FACTORS THAT INFLUENCE THE FORMATION OF NEW TECHNOLOGICAL ENTERPRISES

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Introduction

In recent years, much attention has been given to high technology firms. Entrepreneurs, governments, investors, and academicians have been studying them with different objectives. The specific aspect that I am interested in is the process of starting up a high technology company and how different locations may affect it.

The objective of this paper is to develop a conceptual framework for analyzing the complex birth process of new technology-based companies. In future research, I plan to apply the framework to compare start-up rates for such companies in different geographic regions and to study which factors make a region more or less fertile.

For the purpose of this study, I will consider “high-technology companies or technology-based firms” to be those that spend more than 3% of sales in research and development. These companies are characterized by a rapid rate of change in their products and technologies.

Also for the purpose of this analysis, I will focus on firms offering some type of product or technical hardware, excluding firms offering only consulting, computer software or wholesaling and distribution. I will also omit spin-offs sponsored directly by an established firm that has formed voluntarily a new company, holding all or part of its stock, and exploiting some type of business related to the parent firm.

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1 Definition used by the National Science Foundation in Science Resources Studies Highlights, NSF81-331, December 31, 1981, p. 2.
Several studies have addressed the creation of new high-technology firms, but most of them focus on specific aspects of the process or on the characteristics of the technical entrepreneur. Also, most of these studies have been conducted within the same geographic area and industry. The framework that I am interested in developing here is global in order to apply it in different regions and different high-technology industries.

This paper presents first an introduction on the role that technology-based companies play in the economic development of the United States. Following this are five parts, each one reviewing the different factors that influence what I consider to be the five driving forces behind the birth of a technology-based firm:

- The entrepreneur
- Market opportunity
- Technology availability
- Risk capital access
- Local infrastructure

Finally, I give some conclusions and the main lines of the future research to conduct.

Given the preliminary aspects of this proposed research, I would appreciate any comments or suggestions on the present paper or the future subjects of research.

The Role of New High-Technology Companies in United States Economic Development

Technology-based companies can play a key role in the economic development and competitive position of an industrialized country. Although widely recognized, the capabilities of new technology-based industries for generating important areas of techno-economic activity and new market growth have still not been measured.

The first studies by economists of the role of technological innovation and the entrepreneur in economic growth date back more than half a century, but the measure of their real contribution remains uncertain.

There are difficulties in obtaining reliable, detailed data about new technology-based companies and their participation in the overall economic development of the United States. However, in recent years, a number of studies have been published that give evidence of their capacity for innovation and new job generation.

Both large and small companies play a vital and complementary role in the technological innovation process, although it seems that small firms are more efficient in particular types of innovation.
The contribution of production units to innovation is shown by a model developed by W. J. Abernathy and J. M. Utterback. In this model (Figure 1), product and process innovation proceeds at different rates. Enterprises in a very rapid or “fluid” state of development are characterized by high rates of product innovation, competition based on performance maximization rather than price, small size, loose entrepreneurial organization and the use of general-purpose manufacturing technology with relatively skilled labor. By contrast, as a product line matures, individual products become more and more standardized; process change tends to predominate over product change; competition is primarily based on cost minimization and minor product differentiation, and the enterprise becomes larger and more hierarchically organized with highly specialized production equipment. If we identify the small high-technology companies as being in the fluid stage of development, we may conclude that these companies are better in product innovation.

Figure 1
Stage of Development of the Manufacturing Process

Although precise measurement or description of the small businesses’ contribution to innovation is an ongoing pursuit, there are some results that suggest that small companies are efficient innovation performers. In the studies shown in Table 1, the proportion of innovation attributed to small businesses ranges from 24 to 86%.

The 1982 Gellman study, one of the most extensive studies conducted covering 635 product innovations marketed in the United States during the 1970s and representing 121 industries (4-digit level), indicates that 40% of the successfully marketed products were from small businesses. It also found that small companies bring these products to the market faster than large companies (2.22 vs. 3.05 years on average). The study also found that the incidence of innovation among the employees of small firms is significantly higher than among the employees of large firms. Small companies produce 2.5 times as many innovations as large companies, relative to the total number of people employed.
Table 1
Selected Research on the Frequency of Major Innovations by Small Firms or Independent Inventors

<table>
<thead>
<tr>
<th>Author</th>
<th>Type of Innovation</th>
<th>Innovations by Small Firms or Independent Inventors (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jenkes, Sawers, Stillerman (1958)</td>
<td>61 important inventions and innovations of the 20th Century (more than)</td>
<td>50</td>
</tr>
<tr>
<td>Hamberg (1963)</td>
<td>Major inventions during the decade 1946-1955 (more than)</td>
<td>67</td>
</tr>
<tr>
<td>Peck (1952)</td>
<td>149 inventions in aluminum welding fabrication techniques and aluminum finishing</td>
<td>86</td>
</tr>
<tr>
<td>Hamberg (1963)</td>
<td>7 major innovations in the American steel industry</td>
<td>100</td>
</tr>
<tr>
<td>Enos (1952)</td>
<td>7 major inventions in petroleum refining and cracking</td>
<td>100</td>
</tr>
<tr>
<td>Gellman (1976)</td>
<td>319 product innovations by United States industries. 1953-1973</td>
<td>24&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gellman (1982)</td>
<td>635 product innovations in 121 industries (4-digit level). 1970-1978</td>
<td>40&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Mueller (1982)</td>
<td>246 award-winning process innovations in the food processing and manufacturing industries</td>
<td>45&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Firms with fewer than 100 employees. Firms with 100 to 1,000 employees contributed another 24 percent of innovations.

<sup>b</sup> Of the total, 563 are classified by size and 226 of these are small.

<sup>c</sup> Small firms under $10 million in sales account for 45 percent of the recipient firms of known size (226).


Another interesting subject is to analyze how good high-technology companies are in creating jobs. In recent years, there has been much debate about the real role played by small companies in generating jobs in the United States. Four years ago, Birch at the M.I.T. using a computer analysis of data collected by Dun and Bradstreet on nearly 6 million companies, found that small companies, those with fewer than 100 employees, employ 30 to 40% of the United States workforce but they generated 82% of the jobs created from 1969 through 1976. This finding was questioned when a research team at the Brookings Institute released two years ago new and apparently conflicting statistics about job creation, based on their own analysis of Dun and Bradstreet's data. Small companies, they concluded, really create only about 40% of the new jobs in the United States, not much more than you would expect from their proportion of the workforce. While this debate was going on, the M.I.T. and Brookings researchers went back to their data, and they found that while they still had disagreements, the differences were more technical than real. It seems that nearly half of the companies in the Dun and Bradstreet file that have more than one plant site do not report employment for all their establishments. Birch, for his part, agreed that this had the effect of introducing a slight bias in favor of small companies. The Brookings researchers, on the other hand, agreed that their counting technique erred in the other direction, giving large companies more credit than they deserved. In fact, they said small companies generated 51% of the new jobs created from 1976 to 1980 in the United States.
This debate leads to some interesting results. The proportion of new jobs attributable to small companies in any specific period depends on how many jobs big business creates. When the economy is expanding and large companies are hiring, the ratio declines. When large companies are laying off, small companies can, in fact, be credited with more than 100% of the net new jobs generated. On the other hand, it seems that the total new jobs created by small firms as a whole is to be attributed to only a small fraction of them.

High-technology and particularly start-up companies are an important part of that fraction. Birch created a simple model to illustrate the job generation process among companies of different sizes. Let us put in a box all the jobs that exist in companies with fewer than 20 employees. Over a two-year period, the number of jobs in the box grew by a modest 2.3%. In order to illustrate this net growth in the number of jobs, Birch investigated and found that start-up companies added 9.5% more jobs to the box. Declining companies with work forces that fell below 20 employees during the period analyzed added 1.4% more jobs. The net contribution of companies that started and ended the period with fewer than 20 workers added another 2.6%. On the decreasing side, 2.3% of the jobs left the box as companies got larger than 20 employees. And finally, business failures accounted for 9% of job losses. This example illustrates the importance of jobs created by the start-up process.

While there is no specific data available at the national level on what has been the real contribution of high technology companies to job generation during the last decade, some important findings at the regional level have been published. Thus, L. E. Smollen and M. A. Levin analyzed the M.I.T. data file of about 330,000 firms in New England and found that between 1970 and 1977, Massachusetts showed an increase of 29,000 jobs in high-technology manufacturing while non-high-technology manufacturing decreased by 58,000 jobs.

It is possible to conclude that small high-technology companies generate more jobs than large ones in proportion to their share of the workforce, and that the health of an advanced industrial sector depends on the number of newly-formed high-technology businesses and the number of new jobs created by those businesses. As the MIT/Brookings work concludes, the companies that will be creating many, or possibly most of the new jobs that the United States will need 20 years from now, probably do not yet exist. That suggests that one of the things that need to be paid more attention to and encouraged is business birth if this country is to maintain its technological leadership.

The rest of this paper is devoted to an analysis of the driving forces behind the birth process of high-technology companies.

**Market Opportunity**

In the early months, new firms are often largely dependent on a single product and sometimes even on a single client. This is the reason why the start-up of high-technology companies depends so much on coupling a market opportunity with a technology application.

A company in the birth process or in its early days cannot afford to fail in its intent to introduce a new product, given in most cases the lack of financial resources. In other words, the birth of a technology-based firm depends in most cases on the success of its original new products. Successive product changes are reserved for the larger firm that has developed a cache of resources over time.
This part of the paper will analyze the factors that seem to have more influence on the success of product development, the factors that increase the market opportunities and, finally, the role that the government may play in stimulating market demand for new products offered by starting companies.

From the research done on product development, it seems that success depends on many factors. However, it is generally agreed by researchers in the field that some factors play a key role in a product’s success. The ones that have been found to have a higher correlation with success are those related with detecting, understanding and taking advantage of market opportunities.

First SAPPHO and NEWPROD Projects and, more recently, the Stanford Innovation Project\textsuperscript{10}, the only one conducted in the United States, found that of the factors statistically correlated with the success of new product development, the most important are market-related. The first and most important factor that Maidique and Zirger found to influence the success of a new product is “in-depth understanding of the customer and marketplace.” In this sense, it is very important to have good multiconnections with future customers and even physical proximity. In many cases, it is the potential user who helps the developer redesign and review the product before it is launched on the market. This finding corroborates the importance given by some authors\textsuperscript{11} to the interrelation between the new firm and the potential customer as a major contributor to the start-up.

The attractiveness of the marketplace, measured by its rate of growth, and intensity of competition, was another key factor found in the Stanford Innovation Project. Industries with high growth rates, a large market and low entry barriers (niche with low competition, lack of standards, atomization) are the best for successful new product development, and therefore, for the birth of new companies. Finally, knowledge of the future market and the entrepreneurs’ marketing proficiency were the other two key factors that Maidique and Zirger found to be of great importance in a new product’s success. These factors will be commented upon in another part of this paper where the role of the entrepreneur/s will be analyzed. These findings on the importance of market evaluation in the success of new products were consistent with the other major studies mentioned previously and were also in agreement with the results of other research done in this field\textsuperscript{12}.

In a general sense, new companies are formed by demand conditions, which vary over the business cycle. For example, when optimism rises and there is reason to assume that demand will rise, there is an increase in business starts (e.g., one of the reasons widely attributed to the increase in starts during the third quarter of 1982 in the United States). However, this could be more of an indirect than a direct effect that may lead entrepreneurs to anticipate a large demand for their specific products and therefore encourage them to start up earlier or make the demand earlier.

\textit{The Government as Market Stimulator}

There are different government actions directly affecting the market that may be an important incentive for the creation of new companies. The procurement programs through purchases and contracts offered by central or local governments, public corporations or the Defense Department, have been of extraordinary importance in the development of new industries in the United States. Arthur D. Little\textsuperscript{13} has reported that in the United Kingdom and in the German Federal Republic, contrary to the situation in the United States, only a very small fraction of
government research and development funds are available to new firms. In Europe generally, the preference seems to lie in achieving the national objectives of technology policy through large institutions and large firms; this is one of the reasons that has been argued why the rate of starting new technology-based businesses has been historically lower in these countries than in the United States.

Rothwell and Zegveld\textsuperscript{14} conducted a review of 50 major clusters of technical innovations introduced over the past half century. In a subjective assessment of the importance of the main government instruments toward technical innovation, they showed that government demand was overall the most influential factor in product development. Government support of the scientific community and universities is also important for innovation, as will be mentioned later in this paper. Contrary to public opinion, direct government subsidy makes a limited contribution, except in the nuclear power industry (Table 2).

\textbf{Table 2}
Government's Contribution to Innovation

<table>
<thead>
<tr>
<th>Industry Group (Number of Products)</th>
<th>Demand</th>
<th>Infrastructure</th>
<th>Universities</th>
<th>Subsidy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronics (10)</td>
<td>4.5</td>
<td>3.2</td>
<td>3.7</td>
<td>1.8</td>
</tr>
<tr>
<td>Chemicals (10)</td>
<td>3.6</td>
<td>2.3</td>
<td>3.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Engines, Transportation Equipment (8)</td>
<td>2.6</td>
<td>3.1</td>
<td>2.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Nuclear Power (6)</td>
<td>4.3</td>
<td>4.7</td>
<td>2.7</td>
<td>3.0</td>
</tr>
<tr>
<td>Machinery and Instruments (10)</td>
<td>2.0</td>
<td>2.1</td>
<td>1.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Basic Materials (8)</td>
<td>2.6</td>
<td>2.9</td>
<td>2.4</td>
<td>1.9</td>
</tr>
<tr>
<td>Overall Average 52 Products</td>
<td>3.3</td>
<td>2.9</td>
<td>2.7</td>
<td>1.7</td>
</tr>
</tbody>
</table>

1 Key to Rankings
5 Very big contribution or stimulus to success (i.e., radical innovation)
4 Major contribution or stimulus
3 Significant contribution
2 Small contribution
1 Very low or negligible contribution

Note: The rankings were developed by Rothwell and Zegveld.

2 Infrastructure is the scientific and technological infrastructure, i.e., public and non-profit organizations and universities.

Source: Compiled by the Office of Advocacy, United States Small Business Administration, from Roy Rothwell and Walter Zegveld. Industrial Innovation and Public Policy (Westport, Conn.: Greenwood Press, 1981), pp. 52-53.

As a major customer in many markets, government has a critical impact on demand in the innovation process and therefore in the creation of new businesses. In Fiscal Year (FY) 1981, the Federal Government of the United States spent more than $126 billion on federal procurement contracts. About $20 billion, 15.6%, of the contracts were awarded to small businesses\textsuperscript{15}. 

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Although government influence on innovation comes from different demand components, government research and development (R&D) receives greater attention than other components. In FY 1981, federal R&D contracts accounted for about 13%, or $16 billion, of all federal procurements, comprising a major share of all federal R&D expenditure in the United States [15]. Total federal expenditure in 1982 amounted to an estimated $36.1 billion and represented 47% of all R&D spending in the United States. About 6% of federally-funded R&D contracts go to small firms. Table 3 shows the distribution of R&D contracts over $10,000 by agency.

Table 3
Federal R&D Contracts Over $10,000 to Small Business by Agency, FY 1981 and FY 1979 (Thousand Dollars)

<table>
<thead>
<tr>
<th>Agency (Abbreviation)</th>
<th>FY 1979</th>
<th></th>
<th>FY 1981</th>
<th></th>
<th>Change Percent FY 79-81</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Small Firms</td>
<td>Total</td>
<td>Small Firms</td>
<td>Total Small Firms</td>
</tr>
<tr>
<td>All Agencies</td>
<td>12,682,058</td>
<td>843,987,15,820,124</td>
<td>945,745</td>
<td>12.1</td>
<td></td>
</tr>
<tr>
<td>Department of Defense (DOD)</td>
<td>8,370,008</td>
<td>526,343,10,371,273</td>
<td>666,896</td>
<td>23.9</td>
<td></td>
</tr>
<tr>
<td>National Aeronautics &amp; Space Admin. (NASA)</td>
<td>2,084,502</td>
<td>47,218,2,613,408</td>
<td>51,775</td>
<td>25.4</td>
<td></td>
</tr>
<tr>
<td>Department of Energy (DOE)</td>
<td>1,177,478</td>
<td>109,150,2,008,530</td>
<td>62,547</td>
<td>42.7</td>
<td></td>
</tr>
<tr>
<td>Department of Health &amp; Human Services (HHS)</td>
<td>519,512</td>
<td>42,632,333,110</td>
<td>32,304</td>
<td>24.2</td>
<td></td>
</tr>
<tr>
<td>Environmental Protection Agency (EPA)</td>
<td>115,711</td>
<td>42,704,190,989</td>
<td>64,452</td>
<td>50.9</td>
<td></td>
</tr>
<tr>
<td>Department of Transportation (DOT)</td>
<td>184,007</td>
<td>39,295,58,997</td>
<td>30,050</td>
<td>23.5</td>
<td></td>
</tr>
<tr>
<td>Department of the Interior (DOI)</td>
<td>110,150</td>
<td>21,747,74,696</td>
<td>21,655</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>National Science Foundation (NSF)</td>
<td>22,429</td>
<td>232,46,335</td>
<td>13</td>
<td>94.4</td>
<td></td>
</tr>
<tr>
<td>Department of Commerce (DOC)</td>
<td>7,469</td>
<td>1,423,17,623</td>
<td>5,935</td>
<td>317.1</td>
<td></td>
</tr>
<tr>
<td>Department of Labor (DOL)</td>
<td>18,760</td>
<td>640,16,629</td>
<td>298</td>
<td>53.4</td>
<td></td>
</tr>
<tr>
<td>Nuclear Regulatory Commission (NRC)</td>
<td>2,772</td>
<td>705,14,786</td>
<td>1,199</td>
<td>70.1</td>
<td></td>
</tr>
<tr>
<td>Department of Housing &amp; Urban Dev. (HUD)</td>
<td>31,977</td>
<td>6,947,13,991</td>
<td>963</td>
<td>86.1</td>
<td></td>
</tr>
<tr>
<td>Federal Emergency Management Agency (FEMA)</td>
<td>.473</td>
<td>50,9,345</td>
<td>2,316</td>
<td>4,532.0</td>
<td></td>
</tr>
<tr>
<td>Department of Agriculture (USDA)</td>
<td>1,321</td>
<td>368,6,738</td>
<td>2,742</td>
<td>645.1</td>
<td></td>
</tr>
<tr>
<td>Veterans Administration (VA)</td>
<td>4,068</td>
<td>1,314,3,590</td>
<td>873</td>
<td>33.6</td>
<td></td>
</tr>
<tr>
<td>International Development Cooperation Agency (IDCA)</td>
<td>10,150</td>
<td>493,3,056</td>
<td>-</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Tennessee Valley Authority (TVA)</td>
<td>1,429</td>
<td>22,1,937</td>
<td>-</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Arms Control &amp; Disarmament Agency (ACOA)</td>
<td>2,146</td>
<td>1,028,1,550</td>
<td>242</td>
<td>76.5</td>
<td></td>
</tr>
<tr>
<td>Department of Education (ED)</td>
<td>15,302</td>
<td>1,351,1,229</td>
<td>653</td>
<td>51.7</td>
<td></td>
</tr>
<tr>
<td>Another 11 Agencies</td>
<td>1,794</td>
<td>318,2,312</td>
<td>832</td>
<td>161.6</td>
<td></td>
</tr>
</tbody>
</table>


Gellman and Obermayer emphasize that federal R&D contracts are a significant factor in innovation. In a recent study prepared for the Office of Advocacy, SBA, Obermayer said that federal R&D contracts provide the financing for the establishment and survival of small high-tech firms. Seventy-four percent of these firms had federally-funded R&D contracts in their early years, and 48% of their chief executives stated that without these R&D contracts, their firms could not have survived.
Therefore, though the percentage of total federally-funded R&D contracts is quite small, it appears to have a considerable role in developing high-technology companies. In order to stimulate further technological innovation and increase the share of federal R&D funds allocated to small firms, in July 1982, the President signed into law the Small Business Innovation Development Act (P.L. 97-219). This Act will require each federal agency with an extramural R&D budget of $100 million or more to set aside 1.25% of those funds and award them to small businesses through a Small Business Innovation Research (SBIR) program.

Other ways in which the government can influence demand, with a direct impact on the international trade of new products, is through trade agreements, tariffs and currency regulations. These measures may increase the export of particular products, or may act as protection until the new firms in an industry have reached sufficient size to compete in an open market.

Finally, another measure that has fostered the creation of new technology-based firms has been the deregulation of certain industries (e.g., telecommunications).

Technology Availability

High-technology companies are those whose competitive strategy is driven primarily by technology. The availability of technology is a necessary condition for starting and developing a technology-based firm.

In this section of the paper, we will discuss the importance of technology in the development of new products and the ways that new firms use to obtain this technological knowledge. Universities, incubating organizations and spin-offs will be studied as sources for obtaining the technology required to fill the market need. Finally, different policies through which the government may influence the flow of technology required for the development of high-technology companies will be reviewed.

Researchers in the field of product development, such as R. G. Cooper (1979) and M. A. Maidique and B. J. Zirger (1983), have found that an important dimension leading to new product success is product uniqueness. New high-technology companies generally use technological or concept features to differentiate their products.

In order to be able to compete technologically, the new firm needs excellence in the technological capabilities of the founder or group of founders. Sometimes, in the first stages of creating a new high-tech company, the entrepreneur himself is not an expert in that technology, but it seems that at least he should become familiar with it in order to successfully take advantage of external technological resources. Roberts\(^{16}\) has found that founders of high-technology firms tend to be highly educated. But entrepreneurs with M.Sc. degrees proved to be more successful than those with B.Sc. or Ph.D. degrees. Therefore, a technically skilled labor force is an important factor conducive to entrepreneurial activity.

Allison\(^{17}\) concludes that schools with strong engineering and science capabilities and policies that encourage entrepreneurship stimulate new enterprises. The university clearly plays an important role in providing a technically skilled labor force, technical consulting and even technical spin-off companies.
The extent to which universities have functioned as incubators, with students or professors spinning off to start new firms, varies widely. In Boston, Austin and Ann Arbor, substantial percentages of the new firms studied were direct spin-offs from a university or one of its laboratories (Roberts, 1969; Susbauer, 1972; Lamont, 1971)\(^1\). In these cases, faculty have been involved in a variety of roles, sometimes being the “driving force” of the start-up, but mainly giving advice on a part-time basis and rarely giving up full-time positions to become founders. However, in Palo Alto, the epicenter of Silicon Valley and the home of Stanford University, only 6 out of 243 firms founded in the 1960’s had one or more full-time founders who came directly from a university (Cooper, 1971)\(^1\).

Thus, although this interaction between companies and universities has been shown to be a good facilitator in starting new technology-based firms, there are also instances of substantial entrepreneurship without the presence of a strong university. Shapero found that of 22 technical complexes studied, only 7 had major universities nearby\(^2\).

In some cases, universities may provide space at low cost for starting companies, thereby creating an industrial park (e.g., Stanford University), or an “incubator space” in campus-owned buildings (e.g., Rensselaer Polytechnic Institute).

As Arnold C. Cooper found in his study of the founding of new technology-based firms on the San Francisco peninsula\(^1\), the organizations already established in a particular area have a significant effect on regional entrepreneurship. Thus, the percentage of new companies with at least one founder who was already working in the area was 97.5% in Palo Alto and 90% in Austin, as reported by Cooper (1971) and Susbauer (1972), respectively. The established organizations also influenced the nature of the new businesses started. In Palo Alto, 85.5% of the new companies used the same general technology or served the same market as the parent company (see Table 4)\(^1\). In Ann Arbor, 85.7% of the new firms had initial products or services which drew directly on the founders’ previous technical employment experience and knowledge (Lamont, 1971)\(^1\).

Spin-off rates also appear to vary widely, even among firms in the same geographical region\(^1\). Some organizations function as incubators to a much greater extent than others. In Palo Alto, small firms with less than 500 employees had spin-off rates 10 times higher than large firms considered as groups. The same author, with very limited data, suggests that within large industrial firms, spin-offs occur chiefly from the “small business” within the firm and rarely from the large dominant divisions. It seems that for a business unit to be a good “incubator”, it needs to have an entrepreneurial culture. Another reason could be that the consolidated business usually deals with more mature products, with higher entry barriers. The small or development divisions are usually concerned with new emerging products which makes it easier for an independent to compete. Also some of the large firms sometimes decline to proceed with some new product projects because the potential market for that technology seems to be too small and not worth their time. But for the entrepreneur with a much lower overhead, it could be a good opportunity to start up a new company.
Table 4
Comparison of a New Firm’s Technology and Market with Those of the Parent Firm

<table>
<thead>
<tr>
<th>Market</th>
<th>Technology Similar to Parent</th>
<th>Technology Different from Parent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Similar to Parent</td>
<td>139 firms (63.2%)</td>
<td>1 firm (.5%)</td>
</tr>
<tr>
<td>Different from Parent</td>
<td>48 firms (21.8%)</td>
<td>32 firms (14.5%)</td>
</tr>
</tbody>
</table>

Note: The size of the sample was 200 companies located in Silicon Valley.


Finally, the economic and social impact of technical spin-offs can be seen from data gathered on spin-off formation. At MIT’s Lincoln Laboratory, 50 new ventures formed prior to the study had resulted in a total employment greater than that of the Lincoln Laboratory itself, namely, 1800 people. More significantly, 36 ventures that were spin-offs from a large Boston electronics firm over a 5-year period had total sales exceeding those of the parent firm at the end of the period. Therefore, it seems that in the technology-based industries, spin-offs are characterized by high growth and survival rates and by a high degree of technology transfer into new markets.

Possible Government Actions to Increase Technology Availability

In addition to the federal R&D contracts mentioned previously in this paper, the federal and state governments have different policy tools that may increase the potential technology supply of a particular state or region. Some of the more important measures can be summarized as follows:

- Setting up and supporting research laboratories to interact with industry and which are organized to function as good incubators;
- Providing technical education through public universities, and special retraining programs in order to increase technical manpower;
- Promoting collective industrial research in a variety of firms in order to improve technical progress in a branch of a particular industry or sector or in a particular scientific or technical discipline;
- Facilitating technological information flow by establishing information networks and technology brokers;
- Achieving international trade agreements favoring the development of new markets and subsequent technology transfer. This measure has been particularly effective in creating new technology-based companies in countries that adopt the strategy of technology followers.

How effective these measures are depends largely on how the policy is implemented.
Access to Risk Capital

The birth rate of high-technology companies is strongly influenced by the availability of risk capital. In the United States, changes in risk capital investment have been closely correlated to changes in the number of new companies created.

The market opportunities for new technologies are characterized by a high degree of change and growth. Accordingly, once an entrepreneur has detected a market niche for his/her technology, it needs to be exploited very rapidly in order to take advantage of the market. Otherwise, it is very likely that another competitor will enter the market or an alternative technological evolution will make the current technology obsolete.

In order to compete, high-technology companies must invest a high percentage of their resources in research and development. This means that in the worst case scenario, high-technology companies in the first stages of development require a significant amount of funds that they may not be able to generate or borrow.

The venture capital or risk capital function is to exchange cash for “equity” – a portion of the ownership. Usually, risk capital groups are interested in investing in the start-up process with “seed capital”, with the possibility of second and third-round investments in the later stages of development. However, the original risk capital must be viewed more as “creative” capital than as “expansion” capital. In this sense, “risk capital exploits market imperfections. It is the cutting edge that, together with entrepreneurs, exploits opportunities to put together apparently neutral or sterile resources to create firms with capitalized earning power, or market value, well in excess of the cost of invested funds.”

The sources of risk financing include the entrepreneurs’ personal savings, which represent the bulk of the investment in the very first seed stage of the start-up; the informal investor market, which includes family, friends, and other local individuals; the more formalized venture capital industry in the subsequent rounds; and finally, the public equity investors who invest in equity-type situations when companies go public.

Personal investments by the founders, in addition to assisting in initial financing, also play a key role in providing the credibility required in order to raise substantial capital from others. In one American study it was found that 40% of technically-oriented firms were started primarily with founders’ capital. The extent to which founders can save sufficient capital depends on salary and taxation levels. Researchers in this field believe that these factors have been very important in providing available “seed” capital in some areas of the United States to facilitate the birth of new companies.

Informal investors are defined as sources of risk capital other than professionally managed venture capital funds, equity-oriented small business investment companies (SBICs), other institutional investors or the public equity markets. Informal investors are usually relatives or friends and, above all, the so-called business “angels”, and do not include founders, friends or relatives. In a recent study conducted in New England, Wetzel concludes that “the business angels are often the most likely sources of funds for technology-based firms looking for start-up and growth capital.”

He also reports that this sample of 133 “angels” totaled over $16 million in 320 ventures from 1976 through 1980. The average investment size was about $50,000, with a median investment size of about $20,000. They teamed with other individuals, thus permitting venture
financing that approached $250,000 to $500,000. The study also shows the preference of the informal investor for investing close to home and in maintaining an active professional relationship with the investee firm. These individuals generally seek rates of return of 22 to 50%, depending on the firm’s stage of development. The study estimates that the total informal risk-capital market in New England amounts to $15 to $30 million per year for 300 to 500 ventures. It is difficult to generalize these findings, but what seems apparent is that historically informal investors have been the principal source of external seed capital.

The function of venture capital institutions is to find investment opportunities that, when proven, will yield returns in excess of those demanded in the market with comparable risk. Venture capital investors receive the bulk of their return from capital gains, from the difference between the cost of resources invested and the market value of the firms created. Venture investors normally close their investments after a period between five and ten years in order to recycle them in new opportunities. The exit is basically through public sale of the firm’s shares, merger with or sale to a larger established firm or repurchase of shares by the firm or its management.

When analyzing potential projects, venture capitalists seek new technology, entrepreneurial talent, and management resources for new business opportunities that may have significant market growth potential. The organized venture capital community consists of: venture capital subsidiaries and affiliates of banks and insurance companies and their affiliated SBICs; publicly-held venture capital firms; venture capital subsidiaries and affiliates of industrial corporations and their affiliated SBICs; unaffiliated privately-held venture capital firms and their related SBICs, and publicly-held venture capital SBICs. SBICs are private investment firms licensed, regulated and partially funded by the Government.27

Venture capital experts believe that the vigorous and sustained expansion of the venture capital industry, as noted in Table 5, has resulted primarily from government action that:

- reduced the capital gains tax from 49 to 28% in 1978;
- relaxed pension trust fund investment rules in 1979; and
- further reduced the maximum capital gains tax from 28 to 20% in 1981.28

In 1977, the industry received an infusion of $39 million of new capital. Five years later, new capital injections stood at approximately $1.7 billion. Table 5 illustrates the historical flow of venture capital in the United States and how this flow was punctuated by changes in the capital gains tax rates.

By mid-1982, the venture capital resources pool had grown to approximately $6.7 billion compared with approximately $2.5 billion in 1977. Figure 2 shows the sectors of the venture capital industry, consisting of private funds, corporate subsidiaries, and SBICs with their private capital and government leverage. Those SBICs classified as non-venture capital-related are excluded.

Pension funds may be one reservoir for enhancing the flow of long-term funds to firms with growth potential. Such funds represent the single, largest dollar source of venture capital money in the United States.
### Table 5
Venture Capital Industry – Estimated Fundings and Disbursements (Million Dollars)

<table>
<thead>
<tr>
<th>Year</th>
<th>New Private Capital Committed to Venture Capital Firms</th>
<th>Estimated Disbursements to Portfolio Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982 Estimate</td>
<td>1,700</td>
<td>1,150</td>
</tr>
<tr>
<td>1981</td>
<td>1,300</td>
<td>1,400</td>
</tr>
<tr>
<td>1980</td>
<td>900</td>
<td>1,100</td>
</tr>
<tr>
<td>1979</td>
<td>319</td>
<td>1,000</td>
</tr>
<tr>
<td>1978</td>
<td>570</td>
<td>550</td>
</tr>
<tr>
<td>1977</td>
<td>39</td>
<td>400</td>
</tr>
<tr>
<td>1976</td>
<td>50</td>
<td>300</td>
</tr>
<tr>
<td>1975</td>
<td>10</td>
<td>250</td>
</tr>
<tr>
<td>1974</td>
<td>51</td>
<td>359</td>
</tr>
<tr>
<td>1973</td>
<td>56</td>
<td>450</td>
</tr>
<tr>
<td>1972</td>
<td>62</td>
<td>425</td>
</tr>
<tr>
<td>1971</td>
<td>95</td>
<td>410</td>
</tr>
<tr>
<td>1970</td>
<td>97</td>
<td>350</td>
</tr>
<tr>
<td>1969</td>
<td>171</td>
<td>450</td>
</tr>
</tbody>
</table>


### Figure 2

As of June, 1982

- **Independent Private Funds**: 35%
- **SBIC's ***: 24%
- **Corporate ****: 41%

- **$2,521 Million**
- **$6,711 Million**

* Exclusive of Non-Venture Capital-Related SBICs
** Financial and Industrial Subsidiaries and non-SBIC Public Funds

Approximately $200 million of pension funds were invested in venture pools during 1981. For 1982, venture investment by pension funds increased to approximately $474 million, representing 33% of all venture capital raised for that period. From 1978 to the present, pension funds have contributed approximately $1 billion to the venture development process, or slightly more than one-tenth of 1% of total pension fund assets. Even this relatively small portion has provided a significant source of equity financing for growth firms. The Venture Capital Journal estimates that one out of every three dollars is invested in infant companies (see Figure 3) and that two thirds of the venture capital invested in the United States goes to computer, communication and other electronics-related companies.

Figure 3
Venture Funding

Source: Data from Venture Capital Journal.

About 600 venture capital partnerships exist now in the United States which are run by up to six people with direct business experience. In addition to funds, they provide technical entrepreneurs with experience in management, finance, marketing, production and contacts in the business community.

Though venture capital funding extends all over the United States, there is a higher concentration in the high-technology centers. Venture Capital Journal calculates that 22% of the country’s venture capital funds were managed in California in 1982, and that companies in this state attracted 39% of the venture capital invested in the United States; in contrast, New York contributed 25% of the funds in 1982 and attracted only 7% of the capital invested.

In the United States, the role of venture capital firms in the creation of new companies is enhanced by the existence of an active market in which new companies’ shares are traded and the new companies themselves are bought as a source of diversification for large firms. This facilitates fund feedback to other firms that may be starting once a new company has taken off.
Government Role Providing Risk Capital

The United States federal government has become increasingly involved in funding start-ups and expanding small firms via The Small Business Administration’s Small Business Investment Companies (SBICs), and recently announced plans to establish regional corporations to finance innovation through equity funding.

SBICs are privately owned-institutions licensed, regulated and funded through the Small Business Administration (SBA). The SBICs have played an important role in providing funds for the birth of new companies (see Figure 2). However, it seems that they have contributed more in other business types than high technology.

Local Infrastructure

From the empirical research carried out in fertile areas for creating high-technology companies, it seems that there are various factors related to the local infrastructure that stimulate the birth of this type of new firm. These factors by themselves are not sufficient to start up new technology-based companies but they may act as enhancing factors in order to facilitate the development of the other driving forces mentioned in this paper.

Before starting to analyze these infrastructure factors, it is useful to briefly mention the two contrasting views of organizational environments developed recently in organizational theory and how they can be related to the birth of high-technology companies.

The resource exchange or dependence model (Thompson, 1967; Child, 1972; Hirsh, 1975; Peffer and Salancik, 1978; Bruno and Tyebjee, 1980) views organizations as part of a continuous transactional relationship with environmental factors, given that they cannot generate all the necessary resources internally. Due to their dependence on external resources, organizations make strategic choices to minimize threats and exploit opportunities. In other words, the entrepreneur selects and acquires the most adequate external resources in order to establish his venture.

On the other hand, the population ecology model (Hannan and Freeman, 1977; Meyer, 1978; Aldrich, 1979; Pennings, 1980) views firms as members of organizational populations. As the term population denotes, for this model, organizations survive only if they are isomorphic with their environment, analogous to biological “species”. Though it has been accepted that sometimes the organization may try to manipulate its environment, the organization’s posture is much more passive and reactive to the environment than the first framework. In other words, the environment is composed of a set of influences which selectively permits some ventures to survive.

So far, we have seen that the new technology-based company has to adapt to the environment in which it is born. However, it also needs to access technological, financial and human resources available in its area in order to exploit market opportunities. Given the complexities that the entrepreneur employs to combine these resources and put enough commitment into marketing his/her product, it seems that the creation of a high-technology company can be better treated under the resource exchange approach.

The following section will comment on some of the infrastructure resources or factors that have been found to be related to the rate of creation of technology-based companies.
**Taxation**

In its different forms and different levels (local, state and federal), taxation can have a positive or negative impact on entrepreneurship. State and local personal income tax is of primary importance in relocating professional employees. Also, as we have seen, high personal income tax rates can affect the ability to collect “seed” capital for starting new ventures.

As has been mentioned previously, one of the main reasons for the expansion of venture capital availability since 1978 has been the reduction in the capital gains tax. Other tax incentives that some states are using in order to promote high-technology development are: reduction in corporate taxes, abatement of property taxes, exemption from sales tax, and research and development tax credits.

However, as shown by past experience in states such as California and Massachusetts, which have high taxes and as one author has suggested, it seems that taxation laws often delay rather than accelerate a decision to start a new company.

**Quality of Life**

The term “quality of life” is a very broad term and as Pennings has suggested recently. Quality of Life is a “multidimensional construct that some of its dimensions are positive and others are negative antecedents of entrepreneurship.” Though his study is based on urban environments and not on differentiated, high-technology businesses, he found that economic dimensions are predicated on good environmental living conditions. If we focus on some particular dimensions such as culture, climate or recreational amenities and cost of living, it seems that they can be very important for attracting highly trained people to companies. They can also have an indirect effect, if we consider the role of some large companies as “incubators”, and it is very rare for entrepreneurs to change the place they live and work in when starting new companies.

Primary and secondary schools also have their importance because most scientists and engineers, who are well-educated themselves, are convinced that a good education has been key to their own success and want good educational facilities for their children.

**Availability of Industrial and Incubator Space**

Like most companies, high-technology firms suffer from an acute shortage of capital at the start-up stage. One obvious way of making their early days easier is to provide the entrepreneur with space in adequate condition at a reasonable cost.

**Transportation Accessibility**

Accessibility to good transportation has been traditionally cited as another important consideration for high-technology companies by a number of authors. Although transportation costs may not be very important for many high-technology products, the ability to work closely with customers and the need for components may sometimes be crucial.
Management Support Services

The availability of lawyers, accountants, tax experts and consultants specializing in new high-technology ventures may be vital in facilitating the start-up process for this type of company. Most technical entrepreneurs have very little education in these fields and without the right advice, it is more difficult for the venture to be successful.

Business Climate

Like many other businesses, high-technology companies are very sensitive to an area’s business climate, including community attitudes toward business and regulations governing business start-up and operation. The community’s general attitude toward high-technology business and particularly toward the entrepreneur, as we shall see later in this paper, may be a very important incentive when the entrepreneur is deciding to create a new firm.

Finally, regulations may have a very positive effect if they are designed and applied to facilitate the development of new technologically-based firms. However, some types of regulations and particularly overregulation can be inhibiting factors for the birth of new companies.

The Entrepreneurs

In the context of this paper, the high-tech entrepreneur is seen as an individual or a group who takes the initiative to form an organization to produce a product and/or service in the area of high technology, managing with relative autonomy and sharing the risk of success or failure. The high-tech entrepreneurs are the final and main driving force in the framework that I propose for analyzing the creation of new technologically-based companies.

In this final part of the paper, I will describe the role played by the high-tech entrepreneur in the birth of a new company and the characteristics and motivating factors that these entrepreneurs seem to have. Finally, I shall briefly analyze the government as an entrepreneur.

I see the creation of high technology as a problem-solving process. Once the entrepreneur generates an idea, there is a series of goals to achieve which necessitate designing alternative solutions in order to reach them.

As indicated in Figure 4, and as we have seen previously in this paper, the first mission of the high-tech entrepreneur is to couple a market opportunity with a technology application. Usually, given the major outlay in research and development and the need to quickly exploit the market opportunity, this type of company requires a considerable amount of capital. Though the founder/s’ “seed” capital is necessary, normally it is not sufficient. Access to risk capital is therefore vital for the initial investment in a company. This process must be supported by an adequate infrastructure to facilitate the start-up. Lastly, the entrepreneur’s personal characteristics are the main driving force behind the birth of a new firm. The entrepreneur provides the energy and controls the process, looking for alternative ways of combining different forces in order to achieve the final goal.
Characteristics and Motivating Factors of High-Tech Entrepreneurs

According to the research done in this field, some personal characteristics are more frequently found among high-technology entrepreneurs. Also, it seems that particular psychological and social factors influence the decision to start a new firm.

Founders of high-technology firms tend to be highly educated. Their education includes mainly B.Sc. and M.Sc. degrees, as found in studies performed in the Palo Alto, Boston and Philadelphia areas. Their average age is in the early thirties. It seems that at this time of their careers, they have the experience and financial resources and are still willing to accept the necessary sacrifices and risks.

A number of studies of high-technology start-ups suggested that founders form groups, and these teams tend to be more successful than single founders\(^3\). A team of founders usually provides broader experience and psychological support.

Also, as has been mentioned previously, it is very common for founders of new technologically-based companies to have worked in companies that were serving the same general market or used the same general technology\(^\)\(^{3}\). In addition, in a small study involving interviews with senior executives of established firms which had generated spin-offs, Cooper found that those who had become entrepreneurs, when compared with the average technical manager or engineer who stayed, had above-average ability, were more competent, more energetic, and more concerned about the organization’s progress.
McClelland was the pioneer and major contributor to the study of whether entrepreneurs share a certain mindset. His research was based on the concept of a “need for achievement” (n Ach). He characterized individuals with high n Ach as those willing to be responsible for solving problems, setting goals, reaching these goals by their own efforts, and knowing how well they are doing in accomplishing their tasks.

On the basis of these demonstrated characteristics, McClelland suggested that entrepreneurs should have high n Ach. He conducted empirical research on this hypothesis in these major studies. First, he reported the relationship between n Ach scores and “entrepreneurial” behavior in young men in different countries. In a second study, he found that 83% of the men in entrepreneurial positions had shown high n Ach 14 years earlier, while only 21% of those in non-entrepreneurial positions had shown high n Ach. In a third study, McClelland and Winter reported that 48% of Indian businessmen who had participated in a program designed to increase the level of n Ach had subsequently been unusually active in entrepreneurial efforts, concluding in later research that such training increases the energy to establish and improve small businesses.

In all his studies, McClelland used a rather general definition of entrepreneur; he did not directly connect n Ach with the decision to own and manage a business nor with starting technology-based firms. However, several years later, it was found that 20 high-technology entrepreneurs who tended to be successful were high in n Ach and decisiveness categories.

Another characteristic that researchers have found in entrepreneurs is what they called being “Internals” or having “locus-of-control” beliefs; that is the entrepreneurs believe that their behavior is decisive in determining their fate, or in other words, they perceive the outcome of an event as being either within or beyond their personal control and understanding. Given the direct influence that entrepreneurs’ decisions have on their business performance, it seems reasonable that they believe in the efficacy of their actions.

In the same direction of trying to explain the motivation that leads to an entrepreneurial event, Shapero had identified some social factors influencing action that led to a change in the entrepreneur’s former life path and which led him to create a new company, in contrast with other actions available. Thus, the process of change in an individual’s life path is described in terms of vectors (job, family situations, force of inertia, daily “pushes” and “pulls”) that keep the individual moving in a given direction at any given time. It takes a powerful force in a new direction or the accumulation of many detracting forces before an individual is pushed into or consciously opts for a major change in his life path.

Shapero shows that individuals are much more likely to take action on negative information than on positive information, and his company’s formation data support that conclusion. Thus, negative displacements are found to precipitate far more company formations than positive displacements. Table 6 shows some of the more frequent negative displacements. Also, being out of place or between things (military service or completion of studies) led more easily to the formation of a company. Finally, although negative displacements predominate, there are many positive pulls that lead to the start-up of a business (Table 6).
According to Shapiro, “the particular action taken by an individual in a major shift from one life path to another is a product of the situation and of socially and culturally implanted predispositions.” Thus, in a social system that places a high value on risk-taking, independence and formation of new ventures, a greater percentage of individuals will choose that path in times of transition.

Other factors that influence the perception of desirability for company formation are: family background with a predominance of having one’s own business, peers who previously took this type of action, colleagues (“If he could do it, I knew I could too!” has been reported as a very frequent comment in entrepreneur interviews), and belonging to certain ethnic groups. Supporting this last point, in Boston, it was found that 13% of the technological entrepreneurs were Jewish.

Finally, the perception of feasibility also plays an important role. If one perceives the formation of a company as unfeasible, one may conclude that it is undesirable.

Therefore, the overall characteristics and motivating factors of the entrepreneur who starts a new company are consistent with conventional wisdom. Thus, the birth of a new technology-based company is easier for those entrepreneurs who are better educated, who are involved in a founding team, who have had previous related experience, who have a high “need for achievement”, and who are subjected to specific negative or positive displacements with a positive perception of desirability and feasibility.

**Government as High-Tech Entrepreneur Surrogate**

Given the importance of the creation of new companies in a country’s economic development, many governments are playing an important role in this function. However, it is not the purpose of this paper to analyze this controversial subject, which has been a long-standing object of study by economists. I will mention only the initiative taken by the governments of
some developed countries in starting new state-owned technology-based companies or participating in new private enterprises.

In the United States, the various levels of government have not taken any action in this direction so far. However, in other countries such as France, the United Kingdom, Sweden, Italy or Spain, governments have created their own high-technology firms.

The reasons that may justify direct intervention by governments in founding public technology-based firms have been studied by different authors. I will summarize some of the situations that may seem to justify their direct intervention:

- when there is a well-developed government structure and a poorly-developed private structure;
- when existing problems of private ownership bestow significant advantages on certain individuals or groups;
- when there is the desire to redistribute income;
- when capital markets are poorly developed and there is an interest in spreading the risk over the whole economy.

On the other hand, some of the reasons more frequently given against the direct intervention of the government through public enterprises are:

- without the threat of personal losses, the risks may be underestimated or even ignored by public officials;
- while there are few or no rewards to the bureaucrat for success, there may be direct cost for failure which will discourage risk-taking;
- the management style required for this type of companies in their first stages is very difficult to find among bureaucrats and to fit the culture philosophy of state-owned companies.

Therefore, although it may be possible to substitute government initiative for private initiative, as a general policy it seems difficult and unlikely to give positive results in the long term. Only in very specific cases, realizing and providing the type of resources needed in such ventures and probably only on a temporary basis, is it possible to expect some financial success.

Conclusions

High-technology companies play a key role in the economic development of a country or region through their capacity to innovate and generate employment. The birth of new technology-based firms is driven by five main forces: local entrepreneurs, market opportunity, technology availability, access to risk capital, and the local infrastructure. As we have seen from the review of the published research, there are many and diverse environmental factors influencing these driving forces. Some of these factors seem to be clearly enhancing, while others seem to be just facilitators.

From the research done in this field, it is difficult to conclude the real contribution made by each factor, and at which level one factor may be substituted by another in order to achieve the
same effect on the corresponding driving force, or whether this factor is really necessary. Also, there are no data available on which factors seem to be more important, depending on the characteristics of the region or the new firm’s industry.

If we see the start-up stage as a problem-solving decision process that requires combining the available driving forces in the right way, we can expect the efficiency of this process to be improved if adequate stimulating factors are provided or factors that act as bottlenecks are eliminated. Therefore, the first objective of my future research would be to better understand the role played by each factor and how they contribute to stimulating or stifling the corresponding driving forces. In order to achieve this objective, I plan to study and compare the start-up process in regions with different rates of formation of new technology-based companies.

From this research, I expect to establish some preliminary conclusions on why some areas are more fertile than others and what it is possible to do in order to increase or maintain that level of fertility.

The three regions that I plan to study are:

1. California’s Silicon Valley, an area renowned for its high degree of technological fertility,
2. South-Central Florida (the Miami-Tampa-Orlando-Melbourne triangle), with a moderate and rising degree of fertility,
3. the Madrid-Barcelona industrial areas in Spain, which have a very low fertility rate for new technological enterprises.

The research will involve intensive structured interviews with the entrepreneurs of 10-15 firms in each of the three regions, complemented by interviews with others that influence the process: venture capitalists, regional economic development officials, academics, and the top management of incubating companies.

Using the framework developed in this paper, and focusing on the driving forces, I plan to use the data obtained from the interviews to explain which factors affecting the driving forces were enhancing and which were inhibiting. In other words, given the existence of factors that are seen as a resource (technical labor force, incubator organizations, venture capital, etc.) or as a cost of doing business (tax structure, land cost, cost of living, etc.), the objective would be to find which of these resources and costs provide incentives and which act as bottlenecks in the start-up process.

The research sample will be drawn from companies established after 1980. The reason for this choice is that I consider the start-up process to last in general between one and five years. Of course, in some cases, it may be longer but usually, after five years, a company has to be able to start the growth process or to stabilize as a small profitable company.

I will consider the date of founding to be the time when at least one of the founders began to devote himself full-time to the business. If the initial founder is unsuccessful in putting together the necessary resources to start the venture and spends time in other activities before trying again, I will consider the date of founding to be the time when a viable firm is definitively launched.

Finally, the time schedule for conducting the field research is 18 months beginning in Summer 1984.
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   Firm Size, and Technological Innovation” (Jenkintown, Pa., prepared for the Office of
   Advocacy, United States Small Business Administration (SBA) under award no. SBA-
   2633-0A-79, May 1982). Products identified from trade journals, such as Industrial
   Research and Development, Product Engineering, Tooling and Production and Review
   of Scientific Instruments, tracked to the innovation firm or individual. Forty percent, or
   226 firms, of the 563 successfully tracked by size are small businesses. This study is an
   extension of the earlier Gellman Research Associates, Inc., “Indicators of International
   Trends in Technological Innovation” (Jenkintown, Pa., prepared for the National
   Science Foundation (NSF), April 1976). The 1982 Gellman study defines small
   businesses as having under 500 employees; the 1976 study presents innovations for
   small businesses under 100 employees and under 1,000 employees.

4. The time required to bring an innovation to market averaged 2.22 years for small firms,
   compared with 3.05 years for large firms. Similar results on the gestation period of
   product innovations were found in a study by Judith H. Obermayer on the use of
   patents in new technologies titled, “The Role of Patents in the Commercialization of
   New Technology for Small Innovative Companies” (Cambridge, Mass., prepared for the

5. D. Birch, who heads the Massachusetts Institute of Technology’s Program on
   Neighborhood and Regional Change.

6. Research conducted by The Brookings Institute, Washington, sponsored by The Small
   Business Administration.


9. The Office of Advocacy, SBA jointly with the National Science Foundation (NSF) are
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   on the Formation of High-Technology Firms and on Employment Growth” by The
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    SAPPHO – A Comparative Study of Success and Failure in Industrial Innovation,

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14. Roy Rothwell and Walter Zegveld, Industrial Innovation and Public Policy, Westport, Greenwood Press, 1981, pp. 52-53. Rothwell and Zegveld conducted extensive research into case studies and research projects on innovations introduced in the United States, France, Germany, the United Kingdom, the Netherlands, Sweden, Canada, and Japan. The authors emphasize the importance of all government demand (procurements) but do not eliminate the research and development portion of this demand.


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