Working paper 2002·11

The Triple Helix of University - Industry - Government
Implications for Policy and Evaluation

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ISSN 1650-3821

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The Triple Helix of University-Industry-Government Relations

Implications for Policy and Evaluation

The US has the strongest industrial policy in the world, bar none. The US is acting from the bottom up, sideways, criss-cross as well as top down, although in an indirect and hidden manner. Europe has a long way to go to catch up with the US because it has only emphasized certain limited areas of intervention, primarily from the top down. Nevertheless, other forms of intervention such as bi-lateral initiatives are beginning to appear, especially in cross-border regions such as Öresund (Copenhagen/southern Sweden). University-industry relations are gaining strength in regions, such as Sienna, where government industry relations previously predominated.

In Europe, the US, Latin America and Asia, issues of knowledge and technology transfer have moved to the forefront of attention in economic, social and industrial policy. As the sources of future development increasingly derive from innovation, attention must be paid to non-traditional sources that have the potential to become the basis for construction of new business and social models as well as the renovation of old ones.

The National Systems of Innovation (NSI) approach is especially well suited to analysis of bounded phenomena, within nations or individual firms. Although other sources are taken into account, incremental innovation is viewed as primarily occurring within the firm, through various forms of learning (Lundvall, 1988). A different model of the sources of innovation is required to account for discontinuous as opposed to incremental innovation.

Innovation is increasingly likely to come from outside of the individual firm or even from another institutional sphere such as the university where the focus of attention is on original path breaking developments, whether in science or technology. It was not an accident that US universities were favored over government and industrial laboratories as the site for path-breaking military R&D during the Second World War. Moreover, it can be expected that discontinuous innovations, which originate in a company, are more likely to be utilized in a different environment where the blinders of current taken for granted practices or commitment to existing technologies and products are less likely to have effect.

As innovation moves outside of a single organization, lateral relationships across boundaries, rather than hierarchical bureaucratic structures, become more important. To both analyze these developments and guide their future development, a new model of the relationship among the institutional spheres and their internal transformation is needed. In this article, I outline a model that takes account of border crossing and the co-evolution between technological and institutional transformation as well as a regional research project to elucidate these processes.

The Triple Helix Model

The "triple helix" is a spiral model of innovation that captures multiple reciprocal relationships at different points in the process of knowledge capitalization. The first dimension of the triple helix model is internal transformation in each of the helices, such as the development of lateral ties among companies through strategic alliances or an assumption of an economic development mission by universities.

The second is the influence of one helix upon another, for example, the role of the federal government in instituting an indirect industrial policy in the Bayh-Dole Act of 1980. When the rules of the game for the disposition of intellectual property produced from government sponsored research were changed; technology transfer activities spread to a much broader range of universities, resulting in the emergence of an academic technology transfer profession. The third dimension is the creation of a new overlay of trilateral networks and organizations from the interaction among the three helices, formed for the purpose of coming up with new ideas and formats for high-tech development.

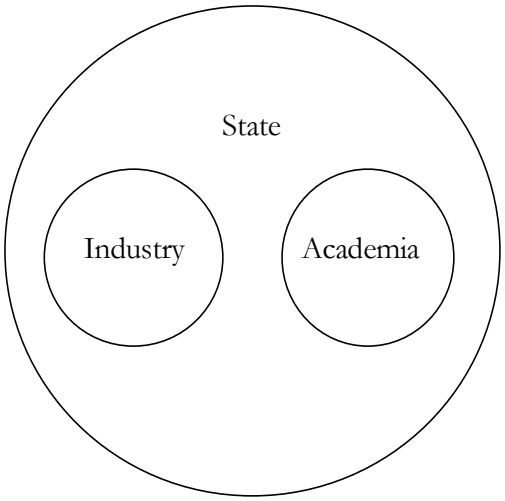
The triple helix denotes the university-industry-government relationship as one of relatively equal, yet interdependent, institutional spheres which overlap and take the role of the other. There has been a movement from separate institutional spheres, which represent, at least in ideology, the US situation. There has also been a shift from the model of the state encompassing industry and academia, in its strongest form in the former Soviet Union but versions could also be found in Latin American and European countries.

Bilateral relations between government and university, academia and industry and government and industry have expanded into triadic relationships among the spheres, especially at the regional level. Academic-industry-government relations are emerging from different institutional starting points in various parts of the world, but for the common purpose of stimulating knowledge-based economic development. Older economic development strategies, whether based primarily on the industrial sector as in the US or the governmental sector as in Latin America, are being supplemented, if not replaced, by knowledge-based economic development strategies, drawing upon resources from the three spheres.

A new institutional configuration to promote innovation, a “triple helix” of university, industry and government is emerging in which the university displaces the military as a leading actor. The dynamic of society has changed from one of strong boundaries between separate institutional spheres and organizations to a more flexible overlapping system, with each taking the role of the other. The university is a firm founder through incubator facilities; industry is an educator through company universities and government is a venture capitalist through the Small Business Innovation Research (SBIR) and other programs (Etzkowitz, Gulbrandsen and Levitt, 2000). Government has also encouraged collaborative R&D among firms, universities and national laboratories to address issues of national competitiveness (Wessner, 1999).

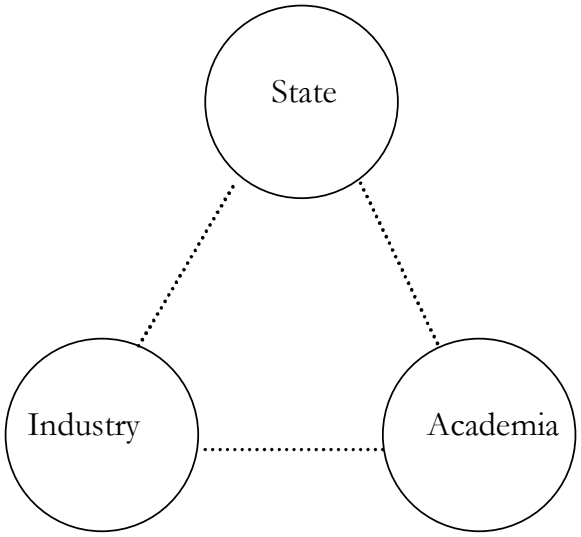
This is a different model of the relationship among the institutional spheres either than one in which the spheres are separate from each other and do not collaborate or one in which one sphere dominates the others. This picture, for example, depicts a model in which the state incorporates industry and the university. This would represent the Former Soviet Union and some Latin American countries in a previous era, when state owned industries were predominant.

Figure I



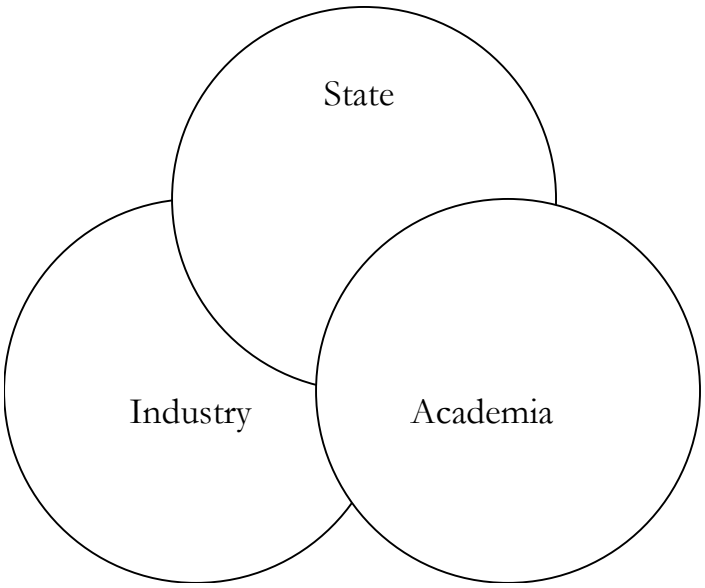
The model of overlapping spheres is also different from the model of institutional spheres as separate from each other, which, at least in theory is how the US is supposed to work.

Figure II



From each of these previous models, whether it was the state dominating the other institutional spheres or the spheres separate from each other, we are moving to a model where the institutional spheres overlap and collaborate and cooperate with each other.

Figure III



Normative Implications

The triple helix model of innovation, with converging institutional spheres of academia, industry and government each taking the role of the other has been read in different ways in various parts of the world. In countries where the interface is well underway, whether occurring from the bottom up, through the interactions of individuals and organizations from different institutional spheres, or top down, encouraged by policy measures, the triple helix can be recognized as an empirical phenomenon. The US has been seen to exemplify the former and Europe the latter mode of triple helix development (Viale, and Campodall' Orto, 2000).

Both types of triple helix development may actually be under way in the US and Europe albeit at different rates and with varying emphases. Top down processes can be identified in the US. even through they are often hidden behind "bottom up" formats. Thus, Advanced Technology Program (ATP) program managers at the National Institute for Standards and Technology have been known to seek out technical leaders in industry to encourage them to initiate an "industry led" focus program. Nevertheless, as industry takes on the project as its own and draws academics as well, or vice versa, who can say where top down ends and bottom up begins. It may be more accurate to recognize both processes going on simultaneously and in tandem. Indeed, such a dual track for innovation promotion may be more productive than any single path.

Similarly in Sweden when young computer and business consultants join together to form an e-commerce firm, a new development is at hand in a society whose industry was led by a definable group of large firms for several decades. Certainly government supported entrepreneurship programs and incubator facilities are available to support these initiatives. Once again bottom up meets top down in a creative fashion, creating a broader context for innovation than would likely arise from either approach in isolation.

In other parts of the world, Latin America, for example, where industry and university have traditionally existed apart from each other, with academia as part of the governmental sphere, the triple helix is sometimes taken as a normative model. Some view it as a goal to strive for in bringing about change to enhance the prospects for innovation. Other observers see the coming of the triple helix as representing the downfall of the existing system of innovation, represented by government owned corporations sponsoring laboratories adjacent to university campuses.

Privatization of companies, it is believed, will reduce the resources available for R&D, including collaborations between the state-owned company laboratory and university researchers. On the other hand, many of these collaborations were not sufficiently market driven and resulted in innovations that lacked a context to be put to use, having been based upon a negotiation between two public laboratories, neither of which was closely enough tied to production and use (Mello, 1998).

This gap is not only a peculiarity of Latin American public research but has been noted in the large corporate laboratories in the US that had been separated from production facilities and were operating as isolated entities, until quite recently. In the later case the reintegration of the laboratory into the firm and directing it more closely toward company goals has been occurring at IBM and GM, in recent years. Typically as corporate R&D facilities are moved closer to product development, longer term R&D is conducted in collaboration with other firms, university research groups and government laboratories.

Policy Implications: The dynamics of innovation spaces

The level (multi-national, national and regional) is also to be taken into account. At the regional level, one can also look at this overlapping of institutional spheres as involving knowledge, consensus and innovation spaces, created at the intersection of the spheres. There is no necessary order to this sequence. A reversal of traditional orders of staged development is among the possible outcomes. Any one can be the basis for the development of the others but a fully developed triple helix will eventually comprise all three elements.

These spaces are created as a consequence of a change in values among promoters of regional economic development from a sole focus on "business climate" and subsidies to firms to creating the conditions for knowledge-based economic development. One indicator of this shift is the increased involvement of universities and other knowledge producing and disseminating institutions, such as Academies of Science, in regional development. The first step in a three-stage process of knowledge-based economic development is the creation of "knowledge spaces" or concentrations of related R&D

activities in a local area. The existence of such "reticulated" agglomerations has been identified as a precursor to knowledge-based regional economic development (Casas, Gortari and Santos, 2000).

Knowledge Space

The concept of knowledge space was developed by Dr. Rosalba Casas at UNAM as a way of conceptualizing some of the decentralization of research institutes from Mexico City to other regions of Mexico. This provided a base for the development of research projects and new technology related businesses in areas of the society which had not previously had this potential.

Some of this decentralization took place due to the earthquake. Other because it was decided it was not best to keep everything concentrated in one place but to move some of the technical resources to other parts of the society. Nevertheless, just as the existence of research universities by the 1920's and 30's in the US represented a potential for knowledge-based regional economic development, similarly these research institutes moved to other parts of Mexico still only represent a potential until they are put to use.

Consensus Space

How are knowledge spaces transformed from potential to actual sources of economic and social development? The second stage is the creation of a "consensus space" a venue that brings together persons from different organizational backgrounds and perspectives for the purpose of generating new strategies and ideas. The concept of knowledge-based regional economic development is derived from activities of the New England Council, representing academic, business and political leaders. Based on the formation of firms from research at MIT in the 1920's, MIT President Karl Compton proposed to utilize the region's comparative advantage, its extensive academic base, to systematically create new firms from scientific research (Etzkowitz, In Press).

After reviewing the existing ideas for economic development, which were typically to reduce taxes or to attract branch plants, it was realized that these approaches would not work in New England because they were too far from raw materials and distribution distances were too long. However, the special resource that the region had were its universities, such as Harvard and MIT in the Boston area, and examples of new firms that had been started from universities. There were only a few individuals who had started such firms so the idea was to establish an organizational support structure to promote high-tech firm formation.

In the 1930's, New England business and political leaders were open to new ideas, given the failure of traditional business models of regional development. Joint Venture Silicon Valley (JVSV), through its open regional "brainstorming sessions," played a similar creative role in Silicon Valley during the recession of the early 1990's (Etzkowitz, 1998). The New York Academy of Science has recently taken this role in the New York metropolitan region, drawing together a leadership group from different institutional spheres for a series of discussions (Raymond, 1996).

Innovation Space

The third stage is the creation of an "innovation space" a new organizational mechanism that attempts to realize the goals articulated in the consensus space. From the analysis of the resources in a region and the creation of a consensus space bringing the different actors in a society together, a new innovation space was created, in this instance the venture capital firm to provide business advice, technical assistance and financing to start new firms.

In 1946 the first venture capital firm the American Research and Development Corporation (ARD) was founded which acted more or less as an incubator for these new firms in helping them with business and technical advice as well as financing. The "incubator" was not a formal entity at that time. Some of the firms were established in underutilized spaces on the MIT campus, in an informal adumbration of the later incubator concept.

Hybridization of organizational roles and functions, arising from the interaction that occurred in the consensus space is an expected development. The new institutional mechanism is typically a "hybrid organization," synthesizing elements of theory and practice from the different spheres. In the case of ARD, the elements were drawn from academia (MIT and the Harvard Business School), the financial industry (investment trusts and investment clubs) and government (changes in regulatory practices defining risky investments).

Summary: conceptual framework for knowledge-based regional economic development

Stage of development	**Characteristics**
Creation of a *knowledge space*	Focus on "regional innovation environments" where different actors work to improve local conditions for innovation by concentrating related R&D activities and other relevant operations
Creation of a *consensus space*	Ideas and strategies are generated in a "triple helix" of multiple reciprocal relationships among institutional sectors (academic, public, private)
Creation of an *innovation space*	Attempts at realizing the goals articulated in the previous phase; establishing and/or attracting public and private venture capital (combination of capital, technical knowledge and business knowledge) is central

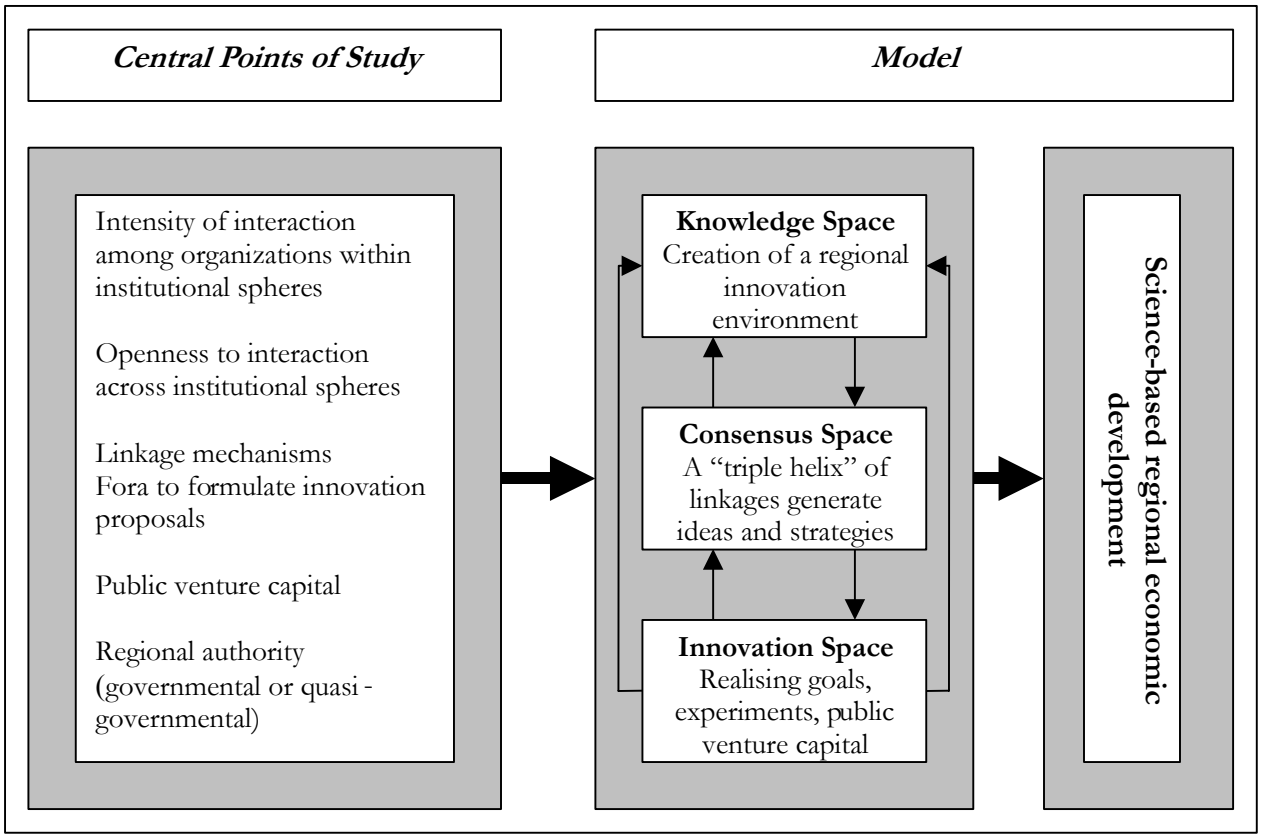
Public Venture Capital

The invention of new ways to promote knowledge-based regional economic growth and the adaptation of old mechanisms to new circumstances is an on-going process. For example, the incubator facility has been creatively revised from an on-site support structure for new firms into a mechanism for linking proto-firms to available resources in a region. In the former case, a greenfield site had few available resources; in the latter a declining industrial region had a variety of financial and business instruments available but lacked the means to connect them to new ventures. Thus, an organizational entity with the same name can play quite different roles in different circumstances. Of course, the possibility also exists for a mis-match between innovation mechanisms and regional activities. It is the task of qualitative research, through in-depth interviews and focus groups to tease out the differences between such situations.

These integrating entities go beyond the activities of traditional boundary spanning mechanisms such as technology transfer offices that arrange interaction across delimited boundaries. Encouraging the establishment and extension of the activities of both these older (boundary spanning) and newer (integrative) linkage mechanisms have become part of the organizational strategy of regional groups that are established with the intention of intensifying the process of knowledge based economic development.

In recent decades, federal, state and local governments have created a variety of mechanisms to encourage knowledge-based economic development. These initiatives include the supply of bridging funds, grants and matching funds to support R&D and access to participation in joint projects with government laboratories. Public venture capital is a subset of "public investment," a rationale for support of various government initiatives that enhance the health, education and welfare of the population.

These programs have in common the commitment of public funds to support the entrepreneurial development of technology in situations where private venture capital finds it too risky to venture. The gap between the creation of intellectual property and its translation into products and processes has been called "the valley of death." The use of public resources to reduce risk in the development of new technology has long been accepted in the agricultural, military and health areas. In recent years, marked by controversy, public entrepreneurs have extended the role of government from the macro factors affecting innovation such as interest rates and money supply to the micro conditions of innovation.



Implications for Evaluation

The triple helix also has implications for evaluation method as well as for what is evaluated. Arie Rip's slide of a falling ivory tower overlaid on an image of an intertwined "triple helix" in the opening talk of the Workshop exemplifies the changing context of evaluation. There is a shift in evaluation from an internal organizational focus to what is happening at the interface. This shift affects both what is evaluated and when evaluation takes place. It includes a shift from autonomous to interdependent institutional spheres, with the quantity and quality of these relationships seen as more significant. The other indicator of transformation came from evaluators themselves who noted the consequences of "overnetworking," the burden of having to travel to too many meetings.

Evaluation needs to be focussed not only on what is happening within an organization in meeting its goals but in interaction with other organizations. This becomes especially clear in EU evaluation where the quality of the network and increasing interactions through the network for purposes of enhancing cohesion, breaking down national boundaries may be as important as R&D outcomes.

In addition to tension and conflict of interest, there is also convergence and confluence of interest. "Priorities have to be set no longer solely on intellectual grounds, but also with an eye to the resources available, the research agenda of the receiving units, and the ex ante assessment of the likelihood of success. (Leydesdorff, 2000). Evaluation becomes multi-valent as differing perspectives and success criteria must be taken into account. For

example, the expected tradeoff between research quality and cohesion may become mutually reinforcing, with better results achieved on both scores.

Networks also play a role in "teaching and learning" including partners from developing regions is a way of raising their level through their participation with more experienced partners. These side-benefits of network participation need to be taken into account in evaluating networks. US evaluation of networks, such as those sponsored by the ATP, tends to be technocratic, focused on specific technological outcomes and spillovers to the virtual exclusion of human factors.

The interaction within a network may be as important as the product of the interaction. Beyond ex ante decisions about whether to proceed with a project, or ex post assessment of results, evaluation has increasingly moved to a "real time" mode of analyzing and benchmarking social processes as they take place and providing "feedback" for course corrections.

As evaluation attempts to capture social processes as well as inputs and outputs it draws upon social science analysis and techniques and more closely resembles other social research practices. The convergence of evaluation and general social science research is part of a broader movement toward the intersection of basic and applied research, a reflection in the social sciences in general, and innovation studies in particular, of a shift in social structure.

Regional Synergies

Perhaps the most significant development in social structures in recent decades both Europe and the US is the rise of innovative regions, based on various knowledge and technology bases. Traditionally, regions were based on natural geographical characteristics such as a watershed e.g the Mississippi Delta or a cultural area, with a common social characteristic such as slavery in the ante-bellum American South (Odum, 1936). More recently, Regions have been organized for functional purposes, whether it is economic development or flood control.

Typically, regions lack political boundaries although over time they may develop a quasi-political infrastructure. This can take place through informal councils based upon self-selection and co-optation such as the Pittsburgh High Technology Council and special districts such as the New York Port Authority based on compacts negotiated between adjacent political entities, in this case the states of New York and New Jersey.

The regional level offers an opportunity to get closer to the user perspective. If you take the viewpoint of the individual US federal or European Union program it is difficult to see how various initiatives fit or do not fit into a coherent picture. The evaluator or policy analyst comes to this realization by taking the perspective of the user of various programs. In the US some of the pieces include various state programs, which often fill gaps in the federal programs. These users on the regional level begin to fit the pieces together and see the broader picture.

Conclusion: The Triple Helix in Regional Development

A trilateral series of relationships among industries, governments and universities is emerging in regions at different stages of development and with different inherited socio-economic systems and cultural values. As regions seek to create a self-reinforcing dynamic of knowledge-based economic development, the three institutional spheres are each undergoing an internal transformation, even as new relationships are established across institutional boundaries, creating hybrid organizations such as technology centers and virtual incubators.

The new networks within a region, established by means of concerted tripartite interactions, may allow the emergence or renewal of high-tech complexes and the creation and organization of new industrial sectors. Academic-industry-government cooperation requires new learning, communication, and service routines on the part of institutions that produce, diffuse, capitalize, and regulate processes of generation and application of useful knowledge. The paradigmatic institutions are the university, the firm, and the government, and the paradigmatic relationship is interactive concerted action embedded in projects, communication, and new kinds of shared values.

A university-industry-government interaction at the regional level is not an entirely new phenomenon. The post-war "Route 128" high-tech conurbation can be traced to policy initiatives in the 1930's and even to the founding of MIT in the mid-nineteenth century for the purpose of infusing industry with new technology. What is new is the spread of technology policy to virtually all regions, irrespective of whether they are research or industrially intensive.

A normative injunction to attend to the commercial implications of research has arisen not only from the emergence of an entrepreneurial dynamic within academia but from government polices that changed the rules for disposition of intellectual property arising from federally funded research. Taking organizational forms such as technology transfer offices and the requirements of government granting programs for the support of research; the capitalization of knowledge changes the way that scientists view the results of their research.

Within specific regional contexts universities, governments and industry are learning to encourage economic redeployment through the development of loosely coupled reciprocal relationships and joint undertakings. For this to happen a local region must have some scientific and technological institutions and have produced or obtained access to other necessary kinds of innovation supporting instruments such as investment mechanisms and institutions to promote concerted action.

Appendix I: Outline for a Europe/US Collaborative Research Project

Knowledge-Based Regional Economic and Social Development

Henry Etzkowitz and Magnus Gulbrandsen

Introduction

The following document is an outline draft proposal for an ongoing collaborative research project for the "Bad Herrenalb Group," to conduct a comparative analysis of regional levels in the US and Europe and compare the effect of the framework programs at the regional level to the state programs. In the US, it is difficult to arrange for the individual state programs to be evaluated in a comparative fashion. At the most the Southern Technology Council will examine the southern region but it will be very difficult to go beyond that.

Europe could learn from the state programs in the US and there is much that the US could learn from the framework programs. The premise of this study concept is that a combination of insider and outsider perspectives will lead to greater insight. Insiders are usually the object of study and outsiders the researchers. In this scheme, insiders and outsiders (European and US researchers), reverse and combine roles as they engage in collaborative studies of each other's regional innovation environments.

This study will use the "triple helix" model to analyze new linkages that transcend the traditional "contract" between science and society. The purpose of this research project is to elucidate some of the underlying dimensions on which future evaluations, polices and programs can be based. A comparative scheme is proposed to investigate the pre-conditions for success of the European Framework programs and State S&T programs. Both are oriented toward the regional level, although one derives from the multinational and the other from the sub-national levels. Both are valued at approximately US $3.5 billion.

Theory

The conceptual framework is based on three main and related nested ideas:

(1) The "triple helix" which refers to the multiple reciprocal relationships among institutional sectors (public, private and academic) at different points in the knowledge capitalization process (knowledge, consensus and innovation spaces);

(2) The concept of "regional innovation environment (RIE)", which consists of the set of political, industrial and academic institutions that, by design or unintended consequence, work to improve the local conditions for innovation (knowledge space);

(3) The concepts of social capital and embeddedness which refer to the density of social relationships and trust in interpersonal relationships. We extend these concepts across institutional boundaries in inquiring into the conditions for production of social capital and trust across institutional spheres, allowing lateral rather than hierarchical coordination (consensus space)

Objectives

The purpose of this project is to produce useful knowledge about emerging forms of knowledge-based economic development in the United States and Europe and value changes that occur as institutional spheres interact more intensively. It is expected that significant differences can be identified in conditions, intentions, policies, mechanisms, processes and outcomes exist in regional innovation experiences.

General objectives:

1. elaborate the concepts of "knowledge" "consensus" and "innovation" spaces based upon data collected from a sample of regions with different conditions: high-tech; declining and excluded

2. explore the tensions, complementarities, interfaces and linkages between the academic, industrial, and governmental spheres in different kinds of innovation complexes.

3. analyze the intended and unintended effects of national policies and programs (public venture capital)) in the regional innovation environment.

4. identify and understand the conflicts of interests and tensions that the "triple helix" model implies at a regional level.

5. analyze bilateral interactions between academia and industry (e.g. technology transfer offices and firms) and government and academic (e.g. local economic development agencies and universities) as a precursor to trilateral interactions.

6. analyze tripartite concerted action (i.e. the formation of High-Tech Councils and other organizations) at the local level, as an impetus to knowledge-based economic development.

Specific Objectives:

- To map the quality of the innovation environment of the regions both, in terms of the existing elements (economic, political, cultural, academic and organizational), and in terms of new formal mechanisms and institutions.

- To identify the factors and conditions that allow or limit multiple reciprocal linkages between academic institutions, industry and government in a regional context.

- To identify the actors and their backgrounds and initiatives in the innovation process i.e. identify "entrepreneurial gatekeepers" that span institutional boundaries.

- To identify the emergence of a new group of knowledge-based technologies and their related industrial sectors within each region.

- To identify and analyze informal and formal mechanisms of academy-industry and government concerted actions for innovation.

Research Questions

Value conflicts in inter-organizational relations are typically generated either from the explicit statement of values to justify intended changes in policy or from the initiation of actions which are later realized to have important consequences for values. Studies of strategy formation in government and business have suggested the analytic utility of making a distinction between intended and realized strategies i.e. between organizational

goals explicitly set forth and an underlying stream of actions which result in an implicit policy, which the organization often does not wish to recognize (Mintzberg & Waters 1985). How are value issues of university-industry-government relations defined by representatives from different sectors of the region? What are the themes used to legitimize the new regional ties? How are value conflicts emanating from university-industry-government interactions resolved? What are the effects of the state programs in the US and the Framework Programs in Europe on Regional Innovation Environments? Are the US and European programs functionally equivalent, even though they derive from different levels, although both are above the regional level, albeit to significantly different degrees. What are the differences and similarities in U.S/European experience in promoting innovation through key actions and public venture capital. Does the US represent a "bottom up" form of the "triple helix" model and Europe a "top down" version or can both processes be identified in various formats.

Main Hypotheses

Is the existence of certain level of R&D activity a sufficient impetus to science-based regional development, the "island of innovation" hypothesis or must these activities be significantly related to each other in order to induce a "critical mass" of development activity, the "cluster" hypothesis?

Do these various regional experiences suggest the existence of alternative models of regional development or are they merely at different stages of a common process? For example, is there a single line of knowledge-based economic development based on the venture capital model or multiple cultural formats unique to each region (Saxenian, 1993).

In some areas, regional innovation systems may have to cope with traditions of isolation that still prevail in several economic, social and political spheres, that may inhibit the development of a regional innovation environment. Insular institutions and weak networks among institutional spheres are suggested as hypotheses to explain relatively low levels of high technology development in some research-intensive regions.

Research Design

Based on the ideas of knowledge, consensus and innovation spaces as the providing the basis for knowledge-based regional economic development, a sample will be drawn that will allow us to analyze the development of these "spaces" under contrasting conditions and at different phases of their development.

A sample will be constructed to include regions with different characteristics that are hypothesized to influence variants of the model such as research intensity. The objective will not be to conduct regional studies but rather to focus on the emergence of networks and organizations that facilitate science-based economic development. The analysis will concentrate on the implications of these linkages among academia, industry and government that formerly operated at arms length but are increasingly working together to promote innovation.

References

Braczyk, Hans Joachim et.al. eds. 1998. *Regional Innovation Systems.* (London: UCI Press)

Casas, Rosalba, Rebecca de Gortari and Ma. Josefa Santos "The Building of Knowledge Spaces in Mexico: a regional approach to networking." *Research Policy* 29 225-241.

Etzkowitz, Henry. In Press. *The Second Academic Revolution: MIT and the Origins of the Venture Capital Industry.* (London: Gordon and Breach)

Etzkowitz, Henry and Magnus Gulbrandsen and Janet Levitt. 2000. *Public Venture Capital: Government Funding Sources for Technology Entrepreneurs* (New York: Harcourt)

Etzkowitz, Henry. 1998. From Zero-Sum to Value-Added Strategies: The Emergence of "Knowledge-Based Industrial Policy in the States of the United States." *Policy Studies Journal*

Etzkowitz, Henry and Loet Leydesdorff. Eds.1997. *Universities in the Global Knowledge Economy: A triple helix of university-industry-government relations* (London: Cassell)

Leydesdorff, Loet. 2000. "The promotion of university-industry-government relations: a methodological contribution to its evaluation." National Academy of Sciences Conference on "Policies to Promote Entrepreneurship in A Knowledge-Based Economy: Evaluating Best Practices form the US and the U.K."

Lugar, Michael. 1994. "Science and technology in regional economic development: the role of policy in Europe, Japan and the United States." *Technology in Society*, 16: 9-33.

Lundvall, Bengt-Åke. 1988. "Innovation as an interactive process: from user-producer interaction to the national system of innovation." In Giovanni Dosi et.al. eds *Technical Change and Economic Theory* (London: Pinter)

Mello, Jose. 1998 "Management of Technological Diffusion: A Case Study in a Brazilian Public Technological Institute." Presented at the Seventh International Conference on the Management of Technology, Miami, Florida

Mintzberg, H. & Waters, J. A.: "Of Strategies, Deliberate and Emergent." *Strategic Management Journal*, Vol. 6, 1985, pp. 257-272.

Odum, Howard. 1936 *Southern Regions of the United States* (Chapel Hill: University of North Carolina Press)

Raymond, Susan ed. 1996. *The Technology Link to Economic Development*. New York: New York Academy of Sciences

Saxenian, AnaLee. 1994. *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge: Harvard Unviersity Press)

Viale, Riccardo, and Sergio Campodall'Orto. 2000. "Neocorporations or Evolutionary Triple Helix? Suggestions Coming from European Regions." Presented at the Third Triple Helix Conference, Rio de Janeiro

Wessner, Charles ed. 1999. *The Advanced Technology Program: Challenges and Opportunities*. (Washington D.C. National Academy Press)

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