and almost all (24) took a risk when opportunities presented themselves. When asked their approach to risk only three reported being risk averse and eight admitted intentionally seeking risk. **The majority of respondents (14) maintained that they could manage risk by reducing or better understanding it.** For example, one company described a product development challenge in terms of reducing the market risk (knowing the client and developing a custom product) and the technical risk (engaging partners who had the appropriate knowledge).

Response to growth means changing how firms are managed and sometimes the people in place (managers have different capacities and can work better in different sizes of firms). This is partly a legacy-hires issue but also an issue of knowledge transfer, bringing new hires up to speed, changing roles and responsibilities (and ensuring that these changes are accepted) and changing the company culture - how to step back from employees when moving from small to medium size. The issues include work not being done as it used to be done; loss of horizontality and perceived loss of access to the boss as well as organisational flexibility. Firms need to develop organisational roadmaps and visions early in the growth plan to ensure that the "right people" or nearly right people are hired.

### 3.15. *Location*

Location is often a function of where the founder wants to live. Often times this causes problems or at least requires frequent travel. The advantage for regions is that local entrepreneurs have a strong sense of place and loyalty to the regions. For those that have located in the smaller cities, this is not seen as hampering business in an international market. Many of the respondents found ways of serving an international market from smaller cities: delivering services via the Internet, locating sufficiently close to an airport that connects to the market and establishing offices in the US and foreign market.

### 3.16. *Cost of doing business*

Canadian federal government purchasing and funding practices were sometimes criticized. The cost of doing business with the Canadian government agencies appears often to inhibit business of any substantial size. It was frequently suggested that the government should investigate the American, in particular NASA and US defence, purchasing mechanisms for new technologies, which are linked to funding for R&D.

Also, transborder shipping implies customs inspections. One company mentioned that opening of packages should have a guarantee that the contents are re-packaged correctly, damaged goods are costly.

### 3.17. *Language*

In Québec, firms with a global orientation expressed difficulties in acquiring skilled labour fluent in both French and English. As many small to medium-sized firms require that their technical employees have strong soft-skills (marketing, client relations, etc.) the ability to speak both official languages was considered essential with a third language desirable. Other firms commented that translation requirements for products developed for the Canadian government made dealing with the US and other foreign administrations much more profitable (English was the technical language required). The small and medium-sized firms found the costs of translation high and resulting work burden for verification and requirement of language skills onerous.

## 4. **A combined growth model**

A model (Table 3) considers three sets of characteristics of a technology-based business (Technology, Business and Management) through five phases of its development (Creativity, Direction, Delegation, Coordination and Collaboration; see Greiner, 1998). A business could be in different phases for each of the sets of characteristics. For example, a technically mature business may know little about its market or have little management structure. Therefore, rather than classifying a firm into a single growth phase, it is possible to classify each of the characteristic

sets. This could be done by assessing the distribution of the answers to the following questions. If, for example, the “yes” responses are mostly in Phase 1 and Phase 2, the firm would be in Phase 2 for that characteristic.

The characteristics and questions are not sufficiently well-established to provide advice on the “evenness” across the characteristics. For example, if a business is in Phase 4 for Technical but only in Phase 2 for Business, the focus should be on bringing Business up to Phase 4 before further advancing the Technical characteristics? The assumption of the model is that firms should be evolving in all three characteristics (technology, business and management).

There are many other factors besides their growth phases that differentiate firms. Business in different industries (e.g., biotechnology versus ICT; technology users versus technology developers) and with different management styles (e.g., control vs. growth) would require different sets of characteristic questions. The current model combines all archetypes into the five growth phases. Further refinement would separate the questions by archetype.

The model is best applied to projects, technologies or business lines rather than to the firm overall. Small businesses would likely be focusing on one business line whereas larger ones would be pursuing several business lines at various stages of development simultaneously. In this respect, the framework may be viewed as cyclical with new technologies being developed and becoming new business lines as the business diversifies.

**Table 3 A combined growth model for technology-based firms**

Growth Phases <sup>1</sup>	Characteristics		
	Technical (Knowledge)	Business (Market)	Management (People)
<p><b>Phase 1 – Creativity</b></p> <p><i>“In the birth stages of an organization, the emphasis is both on creating a product and a market”</i></p>	<p>Are there multiple sources of new ideas?</p> <p>Do you conduct technical feasibility studies on new ideas before you turn them into products?</p> <p>Is the technology incrementally innovative?</p>	<p>Do you have existing clients?</p> <p>Do you conduct market feasibility studies on new ideas before they are produced?</p> <p>If you are a small business, do you target small, specific clients?</p> <p>Do you collaborate with clients to produce the product?</p>	<p>Do you have access to scientific and technical skills?</p> <p>Do you have access to business (marketing and financing) skills?</p> <p>Do you have access to experienced business advice?</p>
<p><b>Phase 2 – Direction</b></p> <p><i>“Those companies that survive the first phase by installing a capable business manager usually embark on a period of sustained growth under able, directive leadership.”</i></p>	<p>Do you undertake formal IP protection?</p> <p>Do you construct prototypes?</p> <p>Do you conduct proof-of-concept studies?</p> <p>Do you collaborate with universities?</p> <p>Do you collaborate with federal laboratories?</p>	<p>Do you have access to business development funding?</p> <p>Do you have a formal business plan?</p> <p>Do you have access to sufficient capital for growth?</p> <p>Do you have a specific growth plan?</p> <p>Do you establish advisory or collaborative relationships with your suppliers?</p> <p>Do you conduct analyses of competing technologies?</p> <p>Do you assess export potential?</p>	<p>Is one of the management team an experienced businessperson?</p> <p>Does the management team establish personal networks to obtain financing and skilled human resources?</p> <p>Does the management team have access to knowledge of the regulatory environment?</p> <p>Does the management team have access to legal skills for managing IP?</p>

Growth Phases <sup>1</sup>	Characteristics		
	Technical (Knowledge)	Business (Market)	Management (People)
<p><b>Phase 3 – Delegation</b></p> <p><i>“The next era of growth evolves from the successful application of a decentralized organizational structure.”</i></p>	<p>Do you license technologies to or from other firms?</p> <p>Do you conduct scale-up or production feasibility tests?</p>	<p>Do you have a formal strategic plan?</p> <p>Do you apply for government business assistance (including R&amp;D, technology development, tax incentives) programs?</p> <p>Do you seek sources of venture capital?</p> <p>Has the firm gone public to raise funds for growth?</p> <p>Do you engage in alliances with clients or suppliers or other “complementary” firms?</p>	<p>Does the management team have access to skills for team-building?</p> <p>Does the management team have access to skills for project management?</p> <p>Does the management team have access to skills for communication?</p> <p>Has the firm developed a decentralized decisionmaking structure?</p>
<p><b>Phase 4 – Coordination</b></p> <p><i>“The evolutionary period of the coordination phase is characterized by the use of formal systems for achieving greater coordination by top-level executives taking responsibility for the initiation and administration of these new systems.”</i></p>	<p>Do you investigate alternative locations for production?</p> <p>Do you conduct production analysis to lower costs?</p>	<p>Do you establish or use distribution networks?</p>	<p>Does the firm have separate groups for sales, marketing and distribution?</p> <p>Has the firm diversified its client base beyond one industry (or market)?</p>
<p><b>Phase 5 – Collaboration</b></p> <p><i>“The last observable phase emphasizes strong interpersonal collaboration in an attempt to overcome the red tape crisis”.</i></p>	<p>Do you monitor new technologies to replace the ones you originally developed?</p> <p>Do you monitor other industries for opportunities for new applications for your technology?</p> <p>Do you monitor your competitors to determine IP infringement?</p> <p>Do you litigate IP infringements?</p> <p>Do you conduct continual R&amp;D to maintain your world-first position?</p>	<p>Do you engage in branding the company image?</p> <p>Do you work with existing clients to develop solutions in new technology areas?</p>	<p>Does the management team still have technical skills to oversee the development of new technologies?</p>

**Notes:**

1. Quotes are from Greiner, 1998.

The transition from one phase to the next, emphasizes by Greiner as the “revolution” or management change, is not well represented in this model. A second iteration of the model could add the transitions with more specific questions about leadership.

## 5. Using the model

The questions in the table may be used as the basis of a questionnaire, interview or focus group. It is important to maintain a consistent scope throughout the questioning. A smaller company should be asked to focus on its main

technology. A larger company with several product lines should focus on one. Ideally, one that typifies the technology development process in the company.

For simple situations, a yes/no answer should be possible. For more complex product lines, it may be necessary to score the response as never/sometimes/usually/always.

Within each cell, a product line can be given a score relative to the total. For an example, see Table 4.

The company profiled in Table 4 is mostly in the “Direction” phase and is moving into “Delegation”. Its technical characteristics are the least mature.

The main areas for improvement are Direction/Technical (the business may not yet collaborate with universities and federal labs, it may also not conduct feasibility studies or construct prototypes), and Delegation/Business (the business may not yet engage in alliances or seek government business assistance).

**Table 4 An example of scoring using the technology growth model**

Growth Phases	Characteristics		
	Technical (Knowledge)	Business (Market)	Management (People)
Phase 1 – Creativity	2/3=66	3/4=75	2/3=66
Phase 2 – Direction	2/5=40	7/8=87	2/4=50
Phase 3 – Delegation	1/2=50	2/5=40	2/4=50
Phase 4 – Coordination	0/2=0	0/1=0	0/2=0
Phase 5 – Collaboration	1/5=20	0/2=0	0/1=0

## 6. Conclusions

The conclusions of the first set of interviews still hold true: **R&D, alliances, expertise in funding, IP protection and a non-competitive market are important in establishing the technology.** To establish and grow the business they also need business advice, formal organization, formal business planning, access to business development funding, incrementally-innovative products and adaptability to rapidly-changing conditions. The second phase of the study has added to our understanding of how these characteristics are applied and has helped explain the development more systematically.

Firms that have the capacity to grow and are willing to grow adopt strategies and techniques that may be unique to their industry, lifecycle stage, management style and the nature of the technology they have developed. The firms interviewed for the second part of this study were largely high-technology firms with niche-market products. These firms preferred to work with a few long-term clients that were themselves financially stable. For these clients, the firms were willing to develop custom products. **Growth firms were generally unwilling to build new products for new clients.** This “build it and they will come” approach was mentioned as a common error among start-ups.

For many of these technology-based firms, **growth was maintained by developing new product lines for existing clients.** Once client relationships and track records had been established, the firms could enter into more competitive markets.

Client relationships and track records were also important to the firms since these qualities helped substantiate the firm’s legitimacy with financiers and new clients. **Firms wanted a “big client” to champion their product.** To get the “big client”, they would sometimes need to have a ready-made solution to fulfill the potential client’s need. Other companies won the big client by attracting the support of a world expert to get their product considered.



**Growth firms also faced people-related challenges.** These included not only **finding the right people** with the necessary skill sets but also **firing employees and managers who are no longer needed.** For mid-sized firms, skill sets that were in demand included strong technical and business skills as well as soft skills such as language, sales and team-building. Human infrastructure is seen as costly and managing costs is a major challenge through the growth stage.

A firm's location is often chosen by the founder. **The original location may support or hinder the firm's plans to grow.** In some cases, the community and the firm can adapt and benefit mutually.

**Alliances based on trust require nurturing and shared goals.** Firms will forego markets (e.g., foreign expansion) if they cannot develop good alliances.

Leadership is not easily imported into a firm. **Firms develop cultures early in their development and these are difficult to change.**

Many of the firms interviewed had made their breakthroughs when the technology was still new and the firm was still small. That is, **small firms can attract large clients with new solutions.** As the technology matures, it becomes the playground of larger firms. Some firms could grow to become those larger firms. Others remain small and develop new technologies.

As firms grow, **one challenge is not to lose their creativity at the expense of efficiency.** The proposed model views business growth as a cycle of creative renewal as units grow within firms to create new technical solutions and build the organizational structures that make them commercially successful.

## 7. Demographics of interviewees

### 7.1. Location

The interviews were conducted in the cities as specified in the objectives (Table 5). Seventeen of the interviews were face-to-face and 8 were teleconferences.

**Table 5 Geographic distribution of firms interviewed**

City	Number
Calgary	5
Halifax	5
Montreal	2
Ottawa	6
Quebec City	2
St. John's	4
Toronto	1
<b>Total</b>	<b>25</b>

### 7.2. Size

The distribution of size (before the growth phase) is shown in Table 6. Most of the firms began as small firms. Only in two cases were the firms interviewed medium or large-sized before their growth stage.

After the growth stage (Table 7), while all firms had grown, ten had made transitions to larger size classes. Seven became medium and three became large-sized.

**Table 6 Size distribution of firms interviewed (before growth stage)**

Size of firm	Number
Large (500+)	1
Medium (100-499)	1
Small ( $\leq 99$ )	23

**Table 7 Size distribution of firms interviewed (after growth stage)**

Size of firm	Number
Large (500+)	3
Medium (100-499)	7
Small ( $\leq 99$ )	15

### 7.3. Age of firm

The ages of the firms ranged from over 100 years to 5 years (Table 8). Most were over 10 years in age.

**Table 8 Age distribution of firms interviewed**

Age of firm	Number
less than 10 years	4
10 to 19 years	11
20 years and over	10

### 7.4. Growth stage and status

There was a variety of growth stages (Table 9) and growth statuses. Most firms were already growing or mature at the beginning of the growth stage analysed.

**Table 9 Growth stage distribution of firms interviewed**

Growth stage	Declining	Growing	Stable
Capped growth	0	1	0
Expansion	2	2	2
Mature	0	7	3
Spin-off	1	2	1
Start-up	1	3	1

## 8. References

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## Catalogued publications

### Science, Technology and Innovation statistical publications

88-001-XIE	<a href="#">Science statistics</a>
88-003-XIE	<a href="#">Innovation analysis bulletin</a>
88-202-XIE	<a href="#">Industrial research and development, intentions (with 2004 preliminary estimates and 2003 actual expenditures) (annual)</a>
88-204-XIE	<a href="#">Federal scientific activities (annual)</a>
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88F0017MIE	<a href="#">Science, Innovation and Electronic Information Division research papers</a>

#### **88-001-X Volume 30 – 2006**

- No. 1 Provincial distribution of federal expenditures and personnel on science and technology, 1997/1998 to 2003/2004 (February)
- No. 2 Biotechnology scientific activities in federal government departments and agencies, 2004/2005 (March)

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- No. 1 Distribution of federal expenditures on science and technology by province and territories, 2002-2003 (January)
- No. 2 Research and development (R&D) personnel in Canada, 1993 to 2002 (May)
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- No. 5 Estimates of total spending on research and development in the health field in Canada, 1988 to 2004 (July)
- No. 6 Estimation of research and development expenditures in the higher education sector, 2003-04 (December)
- No. 7 Federal government expenditures on scientific activities, 2005/2006<sup>P</sup> (December)
- No. 8 Total spending on research and development in Canada, 1990 to 2005<sup>P</sup>, and provinces, 1990 to 2003 (December)

#### **88F0006XIE Working papers – 2006**

- No. 1 [Provincial distribution of federal expenditures and personnel on science and technology, 1997-1998 to 2003-2004 \(April\)](#)
- No. 2 [Buying and selling research and development services, 1997 to 2002 \(May\)](#)

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- No. 1 [Federal government expenditures and personnel in the natural and social sciences, 1995/96 to 2004/05 \(January\)](#)
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- No. 3 [Industrial R&D statistics by region, 1994 to 2002 \(January\)](#)
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- No. 6 [Summary: Joint Statistics Canada – University of Windsor workshop on intellectual property commercialization indicators, Windsor, November 2004 \(March\)](#)
- No. 7 [Summary: Meeting on commercialization measurement, indicators, gaps and frameworks, Ottawa, December 2004 \(March\)](#)
- No. 8 [Estimates of research and development personnel in Canada, 1979 to 2002 \(April\)](#)
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- No. 15 [Innovation in selected industries serving the mining and forestry sectors: Results from the Survey of Innovation 2003 \(November\)](#)
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- No. 18 [Survey of intellectual property commercialization in the higher education sector, 2003 \(November\)](#)
- No. 19 [Estimation of research and development expenditures in the higher education sector, 2003-2004 \(December\)](#)
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