Entrepreneurial Clusters in Knowledge-Driven Economies: An Essay on Their Evolutionary Dynamics

by

Mitsuyuki Ueda

M.E., Aeronautics and Astronautics
University of Tokyo, 1997

Submitted to the Sloan School of Management
In Partial Fulfillment of the Requirements for the Degree of

Master of Science in Management of Technology
at the
Massachusetts Institute of Technology

June 2003

Signature of Author: _____
Management of Technology Program
Sloan School of Management
May 9, 2003

Certified by _____
Henry Birdseye Weil
Senior Lecturer, Sloan School of Management
Thesis Supervisor

Accepted by _____
David A. Weber
Director, Management of Technology Program
Sloan School of Management

Entrepreneurial Clusters in Knowledge-Driven Economies: An Essay on Their Evolutionary Dynamics

by

Mitsuyuki Ueda

Submitted to the Sloan School of Management
on May 9, 2003 in Partial Fulfillment of the
Requirements for the Degree of Master of Science in
Management of Technology

Abstract

Technology-based entrepreneurship tends to cluster in certain regions. The most famous examples include Silicon Valley and the Route 128 area of Boston. The results of this study provide insight into why and how such entrepreneurial clusters have evolved to generate more entrepreneurial opportunities than others. With a proposed framework, the thesis first examines their evolutionary dynamics along with the System Dynamics models and the Silicon Valley case. The results show their self-reinforcing characteristics and the implication that those clusters won't start their self-reinforcing process easily at the beginning of the evolution. Subsequently, the thesis compares three case studies of Cambridge, Munich, and Tokyo, in addition to the case of Silicon Valley. The results show a similar pattern of a series of abnormal events in the history of each cluster that prompted the start of the self-reinforcing process. Throughout the study, the framework demonstrates its usefulness to streamline many factors involved, state the conditions of the entrepreneurial clusters, and extract the characteristics of the evolutionary dynamics of those clusters.

Thesis Supervisor: Henry Birdseye Weil
Title: Senior Lecturer of the Sloan School of Management

Biographical Note

The author was born and grew up in Toyama, Japan. He spent his university days in Tokyo and finished the B.E. and the M.E. in aeronautics and astronautics at the University of Tokyo. He conducted the master's thesis on the structural dynamics of large space structures at the Institute of Space and Astronautical Science. He has since worked for Japanese Government at Science and Technology Agency, which was later transformed into Ministry of Education, Culture, Sports, Science and Technology. He has worked as a government officer mainly in the areas of the nuclear energy development and the space program.

On the scholarship program of Japanese Government, he studied the public administration at the Maxwell School of Syracuse University since 2001. In the following year, he has moved to the Massachusetts Institute of Technology to study at the Management of Technology Program of the Sloan School of Management.

His wife, Takako, and the author have a baby boy, Akito, born in Syracuse.

Acknowledgement

This thesis could not be done without the influence of many people and the opportunities I have met during the stay at the Massachusetts Institute of Technology.

First of all, I would like to express my sincere gratitude to Henry Birdseye Weil. The rich conversation with him throughout the process of the research has given me an amount of inspiration which produced a number of thoughts and ideas. His experienced insights and generous attitude always encouraged me, and his broad networks helped me to get the contacts for the interviews.

I would also like to thank all the interviewees. I am afraid that the unique interview method may have troubled them and bothered their businesses, but they gave fruitful interviews providing the precious lively information of the inside people of the clusters.

Entrepreneurship is an infectious disease. The reason that a person who had never been familiar with entrepreneurship got so interested in it is due to the environment and the opportunities that the Institute brought to my life. Especially, the Management of Technology Program and my cheerful classmates were the powerful catalyst for me to have gotten infected.

Finally, I would like to thank Takako and Akito, who continuously encouraged me toward this interesting but challenging topic. I owe the development of some of my ideas to the daily conversation with Takako.

Table of Contents

Table of Figures

1 Introduction

Having the turn of the new century, it seems that a growing number of countries have come to renew their interpretation on entrepreneurship. Many governments around the world including European counties, Japan, Singapore, Korea, Mexico, and China have introduced over the past years initiatives to promote the creation of startups and new technology-based firms with the hope of having another engine of the economic growth and innovation. This widely spreading recognition is surprising because it was just up until recently that many believed large firms were the key players responsible for the economic growth and innovation.

The challenge to that belief comes from the strong economy of the United States and findings on the country: more than 95 percent of the wealth in the country has been created by entrepreneurs since 1980; new and smaller firms are responsible for 50 percent of all innovations and 95 percent of all radical innovations in the country since the World War II; 77 percent of the eight million new jobs created in the country between 1993 and 1996 were done by just 5 percent of the young and fastest growing companies (Timmons 1994, 1999); and so on. While developed large economies such as Germany and Japan have wondered at their long-lasting low economic growth in the last decade, the United States seems to fully enjoy the benefits of the advent of the knowledge-driven economy, where technology increasingly matters, with its famous historical asset of entrepreneurship.

Once it comes to a mix of entrepreneurship and technology, it tends to be seen as concentrations in certain geographical areas, not everywhere in the country. Only three regions of Silicon Valley, Southern California, and the Boston area accommodate 86 percent of the telecommunications firms and 45 percent of the computer firms in the United States. Of the semiconductor startups founded around the world between 1977 and 1989, 55 percent were located in Silicon Valley (Cooper and Folta 2000). Silicon Valley with only one percent of the population of the country gathers twenty percent of the total venture capital investments in the United States. This astonishing phenomenon is where this research started questioning. Why has a certain region like Silicon Valley evolved as a place full of entrepreneurship and technology, and not elsewhere in the same country? How has a region become capable of progressively attracting people and capital, and delivering another wave of growing firms and knowledge? Is it possible for other countries to emulate Silicon Valley in their own soil?

This thesis studies the regions with entrepreneurship and technology, first by exploring the conditions and the characteristics of them, then by examining the evolutionary dynamics of them. It is argued that those regions have the characteristics of the self-reinforcing system in their ability to let create entrepreneurial opportunities, that those regions won't start their reinforcing process

easily at the beginning of the evolution, and that it is a series of abnormal events in the history of the region that prompt the start of the reinforcing process.

The subsequent chapter overviews the literature of entrepreneurship. In Chapter 3, a framework to study those regions is proposed and used to discuss the dynamics of them along with the System Dynamics models and the Silicon Valley case. In Chapter 4, three case studies of Cambridge, Munich, and Tokyo are presented, and findings are discussed.

2 Overview: Entrepreneurship and Knowledge-Driven Economies

2.1 Entrepreneurship and Economy

The concept of entrepreneurship has drawn scholarly attention for a long time. Psychologists and sociologists have explored characteristics and social backgrounds of entrepreneurs. Economists and management researchers have examined opportunities and performance of entrepreneurial activities. The attracting nature of entrepreneurship, which has induced a pile of research, seems to rest in the notion that it is an essential driver of growth and change in our society. Although there is very little that generates consensus in the field of entrepreneurship (Verheul et al. 2002; Schoonhoven and Romanelli 2001), it is widely believed that entrepreneurs are important contributors to our society in various ways.

In his famous textbook for contemporary entrepreneurs, Timmons (1994) lists their contributions in variety. They include leadership; management, economic, and social renewal; innovation; research and development effectiveness; job creation; competitiveness and productivity; the formation of new industries; and regional economic development. From earlier years, Joseph Schumpeter, an eminent economist, sees the entrepreneur as the key impulse to set and keep the capitalist economy engine in motion in its process of *creative destruction*: '… the function of entrepreneurs is to reform or revolutionize the pattern of production by exploiting an invention or, more generally, an untried technological possibility for producing a new commodity or producing an old one in a new way, by opening up a new source of supply of materials or a new outlet for products, by reorganizing an industry and so on.' (Schumpeter 1962, p. 132)

As Schumpeter's words depict, what entrepreneurs are doing essentially is, upon recognizing opportunities, creating value by exploiting new possibilities and capturing value by offering value-added or value-created commodities (i.e., products and services) to customers in certain markets through the whole process of business, which may result in various contributions on the society as Timmons lists. Schematically this process is expressed like Figure 2-1 with the various contributions.

In this regard, we can simply categorize the ways entrepreneurs anchor opportunities, along with types of commodities and markets, largely into four: (1) introduce a new commodity to form a novel market; (2) introduce a new commodity to an established market; (3) introduce an old commodity in a new way to an established market; and (4) expand to another market with an old or new commodity (Table 2-1). These categories are not necessarily mutually exclusive. In reality, we may often see overlapping characteristics of the way entrepreneurs introduce commodities.

Table 2-1 Four ways that entrepreneurs capture value

		Market		
		Established	*Novel*	*Another*
Commodity	*Old*	Developing Market	-	Invading Market
	New	Expanding Market	Creating Market	

The four categories have different levels of impact on the economy. First, to introduce a new commodity to form a novel market is to offer new value to a whole new market that never existed. Entrepreneurs introduce a commodity that is unfamiliar to anybody and that does not belong to any established market. An example of this category would be personal computers in their infant age. There were few adopters who could imagine that personal computers would become such great gadgets as to be used in all kinds of lives in the future. This is to say *creating market*. Second, to introduce a new commodity to an established market is to offer new value to an extension of an established market. Entrepreneurs introduce a new commodity that existing customers and potential customers feel new about. An example would be personal computers with higher clock speed. This is to say *expanding market*. Third, to introduce an old commodity in a new way to an established market is to offer an established market with new value such as low price and convenience. This is to say *developing market*. Finally, to expand to another market with an old or new commodity is to offer new value to different customers. Entrepreneurs bring commodities to another market where customers are unfamiliar with them.

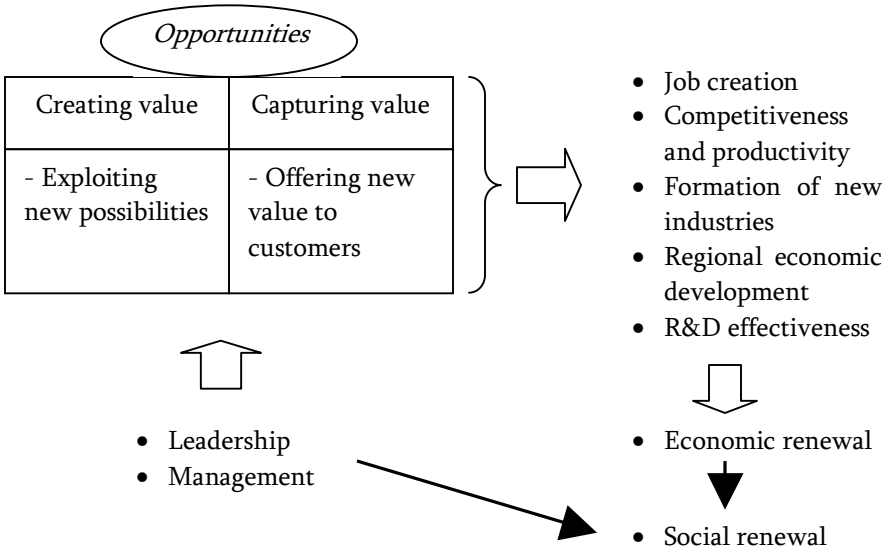


Figure 2-1 The process and contributions of entrepreneurial activity

This is to say *invading market*. Obviously creating market has the highest impact on the economy (Figure 2-2), firstly because the novel market may eventually become a huge market such as personal computers from virtually nothing, and more importantly because it is a totally new way of wealth creation to human kind. Expanding market, developing market, and invading market have impact on the economy to a lesser extent compared with creating market.

Progressing globalization and capitalism have made it almost mandatory for all economies to continuously seek higher productivity. Developing economies, by adopting technology, achieve productivity growth through manufacturing products and developing services with cheaper labor. But as their standards of living improve, they have to seek another source of productivity growth. Advanced economies, often losing manufacturing functions to developing economies, always possess compulsive incentive to seek another source of productivity through exploiting new technology. All economies are migrating, or seeking to migrate, toward higher levels of productivity where knowledge increasingly matters. In this knowledge-driven economy that has to migrate, inventing new ways of wealth creation through creating market (probably expanding market also contributes to it to a lesser extent) is invaluable.

The invention of new ways of wealth creation is a disruptive process. In his book '*Mastering the Dynamics of Innovation*,' Utterback (1994) portrays S-curves of the progress of product performance improvements. The performance of a product leaps up exponentially from the level of its *fluid phase* during its *transitional phase*, then gradually saturating in its *specific phase*. This 'established' product, which seems to enjoy its high level of performance, is eventually susceptible to being surpassed by another S-shaped progress of an 'invading' product, which started its fluid phase from a lower level of performance than the established product. Disruptiveness of the invading product is a threat to the established product, but it is the invading product that actually becomes the winner. The question is who will invent the invading product, and create new market. Christensen (1997), in his book '*The Innovator's*

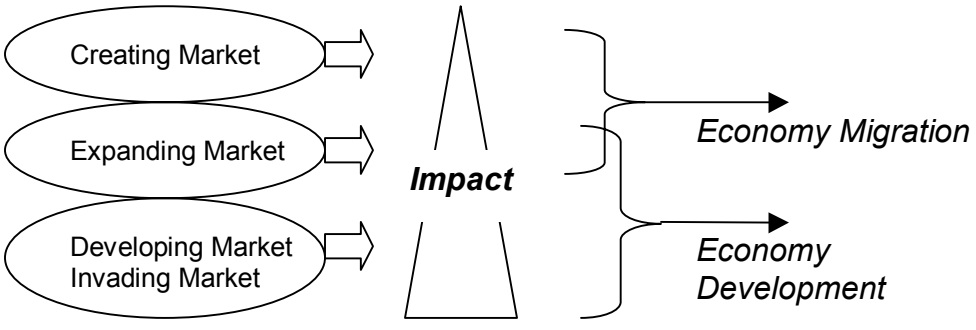


Figure 2-2 The impacts of entrepreneurial activity

Dilemma,' describes the disruptive technological innovation as a capturing process of the low end of the market that has over-served by the progress of sustaining technologies. Established firms often tend to trace a path of the technological progress that an established market demands, failing to capture the disruptive technological innovation. While he is describing as 'capturing the low end of the market,' capturing it by a new business model is in fact what seems to be creating market.

This is where entrepreneurship exercises its power. Successful entrepreneurs (and even established firms that succeed to have entrepreneurial activities) can create market with disruptive innovation, and eventually and aggregately become a huge migrating force that upgrades knowledge-driven economies. What made a difference in economic development between the United States and other advanced economies in the 1990's since the expansion of globalization and capitalism after the Berlin Wall collapse seems to be this process of migration and upgrading, or creative destruction, of its economy itself. And the entrepreneurship that has high impact is the key to mobilize economies toward successful migration and upgrade toward new wealth creation.

This thesis discusses high impact entrepreneurship that can create new market. And in this knowledge-driven economy, it increasingly involves new technologies and highly-specialized knowledge. Therefore, the author uses technology entrepreneurship as an identical notion of high impact entrepreneurship in this thesis. The definition of entrepreneurship succumbs to Schumpeter's definition mentioned above. Further, when comparison among nations is needed, the author will use advanced countries with larger population, because (1) advanced nations with higher standards of living better match characteristics of knowledge-driven economies; and (2) when entrepreneurship in a community is studied, the size of the community is considered to matter (it might be unfair to compare extremely small populations with large populations). Nations with GDP per capita (PPP) higher than US$ 20,000 and population larger than 30,000,000 in 2000 are the United States, Canada, Japan, Germany, France, Italy, and the United Kingdom. They are in fact the G7 countries.

2.2 Literature Review

2.2.1 Measurement and Impact of Entrepreneurship

Comparing the level of entrepreneurship across locations is difficult because there is no generally accepted definition of entrepreneurship. Therefore, it is complicated by the absence of a universally agreed upon set of indicators (Verheul et al. 2002; Wennekers et al. 2002; OECD 1998).

Yet there are some measurements. There seem to be two types of the measurements: static and dynamic. The static measurement is the number or the fraction of entrepreneurs in a location, which doesn't concern how young those entrepreneurial activities are. It includes unincorporated business owners, incorporated business owners, and small and medium-sized enterprises. It is mostly the stock measurement. The other one is the dynamic measurement, which concerns how young entrepreneurial activities are. It is the number or the fraction of nascent enterprises within a certain period of operation or incoming and outgoing entrepreneurs during a certain period. It includes nascent startups, incorporation registrations, establishment registrations, tax registrations, and deregistrations of those. It is either the stock measurement or the flow measurement. By using both, sometimes the entry rate, exit rate, or the combination of them is calculated.

Verheul et al. (2002) presents a static data set of business owner rate across countries done by EIM, an independent research organization in the Netherlands (Table 2-2 shows those of selected countries among 23 OECD countries they present).

Table 2-2 Static measurement: business owners as a percentage of the labor work force (EIM)

	1972	*1984*	*1998*
USA	8.0	10.4	10.3
Canada	7.9	10.0	14.1
Italy	14.3	16.5	18.2
United Kingdom	7.8	8.6	10.9
Germany*	7.6	6.8	8.5
France	11.3	9.8	8.5
Japan	12.5	12.6	10.0

Notes: Definition – Business owners are owners of both incorporated and unincorporated businesses, but excluding the so-called unpaid family workers and wage-and-salary workers operating a side-business as a secondary work activity as well as business owners in the agricultural sector.

* The data for Germany refer to West Germany for the period 1972-1990.

Source: EIM: COMPENDIA 2001.1 (Verheul et al. 2002).

The measurement is the number of business owners divided by the labor force, in which entrepreneurs are defined broadly, including the owners of both incorporated and unincorporated businesses, but excluding so-called unpaid family workers and wage-and-salary workers operating a side-business as a secondary work activity as well as business owners in the agricultural sector. This measurement includes all types of heterogeneous activities across sectors. For example, unincorporated businesses and incorporated businesses have different aspects of activities. People leading an unincorporated business usually draw no salary but use the profits of the enterprise to cover personal expenses. They have full personal liability for the conduct of the business. On the contrary, people leading an incorporated business are owner-managers who gain a share of the profits as well as a salary. They run a risk equal to his/her share of the invested capital in the business (Verheul et al. 2002). It seems that the high impact entrepreneurship that this thesis concerns fits better to the profile of incorporated businesses because those businesses are ready to grow.

Data of dynamic indicators of entrepreneurship are scarce (Verheul et al. 2002). Reynolds et al. (2002) are leading an initiative, called Global Entrepreneurship Monitor, to describe and analyze entrepreneurial processes within a wide range of nations. Their Total Entrepreneurial Activity (TEA) index is based on the surveys of representative samples of the adult population in nations. The TEA measurement is the sum of those individuals involved in the startup process (nascent entrepreneurs) and individuals active as owner-managers of firms less than 42 months old, and those who qualified for both are counted only once. From 1,000 to 16,000 individuals were interviewed in each nation, and the measurement is a statistical estimate.

Table 2-3 Dynamic measurement: people with entrepreneurial activity as a percentage of the labor work force (GEM TEA index)

	2000	*2001*	*2002*	*Average*
USA	12.7	11.7	10.5	11.6
Canada	7.9	11.0	8.8	9.2
Italy	5.7	10.2	5.9	7.3
United Kingdom	5.2	7.7	5.4	6.1
Germany	4.7	7.0	5.2	5.6
France	2.2	7.2	3.2	4.2
Japan	1.3	5.1	1.8	2.7

Note: Definition – People with entrepreneurial activity are those individuals involved in the startup process (nascent entrepreneurs) and individuals active as owner-managers of firms less than 42 months old (those who qualified for both are counted only once).

Source: Global Entrepreneurship Monitor.

Table 2-4 Dynamic measurement: enterprise entry rates and exit rates in the period of 1995-2000 (averages per year) (non-harmonized data)

	# of Entries	*Entry rate (%)*	*# of Exits*	*Exit rate (%)*
USA	594,133	10.9	529,123	9.7
Japan[1]	92,811	4.5	80,435	3.3
Singapore[2]	8,807	11.0	4,416	5.3
Austria	20,341	7.4	13,369	4.9
Belgium	57,900	8.4	56,398	8.2
Finland	24,946	12.3	21,684	10.6
France	273,084	11.6	248,250	n.a.
Germany[3]	443,600	15.7	352,200	12.6
Greece[4]	87,423	11.0	61,702	7.8
Ireland[5]	21,015	14.2	11,923	8.2
Italy	352,121	8.1	280,364	6.5
The Netherlands	75,351	10.2	40,962	5.5
Portugal[6]	28,744	13.2	19,449	9.1
Spain[7]	327,564	13.3	282,035	11.4
Sweden	36,238	8.2	9,259	2.0
United Kingdom[8]	175,888	10.9	166,132	10.3
Iceland	2,534	8.2	764	2.6
Switzerland	29,512	7.5	20,217	5.1

Notes: Entry and exit rates are percentages of the total stock at the end of the previous year, and are expressed as annual averages. USA – Units are employer firms. Years start at March of the previous years. Japan – Units are establishments covered by unemployment insurance. Years start at April (FY). Singapore – Units are companies. Austria through Switzerland – Units are enterprises/establishments/VAT units.

1 # of entries and exits are averages of FY1999 and FY2000. 2 Data are from 1996 to 2000. 3 No data on 1995 exist; rates start from 1997. 4 No data on 1998 and 2000 exist. 5 No data on 2000 exist. 6 Entries have been calculated until 1998; data on exits until 1997. 7 Rates have been calculated from 1996 onwards. 8 Data only until 1999.

Sources: Japan – Ministry of Health, Labor, and Welfare; Annual Report on Unemployment Insurance Programs.

USA – U.S. Small Business Administration; Statistics of US Businesses.

Singapore – Registry of Companies and Businesses.

Austria through Switzerland – European Commission; Observatory of European SMEs 2002/No 5.

Measurements of the TEA index are available for 20 countries in 2000, 20 countries in 2001, and 37 countries in 2002. Table 2-3 shows the TEA indices of selected countries. According to Reynolds et al., the TEA index is the only one in

existence to provide a direct measure of individual-level, grassroots entrepreneurial processes, which can be used as a basis for reliable international comparisons. The two data sets of EIM and GEM exhibit a contrast, especially for Italy and Japan. The measurements of Table 2-3 are much lower than the measurements of Table 2-2 for the two countries. This is probably due to that those countries have large fractions of unincorporated businesses.

Another dynamic measurement is entry rates and exit rates. The entry rates and exit rates are often used for examining the trend of entrepreneurship for a location in a span of certain time period. The difficulty for comparing across countries is that the indicators are not harmonized across countries. Some countries have the data on establishments that register for value added tax (VAT); others have the data on establishments that resister for unemployment insurances; and so on. Table 2-4 is a collection of the data of the countries relatively easily available to the author. The definitions of the measurements differ among countries. Therefore it makes little sense to compare the number of entries and exits, but entry rates and exit rates are rather more comparable because they measure dynamic changes of the each country's status of business activities no matter what definitions are used. We can see high rate of entry and exit, or turbulence, in business activities in such countries as the United States, the United Kingdom, France, and Germany; and low turbulence in Japan.

The impact of entrepreneurship on economic development, especially the process of how it impacts, is controversial. Thurik et al. (2002) explore the relationship between entrepreneurship and economic performance with several historical case studies. They conclude that the explanatory power of the various determinants and the weight of the various consequences differ between historical periods.

Yet, economic evidence suggests that entrepreneurship is a vital determinant of economic growth. The positive and statistically robust link between entrepreneurship and economic growth has been indisputably verified across a wide spectrum of units of observation, spanning the establishment, the enterprise, the industry, the region, and the country (Audretsch et al. 2002; Reynolds et al 2002).

Reynolds et al. (2002) study the association between the level of entrepreneurship activity and economic growth by using the Total Entrepreneurial Activity (TEA) index and GDP growth. The correlation of the TEA index is zero with the two-year previous economic growth, low but nearing statistical significance with the prior-year and current-year growth, statistically significant and moderately positive with the following-year growth, a clearly statistically significant positive correlation with the second-following-year growth, and a positive but not statistically significant relationship with the third-following-year growth. This association infers that the high level of entrepreneurial activity leads to the positive change in economic growth in about two years after. Reynolds et al. say that it indicates that changes in the economic structure and market processes within a country that lead to economic

growth may occur more quickly when an active entrepreneurial sector is available to implement such changes.

Here as a trial to follow these observations, the association between the entry rates and GDP growth is presented in Figure 2-3. The entry rates are the annual averages during 1995-2000 from Table 2-4 and GDP growth is the annual averages during the same period. Although we should take a note that entry rates are based on non-harmonized data, we see a nearing statistically significant positive correlation (p=0.06).

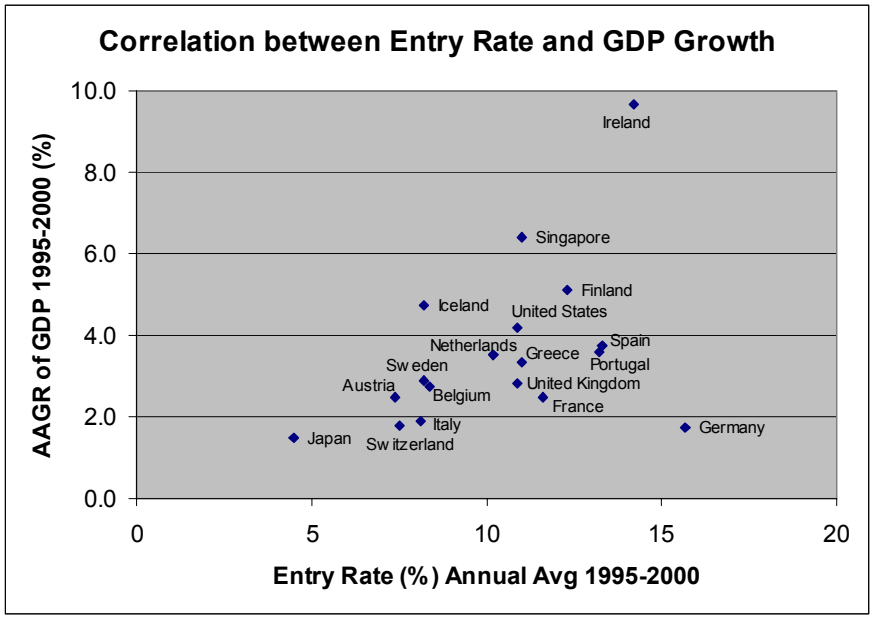


Figure 2-3 An example of correlation between entry rates and GDP growth

Note: Based on non-harmonized data. Y = 0.31 X + 0.35 (R square = 0.20).
Sources: Table 2-4. GDP data – World Bank, World Development Indicators.

2.2.2 Determinants of Entrepreneurship

Some studies have been conducted to assess the origins or determinants of entrepreneurship to explain the level of entrepreneurship across times or locations, although at the level of individuals, many studies span a wide spectrum of theories and explanations.

Wennekers et al. (2002) explore the determinants of variations in entrepreneurship, both historically and across nations, at the macro-level analysis. They illustrate differences in aggregate conditions, such as technology, level of economic development, institutions, culture, and demography, causing differences in opportunities, resources, skills and preferences with regard to entrepreneurship using Dutch case of the 17th century and Britain case of Industrial Revolution.

Verheul et al. (2002) introduces the Eclectic Theory as a framework for understanding and analyzing what determines entrepreneurship. The Eclectic Theory integrates factors shaping the demand for entrepreneurship (product market perspective, carrying capacity of the market) on the one hand, with those influencing the supply of entrepreneurs (labor market perspective) on the other hand, which can be referred to as pull and push factors. The Eclectic Theory involves all levels of consideration such as micro (individual entrepreneurs), meso (sectors of business), and macro (national economy) perspective. Figure 2-4 shows their framework. Demand represents the opportunities for entrepreneurship. The greater the diversity of consumer demand, the more room is created for entrepreneurs. The opportunities are also influenced strongly by industrial structure. Supply of entrepreneurship is dominated by the characteristics of the population. Key elements are the resources and abilities of individuals and their attitudes towards entrepreneurship (preferences). The cultural and institutional environment influences the supply side of entrepreneurship. Risk-reward profile is based on the demand factors and the supply factors. Then the occupational choices of individuals are made on the basis of their risk-reward profile. At the aggregate level these choices materialize as entry and exit rates, which form the rate of entrepreneurship. Government can influence various factors.

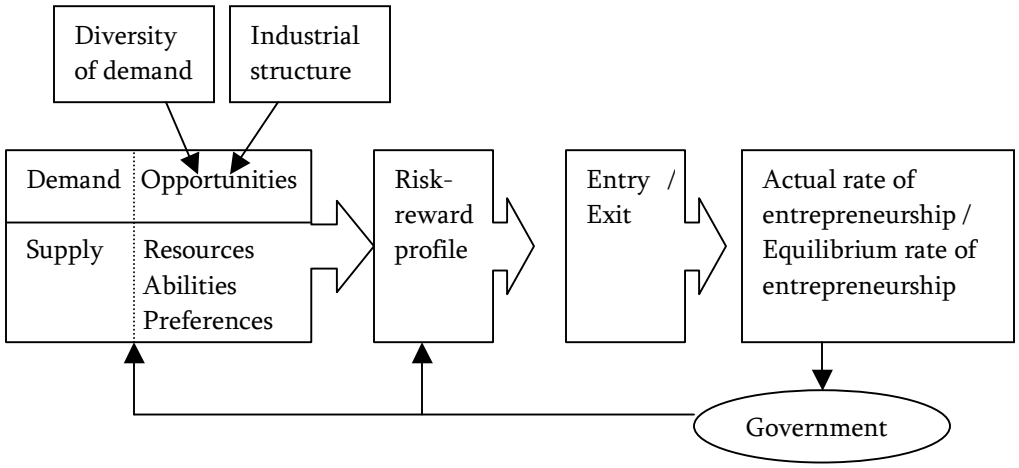


Figure 2-4 Verheul et al. (2002), Eclectic Theory framework

Reynolds et al. (2002) present a conceptual model of the determinants of entrepreneurship as well as the economic impacts of it. Figure 2-5 contains 'entrepreneurial framework conditions,' which span from financial conditions to cultural/social norms, that influence the emergence or presence of market opportunities and the capacity of the people to initiate new firms in pursuit of those opportunities, leading venture creation. As an impact, the role of entrepreneurship in

the creation and growth of new firms is considered one of the primary sources of national economic progress, with the role of large established firms.

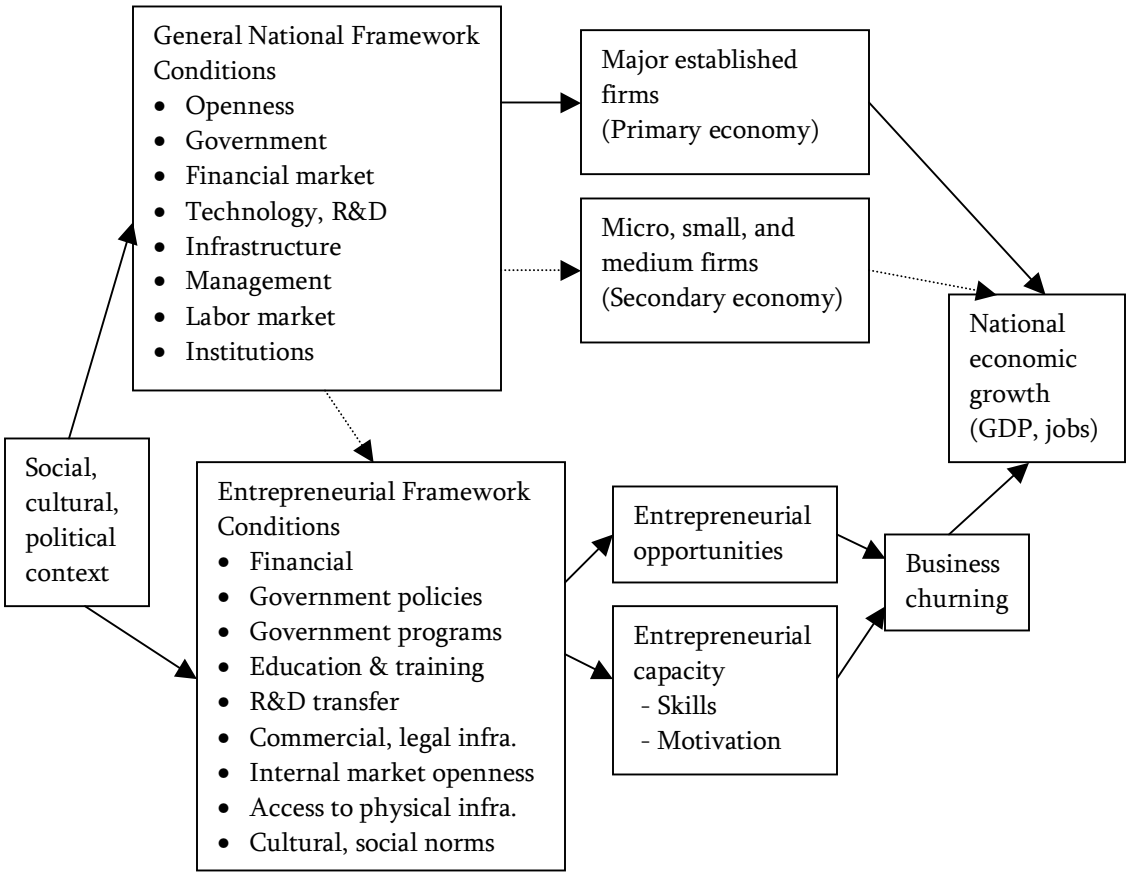


Figure 2-5 Raynolds et al. (2002), GEM conceptual model

2.2.3 Clusters and Technology Entrepreneurship

Clusters are geographically proximate groups of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities (Porter 1990, 1998). Clusters have been drawing more attention than ever although expanding globalization allows us to gain goods, capital, and information more cost effectively from the world. Clustering can be seen in a lot of particular fields from traditional industries to high tech industries in various levels of geographic areas such as winery in Northern California, video games in Tokyo, ceramic tiles in Italy, telecommunications in the Nordic countries, and so many examples. Porter sees that even though old reasons for clustering have diminished in importance with globalization, new roles of clusters in competition have taken on growing importance in an increasingly complex, knowledge-based, and dynamic economy. With his excellent model (Figure 2-6) of Diamond Theory, Porter explains

the competitive advantages of a location lying in the quality of the environment it provides for achieving high levels of productivity. Four aspects of a national (and state or local) environment that define the context for growth and innovation and productivity are: factor conditions (basic inputs of factors of production); the context for strategy and rivalry (context of rules, social norms, and incentives fostering investment); demand conditions (characters of local markets); and related and supporting industries (local presence of capable suppliers and related industries). He has been proving that the four types of location-based advantages together constitute a dynamic system that drives the competitive advantage of a location.

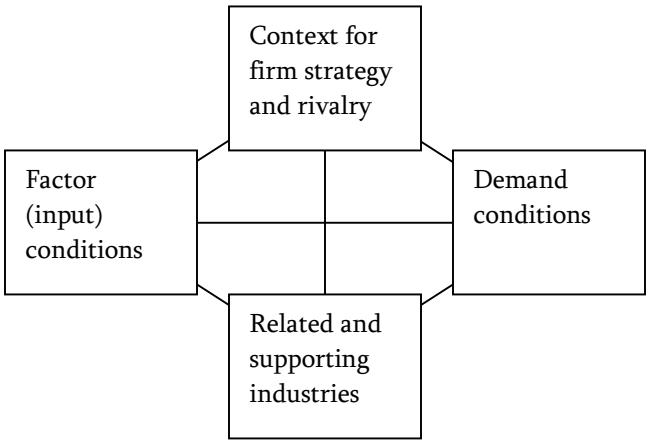


Figure 2-6 Porter (1990, 1998), Diamond Theory framework

Concerning the question if entrepreneurship itself tends to be geographically concentrated, Cooper and Folta (2000) cite academic findings showing that there is a positive relationship between new firm formation and regional population density, and that higher firm entry rates and exit rates tend to go together and are found in regions characterized by greater economic diversity, more population growth, more volatile industries, and where greater personal wealth and more mid-career experienced adults are found.

Yet what we often see is that technology startups cluster particularly in certain regions, probably much higher concentration than all startups. However, few have considered why some clusters may have higher rates of new venture formation than others (Cooper and Folta 2000).

At the same time, technology entrepreneurship is a relatively unexplored topic (Shane and Venkataraman 2003). Reviewing related literature, Shane and Venkataraman point out the importance of careful examination of the context in which entrepreneurs operate instead of focusing exclusively on the entrepreneurs

themselves when considering technology entrepreneurship because of the role of technology, technical systems, and institutions in the founding processes of firms.

Several articles show interesting locational aspects of technology entrepreneurship. Gregorio and Shane (2002) examine the rate of new firm formation with exploitation of university patents in the U.S. By statistical analysis of 101 universities, they find that three university characteristics influence this entrepreneurial activity from universities: intellectual eminence of universities; policies of making equity investments in start-ups; and policies of giving inventors a low share of royalties. What is interesting about their findings, though, is that the availability of venture capital proximate to universities doesn't have statistical significant effect on the formation rate of startups.

Stuart and Sorenson (2003) examine the founding rates of new biotechnology firms from 1978 to 1996 in the U.S. in association with proximity to resources that entrepreneurs would need. The resource factors include proximity to universities with biotech-relevant departments, proximity to biotech patents, proximity to venture capital firms, and proximity to established biotech firms. Their statistical analysis shows that the areas with high density of established biotech firms experience the highest rate of new biotech firm creation, so do the areas with high density of venture capital firms. They argue that biotech firms concentrate because entrepreneurs find it difficult to leverage social ties necessary to access to expertise workforce when they reside far from those resources. Also concerning biotechnology, Prevezer (1997) examines several states in the U.S. that have a significant number of biotechnology firms, and finds that the founding rate of biotech firms is strongly correlated with the number of employment in the related science base such as universities and research institutions in each state.

Some literature examines the characteristics of particular clusters of technology entrepreneurship. Saxenian (1996) compares Silicon Valley and the Route 128 area of Boston, and observes the regional advantage of rapid growth of Silicon Valley over the Route 128 area. She argues that it rests in a regional network-based industrial system of Silicon Valley that promotes collective learning and encourages more experimentation and entrepreneurship, which the Route 128 area in contrast lacks due to a small number of relatively integrated corporations. We will examine particular clusters in Chapter 3 and Chapter 4 with other studies on the clusters such as Silicon Valley and Cambridge of the United Kingdom (e.g. Segal 1986; Garnsey and Smith 1998).

2.3 Entrepreneurial Clusters

From the literature review, we can understand that (1) the level of entrepreneurship varies across locations and times; (2) the level of entrepreneurship has positive association with economic growth; (3) some studies have explored the determinants of entrepreneurship and presented wide arrays of factors and conditions, but not specifically those of technology entrepreneurship; and (4) technology entrepreneurship has dynamic tendency to cluster in particular locations with some determinants such as university characteristics and the presence of existing firms and science base. There seems to be, however, no comprehensive explanation of the determinants and dynamics of technology entrepreneurship in light of the strong clustering nature of it. There needs to be a systematic way of understanding the nature of entrepreneurial activities in knowledge-driven economies often concentrated and evolved in a specific geographic region, a way which enables us to see those entrepreneurial activities from a different perspective from the entrepreneurship research on individuals or Porter's general Diamond Theory of clusters.

This thesis treats this area first presenting a framework to analyze it. The framework is to capture the determinants and dynamics of entrepreneurial activities that have the high impact and technology-involving nature, and tend to cluster in specific regions. The author calls those geographic concentrations of technology entrepreneurship *entrepreneurial clusters*. In this knowledge-driven economy, technology entrepreneurship is becoming a center of interests for achieving economic growth and migration. The author thinks that understanding the nature of entrepreneurial clusters is an important and useful approach to serve those interests.

3 Entrepreneurial Diamond

3.1 Opportunities

Before exploring factors and conditions that drive dynamics of entrepreneurial clusters, it is useful to review insights of entrepreneurship education because it is ultimately microeconomics that determines aspiring entrepreneurs' decisions to settle and start their businesses.

In his textbook of entrepreneurship education, Timmons (1994, 1999) provides a useful analytical model that isolates three primary forces behind successful venture creation: team (founders), opportunity, and resources (Figure 3-1). Timmons says that by assessing and influencing these forces, an aspiring entrepreneur can improve the chance of success. This process is a core, fundamental entrepreneurial process that accounts for the substantially higher success pattern.

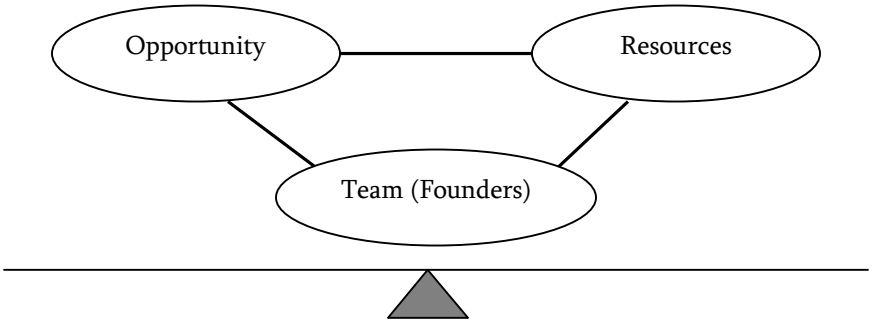


Figure 3-1 Timmons (1994, 1999), model of entrepreneurial process

First, the entrepreneurial process starts with opportunity. It is a business opportunity from underlying market demand. Entrepreneurs create, shape, recognize, and seize the opportunity. While at the center of an opportunity is always an idea, not all ideas are opportunities. Successful new ventures are anchored in good opportunities with rewarding margins and free cash flow. Second, to execute the opportunity requires identifying, attracting, and managing the resources such as assets, key people, business plan, and financial resources. Timmons says that entrepreneurs' approaches are to minimize and control the resources, not necessarily own the resources. Third, the team, consisted of a lead entrepreneur and an entrepreneurial team, is a key ingredient in the higher potential venture. Timmons emphasizes that founders are more important than the technology even for high-technology companies. There is a saying among venture capitalists that a grade A entrepreneur and team with grade B idea is preferred over a grade B team with a grade A idea. Quality management team is critically important to the chances of survival and

expansion of new ventures. Finally, Timmons says that successful entrepreneurs seek fit and balance among the three forces throughout the startup processes.

Different environments surrounding entrepreneurs offer different levels of difficulty to manage all of those success criteria: it may be easier for entrepreneurs to recognize business opportunities at some locations in some time; entrepreneurs may encounter difficulty to find resources at a location they live; and entrepreneurs at some locations may have little chances to meet candidates for their founding colleagues. In this regard, the manageability of all of the three criteria of the entrepreneurial process is characterized by opportunities in a broad sense that an environment surrounding entrepreneurs can offer. Timmons' 'opportunity' is business opportunities or market opportunities that entrepreneurs can recognize from their environments. The difficulty to identify and attract the resources depends on the availability of the opportunities to access them. The probability of forming good founding teams is affected by the opportunities to meet bright people with common interests. With this importance of opportunities in mind, a framework for entrepreneurial clusters is introduced in the next section.

3.2 Entrepreneurial Diamond: A Framework

Why is a certain region like Silicon Valley full of high impact entrepreneurial activities and not elsewhere in the same country? Why is a region capable of progressively attracting quality people, firms, and capital? Why do we often see intensive knowledge creation and innovation flourish from a region?

A key to answer these questions can be found in opportunities. Opportunities are not inherently given to a location. Opportunities concerning entrepreneurial activities are recognized and seized by people and through their interactions. A successful entrepreneurial cluster like Silicon Valley is a place full of entrepreneurial opportunities. Some are attracted to the region by the hope of seizing opportunities. Some are inspired by opportunities arising in the region. Then, a part of them are successful enough to anchor the opportunities to create high impact growing ventures. As is the case far back in the age of Gold Rush, opportunity is what fascinates human nature deeply.

To understand the capability of a region to let create entrepreneurial opportunities and analyze the dynamics of entrepreneurial activities, a comprehensive framework embracing determinants of technology entrepreneurship is useful. A proposed framework (Figure 3-2) is to help work with entrepreneurial clusters. The framework consists of four broad attributes of a region: *Input Conditions*, *Entrepreneurial Context*, *Networking Conditions*, and *Market Conditions*. These attributes, independently and as a system, drive opportunities, and evolutionary dynamics of entrepreneurial clusters. The author calls it *Entrepreneurial Diamond* framework.

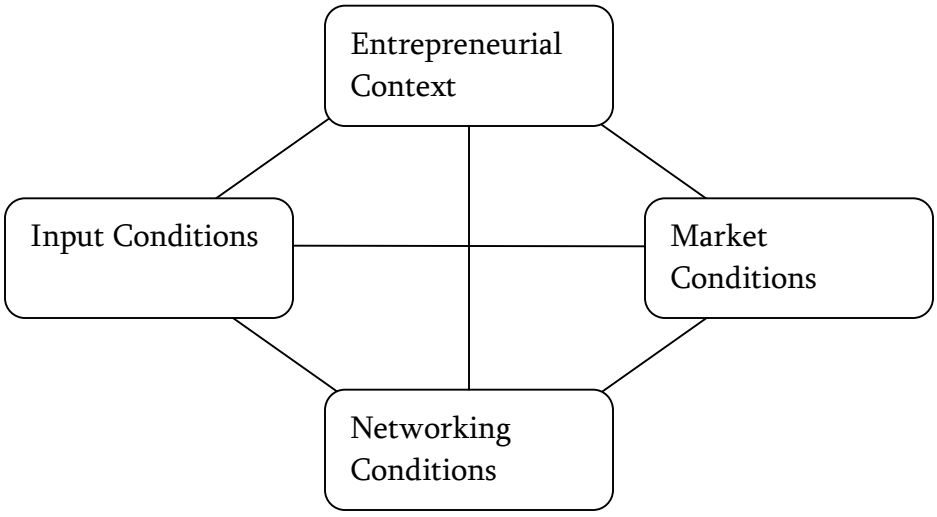


Figure 3-2 Entrepreneurial Diamond framework

INPUT CONDITIONS are the availability conditions of what people involved in entrepreneurial activities need to get throughout the whole process of entrepreneurship. Factors relating the input conditions include inputs such as technical knowledge, founding colleagues, management skills, employees, loans, risk money, mentors, office spaces, lawyers, accountants, suppliers, and so on. The availability of those inputs to form entrepreneurial opportunities is a crucial matter to high impact entrepreneurship.

Among those, several factors are what distinctively shape a profile of the input conditions favorable for high impact entrepreneurial clusters. First, a number of quality people in a region enhance the chance of encountering good entrepreneurial opportunities. Here, quality people are those with specialized knowledge, good management skills, or proactive energy for innovation. A technology startup that has included quality people simply has a greater chance of success. Further, in a region, sophisticated conversations among them may generate good ideas and business chances. Interactions of them may give a birth to a promising founding team. Some of them may become an insightful mentor and financier that back another startup. The availability of quality people and the chances of interactions among them are a positive force to drive startup creation and growth. Universities, research institutions, and business schools play an important role to provide a base of quality people.

Second, getting finance is one of the central opportunities that technology entrepreneurs seek. However, the risk profile of technology startups, whose principle assets are often merely ideas, knowledge, and human resources, is different from the risk profile of other enterprises that have substantial real assets. A failed technology startup leaves virtually no residual assets, although rewards of success of technology startups are very high. Money that assumes such risk and return are different from that of ordinary banks. Risk money providers such as venture capital partnerships and individual investors, often called angels, are an important factor of technology entrepreneurship. Because of the huge risk, risk money needs close monitor and mentoring so that successes more than make up for failures. It requires them to understand technology, know how to structure the business, and physically locate proximate to their investment. Proximity further matters because technology often involves tacit knowledge that face-to-face communication better transfers. Another aspect of risk money is that venture capitalists and angels can provide not only money but also mentoring. These backers often coach founders who lack management know-how and advice, and provide social networks to experienced candidates for executives or business services that founders' networks cannot reach.

Third, knowledge that is created in a region intensifies opportunities for technology entrepreneurship by being transmitted or exploited. It is created in technology ventures, established firms, universities, and research institutions such as public laboratories. High context technical knowledge, which drives innovation and new wealth creation in the knowledge-driven economies, is often intangible,

uncertain knowledge. It is best transmitted via face-to-face interactions and through frequent contacts. This aspect of knowledge, rendering the importance of geographic proximity, works in entrepreneurial clusters paradoxically in the age of globalization where information transfer to a distant place gets cheaper and faster.

ENTREPRENEURIAL CONTEXT is social and regulatory frameworks that either encourage or discourage entrepreneurial activities. Factors that shape the entrepreneurial context include stigma of failure, prestige, familiarity, success stories, failure stories, cultural features, labor mobility, laws and regulations governing startup process or bankruptcy, tax system permitting concentrations of wealth, and so on.

Although social part of this attribute is often called a climate or a culture, we can identify several factors that play different roles in it. First, the so-called stigma of failure hangs over would-be entrepreneurs as a powerful deterrent to starting ventures because the majority of technology ventures are considered to fail. We sometimes hear the difference of the level of entrepreneurship across regions explained by the difference of the level of the stigma of failure, but nasty image toward failures is universal in all cultures in the world. Failures are failures. However, if we consider it practically, what distinguishes some regions with generosity toward failures from others seems to be in part the existence of another chance from a failure. People can not be generous toward an unsuccessful person if the person has no chance and motivation to climb up again. Growing economies create growing job opportunities even for a person with the stigma of failure attached to him. Knowledge-driven economies with various knowledge-based sectors tend to suffer from shortage of specialized workforce constantly. A successful entrepreneurial cluster like Silicon Valley matches both characters of growing economies and knowledge-driven economies, having a plentiful of chances from a failure for those who are eager to succeed and have specialized knowledge or skills. Thus the existence of another chance from a failure plays an important role for shaping social part of the entrepreneurial context.

Second, the prestige attached to entrepreneurs and the familiarity with entrepreneurs is the catalysts for aspiration of entrepreneurs. The high prestige in a society attracts followers of quality people. The familiarity affects would-be entrepreneur's decisions of entry. Role models often strongly affect followers. These factors along with factors such as success stories and failure stories tend to shape the perception and mental models of people toward entrepreneurial activities. We will examine these factors and their interactions in the next section.

Finally, there are some cultural features that are notable. Results-oriented meritocracy is a cultural feature that can be seen in some companies and nations as well as in an entrepreneurial cluster. Lee et al. (2000) describe this feature in Silicon Valley. 'In the Valley, talent and ability are king. In today's Silicon Valley, ethnicity,

age, seniority, and experience are not what dictate opportunity or responsibility… The region's merit-based system removes obstacles for immigrant entrepreneurs.' Further, they describe open business environment. 'Although companies in Silicon Valley fiercely compete, there is also an attitude that all can gain from sharing knowledge that is not company-secret… Within this open environment, individuals are open to win-win exchanges of knowledge. Whether in formal or informal settings, interactions among people with overlapping networks of relations are continuous and intense.' What can be said from these cultural features is that both are enhancing opportunities; opportunities for talented minority and opportunities for exchanges of knowledge to exploit. A favorable entrepreneurial context in a region is what enhances the entrepreneurial opportunities.

NETWORKING CONDITIONS are the existence and usability conditions of social/personal networks or networking opportunities. Factors involved in the networking conditions include universities, institutions, personal networks among entrepreneurs, academic/industry collaboration, seminars and conferences, ethnic identity, and so on.

Networks arise from many overlapping kinds of associations. People may have been colleagues at an established firm, or share university ties. They may share an ethnic identity and belong to a group, or they may share a professional identity. Networks among different associations are also formed by active involvement in daily life activities such as external jobs, joint projects, academic/industry collaboration, and seminars and conferences. Another noteworthy generation process of networks is spin-offs. Spin-off is a new company that arises from a parent organization. Typically, employees leave the parent organization, taking along a technology that serves as the entry ticket for the new company in a high-tech industry (Carayannis et al. 1998). By generating ties in the process of spin-offs among entrepreneurs and investors, as well as maintaining ties with the parent organizations, spin-offs contribute to the construction of dense social networks of entrepreneurs, investors, research institutions, and established firms. Finally, universities play a very important role. For graduates and many spin-offs from universities, universities are the place they can rely on for the consultancy of latest knowledge and the source of specialized workforce. Universities are the center of people's social ties as well as the center of knowledge, therefore, the anchors for networks.

Networks convey information on various things. Information on people through networks makes it productive to hire employees, to find founding colleagues, to explore potential customers and suppliers, or to evaluate potentials of technology ventures. Information of knowledge and ideas goes through networks to generate another knowledge and collective learning. Information on success stories inspires would-be entrepreneurs and attracts money. Information of risk money and mentoring becomes available through networks reaching venture capitalists and

angels. These kinds of information are so central to technology ventures that it is not an exaggeration to say that the chance of success for a technology venture can be determined by effective networks that it possesses.

Geographic proximity promotes repeated interactions and mutual trust needed to sustain effective networks. Sensitive information on people and high context knowledge is best transmitted by face-to-face communications. In fact, the most strategic relationships are often local because of the importance of timeliness and face-to-face communication for rapid innovation. Tight links built over time by the accumulation of shared conversations yield rich and productive relationships, which facilitate the critical flow of knowledge and ideas, people, and capital. Effective networks themselves seem to have an affinity with critical entrepreneurial opportunities clustering in a region.

MARKET CONDITIONS are the existence, potential, and accessibility conditions of markets for goods and services, as well as equity stocks of ventures. The market conditions are directly related with market opportunities. Factors concerning the market conditions include innovativeness of demand, diversity of demand, development stage of new technologies, government procurement and R&D contracts, related industries as customers, and equity market.

Many new ventures run out of money before they find enough customers for their products or services. It is crucial for entrepreneurs to timely seize market opportunities. General observation is that the more imperfect the market is, the more abundant the market opportunities are. There are some implications from this observation. First, innovativeness of demand matters. The first customers for high impact ventures, innovators and early adopters as defined in the adoption theory, have to be willing to assume risks involving information asymmetries and inconsistencies of information. Geographic concentration of the adopters of such characteristics offers an advantage for nearby entrepreneurs to seize this market opportunity. Second, entrepreneurs are more likely to find niche markets when they are familiar with demographic population that has diversity in demand because gaps in demand offer more room for niche markets.

New technology itself is a market opportunity. Government procurement and contracts, especially from the military, may serve as early demands of new technologies in an early development stage. Government may set high standards for the technologies and be willing to take the risk involved in the technologies with a lump sum of finance. Related industries that run in the same development stage of a new technology field as technology ventures are collaborators with whom entrepreneurs can share knowledge, as well as customers that entrepreneurs may find dependable.

Finally, an access to a developed equity market for technology ventures is an important requisite for technology entrepreneurship. By selling growing ventures,

entrepreneurs and risk money providers can retrieve the awards they deserve. Without such an exit, risk money cannot make investments in young ventures.

Dynamics of the Diamond

The four attributes of a region constitute the four nodes of the entrepreneurial diamond. Each attribute includes necessary conditions for the success of a region as an entrepreneurial cluster, and the cluster fosters entrepreneurial activities when all the attributes have more or less favorable profiles. No matter how favorable three of them are, entrepreneurial activities will be limited if the cluster leaves one attribute awkward. For example, a cluster that has favorable profiles of the input conditions, the entrepreneurial context, and the market conditions, but no favorable networking conditions may not create a lot of opportunities because close interactions and communications do not happen. The diamond works as a system.

Moreover, the favorable four attributes are self-reinforcing. A favorable diamond fosters entrepreneurial activities, and creates new ventures continuously. Some portion of the new ventures will eventually grow to the level where they have high impact on economies. These high impact ventures will influence on the profile of the diamond where they were born.

Figure 3-3 shows the dynamics of a cluster from the broadest level. The high impact ventures influence on many things. Among them, three of the Diamond nodes are affected directly. First, high impact venture creation improves the profile of the input conditions. New growing ventures add to the number of growing companies in the cluster. Because of the growth, a larger number of growing companies attract more equity investment, which improves risk money availability. New growing ventures also deliver success entrepreneurs. Success entrepreneurs tend to provide capital and mentoring to new ventures, thus improving risk money and mentoring availability. Thus the input conditions are improved. Second, the accumulation of the successes of high impact ventures and entrepreneurs also leads to the improvement of prestige, meaning the higher profile of the entrepreneurial context. A larger number of growing companies lead to more jobs, enhancing chances from a failure, another factor of the entrepreneurial context. Third, because high impact ventures created or expanded markets, more market opportunities must have arisen. And a larger number of growing companies form or develop an equity stock market for technology ventures. The market conditions are also improved.

Once the improvement of the profile of the nodes of the diamond occurred, it has ripple effects on other nodes. Examples are the following.

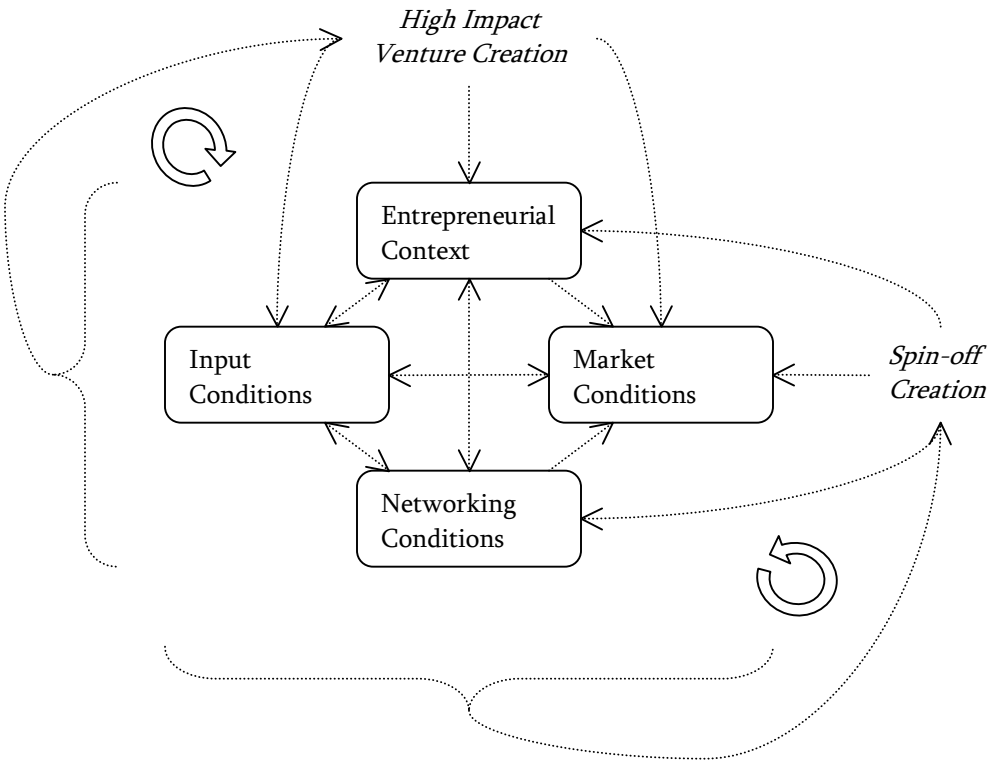


Figure 3-3 Self-reinforcing loops of entrepreneurial clusters

The entrants of quality people change the perception of entrepreneurs little by little to accumulate to the improved prestige (input conditions to entrepreneurial context). More quality people may open new market opportunities (input conditions to market conditions). Entrants of quality people and risk money providers along with success entrepreneurs enhance networking opportunities (input conditions to networking conditions). The improvement of prestige attracts quality people (entrepreneurial context to input conditions). People who get another chance from a failure move to other firms (entrepreneurial context to networking conditions). Improved entrepreneurial context, along with factors of the input conditions, prompts more entrepreneurs to try to shape another market opportunity (entrepreneurial context to market conditions). Opened market opportunities attract more quality people and risk money (market conditions to input conditions). We can list such a number of effects as the first ripple effects. Furthermore, among the second ripple effects, the improved networking opportunities attract quality people and venture capitalists (networking conditions to input conditions). It also enhances job opportunities by conveying information on people, influencing another chance from a failure and labor mobility (networking conditions to entrepreneurial context).

Finally, it prompts, by rich interactions of people, more entrepreneurs to try to shape another market opportunity (networking conditions to market conditions).

Above are the effects of the high impact venture creation. With ripple effects among the diamond, it improves all the profiles of the diamond nodes. The improved profiles of the diamond, then, foster another wave of high impact venture creation, thus creating a self-reinforcing loop through waves of high impact venture creations. Because we traced only a limited number of factors, this analysis may sound a little simple. (We will examine causal relationships of several factors with more details in the next section.) But the factors we used are among the most important factors identified in each of the attributes. Therefore, the overall dynamics of the diamond itself should have been well traced. Or rather, by this simplicity, we are able to overview the dynamics of the diamond.

There is in fact another self-reinforcing loop. It is a loop with spin-off creation (Figure 3-3). Spin-offs produce another set of effects on the diamond. Here, spin-off creation is defined as mere entries of spin-offs. Therefore, spin-offs do not have to be successfully grown at this moment of analysis, unlike high impact venture creation. Grown spin-offs can be considered as high impact ventures.

First of all, the favorable profiles of the diamond nodes foster spin-off creation, like new venture creation. Then, spin-off creation has three direct effects. As we saw previously, the entries of spin-offs contribute to the construction of dense social networks. This effect on the network conditions is the major effect of spin-offs. The second effect is on the market conditions. Because spin-offs created or expanded markets, more market opportunities must have arisen. Finally, the third effect is the impact on the labor mobility. Spin-offs themselves are transferring labor from a firm to another firm. It accrued to the accumulation of the labor mobility, influencing on the profile of the entrepreneurial context. The improved profiles of the three attributes then cause ripple effects within the diamond. The improved profiles of the diamond, then, foster another wave of spin-off creation, thus creating a self-reinforcing loop of spin-offs.

These self-reinforcing loop models of high impact venture creation and spin-off creation explain the basics of their dynamics. Favorable attributes of a region foster the creation of technology ventures and their successes. In turn, they improve the attributes of the region. It is usually hard to let fast positive flows of self-reinforcing loops happen instantly from where they are static or the flows are very slow. This is why many regions emulating Silicon Valley are frustrated by the little improvement in short-term, whereas a successful region like Silicon Valley evolves its attributes themselves seemingly faster and faster than those who emulate. Further, because self-reinforcing loops are positive feedback loops, once a down turn flow occurs, the positive feedback loops self-reinforce negative flows that undermine the attributes.

Then the next question is; what is the threshold of the beginning of positive self-reinforcing? It will be discussed in the next section. Another question is; how far is

this self-reinforcing loop going around? And are there balancing loops that limit the self-reinforcing loops? Things such as the limit of human resources from the national level, the saturation of the growth of the prestige and the familiarity, the technology maturity, the market saturation, and the limit of time that individuals can spare for networking are considered some of the factors that constitute balancing loops, but further research is required in order to understand the limitation of the self-reinforcing dynamics. For the sake of the objectives of this thesis we will focus on the beginning of the self-reinforcing dynamics.

Finally, there are two arrows seeming to be missing in Figure 3-3; arrows from the market conditions to the entrepreneurial context and the networking conditions. There seem no direct causal relationships concerning them. However, this does not mean that the importance of the attribute of the market conditions in the diamond is undermined. First, the diamond works as a system to foster entrepreneurial activities. The self-reinforcing loops of high impact venture creation and spin-off creation, which treat the whole diamond as one factor within the loops, are more important than the two direct relationships that are buried among a countless of ripple effects. Second, as we will discuss later, the market conditions are among the only attributes which government can influence directly by its procurements. Government can influence the other attribute, but it is indirect and government must wait until market mechanisms will settle the influence.

Regional Level and National Level

The discussion was focused on a region or a cluster so far. The entrepreneurial activities are affected by regional factors such as availability of inputs or usability of networks. But laws and regulations governing startup process and bankruptcy, or tax system permitting concentrations of wealth are mostly determined at the national level. The availability of quality people depends on the settlement of the graduates of

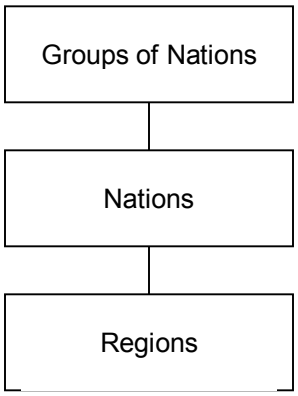


Figure 3-4 Geographic levels for analysis

regional universities as well as the aggregate quality and number of graduates in a nation that is often shaped by national policies.

The analyses of entrepreneurial activities have to be aware of the distinction that there are regional level analysis and national level analysis. The environment of entrepreneurial activities is on the one hand shaped at the national level. On the other hand, there is the regional environment, under the influence of the national environment, shaped at the regional level (Figure 3-4). Like European Union, sometimes the policies affecting small and medium-sized enterprises are shaped at the higher level of groups of nations.

The framework used in the analysis at the regional level can be called the *entrepreneurial cluster diamond* that has been discussed so far. The framework used in the analysis at the national level is the *entrepreneurial national diamond*. The cluster diamond works under the influence of the national diamond. Like this, we must analyze entrepreneurial activities according to different geographic levels.

Role of Government

The national government, the state government, and the regional government play large roles to influence attributes of both national diamond and cluster diamond.

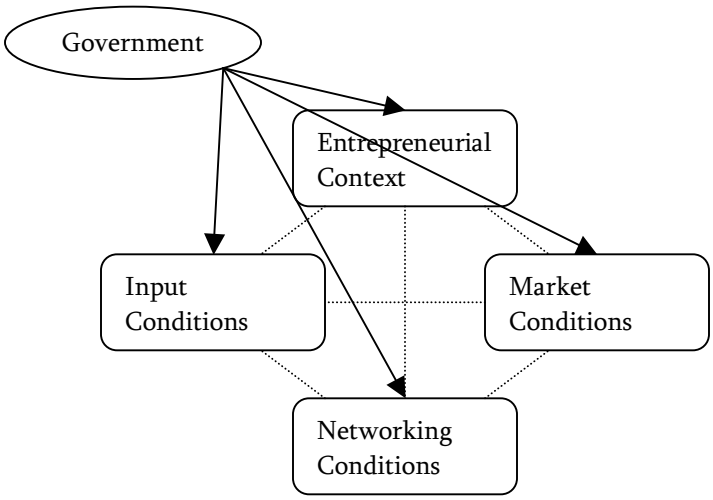


Figure 3-5 Role of government in entrepreneurial cluster

Government is a rule maker, a financier, or a buyer in different settings. In the area of entrepreneurial activities where opportunities are floated and captured, and a self-reinforcing mechanism is embedded, what government primarily can do is to create a favorable environment that can foster, or at least does not undermine, entrepreneurial opportunities. Entrepreneurial clusters are the ecological systems in this sense. Then the government can think about how to stimulate a positive flow in

the self-reinforcing mechanism, or the sprouting power of the ecology. Some of the policies to create a favorable environment, that is, the favorable four attributes of the diamond, include the following.

Input Conditions. The appropriate education for knowledge-driven economy is one of the first agenda. Advanced and specialized education at higher educational institutions and management education is central to provide the economy with quality people. Government can funnel funds to universities, business schools, professional schools, and professional training institutions, as well as encourage them to adapt themselves to the rapid change of the economy.

Knowledge creation and intellectual property protection is another first agenda. Because of the nature of knowledge as public goods and the inappropriability of it, government assumes large roles to facilitate knowledge creation so that entrepreneurs can shape opportunities from it. Entrepreneurs often have little asset other than their intellectual properties, it is critically important that intellectual properties are protected by appropriate legal framework.

Concerning risk money, government has the ability to set rules for encouraging risky investments. For example, in the United States the lowering of the top capital gains tax rate from 49 percent to 28 percent in 1978 and then to 20 percent in 1981 made risky investments more attractive (Rowen 2000). Allowing corporate pension funds to risky investments is another way. Encouraging risky investment increases angels as well as funds available to venture capital partnerships. Further, government can modify restrictions on the institutional investors' holding of unlisted equity so that institutional investors also offer risk money. Rules encouraging activities of venture capital partnerships are also important because it is a risky business that otherwise many entities hesitate to engage in. Government can limit the liability of limited partners to the money they invest. It also can make firms' financial status more transparent by improving accounting rules. Permitting or encouraging firms to have outsiders sitting on the boards makes it easier for risk money providers to monitor as well as to mentor.

Subsidies or subsidized loans to startups or risk money are controversial. They create new entrepreneurial opportunities. But they may also distort opportunities, or the environment generating opportunities, by letting somebody have 'easy money' that is not well thought-out and expelling private businesses of risk money providers. They may serve as an initial kick to let the self-reinforcing loop start rotating, but too much of the subsidies may stifle the sprouting power of the ecology.

Entrepreneurial Context. Government can influence social frameworks in several ways. Concerning labor mobility, deregulation of labor markets, through changes in rules such as that employment is at the choice of either employer or worker, makes wage and employment more insecure and stimulates labor mobility. For firms in California the unenforceability of non-compete clauses in labor contracts further encourages worker mobility (Rowen 2000).

Bankruptcy law shapes personal financial risk of entrepreneurs. In the United States, owners of failed businesses are not required to pay off their debts with the exception of their pay roll taxes (Verheul et al. 2002). In other countries, entrepreneurs that go bankrupt are required to settle the businesses' debts.

Many advanced nations adopt progressive taxation systems. Changing taxation on personal income permitting concentration of wealth, if permitted, makes more room for success entrepreneurs to be rich, and create more role models that inspire followers. Entrepreneurship education from primary education enhances the familiarity and the prestige. Government can set up honorable recognitions awarded to success entrepreneurs. It signals the importance of entrepreneurship to citizens and enhances the prestige.

Concerning regulatory frameworks for startups and their growth, government is directly responsible. Government can change laws and regulations governing startup process. Small businesses are relatively sensitive to the administrative costs. The administrative burdens are not only a barrier to entry but also an obstacle to firm growth. Government also can give startups corporate tax exemptions to encourage entrepreneurial activities. Stock options are good awards and incentives to encourage motivation among employees at growing startups. Some countries tax on stock options only when exercised, not when granted. Taxed when granted, option awardees have to pay cash even though options still don't turn into money.

Networking Conditions. Government can facilitate networking opportunities by various ways. Among them, encouraging universities to be more open to industries is very important because universities can work as anchors of knowledge-based networks. Government can financially support technology licensing activities. It can mitigate regulations on universities, especially public universities, such as the ones limiting corporate donations and prohibiting faculty to sit on the board, and encourage universities to lower administrative burden for academic/industry collaboration.

Government can provide funds for formal networking activities. For example, government can support finance for the institutions that facilitate networking opportunities. Holding seminars and conferences does not cost huge money, but those institutions are often sensitive to those costs.

Market Conditions. Knowledge creation is a main factor of the input conditions, but it also opens up new possibilities of markets. Government is often responsible for the new technologies that are eventually exploited by entrepreneurs. Government as a financier can funnel public money into universities and research institutions such as public laboratories and into private companies by R&D contracts or subsidies for new knowledge creation. Government can also have a direct influence on the diamond through providing attractive market opportunities as procurements with private companies including technology startups. As a buyer, it can make procurement deals with private companies for high context technologies. Procurements, if carefully

designed, benefit both governments for gaining the latest technologies and encouraging innovation, and startups for securing steady and lump-sum finance.

Monopoly may permit established firms to invest in long-term R&D, but it may also hinder the innovations that come through competitions among private firms. Especially, monopoly gives little chances to entrepreneurial activity that may create new markets. In order to facilitate entrepreneurial opportunities, promoting competition by anti-trust regulatory frameworks should be taken into account. It will enhance opportunities of entries for startups. Finally, concerning equity market, government can deregulate stock market and prompt lowering requirements for listing stocks of firms that do not include having a history of profits.

Enhancing Entrepreneurial Opportunities

Not only government but also private firms and institutions can improve the profile of the diamond. Although there are competitions among private firms, collective actions, or collaboration, can influence their business environment in the positive direction. Here, collective actions in discussion are not a type of collaboration such as political influence over government to seek protection from foreign competitors, which may hinder the innovation in the long run. The type of collaboration in discussion is to improve their business environment, which may foster things such as activities of risky investors, availability of quality people, interactions of people, collective learning, exchange of ideas, and so on. The important criterion is if the action enhances entrepreneurial opportunities in an entrepreneurial cluster or not.

Like the government's roles, many examples can be derived. Firms in a cluster can influence government to improve regulatory frameworks governing entrepreneurial activities by collective actions. They can prompt government to set up policies toward fostering entrepreneurship. They can improve the input conditions by forming funds to open related courses at professional schools and establishing an institution for research interests in common. They can improve the entrepreneurial context by awarding entrepreneurs for social philanthropy. They can improve the networking conditions by creating an institution that convenes various programs that facilitate networking. They can improve the market conditions by promoting the concept of their innovative products to customers. By collective actions to enhance entrepreneurial opportunities, all can benefit in the cluster.

Those collaborations should include government and other entities such as non-profit organizations. They may help the collaborations via funding and other means. Although collaborations may not be necessary conditions for the presence of entrepreneurial clusters, they can enhance the strength of the clusters. The important thing, and probably somewhat difficult thing, is that the constituents in the

cluster have the common vision and some kind of cohesion in mind toward enhancing entrepreneurial opportunities.

Use of the Framework

The entrepreneurial diamond framework is to help researchers, constituents, and policy makers understand the conditions and characteristics of the entrepreneurial clusters of interest. It can be used as a tool to overview the conditions of an entrepreneurial cluster, to understand the dynamics of the cluster, to identify the strengths and the weakness of the cluster, to set a priority to enhance entrepreneurial opportunities of the cluster, and to generate consensus on it among the constituents of the cluster.

After the next section that goes further into the dynamics of the diamond, we will apply the framework to Silicon Valley, perhaps the most famous entrepreneurial cluster in the world, to demonstrate its usefulness for analyzing and understanding the determinants and dynamics of technology entrepreneurship. Further in the following chapter, we will examine several 'evolving' entrepreneurial clusters around the world using the framework.

3.3 Deterrents of the Evolution

The four attributes of the entrepreneurial diamond constitute self-reinforcing loops with high impact venture creation and spin-off creation. Once a positive flow occurs, these positive feedback loops reinforce the positive flow further. However, many regions emulating Silicon Valley often see little change. This is probably because some of the four attributes have unfavorable profiles, but even if the four attributes have favorable, or at least moderate profiles, the positive flow may only be a slow, tiny indication at the beginning, taking a long time to become a massive flow.

However, an input to the system may provoke a vigorous flow from a tiny indication. The input may be a noise but a positive input that starts the engine of the self-reinforcing loop. In reality, some chance event may become this input: a venture that had endeavored on a dangerous voyage, making a strike success with some luck; a genius that grabbed a tremendous market opportunity, becoming a millionaire; an article spotting a light on a hidden success in the shade, becoming widely recognized; and so on. However, why is a flow of an indication so slow and small in spite of successes and efforts to materialize them? This is considered due to inertia. The larger the economy is, the bigger the force of inertia is. Sometimes, this force of inertia is called deterrents in the real economy.

The deterrents to forbidden new venture creation include a lot of things. Let's take an example of Japan, where entrepreneurship is considered underdeveloped and the entry rate of new ventures continues to decline in recent decades. One measurement indicates that the fraction of the people with entrepreneurial activities

Reasons for falling entry rate in Japan
(A survey on venture capitalists and other backers)

- Risk of impact on lives in case of failure 65.1%
- Strong preference for 'salary man' lifestyle 42.5%
- Low level of management skills 41.4%
- Low prestige for starting a business 36.0%
- Increase in startup costs 19.4%
- Greater competition 17.7%
- Regulations 17.2%
- Difficult entry due to business practices 12.9%
- No business seeds to speak of 12.9%
- High level of specialist knowledge required 9.7%
- Family unsupportive 5.1%
- Other reasons 5.9%

Figure 3-6 Reasons for falling entry rate in Japan

Note: Total exceeds 100 due to multiple responses.
Source: Small and Medium Enterprise Agency, Japan; White Paper 1999.

in the labor work force is only 1.8% in 2002 (Table 2-3), considerably lower than other counties. Figure 3-6 shows a result of a survey asking the reasons for falling entry rate in Japan. From the top reasons, 65.1 percent of venture capitalists answered 'risk of impact on lives in case of failure;' 42.5 percent answered 'strong preference for salary man lifestyle;' 41.4 percent answered 'low level of management skills;' and 36 percent answered 'low prestige for starting a business.' As should be along with these four main reasons, in this chapter, we will examine the risk of impact on lives, the psychological barrier to change from salary man to entrepreneurs, the availability of quality people with management skills, and the low prestige of entrepreneurs as the representative deterrents that hinder the vigorous flow in the self-reinforcing loop of technology entrepreneurship.

Personal Financial Risk and Social Risk

The 'risk' that may destroy lives in case of failure includes personal financial risk and social risk. An entrepreneur who had appropriated large personal loans for his venture's equity may have to pay the debt even after he has no salary from the failed venture. An entrepreneur who failed may have to assume the severe reality that gives no other job and cold attitudes from friends and relatives from whom he had borrowed his startup finance.

Figure 3-7 shows a System Dynamics model of personal financial risk. The model consists of variables and causal links that represent causal relationships. Causal links with plus marks indicate positive links, that is, variables at the heads of arrows increase/decrease in the same direction as variables at the bottoms of arrows. Causal

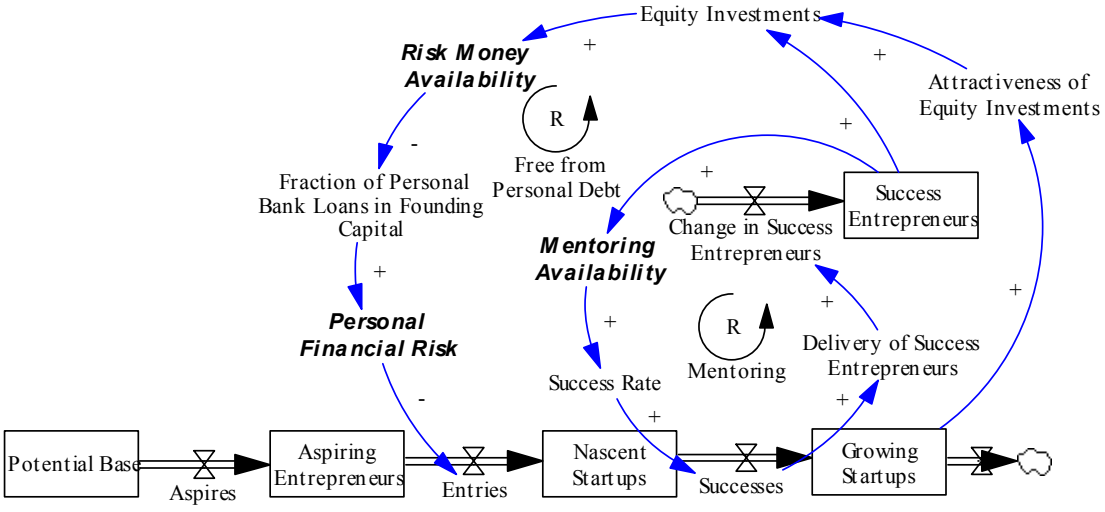


Figure 3-7 System Dynamics model of personal financial risk

Note: Networking conditions and market conditions are omitted.

links with minus marks indicate negative links, meaning that variables at the heads of arrows increase/decrease in the opposite direction as variables at the bottoms of arrows. Boxes represent stocks, into which flows accumulate, and from which flows spill over. The four boxes and flows at the bottom are entrepreneurial activities. From Potential Base, Aspires accumulate to Aspiring Entrepreneurs in a region. By Entries, Aspiring Entrepreneurs form Nascent Startups, and Successes turn Nascent Startups into Growing Startups. For the sake of simplicity, important factors such as the networking conditions and the market conditions are omitted in the models in this section.

Successes accumulate into Success Entrepreneurs. A larger number of Growing Startups attract more Equity Investments because investors see a big chance in a region with a lot of growing firms. More Equity Investments lead to improved Risk Money Availability. If risk money is available to aspiring entrepreneurs, they don't have to borrow personal loans for all of the needed capital at the startup stage. Then even if the venture fails, entrepreneurs themselves are free from the part of the loss of the equity which risk money invested. By these causal relationships, Personal Financial Risk is lowered by Successes, and the lowered Personal Financial Risk prompts entries, thus influencing on the increase in the number of Successes. These links constitute a reinforcing loop of 'Free from Personal Debt.'

The model indicates that once a lot of successes of startups occur, it is likely for personal financial risk to be lowered. With other things equal, personal financial risk

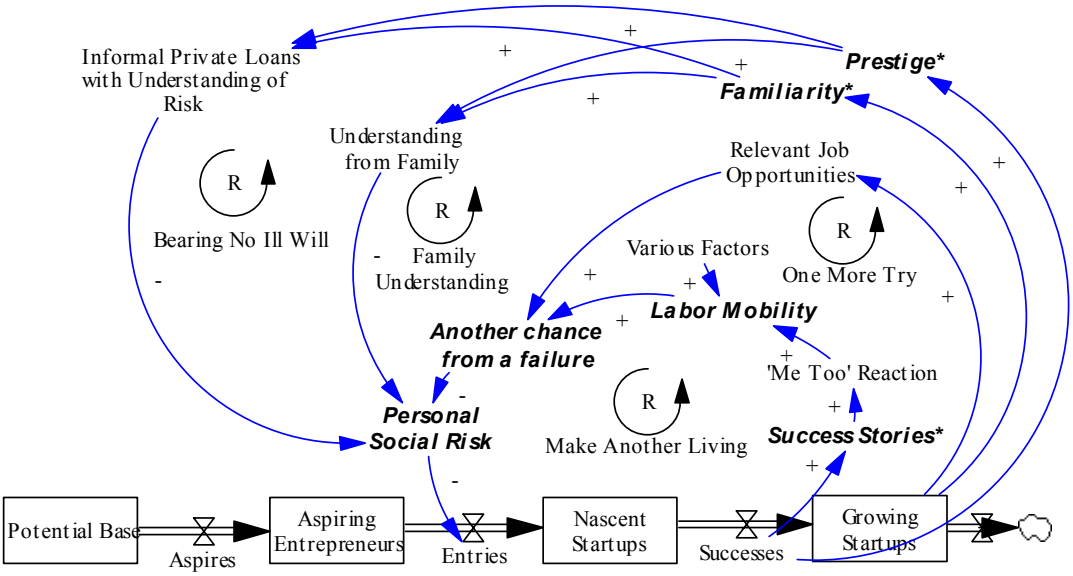


Figure 3-8 System Dynamics model of personal social risk

Notes: Networking conditions and market conditions are omitted.
* Detailed causal links are shown in other relevant figures.

remains to be a deterrent to entries if successes don't happen. This is an aspect of the nature of the deterrent. Because of the force of inertia concerning this reinforcing loop, personal financial risk remains to seem a big obstacle that is hard to remove.

Figure 3-8 shows a model of personal social risk. More Successes are likely to increase Labor Mobility by 'me too reaction' of followers. More Growing Startups create more jobs, increasing Another Chance from a Failure together with the increased Labor Mobility. On the other hand, Familiarity is increased by the increased number of entrepreneurial activities (details will be shown in a following figure), so is Prestige. The improved Familiarity and Prestige are likely to enhance Understanding from Family and Informal Private Loans with Understanding of Risk so that a failed entrepreneur may not have to worry about the attitudes of his family and the people from whom he borrowed startup loans because they had understood high possibility of failures and a significance of entrepreneurship. This understanding of surrounding people, coupled with the improved availability of another chance from a failure, is likely to lower Personal Social Risk involved in entrepreneurial activities, thus leading to more entries. These loops are reinforcing loops.

The model indicates that once a lot of successes of startups occur, it is likely for personal social risk to be lowered. However, with other things equal, personal social risk remains to be a deterrent to entries if successes don't happen.

Psychological Barrier

The psychological barrier to entrepreneurship hinders people to think positively about entrepreneurial opportunities. It can be modeled that with this barrier, people tend to think that they will remain to what they are now. Figure 3-9 shows a model of psychological barrier. Psychological Barrier is likely to be lowered if Prestige of entrepreneurs is higher; people hear a lot of success stories; and people are familiar with entrepreneurs. Familiarity is the accumulation of contacts with entrepreneurs and news of successes and failures. News of both successes and failures accumulate to Familiarity, leading to lowered Psychological Barrier, because by them people know and understand what the bright side and dark side of entrepreneurial activities are. Familiarity as a stock is going to saturate as it grows. On the other hand, Failure Stories themselves raise Psychological Barrier because the negative perception of the dark side of entrepreneurial activities is emphasized. The lowered Psychological Barrier is likely to prompt aspires and entries, influencing on the increase in Successes and the number of entrepreneurs. These loops, except for the one with Failure Stories, are reinforcing loops. The model indicates that once a lot of aspires and entries occur, it is likely for psychological barrier to be lowered. However, with other things equal, psychological barrier remains to be a deterrent to both aspires and entries.

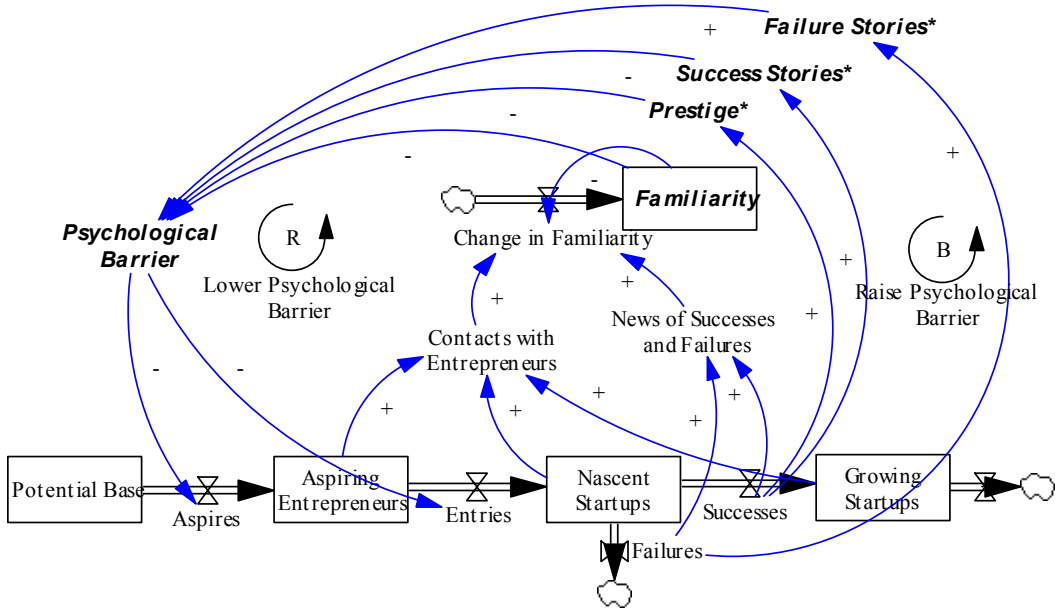


Figure 3-9 System Dynamics model of psychological barrier

Notes: Networking conditions and market conditions are omitted.
* Detailed causal links are shown in other relevant figures.

Quality People

Figure 3-10 shows a model of entrants of quality people. Entrants of Quality People are likely to be raised when Prestige, Familiarity, and the number of Success Stories are high; and the number of Failure Stories is not large. Prestige is the accumulation of News of Successes. The incident of Philanthropy by success entrepreneurs also accumulate to Prestige. But News of Failures works in the opposite way so that the accumulation of them lowers Prestige. Entrants of Quality People are in turn likely to raise Prestige. Prestige as a stock is going to saturate as it grows. As Entrants of Quality People increase, Chance of Encountering Quality People increases. Therefore, the chance of forming good founding teams is enhanced, leading to the increase in Success Rate. Increased quality people also increase the number of Aspires. We see a reinforcing loop of 'Quality People,' as well as a reinforcing loop of 'Smart People Gather.'

The model indicates that once a lot of successes occur, it is likely for quality people to enter entrepreneurial activities. Further, once the prestige is raised by the entrants of quality people, it attracts quality people more. However, with other things equal, the low availability of quality people remains to be a deterrent to both aspires and entries if successes don't happen, and the prestige remains low.

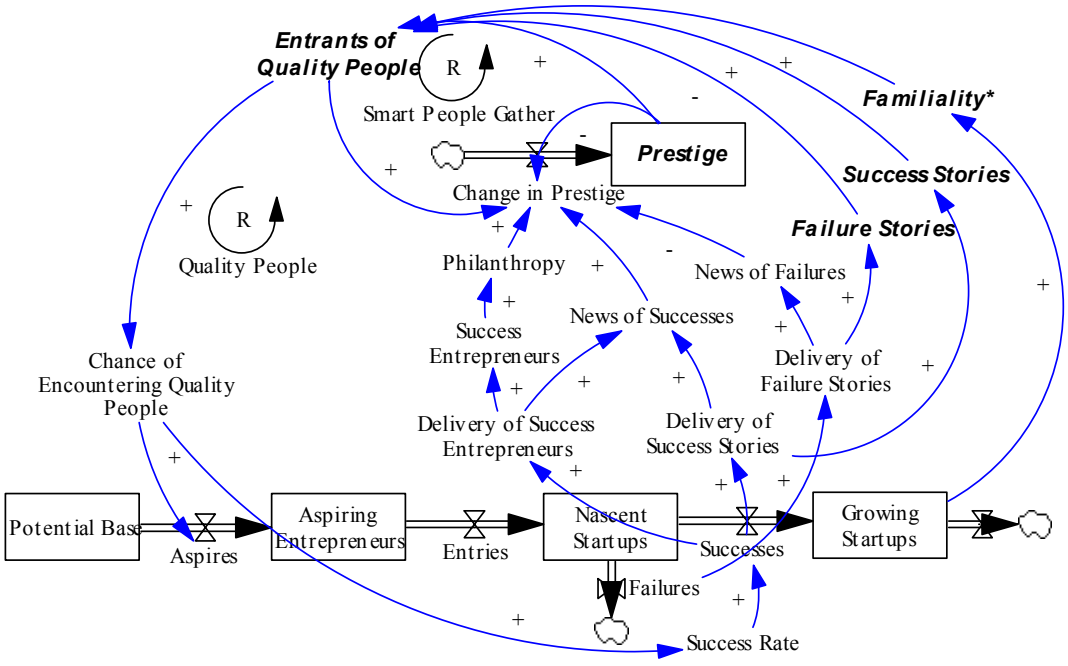


Figure 3-10 System Dynamics model of entrants of quality people

Notes: Networking conditions and market conditions are omitted.
* Detailed causal links are shown in other relevant figures.

All of the representative deterrents we examined have characteristics of the self-reinforcing loop. Because of the force of inertia, the positive flow may be only a slow, tiny indication at the beginning. Especially, the bigger the economy is, the heavier the force of inertia is. This is why many regions emulating Silicon Valley tend to lose their temper before the motion of the system becomes noticeable. However, the characteristics of the reinforcing loop with the force of inertia also mean another aspect: a tiny indication and the accumulation of successes may eventually become a noticeable flow of the system; and inputs in the positive direction may fuel the flow and change the situation rapidly. It is possible that inputs such as chance events and government policies may become striking inputs and trigger a vigorous flow in the self-reinforcing loop of the entrepreneurial diamond.

3.4 Silicon Valley Case

On January 1, 1939, two classmates at Stanford University launched from a one-car garage in Palo Alto an electronic measuring device company. Six decades later their company, Hewlett-Packard, led the Valley in revenues, with $47.1 billion in 1999. In April 1994, another pair of Stanford students worked during their spare time to build 'Yet Another Hierarchical Officious Oracle.' Today their firm is called simply Yahoo! and is the first and leading web search engine, with a market capitalization of $70 billion (Lee et al. 2000).

Silicon Valley is a region in Northern California that spans from its heart in Palo Alto of Santa Clara County to San Mateo County in the north and Santa Cruz County in the south. Within this region, 2.3 million people live and total jobs amount to 1.35 million. The driving industry clusters are computer and communication hardware manufacturing, semiconductor and equipment manufacturing, electronic component manufacturing, biomedical, software, innovation services, creative services, and corporate offices[1]. The beauty of the San Francisco Bay Area, its proximity to open spaces and the urban amenities of San Francisco, and the intellectual qualities of its leading universities historically have been major attractions[2].

Source: Joint Venture: Silicon Valley Network

Silicon Valley has experienced a sharp decline after the Internet babble around 2000. It lost 127,000 jobs since the first quarter of 2001. The venture capital investment in Silicon Valley companies declined from over $20 billion in 2000, the record high, to $4.8 billion in 2002, equivalent level of 1998 and 1999. Yet, overall value added per employee in Santa Clara County steadily reached $184,300, much higher than the U.S. average of $82,300. The portion of the Valley's workforce in R&D-related jobs hovered around 10 percent, a full 2½ times the national average. And the venture capital investment in the region remains to account around 20

[1] Joint Venture: Silicon Valley Network, 2003 Index of Silicon Valley.

[2] Lee et al. (2000)

percent of the national venture capital investment[3]. Still, Silicon Valley reigns as the leading cluster of innovation and entrepreneurship that virtually any region in the world wants to emulate.

National Level Analysis

Even at the national level, the United States is widely considered to have favorable attributes for entrepreneurial activities. In fact, the entrepreneurial activity of the country is high. Concerning Total Entrepreneurial Activity (TEA) index, which measures the fraction of the people with entrepreneurial activities in the labor work force, the United States has 11.6% for the average of 2000-2002 (Table 2-3), exhibiting the highest level among the G7 countries. Figure 3-11 shows the entry and exit rate in the U.S. in the last decade. Except for 1991 when the GDP growth was negative, we can see the steady level of the entry rate exceeding the exit rate. Although the two measures don't distinguish technology entrepreneurship from the overall entrepreneurial activities, the high level entrepreneurial activities are a positive factor to nurture technology entrepreneurship.

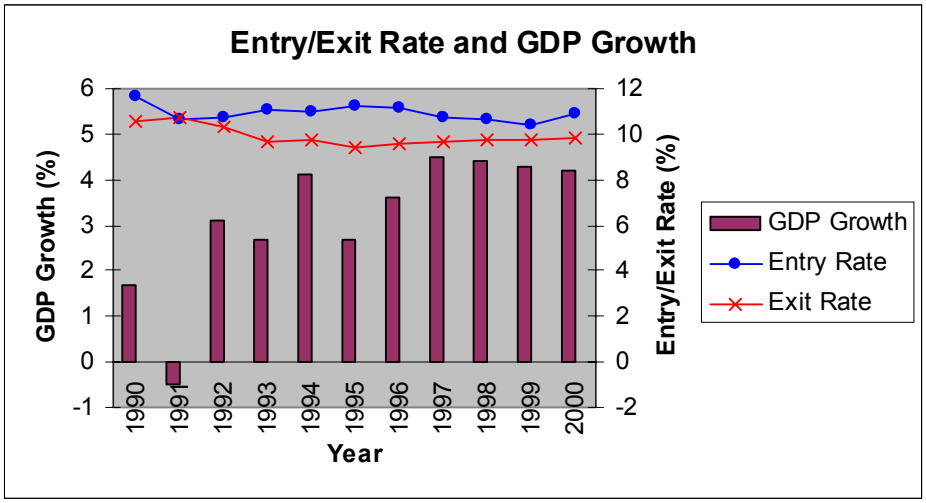


Figure 3-11 Entry/exit rate and GDP growth of the United States

Notes: Entry and exit rates are percentages of the total stock (employer firms) at the end of the previous year. Years start at March of the previous years.
Sources: U.S. Small Business Administration, Statistics of US Businesses.
GDP data – World Bank, World Development Indicators.

In order to assess the four attributes of the national diamond, it is desirable to have objective benchmarking measures across countries. Although it is considered practically impossible to gather harmonized numerical measurements of the factors

[3] Joint Venture: Silicon Valley Network, 2003 Index of Silicon Valley.

from risk money availability to labor mobility, World Economic Forum, an independent international organization, succeeds in measuring various factors concerning the microeconomic competitiveness across countries, by adopting the country ranking system based on a survey (World Economic Forum 2002).

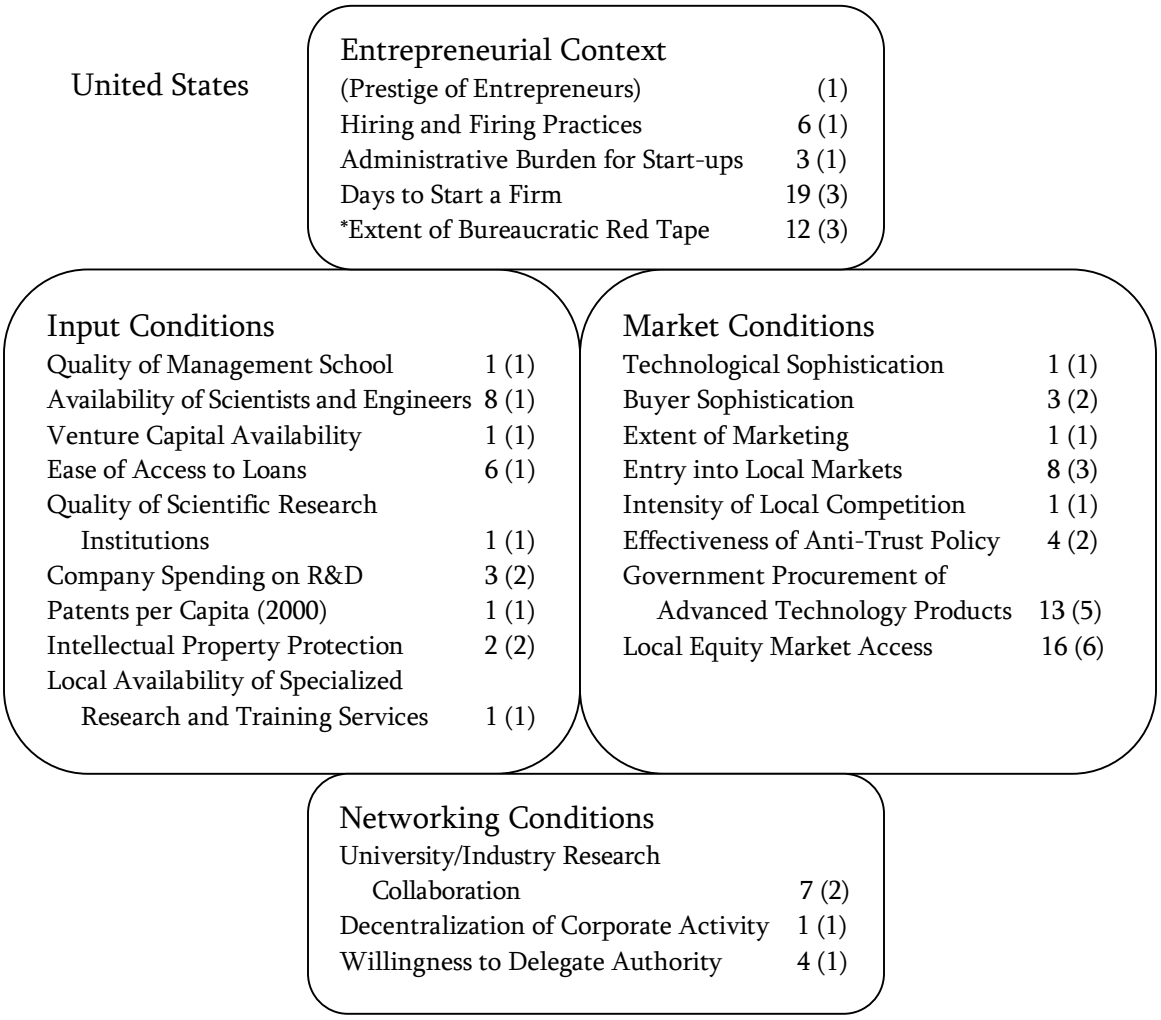


Figure 3-12 Country rankings concerning the entrepreneurial diamond of the U.S.

Notes: Values are relative positions among 75 countries. Ranks are determined basically by the average of the scaled points scored by senior business leaders in the 75 countries. The United States ranks 1st on Company Operations and Strategy and 2nd on Quality of the National Business Environment. '()' indicates rankings among the G7 countries. * The value is ranked opposite to the favorable direction. (Prestige of Entrepreneurs) is a complement measure.

Source: Global Competitiveness Report 2001-2002.

It is conducting a detailed survey across 75 countries about the quality of the microeconomic business environment and the sophistication of company operations

and strategy. The survey involves more than 4,700 respondents, mainly senior business leaders, from those countries and about 70 criteria. The ranking among countries for each criterion is determined by the average of the scaled points scored by respondents. For example, a criterion of Venture Capital Availability is scored by the question that 'Entrepreneurs with innovative but risky projects can generally find venture capital in your country (1=not true, 7=true)'. Among over 70 criteria, the author chose about 25 as related to the entrepreneurial diamond. Figure 3-12 shows those criteria and their rankings about the United States.

Further, the author chose another criterion concerning the prestige of entrepreneurs in order to complement those criteria. There is a survey across countries done by Global Entrepreneurship Monitor in 1999. The survey asked about 1,000 people in each country that 'Do you think starting a new business is a respected occupation in your community?' The result of the survey is presented in Table 3-1.

Table 3-1 A survey result concerning the prestige of entrepreneurs

	Percentages who think entrepreneurs are respected
USA	91
Canada	86
Italy	68
United Kingdom	38
Germany	73
France	83
Japan	8

Note: Percentages of respondents who answered yes on 'Do you think starting a business is a respected occupation in your community?'
Source: Global Entrepreneurship Monitor, Adult Population Survey 1999.

The rankings of the countries and the complementary survey result might not be perfect criterion for assessing the profiles of the four attributes of the national diamond, but those are the objective benchmarking measures that are usually not easily available across nations and are very valuable for the sake of this study. At least, we can get some sense of relative strengths and weaknesses of the profiles of the national diamond by using those relative-positioned measures.

Input Conditions. Concerning the quality people with management skills, the U.S. is ranked 1st on Quality of Management Schools, inferring a good availability of them. The U.S. is ranked 8th on Availability of Scientists and Engineers, and this is the top position among the G7 countries. Concerning the risk money, the U.S. is ranked 1st

on Venture Capital Availability, leading other G7 countries far ahead (the second is Canada ranked 8th). Concerning the knowledge creation, Quality of Scientific Research Institutions of the U.S. is ranked 1st and Company Spending on Research and Development is ranked 3rd, second among the G7 countries only to Japan ranked 2nd. The U.S. has the 1st position on the patents per capita granted in the U.S., which is considered a measure of international patents. The United States has the most leading position among the G7 countries on the profile of the input conditions.

Entrepreneurial Context. Concerning the prestige, 91 percent say that entrepreneurs are respected, stunningly higher fraction compared with other G7 countries. The higher fraction of people with entrepreneurial activity (TEA index) and the steady entry rate in the last decade indicates that the familiarity with entrepreneurs is also high among the G7 countries. Concerning the labor mobility, the U.S. is ranked 6th on Hiring and Firing Practices that indicates the flexibility of hire and fire without impedance of regulations. Although this is not the only measure of the labor mobility, the rank that is far higher than other G7 countries (Canada positions the second by the 24th rank and France is the worst by the 74th rank) infers higher labor mobility. Concerning the regulatory frameworks, although the median response of the Days to Start a Firm is 30 days and ranked 19th (lagging behind the United Kingdom and Canada), Administrative Burden for Startups is considered light and ranked 3rd, the top position among the G7 countries. On the contrary, the U.S. is ranked 12th on Extent of Bureaucratic Red Tape, which measures how much time senior management spends working with government agencies/regulations. This is the third worst behind Japan and Germany, and might influence the growth of startups.

Networking Conditions. Because virtually nobody monitors the amount and quality of communications and interactions, it is generally difficult to quantify the networking conditions. Yet some criteria of World Economic Forum give insights. University/Industry Research Collaboration criterion asked 'In its R&D activity, business collaboration with local universities is: (1=minimal or nonexistent, 7=intensive and ongoing).' The U.S. is ranked 7th, second among the G7 countries to Canada ranked 6th. The culture of corporate operations such as Decentralization of Corporate Activity and Willingness to Delegate Authority gives us inference on the condition of inter-corporate networks because more open corporate culture facilitates, or at least permits, more open interactions across employees in different firms. The U.S. is ranked 1st on Decentralization of Corporate Activity and 4th on Willingness to Delegate Authority that is the top position among the G7 countries. It can be said that the United States has higher possibility of having favorable networking conditions than the other G7 countries.

Market Conditions. A country's position in Technological Sophistication is a broad measure for the innovativeness of market demand and market opportunities. The U.S. is ranked 1st on this. Buyer Sophistication, which asked 'Buyers in your

country are: (1=unsophisticated and choose based on the lowest price, 7=knowledgeable and demanding and buy innovative products),' is another measure. The U.S. is ranked 3rd, the top position among the G7 countries. Extent of Marketing, which asked 'The extent of marketing in your country is: (1=limited or primitive, 7=high and among the world's most sophisticated),' enhances the diversity of market demand. The U.S. is ranked 1st on this. Further, the pro-competition conditions of markets make it more possible to create market opportunities. The U.S. is ranked 8th on the occurrence of Entry into Local Market, third among the G7 countries to Germany and the United Kingdom. Intensity of Local Competition is ranked 1st, and Effectiveness of Anti-Trust Policy is ranked 4th, second to Germany ranked 2nd. The United States has the top position on the innovativeness and diversity of market demand within the G7 countries, and among the highest on pro-competition conditions. On the other hand, concerning Government Procurement of Advanced Technology Products, which directly enhances the market opportunities for technology entrepreneurship, the U.S. is ranked 13th, 5th among the G7 countries. Finally, concerning the equity stock market, the United States has developed stock markets for growing new ventures such as NASDAQ. However, Local Equity Market Access, which asked 'Raising money by issuing shares on the local market is: (1=nearly impossible, 7=quite possible for a good company)," is ranked 16th, the second worst to Japan among the G7 countries. It is not an only measure, but it is relatively hard to raise money in local equity market in the U.S.

Overall, from the view point of this analysis, the United States has the very strong profile of the entrepreneurial national diamond among the G7 countries. Summary is shown in Figure 3-13.

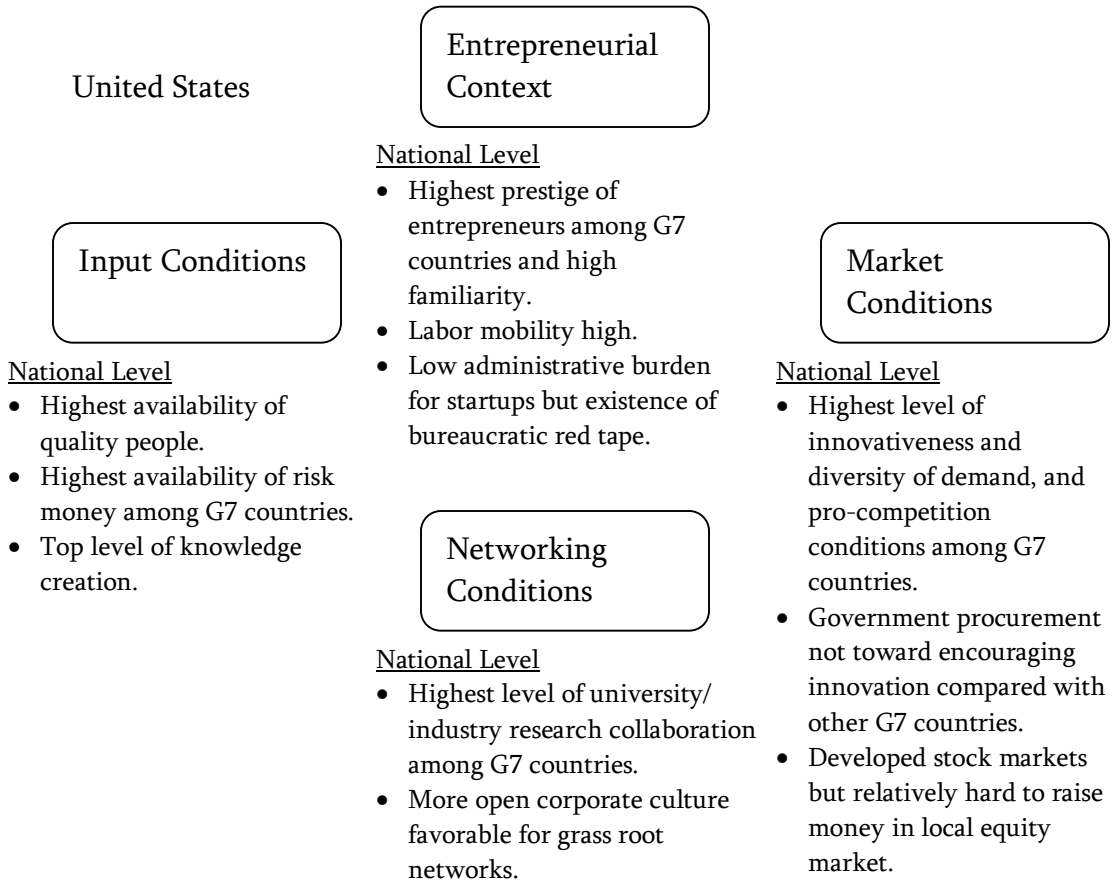


Figure 3-13 Analysis of the entrepreneurial national diamond of the U.S.

Early Evolution of Silicon Valley

Many observe the origins of Silicon Valley traced back to the establishment of Hewlett-Packard in 1939 at a small Palo Alto garage, and a notable individual, Fredrick Terman. Frederick Terman, who moved to Stanford University to become an electrical engineering professor after his graduation from MIT, encouraged his graduate students William Hewlett and David Packard to commercialize an audio-oscillator that Hewlett had designed while working on his master's thesis (Saxenian 1996). It was his frustration with the lack of jobs for graduates of the Stanford electrical engineering department that led him to energetically encourage several of his former pupils to start their own businesses (Gibbons 2000). Terman lent Hewlett and Packard $538 to start producing the machine, he helped them find work to finance their initial experiments, and he arranged a loan from a Palo Alto bank which allowed them to begin commercial production (Saxenian 1996). Here we can see an early wave of entrepreneurship evolution stimulated by an eager individual within the vicinity of Stanford University.

However, this kind of entrepreneurial episode does not seem to have happened from nothing. Sturgeon (2000) points out that it grew out of a historically and geographically specific context. Sturgeon traces the origin of a context for electronics innovation and entrepreneurship to the earliest days of the twentieth century. In 1909 in Palo Alto, a graduate from Stanford University named Cyril Elwill established a radio transmission company, later called Federal Telegraph Corporation (FTC). Upon the establishment, he turned to the president of Stanford and the head of Civil Engineering Department to finance a new company, which illustrates an earlier example of the involvement of Stanford University than Terman (note that Stanford University was established in 1891). He built and demonstrated a wireless voice transmission system, and impressed San Francisco financiers invested in the company. The transmitters were adopted later by the U.S. Navy, and with the large orders from the Navy during World War I, FTC grew. The Stanford High Voltage Laboratory was of great assistance to FTC's efforts to improve the technology. More interestingly, FTC generated some spin-off companies such as Magnavox, Fisher Research Laboratories and Litton Industries in the area. For example, Litton Industries was established in 1932 by a Stanford graduate who had worked for FTC. Like Hewlett-Packard, it made a fortune during World War II, becoming a major manufacturer of military electronics systems. Further, in the early 1920s a young Frederick Terman spent a summer there at FTC as an intern. FTC continued to be one of the key players in the early San Francisco Bay Area electronics industry through the early 1930s (Sturgeon 2000). In this regard, Frederick Terman's activities encouraging entrepreneurship did not arise in a vacuum; rather, he can be better understood as a catalyst and a booster in an already prepared environment (Kenney 2000).

The early commercial successes of firms such as Hewlett-Packard and Litton Industries consolidated Northern California's position as an emerging center of electronics production. However, the scale of industrial activity was insignificant compared to that of the East Coast at that time. In fact, some of the region's leading companies moved east during the 1930s when radio became a national medium (Saxenian 1996).

Terman, later Dean of Engineering Department and Provost of Stanford, seems to have continued his pivotal role. He had strongly encouraged William Shockley, a Novel Prize laureate in physics and a native of Palo Alto, to locate his new Shockley Semiconductor Laboratory in the university's vicinity (Lecuyer 2000) in 1956, leading to the foundation of Fairchild Semiconductor, which would be the second major inflection point of Silicon Valley after Hewlett-Packard and Terman.

Fairchild Semiconductor was established in Palo Alto in 1957 by a group of eight physicists and engineers from Shockley Semiconductor Laboratory to manufacture advanced silicon transistors. Among these famous eight, including Gordon Moore and Robert Noyce, later founders of Intel, five had PhDs in the physical sciences from

eminent universities such as MIT and Cal Tech, and other three were engineers, one of which was a Stanford graduate. A year earlier, the group had joined the Shockley Semiconductor Laboratory founded by William Shockley. The eight were attracted to the laboratory by an interesting opportunity for young and ambitious scientists with an interest in the promising semiconductor field, and also by the Bay Area's beauty and proximity to the Sierra Nevada Mountains (Lecuyer 2000). They soon were increasingly unhappy with Shockly's heavy-handed management style, and started seeking another opportunity, intent upon staying in the area and keeping the group together. They could not easily find jobs in the area, but socialized in academic science rather than entrepreneurship, they had never thought of establishing their own firm (Lecuyer 2000). They asked Hayden, Stone & Company, a small investment bank in New York with which one of them had a contact, to help them find a corporation interested in hiring them collectively. Arthur Rock and his colleague at Hayden Stone, interested in developing new types of financial services for new firms and attracted by the group's intellectual abilities and the potential of the semiconductor business, suggested that the group establish its own corporation and offered to secure capital among corporate backers. However, Rock encountered considerable difficulties in raising the needed capital from East Coast large firms. Only Fairchild Camera and Instrument, a medium-sized military contractor based in Long Island, expressed an active interest. Exploiting Fairchild Camera's keen interest in reorienting the company toward electronics, Hayden Stone negotiated one of the first venture capital agreements on the West Coast. Fairchild Camera financed the establishment of a new firm, Fairchild Semiconductor Corporation, with a loan of $1.38 million for its first year and a half of operation (Lecuyer 2000).

By gaining a large share of high-performance silicon transistors for the military which the founders reasoned would have the financial resources to buy such complex and expensive products, Fairchild emerged as the leading silicon manufacturer in the late 1950s and very early 1960. It revolutionized the industry's products by introducing high-performance and reliable devices that other firms later copied (Lecuyer 2000). Fairchild Semiconductor was successfully sold to Fairchild Camera in 1959.

Fairchild Semiconductor had an enormous impact on Silicon Valley. Fairchild's founders and Hayden Stone played a major role in the formation of the venture capital industry in the area. Arthur Rock co-established the Peninsula's first venture capital partnership, Davis and Rock, in 1961, raising monies among Bay Area industrialists. Four Fairchild's founders, each of whom had received $250,000 after the sale of the company, invested in his fund. In addition to their investments in Rock's partnership, Fairchild founders also independently financed new science-based firms in the area. Out of these activities emerged yet another venture capital partnership, Kleiner Perkins. These funds were rapidly emulated. As a result, the San

Francisco Peninsula became one of the largest centers for venture capital in the nation in the late 1960s and early 1970s (Lecuyer 2000).

The rise of the venture capital industry, along with Fairchild's spectacular success and the numerous business and technical opportunities arising from its research and development efforts, led to an extraordinary entrepreneurial expansion on the Peninsula in the 1960s. Twenty-six silicon firms were founded in the area between 1960 and 1969. They were almost all established by former Fairchild engineers and managers. Among the most notable was Intel, founded by Noyce and Moore in 1968. While Fairchild had a workforce of 1,400 in 1960, the firm and its spin-offs employed 12,000 technicians, engineers, and operators on the Peninsula ten years later (Lecuyer 2000). Now many Silicon Valley firms have a 'genealogy chart,' first developed by a journalist and later maintained by the trade association SEMI, hanging in their lobbies, tracing their ancestry back to Fairchild (Castilla et al. 2000).

Fairchild also developed new corporate culture that was later widely adopted by other silicon firms. It had a vision for this newly emerging industry that explicitly rejected the hierarchical East Coast corporate culture. For example, there was no reserved parking at Fairchild, which was conceived of as a democratic community rather than a hierarchical workplace. And this new approach diffused as employees from Fairchild spun off to start their own companies (Castilla et al. 2000). These spin-offs led to rapid technological breakthroughs created by networks of scientists and engineers building on the accumulated knowledge of their predecessors, and their experience in previous firms.

The Entrepreneurial Diamond

Silicon Valley exhibits a perfect profile of the favorable diamond for entrepreneurial activities. Some of the examples that indicate it, along with the summary of the early evolution, include the following.

Input conditions. Although Stanford University had produced trained quality people such as electronics engineers long since its foundation in 1891, there had not been ample risk money from the earliest days of Silicon Valley. It was impressed local financiers who backed FTC, Terman-arranged local banks who backed Hewlett-Packard, and sympathetic individuals at a NY bank who arranged finance of Fairchild Semiconductors. But it was the success entrepreneurs of Fairchild who triggered the formation of venture capitals in the 1960s, and the emulation and success models have accumulated since then, now to the state where the venture capital investment in the region accounts around 20% of the national venture capital investment.

Today Stanford University has continued to be an eminent university for education and knowledge creation within the region among other Bay Area universities such as University of California at Barkeley. Stanford itself has 14,000

undergraduates and graduate[4]. Stanford is ranked 2nd in the top business schools and 2nd in the top engineering schools on America's Best Graduate Schools[5]. Stanford startups accounted for about 60 percent of total Silicon Valley revenues in both 1988 and 1996 (Gibbons 2000). The number of science, engineering, math and computer science degrees awarded by Bay Area postsecondary institutions is 5,294[6] annually. Further, Silicon Valley has an array of support services for new high-tech businesses that include venture capitalists and bankers, lawyers, headhunters, accountants, consultants, and a host of other specialists (Lee et al. 2000). About half of the six hundred venture capital firms in the United States are in Silicon Valley, and one group of 120 industry executives, known as the 'Band of Angels,' has helped launch sixty startups (Cooper and Folta 2000).

Entrepreneurial context. It is notable that there had been early entrepreneurs since the early 20th century, which are considered to have generated the prepared context to produce such an eager encouragement of entrepreneurship by Terman. Through the encouragement of startups and the subsequent successes of startups such as Hewlett-Packard since the late 1930s, they are considered the first inflection point of Silicon Valley that evolved the entrepreneurial context. Fairchild and its success entrepreneurs since the early 1960s are considered the second inflection point that propagated spin-off creation and open corporate culture that accumulated into the favorable profile of the entrepreneurial context.

Today with the accumulation of 40 years since then, the engineers in the Valley move frequently from one project or company to another (Castilla et al. 2000). Lee et al. (2000) depicts a climate in Silicon Valley that rewards risk-taking and tolerates failure. 'Certainly a distinctive – and to many observers, unique – feature of Silicon Valley in comparison with other regions, especially non-U.S. ones, is the degree to which its business climate encourages risk-taking and tolerates failure… In Silicon Valley, there are many examples of entrepreneurs who have failed and successfully started over. These entrepreneurs (and their financiers) usually view failure as a learning experience.'

Networking conditions. We saw Stanford University working as an anchor of networking opportunities with graduation ties to ask financial support and faculty to provide incubator roles even before the WWII. The 'genealogy chart' of Fairchild indicates broad and substantial networks its spin-offs have created since the 1960s. Today at both Stanford University and U.C. Berkeley, lively exchanges regularly occur among industry professionals, faculty, and students at seminars and conferences (Lee et al. 2000). Its network-based industrial system promotes collective learning and flexible adjustment among specialist producers of a complex of related

[4] Stanford University website. March 2003.

[5] U.S. News & World Report, America's Best Graduate Schools 2004.

[6] Ibid.

technologies (Saxenian 1996). Further, in Silicon Valley, networks have so special importance in the movement of labor, the evolution of influence and power, and the actual production of innovation that there is a saying 'the most crucial aspect of Silicon Valley is its networks' (Castilla et al. 2000). The institutions such as Joint Venture also promote cohesion and networking opportunities among members.

Market Conditions. It was the defense-related government procurement that gave rises to FTC, Hewlett-Packard, Fairchild Semiconductors, and others in Silicon Valley. It encouraged technology-intensive efforts of expensive complexity with rewards of large purchases of the military demand. Further, Rowen (2000) argues that the advances in technology and markets generally in the latter half of the 20th century have fitted the Valley's industrial structure particularly well (Rowen 2000). Today, although the military procurement might not be a large player, high density of high-tech companies such as computer and information technology and biotechnology are themselves the source of the innovative demand. The population of 2.3 million with 34 percent of immigrants, and per capita income 66 percent higher than the national average also account a favorable profile of the market conditions of Silicon Valley.

A narrative summary of the analysis is presented in Figure 3-14. Silicon Valley from this analysis shows several important features of the evolution of the entrepreneurial cluster: (1) Stanford University has been as a source of trained engineers and an anchor of networks that gave chances for the successes of ventures such as FTC and Hewlett-Packard; (2) Electronics, as a new technology, has offered market opportunities to the series of ventures such as FTC, Hewlett-Packard, and Fairchild. The opportunities had been further enhanced by the defense procurements; (3) two major inflection points that had had big impacts on the evolution of entrepreneurship are identified: Terman and Fairchild Semiconductor.

A schematic summary of the analysis on the evolutionary dynamics of the cluster is presented in Figure 3-15. In the series of self-reinforcing loops of the diamond since the early 20th century, we see several points that inflected from the regressed expectation of the previous tendency and worked as a fuel to the positive flow of the loop. In the early 20th century, Stanford University and its trained engineers were existent conditions since the university's foundation of 1891. Then a trained engineer established Federal Telegraph Corporation (FTC) in 1909. This would not have happened without the emergence of electronics and the risky investment of San Francisco financiers who were attracted by the possibility of the new technology. These 'abnormal' events triggered the start of FTC: the electronics as a kick input to the market conditions and the investment as a kick input to the input conditions. FTC's success with the help of the defense procurement formed the 'self-reinforcing loop of high impact venture creation' and the following spin-offs from it formed the 'self-reinforcing loop of spin-off creation,' improving the profile of the diamond.

Terman's role in the late 1930s is characterized as a catalyst and his emergence was a major abnormal event that had many influences. He encouraged his students, helped the students to get finance, worked as a bridge between the students and Stanford University, and invited Shockley to settle there. Through this catalyst, Hewlett-Packard's success with the help of the defense procurement formed another 'self-reinforcing loop of high impact venture creation,' leading to the improvement of the profile of the diamond. Another major abnormal event of the cluster is the emergence of the eight individuals of Fairchild Semiconductor from Shockley Semiconductor Laboratory in the late 1950s. Also, the individuals at a New York bank worked as an abnormal input to the input conditions to help start Fairchild Semiconductor in 1957. Then the 'self-reinforcing loop of high impact venture creation' and the 'self-reinforcing loop of spin-off creation' were formed again. The results include the improved input conditions by the creation of venture capitals of the success entrepreneurs, the improved entrepreneurial context by the spread of the Fairchild's corporate culture, and the improved networking conditions by the ties of the networks of the spin-offs. Once the diamond gets this size of inertia, the self-reinforcing loop continues itself. Today Silicon Valley stands as the most advanced entrepreneurial cluster in the world.

In addition to the very strong profile of the national diamond, Silicon Valley has the outstanding profile of the cluster diamond amongst any regions of the United States because of the accumulation of the evolution of technology entrepreneurship of almost 100 years.

The analysis demonstrated how the entrepreneurial diamond framework works. It helped streamline many factors involved, state the conditions of the technology entrepreneurship both at the national level and the regional level, and extract the abnormal points such as chance events and emerging catalysts from a lot of events in the evolution of the cluster.

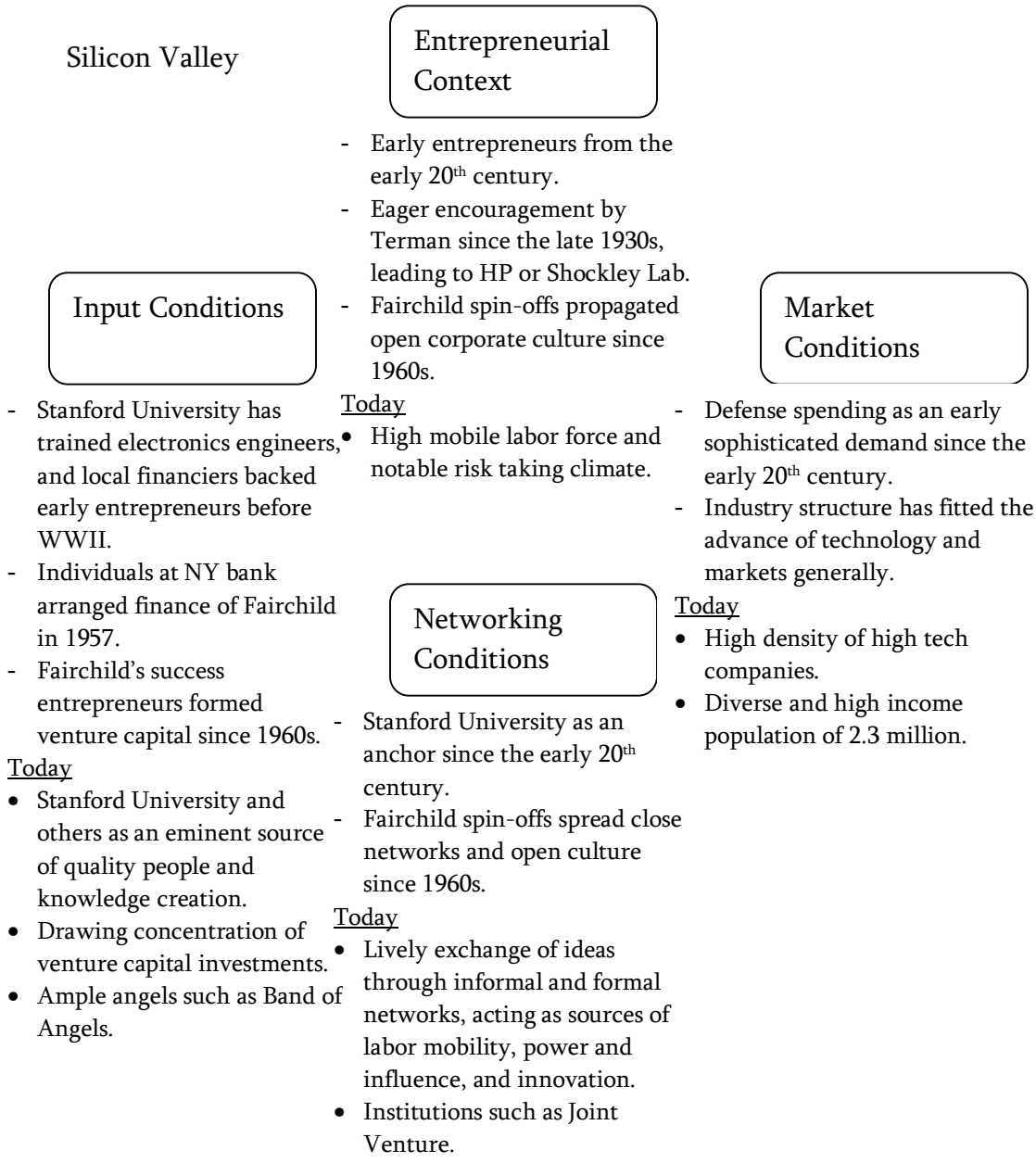


Figure 3-14 Analysis of the entrepreneurial cluster diamond of Silicon Valley

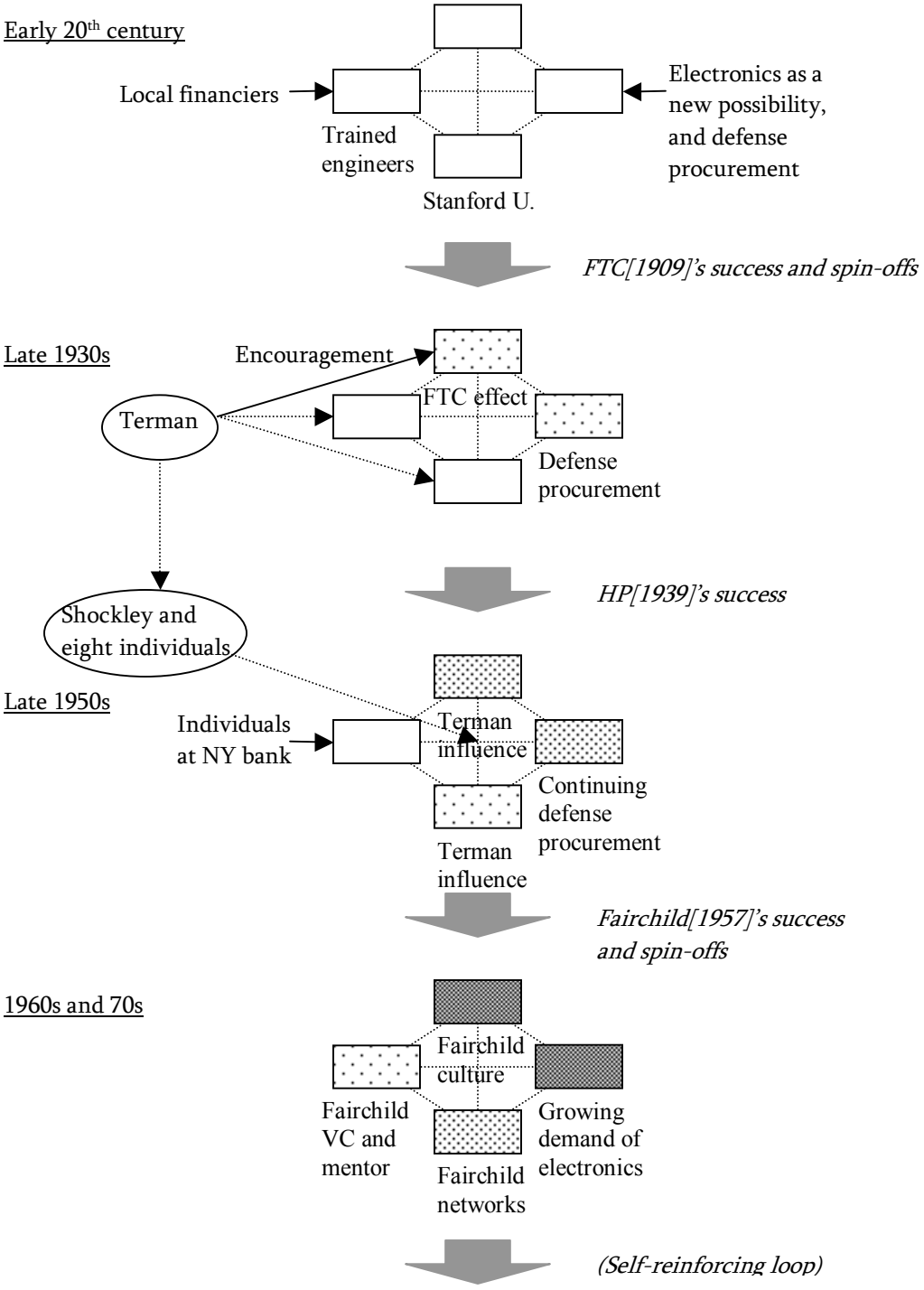


Figure 3-15 Analysis of the evolutionary dynamics of Silicon Valley

Notes: Boxes represent the four attributes of the diamond (right: input conditions, top: entrepreneurial context, bottom: networking conditions, left: market conditions). Statements under the boxes represent existent conditions at times. Solid arrows represent abnormal events. Circles represent major abnormal events. Shades are for illustrating gradual improvements, not absolute evaluations.

4 Case Studies

4.1 Methodology

4.1.1 Evolving Clusters

In order to further demonstrate how the entrepreneurial diamond framework works and understand the determinants and dynamics of entrepreneurial clusters, three case studies were conducted: Cambridge, the United Kingdom; Munich, Germany; and Tokyo, Japan.

Table 4-1 shows locations of 'Europe's 50 hottest tech firms' of the innovative products and services and the promising business models with the future potential that TIME identified by interviewing venture capitalists, industry experts and entrepreneurs in May 2002[7]. We can see some locations have plural 'hot' tech firms: Cambridge of biotech, Cambridge of semiconductors, Glasgow of Optics, and Stockholm of wireless. Cambridge has the most 'hot' tech firms. At the country level, the United Kingdom has 21 firms, and Germany and Sweden each has 6 firms.

Table 4-1 Locations of 'Europe's 50 hottest tech firms'

	Biotech	*Semi-conduc-tors*	*Optics*	*Wireless*	*Business Appli-cation*	*Emerging Tech-nology*	*Total*
UK	7	5	2	4	2	1	21
(Cambridge)	(4)	(3)			(1)	(1)	(9)
(London)	(1)	(1)		(1)	(1)		(4)
(Glasgow)			(2)				(2)
Germany	2	2			1	1	6
(Munich)		(1)					(1)
Sweden				5	1		6
(Stockholm)				(3)	(1)		(4)
France	2	1	1			1	5
Switzerland	2	1		1			4
Belgium	1				1		2
Ireland		1		1			2
Netherlands	1		1				2
Czech					1		1
Finland				1			1

Note: Cities cited are those who have multiple firms and Munich.
Source: TIME Digital 2002, Europe's 50 Hottest Tech Firms, May 2002.

[7] TIME Digital 2002, Europe's 50 Hottest Tech Firms, May 27, 2002.

The author chose Cambridge and Munich because, at the country level, the U.K. and Germany are among the G7 counties and, at the location level, Cambridge has the most 'hot' tech firms and Munich is known as the highly developing region in Germany. The third country was chosen Japan because it is considered one of the least favorable environments for entrepreneurship among the G7 countries, and was considered to exhibit an interesting contrast. Yet, as is rare in Japan, Tokyo is identified as a location that has relatively many young Internet ventures having emerged around 1999 and 2000.

Although we don't pick up Sweden as a subject, it is known to have several high tech clusters such as Stockholm and Lund. One of them is Linkoping, and is described here as a short example of an evolving cluster as it is reported in academic literature. Klofsten and Jones-Evans (1996) describe the Linkoping area as one of the regions in Sweden at the forefront in the creation and development of new technology-based firms. During the ten years, over 350 small technology-based spin-offs have been established in the Linkoping region, with approximately 70 of these emerging directly as a result of academic research activities (Klofsten and Jones-Evans 1996). The Linkoping region has Saab's aircraft division, Ericson Radio, Mjardevi Science Park, Swedish Defense Research Establishment, and Linkoping University. A number of firms have also evolved from business ideas conceived by one or more students during their studies. Shedding light on a successful model of a close link between an institution founded by a group of business leaders and individuals from the university, and the university's entrepreneurship center, they extract the link's roles to encourage entrepreneurial activities, promote collective learning of management skills, and facilitate networking activities. The case exhibits a good example of the evolution of an entrepreneurial cluster with a distinctive role of the favorable profile of the networking conditions.

4.1.2 Interview

Because the three locations that the author picked up are the relatively recent clusters, literature and articles were limited compared with Silicon Valley. Therefore, the author conducted interviews to gain information on determinants and dynamics of these entrepreneurial clusters.

Yet it is hard to identify legitimate determinants and dynamics from interviews because the information of this kind of social phenomenon resides basically in people's vague perception until they are well written and known. Further it would take thorough interviews with a lot of inside people to compensate the biases often involved in this kind of phenomenon. In order to overcome this nature of the case study interview, and let both the purpose of the study that needs plural cases and the time and resource constraint be taken into account, the author adopted a unique

interview method based on a language analysis technique called the Language Processing (LP) Method.

The LP Method was originally developed by a professor Shiba in the area of Total Quality Management to solve management problems such as manufacturing process improvement with non-quantitative data (Center for Quality of Management 1995). In order to compensate the ambiguous nature of qualitative data due to the fact that each person perceives the meaning of language differently, the LP Method uses semantics rules to make qualitative language data uniform and suitable for analysis. Take for example that somebody wants to solve an organizational culture problem. First, the method distinguishes the language of report that conveys the same meaning to everybody from the language of affection that conveys a sentiment. Only using the language of report to the utmost, the participant writes down key symbolic statements about the problem based on his/her experience. The number of the statements should be around twenty, or at least twelve, in order to capture the whole aspects of the problem and let later analysis easier. Second, the statements will be grouped into several groups so that each of the groups has a common thread of a mental image, rather than the words themselves. The number of the statements in a group should be three or lower than three. Third, titles are given to each of the groups by using language of a higher level of abstraction going up from the level of the original statements. Again, mental image should be used for developing titles. This is the first-level abstraction. Finally, the second-level of abstraction is done from the first level groups with the same methodology of the previous stage. The output is an extraction or a straight-forward identification of the organizational culture problem without a mix of different levels of statements and ambiguity. (For further information of the method, see Center for Quality of Management 1995.)

This LP Method is adopted for the interviews for this study, asking 'What were the essences of the entrepreneurship evolution in your location?' (The questionnaire and explanation of the method sent to interviewees are shown in Exhibit 4-1.) Yet because applying semantics rules, grouping, and abstracting need some training that interviewees are not supposed to have taken, the interview becomes a collaborative way. The interviewees are asked to describe about sixteen key symbolic statements to answer the question in language of report with the author's help. After collecting the statements, the author groups them and abstracts them with the interviewees' help, finally coming up with an output diagram for each of the interviewees.

The purpose of the interviews is (1) gain information on determinants and dynamics of entrepreneurial clusters from the statements of 'key symbolic' facts that are supposed to be language data suitable for analysis; and (2) grasp the perception of inside people on determinants and dynamics of entrepreneurial clusters from the abstracted titles that are supposed to be uniform qualitative language data. The results of the interviews are used for complementing the information from the

available literature and articles, as well as checking if the descriptions of the entrepreneurial clusters are aligned with the perception of the inside people.

The interviewees are inside players such as entrepreneurs and venture capitalists or close watchers such as academic researchers in Cambridge, Munich, and Tokyo. Because of the time-taking nature of the interview, the author first sought commitments to participate in the interview from interviewees, then conducted the interviews. The collaborative LP interviews were done mainly via email sessions supplemented by telephone communication. For the interviewees in Japan, a translation in Japanese of the questionnaire was used, and the results were translated in English by the author. The results are shown in Exhibits at the end of each section of the case studies. One interview for Cambridge, two interviews for Munich, and three interviews[8] for Tokyo were conducted according to the extent of the need to achieve the purpose of the interviews for each of the cases.

[8] One of them is an LP diagram abstracted from a collection of publications of one individual.

Exhibit 4-1 The interview questionnaire used for the interviews (Collaborative LP interview)

Please list down about 16 facts to answer the question.

Question: What were the essences of entrepreneurship evolution in XXX?
The question is about environments or mental models surrounding entrepreneurs and start-up activities, which include but not limited to:

- Input condition (e.g. risk money, managers, technology availability)
- Entrepreneurial culture, legal framework
- Networking opportunities
- Market conditions for start-ups' outputs such as products and companies' stocks

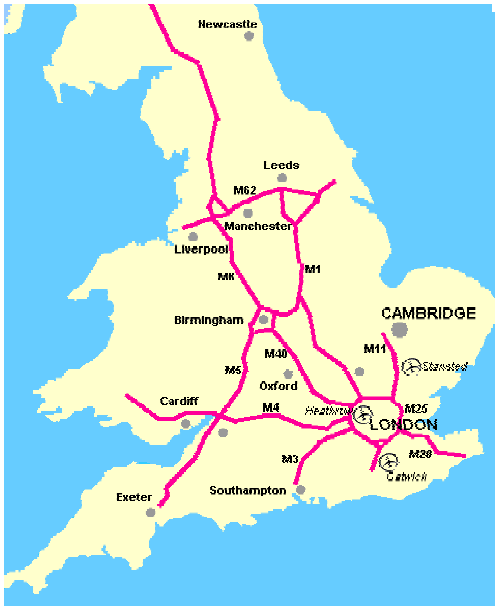
'Essences' include:

- Events that had impact on them.
- Changes that represent evolution of them.
- Prerequisite conditions that the location has had.

How to do:
1. Remember your perception or image about the issue in your mind. (Thought or opinion level)
2. Don't try to describe your perception at this level, but first put your perception down to many facts. (Fact or experience level)
3. Describe about 16 key symbolic facts, each in one sentence. Sentences should be concrete including preferably proper nouns and all of (when), (where), (what/who) and (how).
Please try to describe facts by visible or noticeable actions that can be recognized by others, not by inferred emotional words that cannot be recognized by others. (Example: not 'My boss is angry', but 'My boss sits at his desk looking at me and saying nothing'.)
Because we will examine causal relationships later, you don't have to try to include causal explanations in all the sentences.

Examples:
- In spring of 1999, a success of three-year old company XXX at Munich became obvious to everybody in Germany by an article of YYY newspaper describing the company's profits.
- During 1998-1999, at least 5 start-up companies were established continuously at AAA Park at Cambridge, right after US-based venture capital BBB opened its branch at AAA Park in fall of 1998.
- Last year, Mr. CCC could contact with graduates from DDD university engineering school at the monthly conference about EEE that started a few years ago, resulting in him hiring two graduates for his start-up company.
- In the late 1990s, venture capital investment in Munich region increased 80% per year to 3,333 million euro in 2000.
- FFF Government reduced paper work by about half to register company in 1997.
- Company XXX has spun off at least 10 companies at Munich since it came to Munich in 1995.

4.2 Cambridge, UK



Cambridge is located 50 miles north of London, historically having been a market town with the University of Cambridge. The university, with 16,500 full-time students and 31 Colleges such as Trinity College and St John's College, has a world-wide reputation for outstanding academic achievement and the high quality of research undertaken in a wide range of science and arts subjects[9].

It was in 1985 when a study of the so-called 'Cambridge Phenomenon' (Segal Quince Wicksteed 1985) was published by a consultancy. The study, sponsored by private companies, the University of Cambridge, and the government, first revealed the growing numbers of advanced technology companies established in and around the university and the market town of Cambridge, although it had been known for at least the past five years in some banking quarters and in the area itself that something interesting was happening in Cambridge by way of the startup and growth of indigenous high technology companies linked in some way to the university. The study identified a total of 322 high technology firms in the Cambridge area by the end of 1984, having grown from 100 companies 10 years before and 30 companies 25 years before.

Today, with a similar population around 100,000[10], there are around 1,500 high tech businesses with 40,000 employees in the Cambridge area. 20 businesses are listed on stock markets[11]. The firms are mostly in computing hardware and software, scientific instruments, electronics and telecommunications, technology consultancy and R&D, and increasingly biotechnology.

National Level Analysis

At the national level, the United Kingdom has Total Entrepreneurial Activity index of 6.1% for the average of 2000-2002 (Table 2-3). Not as high as the United States and Canada, but higher than France and Japan. Figure 4-1 shows the entry and exit rate in the U.K. in the last two decades. The entry rate fluctuates from over 10 percent to about 16 percent in the late 1980s. The exit rate exceeds the entry rate

[9] University of Cambridge website as of April 2003.
[10] Surrounding area of the City of Cambridge, Cambridgeshire, has a population of 684,000.
[11] St. John's Innovation Centre website as of April 2003.

right after the low GDP growth in the early 1990s although the entry rate is on the steady level in recent years. The overall entrepreneurial activities that include from low impact entrepreneurship to high impact entrepreneurship seem moderate among the G7 countries.

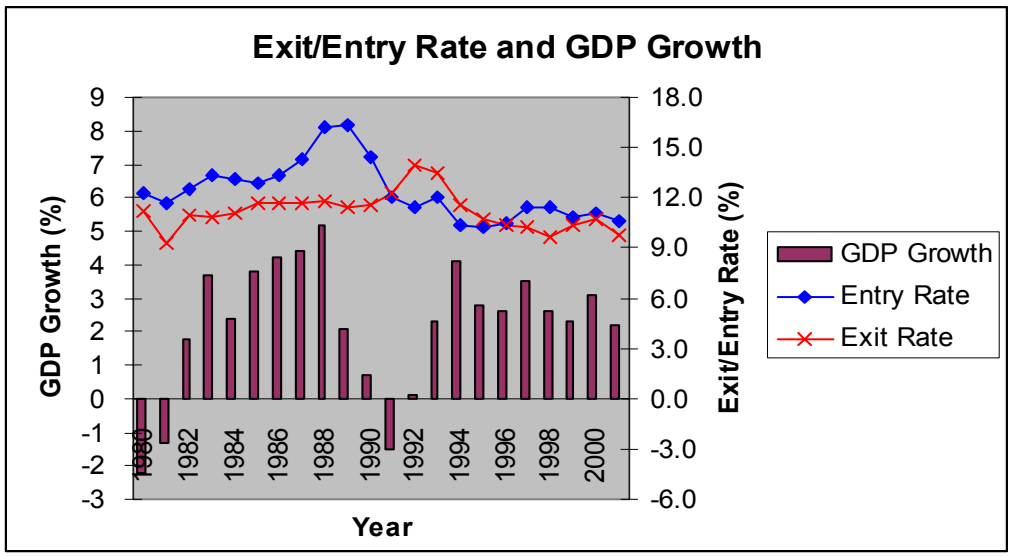


Figure 4-1 Entry/exit rate and GDP growth of the United Kingdom

Notes: Entry and exit rates are percentages of the total stock (enterprises registered for VAT) at the start of the current year. VAT registration threshold were changed in 1991 and 1993.

Sources: U.K. Small Business Service.
GDP data – World Bank, World Development Indicators.

As we did in the national analysis of the United States, the same benchmarking measures related to the entrepreneurial diamond are adopted for assessing relative strengths and weaknesses of the profiles of the national diamond (Figure 4-2).

Input Conditions. Concerning the quality people with management skills, the U.K. is ranked 6th on Quality of Management Schools, fourth but still among the leading group of the G7 countries with the United States, France, and Canada. The U.K. is ranked 37th on Availability of Scientists and Engineers, and this is the lowest position among the G7 countries. Concerning the risk money, the U.K. is ranked 9th on Venture Capital Availability, right behind the Canada's second position among the G7 countries. Concerning the knowledge creation, Quality of Scientific Research Institutions of the U.K. is ranked 7th, third after the United States and France, and Company Spending on Research and Development is ranked 12th, the third worst among the G7 countries to Canada and Italy. The U.K. has the 16th position on the U.S. patents per capita, the second worst among the G7 countries. The United Kingdom has relatively low availability of scientist and engineers, moderate

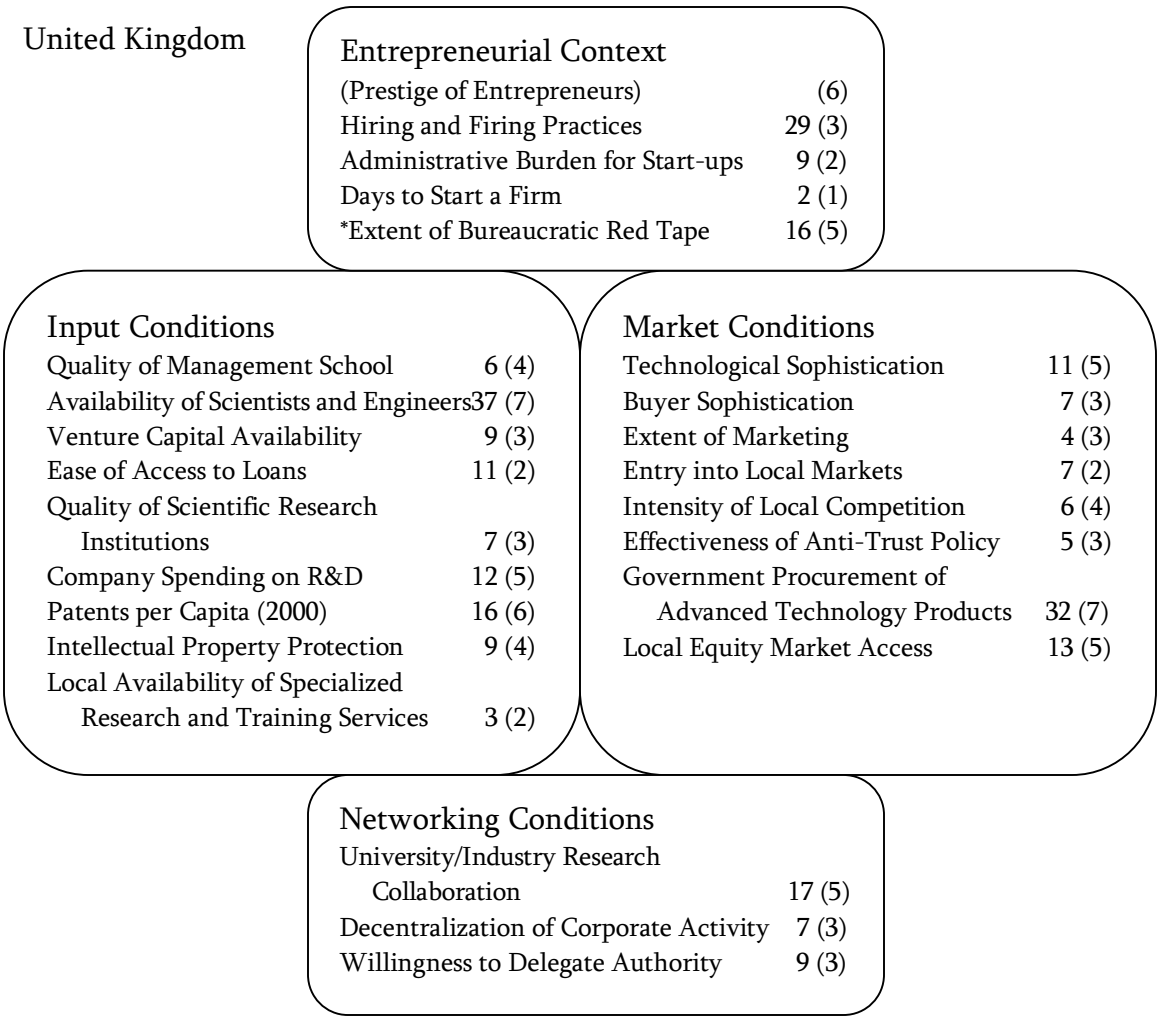


Figure 4-2 Country rankings concerning the entrepreneurial diamond of the U.K.

Notes: Values are relative positions among 75 countries. Ranks are determined basically by the average of the scaled points scored by senior business leaders in the 75 countries. The United Kingdom ranks 7th on Company Operations and Strategy and 8th on Quality of the National Business Environment. '()' indicates rankings among the G7 countries. * The value is ranked opposite to the favorable direction. (Prestige of Entrepreneurs) is a complement measure.

Source: Global Competitiveness Report 2001-2002.

availability of risk money, and low level of knowledge creation as measured by patents per capita in spite of good scientific research institutions among the G7 countries on the profile of the input conditions.

Entrepreneurial Context. Concerning the prestige, only 38 percent say that entrepreneurs are respected, much lower fraction compared among the G7 countries except Japan that has 8 percent. The moderate fraction of people with entrepreneurial activity (TEA index) and the fluctuating entry rate and exit rate in the last two decade indicates that the familiarity with entrepreneurs is not as high as

the United States. Concerning the labor mobility, the U.K. is ranked 29th on Hiring and Firing Practices, the third position among the G8 countries, which is still much higher than the other European countries such as France, Germany, and Italy, and inferring moderate labor mobility. Concerning the regulatory frameworks, the median response of the Days to Start a Firm is 7 days and ranked 2nd (top among the G7 countries), and Administrative Burden for Startups is considered easy and ranked 9th, just behind the United States. Further, the U.K. is ranked 16th on Extent of Bureaucratic Red Tape that ranks in the opposite way, being favorable above the United States as well as Japan and Germany.

Networking Conditions. University/Industry Research of the U.K. is ranked 17th, fifth among the G7 countries above Italy and Japan. Concerning open corporate culture, the U.K. is ranked 7th on Decentralization of Corporate Activity and 9th on Willingness to Delegate Authority both of which are the middle positions among the G7 countries. It can be said that the United Kingdom has moderate possibility of having favorable networking conditions compared with the other G7 countries.

Market Conditions. The U.K.'s position in Technological Sophistication, a broad measure for the innovativeness of market demand, is ranked 11th, fifth among the G7 countries. Buyer Sophistication, another measure, is ranked 7th, third among the G7 countries. Extent of Marketing of the U.K. is ranked 4th, third among the G7 countries. Concerning the pro-competition conditions of markets, the U.K. is ranked 7th on the occurrence of Entry into Local Market, second among the G7 countries to Germany ranked 4th. Intensity of Local Competition is ranked 6th, fourth among the G7 countries but still in the leading group. Effectiveness of Anti-Trust Policy is ranked 5th, behind Germany and the United States. The United Kingdom has the middle position on the innovativeness and diversity of market demand within the G7 countries, and among the highest on pro-competition conditions. On the other hand, concerning Government Procurement of Advanced Technology Products, the U.K. is ranked 32nd, worst among the G7 countries. Finally, concerning the equity stock market, Local Equity Market Access is ranked 13th, the third worst to Japan and the United States among the G7 countries. It is not an only measure for the conditions of stock market, but it is relatively hard to raise money in local equity market in the U.K.

From the view point of this analysis, the United Kingdom has (1) a skewed profile of the input conditions such as lack of scientists and engineers, the moderate venture capital availability, and good management schools and scientific research institutions; (2) low administrative burden for startups but a low profile of social aspect of the entrepreneurial context; (3) a moderate or low potential for the networking conditions; and (4) a middle level potential for the market conditions. Overall, the country does not have a very strong profile of the entrepreneurial national diamond among the G7 countries, except for some potential such as venture capital, management schools and scientific research institutions, and market conditions. Summary is shown in Figure 4-3.

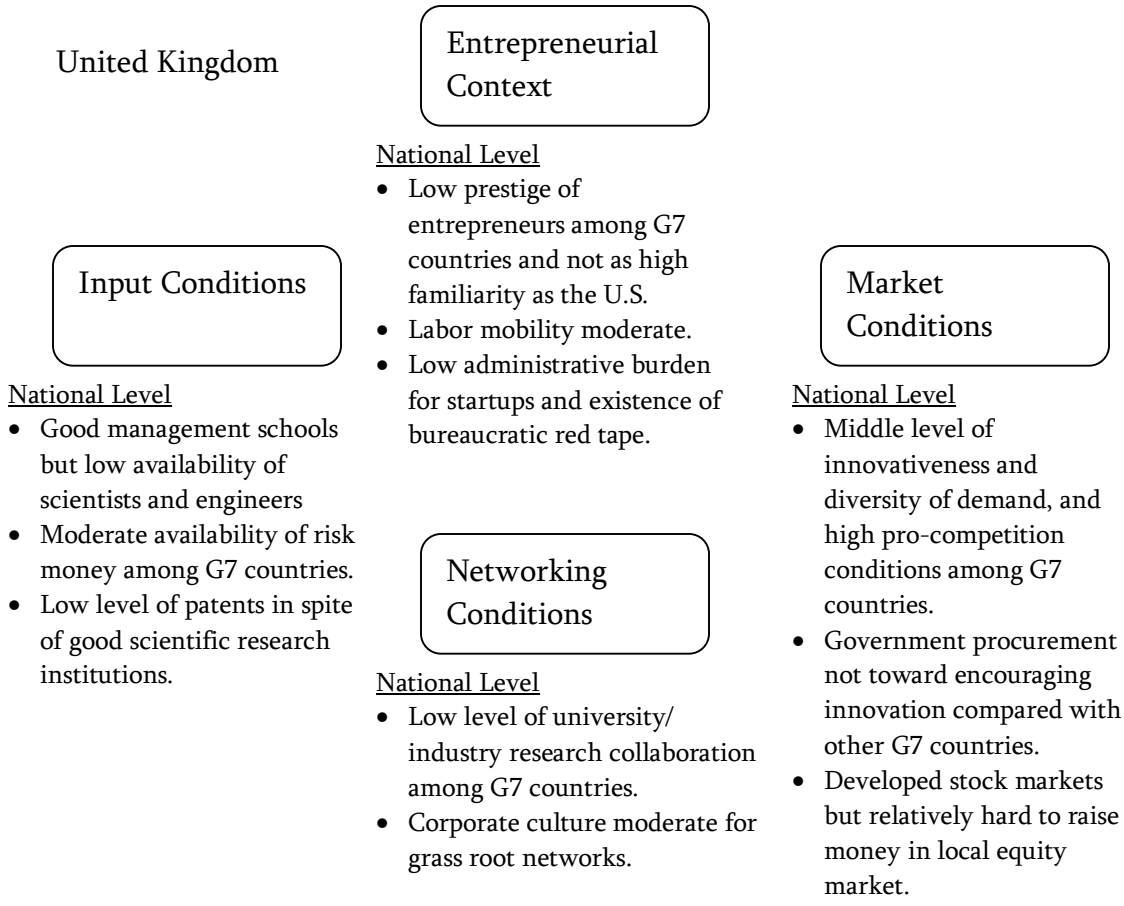


Figure 4-3 Analysis of the entrepreneurial national diamond of the U.K.

Early Evolution of the Cambridge Cluster

The early history of the entrepreneurial cluster of Cambridge is relatively well written. The interview result (Exhibit 4-2), which helped identify some key events, supports what is written.

In Cambridge it had long been that the only industrial activity was in electronics and scientific instruments in a few firms (Garnsey and Smith 1998). One of them is Cambridge Instruments, an oldest startup related to Cambridge University, formed in 1881 by a son of Charles Darwin who was a member of Trinity College.

Late history starts around a report in 1969 by the Mott Committee, a Cambridge University committee set up under the chairmanship of Sir Nevill Mott. The report, as a response to an initiative of the labor government, recommended an expansion of 'science-based industry' close to Cambridge to take maximum advantage of the concentration of scientific expertise, equipment and libraries and to increase feedback

from industry into the Cambridge scientific community[12]. Although Cambridge Science Park was started by Trinity College in the following year, there were many opposed to the developments recommended by the Mott report. But authoritative endorsement of these recommendations swung influential opinion in their favor and brought round local government, with the consequence relaxation of planning restrictions on high-tech firms in the 1970s (Garnsey and Smith 1998).

Segal (1986) writes an interesting aspect of the Mott Committee. A few key individuals, influenced by what they saw happening around Stanford and MIT, perceived the importance of there being in the vicinity of the university a good number and diversity of science-based companies, leading to the formation of the Mott Committee. He also writes that after much argument and lobbying they have created a relaxed and generous attitude in the university toward the dealings with the outside business world, and have made it easy for faculty to enter into commercial activity while retaining their academic posts and salaries.

In the 1970s, new opportunities for entrepreneurs were available as a result of technological and scientific development. In particular, the development of the micro-processor led to the foundation of a number of computer firms producing hardware. Subsequently software houses proliferated. The presence of the Computer Aided Design (CAD) Centre in Cambridge was a major contributor to these developments (Garnsey and Smith 1998). One success example of this period is Acorn, a computer company, founded in 1978 by Hermann Hauser. Acorn made a success when the BBC approached them to design a computer. Their prototype became the hugely successful BBC computer, which sold 100,000 in its first year alone. Acorn was floated on the stock exchange in 1981 and Hauser and his co-founder became millionaires overnight (Beveridge 2001). Hauser later founded a venture capital and became one of the founders of Cambridge Network, a limited company aimed at creating and supporting the Cambridge community.

The potential for a cluster in Cambridge was first recognized by Barclays Bank[13] in 1978[14]. Certain bank managers, notably Matthew Bullock of Barclays Bank, were by the late 1970s sympathetic to high-tech ventures (Garnsey and Smith 1998). Barclays Bank took a strategic decision to invest not just money but, more crucially, the time of one of its business advisory managers in development and implementation of the business plan of first-time technological entrepreneurs (Segal 1986). During the early days of the phenomenon it was noticeable that many spin-offs were driven more by the desire of the founders to exploit their proprietary technology than in trying to create real businesses. Part of the role of Barclays Bank has therefore been to try to

[12] Cambridge Science Park website.

[13] One of the largest financial services groups in the United Kingdom with many branches today.

[14] St John's Innovation Centre website.

encourage a more commercial approach to exploitation[15]. It also formed a club and invited key speakers to help improve the business knowledge. The purpose of the club was also to encourage networking between individual members[16]. Barclays Bank encouraged other forms of financial institutions operating nationally and internationally, as well as other local investors, to finance the local high technology companies both at start-up and later rounds of financing (Segal 1986).

By 1985 when the 'Cambridge Phenomenon' report was published, firms engaged in innovative software applications multiplied, with clusters of firms specializing in CAD, geographic information systems and image processing. In Cambridge job mobility and interaction ensured the circulation of know-how among these firms. Cambridge Consultants Ltd, founded in the 1960s by university engineering department staff was a key catalyst, stimulating spin-offs of a cluster of ink jet printing firms with common suppliers. A cluster of technical consultancies, deriving ultimately from Cambridge Consultants Ltd, in turn gave rise to further firm formation (Garnsey and Smith 1998). Technology consultancies, a distinctive element of the cluster, have continued to prosper and are evolving into more rounded technology houses. Finance and professional services have greatly increased their scale and focused on the needs of high-tech businesses. All the big five accountants/consultancies have significant offices in the city, and legal specialists on intellectual property rights and related issues operate from Cambridge and there is an active, locally based, investor community[17].

The Entrepreneurial Diamond

According to Segal Quince Wicksteed which published 'Cambridge Phenomenon Revisited' in 2000, the process of new firm spin-offs continues to be a feature of the Cambridge scene, with founders coming from both existing high-tech firms and the research community[18]. As we saw, an evolutionary dynamics within the small town since the Mott Committee is notable. The evolution has placed Cambridge University in a center of dynamics, not always directly but rather in various indirect ways. According to Segal (1986), Cambridge University has two distinctive aspects. The first aspect is to do with the terms of employment of staff. Most other U.K. universities have a uniform and highly specific structure for all employment contracts with little margin for flexibility. Cambridge, by contrast, has a variety of loose contractual relationships which place rather more emphasis on academic staff living close to the city. The second is to do with the authorities' policy towards links with

[15] St John's Innovation Centre website.
[16] Ibid.
[17] Segal Quince Wicksteed website.
[18] Ibid.

industry. The university has a benign and supportive posture towards faculty members' involvements with industry. 'Policy in Cambridge was essentially laissez faire' (Garnsey and Smith 1998). With this in mind, let's review key features of the cluster of Cambridge along the four attributes of the entrepreneurial diamond.

Input Conditions. It is no doubt that Cambridge University has been a main source of both quality people with scientific and technical knowledge, and knowledge creation. Although among over 300 high technology businesses in 1984 only some 45 in the area had been set up by individuals coming straight from the university, first generation spin-offs from the university have themselves spawned new companies (Segal 1986), hiring employees from the university.

The initiatives of the individuals at Barclays Bank started in the late 1970s were the catalytic events. It provided not only finance, but also management skills and mentor. This kind of support is not usually seen at banks. A guess is that the individuals seeing a future in small high tech businesses encouraged and moved the organization of a large bank branch. This bold movement prompted followers of the local business community and others. Interestingly, at least until the 1980s, the venture capital industry had not been particularly active on the Cambridge scene (Segal 1986). It is inferred that finance from Barclays Bank had worked as risk money available in the area. Later, three small venture capital funds were set up in association with the university, with a dozen or so investments by the early 1990s (Garnsey and Smith 1998). Today, technology consultancies are not only a major source of spin-offs but also active in the seed and venture capital business[19]. Further, there is a business angels network based in Cambridge, called Great Eastern Investment Forum. It was established in 1995 and its members have invested in over 70 early stage companies since then[20].

There is another enhancement of the input conditions. In 1987 St John's College founded Innovation Centre and Innovation Park playing a role of incubator by providing physical space, seed capital fund, and in-house management support for startup firms. It houses 50 businesses and works with around 400 earlier stage or embryonic businesses in 1999. The failure rate over 13 years has been around 15% compared to the 50% that might have been expected. One of the success firms is Autonomy, founded in 1996, which is valued at over 3 billion dollars on NASDAQ[21].

Entrepreneurial Context. It can be said that Cambridge University's 'hands-off but positive' (Segal 1986) posture of the administration led to the Mott Committee, and the Mott Committee further created a generous attitude toward entrepreneurship of staff. Segal points out the fact that there has never been heavy industry, or industries in which large plants and large unionized labor forces have been prominent

[19] Segal Quince Wicksteed website.

[20] Great Eastern Investment Forum website, as of April 2003.

[21] St John's Innovation Centre website.

has helped create a labor market and a general attitude in which flexibility and individualism have never been suppressed in Cambridge. The Mott committee also affected the regional legal framework with the consequence of relaxation of planning restrictions which meant a lot in a small old town.

Today the fact that 1,500 high tech businesses in a small town with a population of 100,000 means that the familiarity with entrepreneurs is really high. Further, the existence of role models and the prestige is inferred by a book published in 2001 describing the positive profiles and stories of 41 entrepreneurs and key players in the entrepreneurial scene in Cambridge (Beveridge 2001), which also appeared on a local business newspaper. Cambridge University began Cambridge Entrepreneurship Centre in 1999 following the seed funding from the government, signaling the evolution reaching to a certain level. It provides entrepreneurship education to would-be entrepreneurs at the university, as well as networking opportunities to them. Further, in the same year, Cambridge University and Massachusetts Institute of Technology established the Cambridge-MIT Institute, a joint venture backed by the U.K. government and private sector. It is to enhance the competitiveness, productivity, and entrepreneurship in the U.K. economy by improving the effectiveness of knowledge exchange with educational programs and research projects[22].

Networking Conditions. There is no question that Cambridge University has played the anchor role of networks in the small town. There are numerous interlocking networks of talented, influential and accessible individuals, which make for informal, congenial and efficient business dealings (Segal 1986). In the early days, the Mott Committee not only affected the entrepreneurial context but also improved the networking conditions by creating a generous attitude toward university/industry collaboration in the university. Further, it is impressive that Barclays Bank recognized the importance of networking opportunities and formed a club for enhancing networking opportunities.

Today there are several institutions that promote the networking conditions. St John's Innovation Centre not only works as an incubator but also works as a node of dense networks. It helped establish Cambridge Entrepreneurship Centre at the university, and closely works with other communities such as Cambridge University and Business Link[23]. Cambridge Network, a limited company founded in 1998 by private firms and Cambridge University, aims to create and support a community from business and academia in the Cambridge region and link the community to the global high-tech network for the benefit of the Cambridge region[24]. It offers cohesion of the community ideal for dense networks and forums to over 1000 members.

[22] The Cambridge-MIT Institute website.

[23] St John's Innovation Centre website.

[24] Cambridge Network website as of April 2003.

Eastern Region Biotechnology Initiative (ERBI), organized in 1997 by the local biotech community, improves communications and networking through newsletters, meetings and conferences, and provides surveys, reports, and database for the biotech community[25].

Market Conditions. Segal (1986) says that Cambridge's short and modest industry history and the town's small size and its relative remoteness and compactness make specialist market opportunities readily identifiable locally, generated originally by demand mostly from the university, and later by already established larger local firms. It is worth noting that the technology development in computers opened ways to early entrepreneurs in the related academics in Cambridge in the 1970s. Further, technology consultancies, derived from the demand of the local high tech firms, has evolved and spun out a lot of firms and venture capitals.

A narrative summary of the analysis is presented in Figure 4-4. The Cambridge cluster from this analysis shows several important features of the evolution of the entrepreneurial cluster: (1) a small-sized community with an accumulation and concentration of knowledge and technical expertise has had a decentralized and open context, distinctive from other regions, shaped by the posture of the university; (2) key individuals at the university formed the Mott Committee succeeding to influence the entrepreneurial context rather rapidly within the small community; (3) around the same time, an advent of microprocessors opened new possibilities for early entrepreneurs; and (4) key individuals at Barclays Bank made a bold move for a bank to offer finance, mentoring, and networking opportunities for entrepreneurs within the community, leading to the entrants of many followers.

A schematic summary of the analysis on the evolutionary dynamics of the cluster is presented in Figure 4-5. Since around 1970, several abnormal events that fueled the positive flow in the series of self-reinforcing loops of the diamond are identified. In around 1970, Cambridge University, its technical knowledge, and its specialist demand were existent conditions, and its generous policy was favorable for the entrepreneurial context. Then Mott Committee started lobbying with its 1969 report, creating generous attitudes toward entrepreneurship and university/industry collaboration among the faculty. Together with microprocessors as a new technology, Cambridge saw the creation of computer ventures in the 1970s, forming the 'self-reinforcing loop of high impact venture creation and spin-off creation.' Mott Committee worked as a catalyst, as well as kick inputs to the entrepreneurial context and the networking conditions. Microprocessors were an abnormal input to the market conditions to prompt computer venture creation. At this time, Cambridge Consultants had already existed, working as a catalyst to prompt ink jet and consultancy spin-offs. In the late 1970s, individuals at Barclays Bank started offering

[25] ERBI website.

finance, mentoring, business skills, and networking opportunities to technology ventures. This is an inflection point of the Cambridge cluster, and the emergence of the Barclays individuals were a major abnormal event, working as kick inputs to the input conditions and the networking conditions. After that, we saw a dramatic improvement in the input conditions by followers of Barclays Bank. Now Cambridge is considered to have already been in motion of the self-reinforcing loop.

The United Kingdom as a nation has the weaknesses in the national diamond such as lack of scientists and engineers, and the low profile of social aspect of the entrepreneurial context. But Cambridge has had ample scientists and engineers, and the small-size community with the accumulation of technology entrepreneurship of 30 years is considered to help compensate the low profile of the social aspect of the entrepreneurial context.

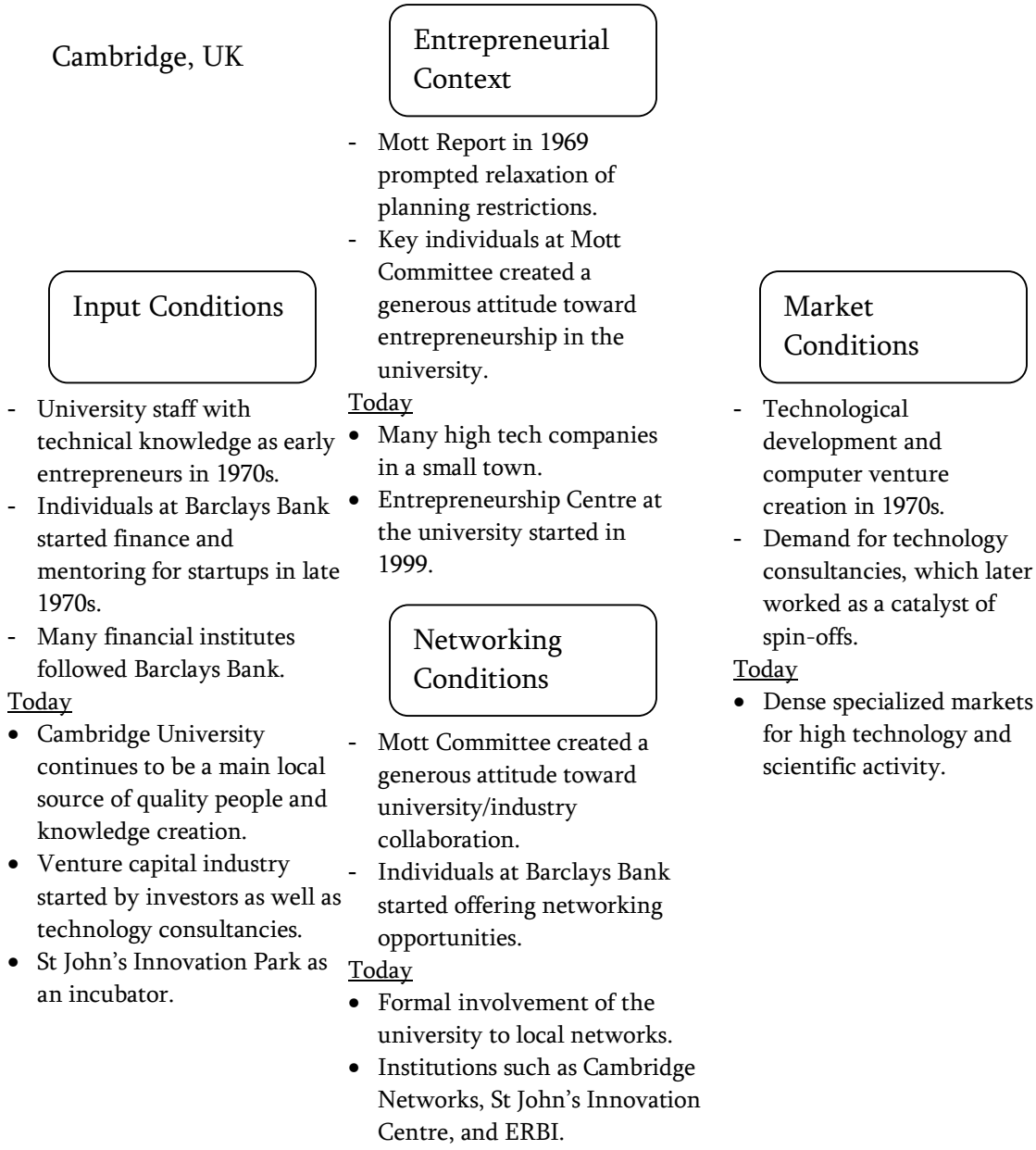


Figure 4-4 Analysis of the entrepreneurial cluster diamond of Cambridge

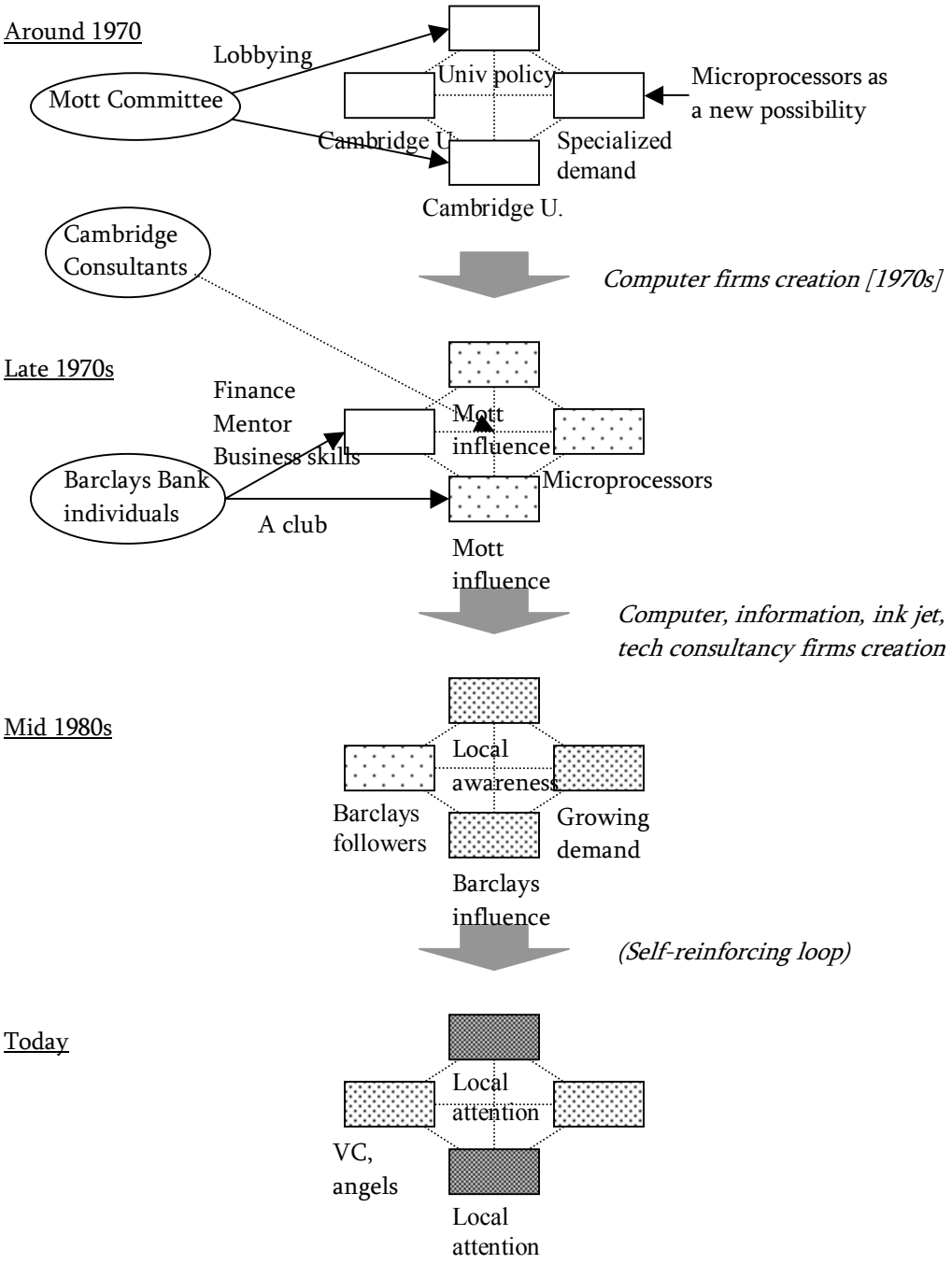


Figure 4-5 Analysis of the evolutionary dynamics of Cambridge

Notes: Boxes represent the four attributes of the diamond (right: input conditions, top: entrepreneurial context, bottom: networking conditions, left: market conditions). Statements under the boxes represent existent conditions at times. Solid arrows represent abnormal events. Circles represent major abnormal events. Shades are for illustrating gradual improvements, not absolute evaluations.

Exhibit 4-2 Interview result (Cambridge, Dr. T.M.)

Language Processing Diagram built from the interview in March 2003 of Dr. T.M., a university researcher who earned Ph. D from Cambridge University and had worked at St. John's Innovation Centre.

Theme: What were the essences of entrepreneurship evolution in Cambridge, UK?

Cambridge has a history of technology ventures since 1881, and more recently, the 1970s.

After Cambridge Science Park was established in 1970, some high-tech start-ups attracted national attention and Barclays Bank started supporting high-tech start-ups in the late 1970s.

- Trinity College established the Cambridge Science Park in 1970.
- In the 1970s, companies that attracted a lot of national attention such as Acorn Computers and Sinclair Research were established in Cambridge.
- In an unusual move for a bank, in the late 1970s Barclays Bank began actively supporting the growth of new technology ventures.

- In 1881 Horace Darwin establishes 'Cambridge Instruments' (now part of Leica Microsystems) that many people regard as the first university technology-based spin-out venture.

Start-up creation and technology consulting businesses grew up moderately throughout the 1980s.

'Cambridge Phenomenon' report was published in 1985 and an institution to support high-tech start-ups was established in 1987.

- The 'Cambridge Phenomenon' report was published in 1985 by consultants SQW and this gave a new 'label' to what was happening in Cambridge.
- St. John's College established an Innovation Centre to support the growth of new technology based ventures in 1987.

Technology consulting businesses grew throughout the 1980s, kick starting new industry sectors, and from the 1990s becoming incubators.

- Throughout the 1980s, Cambridge saw the growth of technology consulting firms that not only attracted high quality consulting business to the region, but also kick started whole new industry sectors - industrial inkjet printing is one example of such.
- In the late 1990s, Cambridge consulting businesses become incubators for new technology ventures - many new companies are created.

The appearance of clustering opportunities had become more apparent around 1997-98, and business communities started exploiting from them actively.

From 1997, young growing companies with more than US$1 billion valuations have become visible even to the US investors, attracting more investment.

- In 1997, the telephone company Ionica plc became the first publicly floated Cambridge company to have valuation of more than US$1bn and hence put Cambridge in the radar screen for US investors.
- In the late 1990s, a number of publicly quoted Cambridge companies, including ARM and Autonomy, reached multiple billion US$ valuations and this attracted more and more investment to Cambridge.

In 1997-98, two private organizations were formed by business communities to facilitate networking and collaboration.

- 1997: Eastern Region Biotechnology Initiative established to provide coherence to the community of biotechnology companies.
- In 1998 the Cambridge Network was formed to bring together and provide a voice for the high-technology business community in Cambridge.

Academics and government started more actively being engaged in technology entrepreneurship around 1997-99.

- In 1997 1st Cambridge Enterprise Conference held - this was the first conference to be held in Cambridge that brought together academics and practitioners to help improve the performance of new technology ventures.

In 1999, government and university established university-sited programs to promote entrepreneurship.

- In 1999 the University of Cambridge established an 'Entrepreneurship Centre' to help train, develop and support the people who will make new technology ventures successful.
- At the end of 1999, the UK Government decides to award the University of Cambridge UK£65m to establish the Cambridge MIT Institute to promote entrepreneurship, productivity and competitiveness.

Since the late 1990s, the success of Cambridge cluster has been more and more widely recognized.

From the late 1990s, the fame of Cambridge as a high-tech cluster has been reinforced by publications, news, and government action.

- Throughout the late 90s and early 00s, Cambridge appeared in numerous publications as "Europe's answer to Silicon Valley."
- News stories begin to talk of ' the future being plastic' (referring to the development of Cambridge companies such as Cambridge Display Technology and Plastic Logic who are leading the development of 'plastronics') and its home being in Cambridge.
- In 1998, the British PM Tony Blair chose to launch the Government's e-commerce strategy from St John's Innovation Centre in Cambridge giving very high visibility to what was happening in Cambridge.

Role models of successful entrepreneurs at Cambridge have been publicized widely since 1999.

- In 1999, the Entrepreneurship Centre begins a portrait gallery of Cambridge entrepreneurs to highlight successful entrepreneurs and boost their capacity as role models.
- In 1999, 'Cambridge Entrepreneurs' was published providing case studies and role models of successful entrepreneurs.

- In 2000 & 2002, Cambridge was recognized by the European Commission as being a "region of excellence for the support of high tech start-ups".

4.3 Munich, Germany

Munich is the capital city of the State of Bavaria in Germany, with a population of 1.25 million, 80,000 companies, 900,000 jobs, and 10 universities with 80,000 students[26].

Munich is Europe's largest high-tech cluster in the areas of life science, technology, information, media and entertainment, and financial services, comprised of global players (e.g. Siemens, BMW Allianz), fast growing startups, and foreign-owned high-techs. The city accommodates Germany's largest skilled labor, venture capital, real estate markets, and Germany's best rates of job creation and purchasing power[27]. In Munich, 14,000 new companies are founded per year, and 13 business incubators are located in the Munich area[28].

Concerning information and communication technology (ICT), Bavaria has been the most important region for years in Germany. ICT enterprises of worldwide reputation located either their German or European headquarters in Bavaria (e.g. 3Com, Cisco, Compaq, Lucent Technologies, Microsoft, Oracle, Netscape, SAP, Siemens, SUN)[29]. 19% of all new Internet companies in Germany are set up in Munich. Concerning biotechnology, in the last few years the Munich has experienced an exceptional rate of development. The number of small and medium-sized biotechnology companies increased from 34 in 1996 to 115 in 2002, employing a total of over 3,000 people, ten times larger than in 1996[30]. There are two sub-regional clusters situated southwest of Munich (Martinsried) and north of Munich (Weihenstephan). Martinsried itself has 46 young biotech companies. Both of them have the incubators called Innovation and Foundation Center for Biotechnology (IZB) funded by Bavarian and local governments[31]. Among the 115 biotech companies, five companies are listed on the stock exchange.

National Level Analysis

At the national level, Germany has Total Entrepreneurial Activity index of 5.6% for the average of 2000-2002 (Table 2-3), a little behind the United Kingdom, but higher than France and Japan.

---

[26] The population of the State of Bavaria is 12 million.
[27] The City of Munich website as of April 2003.
[28] Ibid.
[29] gotoBavaria website.
[30] Bio-M website as of April 2003.
[31] IZB mbH website.

Like the national analysis of the United States and the United Kingdom, the same benchmarking measures related to the entrepreneurial diamond are adopted to assess relative strengths and weaknesses of the profiles of the national diamond (Figure 4-6).

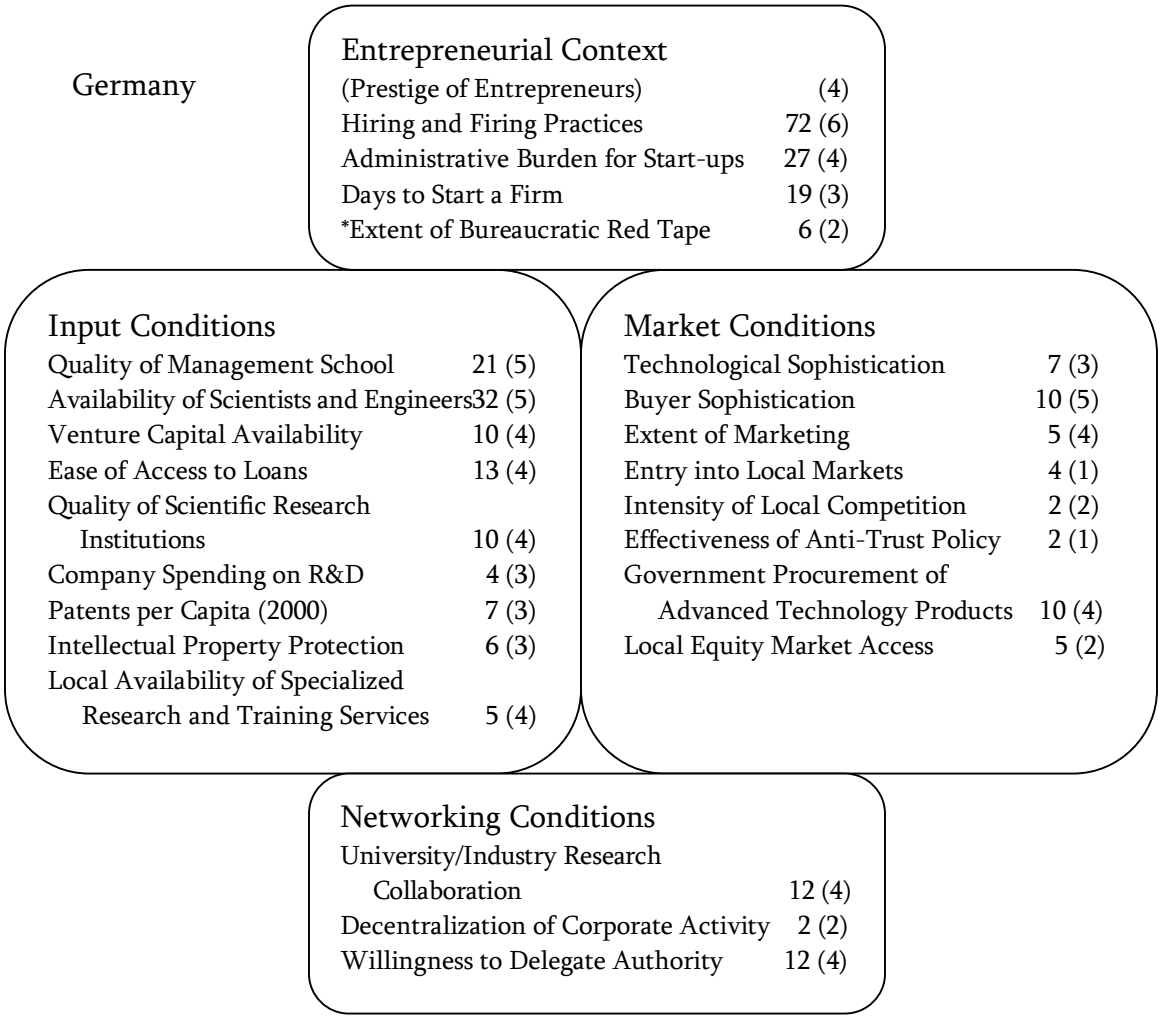


Figure 4-6 Country rankings concerning the entrepreneurial diamond of Germany

Notes: Values are relative positions among 75 countries. Ranks are determined basically by the average of the scaled points scored by senior business leaders in the 75 countries. Germany ranks 4th on Company Operations and Strategy and 4th on Quality of the National Business Environment. '()' indicates rankings among the G7 countries.
* The value is ranked opposite to the favorable direction.
(Prestige of Entrepreneurs) is a complement measure.
Source: Global Competitiveness Report 2001-2002.

Input Conditions. Concerning the quality people with management skills, Germany is ranked 21st on Quality of Management Schools, lagging behind the

leading group of the G7 countries. Germany is ranked 32nd on Availability of Scientists and Engineers, and this is among the lowest group of the G7 countries, a little ahead of Italy and the United Kingdom. Concerning the risk money, Germany is ranked 10th on Venture Capital Availability, among the second group of the G7 countries with Canada, the United Kingdom, and France. Concerning the knowledge creation, Quality of Scientific Research Institutions of Germany is ranked 10th, fourth after the United Kingdom. Company Spending on Research and Development is ranked 4th, consisting the first group of the G7 countries with Japan and the United States. Germany has the 7th position on the U.S. patents per capita, third behind the United States and Japan among the G7 countries. Germany has relatively low availability of quality people, moderate availability of risk money, and middle-high level of knowledge creation as measured by patents per capita on the profile of the input conditions.

Entrepreneurial Context. Concerning the prestige, 73 percent say that entrepreneurs are respected, much higher than the United Kingdom and Japan. Concerning the labor mobility, Germany is ranked 72nd on Hiring and Firing Practices, among the lowest with France and Italy, inferring possibly low labor mobility. Concerning the regulatory frameworks, the median response of the Days to Start a Firm is 30 days and ranked 19th (same as France, Japan, and the United States), but Administrative Burden for Startups is considered rather heavy and ranked 27th, considerably lagging behind the United States, the United Kingdom, and Canada. Further, Germany is ranked 6th on Extent of Bureaucratic Red Tape, the second worst to Japan. Germany has a low profile of the entrepreneurial context except for the middle-high prestige of entrepreneurs.

Networking Conditions. University/Industry Research of Germany is ranked 12th, fourth among the G7 countries above the United Kingdom. Concerning open corporate culture, Germany is ranked 2nd on Decentralization of Corporate Activity, second only to the United States, and 12th on Willingness to Delegate Authority, fourth among the G7 countries. It can be said that Germany has moderate possibility of having favorable networking conditions compared with other G7 countries.

Market Conditions. Germany's position in Technological Sophistication, a broad measure for the innovativeness of market demand, is ranked 7th, third among the G7 countries. Buyer Sophistication, another measure, is ranked 10th, fifth among the G7 countries. Extent of Marketing of Germany is ranked 5th, fourth among the G7 countries. Concerning the pro-competition conditions of markets, Germany is ranked 4th on the occurrence of Entry into Local Market, first among the G7 countries. Intensity of Local Competition is ranked 2nd, lagging only behind the United States. Effectiveness of Anti-Trust Policy is ranked 2nd, top among the G7 countries. Germany has the middle position on the innovativeness and diversity of market demand within the G7 countries, but the highest on pro-competition conditions. Concerning Government Procurement of Advanced Technology Products, Germany

is ranked 10th, fourth among the G7 countries. Finally, concerning the equity stock market, Local Equity Market Access is ranked 5th, second among the G7 countries to France.

From the view point of this analysis, Germany has (1) a skewed profile of the input conditions such as lack of quality people, the moderate venture capital availability and middle-high level of knowledge creation; (2) a low profile of the entrepreneurial context except for middle-high prestige; (3) a moderate or low potential for the networking conditions; and (4) a middle-high level potential for the market conditions with high occurrence of entry to local markets and easy access to local equity market. Overall, the country does not have a distinctively strong profile of the entrepreneurial national diamond among the G7 countries, except for some potential such as venture capital, knowledge creation, prestige, and market conditions. Summary is shown in Figure 4-7.

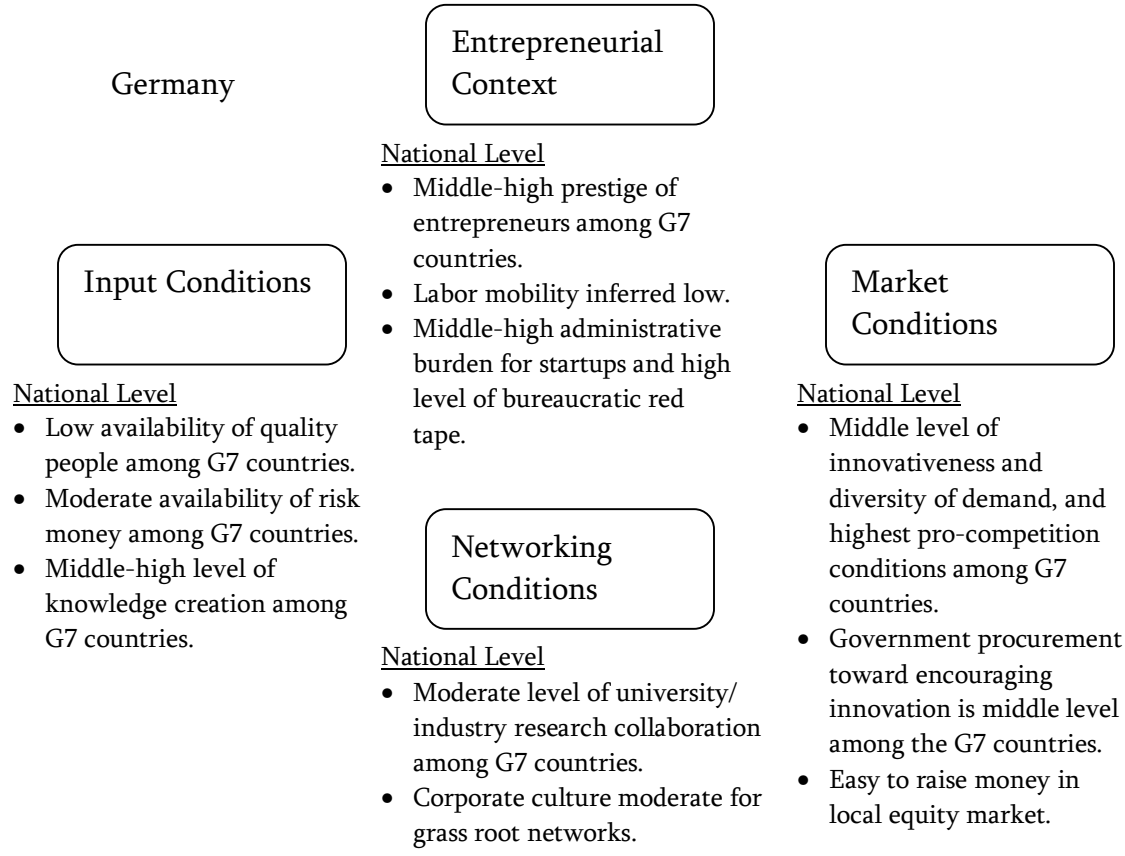


Figure 4-7 Analysis of the entrepreneurial national diamond of Germany

Evolution of the Munich Cluster and the Entrepreneurial Diamond

The Munich area has several high tech clusters, notably biotechnology and information technology. In order to trace the dynamics of technology entrepreneurship, biotechnology is mainly focused for the case. Although literature that treats the evolution of the Munich cluster is scarce, here with the help of the interview results, the effort to describe the evolution is done. (The interview results themselves describe the evolution of the cluster. See the Exhibits at the end of the section.)

There seems to be an evolutionary change in entrepreneurial activities in Munich in the 1990s. Until the early 1990s, entrepreneurship didn't seem to be widely recognized. An interviewee says, 'When I graduated from Technical University Munich in 1991 everyone wanted to join large firms such as Siemens or BMW. Entrepreneurship was not part of the curriculum[32].' But that German companies have been downsizing in the domestic economy (Audretsch 2000) and the recession in the early 1990s seemed to change the atmosphere a little bit. 'Downsizing of large companies set free a pool of highly qualified and eager managers in the early 1990s, several of which became entrepreneurs. In the 1990s, a growing number of managers came out of mid to large size industrial firms[33]' to engage in entrepreneurial activities.

According to a report of the regional initiative for the Munich biotechnology cluster, the development of a German biotechnology industry started in the middle of the 1990s[34]. However, in fact the foundations of four of the five Munich-based biotech companies that were later listed on the stock market during 1998-2000 were before the mid 1990s. MWG Biotech was founded in 1990; MophoSys was founded in 1992; and Bavarian Nordic and MediGene were founded in 1994. The latter three of them are located closely in Martinsried, a southwest region of Munich, where there had already been biomedical research institutions such as a university hospital, Max-Planck Institute for Biochemistry and Neurobiology, the pharmacy and chemistry faculties of Ludwig Maximilians University, and the Gene Center of the University of Munich. For example, MediGene is a spin-off firm from the Gene Center[35].

Around 1995 the government effort for fostering entrepreneurial activities and clusters became apparent.

Innovation and Foundation Center for Biotechnology (IZB) was founded in 1995 funded by the State of Bavaria and local governments. IZB offers inexpensive building infrastructure for biotech startups as an incubator. Their first site was located in Martinsried that had already exhibited a concentration of the biomedical

[32] Interview of Mr. F.F. (see Exhibit 4-3)
[33] Interview of Dr. C.S. (see Exhibit 4-4)
[34] BioTech-Region Munchen Annual Report 2002.
[35] MediGene website.

research institutions. IZB reports that there had been also about 60 biotech-related companies around Martinsried then[36].

Bayern Kapital is another initiative by the Bavarian State as a hundred percent subsidiary of a state-owned bank. Since its formation in 1995, Bayern Kapital has invested in more than 100 companies primarily in the areas of life sciences and healthcare, software, communication, and engineering.

At the federal level, in 1995, German Federal Government started the BioRegio contest in which Germany's regions interested in biotech competed for a given amount of public funding. Falling behind other countries such as the U.S. and the U.K. in the biotechnology industry was a matter of concern for German policy makers in the early 1990s, therefore the contest was designed to work as the motor of the catch up process, stimulating biotech firm startups, the growth of existing companies, and the provision of venture capital (Dohse 2000). The policy differed from German traditional technology policy in that it addresses the regions and stimulates interregional competition while the traditional system tends to be in favor of existing industries and incremental rather than radical innovation (Dohse 2000; Giesecke 2000).

Munich was chosen as one of the three winners among 17 regions in 1996[37]. The criteria for choosing the three winners included conditions on existing companies and research institutions as well as interaction and cooperation of different branches. Three winners were entitled to receive 150 million DM and priority in the appropriation of funds amounting to about 1.5 billion DM from 1997 to 2001. At the national level of Germany, small or medium-sized biotech firms increased from 75 in 1995 to 222 in 1998 which is the highest increase in all European countries (Dohse 2000).

In response to the award, Bio-M, a financing and consulting company for biotech entrepreneurs, was founded as the central point of contact for the regional biotech initiative, named BioTech-Region Munchen, in 1997 in Munich. The Bavarian State is the largest shareholder, and other shareholders include banks, venture capitals, pharmaceutical and chemical companies. It provides capital for the seed and startup phase of biotech firms and other support services. The current managing director since 1998 is Horst Domdey, who co-founded MediGene in 1994 and another biotech company in 1997. Domdey also chaired the regional biotech initiative from 1996 to 1997[38].

The situation had changed. The number of small and medium-sized biotechnology firms have dramatically increased during the latter half of the 1990s (Figure 4-8). In 1996, the first Munich Business Plan Competition was held in which

[36] IZB website. 60 biotech companies probably include large firms and related firms.

[37] The other two regions are Rhineland (inc. Cologne) and Rhine-Neckar Triangle (inc. Heidelberg).

[38] Bio-M website.

would-be entrepreneurs compete for award money that can be used for the seed fund. The idea of the competition was brought to Munich by the management consulting firm McKinsey drawing a hint from the MIT's 50k Competition. The first competition itself produced several new companies by the following year[39]. Further, in the late 1990s entrepreneurship programs were established at universities in Munich. The interviewee who was a student in 1991 says, 'Today many more graduates are willing to join start-ups[40].'

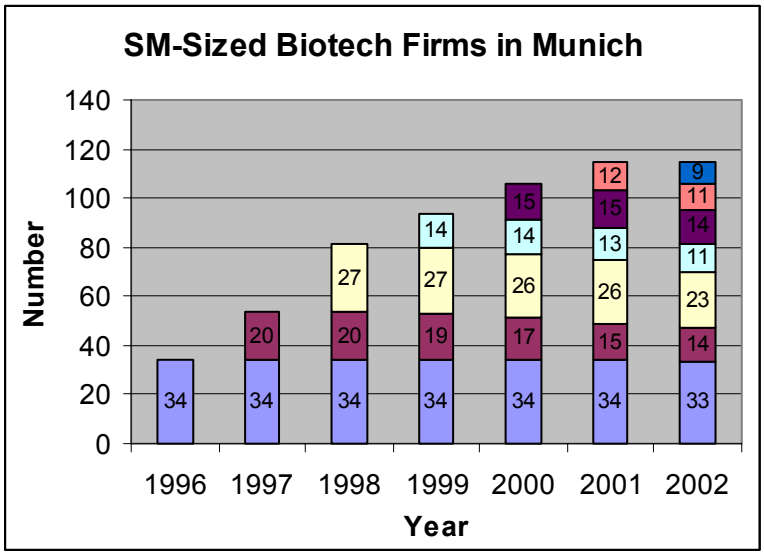


Figure 4-8 Number of small and medium-sized biotechnology companies in the Munich area

Source: BioTech-Region Munchen Annual Report 2002.

It may seem that a catalyst were the governments since the mid 1990s. But more importantly there had been entrepreneurial activities such as MediGene around a strong science base of biomedical research institutions before then, and it is more rational to say that the pre-condition of those activities moved the governments and they facilitated entrepreneurial activities by the financial support.

With this context of the evolution in mind, let's review key features of the cluster of Munich along the four attributes of the entrepreneurial diamond.

Input Conditions. As we saw previously, Munich has a strong science base for biotechnology: two major universities (Ludwig Maximilians University Munchen and Technical University Munich), two polytechnic schools, two university hospitals, three Max Planck Institutes, the Gene Center of the University of Munich, and a

[39] Munich Business Plan Competition website.

[40] Interview of Mr. F.F. (see Exhibit 4-3)

national research laboratory for environment and health. They are the sources of both quality people with scientific and technical knowledge, and knowledge creation.

Concerning risk money, in addition to government-sponsored Bayern Kapital and Bio-M, there are more than 35 Munich-based venture capitals, which comprise of 'all major German and many international venture capitals[41].' More than half of them are investing in biotech[42]. Bio-M itself has reviewed more than 150 business plans since 1997, and in 2003 its seed portfolio comprises 26 young biotech companies with 4.9 million euros. An interviewee points out that 'at the same time when venture capitals were starting to provide money in the late 1990s, good ideas about business opportunities have come out of professors and students from universities around Munich[43].' Further, there are individual angles emerging in Munich. Munich Business Angels Network has 60 angels, one of the largest networks within Germany[44]. 'Today there are successful entrepreneurs who give advice and angel investment[45],' says one interviewee. On the contrary, the interview results reveal several negative points: German institutional investors are still hesitant to invest in venture capitals; the legal framework is still not conducive to venture capitals; and many angel investors have stopped investing due to heavy losses incurred from the Internet boom (Exhibits at the end of this section).

There are 30 incubators in Bavaria State[46] and 13 of them in the Munich area in which the foundation of new companies is being continuously supported. Martinsried site of the government-sponsored IZB has now 24 small and medium-sized biotech firms, and IZB opened another incubator in Weihenstephan, a north region of Munich, in 2001.

Entrepreneurial Context. The change of attitude toward entrepreneurial activities among students and managers at mid to large-sized companies has been seen in the 1990s. The successes of the five IPOs during 1998-2000 and a growing number of startups may have accumulated to the prestige and the familiarity. Munich Business Plan Competition since 1996 and entrepreneurship programs at universities play a role to improve them and lower the psychological barrier also. On the contrary, an interviewee reports, 'Still not enough qualified people leave big companies such as Siemens, Infineon, or BMW to start their own company.'

The regional initiative, BioTech-Region Munchen, started from the BioRegio contest, seems to have created cohesion and shared strategy among governments, venture capitals, and private industries. The cohesion and shared strategy is favorable to improve the entrepreneurial context and the networking conditions because it is

---

[41] Interview of Mr. F.F. (see Exhibit 4-3)

[42] Bio-M website as of April 2003.

[43] Interview of Dr. C.S. (see Exhibit 4-4)

[44] Bio-M website as of April 2003.

[45] Interview of Mr. F.F. (see Exhibit 4-3)

[46] gotoBavaria website as of April 2003.

much easier to form collaboration and collective actions. Interestingly, there seems to be a key individual behind this movement, Domdey, the managing director of Bio-M, who is the serial entrepreneur and holds a doctorate degree in biochemistry from the University of Munich and worked at the Gene Center before he started a spin-off in 1994. Domdey was a chairman of the regional biotech initiative from 1996 to 1997.

Networking Conditions. The proximity of locations of research institutions in Martinsried is favorable to the networking conditions, which is further improved by spin-offs such as MediGene. The annual report of BioTech-Region Munchen identifies a total of 350 collaborative agreements between Munich biotech companies and research institutions, more than one third of which are with institutions in the Munich area. There are some organizations that promote the networking conditions. Bio-M assists startups though its networks that include public offices, scientific institutions, venture capitalists and biotech companies. It also offers seminars and workshops, and connects entrepreneurs with related conferences. Munich Network supports foundation, expansion and sustainable success of technology based high growth businesses by its programs that include promotion of entrepreneurship education and network conferences[47]. Munich Business Angel Network provided 'excellent networking opportunities for entrepreneurs and investors, bringing together the people for the crucial, early seed phase financing[48]'.

Market Conditions. Munich itself is a large market with a population of 1.25 million and good purchasing power, as well as home bases of large companies and regional offices of multi national companies. Concerning biotechnology, no products originating from German biotechnological research have been approved for the market as yet, although MediGene is expecting an approval of their product next year[49]. Concerning the stock market, Neuer Markt was established for growing companies at the Frankfurt Stock Exchange in 1997. After the establishment, five IPOs of Munich biotech companies were made.

An interview result indicates an interesting aspect of the market conditions. It says 'indeed for many start-ups in Munich the existence of a local market was not important. This is because many start-ups do not have customers for years or they have very few and those may be in the U.S. Therefore, the presence, or better the absence, of a local market was not a deterrent to settling in Munich[50].' For the settlement of each startup, various factors of the four attributes matter. Priority to weigh the importance of those factors may differ in different settings, but for highly knowledge-based startups such as biotech startups and Internet startups, proximity of

[47] Munich Network website.
[48] Interview of Dr. C.S. (see Exhibit 4-4)
[49] BioTech-Region Munchen Annual Report 2002.
[50] Ibid.

direct customer markets may not be the important priority compared with other factors such as knowledge availability that is crucial to research-oriented startups.

A narrative summary of the analysis is presented in Figure 4-9. The Munich cluster from this analysis shows a dramatic evolution of biotech startups. Several important features of the evolution of the entrepreneurial cluster include: (1) a strong concentrated science base of research institutions; (2) the downsizing of large firms affecting the entrepreneurial context and a growing possibility of biotechnology as an opener of market opportunities in the period of the early entrepreneurs; (3) the early entrepreneurial activities were fueled by active government finance support since the mid 1990s; (4) the cohesion and shared strategy among governments and private sector, represented by BioTech-Region Munchen, seems to have been formed through the BioRegio contest and an individual Domdey, and to have been acting as strength to improve the profiles of the entrepreneurial diamond; and (5) the current market conditions are not the significant attribute compared with other attributes especially for biotechnology startups that have no products yet. Biotechnology is considered working as a potential to the future market conditions.

A schematic summary of the analysis on the evolutionary dynamics is presented in Figure 4-10. Although we see the rapidly improved profile of the entrepreneurial cluster of biotechnology now, the profile in 1990 is considered to have been the same as the current middle-low profile of the national diamond of Germany, except that Munich has had a strong science base as a source of scientists and engineers.

In around 1990, many research institutions and their proximate locations in Martinsried were existent conditions. From these existent conditions, several key biotechnology firms were created. Although it is not clear from the case survey what prompted the creation of these key firms, the downsizing of large firms may have worked as an abnormal input to the entrepreneurial context and the emergence of the new possibility of biotechnology had become apparent. During this period, Martinsried added up its constituents by the creation of startups and spin-offs such as MediGene of Domdey, inferring the increase in the networking conditions. It also seems to have formed a tiny indication of the positive flow of the self-reinforcing loop.

This indication working as a precondition, the intensive government-funded efforts started around 1995, and the regional initiative was formed around Domdey. The government efforts were the kick inputs to the input conditions and the networking conditions. The regional initiative, or Domdey, can be evaluated as a catalyst because it seems to have created the cohesion and shared strategy among the constituents and enhanced every effort to improve the profile of the diamond. Many biotech startups were established after this, leading to the rapid rotation of the self-reinforcing loop. The opening of the Neuer Markt in 1997 was another abnormal kick input to the market conditions that enhanced entrepreneurial activities. Today Munich has the outstanding profile of the diamond in Germany.

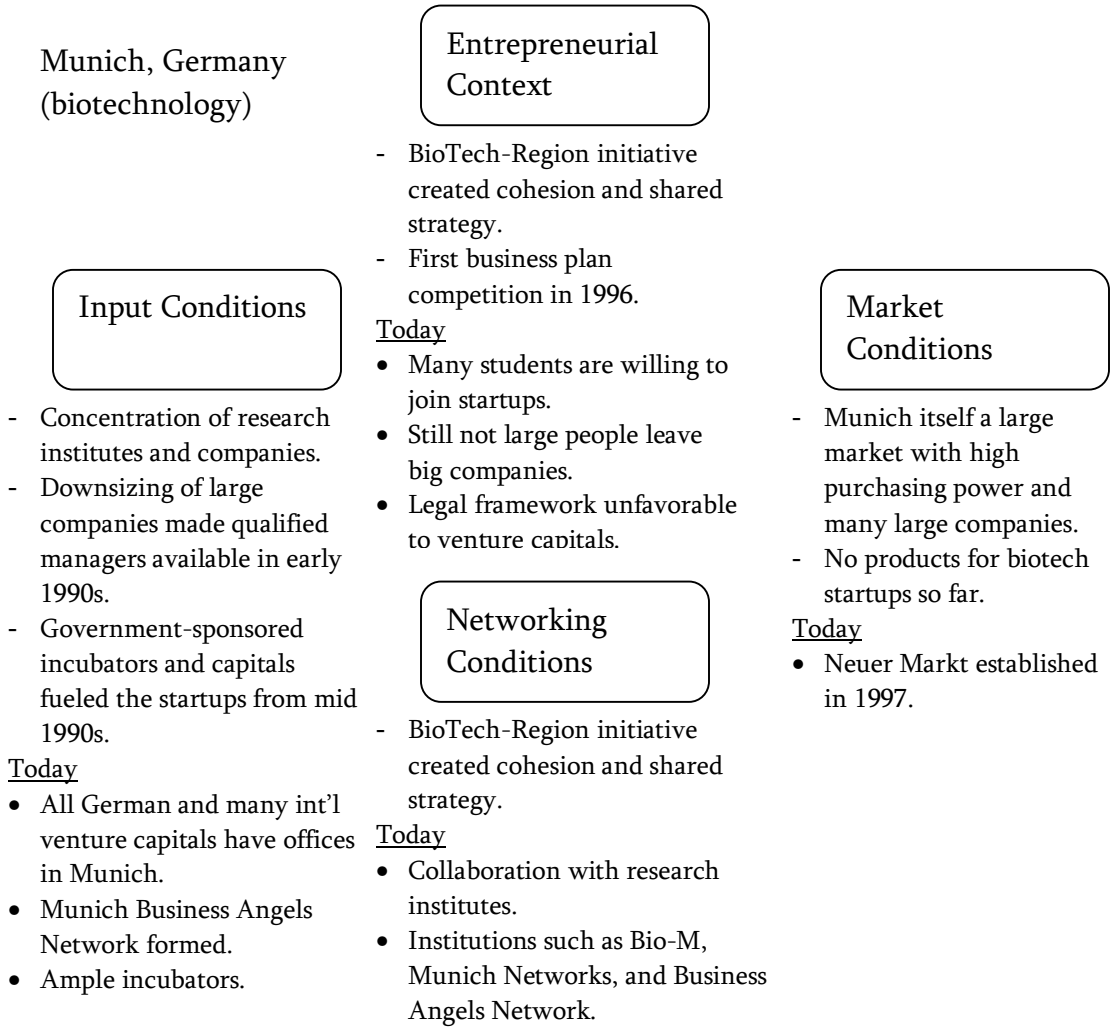


Figure 4-9 Analysis of the entrepreneurial cluster diamond of Munich

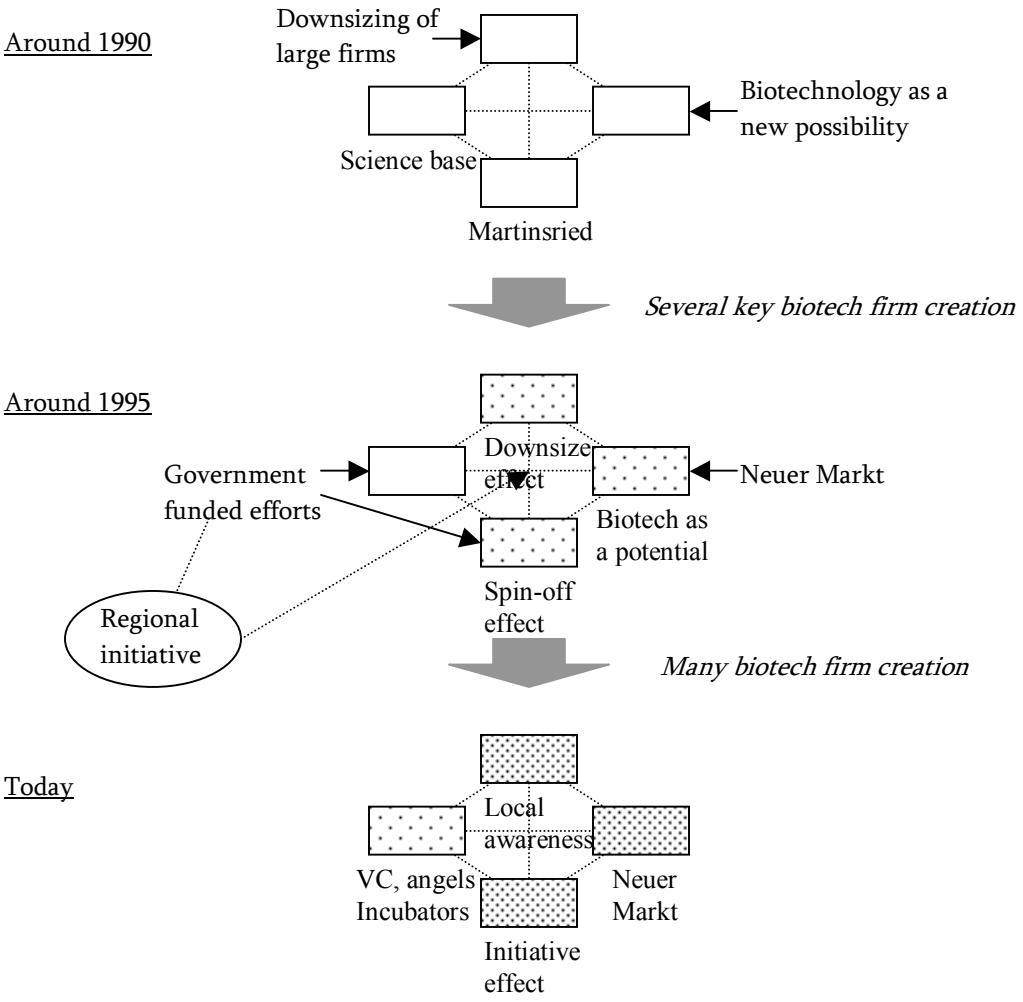


Figure 4-10 Analysis of the evolutionary dynamics of Munich

Notes: Boxes represent the four attributes of the diamond (right: input conditions, top: entrepreneurial context, bottom: networking conditions, left: market conditions). Statements under the boxes represent existent conditions at times. Solid arrows represent abnormal events. Circles represent major abnormal events. Shades are for illustrating gradual improvements, not absolute evaluations.

Exhibit 4-3 Interview result (Munich, Mr. F.F.)

Language Processing Diagram built from the interview in March 2003 of Mr. F.F., a German venture capitalist who was born in Landshut (an hour north of Munich), did undergraduate study in Munich and has worked in Munich for 3 years.

Theme: What were the essences of entrepreneurship evolution in Munich, Germany?

VCs and institutions have dramatically evolved their activities over the past 10 years.

VCs have come to Munich, giving more than 10x increase in VC funding.

- All major German and many international VCs have offices in Munich.
- US and Asian investors are investing in German VCs.
- VC funding in the Munich area has increased by more than 10x over the past 10 years.

Some organizations started offering good entrepreneur-programs, which didn't exist 10 years ago.

- When I was in TUM, entrepreneurship was not part of the curriculum, today there is a successful entrepreneurship program.
- Munich Network, an organization promoting education and support helps would-be entrepreneurs to get started.

- BioM, a state-sponsored program to fund biotechnology start-ups has funded many start-ups.

A cluster of start-ups has formed and successful entrepreneurs have become apparent.

- The bio tech cluster Martinsried has attracted over 40 biotech start-ups.
- Today there are successful entrepreneurs who give advice and angel investment.

Many more students became aspiring, but not prevailing in big companies.

- When I graduated from Technical University Munich (TUM) in 1991 everyone wanted to join large firms such as Siemens or BMW, today many more graduates are willing to join start-ups.
- Still not enough qualified people leave big companies such as Siemens, Infineon, or BMW to start their own company.

A few traditional entities are still not conducive to VCs.

- German institutional investors are still hesitant to invest in VC.
- The political and legislative framework is still not as conducive to VC as it is in other countries, e.g. taxation of carried interest for VC is still not decided.

Start-ups and VCs benefit from local information exchange.

Local start-ups have partnership with large companies.

- Large companies such as Siemens, Infineon, BMW, or Audi are important partners for local start-ups.
- Our portfolio company, FAST technologies, has had trials of their revolutionary torque sensors with BMW and Audi.

- The high density of start-ups, VCs, universities and high-tech companies provides the networks that draw even more VCs and start-ups to the Munich area.

- Munich has many highly qualified employees.

General principles of business economics are also affecting evolution of start-up businesses.

Many start-ups have difficulties in their businesses, which are applicable to all the businesses.

- Many start-ups have since failed since their business model proved not to be viable.
- The current recession has made it much harder for start-ups to generate sales.

- Many angel investors have stopped investing due to heavy losses incurred from the internet boom.

Exhibit 4-4 Interview result (Munich, Dr. C.S.)

Language Processing Diagram built from the interview in March 2003 of Dr. C.S., a German venture capitalist who studied veterinary medicine in Munich and has 11 years of industrial biotech experience, comprising six years in US and three years in Munich biotech firms as well as 2 years in a Munich venture capital group.

Theme: What were the essences of entrepreneurship evolution in Munich, Cambridge?

Start-up and VC activities had soared in Munich in the late 1990s, attracting even more.

Star companies' emergence and clustering has become apparent since the late 1990s, attracting even more.

- Munich has become famous as one of the preeminent clusters of both IT and life science in Europe in late 1990s, which motivated and encouraged people living around Munich to start their own companies.
- Life science companies such as Medigene, GPC, and Morphosys in Munich became role models, which triggered even more life science start-ups.
- Munich IT industry's success and the move of several IT firm headquarters (Microsoft, Sun, Oracle, etc.) during 1999 to 2000 attracted entrepreneurs to settle close-by in the area.

An increasing number of VCs had come to create the highest density of VCs and money available in the late 1990s in Germany.

- An increasing number of VC firms plus an increasing amount of VC money, which had not been there until then, have increased the number of start-ups starting in the late 1990s.
- In late 1990s, VC companies founded at Munich had matured to a stage that created the highest density of VCs and money available in Germany.

- Several British and American VCs created satellite offices in Munich in the recent years increasing the feeling of a technology hot-spot even further.

Competent managers at mid to large companies have started to leave their companies to join start-ups since the early 1990s.

- Downsizing of large companies set free a pool of highly qualified and eager managers in the early 1990s, several of which became entrepreneurs.
- In 1990s, a growing number of managers came out of mid to large size industrial firms. These managers have become more available as entrepreneurs, or more available to entrepreneurs who seek good managers to build up companies.

Government has supported start-up activities by fueling input condition and networking function.

- Bavarian government has provided increasing amounts of soft money funds through various state-run and private/public entities starting in the mid 1990s.
- Bavarian government has provided incubators (in Munich and elsewhere in Bavaria) which have been offering reasonable housing and networking function for entrepreneurs.

Universities, professors, and students around Munich became interested in entrepreneurial activities in the late 1990s.

- In late 1990s, the first entrepreneurship programs were established at universities in Munich, which have produced the first graduates in 2000/2001.
- At the same time when VCs were starting to provide money in the late 1990s, good ideas about business opportunities have come out of professors and students from universities around Munich.

Bavaria is a nice place for knowledge-based industries and people.

Bavaria has become an attractive location for knowledge-based industries since 1970s.

- Bavaria culturally and socially has changed from an agricultural state into an industrial state in the 1970s (by the aggregate initiatives of the government and industries to attract "clean" high tech companies to Bavaria).
- Two Universities and several Universities of Applies Science in Munich with over 100,000 students total in all faculties were significantly enlarged in The 1970s and have delivered a large number of highly-educated people to the Munich cluster since then.

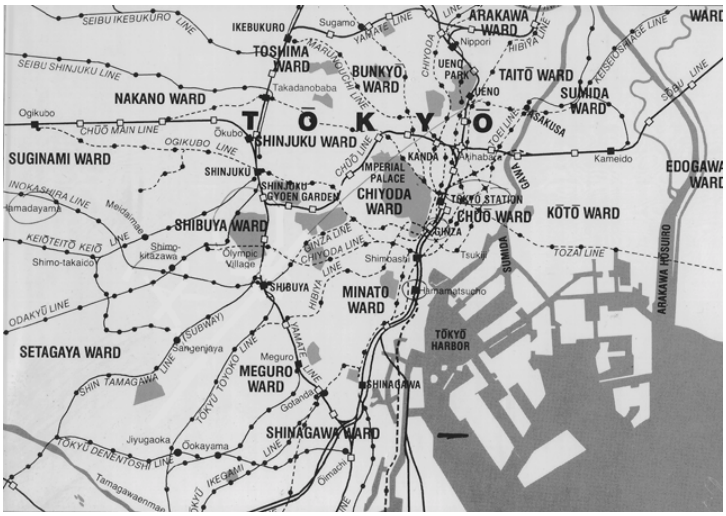
- Social attractiveness of the region in terms of human resources, cultural and natural richness (lakes, alpes, skiing, closeness to Austria/Italy, etc.) and educational opportunities attract people to come to this region.

Institutions facilitating networking opportunities were established.

- Bio-M, the regional, government sponsored Biotechnology organization started from the beginning to bring together people that would be able to help the fledging business such as patent attorneys, accountants, lawyers, business angels, and VCs.
- The Munich Business Angel Network provided excellent networking opportunities for entrepreneurs and investors, bringing together the people for the crucial, early seed phase financing.

- Only a few start-ups in and around Munich settled here because they wanted to be close to their customers. These companies would mostly fall into the category ITC or automotive. But indeed for many start-ups in Munich the existence of a local market was not important. This is because many start-ups do not have customers for years or they have very few and those may be in the US. Therefore, the presence, or better the absence, of a local market was not a deterrent to settling in Munich.

4.4 Tokyo, Japan



Tokyo is the capital of Japan with a population of 12 million, 770,000 business establishments, and 9 million jobs[51]. The Tokyo Megalopolis spreads to neighboring prefectures to constitute the Greater Tokyo Metropolitan Region of over 30 million residents. Tokyo exhibits the huge concentrations of politics, governments, businesses, universities, culture, and virtually every activity. Although many clusters can be identified such as manufacturing, trading services, financial services, publishing, broadcasting, and so on in Tokyo as well as throughout the country, it is hard to identify high technology clusters with a lot of entrepreneurial activities in the country where the level of entrepreneurship is considered very low.

Yet there is an indication of entrepreneurial activity. A survey done by a think tank and the Ministry of Economy, Trade, and Industry in June 2001[52] revealed that there are 1,514 Internet-related businesses in Tokyo 23 Wards, the central districts of Tokyo, a third of which were founded since 1998. Those Internet businesses are software application, intermediary, infrastructure, e-commerce, and others, and have the average of 33 employees. 80 percent of the full-time staff is under 34 years old. Further, the survey found that there are concentrations of 311 businesses in Minato Ward and 295 businesses in Shibuya Ward, both of which are several miles away from the central district of businesses in Chiyoda Ward that accommodates headquarters of Japanese large companies.

The concentration phenomenon started being publicized in 1999 when several young entrepreneurs named it 'Bit Valley' which is from 'bitter valley,' literal translation of Shibuya[53]. Shibuya Ward and Minato Ward are the places of trendy restaurants, night spots, and shopping, where trend-leading teenagers, coolest university students, and art elite hang out[54]. Partly because of its sense of the 'fashionable' trend and the potential of the Internet, the phenomenon was noised

[51] Tokyo Metropolitan Government website.

[52] Fujitsu Research Institute and Ministry of Economy, Trade, and Industry; Survey on Internet enterprises in Tokyo (In Japanese); June 2001.

[53] Japan Inc. Magazine; How Bit Valley got its name; May 2000.

[54] Japan Inc. Magazine; Where is Bit Valley? May 2000.

around by mass media from the end of 1999 to 2000, which Economist depicted as 'the Internet venture boom[55].' NASDAQ and Softbank established NASDAQ Japan in June 1999 and opened the stock market for growing firms a year later. Tokyo Stock Exchange relaxed the listing requirement and opened a stock market called Mothers in November 1999. Although the boom itself was soon over keeping step with the Internet bubble burst around the world and NASDAQ and Softbank withdrew from NASDAQ Japan in 2002, the venture creation of this size was quite a phenomenon that the country saw for the first time in the recent decades. Tokyo Stock Exchange's Mothers now has 48 listed companies. 19 of them are information and communication technology companies. And among them 17 are located in Tokyo and 8 of them are in Shibuya Ward and Minato Ward[56].

National Level Analysis

At the national level, Japan has Total Entrepreneurial Activity index of 2.7% for the average of 2000-2002 (Table 2-3), considerably low among the G7 countries. Figure 4-11 shows the entry and exit rate in Japan in the last two decades.

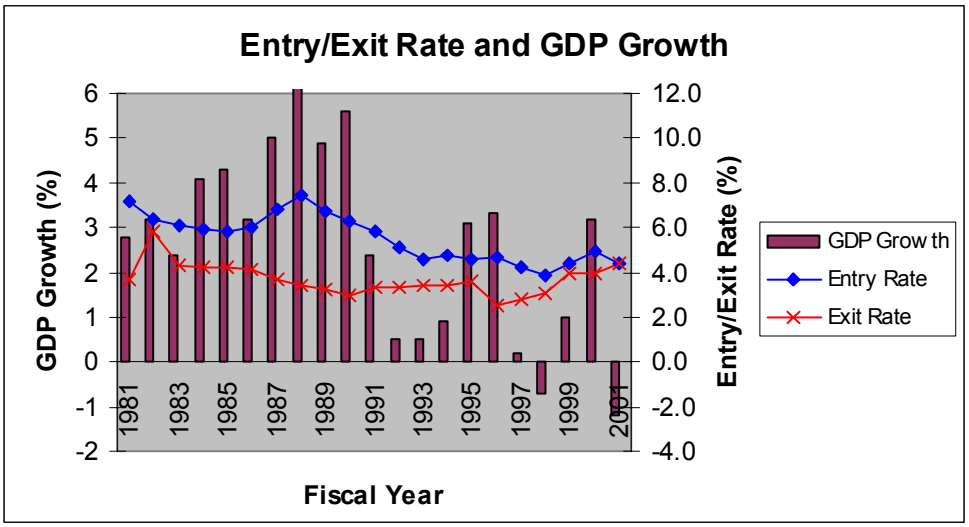


Figure 4-11 Entry/exit rate and GDP growth of Japan

Note: Entry and exit rates are percentages of the total stock (establishments covered by unemployment insurance) at the end of the previous fiscal year.

Sources: Ministry of Health, Labor, and Welfare; Annual Report on Unemployment Insurance Programs.
GDP data (fiscal year) – ESRI, Cabinet Office, Government of Japan.

[55] Economist; In search of the new Japanese dream; February 17, 2000.

[56] The author's count from the information on Tokyo Stock Exchange website as of April 2003.

The entry rate has gradually decreased from 6 to 8 percent in the 1980s to the level of 5 percent. As the economy went worse in the late 1990s, the exit rate increased to match the entry rate in 2001. Together with the low TEA index, Japan seems to have come to the most severe era for entrepreneurial activities among the G7 countries.

Like the national analysis of others, the same benchmarking measures related to the entrepreneurial diamond are adopted for assessing relative strengths and weaknesses of the profiles of the national diamond (Figure 4-12).

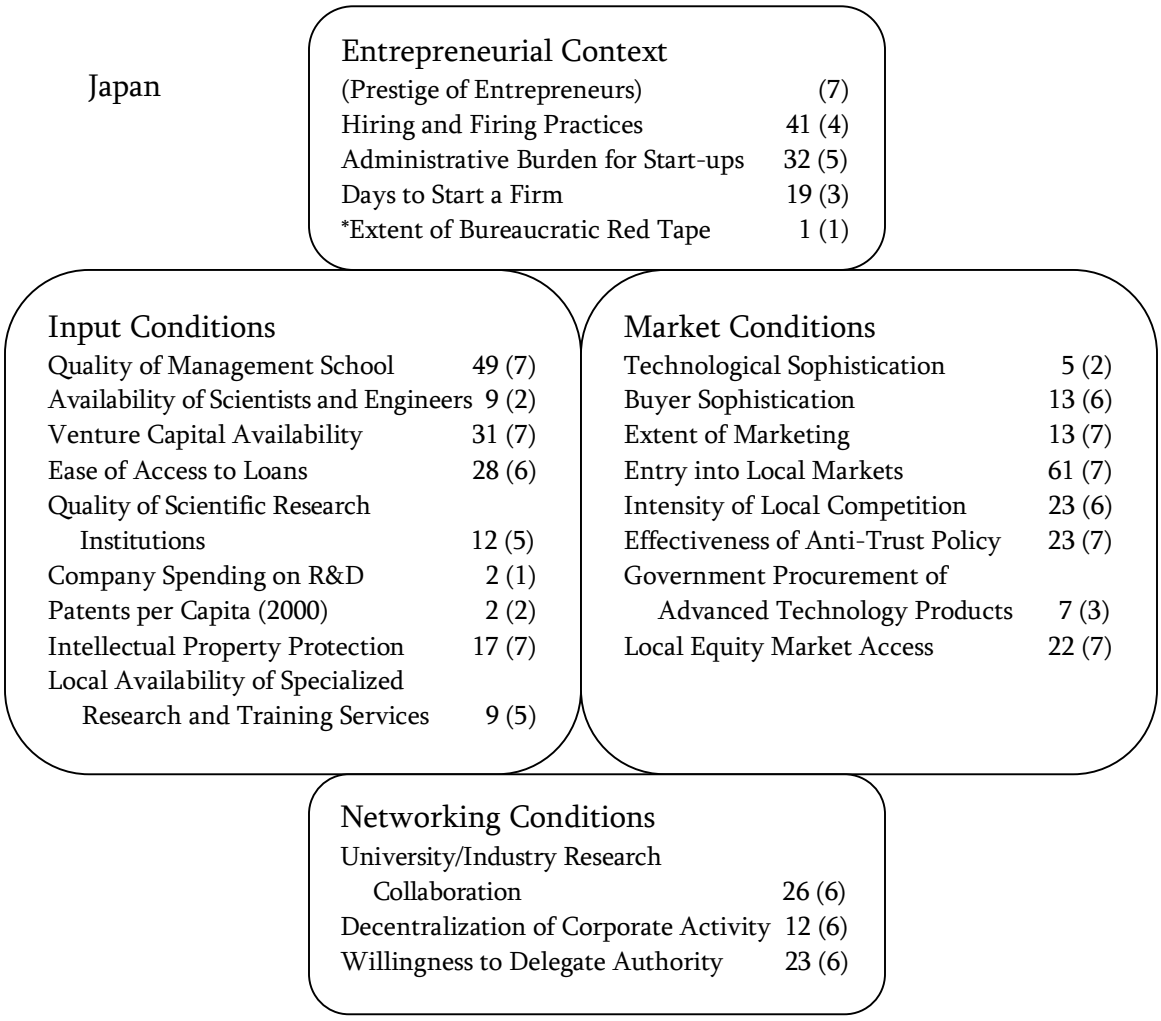


Figure 4-12 Country rankings concerning the entrepreneurial diamond of Japan

Notes: Values are relative positions among 75 countries. Ranks are determined basically by the average of the scaled points scored by senior business leaders in the 75 countries. Japan ranks 8th on Company Operations and Strategy and 18th on Quality of the National Business Environment. '()' indicates rankings among the G7 countries.
* The value is ranked opposite to the favorable direction.
(Prestige of Entrepreneurs) is a complement measure.

Source: Global Competitiveness Report 2001-2002.

Input Conditions. Concerning the quality people with management skills, Japan is ranked 49th on Quality of Management Schools, far lowest among the G7 countries. Japan is ranked 9th on Availability of Scientists and Engineers, second to the United States and in the top group of the G7 countries. Concerning the risk money, Japan is ranked 31st on Venture Capital Availability, far lowest among the G7 countries with Italy. Concerning the knowledge creation, Quality of Scientific Research Institutions of Japan is ranked 12th, fifth after the United Kingdom and Germany. Company Spending on Research and Development is ranked 2nd, first among the G7 countries. Japan has the 2nd position on the U.S. patents per capita, behind the United States. Japan has the lowest availability of quality people with management skills, high availability of scientists and engineers, the lowest availability of risk money, and high level of knowledge creation by private companies on the profile of the input conditions.

Entrepreneurial Context. Concerning the prestige, only 8 percent say that entrepreneurs are respected, stunningly lowest among the G7 countries. The lowest fraction of people with entrepreneurial activity (TEA index) and the declining entry rate in the last two decades indicate that the familiarity with entrepreneurs is very low among the G7 countries. Concerning the labor mobility, Japan is ranked 41st on Hiring and Firing Practices, inferring possibly low labor mobility. Concerning the regulatory frameworks, the median response of the Days to Start a Firm is 30 days and ranked 19th (same as France, Germany, and the United States), but Administrative Burden for Startups is considered rather heavy and ranked 32nd, considerably lagging behind the United States, the United Kingdom, and Canada. Further, Japan is ranked 1st on Extent of Bureaucratic Red Tape, worst among the G7 countries.

Networking Conditions. University/Industry Research of Germany is ranked 26th, worst among the G7 countries with Italy. Concerning open corporate culture, Japan is ranked 12th on Decentralization of Corporate Activity and 23rd on Willingness to Delegate Authority, both of which is the sixth only above Italy among the G7 countries. It can be said that Japan has among the lowest possibilities of having favorable networking conditions compared with other G7 countries.

Market Conditions. Japan's position in Technological Sophistication is ranked 5th, second to the United States. Buyer Sophistication is ranked 13th, second worst among the G7 countries. Extent of Marketing is ranked 13th, worst among the G7 countries. Concerning the pro-competition conditions of markets, Japan is ranked 61st on the occurrence of Entry into Local Market, worst among the G7 countries. Intensity of Local Competition is ranked 23rd, second worst among the G7 countries. Effectiveness of Anti-Trust Policy is ranked 23rd, worst among the G7 countries. Japan has the worst position on the innovativeness and diversity of market demand and pro-competition conditions within the G7 countries, except for the potential of technological sophistication. Concerning Government Procurement of Advanced

Technology Products, Japan is ranked 7th, third among the G7 countries. Finally, concerning the equity stock market, Local Equity Market Access is ranked 22nd, worst among the G7 countries.

From the view point of this analysis, Japan has (1) a low profile of the input conditions except for the availability of scientists and engineers and high level of knowledge creation by private companies; (2) a lowest profile of the entrepreneurial context with the extremely low prestige; (3) a lowest potential for the networking conditions; and (4) a lowest potential for the market conditions except for government procurement. Overall, the country has a very weak profile of the entrepreneurial national diamond among the G7 countries, except for some potential such as scientists and engineers, and knowledge creation by private companies. Summary is shown in Figure 4-13.

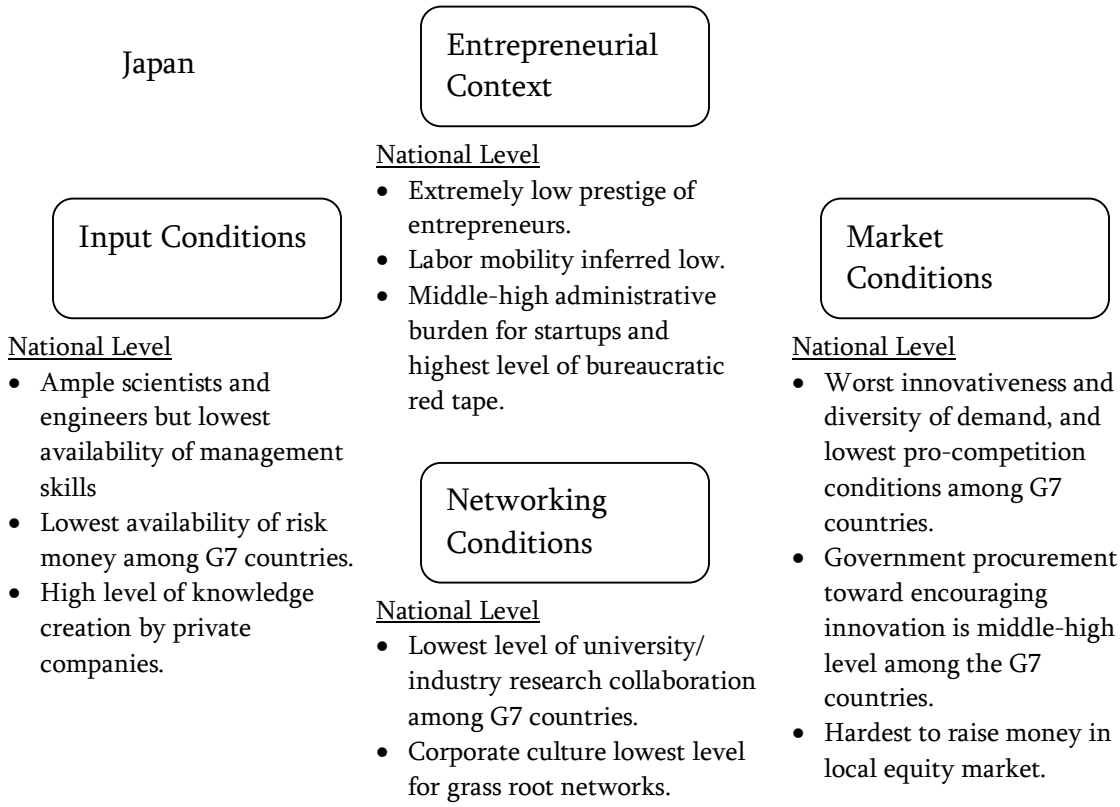


Figure 4-13 Analysis of the entrepreneurial national diamond of Japan

The low profile of Japan's entrepreneurial national diamond is astonishing. It means that it is quite hard for technology entrepreneurship to flourish in the country at least in the short run. However, concerning entrepreneurial activity itself, it does not always mean that Japan has had no entrepreneurship ever. Figure 4-14 shows the entry and exit rates since the WWII was over in 1945. We can see very high entry

rates during the decade after the WWII. Because the whole country was devastated by the war, it is not surprising to see high rates of entry right after the war. Yet more importantly, it was in this period of high entry rates when entrepreneurial activity produced many Japanese firms that later have become global players and become the migration force of the economy. Examples include Sony (established in 1946), Honda (1946), Nintendo (1947), Sanyo (1947), and Omron (1948). They were the part of the economic engine that has driven the miracle of the economy recovery. Although they are now established firms, many of them perform relatively better than the established firms that were founded before the WWII such as Matsushita, Toshiba, and NEC.

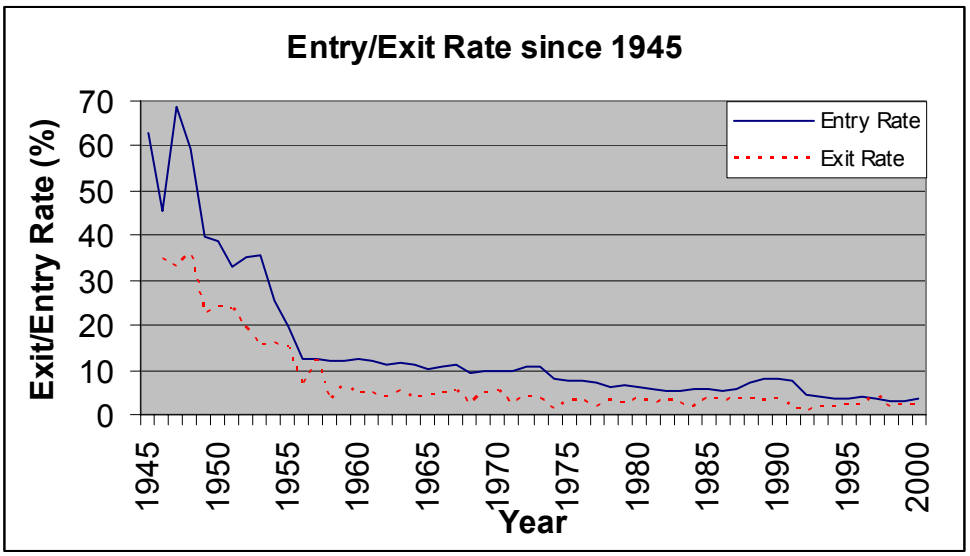


Figure 4-14 Entry/exit rate of Japan since 1945

Note: Entry and exit rates are percentages of the total stock (corporate registrations) at the end of the previous fiscal year.

Source: Small and Medium Enterprise Agency, White Paper on Small and Medium Enterprises in Japan.

Recognizing the current weak environment for fostering entrepreneurial activity, the government seems to make efforts to improve the business environment for entrepreneurs recently. Table 4-2 is a collection of recent regulatory changes concerning entrepreneurial activity. These changes are intensively implemented since the late 1990s. Concerning the input conditions, it has become easier to transfer knowledge created at universities by the new laws in 1998 and 1999. Venture capital partnerships have been allowed to assume limited liability, which opens the way for the pension funds to form venture capital funds because members of the pension funds no longer have to assume full liability. Concerning the entrepreneurial context, stock options were allowed, which is favorable to startups that typically have

difficulties in cash flows for rewarding their employees. The reduced top personal income tax facilitates the concentration of wealth, which encourages people to become rich and may lead to an increase in investments. The exemption of the minimum requirement of equity capital works as a strong incentive to establish ventures. Concerning the networking conditions, the environment for the university/industry collaboration has been improved significantly by the relaxation of bureaucratic rules enforced to national universities. Finally, concerning the market conditions, the relaxation of the listing requirement of the stock market opens the opportunities of exits both for entrepreneurs and risk money providers.

Table 4-2 Recent regulatory changes concerning entrepreneurial activity in Japan

Input Conditions	
1998	Technology Licensing Offices become legitimate and entitled to financial support from the government. (A new law)
1999	Exclusive licensing of government financed research is allowed for universities. (A new law)
1999	Venture capital partnerships are allowed limited liability partnership. (A new law)
Entrepreneurial Context	
1997	Stock options are allowed to give. (Commercial Law amendment)
1999	Top personal income tax is reduced from 65% to 50%. (A related law amendment)
2001	Treasury stocks are allowed to possess. (Commercial Law amendment)
2002	Restrictions on issuing of stock options are eliminated. (Commercial Law amendment)
2002	Limitation of liability of corporate executives is allowed. (Commercial Law amendment)
2003	Exemption of the minimum requirement of equity capital (10 million yen) for the first five years becomes possible to startups. (A new law)
Networking Conditions	
2000	Faculty of national universities is allowed to become corporate executives. (A new law)
2000	Multiple-year contracts between national universities and private firms are allowed. (administrative notice)
2002	University spin-offs are allowed to use facilities of national universities. (administrative notice)
2002	Process of admitting faculty for corporate executives becomes short. (administrative notice)
Market Conditions	
1999	Tokyo Stock Exchange opened *Mothers* for growing young companies.

Sources: various.

Evolution of the Tokyo Cluster and the Entrepreneurial Diamond

The case treats information and communication technology (ICT) businesses especially Internet businesses in Shibuya Ward and Minato Ward. According to the

survey mentioned above, 60 percent of young Internet ventures in Tokyo are located in the two wards[57]. But in fact IT venture creation is not a phenomenon only in Tokyo. A survey done by Japan External Trade Organization in February 2001 observes several concentrations of ICT ventures other than in Tokyo in large cities such as Sapporo, Kyoto, and Fukuoka[58]. However Tokyo is considered the best case in the sense that the concentration of firms in particular places is observed and several successful firms have emerged. Because the literature that treats the Tokyo Internet cluster is rare, here with the help of the interview results, the effort to describe the evolution is done. (The three interview results[59] themselves describe the evolution of the cluster. See the Exhibits at the end of the section.)

Yukawa (2001) finds that Internet businesses in Tokyo can be traced back to 1994 to 1995. The first website in Japan, 'Tomigaya,' was created in 1994[60]. It was an apartment room of an individual, named Joichi Ito[61], where the website was established and students interested in the dawn of the Internet hung out. Together with the students, Ito established a corporation at the apartment room in Tomigaya, a north area of Shibuya Ward in 1994. The corporation became Digital Garage Inc., an Internet business consultant, next year. In that year a website production firm, Kinotrope, was established and a music edutainment software firm, Oracion, was located in Tomigaya area (Yukawa 2001). These firms are still alive today, but Tomigaya area accommodates only 7 Internet businesses now compared with 121 companies in adjacent Shibuya area that is the center of Shibuya Ward and more convenient in terms of transportation and commerce. Ito seems so-called a serial entrepreneur. He later established a venture capital for Internet businesses, Neoteny, in 1999.

Between 1996 and 1998, two listed Internet ventures were formed in Shibuya Ward, with some listed subsidiaries of established firms excluded. An Internet service firm Edge was formed in 1996 and an Internet content firm Cyber Agent was formed in 1998. Later both of them went public in 2000, exhibiting the successes of young Internet ventures. A Japanese entrepreneur mentioned in the interview that Cyber Agent shows 'a model of IPO of ventures.'

From 1999, a rapid and dramatic change started. In February 1999, several entrepreneurs based in Shibuya named a concentration phenomenon of firms around Shibuya as Bit Valley while drinking at a bar[62]. They include Kiyoshi Nishikawa and Satoshi Koike. Nishikawa was a founder of Internet venture incubator firm Net Age

---

[57] Young ventures are defined as companies established after 1994.

[58] Japan External Trade Organization; APEC region industry survey on IT ventures (In Japanese); February 2001.

[59] One of them is an LP diagram abstracted from a collection of publications of one individual.

[60] Digital Garage Inc. website.

[61] Joichi Ito grew up in the U.S. and studied at U.S. universities. (Cassiopeia Magazine Vol.4)

[62] Japan Inc. Magazine; Interview; May 2000.

established in Shibuya in 1998. Koike had become a CEO of a subsidiary of a Japanese firm in the U.S. and did management buyout in 1998. Later he opened an incubator firm Net Year in Shibuya in 1999. The two figures had met at a wine-tasting party in Tokyo a year ago. The notion of the region-oriented community spread rapidly with Nishikawa's email magazine[63]. They held parties hoping to bring entrepreneurs and venture capitalists together. The party culminated in more than 2,000 guests at a night club in February 2000[64], drawing some critique that they are just a party organizer. The party itself went down since then.

This was the time when the Internet bubble accumulated. In April 1999, Net Age became famous by selling its car price estimate website business to a joint venture of Softbank, Microsoft, and Yahoo! for several hundreds of million yen[65]. In June 1999, Softbank and NASDAQ announced that they would open NASDAQ Japan. Tokyo Stock Exchange, the most prestigious stock market, and JASDAQ, traditionally a stock market for smaller-sized companies, followed suit in the following months by announcing that they would also relax their listing requirements and open stock markets for growing firms. At Mothers, two firms were listed in 1999 and 27 firms in 2000. Nishikawa observes that right after the openings of these markets, venture capitalists started seeking Internet startups and people who quit large firms and start their own companies started to appear[66]. Hikari Tsushin, a mobile phone sales agent later forming a venture capital for Internet ventures in 1999, was once ranked seventh in terms of market capitalization on the Tokyo Stock Exchange during the Internet bubble[67]. Around the mid 2000, the bubble burst. Newly listed firms at Mothers were seven in 2001 and eight in 2002. Hikari Tsushin now strives just to survive as a distributor of communications-related equipment. The boom left the image held by the corporate mainstream that Bit Valley is kid's stuff: 'people say Bit Valley is for youngsters, they are just playing, they are not real businesses[68].'

Yet this rapid change in 1999 and 2000 around the Internet bubble seems to have left several things. First, stock markets such as Mothers have been created, which opens an exit for the efforts of entrepreneurs and risk money providers. Second, young ventures and entrepreneurs were publicized, which lets people to recognize that there is another way than staying at large firms. Third, the venture capitals in Japan, traditionally good at later stage investments, started to invest in young firms. Finally, many Internet ventures are still doing their businesses although weak ventures have been wiped out. With this context of the evolution in mind, let's

---

[63] Japan Inc. Magazine; Interview; May 2000.
[64] Economist; In search of the new Japanese dream; February 17, 2000.
[65] Ascii24.com news; April 12, 1999.
[66] See Exhibit 4-7.
[67] Nikkei Weekly; Former IT stars still plugging away; May 13, 2002.
[68] Japan Inc. Magazine; Bit Valley grows up; May 2001.

review key features of the cluster of Tokyo along the four attributes of the entrepreneurial diamond.

Input Conditions. Concerning the quality people, Nishikawa mentions that Shibuya is a convenient place for hiring students who are often strong and good candidates for the workforce as programmers and sales agents for Internet startups[69]. Students are familiar and eager with the Internet and offer cheaper labor. Tokyo has a concentration of universities in Japan and railways and subways cross at the Shibuya station. Some of the leading universities such as Tokyo University and Keio University are located along the railways to Shibuya. One of the entrepreneurs who proposed Bit Valley with Nishikawa and Koike is Haruo Miyagi[70] who founded an NPO ETIC promoting entrepreneurship. ETIC has an internship program that introduces Tokyo students to startups. Yukawa (2001) points out that the region around Shibuya Ward and Minato Ward is one of the towns that have the densest locations of amenities for young people such as movie theatres and night clubs in Japan, and that it is the place that tends to gather people with creative talents. About 40 percent of design firms in Tokyo 23 Wards are located in the two wards. Kinukawa and Yukawa (2001) find by econometric analysis that the concentration of the amenities, especially small and diverse facilities like music clubs, has association with the Internet venture creation in the earlier year of the clustering. Although the high context knowledge creation by research institutions doesn't seem to play a large role in this cluster, the availability of people with creative talents and the proximity of firms that facilitates the exchange of information are considered to work as a favorable force for the innovation in the cluster.

Concerning the risk money, it is said that there are a few hundreds of venture capital firms in Japan, and that the amount of venture capital investment increased to over 400 billion yen in 2000 from the level of 100 to 200 billion yen in the 1990s although there is no official statistics[71]. An interviewee's remark represents the current status of the risk money; 'the availability of risk money such as venture capital has improved significantly compared with five years ago. Now excellent firms can gain investments[72].' From the evolution of the cluster, it is notable that the opening of the new stock markets has affected the behavior of venture capitals. Contrasting the previous behaviors that they had invested only in ventures that were about to go public after a long time of meeting the strict listing requirements since the foundations, they became motivated to invest in ventures from their startup phases

[69] See Exhibit 4-7.

[70] One of the interviewees is Mr. Miyagi. See Exhibit 4-6.

[71] Murase, M.; Venture capital in Japan; in Forum on sustainable scenario for creating new industries (The 21st Public Policy Institute); February 2002.

[72] See Exhibit 4-6.

because of the existence of the shorter exit for them. The fraction of the total venture capital investment in Japan to young ventures less than five years increased from around 20 percent in 1995 to over 50 percent in 1999[73]. An American entrepreneur who founded an Internet venture incubator firm Sun Bridge in Shibuya mentions that around 2000, venture capitals who give hands-on advice started to appear such as General Atlantic Partners, Mobile Internet Capital, Academy Capital Investments, and Sun Bridge[74]. However, he also mentions that it is said that there are only several thousand angels in Japan, significantly smaller than over 1 million in the U.S. and tens of thousands in the U.K.

Entrepreneurial Context. High publicity of the Internet bubble and the events around it is considered to have increased the familiarity with entrepreneurs. Emerging successful firms such as Cyber Age and Net Age are working as the role models for followers. In addition to that, a book written by a failure entrepreneur in 1998[75] became a best-seller. The book is about his upturn and downturn experience of an Internet venture that went bankrupt in 1997. He went personal bankrupt finally but wrote about his experience. The best-seller book prompted another several books written by him also, showing a model of a person surviving from a failure.

Another aspect is that Shibuya accommodates counter-culture against the establishment in the central district of Chiyoda Ward. As a place attracting young people and people with creative talents, Shibuya has a sub-culture atmosphere, a contrast to the atmosphere of Chiyoda Ward where established large firms and governments have suffered from the long-lasting recession throughout the 1990s. Nishikawa says that the recession throughout the 1990s spread feelings of oppression and blockage among large firms, and that many people who start businesses in Shibuya are young people in their 20s and 30s who want to jump out from those feelings[76].

Further, it is notable that many entrepreneurs have experience in working at foreign companies or studying abroad. Ito grew up in the U.S. and studied at U.S. universities. Nishikawa, after graduating from Tokyo University, joined an established company but quitted to work outside Japan. It was in 1990 when he worked at Arthur D. Little in the U.S. when he aspired to become an entrepreneur, seeing young promising colleagues quit the company and start their businesses. Koike did management buyout in the U.S. from his company. Nishikawa describes that quite a number of entrepreneurs at Shibuya are the people who earned MBA outside

---

[73] Ministry of Education, Culture, Sports, Science and Technology; White Paper on Science and Technology 2002.

[74] Miner, A.; Column: Things about ventures 1-17 (In Japanese); Nikkei Net Front Runner; May 2001 to March 2003.

[75] The book is Shacho Shikkaku (meaning 'failed as a president') written by Yuichiro Itakura.

[76] See Exhibit 4-7.

Japan and who are from foreign consulting firms such as McKinsey and Boston Consulting Group[77]. For example, Rakuten, a rapid growing e-commerce firm, has four executives who earned MBA or law degree from leading universities in the U.S. such as Harvard Business School[78]. Those who studied in the U.S. especially at business schools are considered to have familiarity with entrepreneurship and may have aspired to become entrepreneurs. Also, employees at foreign service firms may have touched a different corporate culture and seen management and markets from different views. In fact employees at foreign service firms have been increasing. Figure 4-15 shows an increasing number of employees at foreign firms in Japan. The employment in services has grown from 7,000 in 1995 to 24,000 in 2000, potentially becoming a labor force that has little psychological barrier to join entrepreneurial activities. Those who have foreign experience are accumulating their number and are considered to have been bringing a different taste into Tokyo's entrepreneurial context.

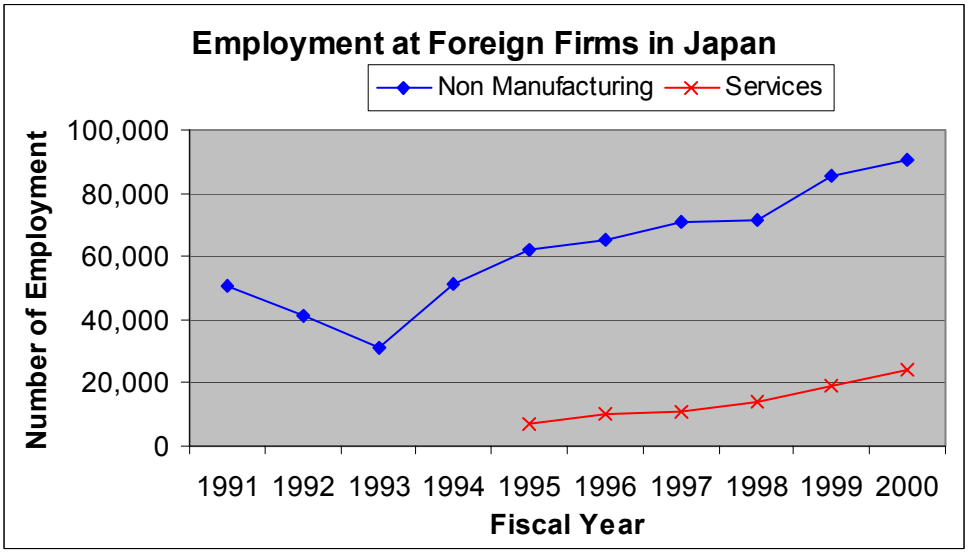


Figure 4-15 Employment at foreign firms in Japan

Source: Ministry of Economy, Trade, and Industry; Foreign firms survey 1996-2001.

Networking Conditions. From the informal interactions among several entrepreneurs, the name Bit Valley was born. It is interesting to see those entrepreneurs gather without specific formal ties and the places that facilitated the interactions were bars. Shibuya has a lot of amenities that can serve as networking opportunities. They gathered to 'create a region-oriented commu

[77] See Exhibit 4-7.

[78] Rakuten website. Rakuten (founded in 1997) is located in Meguro Ward, an adjacent ward to Shibuya Ward.

nity where they could have face-to-face meetings for information/opinion exchange to accelerate Net business here[79].' The proximity within Shibuya may have been facilitating informal networks that help entrepreneurs in terms of hiring and finding customers and suppliers. Unfortunately the effort largely seems to have ended up with holding meetings and parties. It didn't evolve into strong formal networks such as organized networking organizations, although there are some organizations such as Bit Valley Association, Jingumae.org, and Web Design Consortium (Yukawa 2001). These organizations don't seem to offer strong programs.

Market Conditions. It is clear that the advent of the Internet has opened new possibilities of markets for entrepreneurs to start their businesses. If it had not been for the Internet there, no venture creation of this size could have been materialized, because no other big changes in the environment than the creation of pioneering startups in the early years are recognized before the Internet bubble and the opening of the new stock markets. Those pioneering startups may have been in the hardship with the very low profile of the diamond and no precedents before them.

The Internet was totally new market opportunities that the established firms in Japan were not good at seizing. It doesn't need large office space or large capital to start Internet businesses, which works as advantage for startups in Tokyo. Further the rapid increase of Internet users helped startups to grow rapidly (Figure 4-16).

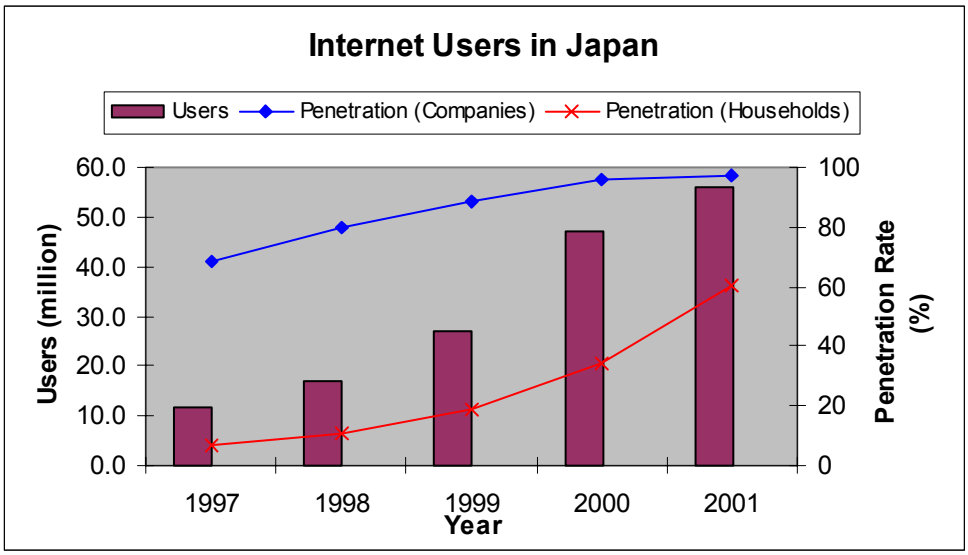


Figure 4-16 Internet users in Japan

Note: Companies are the ones with over 300 employees.
Source: White paper on information and communications in Japan 2002.

[79] Japan Inc. Magazine; Interview; May 2000.

Concerning the stock market, with the support of the Internet bubble, the decisions to open the new stock markets were made in 1999. The decisions made a big difference in terms of venture capital availability and visible successes of IPOs that fueled another entrepreneurial activity.

A narrative summary of the analysis is presented in Figure 4-17. The Tokyo cluster from this analysis shows a dramatic evolution of Internet startups. Several important features of the evolution of the entrepreneurial cluster include: (1) Shibuya Ward and Minato Ward have been an attracting and convenient place for students and people with creative talents, who worked as key labor force for Internet startups; (2) the advent of the Internet opened huge market opportunities for entrepreneurship; (3) people with foreign experience are among entrepreneurs who endeavored to challenge in the midst of the low profile of the entrepreneurial diamond, and around the same time, the downsizing of large firms has been seen; (4) the rapid growing Internet users helped early successes of ventures and the expectation of further success led to the Internet bubble; and (5) the Internet bubble prompted the decision to open the new stock markets, which fueled entrepreneurial activity by improving venture capital availability and visibility of successes.

A schematic summary of the analysis on the evolutionary dynamics is presented in Figure 4-18. Although the profile of the national diamond of Japan is the least favorable for technology entrepreneurship among the G7 countries, Tokyo is considered to have several key existent conditions. Shibuya Ward and Minato Ward have had the attractive amenities for young people and creative talents and a convenient node of dense traffic systems that many university students use. Further, with its concentration of every activity of Japan, Tokyo is considered to have a largest portion of the people with foreign experience.

Since the early 1990s, several abnormal events are identified. The downsizing of large firms by the low economic growth since the early 1990s and the accumulation of people with foreign experience worked as abnormal inputs to the entrepreneurial context throughout the 1990s. Then in the mid 1990s, the advent of the Internet brought the huge possibilities of new markets, working as a huge abnormal input to the market conditions. Several key firms were created before the Internet bubble. During the Internet bubble, the opening of new stock markets worked as a kick input to the market conditions, prompting further entrepreneurial activities. Regulatory changes now seem in progress. Today Tokyo has an unusually improved profile of the diamond from the standard of Japan.

Tokyo, Japan
(Internet business)

Entrepreneurial Context

- Large firms in their heavy recession throughout the 1990s.
- High publicity during 1999 and 2000 let people recognize entrepreneurship.
- Successful firms as role models.

Today

- Shibuya as counter-culture against the establishment in the central business district.
- Those who have foreign experience accumulate their number.

Input Conditions

- The new stock markets in 1999 encouraged local venture capitals to invest in startups.
- Venture capitals and incubators who give advice emerged around 2000.

Today

- Many universities as a source of cheap labor. Shibuya is a convenient place for hiring students and people with creativity.
- Venture capitals becoming available to startups but angels not developed.

Market Conditions

- Internet brought huge market opportunities from the mid 1990s.
- New stock markets in 1999 prompted the increased venture capital availability and the visibility of successes.

Today

- Mothers have 48 listed companies.

Networking Conditions

- Informal network produced the name Bit Valley in 1999.

Today

- Shibuya has amenities that can serve as networking opportunities. Informal networks with proximity works favorable to startups.
- No strong formal organizations.

Figure 4-17 Analysis of the entrepreneurial cluster diamond of Tokyo

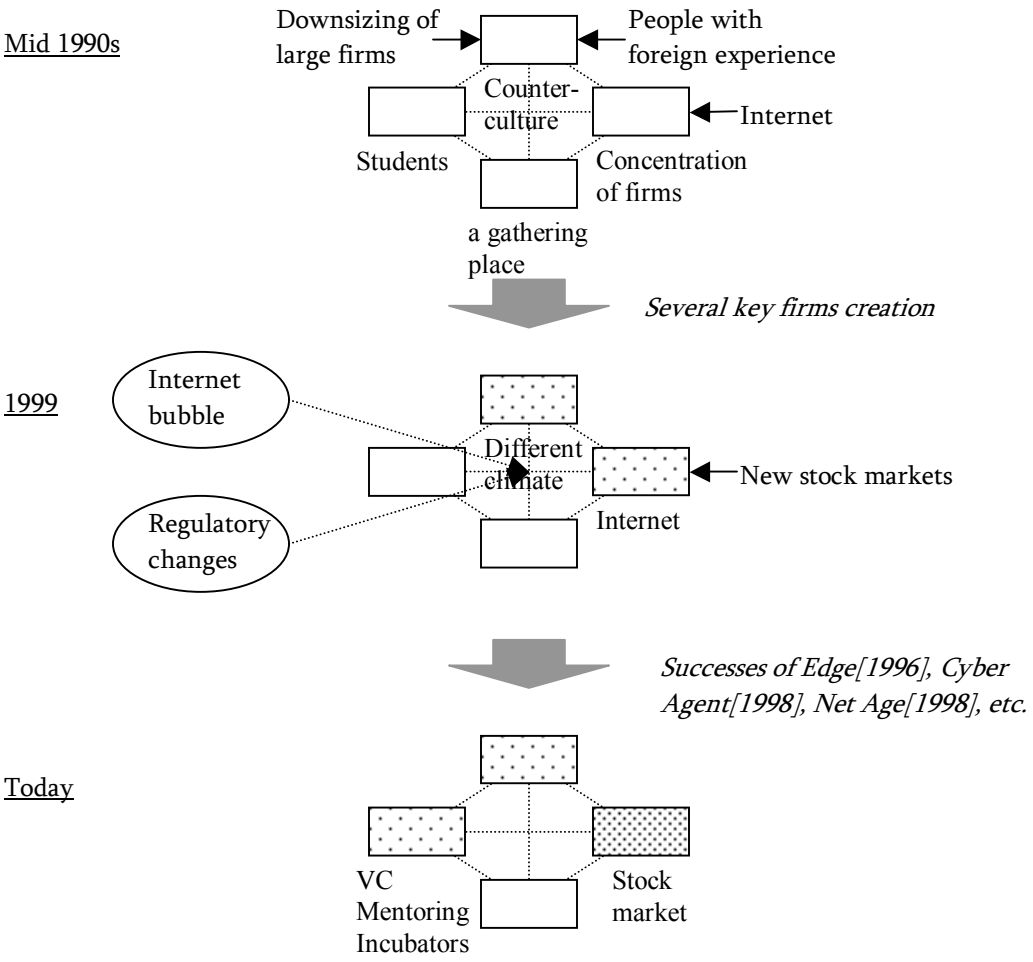


Figure 4-18 Analysis of the evolutionary dynamics of Tokyo

Notes: Boxes represent the four attributes of the diamond (right: input conditions, top: entrepreneurial context, bottom: networking conditions, left: market conditions). Statements under the boxes represent existent conditions at times. Solid arrows represent abnormal events. Circles represent major abnormal events. Shades are for illustrating gradual improvements, not absolute evaluations.

Exhibit 4-5 Interview result (Tokyo, Mr. K.M.)

Language Processing Diagram built from the interview in April 2003 of Mr. K.M., a Japanese entrepreneur who co-founded an Internet venture in Tokyo in 1996.

Theme: What were the essences of entrepreneurship evolution in Tokyo, Japan?

From the late 1990s, pioneering entrepreneurs, university education, and new stock market emerged.

From the late 1990s, some entrepreneurs pioneered a new way of entrepreneurship, becoming prompts for followers.

- A book written in 1998 by an entrepreneur named Yuichiro Itakura, who had experienced rapid upturn and downturn of an Internet venture, became a best-seller, showing a way for Japanese entrepreneurs as a role model.
- In April 1999, an Internet venture, Net Age, sold its car website business to Yahoo! for 400 million yen, showing a model of incubation. After it, several venture incubators were formed such as the one in July 1999 by Net Year Group, a US-based firm.
- An Internet venture, Cyber Agent, established in March 1998, went IPO in March 2000 at Mothers, showing a model of IPO of ventures.

New stock markets for growing firms opened from 1999, and affected creation of new IPO support services.

- In November 1999, Tokyo Stock Exchange opened Mothers, a stock market for growing firms. NASDAQ also started NASDAQ Japan in 2000 (although it withdrew in 2002 after the dot com bubble). They have lower hurdles for startups than established stock markets.
- Security printing firms such as Asia Security Printing started consulting services for IPO for startup firms after the emergence of Mothers in 1999.

- Hitotsubashi University and Waseda University, both of them are among the leading universities in Japan, established MBA programs in 1998 offering courses related to entrepreneurship.

- Shibuya (Tokyo) has a concentration of office buildings with office spaces of about 60 – 100 m2, which are called 'pencil buildings,' making it easy for nascent ventures looking for small offices to find them.

Internet opened new possibilities for Internet ventures.

Technology and Internet infrastructure advance made it possible for small businesses to develop Internet-related products.

- Linux, established in 1994, started making it possible for small offices/home offices to develop inexpensive Internet systems by using cluster servers with browsers.
- The event that Intel invested in RedHat in 1998 made Linux more recognized and credible, enabling it easier to sell Linux-based systems that don't require large initial investments.
- NTT Communications, established in 1999, started providing inexpensive high-speed Internet accesses with flat rates of 24 hours, affordable for small firms in Japan.

- An Internet BBS provider, 2ch, emerged as a huge website which counts 2 million hits a day, showing an advantage of new ventures for a different strategy for investor relations that established firms are not capable to adopt.

Education reform and the collapse of large established firms has affected the attention of students averting from ordinary employed works.

- A shift toward the individual-oriented education incorporated in a report of Ministry of Education in 1987 has affected primary education students since then, who started graduating universities in the latter half of 1990s and seeking other jobs than ordinary employed workers.
- One of the large established firms, Yamaichi Securities, went bankrupt in November 1997, prompting the fall of the belief in large established firms among graduates.

From the latter half of 1990s, loose money also increased, which sometimes increases immature ventures.

- After a law to promote finance for SMEs was passed in 1995, finance support for startups increased, but known for the loose following monitor after investment.
- A venture capital business, started by Hikari Tsushin in 1999, propagated a false dream to many immature ventures that they can make money by IPO.

Exhibit 4-6 Interview result (Tokyo, Mr. Haruo Miyagi)

Language Processing Diagram built from the interview in April 2003 of Mr. Haruo Miyagi, a Japanese entrepreneur who founded an organization promoting entrepreneurship since 1993.

Theme: What were the essences of entrepreneurship evolution in Tokyo, Japan?

The entrepreneurial scene has developed to a higher level compared with five years ago.

Many Internet ventures were created and the availability of risk money has improved significantly compared with five years ago.

- Since the latter half of the 1990s, many Internet ventures were created to accumulate to 1,500 in spring of 2001. Entry rate and exit rate are said to be around 10 percent, higher than other industries in Japan.
- The availability of risk money such as venture capital has improved significantly compared with five years ago. Now excellent firms can gain investments, although it is not to the extent as in three years ago when the abnormal Internet bubble was there.

Winners and losers have become apparent since 2001, and succeeding ventures often move to Roppongi.

- Winners and losers have become apparent among the ventures established around the Internet bubble. Since 2001, the tendency is continuing that ventures with 10 employees and unique services have been acquired by the winners such as Rakuten, Cyber Agent, GMO, and Edge. Recent M&As include many cases in which employees of acquired companies continue to work steadily without leaving.
- In addition to Shibuya, Roppongi, with the opening of Roppongi Hills, is drawing attention for concentration of ventures such as Internet businesses. Yahoo!, Softbank, and Rakuten have moved to Roppongi in the recent months. It is often seen that succeeding ventures in Shibuya move to Roppongi and Akasaka, but Shibuya maintains its popularity. Younger generations seem to be attracted by the culture of the town itself.

- Although the stock index has been low, ventures with competitive advantages such as technical superiority are popular among investors, including the ventures listed at Mothers.

- Still quality people with technical or management skills can be hardly obtained from graduates of universities. Rather, it is necessary to train them on-the-job-training through the growth of startups.

Some people started to change their attitudes toward entrepreneurial activity positively since 1998 and 1999.

Since 1998 and 1999, students' attitudes have changed favorable toward entrepreneurship, and some started to create their own companies.

- Since around 1998, students at top national universities such as Tokyo University and Hitotsubashi University, who typically had gone to large firms, started to use the startup support service of ETIC.
- Since around 1999, students' motivation to participate the internship program has changed toward starting their own companies or developing their own businesses.
- Although it was rare cases for students to start companies up to recently, about 5 cases can be seen every year where students participating in the internship program later start their companies and startups established by students are identified for the internship program.

- Although quitting large companies had been considered to involve large risk until the latter half of the 1990s, people who quit and start their companies started to appear within acquaintances since around 1998.

- The first business plan competition for social entrepreneurs was held in 2002, attracting 71 participants. The startup support program for students attracted 51 students and selected 5 teams for the awardees.

Government is implementing serious policies fostering entrepreneurial activity recently.

- Government is making efforts to nurture entrepreneurs through education such as universities. Its famous plan to prompt 1000 spin-off ventures from universities until 2003 already counts 424 ventures so far.
- Government is implementing various efforts to prompt startups to the level of 360 thousand entries per year until 2006 (currently 150 thousand entries per year).
- The exemption of the minimum requirement of equity capital for the first five years of startups began in February 2003, making it possible to establish corporation with one yen. The applications totaled 1500 for the first two months, and the policy is well spoken. It indicates government commitment for fostering entrepreneurship.

Many Internet ventures around Shibuya are young small companies with young entrepreneurs.

- Many entrepreneurs of Internet ventures are in their 20s and 30s, quite younger than the impression of the average age of typical Japanese entrepreneurs so far.
- 100 companies participating in the internship program of ETIC are mainly small-sized companies (80 percent have less than 30 employees and 40 percent have less than 10 employees). Many of the entrepreneurs of those companies are in their 20s or 30s. Nearly half of the companies are located in places such as Shibuya, Akasaka, and Roppongi, the center of so-called Bit Valley.

Exhibit 4-7 LP result from Mr. Nishikawa's publications (Tokyo)

Language Processing Diagram built from the publications of Mr. Kiyoshi Nishikawa, a Japanese entrepreneur who founded Net Age, an Internet incubation venture, in Tokyo in 1998.

Sources: CNET Japan, Column: Entrepreneurs as a career 1-4 (In Japanese), April 2003.
Japan External Trade Organization, Keynote speech at APEC SME Business Network Promotion Forum (In Japanese), February 2001.

Note: Elements are the author's translations of the excerpts from the sources. Tiles are the author's abstraction.

Theme: What were the essences of entrepreneurship evolution in Tokyo, Japan?

Dramatic changes such as the Internet bubble and the opening of the new stock markets happened to the entrepreneurial scene in 1999 and 2000.

The opening of the new markets in 1999 attracted venture capitals and people at large firms to startups.

- Right after the NASDAQ Japan announcement and Tokyo Stock Exchange's opening of Mothers in 1999, venture capitals started seeking Internet venture startups.
- At the same time in 1999, people who quit large firms and start their own companies started to appear.

- When he founded his company in 1998, he could find friends investing his company but nobody intended to quit their jobs and join his company.
- From the late 1999 to the first half of 2000, the Internet bubble happened in Japan.

A number of recent entrepreneurs have foreign experience.

A number of entrepreneurs including Mr. Nishikawa have experience in working at foreign companies or studying abroad.

- In 1990 working at Arthur D. Little in Cambridge, MA, he first became interested in starting business seeing young promising colleagues quit the company and start their businesses.
- Quite a number of entrepreneurs at Shibuya are the people who earned MBA outside Japan and who are from foreign consulting firms such as McKinsey and Boston Consulting Group.

- Japanese traditional entrepreneurs were typically outside the mainstream such as lone wolves or outsiders. Most brilliant students go to large firms or governments.

Shibuya is a convenient place for startups and can accommodate counter-culture against the establishment.

Shibuya is a convenient place for hiring students and working late at nights.

- He opened his office in Shibuya because it was an attractive place for students who were the strong and good candidates for the workforce as programmers and sales agents for an Internet startup.
- Shibuya has a lot of restaurants open late at nights, which are convenient for startups.

Entrepreneurs in Shibuya have counter-culture against the establishment.

- Startups at Shibuya have casual corporate culture without suits and ties.
- Starting companies in Shibuya may convey a meaning of a kind of counter-culture against the establishment around Chiyoda Ward.
- The recession throughout the 1990s spread feelings of oppression and blockage among large firms. Many people who start businesses at Shibuya are young people in their 20s and 30s who want to jump out from those feelings.

- Shibuya has a sub-culture atmosphere of disorder and chaos that can accommodate creativity.

- Many venture capitals don't follow their investments or can't follow because the things are new for them also in 2001.

- Typical IT ventures around Shibuya don't pay well, but use stock options.

- The company has so far incubated 10 startups, including spin-offs from its employees. The total revenue is about 4 billion yen ($33 million) and the total employment is about 300.

4.5 Discussion

We have seen the evolutionary dynamics of Silicon Valley, Cambridge, Munich, and Tokyo. Those entrepreneurial clusters have the characteristics of the self-reinforcing loop, and through the creation of high impact ventures and spin-offs, the entrepreneurial clusters improve themselves in terms of their ability to let create entrepreneurial opportunities and another wave of ventures and spin-offs. We have also seen the features of the early evolution of the clusters. The evolution of the clusters has not happen overnight. In the early periods, the indications of the evolution were tiny and slow in the presence of the force of inertia of the self-reinforcing loop. What made the self-reinforcing loop start rotating around against the force of inertia were abnormal events that work as kick inputs to the self-reinforcing loop. Abnormal events can be characterized as the events that arise from the outside of the expectation regressed from the previous tendency in the cluster. They are sometimes merely a chance event; they are sometimes eagerness or efforts of an individual. Abnormal events range from just one input to the system to a major abnormal event that has broad influence on the system such as the emergence of a catalyst and a genius.

Each cluster had its own path of the evolution with unique events. Silicon Valley has the history of almost 100 years whereas Tokyo has seen the evolution only in the recent years. In Table 4-3, the key features of the studied clusters along with the abnormal events identified through the analyses with the entrepreneurial diamond framework are presented. Although those clusters differ significantly in terms of the population, the time when the evolution started, and the type of the industry, we can see some similar features of the evolution. First, all of them had the key existent conditions as a potential to embrace technology entrepreneurship before the dawn of the evolution. Silicon Valley's Stanford University and Cambridge's Cambridge University have been a source of scientifically and technically-trained people and knowledge creation, as well as an anchor of networks of faculty and graduates. Munich has had a strong science base consisted of universities, hospitals, and research institutions with latest knowledge of biotechnology and qualified scientists within proximate locations. Tokyo has had concentration of students and creative talents working as key labor force for Internet startups. These existent conditions belong to the input conditions in terms of people and knowledge creation, as well as a potential for the improvement of the networking conditions.

One of the first abnormal events in each case was an arrival of new technology wave that brought new possibilities for entrepreneurial activities in the cluster: electronics for Silicon Valley, microprocessors for Cambridge, biotechnology for Munich, and the Internet for Tokyo. Early entrepreneurs were attracted by the potential of the technology as an opener of market opportunities. Then around the same time or a little later in the evolution history, abnormal events that affected the

entrepreneurial context were seen: Terman in Silicon Valley, Mott Committee in Cambridge, the downsizing of large firms in Munich, and the downsizing of large firms and the accumulation of people with foreign experience in Tokyo. They worked as inputs to the entrepreneurial context to let happen climate changes, and prompted the creation of early ventures such as Hewlett-Packard in Silicon Valley.

Table 4-3 Abnormal events in the evolution of the entrepreneurial clusters

		Silicon Valley	Cambridge	Munich (biotech)	Tokyo (Internet)
Population		2.3 million	0.1 million (0.7 million[1])	1.25 million	12 million
sIdentified dawn of evolution		1900s	1970s	Early 1990s	Mid 1990s
Key existent conditions		Stanford University	Cambridge University	Strong science base of institutions	Students and creative talents
Abnormal events	Technology wave *	Electronics	Microprocessors	Biotechnology	Internet
	Climate change **	Terman	Mott Committee	Downsizing	Downsizing/ Foreign experience
	Abnormal finance ***	Local financiers, Individuals at NY bank	Individuals at Barclays Bank	Government fund	(Internet bubble)
	Others	Defense procurement, Shockley and eight individuals	Cambridge Consultants	New stock market	Internet bubble New stock market, Regulatory changes

Notes: * Market conditions. ** Entrepreneurial context. *** Input conditions.
[1] Population of Cambridgeshire

The input conditions in terms of finance exhibited an interesting aspect. In the early periods of all the cases, there were no formal risk money providers for risky startups. However, abnormal events helped the early entrepreneurs. FTC in Silicon Valley was helped by local financiers who were also attracted by the possibility of electronics; Hewlett and Packard were given endorsement by Terman for the access to local financiers; the eight individuals from Shockley Semiconductor Laboratory were helped by the sympathetic individuals at a New York bank; and in Cambridge the bold move of the individuals at Barclays Bank helped finance of technology ventures. In Munich it was the government fund that formed pioneering formal risk money. In Tokyo it was the Internet bubble and the opening of new stock markets that prompted certain investments into young ventures for the first time. In all the

cases, venture capital industry emerged way after the accumulation of the self-reinforcing loops.

The role of the defense procurement in the early evolution of Silicon Valley exhibited an important aspect of the market conditions. A new technology alone may not be a strong input to the market conditions. A new technology assured by the steady and lump-sum procurement of the government turned into a promising improvement of the market conditions.

The improvement of the networking conditions seems to be a late starter. Apart from the existent conditions as a potential, the substantial improvement tends to be seen in the later stage of the evolution. It was after the creation of the spin-offs from Fairchild when the huge enhancement of the networking conditions happened in Silicon Valley. In Cambridge, although Mott Committee improved the attitude toward university/industry collaboration and Barclays formed a club for networking, it was in the later stage when the local awareness and attention to the phenomenon prompted to create the formal organizations such as St. John's Innovation Centre and Cambridge Network. The same thing can be said in the case of Munich. Tokyo doesn't seem to have a solid profile of the networking conditions yet.

However, this characteristic of the networking conditions does not mean that the importance of the networking conditions is undermined. Saxenian (1996) argues that the rapid growth of Silicon Valley over the Route 128 has come from a regional network-based industrial system of Silicon Valley that promotes collective learning and encourages more experimentation and entrepreneurship, which the Route 128 area in contrast lacks due to a small number of relatively integrated corporations. Network-based interactions are more likely to lead to innovations and entrepreneurial opportunities. The profile of the networking conditions seems to have the increasing importance as the cluster matures in the later stage of the evolution.

From these observations, the characteristics of the evolutionary dynamics of the entrepreneurial clusters are summarized as the following. (1) Entrepreneurial clusters had the existent conditions that exhibited the good profile of the input conditions in terms of people and knowledge creation, as well as a potential for the improvement of the networking conditions. (2) An advent of new waves of technology worked as an opener of market opportunities; government procurement assured the new opportunities in one case. (3) Abnormal events enhanced the profile of the entrepreneurial context to let happen climate changes and prompted the creation of early ventures. (4) Abnormal events helped the key early entrepreneurs to get finance for their startups; venture capital industry emerged way after the accumulation of the self-reinforcing loops. (5) The substantial improvement of the networking conditions happened in the later stage of the evolution, although the networking conditions are considered important for further evolution of the cluster.

(6) The opening of new stock markets fueled the evolution of the cluster. A schematic expression of this summary is presented in Figure 4-19.

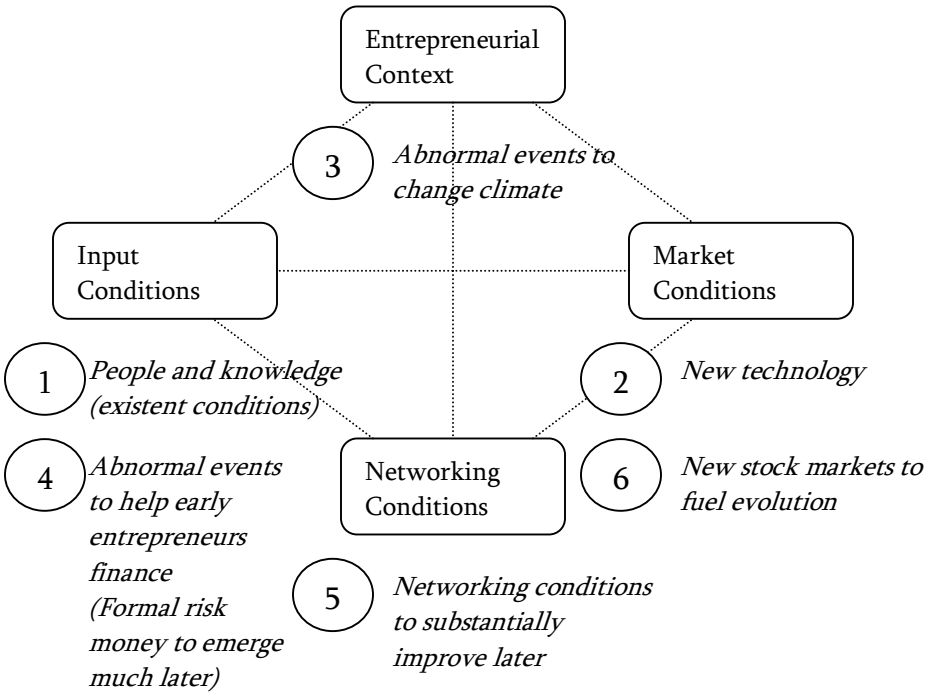


Figure 4-19 Characteristics of the dynamics of the entrepreneurial clusters

5 Conclusion

The conclusion of this research on the evolutionary dynamics of entrepreneurial clusters is threefold. (1) The proposed entrepreneurial diamond framework is useful to understand and analyze both static conditions and dynamic characteristics of entrepreneurial clusters. (2) The dynamics of an entrepreneurial cluster is characterized as the self-reinforcing system through the creation of high impact ventures and spin-offs. (3) Observations from the case studies exhibit similar characteristics of the evolutionary paths of the entrepreneurial clusters.

First, technology entrepreneurship as a social phenomenon is a broad and complex issue that involves a lot of factors from micro level to macro level. The proposed entrepreneurial diamond framework exhibited its usefulness to streamline many factors involved, state the conditions of the technology entrepreneurship both at the national level and the regional level, and extract the characteristics of the evolution of the clusters. The diamond framework, consisted of the four attributes of a region representing the ability of the region to let create entrepreneurial opportunities, can be used as a tool to overview the conditions of an entrepreneurial cluster, to understand the dynamics of the cluster, and to identify the strengths and the weakness of the cluster. It should be of interest to anyone who is interested in the development of a region through technology entrepreneurship. Researchers, key constituents of a region such as leading entrepreneurs and promoters, and policy makers may find it useful for setting a priority of actions to enhance entrepreneurial opportunities, and for generating consensus on policies among the constituents of the region.

Second, building a successful entrepreneurial cluster like Silicon Valley has been an attracting idea for many regions, but it will not happen overnight. The examination of the dynamics of entrepreneurial clusters using the diamond framework exhibited their characteristics of the self-reinforcing system that won't start rotating easily in the presence of the force of inertia of the system. The System Dynamics models, with the entrepreneurial diamond embedded within it, showed that once a flow in the self-reinforcing system accumulates, the profiles of the four attributes of the diamond (the input conditions, the entrepreneurial context, the networking conditions, and the market conditions) improve themselves through the creation of high impact ventures and spin-offs, and their influences on the diamond and ripple effects within the diamond. However, to let a massive flow happen in the self-reinforcing system from a point of condition with little flow in the system encounters the obstacles of deterrents. The deterrents are often perceived in the real life as the large personal risks involved in starting ventures, the psychological barrier

to become entrepreneurs, the low availability of quality people with management skills, the low prestige of entrepreneurs, and so on. The analysis of the System Dynamics models showed that these deterrents are the exhibitions of the characteristics of the force of inertia that the self-reinforcing systems inherently have, and that the force of inertia persists until the system starts rotating. The force of inertia is considered heavier in larger economies.

Then, the question becomes what breaks the obstacles of the force of inertia. The observations from the studied cases of Silicon Valley, Cambridge, Munich, and Tokyo exhibited similar patterns of the evolutionary paths through which the obstacles were gradually removed. Those patterns are characterized as the series of the abnormal events and the subsequent evolutions happened in the clusters. The abnormal events worked as kick inputs to the self-reinforcing system, which prompted the incremental rotations in the system, aggregately overcoming the force of inertia. The abnormal events were sometimes merely a chance event such as a success in getting startup finance from traditional financiers, and sometimes eagerness or efforts of an individual such as Terman in Silicon Valley. The key observations from the cases include: the would-be clusters with good profiles of the input conditions in terms of people and knowledge creation had an advent of new technology as first abnormal events; abnormal events such as the emergence of an eager individual and the downsizing of the large firms enhanced the profile of the entrepreneurial context in the early evolution, prompting the creation of early ventures together with the advent of new technologies; abnormal events such as the emergence of sympathetic bankers helped the key early entrepreneurs to finance their startups; and the substantial improvement of the risk money availability and the networking conditions occurred in the later stage of the evolution. Although these observations are made from a handful of the cases, the implication of them is expected to serve as a good benchmark to practitioners, as well as stimulating interests to researchers.

The notion of entrepreneurial clusters is a powerful and attracting issue for every stakeholder in the knowledge-driven economies. A success of building such a cluster may contribute to the promising growth of an economy and the vitality of the people by continuously generating entrepreneurial opportunities for them, like a fresh spring in the diversely flourishing ecology having the spring at the center of it. The main actors in the ecology are of course brave entrepreneurs and growing ventures, but the author thinks that the roles of other organizations such as universities, institutions, and governments are becoming more important. The governments at all levels from local governments to federal governments have the prime responsibility to create a favorable environment that can foster, or at least does not undermine, entrepreneurial opportunities. It seems that the central roles of the governments are not the direct ones that might distort the natural orders of the ecology, but the indirect ones that

nourish the natural powers of the ecology. Also, together with the governments, the universities and the institutions should be proactive, collaborative constituents of the ecology, not independent entities that are indifferent to the potential and the importance of the entrepreneurial clusters. As we saw in an implication of the presence of the cohesion and shared strategy behind the rapid success of the Munich biotech community, entrepreneurs, private businesses, universities, institutions, and governments can create a tremendous environment for generating entrepreneurial opportunities by the collaborative attitudes and the collective actions.

As for further research, the author would like to expect the accumulation of the descriptive cases that analyze the evolutions of the entrepreneurial clusters probably happening in many knowledge-driven economies. Also further understandings of the dynamic mechanisms, especially the ones that limit or hinder the evolutions perhaps by some characteristic of balancing loop, are expected. The author hopes that the findings of this research may be of interest to any stakeholders in the world of technology entrepreneurship, and that the approach of this research may serve as a further prompter of the awareness and the attention to the entrepreneurial clusters.

References

Audretsch, D. (2000) Entrepreneurship in Germany. In Sexton, D.L. and Landstrom, H. (Eds.), *The Blackwell Handbook of Entrepreneurship*. Oxford: Blackwell Publishers.

Audretsch, D., Thurik, R., Verheul, I., and Wennekers, S. (2002) Understanding entrepreneurship across countries and over time. In D. Audretsch, R. Thurik, I. Verheul, and S. Wennekers (Eds.), *Entrepreneurship: Determinants and Policy in a European-U.S. Comparison.* Boston: Kluwer Academic Publishers.

Beveridge, L. (2001) *Cambridge Entrepreneurs in the Business of Technology*. Cambridge, UK: Granta Editions.

Carayannis, E.G., Rogers, E.M., Kurihara, K., and Allbritton, M.M. (1998) High-technology spin-offs from government R&D laboratories and research universities. *Technovation* 18, 1-11.

Castilla, E.J., Hwang, H., Granovetter, E., and Granovetter, M. (2000) Social networks in Silicon Valley. In C.M. Lee, W.F. Miller, M.G. Hancock, and H.S. Rowen (Eds.), *The Silicon Valley Edge*. Stanford: Stanford University Press.

Center for Quality Management (1995) The Language Processing Method. Cambridge: CQM Quality Improvement Tool Kit.

Christensen, C.M. (1997) *The Innovator's Dilemma*. Boston: Harvard Business School Press.

Cooper, A. and Folta, T. (2000) Entrepreneurship and high-technology clusters. In Sexton, D.L. and Landstrom, H. (Eds.), *The Blackwell Handbook of Entrepreneurship*. Oxford: Blackwell Publishers.

Dohse, D. (2000) Technology policy and the regions: the case of the BioRegio contest. *Research Policy* 29, 1111-1133.

Fujitsu Research Institute and Ministry of Economy, Trade, and Industry (2001) Survey on Internet enterprise in Tokyo.

Garnsey, E. and Smith, H.L. (1998) Proximity and complexity in the emergence of high technology industry: the Oxbridge comparison. *Geoforum* 29, No. 4, 433-450.

Gibbons, J.G. (2000) The role of Stanford University: a Dean's reflections. In C.M. Lee, W.F. Miller, M.G. Hancock, and H.S. Rowen (Eds.), *The Silicon Valley Edge*. Stanford: Stanford University Press.

Giesecke, S. (2000) The contrasting roles of government in the development of biotechnology industry in the US and Germany. *Research Policy* 29, 205-223.

Gregorio, D.D. and Shane, S. (2002) Why do some universities generate more start-ups than others. *Research Policy* 32, 209-227.

Kenney, M. (2000) *Understanding Silicon Valley: The Anatomy of an Entrepreneurial Region*. Stanford: Stanford University Press.

Kinukawa, S. and Yukawa, K. (2001) The location choice of new media companies in Tokyo. *Economic Review* 5, No.2.

Klofsten, M. and Jones-Evans, D. (1996) Stimulation of technology-based small firms: a case study of university-industry cooperation. *Technovation* 16, 187-193.

Lecuyer, C. (2000) Fairchild Semiconductor and its influence. In C.M. Lee, W.F. Miller, M.G. Hancock, and H.S. Rowen (Eds.), *The Silicon Valley Edge*. Stanford: Stanford University Press.

Lee, C.M., Miller, W.F., Hancock, M.G., and Rowen, H.S. (2000) The Silicon Valley habitat. In C.M. Lee, W.F. Miller, M.G. Hancock, and H.S. Rowen (Eds.), *The Silicon Valley Edge*. Stanford: Stanford University Press.

OECD (1998) *Fostering Entrepreneurship*. OECD Job Strategy, Paris: OECD.

Porter, M.E. (1990) *Competitive Advantage of Nations*. New York: Free Press.

Porter, M.E. (1998) *On Competition*. Boston: Harvard Business School Press.

Reynolds, P.D., Bygrave, W.D., Autio, E., and Hay, M. (2002) *GEM 2002 Summary Report*. Global Entrepreneurship Monitor.

Rowen H.S. (2000) Serendipity or strategy: how technology and markets came to favor Silicon Valley. In C.M. Lee, W.F. Miller, M.G. Hancock, and H.S. Rowen (Eds.), *The Silicon Valley Edge*. Stanford: Stanford University Press.

Saxenian, A. (1996) *Regional Advantage: Culture and Competition in Silicon Valley and Route 128, Paperback Edition*. Cambridge: Harvard University Press.

Schoonhoven, C.B. and Romanelli, E. (2001) *The Entrepreneurship Dynamic*. Stanford: Stanford University Press.

Schumpeter J.A. (1962) *Capitalism, Socialism, and Democracy*. New York: Harper & Row.

Segal, N.S. (1986) Universities and technological entrepreneurship in Britain: some implications of the Cambridge phenomenon. *Technovation* 4, 189-204.

Segal Quince Wicksteed (1985) *The Cambridge Phenomenon: The Growth of High Technology Industry in a University Town*. Cambridge, England: Segal Quince Wicksteed.

Sexton, D.L. and Landstrom, H. (2000) *The Blackwell Handbook of Entrepreneurship*. Oxford: Blackwell Publishers.

Shane, S. and Venkataraman, S. (2003) Guest editors' introduction to the special issue on technology entrepreneurship. *Research Policy* 32, 181-184.

Sturgeon, T.J. (2000) How Silicon Valley came to be. In M. Kenney (Ed.), *Understanding Silicon Valley: The Anatomy of an Entrepreneurial Region*. Stanford: Stanford University Press.

Timmons, J.A. (1994) *New Venture Creation, Entrepreneurship for the 21st Century, Fourth Edition*. Burr Ridge, Illinois: Irwin.

Timmons, J.A. (1999) *New Venture Creation, Entrepreneurship for the 21st Century, Fifth Edition*. Boston: Irwin/McGraw-Hill.

Thurik, R., Wennekers, S., and Uhlaner, L.M. (2002) Entrepreneurship and economic performance: a macro perspective. *International Journal of Entrepreneurship Education* 1, 157-179.

Utterback, J.M. (1994) *Mastering the Dynamics of Innovation*. Boston: Harvard Business School Press.

Verheul, I., Bosma, N., van der Nol, F., and Wong, T. (2002) Determinants of entrepreneurship in the United States of America. In D. Audretsch, R. Thurik, I. Verheul, and S. Wennekers (Eds.), *Entrepreneurship: Determinants and Policy in a European-U.S. Comparison*. Boston: Kluwer Academic Publishers.

Verheul, I., Wennekers, S., Audretsch, D., and Thurik, R. (2002) An Eclectic Theory of entrepreneurship: policies, institutions and culture. In D. Audretsch, R. Thurik, I. Verheul, and S. Wennekers (Eds.), *Entrepreneurship: Determinants and Policy in a European-U.S. Comparison*. Boston: Kluwer Academic Publishers.

Wennekers, S., Uhlaner, L.M., and Thurik, R. (2002) Entrepreneurship and its conditions: a macro perspective. *International Journal of Entrepreneurship Education* 1, 25-64.

World Economic Forum (2002) *Global Competitiveness Report 2001-2002*. New York: Oxford University Press.

Yukawa, K. (2001) The cluster of new media industry in Tokyo. *Economic Review* 5, No.1.