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Procedia - Social and Behavioral Sciences 26 (2011) 85 – 93

Procedia
Social and Behavioral Sciences

COINs2010: Collaborative Innovation Networks Conference

The role of trust in innovation networks

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Elsevier use only: Received date here; revised date here; accepted date here

Abstract

Innovation networks, a form of open innovation, can be implemented in several configurations or typologies. One form that has gained some traction in the marketplace is the knowledge intermediary or hub firm that attempts to create two-sided market in intellectual property (Rochet & Tirole, 2004). This paper examines how trust, which has many possible institutional roles, may be critical to the successful operation of innovation networks and hub firms in particular. A case study from the automotive industry is used to examine the role of trust in innovation networks.

Keywords: innovation network; open innovation; trust; technology validation; startup; principal-agent; two-sided markets; automotive

1. Introduction

In 2009, the US domestic auto industry collapsed economically despite many efforts over the years by government agencies and numerous concessions from labor. The size of this "innovation failure" has created enormous and ongoing fiscal pressures on communities dependent upon the auto industry for jobs and economic well being. Clemson University International Center for Automotive Research (CU-ICAR), in partnership with the American Society of Mechanical Engineers (ASME) and with funding from the Department of Energy, designed and implemented a new type of innovation network called the AutoVenture Forum™ (AVF) as an experiment to address one perceived weakness in the US auto industry; a lack of innovation. The forum was designed to bring the entrepreneurial energy and insights of early stage startup companies together with senior managers from the US automotive industry to facilitate new connections, relationships and deal flow that might not occur by conventional methods.

The AVF brings together two disparate groups of companies around a common technology theme, e.g. battery technology or human-vehicle interface, under the general framework of open innovation. The forum is conducted in an environment with all competitors (large firms) and startups present. Several guidelines were established in conjunction with the participants to foster collaboration and sharing. Unlike conventional venture capital

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1877-0428 © 2011 Published by Elsevier Ltd.
doi:10.1016/j.sbspro.2011.10.565

investment forums where the outcome is most likely an equity investment, the AVF seeks to facilitate multiple connections directly between the innovators and key decision makers that can put the innovation to use. The forum is designed as a two-sided market (Rochet & Tirole, 2004) with AVF playing the role of platform developer or "hub firm" (Dhanaraj & Parkhe, 2006). Unlike regional competitions or investment forums where many technologies and markets may be represented, the AVF is global in scope but focused on a single industry. Startups are recruited from around the world in order to present the best technologies available for a specific application.

The AVF is not focused exclusively on pre-competitive research per se, such as might be sanctioned by the National Competitive Research Act (NCRA) of 1984. NCRA relaxed existing anti-trust statues and enabled US companies within a single market to collaborate on pre-competitive research. However, the AVF structure is technology and problem agnostic: it can support any area of interest provided there are enough early stage companies to recruit.

The creation of trust in innovation networks is the primary research question in this paper. The creation and maintenance of trust-based relationships reduces transaction costs, risk and is crucial to long term relationships. Trust within the context of B2B innovation networks is complex, as it depends on both the personal characteristics of the key staff and the trust relationship between organizations (Zaheer, McEvily, & Perrone, 1998). As an example, the large companies who pay the bills in this type of network face problems of validating the claims and capabilities of the small companies. Small companies may be forced to disclose much more information and face higher risks. From the hub firm perspective, not all startup companies are equal in their maturity, strength of their business model or their staff. This requires that each startup company be individually studied and validated prior to granting access to the network, creating a difficult challenge for the network organizer.

The relationships that the two sides are seeking may be dramatically different. Some startups may be looking for that first corporate partner while others are looking to secure licensing or sales. The large firms may be looking for answers to marketing or regulatory problems in one line of business or trying to find technology partners in another. The hub firm then, must create a collaborative environment that can bring together the right mixture of startup companies and large firms and establish an initial level of trust quickly. While risk and interdependence are useful components of trust (Rousseau, Sitkin, Burt, & Camerer, 1998), the B2B innovation network case study shows that risk is asymmetric (Blomqvist, Hurmelinna, & Seppanen, 2005): the large company may forgo a good opportunity but a bad outcome won't be catastrophic. The small company however, takes on considerable risk and may become dependent upon the large company.

Many of the well known institutional problems are present in B2B innovation networks. All of these can influence trust. Principal-agent, moral hazard, adverse selection, knowledge asymmetry, and free-riding problems may arise if the hub firm is not sufficiently independent of the payers or does not adequately enforce the formal and informal rules of the network. Use of public funds such as federal or state grants may tempt political influence being applied to the hub firm's operation. Depending on how the major firms assign their share of costs, larger payers may be tempted to influence the hub's decision making process at the expense of smaller firms. Inadequate screening of startup companies can allow unqualified firms into the network creating adverse selection problems. If the hub firm takes on additional tasks of managing technology validation as a service, then the validation service creates a new expectation but also the risk of moral hazard if the hub's recommendation and technology performance don't match. Inadequate screening and lax enforcement of institutional rules within the network may encourage free riding by large firms. The situation is ripe for agency problems if the hub firm engages in opportunistic new service creation that could potentially take advantage of their proprietary knowledge.

This paper begins with an organizational description of innovation networks. Next the trust problem in innovation networks is defined. Several propositions are offered to explain the role of trust. Three different theoretical lenses are used to analyze the forces affecting trust propositions: two sided markets, the economics of trust and open innovation. The phrase "startup" refers to startup companies and university spin-outs that have acquired seed funding from angel investors. University spin outs are startup companies that have taken a license to university technology. The large firms are referred to as "principals" as they are expected to pay most of the costs.

The AutoVenture Forum format is referred to as a "B2B innovation network" to distinguish it from organizations where the relationship is primarily between individuals and a hub firm.

This research has two major implications for public policy and innovation policy in particular. First, every state and the Federal government is looking for ways to stimulate innovation in the private sector. Some of these policies and incentives can be extremely costly to taxpayers such as providing long term tax breaks, industry subsidies or making loans to companies that are lucky enough to have their technology aligned with current national policy (Lerner, 2010). An innovation network by comparison may enable new job creation within small companies by simply harnessing the collective power of entrepreneurs in a novel way. Second, fifty to sixty thousand startup companies are funded annually by angel investors (Sohl, 2009). Assuming less than five percent of these companies will receive venture financing, there is a potential to create value by connecting a greater fraction of these small companies to large corporate partners.

2. Body

2.1. Organization of Innovation Networks

Networks are essentially a type of organization design. Organizations that exist primarily as networks can have different organizational schema but still face some of the same institutional problems and constraints that are common to other organizations. I propose that there are at least five major components (Dhanaraj & Parkhe, 2006) within the B2B innovation networks suggested by this paper: (a) principals; (b) hub firm or knowledge broker; (c) startup companies as technology providers; (d) specialists and; (e) informal and formal connections to other networks. Hub firms in this paper are considered standalone legal entities. The specific type of organization (profit or non profit), ownership and governance of the hub firm is beyond the scope of this paper.

Principals are the organizations that are seeking technology solutions. Principals provide the initial funding and play a major role in establishing the governance of the organization. They make the economic arrangements with technology providers, facilitated by the hub firm and specialists.

The hub firm or knowledge broker at the center of the firm is the enabling force within the organization. The hub owns the acquisition and trust verification process and coordinates transactions between technology providers and principals, bringing in the specialists when needed. The hub firm also negotiates the connections to other networks such as professional societies that play major roles within a specific industry. Technology providers provide solutions to the problems and investment focus set collectively by the principals. Access to the technology is accomplished outside the formal institutional rules of the network. Specialists provide expert assistance and commentary in all aspects of the network's operation.

Each of these players in the network have different economic incentives. Principals can capture value from the network is several ways. First, there should be a decrease in the transaction costs associated with new technology, when compared to existing methods. Second, they can benefit from an increase in revenue due to innovations acquired from interactions. The hub firm can create and capture value from the deal flow between technology providers and principals. Operation of the network over time may create new value added services that can be offered to principals or technology providers. The technology providers have a strong set of incentives to participate including access to investment capital and expertise, potential partnerships and collaboration with other technology providers.

2.2. The Trust Problem in Innovation Networks

The trust problem facing the innovation network is multi-sided. Principals must be convinced to join the network and participate. Their commitment to the network and its funding is contingent upon the perception of ongoing

value creation and value capture. Startup companies' confidence and continued participation in the network is driven primarily by access to key decision makers within the large companies. Both sides of the innovation marketplace expect the hub firm to provide the right match between providers and large companies looking for solutions. Specialists have a less sensitive role due to their position as service providers. If networks are to be leveraged to bring in candidate companies, the staff members of the hub firm must be able to establish trust quickly with other network operators to gain their support.

Proposition 1: The hub firm is responsible for the creating the environment of trust among all sides of the innovation marketplace.

The connection from the hub firm to other networks is an important organizing task for the hub staff. The distribution, quantity and suitability of a population of startup companies in the initial planning stage for an event sponsored by the AVF is considered an unknown in this paper. Further, an event focused on a specific application such as infotainment (in-vehicle entertainment) can bring in a wide variety of possible solutions from content providers, wireless networking, to software development platforms. Some of these companies may be exclusively focused on the automotive sector while others may be opportunistic and see the auto industry as a new application of their products and services. Therefore, recruiting startup companies to participate in the network can be time consuming and costly. Social and professional networks become extremely valuable in finding the best candidates among a very diverse population. The hub firm staff must be able to leverage its personal and organizational social capital with other organizations in order maintain the flow of the best qualified companies (Burt, 2000). Professional societies, such as ASME, play a key role in enabling the organization of the individual events and leveraging their professional member networks. Regional innovation networks, incubators and angel capital groups can also be a source of startup companies.

Proposition 2: The hub firm trust relationships must extend into the external social and professional networks crucial to recruiting the best technology providers.

Once candidate technology providers are identified and express interest the next step is to validate both the company's business model and their technology. The term "technology" is used broadly to encompass both tacit (know-how) and explicit intellectual property. The larger firms understand that their definition of technology and business model validation may be very different from a small company's point of view. The hub firm must level the expectations. This is a key point of departure between the B2B innovation network envisioned in this paper and current venture capital investing. The range of possible deals at the AVF provide considerable discretion by the hub firm in selecting firms to present. This is in contrast to venture investing where investors are focused primarily on identifying only the most promising candidate companies that can achieve a very high rate of growth and financial return. Essentially, the innovation network seeks to lower the risks and costs of finding new innovations but expects to dramatically increase the volume of deals along the lines of Auerswald's policy recommendations (Auerswald, 2008).

Proposition 3. B2B innovation networks must operate in an environment of high trust

The large number of potential candidate startups coupled with a more relaxed investment objective suggests that the validation or trust process can be simplified for the innovation network when compared to the processes followed by corporate and venture capital firms (Fried & Hisrich, 1994; I. Macmillan, Roberts, Livada, & Wang, 2008; I. C. Macmillan, Zemann, & Subbanarasimha, 1987). In reviewing executive summaries, phone interviews, and other third party sources of validation, the AVF experiment has found that an effective screening process can be designed and executed so that it meets the expectations of both sides of the marketplace.

The screening process then becomes a key proxy for trust between the principals and the hub firm. Failure to bring in companies that are a good match to the principal's expectations causes a loss of confidence. We have found that the screening process in this case study primarily consists of two components: validation of the startup company's business model and validation of the technology platform. We are less concerned about the total

addressable market in the business model and more focused on ensuring that there is a clear value proposition for the principals, in this case the auto industry. Of the two, the validation of the technology seems to be the larger challenge of the two components because many angel investors simply do not want to pay for experiments. Solving the validation problem is both challenging and critical for the company to progress.

Proposition 4. A modified technology and business model validation process, a proxy for trust in B2B innovation networks, can be adapted from existing research into corporate and venture investing.

2.3. Multi-sided Markets

Given the definitions and explanations of the roles of hub firm and trust within an innovation network, the next step is to use several existing theories to probe the definition of trust to better understand the role of trust. An overview of multi-sided markets is helpful in understanding the challenges facing B2B innovation networks like the AVF. Multi-sided markets are an important area of study for economics and public policy. Public policy makers and regulatory agencies that focus on competition policy are concerned with harm to consumers due to monopoly behavior by some market operators. The economics of multi-sided markets are important because of their ability to create value.

Two simple examples of existing multi-sided markets that can help understand trust in innovation networks are credit cards and dating clubs (Evans & Schmalensee, 2005). The credit card clearinghouse or "platform" owns the credit card brand and provides the settlement function between buyers and sellers. In order to grow the business, the owners of the credit card brand and clearinghouse must convince lending banks to encourage consumers to apply for and use the card. Merchants and their banks must be recruited to accept the card for payment. In some cases, one side of the market may be subsidized by the other in order to grow the overall transaction volume. Marketing to each side of the market is done by the respective banks using the credit card brand. Designing the pricing and incentive structure becomes a critical task to enable the network to grow and fend off competitors. The structure leaves in place the natural competition between banks for customers.

Dating services and clubs use a different model. In one simple version of a dating club, the host or organizer puts nearly all operational costs on the men. The women are recruited and allowed to come to the club free of charge. Men get a chance to meet the women and approach those they find interesting. If the selection of women attending the club does not create adequate attention, the men may go elsewhere. If no dates occur despite having both men and women at the club, the club may fold. Unlike credit card transactions that happen electronically in seconds, the dating service transactions have many possible outcomes. They may need time to develop, end quickly or simply not occur for a multitude of reasons. Dating services, which charge both sides of the market, see the two sides as equal and benefit from their ability to find the right match.

In credit card markets, trust is usually established with consumers via credit ratings and enforced with spending limits and penalties. Those with low credit scores may still obtain a credit card (some trust is extended) but face penalties for late payment or carrying balances (risk carries a price). Trust then has a very real measureable economic cost to consumers. Obtaining "trust" via a new credit card for the first time can be done with almost no proof of ability to pay. Credit card transactions per customer are expected to be repetitive and long lasting. If customers use the card frequently and pay bills on time, the card companies will extend more credit, increasing the trust level. Lack of trust or increased risk results in higher borrowing costs or lower credit limits.

In the dating service however, trust is more complicated. The club may establish an informal reputation for facilitating hookups between two groups but this can erode once people stop coming to the club. In addition, the club must establish separate trust relationships with the men versus the women who attend. More importantly for this paper, the trust between two people on a date coordinated by the club won't really be established until a "date occurs". If both parties are interested in a long term relationship then it may take a considerable time for complete mutual trust to occur. But developing the interpersonal trust requires the expenditure of social capital for both men

and woman, something the dating service may or may not be able to reduce. If couples who meet via the dating service simply stop attending, the dating club will have difficulty in demonstrating that they have "created value".

Both examples though are useful in studying how to design, implement and manage B2B innovation networks. Like the dating club, these networks involve two separate groups that are not contractually bound together but still seek to find collaborators and hopefully innovate by bringing new products and services to the market place. Unlike the consumer credit market where consumers are at a distinct legal disadvantage to the banks, B2B innovation networks require more formal consideration between the two parties. One of the basic problems in two sided networks is the question of "who pays" (Evans & Schmalensee, 2005). In the credit card market, the banks pay the clearinghouse a small fee per transaction for use of the brand and the clearing function. The consumer pays their bank via interest and late charges. The merchant banks are paid by the retailers. In the dating service, the men pay most of the costs but over time both men and women will have to expend considerable social and emotional capital to forge a new relationship.

Who should pay for the platform charges for operating the B2B network? The charges may be substantial as considerable interpersonal skill and knowledge depth is required to garner the trust of the numerous corporations from all sides of the market that need to be recruited. Because of the small number of firms in relation to other multi-sided markets, spreading the operational cost of the network equally across all sides may be problematic. However, the value to either the small startup company or large firm from participating in the network could be very high thus creating a very favorable cost-benefit decisions at the margin for those that attend. For example, a small company may spend $2000 in travel costs to attend a forum and come away with connections that may be worth ten or a hundred times their investment. Likewise, a large firm may find a promising technology that enables them to increase sales, compete more effectively, reduce their corporate venturing costs or perhaps shorten the time to market. The public sector benefits primarily from the jobs created in the small companies. If success or "deal flow" occurs at these types of events, local and regional business development organizations that funded the startups will benefit. Summarizing, there are good reasons to assume that the large companies and the public sector will pay for the operation of this kind of network.

2.4. Trust and Principal-Agent Problems in Innovation Networks

The innovation network described in this paper has the potential to create principal-agent (P-A) problems. The hub firm's two-sided relationships may give it an advantage over any one principal or technology provider. This creates a possibility for the hub firm to exploit this knowledge asymmetry for its own gain. Part of this is due to the extensive connections the hub firm must develop into other networks, as discussed earlier, and part is due to the close relationship the hub develops with its members, large and small.

The type and severity of problems that may arise may depend on "who pays" and how value is captured. Two simple examples are helpful in identifying how agency problems may lead to a loss of trust. The first example is an industry-funded organization or hub firm. Assume that the hub firm is funded via contract from an industry association. The association providing funds is governed and funded by industry members. The second example is an organization funded by a professional society. Forums and conferences are a key function and source of revenue. The AVF might be managed as a specialty conference. Other examples, such as a public-private partnerships like Sematech (Carayannis & Alexander, 2004) , or competitions (Fell, 2008) are beyond the scope of this paper.

The industry-sponsored organization could be managed as a purely for profit entity whose primary goal is to create value for members based on its ability to make connections between startup companies and industry firms. The relationship between the hub and the industry association providing the funding is the primary relationship to analyze. If the value creation expectations of the hub firm are clearly stated and can be measured to the satisfaction of the association, then incentives and employment contracts with key staff can be developed. Larger industries may be able to pay all the costs associated with the hub firm and its managed events. If the hub firm's charter is narrowly defined and it serves only a single industry, agency problems should be minimal. The effect on trust is straightforward: a continuous flow of new connections and successful outcomes should build trust between the

industry and its self-funded hub firm over time. Considering the hub firm operates in a truly stand-alone function, the potential for unintended "spillovers" from one industry to another is minimized.

In the second case, a professional society manages the B2B innovation network as an internal function. This approach is not as straightforward as the industry funded example. First, the operating costs of running a hub firm may be significant compared to the revenues of the society. This could create the need to acquire outside funding to support the network. Second, a professional society spreads its revenue, cost and membership functions across several industries creating the possibility of spillovers, from one industry to another. A hub firm operating in this context would need to be careful due to their ability to capture specialized information. Third, to be a self-supporting venue, the society would need to find a way to monetize the deal flow created by the operation of the network or obtain long term industry funding. Given the professional societies' extensive membership network and their expertise at organizing and hosting events, a carefully structured agreement between the society and the industry could enable the network to operate successfully and minimize P-A problems. The challenge for the professional society is developing governance and incentive structure that keeps the hub firm staff together but also discourages opportunistic behavior.

2.5. Trust and Transactions Costs

Two basic questions must be answered by any team that is contemplating starting a B2B innovation networks: how do they create value and can the value be captured? Venture or corporate investors will go to great expense searching for and cultivating a single investment. Because of the magnitude of transaction costs associated with private equity investments, investors would prefer deals with larger value. Smaller deals and non-equity arrangements between early stage startups and large companies need a lower transaction cost platform. This is one of the fundamental problems: how to increase the volume of transactions with early stage companies without incurring the large cost associated with conventional high risk/high return investing.

The traditional view of transaction costs and trust is that two parties considering a possible deal cannot determine the trustworthiness of either player ex ante without incurring great cost (Williamson, 1981). Further, opportunism is expected. Therefore trust is an outcome driven by repetitive successful transactions. A different view of trust and transaction costs was provided in Bromley and Harris's 2006 review (Bromiley & Harris, 2006). Their view is that trust is not simply a yes or no status variable. Opposing parties can determine the basic tenets of a trust based relationship ex ante and without great cost. They defined trust as the answer to three questions. The first question is the expectation of honesty in negotiations. The second is the expectation of that the other party will give their best effort to execute their obligations. The third is the avoidance of opportunistic behavior.

The assumption in this paper is that some amount of trust can be determined ahead of time as Bromley and Harris maintain. However, gaining wider participation and support from both startup companies and larger firms will be contingent upon the AVF demonstrating its goals ex post. Experience with the AVF to date has shown that setting expectations at the beginning of the relationship is crucial in obtaining initial commitments of support from potential members.

2.6. Open Innovation (OI) and Trust

Open innovation (Chesbrough, 2003) research and practice is currently focused on opening up the R&D process to outside collaborators. The theory, and a growing amount of evidence, demonstrates that some firms may innovate more successfully if they can transition from a traditional (closed) to an OI (open) new product development process. Much of the initial theory was developed from studying efforts already underway in industry. A spin-off of this theory is the development of business models based around intellectual property (Chesbrough, 2007). Intermediaries, firms that attempt to create a "secondary market" in intellectual property, have emerged over the past decade to try and capitalize on this concept.

The AVF format roughly translates to a knowledge intermediary (2007). Chesbrough's book on business models is focused mainly on the search for technology. The problem with technology-only search is that the tacit knowledge or the know-how resides with the inventor, not the patent. This transfers the risk of technology validation directly to the large firm. Further, successful commercialization of a new technology requires an entrepreneurial business model that both creates value and enables value capture.

Knowledge intermediaries operating under an OI framework, like the AVF and other companies, may face several problems including two-sided markets, "contamination", and protecting identify (Chesbrough, 2007). Lichtenthaler's (2008) description of the problems facing intermediaries are basically those covered earlier on two-sided markets. Chesbrough's discussion of "contamination" suggests that large and small firms may both be at risk from open innovation. Contamination means that in the event of a dispute, it will be difficult for the large company to defend itself from charges that it has acquired proprietary knowledge without a license. Contamination of the negotiations, essentially opportunistic behavior that destroys trust, between large and small companies in this description fits the argument outlined by Bromily and Harris earlier.

Knowledge intermediaries that attempt to broker deals between multiple individual inventors and large firms may have a more complex trust problem than interactions strictly between two firms. A continuing series of "contamination" problems could cause both sides of the market to back away. Clearly the large companies benefit by having a number of well qualified individual contributors making personal investments to offer solutions to a design or formulation problem. Similar to innovation prizes, this scheme may produce a very low cost solution to problems in two ways (Anonymous, 2010). First, prizes tend to cause a large collective over-investment by competitors, rather than collaboration. Second, outsourcing a solution eliminates the transaction costs associated with the internal R&D or design staff. While this seems a very cost effective way to stimulate interest for a single innovation goal, it is not clear that it is equitable for the many entrepreneurs that invest their time and money.

3. Conclusion

Many factors may affect the success of B2B innovation networks like the AutoVenture Forum. The wide range of potential deals and the expected volume of deals provide the hub firm with considerable decision making discretion in how to recruit suitable startup companies. However, this latitude carries a risk for the hub firm, if they admit a company that is too far outside the theme of the forum. Since risk and trust vary between the two primary sides of the marketplace, repeated small company validation mistakes by the hub can lead to declining attendance by the principals and eventual financial collapse. Trust is also an important consideration in the selection of the staff and how the hub firm develops relationships with all sides of the marketplace.

B2B innovation networks are not immune to the well documented challenges within organizations and institutions. The network may be more susceptible to failure than other types of organizations because of the high reliance on social capital. The use of social capital can be complemented by the development of value added services that will enable the hub firm to become sustainable.

Acknowledgements

I wish to thank Dr. David Bodde, Professor and Senior Fellow, of Clemson University for his support and direction in this project, the US Department of Energy for their financial support, and Robert Leitner director of the South Carolina Institute for Energy Studies. I also thank Ethan Byler and Dr. Christian Przirembel of the American Society of Mechanical Engineers for their generous support and leadership in all phases of the AutoVenture Forum. This paper benefitted immensely from the comments of Dr. Holley Ulbrich of Clemson University and other reviewers. Any mistakes in this paper are mine alone.

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