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INTELLECTUAL PROPERTY AND INTERNATIONAL TECHNOLOGY TRANSFER

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Silicon Valley or Cleveland?

Human capital and mobile labor markets have long been understood to be critical factors in innovation and economic growth. Nevertheless, it is the institutional, organizational characteristics of human capital that turn innovative potential into actuality. Science and technology are valued more by some religions, philosophies, and ideologies than others and it is the social organization of these ideas which pass on to the successive generations the commitment to the values of autonomy, diversity, and experiment characteristic of innovative societies (Skolnikoff, 1993). Science progresses or retards depending on the institutions—education and research organizations, publication outlets, societal value of scientists (Huff, 1993).

A world technological leader during Europe "Dark Ages," China from the advent of the Ming Dynasty in the 14th century declined technologically because education was organized for the examination system, organizational structures were strictly hierarchical, and Confucian thought valued social harmony over deliberative debate (Baum, 1982). A world scientific center from the 8th to the 14th centuries, the Arab Middle East declined scientifically because education was loosely organized, professional networks of philosopher-scientists were discouraged by Koranic law, and Islamic thought valued interpretation of dogma over human reason and the questioning of authority (Huff, 1993).

By contrast, science advanced in Europe because of the establishment of royal societies and universities, scholarly journals, individual and group autonomy conferred by Church-state rivalry, and the re-emphasized value placed on observation and experiment (Cohen, 1994). Science and technology grew together in western Europe and North America, the outcome of markets, culture, government, and societal institutions (Cardwell, 1995). The German chemical industry eclipsed that of the French in the nineteenth century in part due to research in German universities; the American chemical makers in the 20th century matched—and ultimately surpassed—the German companies due to the establishment of chemical engineering departments at MIT and the universities at Delaware, Illinois, Michigan, Minnesota, Pennsylvania, and Wisconsin (Mowery and Rosenberg, 1998).

That the Germans have largely been unable in our contemporary era to leverage science and technology research conducted at their world-class Max Planck Institutes reveals fundamental problems in German institutions. The ideology of "social partnership" that characterizes so much of German institutional life does not extend to its universities and research centers and this is how Max Planck himself would have wanted it: He favored pure science for its own sake and discouraged cooperation with industry and commercialization of technologies (Siebert and Stolpe, 2002).

American universities have become the intellectual centers for high-technology knowledge clusters in certain geographic spaces, the Silicon Valley phenomenon. Before there was Silicon Valley, there was MIT and the beginning of the Cambridge/Boston Route 128 high-tech corridor (Saxenian, 1994). MIT's engineering school dean encouraged government grants and partnerships with industry and thereby established the MIT Model for the American research university. The Stanford Model encourages not just big-firm collaborations (as did the MIT Model) but small-firm, low-budget, project-based collaborations with academia, start-up enterprises, very mobile labor markets, andinformal know-how transfer through dense social networks (Saxenian, 1994). The universities contribute not only the innovative ideas but the human talent, including both the students and the professors, who advise companies, take leaves of absence to start-up or work for companies, or leave academia entirely. Small high-innovation firms especially benefit from the technology and useful knowledge spillovers provided by the local social networks (Almeida and Kogut, 1997). Foreign high-tech companies deliberately seek these geographic knowledge clusters for direct investment and joint venture (Almeida, 1996).

Social networks—it has been called social capital—are key assets for organizations and individuals in technology clusters, though they are difficult to measure and value quantitatively (Lin, 2001). People who bridge across particular networks or communities can be especially valuable to organizations (Granovetter, 1982, 1985). "Exchange" under this type of economic ordering, though still transactional and utility-maximizing, is relational and trust-oriented (Lin, 2001). Networks of people that cross conventional organizational boundaries may be becoming a dominant organizational structure in the U.S. marketplace, challenging the vertically and horizontally integrated firm, and its logic may lead the rest of the world in a similar direction (DiMaggio, 2001).

Nevertheless, the business enterprise remains the preeminent organizational form in the contemporary economy. Firms may be thought of as know-how institutions, but they are much more than depositories of discrete facts. Firms are deeply-embedded with technology and practical knowledge, possessing the organizational capabilities to turn information and know-how into commercially-viable products and services. Economists have begun to theorize the very existence of the firm as due to its information processing capabilities (Demsetz, 1988): Business enterprises exist because they organize knowledge better than their competitors (Kogut and Zander, 1992; Conner and Prahalad, 1996; Grant, 1996). "At the heart of this theory is the idea that the primary role of the firm, and the essence of organizational capability, is the *integration of knowledge*, …the flexible integration across multiple knowledge bases" (Grant, 1996:375). The collective knowledge, know-how, and learning maintained by the organization, its so-called "core competency," is difficult for a competing organization to replicate (Prahalad and Hamel, 1990).

Technology may be made *explicit*, that is, it may be codified. What was "known" was for much of human history passed down and around orally, a rather inefficient communication technique. "All this changed with a revolution in a small town in southern Germany. The revolution transformed knowledge from being idiosyncratic and local to being standardized and universal" (Pysenson, 1999:212). By 1500 some 8 million books had been printed and the technology would later be employed to distribute treatises, manuals, guidebooks, and reference works. Technology has come to be disseminated through journal articles, patent claims, and blueprints. Benjamin Franklin's lending-library has, however, finally been eclipsed in our time by databases, web-sites, and the Internet in the institutionalization of knowledge dissemination.

Yet, as important as explicit knowledge is economically, the technology that matters most in the contemporary world economy is *tacit* knowledge (Polyani, 1966). Tacit know-how and know-why is not written down anywhere but is found in the "heads" of people. Tacit knowledge—contextual, content-laden, and data-rich—becomes embedded in complex, organizational routines that define organizational capabilities and evolution (Nelson and Winter, 1982). "Tacit knowledge is closely associated with production tasks, and raises the more interesting and complex questions regarding its transfer both within and between organizations" (Grant, 1996:377). Tacit knowledge provides the "cutting-edge" competitive advantage under economic circumstances of quick and inexpensive access to explicit technology and codified practical knowledge.

Tacit knowledge explains why organizations and social networks matter so much to economic success. Tacit knowledge also explains why direct investment, joint ventures, licensing, and trade matter so much to international technology transfer.

Silicon Valley and the Boston Route 128 Corridor are the most famous technology clusters, but other economically important technology clusters in the United States include Seattle (the University of Washington), San Diego (University of California at San Diego, Salk Institute), Austin (University of Texas), Atlanta (Emory University Georgia Tech University, University of Georgia), Research Triangle, North Carolina (Duke University, University of North Carolina, Chapel Hill, North Carolina State University), Northern Virginia/Southern Maryland (Virginia Tech University, National Institutes of Health, University of Maryland, Johns Hopkins University), and New York City (Columbia University, New York University, Rockefeller University).

Why hasn't Cleveland, Ohio, become an important technology cluster? Cleveland had been during the first-half of the twentieth century a leading industrial center for steel, automobile parts, and other manufactured goods and its many well-known bigcompanies had once been entrepreneurial startups. Industrial success contributed to world-class social institutions: the Cleveland Orchestra and Orchestra Hall, the Cleveland Museum of Art, Case-Western Reserve University, and the Cleveland Clinic. Admitting the manufacturing decline but recognizing the research capabilities at Case-Western and the Cleveland Clinic, civic leaders in Cleveland in the 1990s articulated a vision for their city as successful cluster of medical and bio-technology businesses. The vision remains largely unrealized, despite that the university and the Cleveland Clinic continue to be successful, because Clevelanders have failed to encourage local social networks, local startup ventures, and local venture capital and failed to draw in and retain creative individuals and innovative business enterprises (Fogarty and Sinha, 1999).

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