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Changing Roles of Universities in Developing Entrepreneurial Regions: The case of Finland and the US

Alok K. Chakrabarti and Mark Rice

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Changing Roles of Universities in Developing Entrepreneurial Regions: The Case of Finland and the US [1]

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ABSTRACT

Universities have critical role as sources of intellectual property and talent in regional development and high technology industries. We present a theoretical framework based on social capital and knowledge management literatures describing the knowledge generation and transfer processes for universities. Our research questions are:

1. What are the roles of universities in regional economic development with respect to knowledge generation and transfer processes and how are they changing?
2. How do these roles and trends differ in the U.S. vs. Finland?

INTRODUCTION

The competitive environment for most firms has been transformed by global competition, rapid changes in technology and shorter product life cycles (Ali, 1994: Bettis & Hitt, 1995: Quinn, 2000). Innovation has become critical in survival in this competitive environment. The average life cycle of the products in many industries has reduced to less than a year. Moreover, the diversity of product standards across the countries and rapid changes in the standards with the evolution of technology are exacerbating the uncertainty and complexity. Successful companies have reduced the cost of innovation and risks by outsourcing. A few scholars (Parkhe, 1993; Pisano, 1990; Shan, Walker & Kogut, 1994) have examined the inter-organizational collaboration in development of new technology.

[1] Some of the interviews reported in this paper were conducted with Professor Richard Lester and his students in the context of a larger project on Local Innovation Systems at the Industrial Performance Center. The authors thank Professor Lester for his support. The authors are responsible for the interpretation and insights presented in this paper.

The problems of product development in a dynamic industry can be explained in terms of newness of the technology, customers and trajectory of the technology development. Classical models of product development assume the process to be a linear one. But as Leonard-Barton (1995) has shown, the process of technology development varies with these parameters. The role of the company changes with the novelty of the technology and novelty of the market. In cases of new technology intended for existing market, the firm has a dominant role. Customers take an increasingly important role in situations where existing technology are modified for new applications. There are situations where market and technology evolve in a symbiotic way. Information and communication technology industry, particularly in the mobile communication area, represents this phenomenon.

There are many compelling reasons for outsourcing innovation by a firm (Quinn, 2000). New market opportunities have been created by the continued growth of the world economy. Most of the major companies in Europe and Japan have set up R&D centers in places like Silicon Valley and Boston in the US, and in Cambridge UK. These centers are conduits for developing relationships with the premier universities in these regions. Better access to scientists and technologists in various parts of the world has provided great opportunities for outsourcing of technology development. The development of information and communication technology has helped effective interaction among the various individuals and coordination among geographically distributed groups. Finally, governments and the financial institutions are providing new incentives for inter-organizational collaboration.

UNIVERSITIES AS ENGINES OF REGIONAL DEVELOPMENT

With the growing importance of knowledge-based industry, policy makers in the private and public sectors have realized the importance of universities in regional economic development (Chakrabarti & Lester, 2002). The roles of Massachusetts Institute of Technology in growth of the industries in greater Boston area and Stanford University in the Silicon Valley area are quite well known. One can observe similar experience of other universities in the US and elsewhere.

After the economic collapse of its principal trading partner, Soviet Russia, Finland experienced a deep recession with high unemployment during the early nineties. Universities

at that time became the important engines of economic development. Helsinki University of Technology became a major center for growth in wireless communication and information technology. The University of Oulu helped build up the Oulu region's capabilities in electronics and information technology. Tampere focused on electro-mechanical and automation industries. The University of Turku contributed to the development of pharmaceuticals and chemistry based innovations. The Finnish Innovation Foundation, a public organization has established Center for Technical Expertise with all major universities in Finland as shown in Figure 1. (See Figure 1)

Each region in our study in the US has had its share of economic crisis. Newark and its surrounding area have a long history of economic stagnation. New Jersey Institute of Technology (NJIT) has embraced economic development as one of its four central missions. Worcester Polytechnic (WPI) is located in central Massachusetts, a region that has experienced an erosion of its economic base with the demise of many mechanical and electrical manufacturing industries. WPI has been a stimulus to regional growth through its contribution to the development of new industrial activity in information technology and more recently in biotechnology. In the Bethlehem area, long disadvantaged by the decline of the steel industry, Lehigh University has become a facilitator of economic development in the region. Rensselaer Polytechnic Institute (RPI) is located in the capital district region of the state of New York, which has struggled through a series of economic cycles and where the dominant company, General Electric, has continued to downsize its local operations including the corporate research center. Both RPI and the nearby State University have set up incubators for new companies and other related activities.

UNIVERSITY-INDUSTRY RELATIONSHIP

University-industry relationship is not a new phenomenon. Germany was the pioneering country where university industry relationship helped create the pharmaceutical industry in the early 19th century. The United States has taken an active role in developing and fostering university industry collaboration. There are many mutual benefits to a close relationship between a university and an industrial firm. Firms gain access to not only leading edge technologies, but also highly trained students, professors and university facilities. A firm can

gain prestige and acceptance in its stakeholder community though its association with a prestigious university. Polar Electro Oy, a manufacturer of wireless heart monitor used by athletes and other fitness enthusiasts, has worked with a large number of universities and medical institutions around the world for testing and developing its products. Polar Electro headquartered in Oulu, is now an internationally known company in the sports industry.

Universities can augment their funding sources by working with the industry. This has become an increasingly important consideration in most countries as public level of funding for higher education has become scarce. Costs of operation of institutions of higher education have outpaced the other indices of price increase. University administration feels the pressure to supplement their funding by various means, one of which is of course sponsored research. Working with the industry provides other pedagogical and academic value to the students and faculty. Faculty and students can keep up with the practical problems and gain access to knowledge developed outside the academe. This is particularly important in many emerging fields where academic research and publication usually lags industry.

Industry-university collaboration takes several forms. The National Science Foundation in the US identifies four inter-related components in the university-industry relationships: research support, cooperative research, knowledge transfer and technology transfer. Research support involves contributions of both money and equipment to the universities by industry. This type of contribution is valuable as it provides great flexibility to upgrade laboratory and develop programs in certain areas of interest. Recently, a consortium of 23 companies has contributed 47 million Finnish Marks ($8M) to several Finnish technical universities to upgrade their programs in information and communication technologies.[2] Although corporate support of universities has been unrestricted in the past, it is more common now to have these funds targeted for specific purposes.

Universities have developed many cooperative research consortiums with industry to pursue research and development in some common areas of interest. In the United States, the National Science Foundation has actively promoted such formation of cooperative research through establishment of Engineering Research Centers (ERC) and Industry University

[2] Personal interview at Nokia Oy

Cooperative Research Centers (IUCRC). These centers provide formal structures to advance technology through various types of collaboration between a university and industrial firms. Contract research by a research center or a professor is often a vehicle for collaboration between university and a firm. In Finland, TEKES, the Finnish Technology Development Agency promotes the industrial collaboration by requiring all of its projects be collaborative. The policy implemented by Tekes not only promotes interaction between a firm and a university, but also decentralizes the control and monitoring of the projects.

Knowledge transfer involves many activities that include both formal and informal means of communication, interactions and personnel exchanges at student and faculty levels. Involvement of the firms in the academic programs of the universities is a major mechanism for knowledge transfer. Often students work on corporate problems for their theses and dissertations in many technical universities in Finland. Cooperative education programs, internships and job placements for students and recent graduates provide means for knowledge transfer.

Technology transfer is generally based on the collaborative research with the industry. The Department of Agriculture in the United States developed the agricultural extension service model for transferring agricultural technology to the farmers where the universities were key sources of information. The concept of "land grant" college was developed by an act of the US Congress in 1862 for "agriculture and mechanic arts, scientific and classical studies, and military tactics for the liberal and practical education of the industrial classes." Major public universities in the US have been established as land grant institutions with a clear mandate for knowledge and technology transfer. From that tradition, different models of interaction with the industry have evolved. Universities have taken active roles in establishing various types of organizations, such as business incubators, science parks, technology parks, etc. to foster entrepreneurship and business development.

Rice (2002) has shown the effective mechanisms for assisting entrepreneurs in business incubators. This study shows that it is complex process and depends on the strategic objectives of the entrepreneurs, their capabilities as well as managers of these incubators. Location in a business incubator offers great opportunity of networking as well as tapping the

resources available at the sponsoring organization, often the university. The traditional view of the business incubator is overly focused on capital and infrastructure related resources. Our study in Finland shows that knowledge exchange is very important in developing unique value in university-linked business incubators.

CHANGING ROLE OF THE UNIVERSITIES AND NATURE OF SCIENTIFIC RESEARCH

Universities are traditionally viewed as bastions of learning and knowledge creation. The culture of academic freedom cherished by the faculty creates problems when a firm or an agency dictates the terms and conditions of support for research including the ownership of intellectual property rights and restrictions on publication. During the Second World War, universities and professors were active participants in developing and implementing knowledge that went into the war effort. Since then, the military has been a big supporter of research and graduate education in many universities in the US.

Discussions about the types of research suitable for universities often are focused on the continuum of basic to applied research. Such one-dimensional analysis does not help to understand the complexity of the issues involved. Stokes (1997) developed a quadrant model of scientific research based on two dimensions that inspire the scientific and technological research. These two orthogonal dimensions are: quest for fundamental understanding and considerations for use. Research in atomic structures by scientist like Nobel laureate Niels Bohr was driven by quest for fundamental understanding with little consideration for its commercial use. Work of Thomas Edison was driven by considerations for use and little by quest for fundamental understanding, if any. Louis Pasteur was concerned with both fundamental understanding as well as use. If the academic research needs to be more utilized, then one needs to be in Pasteur quadrant in Stokes' scheme.

To understand how the Finnish universities and institutions differ from the US universities and institutional structure, we can look at the nature and applicability of knowledge developed in Finnish universities and the US universities. One can categorize knowledge in two ways: theoretical and problem solving. In terms of applicability of knowledge, it can be either generic or context-specific. Finish universities tend to be high on problem-solving type

of research and most often in specific situations. The institutional system in Finland promotes this. For example, Tekes, the technology development agency funds academic research only if one or more companies jointly sponsor it. In such projects, companies have great control over the intellectual property rights. Most of the theses and doctoral dissertations are focused on corporate problems. In developing technology policy and identifying priority areas for funding, Tekes often relies on committees that consist of both academics and corporate executives. Finally, the boundary between the academic and corporate organizations are much more permeable than that in the US. Many of the top executives in the corporate and public organizations move from or to universities at different points in their career.

In the US, universities are motivated to work more on theoretical knowledge development. Reward system in the US academic institutions encourages faculty to be engaged in theoretical and more generic type of research. Public funds can seldom be used to further the interests of a specific company. There are some exceptions. The Small Business Innovation Research (SBIR) program at the National Science Foundation is aimed at rectifying such situation and is geared to help small companies to further their innovative activities. Such programs are too few and often the small companies are not properly equipped to tap into such programs. Most collaborative programs funded at the universities by public money are aimed at pre-competitive technology development. This means that the output of such programs needs further investment for development.

To further understand the differences in the roles that the universities in the US and Finland play in the knowledge exchange process, we look at the mode of transfer of knowledge and the nature of knowledge in terms of its communicability. Transfer of knowledge takes place either through personal or impersonal channels. Nonaka and Takeuchi (1995) differentiated knowledge as tacit or explicit. Explicit knowledge is codifiable and easily expressible. Tacit knowledge is not visible and difficult to formalize. It is not easily expressible and is often highly personal. In order to implement new technology in product or processes, industry needs tacit knowledge. Thus there remains a chasm between what industry needs and what universities are generally geared to offer. In Figure 2 (See Figure 2), we show that universities are often engaged in development of generic theoretical knowledge that is codified and transmitted through papers, patents and presentations. Industry needs tacit

knowledge that can be applied and interpreted for specific problem situation. The chasm between the needs of the industry and what universities generally offer through their papers and patents can be described in three dimensions: structural, cognitive and informational. Traditionally, there lacks structural mechanism for industry to interact with the academic professionals in universities. Cognitively, they also differ in terms of their priorities. Finally, the information that is conveyed to each other becomes not very meaningful.

SOCIAL CAPITAL AND BRIDGING THE ENTREPRENEURIAL GAP

For universities to be effective in fostering high technology entrepreneurship, one needs to bridge the gap as we have outlined above. The three dimensions identified are indeed three components of social capital (Nahapiet and Ghoshal, 1998) that consists of "networks of strong, crosscutting personal relationships developed over time that provide the basis for trust, cooperation and collective action". Nahapiet and Ghoshal (1998) suggested, "social relationships – and the social capital therein- are an important influence on the development of intellectual capital". In defining intellectual capital, they acknowledged the importance of "contextually embedded forms of knowledge".

Combination and exchange of intellectual resources leads to the development of intellectual capital. This combination and exchange process depends on four factors: (1) access to the parties involved, (2) perceived value of such interactions, (3) motivation for engaging in such activities, and (4) creative capability of the parties. According to Nahapiet and Ghoshal (1998), much of this knowledge is socially embedded.

Entrepreneurial universities can create the social capital through various mechanisms that can sustain development of intellectual capital in their regions that will foster development and growth of high technology firms. Other public organizations can contribute significantly in development of such social capital. Universities in Finland have participated in building incubators or enterprise development centers that not only house the entrepreneurial firms, but also provide the opportunity to network with the university personnel. Helsinki University of Technology has Innopoli, the business incubator on its campus. Innopoli has been funded through various public and private sources. Technical University of Tampere

has established Hermia, a business incubator on campus. The philosophy of Hermia is not to provide subsidized real estate, but the advantage of co-locating with the technical university. The success of Hermia can be seen in terms of how the employment in the Tamepere region, a city of 300000 people has changed as shown in Table 1. (See Table 1).

In Turku, the bio-industry is being developed based on the long tradition of the knowledge base in chemistry at the Åbo Academy and the University of Turku. Pharmaceutical companies and companies dedicated to developing functional foods are agglomerated in the Turku area. Bio-Valley is the most recent business incubation program that has been initiated in 2001. The Bio-Turku Network consists of five types of organizations: biotechnology companies, university research organizations, discovery companies, integrated pharmaceuticals manufacturing and marketing companies, and service companies. It is important to note here that the Finnish system is predominantly based on organizational networks and collaboration.

It is also important to note here that other public organizations, Tekes, SITRA[3], a semi public venture investment organization, Finnish Foundation of Innovation, and agencies under the

[3] Sitra, the Finnish National Fund for Research and Development, is an independent public foundation under the supervision of the Finnish Parliament. The Fund aims to promote Finland's economic prosperity by encouraging research, backing innovative projects, organizing training programs and providing venture capital. The Fund was set up in conjunction with the Bank of Finland in 1967 in honor of the 50th anniversary of Finnish independence. The Fund was transferred to the Finnish Parliament in 1991.

Sitra aims to further economic prosperity in Finland by developing new and successful business operations, financing the commercial exploitation of expertise and promoting international competitiveness and cooperation.

Sitra is an autonomous pioneer enjoying economic independence with courage and initiative designed to break new ground. It is an impartial opinion-shaper providing new research information, anticipating and identifying future challenges developing new solutions.

Sitra's corporate funding activities offer financial assistance in the early stages of their existence to technology companies and other kinds of entrepreneurial organizations with a promising economic future. Sitra provides venture capital for companies that exhibit the opportunity, ability and desire to grow on international markets.

jurisdiction of other ministries are significantly involved in working with these incubators. The institutional infrastructure in Finland has developed the appropriate social capital conducive for development of business ventures.

Figure 3 shows (See Figure 3) the annual growth of new technology –based companies in Finland. The explosive growth of the Knowledge Intensive Business Services (KIBS) companies is the culmination of the efforts that the Finnish organizations have made in recent years. Figure 4 (see Figure 4) provides estimated revenues that the Tekes funded or sponsored companies for next five years. The return on investment of the Tekes funds is indeed quite substantial in many respects including creation and retention of jobs.

In the US universities have realized the role that they can play in stimulating growth in their regions. The southern tier of New York has suffered economic stagnation, although it had several reputable universities. In the early 1990s, several civic leaders and corporate executives pooled their resources and formed what is the Ceramic Innovation Corridor (CIC). It has two locations; one in Alfred adjacent to Alfred University and the other one is in Painted Post near Corning Inc. The idea was to leverage the intellectual resources at Alfred University, renowned for its work in the ceramics and glass technology and the resources of Corning to help growth of business in this region. The CIC helped launch several companies and also provided the opportunity to Corning to pursue its telecommunication related activity. However, reflecting the recent debacle in the telecommunication industry and the investment climate in the US in general, the region is struggling hard.

The capital district of New York state has gone through a similar crisis with the decline of the activities of the major employer in the region, General Electric. Manufacturing related activities have significantly declined in other industries and thus have contributed to the economic malaise of the region. There are two reputable universities in the region along with a medical university. Rensselaer Polytechnic Institute (RPI) a nationally recognized technical university has taken the lead to establish a business incubator and a technology park to help

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Sitra is a shareholder in about one hundred different technology enterprises. They operate in the fields of information technology, electronics and life sciences. New innovative small and medium-sized companies need not only finance but also support in developing their activities.

foster entrepreneurial activities in the area. State University of New York at Albany (SUNY Albany) has also established an incubator with public funding. A center for research on nano-technology has been established in Albany with the cooperation of IBM, the State of New York and the SUNY. Although efforts are being made, the region is yet to become another Silicon Valley.

Similar experience can be observed in Newark, New Jersey. New Jersey Institute of Technology, a public research university has established several business incubators. The Public Health Research Institute that specializes on infectious diseases has recently shifted its operation to Newark. The City is also the home of the University of Medicine and Dentistry as well as one of the three major campuses of Rutgers University. Despite the agglomeration of these universities and research organizations, Newark has stagnated over a long period since the race riots of 1968.

The region around Oulu in northern Finland (close to the Arctic Circle) is a case of rapid growth in entrepreneurial firms. In its quest for economic development, a university was established. Major companies like Nokia and Sonera established their research centers. The close collaboration among the university, the university hospital and the companies have made Oulu region a major center in mobile communication technology. There are close to 500 wireless communications related companies in the region. Application of the electronic and communications technology to the medical field has created a new industry in *wellness*. There is a Mobile Forum in Oulu that is a platform for interaction and sharing of non-competitive knowledge among mobile communications companies in Oulu and elsewhere. Recently, the region has initiated a Wellness Forum that helps companies devoted to the wellness related products and services.

OBSERVATIONS ON PRACTICES IN FINLAND AND THE US

Studies on regional development and agglomeration of high technology companies in certain areas have heightened the importance of universities as engines of growth. The recent advances in biotechnology and information and communication technology also have led to the development of knowledge intensive businesses. Importance of knowledge and highly skilled labor has influenced the location decisions of firms near research universities. Finland has made a conscious effort to utilize the universities as a major component of economic development.

Earlier studies have focused on the role of universities from a resource-based view. Most of the studies pointed out the universities as sources for knowledge, technology, and skilled employees. The importance of knowledge transfer has varied for different universities and also on the nature of the firms. Santoro and Chakrabarti (2002) observed that universities differ in terms of their strategic orientations. This study identified two types of university research centers: network-oriented and problem-oriented. Universities with strong reputations, as exemplified their high ranking by the U.S. News and World Report, are network-oriented. Universities in the third and fourth tiers in US News ranking are problem-oriented. The level of interaction between a network-oriented center and its industrial collaborators remain at a low level and tangible benefit also remains low. The problem-oriented centers have a high level of interactions with their industrial collaborators and provide tangible outcomes. Generally large companies become associated with the network-oriented centers mostly for their non-core technology. Smaller sized companies on the other hand become associated with the problem-solving research centers in universities. Thus the university-industry relationship becomes dependent on the centrality of the technology for the business operations in one hand and the capability and reputation of the universities on the other hand.

The network-oriented centers, in fact are contributing to the building of the social capital for the firms that is not readily quantifiable in short term economic gains. But the close association with the research universities of international reputation helps these companies develop the structural mechanisms for interaction. Joint projects and sponsorship of research for thesis and dissertation bridge the cognitive gaps and develop the contextual conditions for meaningful interaction. Many international companies build relationships with organizations like Massachusetts Institute of Technology, Stanford University, and Harvard University. Novartis Corporation has recently established its Institute for Research on Bioscience on MIT campus. Nokia Corporation has close cooperation with most of the top ranked universities in the world. Building social capital has been the key ingredient for the Finnish companies to venture into international market quickly (Arenius, 2002).

The experience of the regions like Tampere, Oulu, Helsinki, and Turku in Finland points to a symbiotic relationship among the corporations, public agencies and universities. Leadership

at the local level is also an instrumental factor in building this social capital. In late 1960s, the City of Tampere realized the importance of an airport in the area. While the national government declined to build one, the local government took the initiative to build one from other sources of funds. Similar entrepreneurial initiative also helped build the Technical University of Technology in late 1960s as this was perceived to be critical in development of the region.

CONCLUSIONS

Universities are now increasingly recognized to have a broader role in the economic development and entrepreneurship. Smilor, Dietrich and Gibson (1993) pointed out the factors that are the main driving forces for developing entrepreneurial universities in the US. Finland has been successful in building a tripartite collaborative relationship among universities, corporations and the public agencies. In the US, some regions have attempted to do so with limited success in sustaining that effort. We need further research to understand the cultural imperatives of Finland that help it to succeed. We have presented our observations based on qualitative interviews with the corporate executives, university officials and public agencies. One needs a more systematic investigation to understand the differences in the social capital that is built by universities in their regions and the contextual conditions supporting the process.

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Table 1

Employment in High Tech Industries in Tampere, Finland

Industries	1993	1998	1999
Mechanical and Automation	20000	24000	25000
Information & Communication	2000	8500	10000
Media Services		4600	5000
Knowledge Intensive Business Services		5500	6000

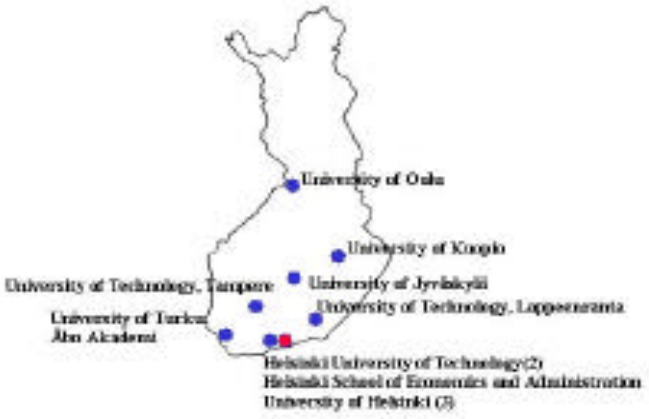

Figure 1
Cooperation between Finnish Invention Foundation & Universities

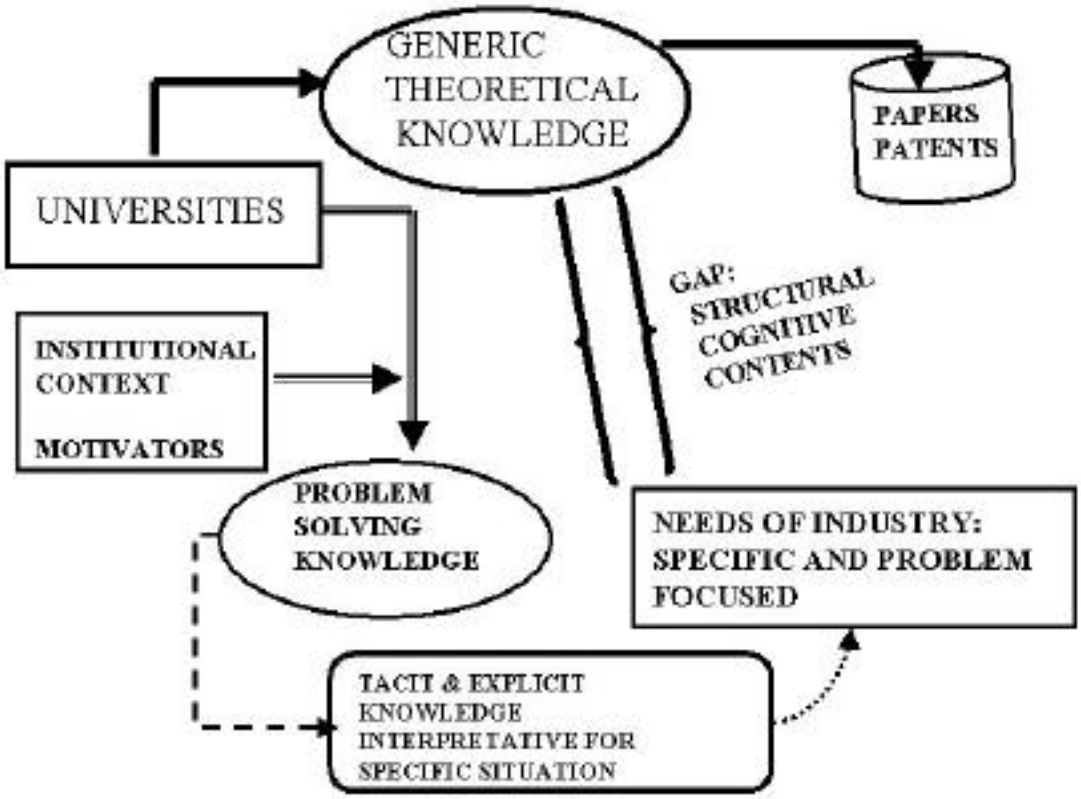

Figure 2
Knowledge Exchange between University and Industry

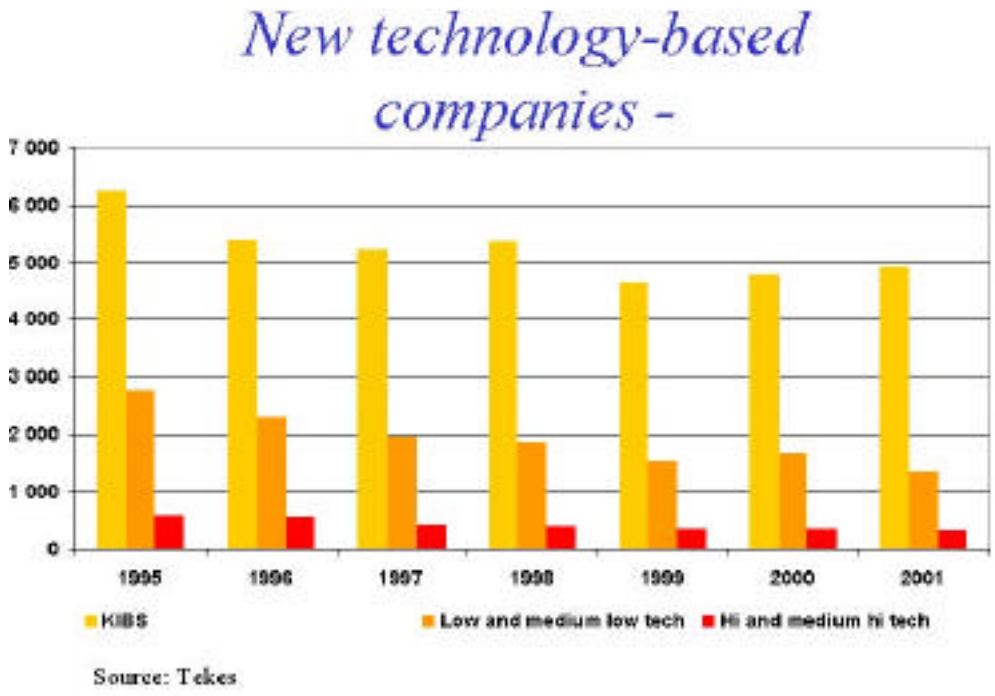

Figure 3
No. of New Technology Based Companies

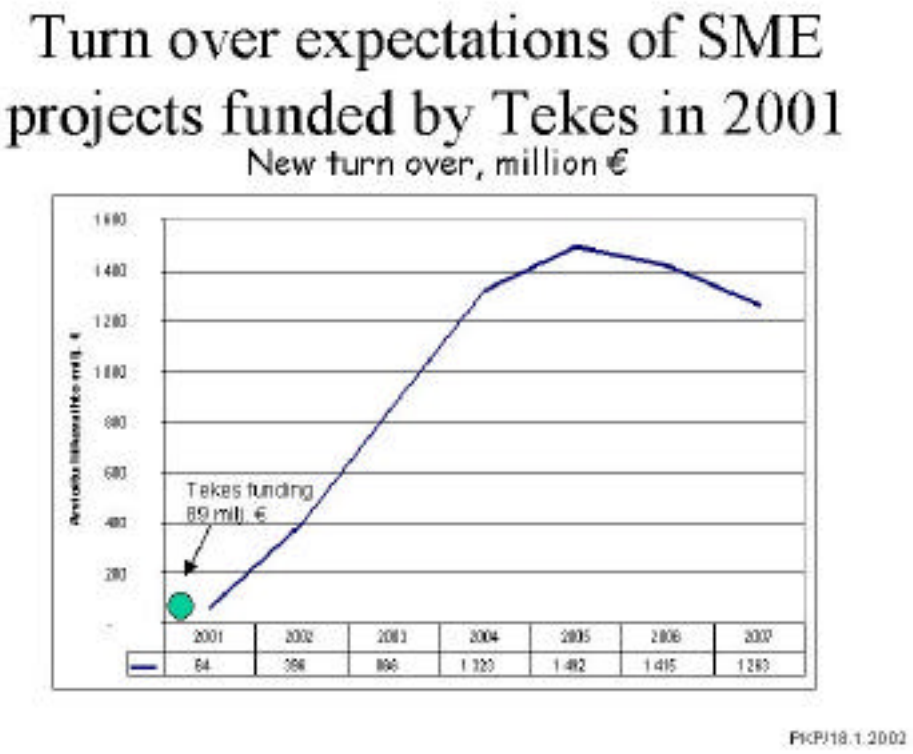

Figure 4
Estimated Growth of SME firms linked with Tekes in Finland