

## 2 Literature Review

As a central feature of this Master Thesis, a literature review of two main topics was conducted. The two main topics researched were Innovation Networks and Knowledge Transfer. Through the analysis of existing literature, two objectives were pursued:

1. To illustrate state-of-the-art theories in both fields. This includes an extensive analysis of the definitions, motivations, benefits, and barriers to firms in both areas of research.
2. To identify gaps in the existing research and where this study can fill those gaps and contribute to the general discussion in both areas of research.

### 2.1 Innovation Networks

#### Definition

The definition of innovation is one which is difficult to come to a consensus. However, the OECD's Oslo manual defines an innovation as "...the implementation of new or significantly improved goods or services, or a process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations (OECD-2, 2005, pg. 46)". An important distinction of innovation is that it must create some value for the organization which implements it.

Studies conducted in the 1960's and 70's first highlighted the relative importance of external sources of inputs into an organization's innovation processes (Gibbons & Johnston, 1974). As a result of this trend, innovation networks have increasingly replaced roles and functions traditionally undertaken within the closed confines of a firm. An examination of existing theories provides three varying yet similar definitions to the concept of innovation networks:

1. Innovation networks are defined as a set of actors who are interconnected by a series of relationships which ultimately is targeted towards the creation of a new innovation (Busquets, 2010).
2. A innovation network is a social network which consists of a finite set or sets of actors and the relation or relations defining them (Wasserman & Faust, 1994).
3. Networks of organizations and people can be described as innovation networks when competitive advantages are realized through the activities of these networks. The main functions found within any innovation network revolve around innovation, collaboration, and communication (Gloor, 2006).
4. Innovation networks are "...real and virtual infrastructures and infratechnologies that serve to nurture creativity, trigger invention, and catalyze innovation in a public and/or private domain context, for instance, government-university-industry, public-private research and

technology development, co-opetive, which is a combination of cooperation and, sometimes, competitive partnerships (Carayannis & Campbell, 2006, pg. 8)."

### Role of Globalization

The proliferation and expanded use of such networks might be linked to multiple factors, however a paramount factor at play is perhaps increasing globalization. Globalization is typically identified with pressures that have resulted in cooperation among various types of innovative organizations. The inherent process of globalization increases the value of access to unique knowledge which is located in different areas and countries, leading to a need to form deep linkages and cooperation in such innovation networks. Perhaps less subtle is the role which innovation networks play themselves in advancing globalization, as cooperative innovation produces complex and overarching relationships which help form global markets. It can be theorized that the advancing regionalization/globalization of consumer markets will only serve to underscore the importance of such networks, while the pointed use of these networks will become a driver of global interconnectedness (Rycroft, 2007).

In first-world developed countries, the long-term growth of firms and, therefore, the region, sprouts from an innate ability to continually develop innovative products. The competencies needed to innovate require access to "invisible factors", or tacit knowledge coupled with sticky information (Hippel, 1994), which can be difficult to procure, but are more easily accessed through linkages in networks. This underpins the theory that globalization increases regionalization, since knowledge and know-how are often found on a global stage and generally utilized in a local and/or regional context. Additionally, the increasing specialization of organizations and firms which allows them to seamlessly integrate into an innovation network are the same qualities seen in driving global business (Sternberg, 2000).

### Success Factors

A fully functioning innovation network can be comprised of a multitude of actors - (internally and externally) and a diversity of relationships (formal and informal). Regardless of its composition, size, or scope, Hopkins identifies 5 major criteria, or success factors, which must be satisfied for the network to function properly (Hopkins, 2003):

- Knowledge creation, utilization, and transfer: a major goal of innovation networks is to create and disseminate knowledge.
- Dispersed leadership and empowerment: highly effective innovation networks are comprised of capable people who collaborate and work well together. The skill-set needed for the proper functioning of an innovation network are related to those needed for the operation of effective teams.

- Adequate resources: Time, finance, and human capital are central to a network meeting its goals.
- Clarity of structure: Effective networks are well maintained and organized with logical and clear operating procedures and mechanisms for ensuring that proper participation can be achieved.
- Consistency of values and focus: It is crucial that innovation networks have a common and clear aim/purpose. The values which underpin the network must be well communicated and shared by all.

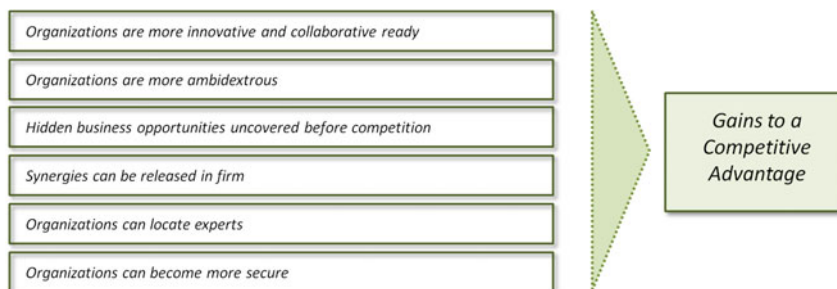
The degree to which an organization can benefit from any knowledge flow which occurs is heavily dependent on the absorptive capacity of the individual unit. The absorptive capacity refers to the ability of the organization to easily integrate external knowledge into its own working stock. The channels of knowledge flow represent one of the most important advantages to using an innovation network. Conversely, absorptive capacity generally increases with the organization's prior cooperation experiences, which highlights the importance of the repeated use of such networks (Küppers & Pyka, 2002).

#### Benefits of Innovation Networks

An important consideration associated with innovation networks is determining what value which they provide its members and how they generate worth for all involved. Existing theory has covered this extensively and the results are varied and diverse. In general, individual firms have five motives which drive them to participation in such networks: The high costs and risks of R&D projects, an attempt to shorten the period between discovery and market introduction, the exploration potential of new markets and new market niches, technology transfer, and the monitoring of technological opportunities and evolution. (Pyka, 1999). As new technologies have been introduced and integrated into current product spaces at rapid rates, the need to mesh new kinds of expertise and knowledge - both in production and innovation activities - has created a new demand previously unseen. This widening of the technological base creates a gap in firms in that the information and technology needed for innovation may lie outside their traditional core competencies, creating motives to enter and use innovation networks. This often leads to firm's filling structural holes, increasing their position of centrality, and the formation of regional temporary clusters. (Cowan, Jonard, & Zimmermann, 2005).

Taken as a whole, it can be said that that any firm which utilizes the services offered by an innovation network can gain a competitive advantage by capitalizing on various organizational benefits, as show on the next page in Figure 2. In general, innovation networks help a firm to achieve these competitive advantages by:

**Figure 2:** Organizational Benefits of innovation Networks



**Source :** Own Illustration based on (Gloor, 2006)

1. Making organizations more innovative and collaborative: by exposing itself to other capabilities not concentrated on within the confines of a firm, the intrinsic innovation capabilities of a company can be improved, leading to a better overall culture.
2. Making organizations more ambidextrous and able to react to market and technology changes as well as new and disruptive market entries: disruptive innovations can enter a marketplace and change the value proposition of a product's paradigm. Firms which are plugged into networks of collaborators often are able to identify threats quicker or themselves become the producer of a disruptive innovation.
3. Uncovering hidden business opportunities before the competition: new markets and distribution channels often come about as a result of innovation networks complimentary processes.
4. Allowing for the release of synergies within the firm: collaborating is a skill which often must be trained with employees. By actively participating in external innovation activities, firm employees will be more likely to cooperate internally as well.
5. Helping organizations locate experts: business problems require solutions which are not always available in-house. Theory holds that if a firm cannot find experts within the confines of a particular innovation network, it will be more likely to find an expert elsewhere based on the contacts it has made within the initial network.
6. Leading to more secure organizations: long-term prospects of a firm are vastly improved by engaging in such activities.

In addition, the various actors of an innovation network generally look to accomplish several goals together as a unit: sharing the costs and risks of innovation (Penrose, 2008), taking advantage of the transaction costs (Williamson, 1991), using strategic and resource advantages, benefiting from the trust in a network dynamic (Van de Ven, Polley, Garud, &

Venkatraman, 2008), and benefiting from the soft social and cultural fit among the actors (Kogut, 2000).

Another important aspect which must be considered when examining a firm's innovation network activities is the financial flow advantage which could be obtained as opposed to merely innovating internally. Start-ups and developing firms generally are missing the economic competencies to finance their own R&D and are forced to find a cooperation partner. In the case of such partnerships, the intellectual property rights of the ensuing R&D results must be defined at the beginning of any undertaking (Küppers & Pyka, 2002).

As an added feature of using networks to innovate, organizational learning can be essentially better addressed and articulated as a result. Firms embedded in an innovation network are required to not only know what other firms/organizations are doing, but how they are doing it as well. To support this inter-firm learning process of long-range know-how, a fixed and cooperative environment is necessary (Pyka, 1999). This points to an improvement not only in the firm as a whole, but in individual efforts as well. Individuals in a network are able to build a wider base of colleagues by being in contact with committed people with shared values. Moreover, personal relationships with leaders of a field can be established. Individuals who participate in their firm's activities within a network often learn new skills and become experts themselves (Gloor, 2006).

The range of the benefits gained through the use of innovation networks is indeed broad and transcends the boundaries of any single firm. Companies can generate momentum in growth both from and for their region, as innovative linkages hold a critical importance for many businesses scattered throughout multiple regions. In the absence of such linkages, lock-in effects can occur which lead to stagnation and path dependency. Simmie and Kirby identify innovation networks as "...the nexus between the forces which increasingly expose more firms to international, competitive markets and the structures and strategies which they adopt to compete successfully in those markets and the local conditions, regulations, and regimes which enable parts of or whole firms to export competitively into those international markets. (Simmie & Kirby, 1998, pg. 19)." This underscores how externalities which positively occur in a firm due to its activities related to an innovation network can indeed benefit the region in general.

#### Innovation Network Members

Examined from an academic perspective, it can be said that innovation networks are comprised of members who assume one of 5 roles (Van de Ven, Polley, Garud, & Venkatraman, 2008):

- The sponsor who procures, advocates, and helps advance innovations.

- The entrepreneur who manages innovations and ventures by often breaking the traditional mold of innovation activities.
- The critic who challenges and questions investments, goals, and progress.
- The mentor who supports processes of innovation by coaching and counseling.
- The institutional leader who often brings all parties together as an intermediary.

When approached from a more pragmatic position, the different actors of a viable innovation network form 6 major categories of players. These categories comprise the bulk of typical actors (Conway & Steward, 1998):

- 1. Upstream actors** : suppliers, producers, etc.
- 2. Downstream actors** : customers, handlers, distributors
- 3. Competitive actors from rival firms** : firms both within and outside the same industry
- 4. Knowledge generating actors** : universities, research institutes, etc.
- 5. Regulatory actors** : government bodies and trade unions
- 6. Social environment actors** : pressure groups, NGOs, etc.

A network can conceivably consist of any constellation of these different actors providing one or more of the above mentioned roles. A relatively important concept discussed within the existing literature of innovation networks focuses on the strength of ties between the various actors (Gilseng & Nooteboom, 2004). Central to understanding this is the recognition that such ties can be strong and cohesive, which aids in cultivating trust and collaboration between members. Conversely, these ties can also present themselves as weak and thin, which would allow for diversity, flexibility, and lost cost exploration. One side of the argument postulates that dense and strong ties aid in creating social control and build up reputation and social capital, which in turn helps foster a spirit of cooperation. The other side states that weak ties, rather than strong, are appropriate in order to gain access for new and simple information. Often, in networks where frequent and intense interaction between actors occurs, much of the information circulating within the system is redundant. It has been suggested that a combination of the two different types of intensity between actors would be ideal, as they serve to provide two different kinds of knowledge: strong ties help promote and transfer complex knowledge, while weaker ties are aimed towards transferring more simple and less coordinated knowledge (Uzzi, 1997).

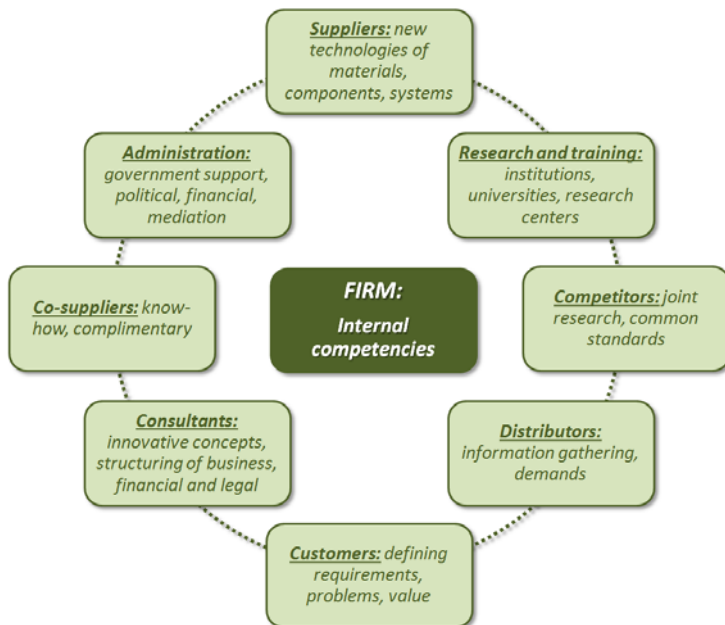
The relationship between the geographical proximity of actors within a network and its ultimate effectiveness is an issue which has been explored and researched. Technological districts, technopoles, and science parks have all been seen as not only sparks igniting the creation of informal networks, but also as incubators where knowledge creation occurs at

faster rates than otherwise. More recent works in the field of economic geography outlines the importance of spatial consequences in technological spill-overs between academic and industry partners (Audretsch & Feldman, 1996).

While geographical proximity is an important concept in facilitating the transfer of knowledge between organizations, the concept of internal organizational proximity may be just as, if not more important to the underlying success of innovation networks. Organizational proximity is characterized by the collective value systems, or the company culture, which tends to homogenize individual behaviors within that organization. This collective culture aids in employees being able to spontaneously and accurately interpret exchanged knowledge the same way. Geographical proximity is effective only when it co-exists with internal organizational relationships. It appears that organizational proximity is a stronger supporter of technology transfer and innovation diffusion than geographical proximity alone (Rallet & Torre, 2000).

A generic view of how an innovation network can function is presented in Figure 3, showing the various actors and their respective roles towards fulfilling their network goals.

**Figure 3: Innovation Network Actors**



**Source :** Own Illustration based on (Pittaway, Roberston, Munir, Denyer, & Neely, 2004)

## Frameworks of Innovation Networks

There are several different frameworks/structures within which innovation networks can function: for example, national vs. regional and formal vs. informal. As a starting point, national systems of innovation can be described as a system of structured interactions between agents who are involved in the process of generating technological progress on a national scale within a country (Pyka, 1999). In this framework, firms and public research institutions such as universities are typically key drivers to the network's activities. Regional structures can be very similar in terms of their activities and member roles, but the positive externalities to the region (improved employment, increased innovativeness of surrounding businesses, etc.) which result is the deciding factor which separates them from a merely national structure. Silicon Valley, Route 128, Wissenschaftsstadt Ulm, and Emilia Romagna are examples of innovative regions which foster regional networks of cooperation, resulting in an overall increase in efficiency for the area. Often, firms which have participated within the confines of a regional network are better prepared to branch out to more national/global institutions, based largely on the experiences and contacts which these firms were able to locally develop (Cooke & Morgan, 1994).

Formal innovation networks can take several forms: Joint R&D agreements, direct investment, licensing of technology, the buildup of a common R&D infrastructure, or research associations (Freeman, 1991). Generally following the course of contractual stipulations and often regulatory and statutory considerations, these types of networks are single-minded in goals but often rigid in terms of the flexibility afforded the members. Recent literature focuses, however, on the growing importance of informal networks. Formal contracts are increasingly becoming displaced by less rigid informal relationships. Behind most formal networks are various types of informal, or ad-hoc, frameworks. These are more fluid in how they operate and allow for a more dynamic relationship between actors which can, and often does, change over time. Although seldom systematically measured, informal networks appear to be important due to their multiple sources of information and diverse patterns of collaboration (Pyka, 1999).

The increase in alliances which are agreed upon to gather or exchange knowledge has helped to break down the traditional roles of markets and firm hierarchies. Networks are different from these hierarchies in a multitude of ways, but primarily in that they depend on particular types of interactions between the actors located within the network. Within a network, company borders are more porous in nature and firms thrive by having relationships with others who have complimentary assets. These relationships between actors can be defined as (Cowan, Jonard, & Zimmermann, 2005):



- Relational embeddedness: The relationship between actors is purely of a contacting/networking nature.
- Cognitive embeddedness: The relationship between actors is of a knowledge sharing/creation nature.
- Structural embeddedness: The relationship between actors takes advantages of organizational structures or processes which one partner has and the other requires.

The different resources of individual partners are combined in any network scheme, thus determining the complementary nature of their relationships. When two or more organizations innovate jointly, the process will be most successful when knowledge profiles complement one another. If two firms' knowledge profiles are too close together, there will be too great of an overlap resulting in little reason to share. If the knowledge profiles are too far apart, difficulties may arise in partners' understanding of one another (Grant, 1996) (Nooteboom, 1999).

#### Problems with Innovation Networks

As with any system of interaction, innovation networks are not immune to problems which could result in their effectiveness being undermined or even prevent their forming in the first place. There are 4 main areas of concern when dealing with multiple partners in a collaborative effort, as shown in Figure 4 (de Man, 2008):

**Figure 4:** Areas of Concern with Multiple Partners

<b>1</b>	<i>Motivation: How to motivate partners to share knowledge</i>
<b>2</b>	<i>Efficiency: How to ensure the right knowledge ends up with the right partner</i>
<b>3</b>	<i>Boundary Crossing: How to overcome cultural, time, and knowledge gaps</i>
<b>4</b>	<i>Free-Riding: How to prevent companies from learning but not sharing</i>

**Source :** Own Illustration based on (de Man, 2008)

1. Motivation: How to motivate partners to share knowledge: There must be incentive for all parties involved to transfer knowledge to others who require it. In the absence of incentive, there can be no transfer.
2. Efficiency: How to ensure the right knowledge ends up with the right partner quickly: Possessing and being motivated to transfer knowledge is the foundation upon which proper use of that knowledge is laid. The identification of gaps in competency among the members of an innovation system is key.

3. Boundary Crossing: How to overcome cultural, time, and knowledge gaps. Once gaps are identified in all areas, action plans must be developed which can help accomplish this. Formal networks with clear leadership roles have distinct advantages here over more ad-hoc, free-spirited networks.
4. Free-riding: How to prevent companies learning but not sharing: By illustrating the intrinsic benefits to all when everyone participates, knowledge hoarders can be coaxed into understanding how their proactive role in the network is just as important as their reactive role.

In general, issues can arise which result in the failure of the entire innovation system as a whole. This includes the thinness of an organization, or a lacking of the proper capabilities needed by other members of the network. Additionally, lock-in, or being such a specialized member of the network that any knowledge which can be offered would be effectively useless to the others, is also a factor to be considered. Fragmentation, or a breakdown in the dynamic interaction between actors for various reasons, can also lead to a system failure (Tödtling & Trippl, 2005).

More pessimistic economists and business researchers note that whatever the objectives of collaboration are, the result is often a failure, as strategic alliances have a success rate of less than 50% (Faems & Van Looy, 2003). Networks themselves are not immune to common conflicts, disputes, and lack of coordination which dooms many internal innovation projects. Similarly, there is some evidence that suggests faster commercialization of a product does not necessarily result in commercial success (Meyer & Utterbeck, 1995). Moreover, cooperation does not always correlate to enhanced innovation speed. Complex innovations may be hindered due to the fact that combining and synthesizing knowledge bases related to multiple systems of a product is difficult to quickly diffuse and communicate through a network (Rycroft, 2007). However, such research outlining the negative effects of networks is minimal compared to the overwhelmingly large amount of positive benefits obtained by firms in using such networks.

## **2.2 Knowledge Transfer**

### **Definition**

The ideals espoused by open innovation have been present in economic theory as far back as the 1960's, though often the term is associated with modern principles in competitive business practice. Central to any understanding of knowledge transfer is a review of the definition of open innovation. Henry Chesbrough, arguably the most prolific promoter of the concept, identifies the term open innovation as:

Innovation Network Functionality  
The Identification and Categorization of Multiple  
Innovation Networks  
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