CHAPTER 12

Globalization of Research and Development in a Federated World

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INTRODUCTION

During the decade of the 1990s, the interaction between the typical research university and industry underwent a profound and accelerating change. As the economy strengthened it was industry that drove much of the interface with its increasing need for people and ideas. By the end of the decade the need for people in all technical disciplines had become insatiable, whereas the perception of technology as the road to immediate riches had become de rigueur. Both these situations were unsustainable, but they managed to reinforce each other in a very unhealthy way. Certainly, some of the emerging trends which occurred over this period – including the increasingly rapid transfer of new ideas from universities to the marketplace – should be considered to be favourable. While this probably reached a crescendo in the dot-com venture capital bubble which is unlikely to be repeated, time horizons have certainly shortened, awareness of the value of intellectual property has increased, and the need to engage sooner and more collaboratively with corporations has intensified.

Another emerging trend in this space is the increasingly global dimension of activity. From the viewpoint of the true multinational corporation, both the necessity and the desirability of engaging with research universities

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became a business imperative. This trend is often confused and lumped under the concept of cost reduction outsourcing. In fact the situation is more complex for the large multinational, and involves decisions around the need to invest globally for a variety of reasons. Some of these include the availability of skilled talent, regulatory requirements, closeness to market, offset requirements for R & D investments in exchange for market access, proximity to exceptional academic expertise, tax incentives and many others.

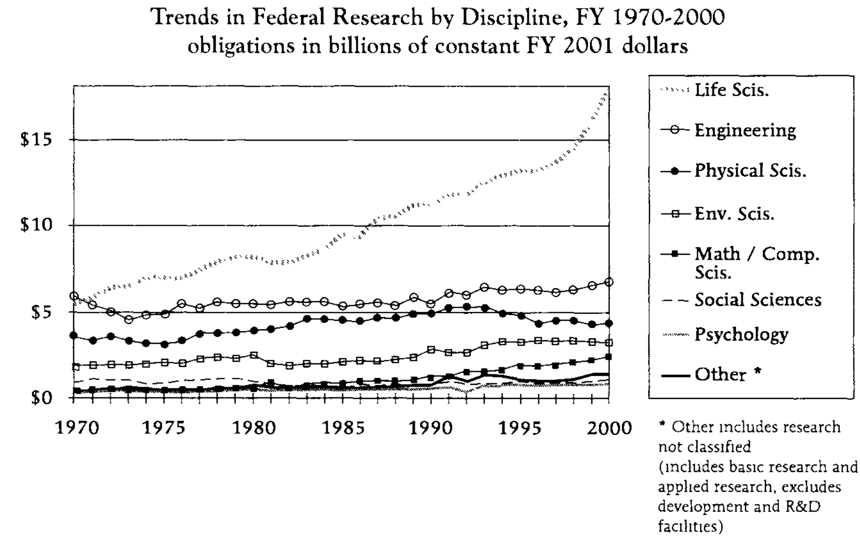
The trend towards business federation also became more pronounced during this period. Again, resources were strained to the breaking point, while at the same time information technology provided new tools for collaboration. This trend included increasing partnership outsourcing between industry and academia. In the research arena this culminated in several high profile industry investments from leading U. S. companies such as Microsoft, HP and IBM in key universities.

The events of the bubble-bursting 1990s with their presumption of wealth creation, and the implicit need for new ideas accompanied by potentially disruptive technology, as well as the opportunities represented in the global marketplace, have resulted in a fundamental change in the relationship between industry and academia. Further, a need exists for substantial reform of the entire U.S. and European ecosystem if long-term damage to the system is to be avoided. Both sides are missing a profound opportunity for strategic partnership resulting from inaccurate perceptions and the lack of a unifying strategic framework coupled with insufficient public policy investment.

EVOLVING U.S. AND GLOBAL R & D ECOSYSTEMS

U.S. investment in the R & D ecosystem after the Second World War, based on the recommendations from Vannevar Bush and the attendant leadership position enjoyed by the U.S. in innovation and the competitive advance in technology, have been well documented. These investments have led to the emergence of a strong U.S. research university ecosystem that has complemented the industry research labs, effectively creating a virtuous cycle of new technology and ideas. At a time when there were few competitors due to the impact from World War II, the National Science Foundation, NASA, DARPA (The Defense Advanced Research Projects Agency) and other government agencies provided the seed funding for R & D expansion and innovation. In the last ten years, these research and development investments have decreased from both the government sector and from within industry. As R. Stanley Williams, a renowned scientist and Hewlett-Packard Fellow engaged in cutting-edge research in nanotechnology, has pointed out in testimony to Congress (2002a): "In the physical sciences and engineering, the support from the U.S. government for academic research has been decreasing in real terms for over a decade."

Figure 1. Trends in Federal Research by Discipline



Source: National Science Foundation, *Federal Funds for Research and Development FY 1999, 2000, and 2001*. 2001. FY 2000 data are preliminary. Constant-dollar-conversions based on OMB's GDP deflators. APRIL '01 © 2001 AAAS

Clearly, corporate research operations steadily declined over the 1990s. This has caused much hand-wringing over the future of corporate research. Famous science and engineering bastions such as Xerox PARC and the old AT&T Bell Labs have gone through painful downsizing. Corporate research and development funding is estimated to be $194 billion in 2003, a modest 0.13 % increase over 2002, and a significant reduction in corporate R&D funding from the 7-8 % above inflation of recent years (Wolff, 2003, p. 8). The old system has been replaced by a new federated model involving collaborative work at various corporate, government and academic labs. As noted previously, the time between new inventions and product roll-outs is collapsing. "Fundamental science breakthroughs now have fairly rapid commercial applications," says Walter W. Powell, a guru in organizational behaviour at Stanford University. (Greene, 2003, p. 74). The impact of globalization has also caused many corporations to conduct research off-shore. The long-term concern, according to Merrilea J. Mayo, director of the Government-University-Industry-Research Roundtable at the National Academy of Science could be the eventual loss of American competitiveness and the permanent loss of higher-skill jobs. "That 'giant sucking sound' that Ross Perot heard [as the result of NAFTA (North American Free Trade Agreement)] is now happening in R & D," according to Mayo. (Greene, 2003, p. 76)

The more substantive issue may be the considerable investments now being made on a worldwide basis that mimic the success of the research investments made by the U.S. government after the Second World War. One example stands out: the enormous investment under way in China in science and technology. Chinese universities granted 465,000 science and engineering degrees in 2001, approaching the total for the U.S. (Einhorn, 2002, p. 80). The bottom line is that the virtuous cycle in the U.S. is being starved, while the rest of the world continues to invest.

CHANGING INTERFACES BETWEEN THE RESEARCH UNIVERSITY AND INDUSTRY

"In the past, internal R & D was a valuable strategic asset, even a formidable barrier to entry by competitors in many markets. Only large corporations like DuPont, IBM and AT&T could compete by doing the most R & D in their respective industries" (Chesbrough, 2003, p. 35). This was the age of "closed innovation", exemplified by corporate research centres like Bell Laboratories and Xerox's Palo Alto Research Centre (PARC). Today, there has been a fundamental shift in how companies generate new ideas and bring them to market. In the new model of "open innovation", a company commercializes both its own ideas as well as innovations from other entities, such as universities. (Chesbrough, 2003, p. 36).

Companies run across the spectrum from closed innovation to open innovation. Even within a large high-tech company like HP, various segments may be closed or fully integrated innovators, while other segments may be open innovators, eagerly embracing collaborations with universities. Also, in the large high-tech companies and IT industry, there may be dozens of patents representing incremental advances associated with a given product, while in other industries, such as pharmaceuticals, there may be a single enabling patent for a given product.

As industry has embraced open innovation, it has come to view the research university both as a source of graduates and applied research. Applied research conducted in universities has replaced a significant portion of the research that had been done in corporate labs such as Bell Labs and IBM research. Researchers in companies have shifted to advanced technology/advanced product development. To take advantage of open innovation, industry and universities need to identify the boundaries and establish effective processes to connect across them.

One of the key boundaries is the cultural differences between industry and universities. "Some boundaries can be addressed through routine, accepted business practices. For example, most sourcing processes use some kind of contractual negotiation to deal with organizations' differing goals, agendas and financial interests. Other boundaries, such as those involving culture and work pace, require more high-touch interventions" (Linder, 2003, p. 48). "Successful innovation partnerships bridge 'like to like' processes: Researchers in one organization work with researchers in another" (Linder, 2003, p. 48). For example, HP often manages research projects with universities through its own closest equivalent, its corporate research laboratory. HP also occasionally improves information flow in strategic partnerships with universities by placing researchers at the partner university. "A company's sourcing approach must ensure enough information flow (another boundary) to keep innovative activities on track" (Linder, 2003, p. 48).

Significant work and personal commitment are necessary on both sides of the boundary to prepare open communication channels and strong working relationships which can result in an effective technology transfer conduit. "Creating a culture in which external contributions are accepted, let alone welcomed, continues to be problematic in many companies that use an ad hoc approach. Overcoming this problem requires a significant investment of management time and effort. For example, a leading high-tech firm recognizes universities as sources of cutting-edge intelligence and research. But to nurture these strategic relationships and take advantage of their benefits, managers have to spend time with the professors while developing internal relationships to ready their own organization to make use of the ideas" (Linder, 2003, p. 44). Another change to the interface between universities and industry is the emergence of functional organizations within companies whose specific responsibility is to manage the external technology and research function. This has been driven by the need to understand the university culture and to have an effective point of contact to ensure that these relationships provide value. HP's University Relations organization is provided strong support from the highest levels of company management, due to a keen awareness that external research relationships are key strategic leverage points for the overall business goals and objectives of the corporation.

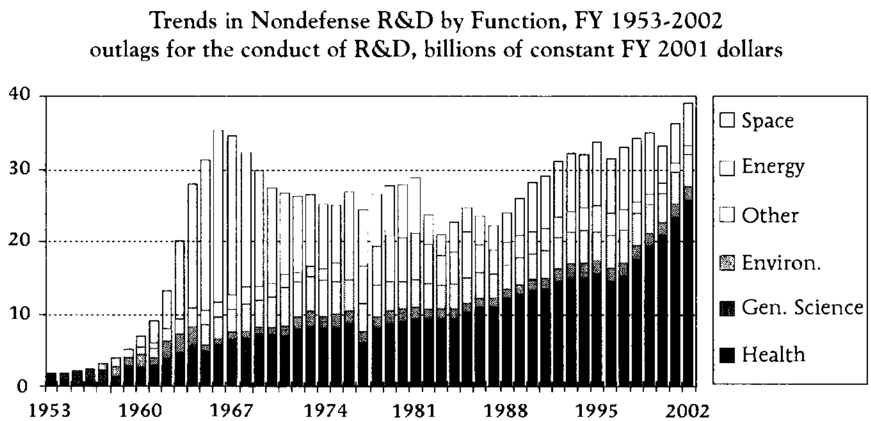
Another boundary is work pace and the high expectations corporations hold for their university partners. The corporation is usually very demanding in terms of accountability for dollars spent. The university must provide regular evidence of accomplishments and communication of planned milestones, as well as continuous delivery of research reports and prototype demonstrations which represent the concrete value of the work performed over a specifically identified period of time. In order for universities to speak the same language to their corporate partners, special organizational accommodations on the side of the university have increasingly been implemented. "... private labs usually work more quickly than those at universities. One large organization has specifically established a small-firm channel to take advantage of the speed differential. Some universities are countering by establishing organizations that sit on the boundary between academia and private industry – for example, MIT's Industrial Liaison Program – to manage university research with a mentality in which meeting deadlines, making progress reports and achieving commercially valuable outputs are part of the effort" (Linder, 2003, p. 48).

CHANGES IN INTELLECTUAL PROPERTY POLICIES

The partnership between industry and universities has been weakened over difficulties associated with the negotiation of intellectual property (IP) rights in research contracts in recent times. The issue is driven by the most part from sheer budgetary issues facing research universities. Economic pressures have affected endowments of even the largest and strongest universities. With the decline in the financial markets and the dependence of universities on financial investments to offset rising operations costs, universities have undertaken an aggressive posture with corporations regarding control of IP as a funding mechanism for retaining research superiority, and, in the process, have alienated and frustrated U.S. companies which are increasingly unwilling to be held captive. Attorneys are heavily involved in these negotiations and the lengthy amount of time to set up research agreements has become unwieldy. On the other hand, foreign universities are highly interested in negotiating quickly and effectively with U.S. corporations to set up research agreements. They do not get sidetracked on IP rights, and are taking advantage of the chasm which has opened between U.S. universities and corporations around the IP disagreements.

R. Stanley Williams, HP Fellow, Hewlett-Packard Laboratories, testified on these troubling issues before the Senate Subcommittee on Science, Technology and Space on September 17, 2002. Williams stated that "large U.S. based corporations have become so disheartened and disgusted with the situation [i.e., negotiating intellectual property rights with U.S. universities] they are now working with foreign universities, especially the elite institutions in France, Russia and China, which are more than willing to offer extremely favourable intellectual property terms." (Williams, 2002a, p. 5). What happened that brought the relationship between U.S. companies and U.S. universities to this point? Stan Williams effectively describes the trend: "Largely as a result of the lack of federal funding for research, American Universities have become extremely aggressive in their attempts to raise funding from large corporations. Severe disagreements have arisen because of conflicting interpretations of the Bayh-Dole Act." (Williams, 2002a, p. 5). The great irony surrounding Bayh-Dole was that it was implemented to encourage the commercialization of government-funded academic research. Over time the exact opposite has happened. In his response to questions by Senator Wyden, Williams amplified: "In my opinion, the root of the problem is in the desperate financial situation of most American universities. In the physical sciences and engineering, the support from the U.S. government for academic research has been decreasing in real terms for over a decade." (Williams, 2002b, p. 1). Williams' assertion is supported by the financial data: "From all sources, support for academic R & D grew 77 % (in constant dollars) during the 1980s, but only 49 % in the 1990s. Federal support grew 55 % in the 1980s, 47 % in the 1990s. Even the biomedical area, which captured at least half of all increases (from all sources) in the two decades, grew less rapidly in the 1990s (68 %) than in the 1980s (89 %)" (Schmitt, 2003, p. 25). (see Figure 2 below)

Figure 2 Trends in Nondefense R&D by Function



Source AAAS, based on OMB Historical Tables in *Budget of the United States Government FY 2003* Constant dollar conversions based on GDP deflators. FY 2002 is the President's request. *Note:* Some Energy programs shifted to General Science beginning in FY 1998. APRIL '01 © 2001 AAAS

"The prosperity of the 1990s was prepared by the R & D investments of the 1960s, when the U.S. federal government was investing 2 % of GNP on R & D. That R & D investment has paid off many folds over the decades, but because we became wealthy, we forgot that we needed to keep investing to stay wealthy." (Williams, 2002a, p. 6). Williams describes the consequences of this reduction: "This has forced the universities to try to raise funds from other sources. Since a few universities have made a large amount of money from a piece of valuable intellectual property, this has encouraged nearly all universities to attempt to duplicate this success." (Williams, 2002b, p. 1).

In response to questions from the Senate Subcommittee, Williams indicated: "Typically at present, negotiating a contract to perform collaborative research with an American university takes one to two years of exchanging emails by attorneys, punctuated by long telephone conference calls involving the scientists who wish to work together. All too often, the company spends more on attorneys' fees than the value of the contract being negotiated. This situation has driven many large companies away from working with American universities altogether, and they are looking for alternate research partners." (Williams, 2002b, p. 1).

Anecdotal evidence appears to indicate that many large companies such as Motorola, IBM, and Intel have encountered similar problems. Because of the law of unintended consequences, the increasingly aggressive, complex and confusing way that universities are approaching technology transfer is souring the relationship between industry and universities in countries like the U.S. and forcing many companies to look overseas for both research and people. Attractive IP arrangements, faster time-to-market, and lower overhead costs have been factors that have enticed these companies to explore relationships with leading universities in India, China and Europe.

"On the other hand, many high-quality foreign universities are very eager to work with American companies, and by keeping attorneys out of the discussion completely they have streamlined processes to allow a successful negotiation to take place in literally a few minutes over the telephone. It is possible to specify what one wants to a professor at a university in China or Russia and then issue a purchase order to obtain a particular deliverable. The deliverable is received and verified to be satisfactory before the American company pays for it, and in this case the American company owns all rights to the deliverable and the process by which it was created. Often, such transactions can be completed in a few months, a fraction of the time required to just negotiate a contract with an American university, which will insist on owning all rights to whatever is produced. Thus, just as American companies were long ago forced to deal with high-quality and lowpriced foreign competition, American universities will either have to modify their behaviour or lose their industrial customers" (Williams, 2002b, p. 1).

Frank Pita, Semiconductor Research Consortium, cites the example of Taiwan. A company can have a \$50,000 research contract in Taiwan, with 15-18 students covered under the agreement (at \$200/month/graduate student). The government of Taiwan subsidizes the students' tuition, room and board, so the research contract is primarily providing stipends for the students. Also, indirect cost rates are typically lower outside the U.S., typically 20 % vs. 50 % in the U.S. Further, the Taiwanese government provides incentives for students in key industries – students who go to work in the semiconductor industry are exempted from military service. Experts like Stan Williams and Frank Pita indicate that there is a time-to-market advantage in working with a foreign university. Industry is able to negotiate a contract quicker, often with no changes in the proposed agreement.

GLOBALIZATION OF R & D

Globalization is becoming a fact of life in much of the world. Companies look for the most cost-effective means to operate their business, thereby maximizing shareholder gains and ensuring available resources for expansion and future growth. "Economic evolution is inevitable. Companies will always pursue the lowest-cost structure, which means less skilled work will move out of the U.S. to emerging economies. And that's a good thing, because living standards around the world will rise. Workers in developing nations will get new and higher-paying jobs, and consumers in the U.S. will be able to buy products that are cheaper than if they were made at home. The shift first occurred in textiles and other manufacturing jobs, followed by low-end services such as telemarketing and data entry. Now, it's moving up the labour food chain, leaving white-collar workers increasingly nervous" (Madigan & Mandel, 2003). India and China are premier examples of countries which have seized this opportunity in order to bring a better standard of living to their citizenry.

An important example of this trend is India's software industry, which continues to grow. Although software jobs are well-paying – in some cases salary and bonus exceed $100,000 – code writing is not perceived as glamorous work by American-born tech workers (Ginsberg, 1997).

According to Patrick Scaglia, Vice President and Director, Internet and Computing Platform Research Center at HP Laboratories, there are additional reasons which make global R & D federation so pervasive at this moment. "One is the very nature of software R & D at an industrial scale. Developing Software includes a creative step (understanding requirements, generating ideas and prototypes, defining architectures) and a production step (coding then testing, bug fixing, verifying and shipping). Software products have very long life cycles (software never dies) so this cycle is repeated typically on a yearly or twice a year basis as 'incremental releases'of the same product, with enhancements and bug fixes shipped with that new release. Although both the creative and production steps are generally considered 'R & D', they profoundly differ in style and substance over the life cycle of a software product. It is generally accepted that at least 70 % of R & D resources are spent on the 'bug fixing/testing/ship' part of the process, 30 % or less on the truly creative portion that require the highest skill level. Over the last 15 years, companies have found that there is a high cost in maintaining and enhancing the software products (the 70 % portion) and have attempted to distribute the process towards lower skilled lower cost locations. The pervasive use of computer networks and the internet enabled it on a large scale. It is now possible to have software R&D done anywhere in the world, while maintaining tight connection among distributed teams. During that same period of time, many countries/governments invested heavily in building up a highly educated workforce with advanced degrees in computer science and related technology fields and continue to do so. As a result the pool of talent in many regions of the world is now highly skilled and competitive and can tackle the most advanced part of software technology."

India's software revenue for the year ending March 2002 was $12.3 billion, and exports rose to $9.6 billion in 2002. More than 60 % of India's software exports are to North America (Rai, 2002a). The rapid evolution of a population of quality software engineers in nations such as India and China could well lead to the outsourcing of advanced engineering and scientific work to low-cost but high-quality overseas suppliers at the expense of domestic high-tech jobs in the U.S. and Europe.

In its globalization efforts, HP has created an R & D programme to deal with the emerging markets in India and other countries. Through HP's e-inclusion programme, HP is working to provide people in some of the world's poorest communities access to greater social and economic opportunities by closing the gap between technology-empowered and technology-excluded communities. HP is partnering with private and public entities to provide technology tools and services, and to create locally sustainable solutions. For example, HP Labs in India is conducting R & D to create a scalable, self-sustaining IT solution in Kuppam, India.

Globalization has become a fact of life for other industries. Frank Pita of the Semiconductor Research Corporation indicates that the SRC has been a global consortium since early 2000. Prior to that time, SRC collaborated with 45-50 universities, all in the U.S. Currently, the SRC works with more than 85 universities with at least 15-20 outside the U.S., in countries like Russia and Taiwan. HP also encourages collaborations with and among universities worldwide. An example of this is the Gelato Federation, founded in 2002 by HP and eight international research institutions. This open-source community initiative is dedicated to developing public software solutions to address real-world problems in academic, government, and industrial research worldwide. There are now more than 20 research universities and national labs worldwide that are members of the Gelato Federation (including Groupe ESIEE in France, National Center for Supercomputing Applications (NCSA) in the U.S., University of Waterloo in Canada, the Bioinformatics Institute in Singapore, University of Illinois in the U.S., University of

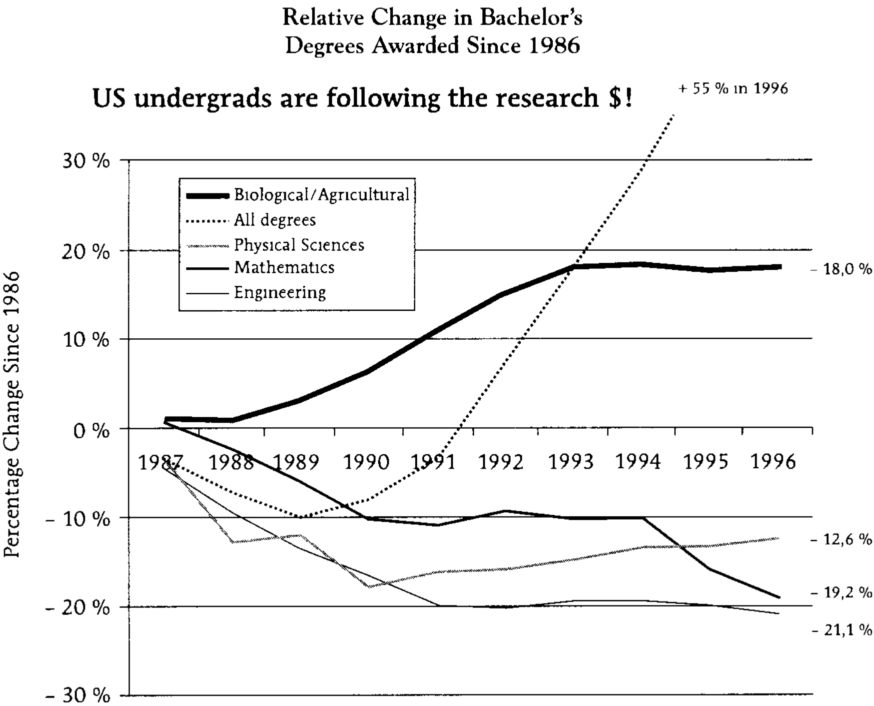
New South Wales in Australia, Tsinghua University in China, National Center for Atmospheric Research (NCAR) in the U.S., CERN in Switzerland, Pittsburgh Supercomputing Center in the U.S., National Institute for Research in Computer Science and Control (INRIA) in France, Pacific Northwest National Lab in the U.S., Ohio Supercomputer Center in the U.S., University of Karlsruhe in Germany, Russian Academy of Sciences in Russia, San Diego Supercomputer Center in the U.S., KTH (Royal Institute of Technology) in Sweden, Pontifical Catholic University of Rio Grande do Sul in Brazil, University of Puerto Rico at Mayaguez, Puerto Rico, Fudan University in China, Zhejiang University in China, and the Georgia Institute of Technology in the U.S.).

Significant attention is needed to address the issue of whether human capital will be built within the U.S. or outside the U.S. "More attention should be paid to educating the U.S. workforce. America is on the cutting edge of the information and technology economy. But others are catching up. India and China award more natural science and engineering degrees than we do" (Madigan, 2003). Stan Williams has observed that U.S. industries based on physical science and engineering face acute shortages of R & D personnel and new ideas to make significant advances in key fields such as nanotechnology. Research conducted at foreign universities provides a source of highly talented graduates. Currently "hirability" is a barrier for this human capital – immigration issues, significant relocation costs, the desire of students to stay in their home country. It is unsettling to realize that in the future, these people may be competitors armed with the knowledge gained in working with U.S. companies.

If we look at the intellectual property problems with U.S. universities, it appears that U.S. universities have inadvertently "shot themselves in the foot" because their research funding may be reduced, with increased corporate flow to foreign universities. "While many of us on the university side of the equation would disagree on why things seemed to have soured in many of our relationships with industry, most of us would agree that something's not right. And while we encourage greater collaboration between industry and our colleagues in foreign universities around the world, it is definitely not a good thing if industry's motivation for developing collaborations with foreign universities is based on the belief that American companies can't work with American universities" (Killoren, 2003, p. 1).

The disturbing convergence of IP struggles that are pushing U.S. corporations to look abroad for university research partners, coupled with the trend towards off-shore contracts with emerging economies, may cause long-term undermining of the U.S. economy and seriously threaten the continued superiority of U.S. research universities. "During the 1980s, the university was posed as an under-utilized weapon in the battle for industrial competi-

Figure 3 Relative Change in Bachelor's Degrees Awarded Since 1986



Source: National Science Foundation *Science and Engineering Indicators 2000*.

tiveness and regional economic growth. Academics and university officials are becoming increasingly concerned that greater involvement in university research is causing a shift from fundamental science to more applied work. Industry, meanwhile, is growing upset over universities' increasingly aggressive attempts to profit from industry-funded research, through intellectual property rights. In addition, state and local governments are becoming disillusioned that universities are not sparking the kind of regional growth seen in the classic success stories of Stanford University and Silicon Valley..." (Florida, 1999).

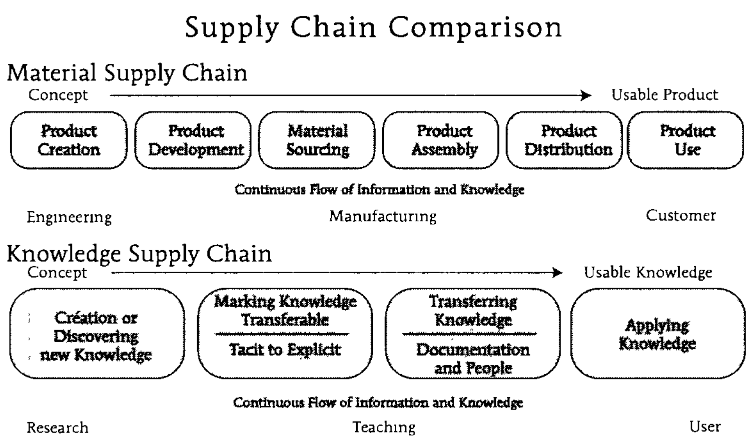
Would companies never have explored building partnerships with foreign universities if they had not encountered the fierce resistance around IP issues? Of course they would have, but it would have taken significantly more time, given the preferences of working with a university partner in the same country, based on time and distance. Unfortunately, universities allowed U.S. industry to experience the benefits of working with foreign universities, and it will take a significant effort to rebalance the equation to place U.S. universities back on a comparable basis.

CHANGING THE ECOSYSTEM: OPPORTUNITY FOR STRATEGIC PARTNERSHIP

U.S. universities and U.S. corporations stand at the edge of opportunity today, with the possibility of renewed partnership and the strategic advantages that can be realized. "Universities are far more important as the nation's primary source of knowledge creation and talent. Smart people are the most critical resource to any economy, and especially to the rapidly growing knowledge-based economy on which the U.S. future rests." (Florida, 1999).

The overriding strategic imperative is the recognition of the importance of the Knowledge Supply Chain (Hanson, 1997). Similar in concept to the material supply chain, the most important aspect of this concept is the need for both parties to view the system in the context of a seamless, end-to-end process of knowledge creation and transfer.

Figure 4. Supply Chain Comparison (Hanson, 1997, p. 159)

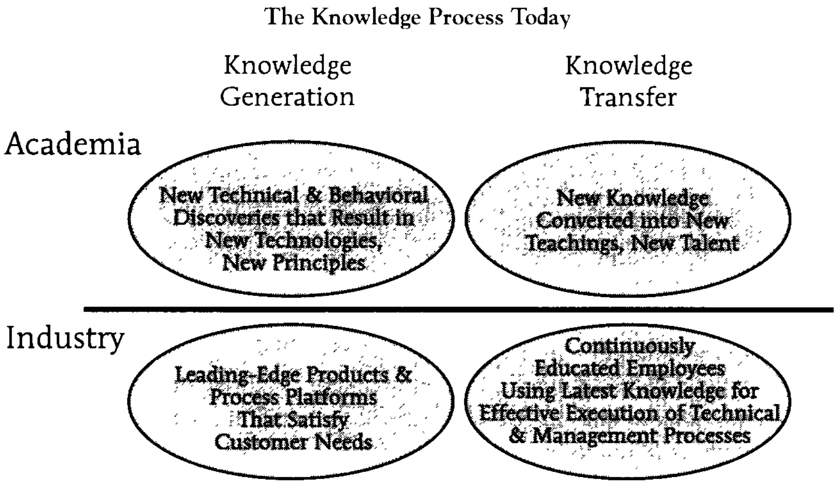


Source: Knowledge Supply Chains: A Next-Generation Manufacturing Project.

The Knowledge Process Today

The knowledge process today is stratified between academia and industry. Both institutions generate knowledge and transfer knowledge, but in most cases there are major barriers between the two cultures that impact the ability of both segments to create new knowledge to satisfy society and to improve competence and the ability to learn.

Figure 5 The Knowledge Process Today (Hanson, 1997, p. 161)



Source: Knowledge Supply Chains: A Next-Generation Manufacturing Project

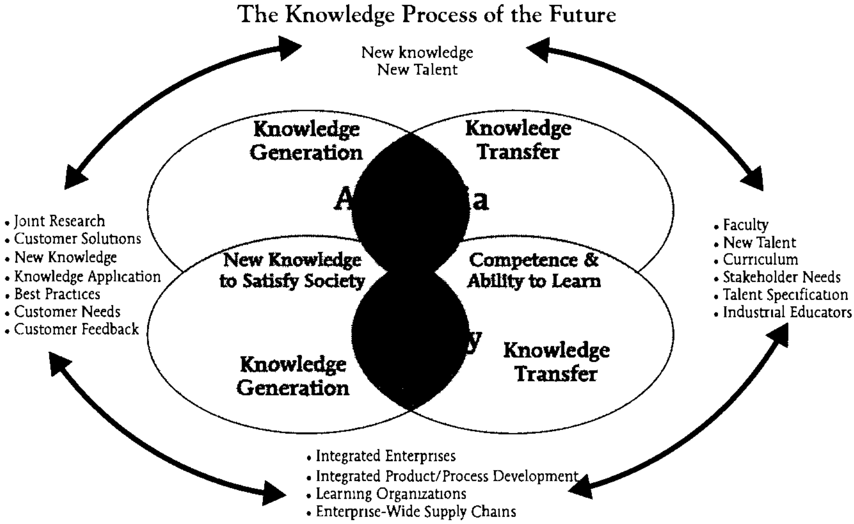
What are the solutions? They include (1) building long-term relationships, moving from sponsorship to real partnership, (2) making a commitment to "live" in each other's environments and (3) learning to trust and capitalize on partnerships to leverage scarce resources.

In order to implement these solutions, partners in the Knowledge Supply Chain must understand how they fit into the larger, integrated knowledge process. They must eliminate ignorance and distrust to capitalize on the different strengths and capabilities of each partner. They must recognize that the ultimate goal is to satisfy the end customer, and the goal can only be achieved when each partner is also satisfied, i.e., that each partner has the responsibility to help others succeed. Lastly, they must be an integral part of the continuous, free flow of information and knowledge, to eliminate time and knowledge gaps that isolate them from users and suppliers.

The Knowledge Process of the Future

What are the potential outcomes? For industry they include a more effective and efficient access to knowledge and reduced technology-development-and-deployment cycles. They also include the potential for improved return-on-investment on corporate expenditures for training and research, to create a better balance between job security and corporate flexibility. For universities, the outcome is increased funds and capacity for continuing and pursuing relevant research, insuring the long-term health of the academic enterprise, and establishing more appropriate and efficient markets for graduates.

Figure 6. The Knowledge Process of the Future (Hanson, 1997, p. 162)



Source: Knowledge Supply Chains: A Next-Generation Manufacturing Project

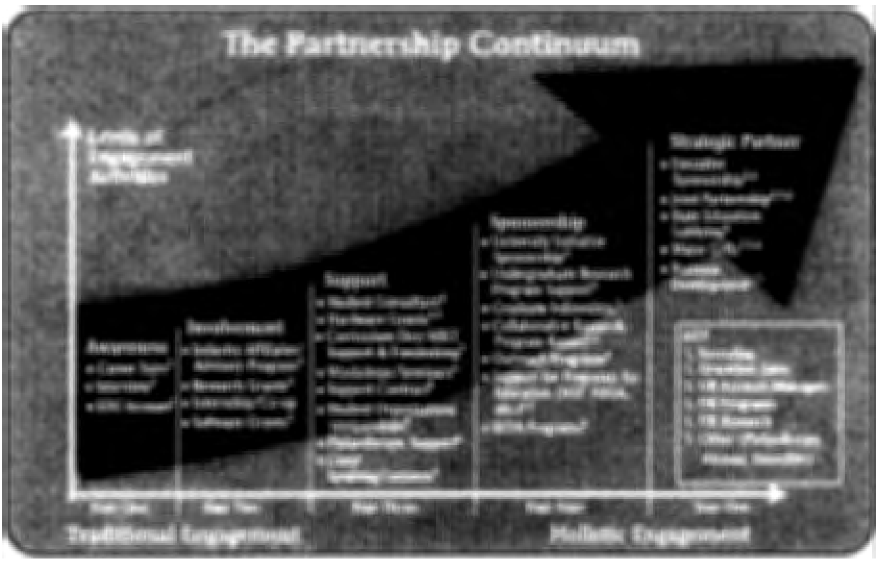
Partnership Framework

From the university perspective, industry is viewed as the partner who is often missing when hiring needs dry up and who produces technology of increasing complexity with little pay-off to increased teaching efficiency and learning. Understanding the lessons of supply chain management as they apply to the management of university relationships, it can be seen that the development of a strategic partnership proceeds along a continuum.

The other important understanding is that this continuum has many of the same characteristics as Maslow's Need Hierarchy. You must satisfy the early steps in interacting with an institution (i.e., safety and security) before you move toward strategic partnership (i.e., self-actualization).

Accordingly, it is possible to map a series of representative activities of engagement with a university, from the more traditional industrial investments (recruiting, sales, job fairs) to those that may be described as strategic (business development, joint partnership). Moves up the continuum require greater group and leadership involvement. Activities can take place out of order within the first three levels of Awareness, Involvement and Support, but the fourth and fifth levels of activity – Sponsorship and Strategic Partner – will not be successful unless the first three engagement levels are secured. The most important ingredient for success in this paradigm is trust.

Figure 7. The Partnership Continuum



Source: Wayne C. Johonson, Worldwide Director HP, University Relations

Based upon experience in working with universities, this process typically takes up to five years to reach the level of Strategic Partner. Most corporations typically operate at levels 1 and 2 in what can be described as a conditioned-response mode of interaction. These interactions tend to be self-serving for the corporation and, although they satisfy some of the requirements for a successful partnership, the university community will not fully engage.

The execution of an effective university-industry strategy requires engagement across a wide-range of university units and departments, with simultaneous coordination of all the corporate stakeholders. The process must be viewed as holistic for long-term success.

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