



Paper to be presented at the Summer Conference 2010

on

"Opening Up Innovation:  
Strategy, Organization and Technology"

at

Imperial College London Business School, June 16 - 18, 2010

## WHY DO INNOVATION INTERMEDIARIES EXIST?

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### Abstract:

Innovation intermediaries are organizations or groups within organizations that work to enable innovation, either directly by enabling the innovativeness of one or more firms, or indirectly by enhancing the innovative capacity of regions, nations, or sectors. They do so by intermediating on the interorganizational level by creating and nurturing interorganizational networks, and by intermediating on the intercommunity level by conducting and supporting technology development activities in the innovation gap between the business and research communities. Firms rely on innovation intermediaries to perform interorganizational networking activities because the commitment of intermediaries to their mission engenders the trust required for network sustainability. Firms rely on innovation intermediaries to perform innovation gap technology development activities because business and research organizations and individuals respond to the goals and performance measures of their respective communities. This creates an innovation system challenge to which innovation intermediaries, as social enterprises, respond. Because innovation intermediaries exist to conduct activities for which performance is difficult to measure, attempts to measure their performance using business or research indicators risk diverting them from their most important work.

## **ABSTRACT**

Innovation intermediaries are organizations or groups within organizations that work to enable innovation, either directly by enabling the innovativeness of one or more firms, or indirectly by enhancing the innovative capacity of regions, nations, or sectors. They do so by intermediating on the interorganizational level by creating and nurturing interorganizational networks, and by intermediating on the intercommunity level by conducting and supporting technology development activities in the innovation gap between the business and research communities. Firms rely on innovation intermediaries to perform interorganizational networking activities because the commitment of intermediaries to their mission engenders the trust required for network sustainability. Firms rely on innovation intermediaries to perform innovation gap technology development activities because business and research organizations and individuals respond to the goals and performance measures of their respective communities. This creates an innovation system challenge to which innovation intermediaries, as social enterprises, respond. Because innovation intermediaries exist to conduct activities for which performance is difficult to measure, attempts to measure their performance using business or research indicators risk diverting them from their most important work.

Business people, policy makers, and researchers have struggled to make sense of the diverse range of government and nonprofit organizations that work to help firms share knowledge, create or adopt new technologies and business practices, find business or research partners, solve technical problems, and work together to create common standards or to improve the regional, national, or sectoral business environment. To date, researchers have focused on describing the behavior or measuring the performance of specific organizations or specific types of innovation intermediaries. For example, researchers have measured the performance, or effect of the activities of the US Advanced Technology Program (Feldman & Kelley, 2006; Sakakibara & Branstetter, 2003), the US Defense Advanced Research Projects Agency (Fuchs, 2009), the Advanced Technology Development Center of the Georgia Institute of Technology (Rothaermel & Thursby, 2005), SEMATECH (Grindley, Mowery & Silverman, 1994), a US-based biological resource center<sup>1</sup> (Furman & Stern, 2006), US regional institutes (McEvily & Zaheer, 1999), Japanese research consortia (Branstetter Sakakibara, 2002), Canadian industry associations (Dalziel, 2006), US small firm manufacturing networks (Human & Provan, 1997), Swedish (Löfsten & Lindelöf, 2002) and Chinese (Yu & Heshmati, 2007) science parks, US (Di Gregorio & Shane, 2003) and European (Kaufmann & Tödting, 2001) university technology transfer offices, and international standards organizations (Rosenkopf, Metiu & George, 2001; Rysman & Simcoe 2006). But it is only recently that researchers have begun to understand intermediaries as an overarching class of organizations (Howells, 2006).

Understanding innovation intermediaries as a single class of organizations is useful for two reasons. First, it draws attention to organizations that are often overlooked in studies of national (Lundvall, 1992; Nelson, 1993), regional (Cooke, Heidenreich & Braczyk, 2004), or sectoral (Malerba, 2002) systems of innovation, and by conceptual models and the data collection efforts of statistical agencies (Godin, 2005; Siegel, 2003). For example, the triple helix model of innovation describes innovation systems in terms of industry, university, and government organizations, diminishing the role of innovation intermediaries, many of which are nonprofit organizations (Etzkowitz & Leydesdorff, 2000). And statistical agencies and researchers that adhere to the OECD's Frascati and Oslo guidelines for data collection find limited evidence of the existence, let alone the impact of, intermediaries (Dalziel, 2006). But when taken together, innovation intermediaries are too numerous, and sometimes too large and important, to be ignored. Hundreds, and in some cases thousands, of industry associations, boards of trade, chambers of commerce, and economic development organizations are active in almost every country in world, and organizations such as Battelle in the US, the Fraunhofer Society in Germany, and the Industrial Technology Research Institute in Taiwan have significant resources, capabilities and spheres of influence. And innovation intermediaries are instrumental in addressing some of the most important problems we face. In developing countries they are critical to economic development through entrepreneurship and technology catch-up (Mazzoleni & Nelson, 2007), and in developed countries they facilitate interorganizational collaboration at the domain level (Trist, 1983), bringing together firms, governments, and universities to address long-term, multi-dimensional problems such as environmental degradation.

Second, approaching innovation intermediaries as single class of organizations facilitates the development of useful theory. Several authors have pointed to the lack of theory on innovation

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<sup>1</sup> Biological Resource Centres are “living libraries” that authenticate, preserve, and provide researchers access to biological materials (Furman & Stern, 2006).

intermediaries as an important part of the explanation for the fragmentary nature of the literature and the non-cumulative nature of research findings (Howells, 2006; Phan, Siegel & Wright, 2005) echoing the conclusions of nonprofit scholars as to why we know so little about nonprofit organizations (Salamon & Anheier, 1992). Just as we would not have gotten to theories of the firm if we had started by asking why specific types of firms exist, theory development on innovation intermediaries will be facilitated by working with a population that is sufficiently heterogeneous as to require abstraction from the specificities of particular types of organizations to develop more general explanations.

This paper aims to contribute to a better understanding of innovation intermediaries as an overarching class of organizations by addressing the most fundamental of research questions:

- 1) What are innovation intermediaries?
- 2) What do innovation intermediaries do?
- 3) Why do innovation intermediaries exist?

The questions have practical as well as scholarly motivations. Business people and policy makers also struggle with the complexity of innovation systems, and seem to long for a simple, utopian state in which university researchers pick up where market forces leave off. They ask similar questions:

- 1) Why is there such a confusing variety of innovation-related organizations, some of which are poorly run, but all of which seem to want my time and money?
- 2) Why can't firms and universities just work together?
- 3) Why should we give taxpayer's money to organizations that are helping private firms?

The next three sections of the paper are structured according to the three research questions identified above. I first provide a definition of innovation intermediaries, then describe the activities of innovation intermediaries, and finally explain why they exist. In the discussion section that concludes the paper I consider the implications for policy and future research.

## **DEFINING INNOVATION INTERMEDIARIES**

Because most researchers have focused on particular organizations or classes of innovation intermediaries, few have found it necessary to define innovation intermediaries as organizational class. And although researchers studying national, regional, or sectoral systems of innovation make reference to intermediaries, they typically do not define them. The implicit definition of an intermediary, sometimes referred to as a bridging organization (Sapsed, Grantham & DeFillippi, 2007) or broker (Hargadon & Sutton, 1997), is an organization that works to connect other organizations to one another in bilateral or multilateral relationships. For example, the working definition of an intermediary used by Howells is: "An organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties" (2006: 720).

I define innovation intermediaries as organizations or groups within organizations that work to enable innovation, either directly by enabling the innovativeness of one or more firms, or

indirectly by enhancing the innovative capacity of regions, nations, or sectors. In my proposed definition I intend for innovativeness to be understood in the broadest possible sense, such that other words such as success, growth, competitiveness, adaptation, or even survival could be substituted. In particular, innovation intermediaries may or may not be involved in technological innovation. This broad interpretation of innovation is consistent with Schumpeter's definition of an innovation as a new or improved good, a new method of production or distribution, the opening of a new market, the use of new supplies or engagement of new suppliers, or a new mode of industrial organization (Schumpeter, 1934). My purpose-based definition of innovation intermediaries is similar to, but necessarily more abstract than, definitions of specific types of innovation intermediaries currently in use. For example, the US National Business Incubator Association defines a business incubator as "an economic development tool designed to accelerate the growth and success of entrepreneurial companies through an array of business support resources and services" (Phan et al., 2005: 167). And the International Association of Science Parks defines a science park as "an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions" (IASP, 2002).

In defining innovation intermediaries I focus on organizational purpose to identify a class of organizations that are innovation intermediaries, and to distinguish this class of organizations from other organizations. Accordingly, industry and trade associations, economic development agencies, chambers of commerce, science (or technology or business) parks, business incubators, research consortia and networks, research institutes, and standards organizations can all be classified as innovation intermediaries insofar as their organizational purpose is to enable innovation. Professional societies and unions are not be classified as innovation intermediaries because their purpose is enable the development of individuals and because, in the case of the latter, they seek to balance the interests of firms against the interests of individuals. University technology transfer offices are a hybrid case. Their primary mandate is to serve their host universities by facilitating research and educational activities, protecting intellectual property, and generating revenues (Jenson & Thursby, 2001). But part of their mandate may involve promoting economic development by engaging with, and thereby enabling, the firms in their region or nation (Markman et al., 2005; Siegel, Waldman & Link, 2003). To the extent that an organization's or organizational unit's purpose is to enable innovation, it may be considered an innovation intermediary.

Defining innovation intermediaries on the basis of their purpose avoids two difficulties created by defining them on the basis of their brokering activities. First, it makes it possible to more clearly circumscribe the class of organizations that are intermediaries. Many organizations, including many for-profit firms, conduct intermediation activities insofar as they act as brokers or boundary-spanning agents between two parties. These include consultants that promote the adoption and use of advanced manufacturing technologies (Bessant and Rush, 1995), and management consultants more generally; patent agents and lawyers that act as intermediaries in the market for technology (Lamoreaux & Sokoloff, 2002), and many other types of professional service firms; and firms such as Toyota that promote collaboration amongst their suppliers (Dyer & Nobeoka, 2000) or biotechnology firms that act as brokers between public sector research and large pharmaceutical firms (Stuart, Ozdemir & Ding, 2007). If innovation intermediaries are

defined as organizations that conduct intermediation activities, the result is a class of organizations that may be too broad to be meaningful or useful. Insofar as my purpose is to explain why innovation intermediaries exist, that is, why there exist organizations whose primary purpose is to support the creation of public socio-economic benefits, I need to distinguish between intermediaries and other organizations such as for-profit firms whose rationale for existence has been explained elsewhere (Coase, 1937).

The second difficulty created by defining innovation intermediaries as agents or brokers is that intermediaries do more than act as brokers or agent between two or more parties. As observed by Howells, and discussed in the next section, intermediaries also engage in bilateral activities and on occasion, unilateral activities:

*There is also the issue of 'when is an innovation intermediary not an innovation intermediary'? Innovation intermediaries were often not only involved in providing mediated innovation services linking their clients with other organizations, but also supplying services direct to their clients on a one-to-one basis, which involved no other interaction with other organizations. Intermediaries therefore can, and do, provide other functions within an innovation system, such as contract research (function 3a) testing or training work (function 5), which have no third-party or brokerage function whatsoever. [...] The role of innovation intermediation may therefore be only one amongst a number of other roles an organization may undertake in terms of its strategic remit (Howells, 2006: 725).*

## **THE ACTIVITIES OF INNOVATION INTERMEDIARIES**

Researchers have described the activities of specific intermediaries or types of intermediaries. Table 1 summarizes the findings of 12 most illustrative studies and classifies the activities into three categories: interorganizational networking activities, technology development and related activities, and other activities.

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Insert Table 1 about here.  
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### **Interorganizational Networking Activities**

Almost all innovation intermediaries, including those with significant in-house technology development activities, work to create and support interorganizational networks. They do so either by influencing the flow of resources through interorganizational 'pipes', or by influencing perspectives by shaping the 'prisms' through which people make judgments in the absence of reliable information (Podolny, 2001). As illustrated in Figure 1, below, the interorganizational networking activities of intermediaries can be understood on the basis of their impact on the firms involved. In the provision of information or advice, the intermediary supports the inward flow of knowledge or perspectives from a range of sources, possibly including the intermediary itself, to the focal firm. Such activities involve scanning and information processing (Howell,

2006), transferring specialized knowledge (Bessant & Rush, 1995), and diffusing information and best practise techniques (Grindley et al., 1994). Conversely, in the facilitation of promotion or influence, the intermediary supports the outward flow of knowledge or perspectives from the focal firm to a range of recipients. Such activities involve cluster promotion (Sapsed et al., 2007), industry promotion (Human & Provan, 2000), and helping users articulate innovation needs (Bessant & Rush, 1995). As discussed below, the facilitation of promotion or influence can be interpreted to include the lobbying activities of industry associations.

In nurturing business or research linkages the intermediary works to facilitate bilateral or multilateral exchanges, again playing a supporting role. Interfirm networking activities are supported by the US Defense Advanced Research Projects Agency (Fuchs, 2009), the UK bridging organization Sussex Wired (Sapsed et al., 2007), and US regional institutes (McEvily & Zaheer, 1999). Specific networking activities include helping to combine the knowledge or experience of two or more partners, brokering, and standards development (Bessant & Rush, 1995; Grindley et al., 1994; Howells, 2006). Research linkages are supported by research consortia (Doz et al., 2000; Grindley et al., 1994), research institutes that network with local firms to facilitate economic development through technology adoption and adaptation (Mazzoleni & Nelson, 2007), and technology transfer offices that promote technology licensing (Siegel et al., 2003) and new venture formation (Markham et al., 2005).

But occasionally, intermediaries take on leadership roles and undertake community and consensus building activities to create collective benefits. Fuchs (2009) describes the activities of DARPA (the US Defense Advanced Research Projects Agency) as going beyond network broking and engaging in leadership activities that as it “re-architects social networks among researchers so as to influence technology directions in the US”. Similarly, Howells (2006) identifies foresight and diagnostic activities and Grindley et al. (1994) report on SEMATECH’s efforts to coordinate generic research and to provide technology roadmaps to promote concurrent investments in new technology.

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Insert Figure 1 about here.  
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***The special case of lobbying and industry associations.*** There are diverging views on the value of promotion and lobbying activities and on the contributions of industry associations that perform them. Some researchers take care to distinguish the innovation intermediaries they are studying from industry associations. For example, Human and Provan distinguish between enterprise networks that “allow firms to accomplish specific organizational objectives that no one member could have accomplished individually” and trade associations where “the primary purpose ... is most often to provide indirect services for their participating firms (e.g. lobbying, promotion)” (1997: 369), and McEvily and Zaheer distinguish between regional institutions and organizations that focus on lobbying activities “While some trade associations may fulfill the criteria of regional institutions as we define them (e.g., SEMATECH), others are geared primarily toward lobbying activities (e.g., the Semiconductor Industry Association) and are outside the scope of our definition” (1999: 1135).

But there is an alternative view emerging from the work of researchers who have considered the impact of the activities of industry associations. In his study of the dye industry of the 19<sup>th</sup> and 20<sup>th</sup> centuries, Peter Murmann concludes that the ability of German industry and academe to coevolve explains why German firms came to dominate an industry in which the UK had the early advantage. Murmann points to lobbying by firms as one of three causal forces behind the coevolution in Germany (Murmann, 2003). Based on Statistics Canada data on over 2000 Canadian innovators, Dalziel (2006) shows that industry associations were more frequently cited as important sources of ideas and as collaborators than either government laboratories or universities, suggesting that industry associations are playing a generative role that extends beyond lobbying. Industry associations may also be playing a positive, if not widely recognized, role in developing countries. In China industry associations were very important in the pre-communist era, and are once again becoming numerous and are playing a positive role in economic development (Kennedy, 2005).

So it is not clear to what degree and in what contexts the activities of industry associations are limited to lobbying, and to what degree lobbying activities enable value creation rather than merely value capture. Political scientists identify two mechanisms through which lobbying activities influence policy: resource transfers such as campaign contributions or bribes that allow firms to “buy” policy, and the provision of specialist policy-relevant information (Austen-Smith, 1993; de Figueiredo & de Figueiredo, 2002). Facilitating the transmission of information from a group of firms to policy makers would certainly be considered an innovation enabling activity and it is an activity engaged in by business incubators (Phan et al., 2005) and other types of innovation intermediaries in addition to industry associations. On this basis, industry associations, even those that only engage in lobbying, can be considered innovation intermediaries.

### **Technology Development and Related Activities**

A smaller number of intermediaries conduct technology development and related activities. These include the large, well-known research institutes such as Fraunhofer Society in Germany; Battelle, SRI, and the Southwest Research Institute in the US; and the Industrial Technology Research Institute in Taiwan, all of which consist of several research institutes in different disciplines, and research consortia, some of which, such as SEMATECH, have in-house technology development capabilities. Sometimes such intermediaries engage with multiple firms simultaneously, but as noted by Howells (2006), sometimes the relationships are bilateral. An intermediary may even undertake independent technology development activities when there is no commercial partner but the intermediary believes it is worthwhile to invest in the technology.

The technology development and related activities described in Table 1 include the provision of access to expertise and equipment (Howells, 2006; Mian, 1996), standards development and support for systems development (Fuchs, 2009; Grindley et al, 1994), testing and validation of new technologies and equipment (Grindley et al, 1994; McEvily & Zaheer, 1999), adapting technologies for alternate applications (Mazzoleni & Nelson, 2007; Bessant & Rush, 1995), and intellectual property management and other activities associated with the commercial exploitation of the inventions of university and other public sector researchers (Markham et al, 2005; Siegel et al., 2003). Some intermediaries do not undertake technology development

activities themselves but instead provide funding for such activities. Examples include government programs such as the Advanced Technology Program (renamed the Technology Innovation Program in 2009) and the Small Business Innovation Research Program in the US, and the ESPRIT and EUREKA and other programs of the European Commission (Georghiou & Roessner, 2000). Intermediary financing may prompt additional investment from other parties, the so-called halo effect (Feldman & Kelley, 2006).

### **Other Activities**

Finally, some innovation intermediaries also conduct other activities that are complementary to their networking or technology development activities, and make it possible for them to provide their members or clients with more complete offerings. Science parks and business incubators provide physical space (Löfsten & Lindelöf, 2002; Phan, Siegel & Wright, 2005), some intermediaries undertake training activities (McEvily & Zaheer, 1999; Mian, 1999) and others provide advice related to sales and marketing activities (Bessant & Rush, 1995; Howells, 2006).

## **WHY DO INTERMEDIARIES EXIST?**

### **Why Innovation Intermediaries Perform Interorganizational Networking Activities**

There is a large body of research that shows that firms with sufficiently large and heterogeneous networks outperform firms with less access to external resources (Baum, Calabrese & Silverman, 2000; Gulati, Nohria & Saheer, 2000). But why do firms rely on third-party innovation intermediaries for the creation and support interorganizational networks? In the following I consider how innovation intermediaries create value and alternative approaches to network creation and support, namely internet-based networks and networks supported by organizations that are not dedicated innovation intermediaries.

In a classic paper, Ouchi (1980) draws on transaction cost economics to suggest that performance ambiguity and goal incongruence criteria can be used to appraise the relative efficiency of alternative modes of organization. The market is most efficient when performance ambiguity is low, authority relations are most efficient when performance ambiguity and goal incongruence are both moderately high, and the network or clan is most efficient when performance ambiguity is high and goal incongruence is low (Ouchi, 1980). The networks supported by innovation intermediaries are typically comprised of groups of firms in the same region or industry that share common goals. But maintaining the goal congruence essential to network sustainability requires ongoing effort, especially when network leaders engage in the types of brokerage activities described earlier. Investigating leadership in open innovation communities, Fleming and Waguespack (2007) find that the inherent lack of trust associated with brokerage demands vigilance on the part of community leaders to mobilize volunteers and avoid forking (the establishment of spin-off communities) and balkanization (the establishment of divisions within the community). Because dedicated innovation intermediaries focus exclusively on supporting the firms in their network, they are able to simultaneously engage in value adding brokerage activities while working to promote goal congruence and trust among network participants.

Supporting a network goes far beyond providing a platform for bilateral or multilateral exchanges or communication. Notwithstanding the network terminology, internet-based platforms such as Alibaba in the business-to-business ecommerce market, Amazon's Mechanical Turk in the low-skilled labour market, and Innocentive in the contract research market facilitate bilateral, market-based exchanges that rely on low levels of performance ambiguity, not low levels of goal congruence to mediate exchanges efficiently. Internet-based social networking sites such as Facebook and Linked-In allow individuals or organizations to create or support networks, but such sites only provide the medium, not the services that ensure the network creates value for users. The value they offer is reflected in their low or non-existent usage fees. To offer value to participants, internet-based networks, no less than traditional networks, require active intervention to create and strengthen network ties and shape network structure.

The argument that firms benefit from the network shaping activities of innovation intermediaries acting as referent organizations does not explain why there exist dedicated organizations to perform this role. Indeed, many organizations that are not dedicated innovation intermediaries also perform this role. These sometime intermediaries include manufacturers that manage supplier networks, venture capitalists and firms that engage in corporate venturing, and management consultancies whose primary objectives are their own business success, rather than the success of the firms in their network. And in some cases these organizations offer more than network support. They may also act as the all-important first customer, a major customer, or provide leverage with customers or suppliers that an intermediary cannot match. What benefits do dedicated innovation intermediaries provide beyond those provided by the sometime intermediaries?

While membership in the networks of dedicated intermediaries is generally open to all firms and allows firms to maintain complete autonomy, membership in the networks of the sometime intermediaries may be limited to their suppliers or clients and may involve compromised autonomy for participating firms. This means that not only are such networks inaccessible or unsuitable for most firms, they may offer reduced network size, scope, and benefits for participating firms. In addition, reliance on the sometime intermediaries may lead to contract failure (Hansmann, 1987) if, when faced with conflicting objectives, the sometime intermediaries abandon their commitment to their networks in favor of their private interests, as Sun Microsystems (Garud et al., 2002) and Intel (Gawer & Cusumano, 2002) have reportedly done. Echoing Ouchi's argument that high levels of performance ambiguity demand low levels of goal incongruence for economic efficiency, contract failure suggests that when the quality of a service is difficult to appraise, compare, negotiate, or verify, consumers will better served by a nonprofit organization than by a for-profit firm because a nonprofit organization will not be motivated to diminish the quality of the service to maximize profits (Hansmann, 1987). Because it is difficult for the clients of intermediaries to judge the relationship between intermediary effort and the quality of intermediary services, they entrust the provision of intermediary services to dedicated intermediaries that are wholly committed to working on their behalf.

## **Why Innovation Intermediaries Perform Technology Development and Related Activities**

While intermediaries that perform interorganizational networking activities benefit from an inherent level of goal congruence to create and support networks, intermediaries that perform technology development and financing activities do not. They operate in the innovation gap, a space between the business and research communities where goals are incongruent and performance is highly ambiguous. As a consequence, economic incentives are weak and legitimacy is hard to come by.

***The business and research communities.*** Occupational communities are groups of people who consider themselves to be in the same line of work, who identify with this work, and who share common values (van Maanen & Barley, 1984). While there is no single business or research community, but rather many such communities that operate in different industrial sectors and different disciplines, in the following I identify the business and research communities as archetypes and describe their common features. I focus primarily on technology-intensive business communities in sectors such as information and communications, energy, environment, transportation, and health care, and on research communities in technical disciplines such as engineering, the natural sciences, and medicine. The business and research communities are depicted on either side of Figure 2, below.

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Firms are the central organizations in the business community. They conduct business activities such as opportunity identification, resource acquisition, new product, process and service design, manufacturing, sales and marketing, and financing, and are supported in these efforts by a wide range of institutional players. There are several universally accepted indicators of business performance including profits, revenues, and market share, so that regardless of the sector or industry of a given firm, its performance can be measured and compared (McGahan & Porter, 1997). As a consequence, high performing individuals and organizations can be rewarded and the set of individuals and organizations participating in business activities can be identified.

Central organizations in the research community, alternatively known as the “Republic of Science” (Dasgupta & David, 1994), include universities, research institutes, and researchers in firms. These individuals conduct research activities such as problem identification and project design, theorizing, experimentation and observation, data collection and measurement, analysis and interpretation, and communication of results. Achievement is measured in awards, citations, and publications, and these measures of accomplishment apply across many research disciplines, allowing cross-disciplinary comparisons of the performance of researchers and research organizations. As a consequence, high performing individuals and organizations can be rewarded (Stephan, 1996).

***The innovation gap.*** As observed by several researchers and commentators, and as depicted in Figure 2, the business and research communities are separated by an innovation gap, alternatively known as a commercialization gap or the ‘valley of death’ (Branscomb & Auerswald, 2002; Dasgupta & David, 1994; Furman, Porter and Stern, 2002; Kaufmann & Tödtling, 2001; Murphy & Edwards, 2003; Wessner, 2005). Dasgupta & David (1994) identify

two organizational spheres, one governed by commercial interests and the other by the “new economics of science”, and an area devoid of economic incentives between them: “Another major conclusion, arrived at in the context of examining policy measures and institutional reforms proposed to promote knowledge transfers between university-based open science and commercial R&D, is that there are no economic forces that operate automatically to maintain dynamic efficiency in the interactions of these two (organizational) spheres” (1994: 487). Furman, Porter and Stern (2002) describe a country’s national innovative capacity in terms of three factors that capture the strength of a nation’s industrial clusters, the strength of its capacity for generating new knowledge, and the strength of the linkages between the two communities. They describe the US and German innovation systems as being composed of private sectors populated by firms in several industries and public sectors populated by several types of research and educational organizations, separated by ‘intermediate’ areas (2002: 904, Figure 2).

The innovation gap is a consequence of the disparity in goals and performance measures of the business and research communities (Dasgupta & David, 1994; Gittelman & Kogut, 2003; Merton, 1973). Firms face ever-increasing pressures to deliver measurable results and as consequence are reluctant to invest in R&D activities. Even in cases where firms do invest in R&D, there is increasing pressure for those activities to produce measureable business results. Branscomb and Auerswald report on a study of US firms: “Increased pressure on R&D to deliver measurable results was also cited as a key force that has driven corporations almost entirely away from basic R&D, and makes it difficult to justify many activities that do not support existing lines of business. Projects that did not have demonstrable financial benefits were not funded, and the R&D portfolio shifted dramatically toward product development. This trend transcended all of the industries that we covered” (Branscomb & Auerswald, 2002: 86). Motohashi and Yun (2007) report a similar decrease in the percentage of Chinese firms carrying out exploratory R&D activities. Even venture capitalists are increasingly reluctant to invest in early stage companies and prefer to invest in revenue-earning companies (Branscomb & Auerswald, 2002: 48).

Researchers in universities and other organizations are similarly compelled to adhere to research objectives and produce measurable research results (Stephan, 1996). Even though researchers recognize that their findings are unlikely to be commercialized without further development and testing, they are reluctant to undertake such activities because doing so will detract from their ability to produce measureable outputs such as high quality papers that are likely to be cited. As a consequence, university inventions, even those that are licensed, are embryonic in nature and require further development once they are licensed. Based on a study of 62 US research universities Jensen and Thursby (2001: 243) report that of the licenses in their sample “only 12 percent were ready for commercial use at the time of license, and manufacturing feasibility was known only for 8 percent. Over 75 percent of the inventions licensed were no more than a proof of concept (48 percent with no prototype available) or lab scale prototype (29 percent) at the time of license!” Companies use inducements such as royalty payments and equity shares to induce university inventors to participate in technology development and testing activities that are unlikely to lead to outcomes such as publications that are valued by the scientific community (Agrawal, 2006).

But progress on innovation gap activities is difficult to demonstrate, as there are no universally accepted indicators for measuring progress on transforming new technologies into states of commercial readiness. While a layperson can use general benchmarks of commercial or scientific success to arrive at a crude appraisal of which firms or universities are high performers, there are no such indicators for organizations that operate in the innovation gap. To understand technology development achievements, it is necessary to understand the specifics of each case. It is impossible to know whether two years work on a new fermentation process has achieved more or less than three years work on the refinement of a machine vision system. As a consequence, organizations and individuals that conduct technology development activities in the innovation gap may be unable to demonstrate much in the way of commercial or scientific output.

***Why innovation intermediaries exist.*** Innovation intermediaries that conduct or support technology development activities are the only organizations that purposefully position themselves in the innovation gap. They do so to enhance the capacities of national, regional or sectoral systems of innovation by intermediating on the intercommunity level, between the business and research communities. Other organizations may have some innovation gap activities or may, of necessity, may operate in the innovation gap for a limited period of time. Examples include the R&D activities of firms (Gittelman & Kogut, 2003), and university spin-offs that must transition from the world of science to the world of commerce (Pries & Guild, 2007). But to fulfill their missions, technology-based innovation intermediaries must operate in the innovation gap and must evolve their activities to avoid getting pulled towards either the scientific or commercial poles. While their activities may generate revenues or scientific publications, to maximize their contributions to the innovation systems in which they operate, they must focus on the problem solving, technology development, and testing activities that other actors are reluctant to undertake. Figure 2, above, shows innovation intermediaries that conduct or support technology development activities and operate in the innovation gap and those that restrict themselves to networking activities and operate in the business community. It also shows research intermediaries that perform interorganizational networking activities in the research community but that do not have a mission to enable firms. Examples include associations of universities and research organizations.

Measurement difficulties also account for why governments are more likely to fund research activities than support innovation intermediaries, despite the fact that the latter may be more likely to yield near-term social or economic benefits. Governments are willing to invest in scientific research despite its exploratory nature and the public dissemination of research results because the impact their investment can be measured and demonstrated to citizens. There are numerous accounts of the scientific performance of nations (King, 2004) and these motivate governments to continue to invest. As a consequence of the reluctance of governments to fund activities whose outcomes are difficult to measure, innovation intermediaries are perpetually vulnerable organizations. There are no annual rankings of innovation intermediaries that organizations can provide their stakeholders with evidence of their effectiveness. Howells describes the vulnerability of intermediaries in the UK; at one time Canada had provincial research organizations in all 10 provinces but now only five remain (Statistics Canada, 2006). Those organizations that are not vulnerable are old, large and have significant revenue streams from past successes or endowments. The Fraunhofer Society earns approximately 50 million

Euros per year from its MP3 licences, and the Battelle Institute at one time earned so much money from xerography royalties that it was at risk of losing its nonprofit status.

## **DISCUSSION**

Innovation intermediaries seek to enhance the innovative capacity of regions, nations, and industries by conducting interorganizational networking activities and technology development and financing activities in the innovation gap that separates the business and research communities. Innovation intermediaries that operate within the business community rely on an inherent level of goal congruence amongst the firms in the region, nation, or industry that they support. They provide value to network participants through brokerage activities design to provide access to external resources, while working to maintain the goal congruence required for network sustainability. Innovation intermediaries that operate in the innovation gap face a dual challenge of high levels of performance ambiguity and high levels of goal incongruence. Performance ambiguity is a consequence of the lack of universal measures of progress on the transformation of early stage discoveries and technologies into commercially viable products and services. Goal incongruence is a consequence of their reliance on the engagement of members of both the business and research communities, who have divergent goals. While innovation intermediaries works towards the economic success of firms, regions, and industries, they are social enterprises insofar as their purpose is not their own success, but the success of their clients or members.

The innovation gap is not the same in all sectors or in all countries (Martin & Scott, 2000). In sectors such as software where capital expenses are low, the innovation gap is minimal. It may also be less problematic in sectors such as biotechnology where there are general indicators of progress, in the form of clinical trials, in the process of transforming scientific knowledge into commercial products. But in primary and secondary sectors such as agriculture, mining, transportation equipment and petrochemicals, transforming scientific advances into commercial practice involves prototyping, piloting and testing activities in which progress is idiosyncratic. It is impossible for the technology developer to convey progress to investors without getting into the details of the specific case. And so it is difficult for both private and public sectors investors to develop a summary understanding of the outcomes of their investments or to compare the prospects of alternative technology development investments.

### **Policy Implications**

Many attempts have been made to reduce the innovation gap and increase the interaction between individuals and organizations the commercial and scientific spheres. Governments everywhere try to motivate firms to increase their investment in R&D, with mixed results. While some firms make significant investments in research, the vast majority of whom neither invest in research nor engage with the scientific community. Governments have also attempted to change the behavior of university researchers, providing greater incentives for them to work on problems of commercial importance and to participate in the commercialization of their research findings. Similarly, while university researcher patents and enterprises are on the rise, the majority of researchers restrict themselves to operating solely within the research community. Ironically,

there are been few calls to increase support for those organizations that whose purpose it is to bridge the gap between the business and research communities—innovation intermediaries. For example, the 139-page report published by the US National Institute for Standards and Technology entitled “Between invention and innovation” mentions only one innovation intermediary in a footnote, despite the fact that two of the four case studies in Annex II (Company Narratives) credit a nonprofit research consortium (the Advanced Battery Consortium in both cases) with important contributions (Branscomb & Auerswald, 2002).

The primary policy implication of this paper is that governments interested in promoting innovation and the performance of firms should look to those organizations whose *raison d'être* is to do exactly that. And they should not be surprised to discover that such organizations have difficulty demonstrating their effectiveness or impact in widely understood metrics such as revenues or publications. Indeed efforts to measure the performance of innovation intermediaries using metrics such as revenues or publications risks diverting them from their most important work. By conducting and supporting innovation gap technology development activities, intermediaries increase efficiency of innovation systems by allowing business people and researchers to specialize on the activities they do best. This brings me to the answer for the second question posed by business people, why should we give taxpayer's money to organizations that are helping private firms? Supporting innovation intermediaries may be the most effective way in which governments can increase the innovativeness of firms in the public interest.

Merton (1995) explains that the function of financial intermediaries is complementary to the function of financial markets. While financial markets operate efficiently when products are standard, serve a large number of customers, and are well-understood, financial intermediaries provide products that are low volume, either because they are highly customized, or because they are new. Products provided by intermediaries migrate to financial markets as they become seasoned and information asymmetries are resolved (Merton, 1995). Similarly, Lamoreaux and Sokoloff (2002) show how intermediaries in the market for technology (patent lawyers and agents) contributed to US inventiveness at the turn of the 20<sup>th</sup> century by allowing inventors to focus on inventing. Innovation intermediaries are similarly best understood as contributing to dynamic efficiency in customizing and adapting knowledge and technologies.

## **Future Research**

Future research is need to explain the founding, growth, and survival of innovation intermediaries and to establish the degree to which existing theories of superior organizational performance, developed to explain the prospects of for-profit firms, apply to innovation intermediaries. Both the resource or competency-based theory and the population ecology theory are contenders for explaining the prospects of intermediaries. This will require methodologies for measuring the performance of intermediaries, to produce an organizational performance metric that is applicable across intermediary types. While it will be all but impossible to develop general metrics on progress on technology development activities, commonalities in the purpose and activities of innovation intermediaries suggest the possibility of a common framework for measuring their impact.

In addition to facilitating research on organizational performance, a general means of measuring innovation intermediary performance would provide many practical benefits. First, it would reduce the need to resort to less appropriate measures such as revenues and publications to measure performance. Second, it would enable the intermediary investors and stakeholders to distinguish between high and low performing organizations. Third, it would induce intermediary employees to focus on activities that maximize organizational objectives and performance. And fourth, it would be a step towards the creation of a competitive market for resources amongst intermediaries, accelerating organizational growth for high performing organizations and changes in management or structure or organizational death for low performing organizations.

I close with some thoughts offered in response to the first question on innovation intermediaries posed by business people—why is there such a confusing variety of innovation-related organizations, some of which are poorly run, but all of which seem to want my time and money? First, it needs to be said that there is a confusing variety of for-profit firms, many of which are also poorly run. So it should not be surprising that there is great variety amongst innovation intermediaries, and it is all but inevitable that some of them will be poorly run. Second, it is important that the resources and capabilities of innovation intermediaries are sufficiently specialized to understand and facilitate a response to the opportunities and challenges that are faced by the firms that are their members or clients. This may require a population of innovation intermediaries whose heterogeneity mirrors that of the population of firms they serve. Third, improved conceptual models of innovation intermediaries should make it easier to make sense of them.

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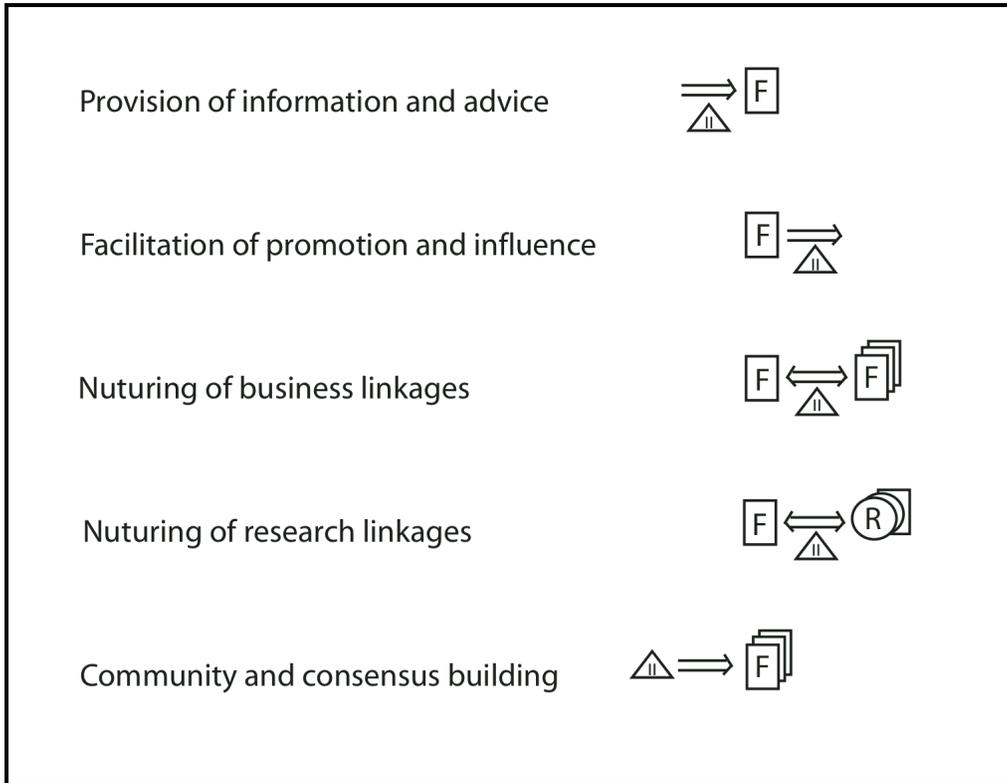
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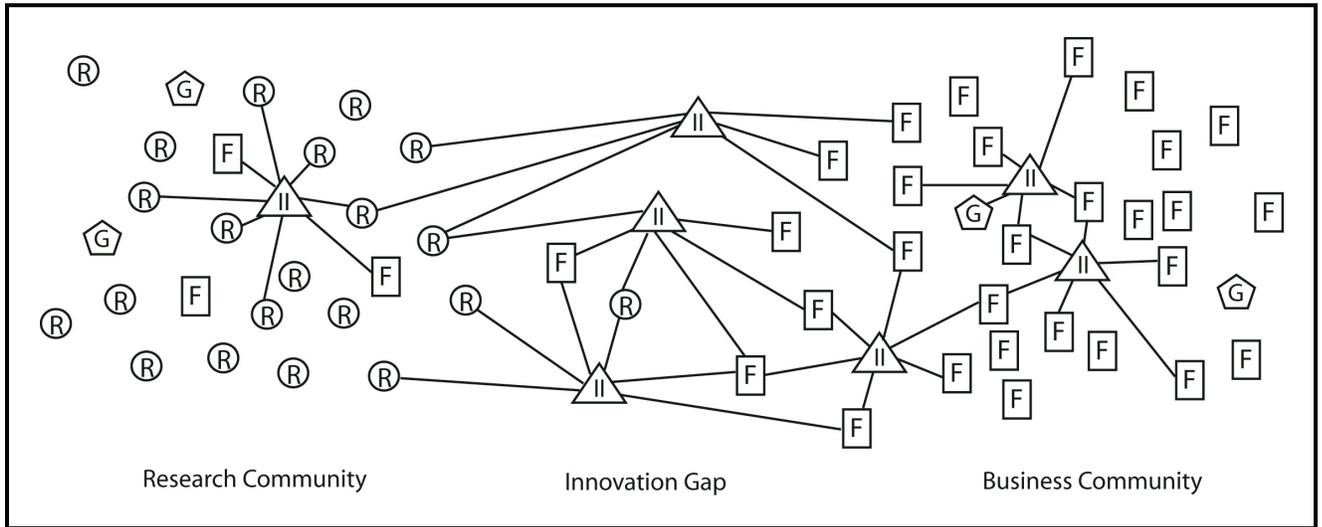
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**FIGURE 1**  
**Interorganizational Networking Activities**



**FIGURE 2**  
**A System of Innovation**



- F Firms
- R Research organizations: universities, government research organizations, nonprofit research institutes
- G Government departments and agencies
- II Innovation intermediaries