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ROLE OF UNIVERSITIES IN THE PRODUCT DEVELOPMENT PROCESS: STRATEGIC CONSIDERATIONS FOR THE TELECOMMUNICATIONS INDUSTRY

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Role of universities in the Product Development Process: Strategic Considerations for the Telecommunication Industry[1]

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Executive Summary[2]

The competitive environment for most firms has been transformed by global competition, rapid changes in technology and shorter product life cycles. Innovation has become critical for survival in this competitive environment. The telecommunication industry is the best example of a dynamic global market environment. The average life cycle of the products in this industry has reduced to less than a year. The diversity of communication standards across the countries and rapid changes in the standards with the evolution of technology is exacerbating the uncertainty and complexity of new products. Successful companies have reduced the cost of innovation and risks by outsourcing.

The problems of product development in a dynamic industry like, telecommunication 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, although the process of technology development differs 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 an existing market, the firm has a dominating role. Customers take an increasingly important role in situations where existing technology are modified for new applications. In the case of new technology intended for new customers, market and technology evolve in a symbiotic way. The mobile communication area is representative of this phenomenon.

New market opportunities have been created by the continued growth of the world economy. Better access to scientists and technologists in various parts of the world has provided great opportunities for outsourcing of technology development. Governments and financial institutions are providing new incentives for inter-organizational collaboration.

Various research organizations, either contract research or cooperative research organizations, are also important partners in the product development process. University-industry collaboration provides access not only to leading edge technologies, but also to

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[1] I thank Dr. Michael Santoro at Lehigh University for our collaborative research in this topic. Dr. Richard Lester, Director of the Industrial Performance Center at MIT has been a great source of ideas and help in my pursuit of this research.

[2] Key words: Technology, industry structure, innovation process, university research, academe, network, collaboration, telecommunication industry, research quadrant, communication, core competence, product development

highly trained students, professors and university facilities. Faculty and students can keep up with the practical problems and gain access to knowledge developed outside the academe.

Firms differ in their strategic orientation for developing a relationship with universities. Large firms are interested in working with universities in the areas of technologies that are not in the core of their business. They use universities for exploring technical areas that have a long-term perspective. Smaller firms are more interested in competence building in their core business areas and solving current problems.

Working with universities also provides a level of flexibility in pursuing different technological trajectories either sequentially or in parallel. This is important in a dynamic technical environment.

Internal R&D groups often become fixated in certain technologies and thus develop a culture of insularity whereas universities are often sources of new ideas. The faculty and students are unfettered by corporate culture and tradition and therefore are able to approach the technical problems from a creative perspective. Since the growth of the telecommunication industry is often driven by a young generation, students in universities are an important source not only for technical ideas but also for important market information.

Building effective relationships with universities for technology and product development is a complex process. Universities also differ in terms of their capabilities and strategies. Policies related to management of intellectual property rights are areas of concern for both industry and universities.

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). The telecommunication industry is the best example of a dynamic global market environment. Innovation has become critical for survival in this competitive environment. The average life cycle of the products in this industry has reduced to less than a year. Moreover, the diversity of communication standards across the countries and rapid changes in the standards with the evolution of technology is exacerbating the uncertainty and complexity of new products. 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.

The problems of product development in a dynamic industry, like telecommunication, 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 differs in the following parameters. As shown in Figure 1, we observe that there are many different processes for product/ technology development. The role of the company changes with the novelty of the technology and novelty of the market. In cases of new technology intended for an existing market, the firm has a dominating role. Customers take an increasingly important new role in situations where existing technology is modified for new applications. In this figure the top right quadrant represents the process where market and technology evolve in a symbiotic way. The rapid development of the telecommunication industry, particularly in the mobile communication area is representative of this phenomenon.

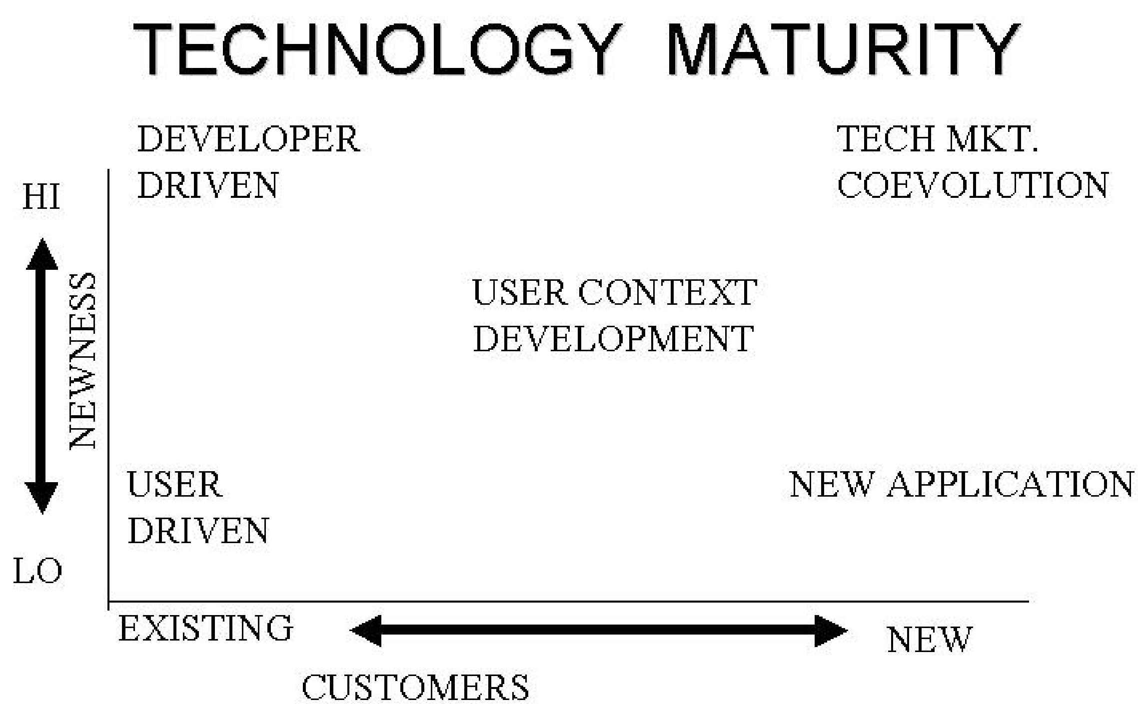

Figure 1:Product Development Processes
Reference: Leonard Barton (1995)

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 the Silicon Valley and Boston in the US and Cambridge in the 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 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 role of Massachusetts Institute of Technology in the growth of industries in the greater Boston area and Stanford University in the Silicon Valley area is quite well known. One can observe a similar experience with other universities in the US and elsewhere.

After the economic collapse of Soviet Russia, Finland experienced a deep recession with high unemployment during the early nineties due the loss of this principal trading partner. Universities at that time became the important engines of economic development in Finland. 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 contribution of

Hermia, a university-based business development effort at Tampere can be seen through employment growth in the regions as shown in Table 1.

Although none of the regions we studied in which the US universities are located experienced economic reversals as dramatic as those in Finland, each has had its share of economic crisis. Newark and its surrounding area have a long history of economic stagnation, and NJIT has embraced economic development as one of its missions. Worcester Polytechnic (WPI), located in central Massachusetts, is a region that has experienced an erosion of its economic base with the demise of many mechanical and

Table 1[3]

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

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

[3] Source: Professor Ollie Niemi, Director of Hermia

nearby State University have set up incubators for new companies and other related activities.

Technology and New Product Development Process

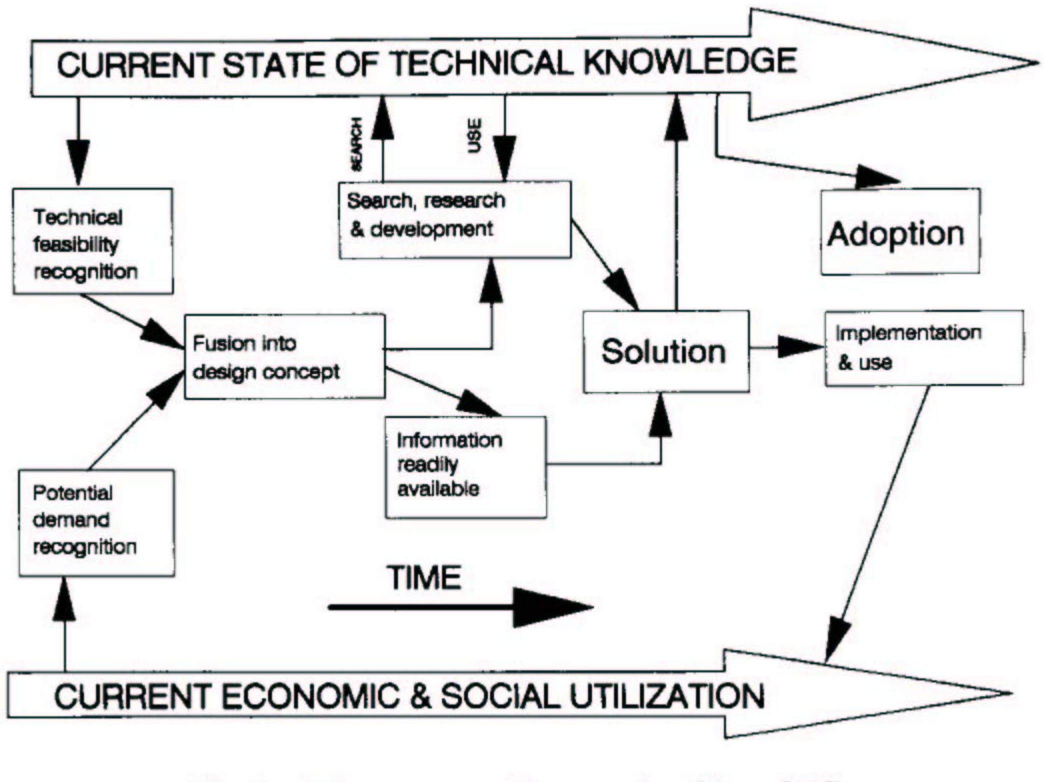

Figure 2 Process of Technology & New Product Development
Reference: Myers & Marquis (1967)

Figure 2 illustrates the process of technology and new product development. A concept for a new technology or product is developed through a fusion of the perception of the technical opportunity in hand and the recognition of potential market demand. Depending on the availability of technical information, further research is needed for development of the technology or product concept before it can be commercially exploited. The technological context is important and acts as a bank for information from where the researcher both receives information and contributes to it by advancing the state of the art in technology. The economic and social conditions of the country are important determinants for demand.

Sources of technology and product concepts are quite varied. First and foremost are the company's internal organizations, such as the corporate or divisional R&D centers, and new product groups. As observed earlier, customers are also important sources of ideas for technology and products. Various research organizations, either contract research or cooperative research organizations, are also important partners in the product development process. Scientists at CERN, the European cooperative research organization, conducted the pioneering work that has led to the development of the Internet. Fraunhofer Institute in Germany has been involved in the development of MP3 technology that has revolutionalized the music industry and created many new possibilities in the telecommunication industry. The German chemical industry has benefited from contributions made by public research organizations, such as Fraunhofer Institutes, Max Planck Institutes and others. VTT, the Finnish National Research Organization, has played a significant role in the development of the mobile telecommunication industry in Finland. Finally, universities are also important sources of new technology and products. Universities of Technology at Helsinki, Tampere and Oulu in Finland have played a key role in the mobile communication industry in Finland. Competitors are also important sources of ideas for new products.

University-Industry Relationship

University-industry relationship is not a new phenomenon. Germany was the pioneering country where a 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 not only to leading edge technologies, but also to highly trained students, professors and university facilities. A firm can gain prestige and acceptance in its stakeholder community through its association with a prestigious university. Polar Electro Oy, a manufacturer of a 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 relationship has become an increasingly important consideration in most countries as the 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 for 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 behind 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 laboratories and develop programs in certain areas of interest. Recently, a consortium of 23 companies has contributed 47 million Finnish Marks to several Finnish technical universities to upgrade their programs in information and communication technologies.[4] 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 the establishment of Engineering Research Centers (ERC) and Industry

[4] Personal interview at Nokia Oy

University 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 that 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.

Changing Roles in the Universities and the Nature of Scientific Research

Building effective linkage with industry is not easy. 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. However, the culture is fast changing. 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. [5] In discussing the type of research that should be done at universities, we often think in terms of basic vs. 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 as shown in Figure 3.

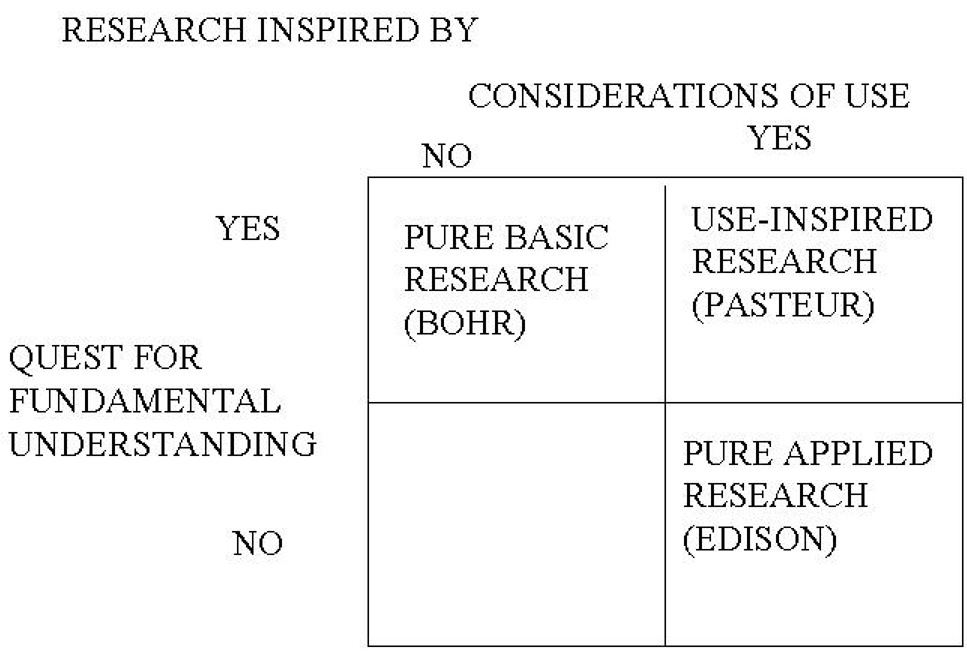

Figure 3
Quadrant Model of Scientific Research
(Reference: Stokes, 1997)

The upper left-hand quadrant includes basic research that is solely inspired by the academic curiosity of the researcher without any considerations for its practical value or utility. The work of Niels Bohr can illustrate this. Bohr's work was solely dependent on his desire to model atomic structure. The initial work of Watson and Crick in discovering

[5] As a biographical note, the US Army Research Office funded part of the cost of my education while I was a PhD student at Northwestern University in the late 1960s.

the DNA structure at the University of Cambridge also falls in the Bohr quadrant (Watson, 1991).

The lower right-hand cell represents the work of Thomas Edison that was inspired by the practical value of the work. Edison is credited with the concept of building an innovation factory. His laboratory became a constant source of new products and innovations. Work in this quadrant may involve sophisticated scientific discoveries, but they are narrowly targeted to commercially viable ideas.

The top right quadrant represents the work that is best exemplified by the work of Luis Pasteur. Here the work is inspired by both a quest for understanding and considerations for use. The challenge for the universities now is how to balance these considerations and develop agendas for strategic research.

As the universities change their role from pure basic research to more user-focused research, the culture and attitude towards different types of research needs to be modified. This requires some strategic adjustments for both the industry and the universities.

SOME STRATEGIC CONSIDERATIONS

In a study of several university-industry research centers in the US, we investigated the strategic considerations for forming such collaboration (Santoro & Chakrabarti, 2001). We identified the following factors that are important in building university relationships:

a. Strengthening skills, knowledge and gaining access to university facilities for advancing core and non-core technologies;
b. Organic and adaptable corporate culture;
c. Flexible university policies for intellectual property rights, patents and licenses;
d. Presence of an I/U champion at the firm;
e. Firm's personal interactions and resource commitments for I/U relationships;
f. Level of tangible outcomes generated from I/U relationships.

Our study showed that the firms differ in their strategic orientation for developing relationships with universities. Santoro & Chakrabarti (2001) identified three categories of strategic orientations among firms: collegial players, aggressive players and targeted players. Characteristics of these three groups are summarized in Table 1. The firms in cluster 1 are network oriented. They are attracted by the university center's high rankings and prestige and believe that this will be beneficial in terms of access to not only the students and professors within the university but also other firms within and outside the industry. In this context, universities become part of the public space or a forum for exchange of ideas and information that is seldom possible in other contexts[6]. Firms in cluster 2 want to use the universities' resources for advancing their immediate business interests. Cluster 3 includes the firms that are motivated to develop relationships with a particular university for a very specific technical or problem area. For example, my own university, NJIT, is recognized for research in remediation of hazardous and toxic substance. Many firms are attracted to work with NJIT in this specific area, although NJIT is not highly ranked among all national universities.

Corollary to the firms, universities also differ in terms of their strategic orientations. We observed 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.

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[6]Richard Lester at the Industrial Performance Center at MIT pointed this out to me. His work on "interpretive management" is relevant in this context. He and his colleagues claimed: "the most important contribution the research university can make to industry, above and beyond the quantity and quality of its graduates, is to help expose private companies to a broad range of new ideas. A company that demands an exclusive, proprietary research relationship may not only be damaging the university, it may also be reducing the value that it will ultimately derive from that relationship" (Lester, et al. 1998)

Large firms are more likely to be associated with network-oriented centers. Aggressive players and Targeted players are attracted to the problem- oriented centers.

In determining the university-industry relationship, one should also consider two other factors: the firm size and the centrality of the technology to the firm's business (Santoro & Chakrabarti, 2002). Large firms are interested in working with universities in the areas of technologies that are not at the core of their business. Studies in corporate strategy suggest that firms will seldom outsource the development of technologies that are at the core of the business. The same is not true for small firms. Small firms have many additional constraints including limitation of resources. Thus, universities are very important sources of technical competence for small firms. Figure 4 provides a schematic diagram of the possible outcomes of university-industry relationships.

Table 2
Profiles of Companies Interacting with University Research Centers in the US

	Cluster 1	Cluster 2	Cluster 3
Name of Cluster	Collegial Players	Aggressive Players	Targeted Players
Number of Firms	40 (22%)	84 (46%)	59 (32%)
Features of I/U Relationship (S)	• Low interactions/resources • Low tangible outcomes	• Highest interactions/resources • Highest tangible outcomes	• High interactions/resources • High tangible outcomes
Firm's Strategic Objectives	• Major focus not to advance new technologies; being a member of an influential consortia is key driver (I)(S) • Privy to and influence pre-competitive research (I) • Leverage consortia to build and enhance additional inter-organizational networks (I) • Gain access to students and recent graduates (S) • Influence university curriculum and training (I) • Exchange technical info with other companies (I)	• Major focus to advance new technologies both *core and non-core* (S) • Expect ROI by advancing a variety of new technologies (I) • Strengthen skills and knowledge for both *core and non-core* technologies (S) • Gain access to university facilities for both *core and non-core* technologies (S) • Use consortia to link up to leading-edge *core and non-core* technologies (S)	• Major focus to advance new *core* technologies (S) • Collaborative projects usually centered around the firm's primary business (I) • Expect immediate ROI by addressing firm's needs (I) • Strengthen skills and knowledge for *core* technologies (S) • Gain access to university facilities for *core* technologies (S) • Center must be especially responsive to firm's needs (I) • Widespread use of consulting arrangements (S)
Size of Firm (S)	Predominantly large firms	Mix of large and small firms	Predominately small firms
Time Horizon (I)	Primarily long-term	Both long and short-term	Primarily short-term
Type of Industry (S)	High tech (60%), resource intense (20%), capital intense (15%), and labor intense (5%)	High tech (70%), capital intense (16%), resource intense (11%), and labor intense (3%)	High tech (60%), capital intense (20%), resource intense (14%), and labor intense (6%)

Reference Santoro & Chakrabarti (2001)

As shown in Figure 4, the two outcomes are either competence building or problem solving. This can happen either in the core technology or in the non-core technology areas. The dimensions of collaboration differ with the nature of the outcomes sought by the firms. For example, knowledge transfer and research support are more likely to be associated with competence building in ancillary and core technology areas. Technology transfer and cooperative research are more likely to be associated with problem solving.

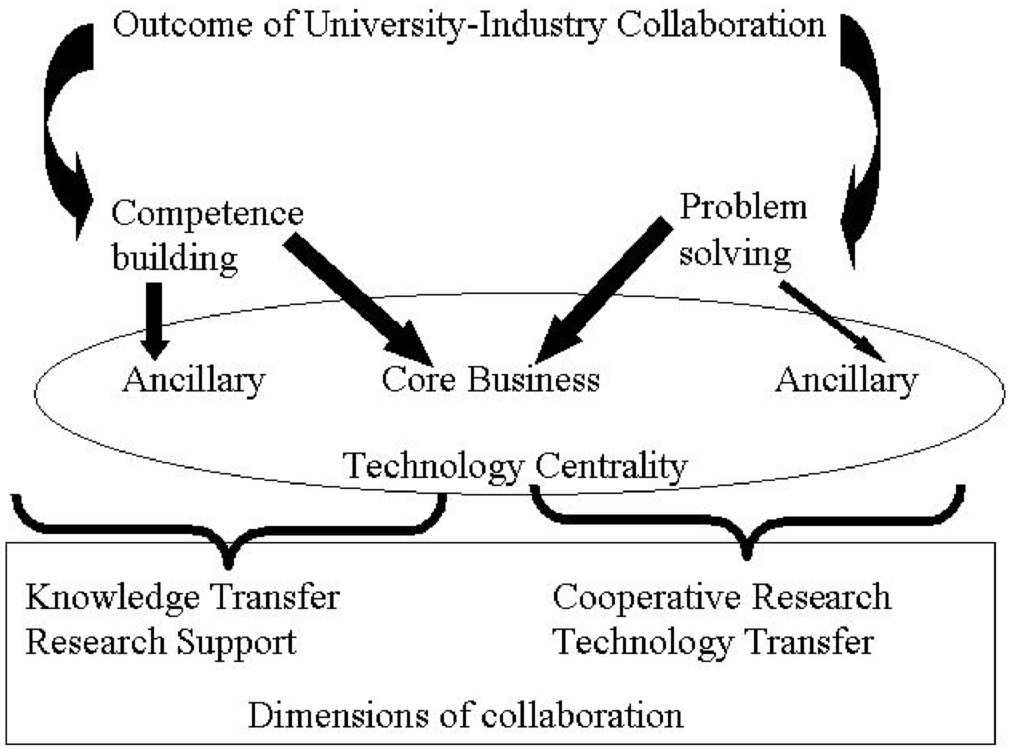


Figure 4
Outcomes from University-Industry Collaboration

Product Development in Telecommunication: Opportunities for Collaboration with Universities

The telecommunication industry is a complex industry that is subject to rapid change due to a number of factors. Technological changes in various facets of the industry introduce a high level of dynamism in this industry. With the development of technology and realization of the potential for various applications, the expectations of customers are changing continuously. This creates both opportunities for new products and services and obsolescence of existing products. This co-evolution of technology and market opportunities posits great challenge to the firms for continually innovating. The convergence of computer, communication and contents industries epitomizes the telecommunication industry. Figure 5 provides the technology value chain in this industry indicating the

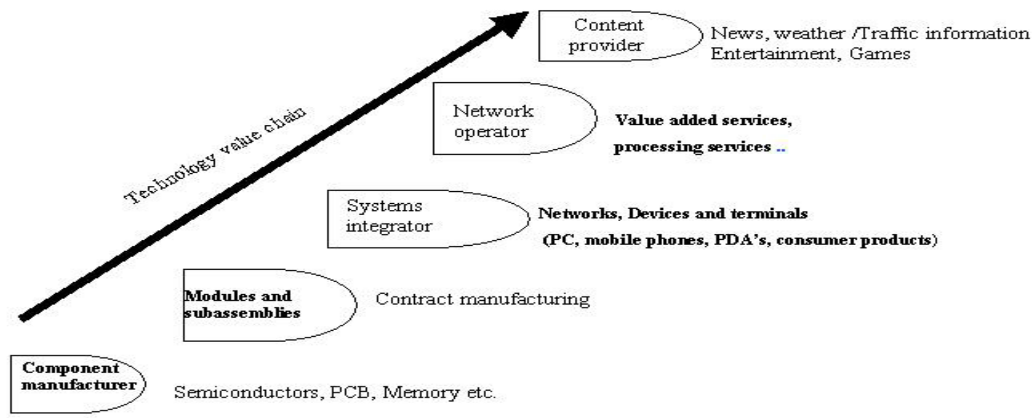


Figure 5
Technology Value Chain in Telecommunication

interaction among the various members of the value chain critically important for product development at each stage. Firms in this industry have the added challenge of working with multiple technical trajectories, as there is no "dominant" technological platform guiding this industry[7]. In such a dynamic environment it is almost impossible for any firm to be totally self-sufficient in developing a product and technology. Nokia, for example, maintains a relationship with 100 or so universities from Boston to Beijing.

[7] James Utterback provided the concept of "dominant design" in his book on product innovation. As an industry gets matured, there evolves a dominant design that wins the allegiance of the market, which is adhered to by competitors. There are many factors that help develop the dominant design. They are: collateral assets associated with the design platform, strategic maneuvering by the dominant firms, user-producer interfaces and most importantly government regulations (Utterback, 1996)

Universities help Nokia in terms of the long-term research needs. A large telecommunication operator elaborated this point by saying that the cost of duplicating the work done at universities would be prohibitive. Working with universities also provides a level of flexibility in pursuing different technological trajectories either sequentially or in parallel. Flexibility is important in a dynamic technical environment where the firm needs to explore several technologies in parallel.

Internal R&D groups often become fixated in certain technologies and thus develop what Leonard Barton (1995) termed as "core rigidity". Core rigidity develops a culture of insularity leading to the following: (a) preferred technology, i.e. how to execute a certain problem; (b) preferred cognitive approach, i.e. how to set up tasks; (c) preferred tasks, i.e. what tasks should be worked on. Past success with certain areas of technology and products is the main cause for this. Politics of power and organizational habits also contribute to develop such fixation with past practices. Consider the case of Motorola, a once formidable company in wireless and radio communication. Motorola was a leader in analog transmission of signal and has been slow to change to a digital network (Crockett, 1998). While Nokia and Ericsson were focused on new digital technology emphasizing better voice quality and greater privacy, Motorola attempted to hang on to it analog models emphasizing the size advantage. Motorola lost a substantial share of the cellular market to its European rivals (Snyder, 1998).

Why did Motorola ignore the digital technology? More importantly, how could it have avoided such a catastrophic mistake? These questions are relevant for many companies and that is why companies need to be aggressive in detecting changes in technology and use multiple sources for ideas.

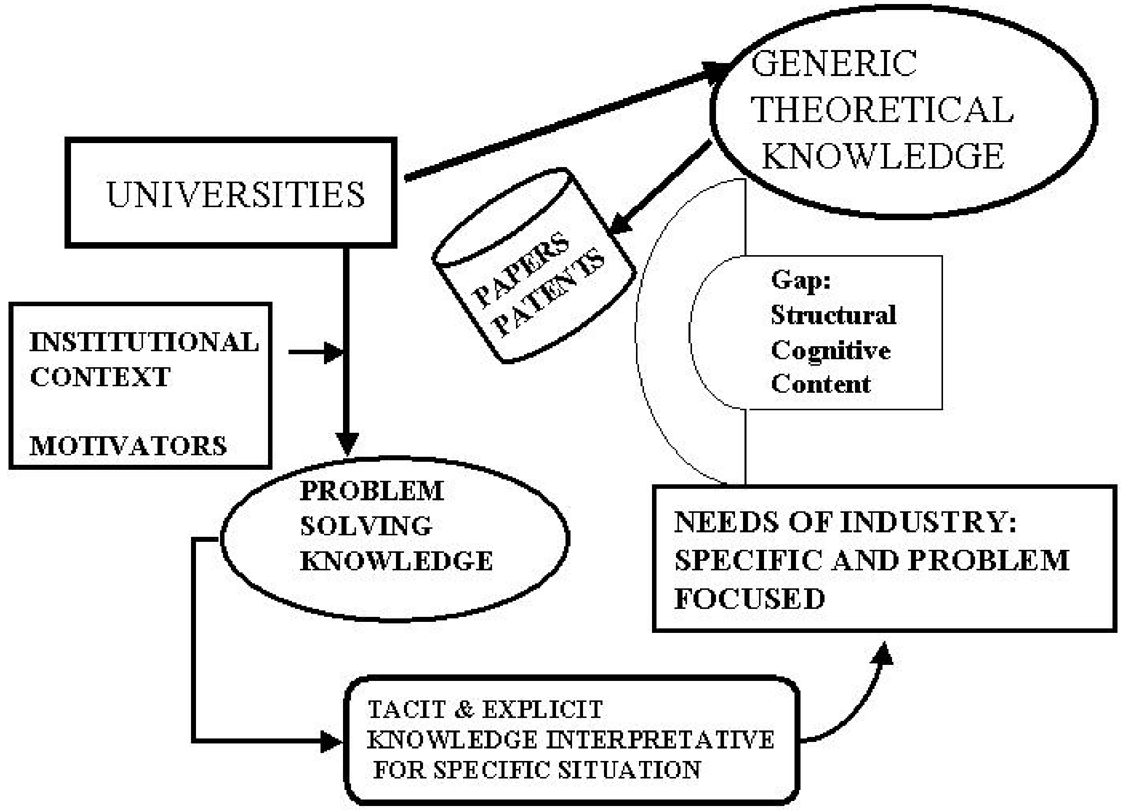
Universities often are sources of new ideas. The faculty and students are unfettered by corporate culture and tradition and therefore are able to approach the technical problems from a creative perspective. The growth of the telecommunication industry is often driven by a young generation. The success of the "iMode" service by NTT Docomo in

Japan is credited to the young people who adopted it. Students in universities are an important source not only for technical ideas but also for important market information.

Conclusions

Building effective relationships with universities for technology and product development is a complex process. Universities are involved in generating knowledge as their primary mission in addition to their teaching functions. Knowledge can be theoretical or abstract in nature and generic in terms of its applicability. In other extremes, one can develop knowledge that is situation specific and primarily problem solving in nature. Traditionally, universities are involved in generic theoretical knowledge development that is disseminated through papers, publications and sometimes patents. In recent years universities have been encouraged to develop knowledge that is problem solving in nature and applicable in specific situations. As Figure 6 shows, the industry needs

Figure 6
University-Industry Knowledge Transfer



are problem solving knowledge applicable to specific situations as dictated by either the industry or the company. The gap between the generic theoretical knowledge and the industry's needs are threefold. In many cases there is no proper communication structure for interaction between the organizations. There also appears to be gap at the cognitive level. Professors in universities and managers in firms do not share their respective concerns and points of view, leading to gaps in the contents of the communication. There has been a trend to steer universities to a more problem solving type of research and knowledge development. Institutional changes have been made in many cases to promote this. For example, the National Science Foundation in the US has developed funding programs that promote stronger collaboration between the university and the industry. Private foundations, such as Alfred P. Sloan Foundation, Ford Foundation, Pew Charitable Trusts, to name a few in the US, are significant institutions in promoting problem solving knowledge. In Finland there are several public organizations, such as TEKES and SITRA that are active in promoting university-industry interaction. Most importantly, TEKES-sponsored projects promote interpretation of the knowledge generated at universities for the firm-specific problem-solving purposes.

As we have discussed earlier, large firms behave quite differently. They have access to more resources. They seldom outsource development of technology and products that are at the core of their business and existence. However, for the development of products and technologies ancillary to the core business, large firms tend to deploy the assistance of universities. In the US, firms, tend to use the help of universities in products in the pre-competitive stage. This practice is important for protecting the intellectual assets associated with the product and technology. Large firms often use universities as a forum for exploring ideas not only with the faculty and students, but also with others in the industry. In this respect, universities help develop social capital for the industry that facilitates technology transfer and innovation[8].

Small firms, on the other hand, interact with universities for the development of technology related to their core and ancillary business areas. Small firms generally lack munificence of resources and so try to make the best utilization of any available resources.

It is also noted here that universities differ in terms of their capabilities and strategies. Large universities with a national reputation of high caliber, such as MIT, Carnegie Mellon or Stanford, can be better suited to add to the social capital of the industry. Smaller and less known universities become more suited as problem solvers.

Cultural difference between universities and firms is an important issue that must be addressed properly. Industrial projects need to be tightly controlled and monitored more closely than universities are accustomed to.

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[8] Social capital has been broadly defines “as the goodwill that is engendered by the fabric of social relations and that can be mobilized to facilitate action” (Adler & Kwon, 2002). Social capital facilitates inter-unit resource exchange and product innovation (Gabbay & Zuckerman, 1998; Hansen, 1998; Tsai & Ghoshal, 1998), the creation of intellectual capital (Hargadon & Sutton, 1997; Nahapiet & Ghoshal, 1998), and cross-functional team effectiveness (Rosenthal, 1996).

Policies related to management of intellectual property rights are areas of concern to both industry and universities. Universities thrive on the idea of publishing the research results, while firms may want to keep much of the information as a trade secret. To build an effective relationship, one needs to resolve these issues.

Universities are potentially great resources for corporations for developing new technology and products. In recent years, there have been more reasons for these two types of organizations to collaborate for mutual benefit. In a dynamic global economy, this has become critically important as evidenced by the experience in Finland.

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Massachusetts Institute of Technology ◆ University of Tampere ◆ Helsinki University of Technology ◆ University of Cambridge ◆ University of Tokyo

The Local Innovation Systems Project

The Local Innovation Systems Project, an international research partnership based at the Industrial Performance Center (IPC) at MIT, is addressing a central issue now confronting industrial practitioners and economic policymakers throughout the world: How can local economic communities survive and prosper in the rapidly changing global economy?

Our particular focus is on the role of innovation – in products, services, and processes – in promoting productivity growth and competitive advantage at the local and regional levels. National and local governments around the world, as well as other institutions with an interest in economic development, are greatly interested in creating and sustaining local environments that are attractive for innovation. Firms, too, recognize that their innovation performance is affected by their location.

The policy debate has been dominated by a few outstandingly successful centers of technological entrepreneurship, notably including Silicon Valley and the Boston area in the United States, and the Cambridge region in the U.K. But most locales do not have clusters of high-technology ventures of such scale, nor are they home to research and educational institutions with world-class strengths across a broad range of disciplines. Many, on the other hand, do have distinctive industrial capabilities and vibrant higher educational institutions, and some of these locales have been quite successful in harnessing new technology to revitalize their economies or even to reinvent themselves as centers of innovation and competitive advantage.

The Local Innovation Systems Project is investigating cases of actual and attempted industrial transformation in more than 20 locales in the United States, Europe, and Asia. Our research is aimed at developing new insights into how regional capabilities can spur innovation and economic growth. We seek ultimately to develop new models of innovation-led industrial development.

We are currently completing the initial year of a projected multi-year study. In the first phase of research, we are investigating the roles of universities and other public research institutions as creators, receptors, and interpreters of innovation and ideas; as sources of human capital; and as key components of social infrastructure and social capital. Later phases of our research will explore the process of enterprise growth and the ability of different locations to attract and retain innovating firms. We are also investigating different approaches to individual and institutional leadership in locally-based systems of innovation.

The founding research partners of the Local Innovation Systems Project consist of an interdisciplinary team of faculty, graduate students and research staff at the MIT Industrial Performance Center, together with their counterparts at the University of Tampere and the Helsinki University of Technology in Finland, the University of Cambridge in England, and the University of Tokyo, Japan.

Current research sites include several locations in the United States (Boston, MA; Rochester, NY; Akron, OH; Allentown, PA; Youngstown, OH; Newhaven, CT; Charlotte, NC; and the Greenville-Spartanburg area of SC), Finland (Helsinki, Turku, Oulu, Tampere, Seinajöki, Pori), Japan (Hamamatsu, Kyoto), and the United Kingdom. Additional research is being carried out in Ireland, India, Taiwan and Israel.

At each location, teams of researchers from the partner institutions are studying innovation trajectories and developing comparative case studies of growth and transformation in several industries, mature as well as new, including polymers, ceramics, optoelectronics, industrial machinery and automation, auto/motorsports, medical equipment, biotechnology, and wireless communications.

The outreach activities of the Local Innovation Systems Project will include the preparation of discussion papers and books, executive briefings and informal workshops, international conferences, and executive education and training programs for policymakers, research managers, and industry executives.

Current sponsors of the Local Innovation Systems Project include, in the United States, the Alfred P. Sloan Foundation and the National Science Foundation, Tekes (the National Technology Agency of Finland), the Cambridge-MIT Institute, and the University of Tokyo.

For further information, please contact the Project Director, Professor Richard Lester (617-253-7522, rklester@mit.edu).

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