



Journal of Applied Sciences

ISSN 1812-5654

science
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Supplementary Effects of Networks and Clusters on Firm Innovation

¹Fakhraddin Maroofi and ²Nasrin Gholamizadeh

¹Department of Management, University of Kurdistan, Sanandaj, Iran

²Management, Islamic Azad University Sanandaj, Sanandaj Branch, Iran

ARTICLE INFO

Article History:

Received: August 27, 2014

Accepted: December 01, 2014

Corresponding Author:

Fakhraddin Maroofi,
Department of Management,
University of Kurdistan,
Sanandaj, Iran

ABSTRACT

A conceptual model is developed to show the firms network and cluster supplements each other in improving the firm's possibility of technological innovations. Innovation accelerators consciousness, innovation obstacle, resource restriction, organizational inflexibility and ambiguity are recognized. The present conceptual model explains how some factors in the cluster such as competitive, social interaction, cluster energy and network factors such as resource, network energy impact innovation accelerators, obstacles, succeeding the firm's possibility of generating incremental and progress innovations. Result shows that the design and management of the firm's network must be a key strategic consideration of managers to ensure that the network continues to furnish innovation opportunities and resources and it decreases underlying innovation obstacle. Competitive and collaborative outlook of cluster and network have provided a differential roles of clusters and networks on innovation. Therefore, high competition intensity and the firm's knowledge base increases the co-located challenger's motivation to obtain the knowledge from the central firm and high social interaction intensity may furnish them with the means to do so. Conceptual framework suggests complete comprehension with clusters and networks and explicates their limitations at the same time.

Key words: Network, cluster, innovation obstacle, accelerators

INTRODUCTION

Innovation is becoming important for survival and growth of firms but firm struggle to innovate (Ahuja and Lampert, 2001) because their internal resources and capacities become insufficient in supported technological examination and resource combining's (Fleming, 2001). Therefore, firms seek resources from their strategic link networks (Srivastava and Gnyawali, 2011) and geographical clusters (Whittington *et al.*, 2009) as these are valuable sources of external resources (Tallman *et al.*, 2004). However, networks and clusters work differently with the flow of resources, therefore maybe resulting into their differential impact on firm innovation. In addition, external resources does not lead to increased innovation unless the firm is motivated to follow innovation opportunities and is able to defeat internal organizational obstacle (Ahuja and Lampert, 2001). According to the knowledge a few research has examined the mechanism methodically through which network and cluster situations exceptionally impact on firm innovation. Therefore, the goal

of this study is to direct the following question: How do firm's networks and cluster situations determine the firm's possibility of generating technological innovations? Therefore, to show the effects of network and cluster on innovation, researchers may serve as obstacle against accelerators for innovation (Mohr, 1969). Therefore it first identify obstacle that restrain and important accelerators that improve a firm's possibility of generating technological innovations before discussing how they would be determined by network and cluster situations. It suggested that competition and cooperation serve as underlying forces in both network and cluster but the direction in which they work and impact firm innovation differ between a network and cluster. Therefore to use competition and cooperation as a basis for present theory identifying related constructs for this conceptual model. As previous research suggests that competition in a cluster furnishes stimulus for innovation (Porter, 1998) and that opportunities for unofficial interactions help knowledge flow (Saxenian, 1994; Tallman *et al.*, 2004). In situations of network, the significance of resources arising from networks (Baum *et al.*,

2000) and show that how a firm studies its network and resources controlled, which it has important implications on the firm's leverage of such resources in pursuit of innovations. According to the previous study (Chen *et al.*, 2007; Saxenian, 1994). The main role of cluster lies in increasing a firm's consciousness of technological evolution and motivation to occupying innovation and in reducing ambiguity in innovation. Further, the concept of cluster energy is extended to which a cluster is diffused with new knowledge resources over time and suggest that cluster energy is important for supported flow of cluster benefits. In terms of network, the resource are suggest inside a network is useful in directing innovation obstacle but the range of network resources which firm gains and influence depend on the firm's network direction, i.e., how a firm studies and applies its network and the resources controlled in them. It showed that network energy with new knowledge resources over time plays an important role in realizing the specific resource benefits from the network. Therefore the innovation of network and cluster is important as: First, recognition and conversation of innovation obstacle and accelerators furnish perception into why and how firm's might struggle in their innovation attempt. An understanding of obstacle and accelerators is an important in directing them. Second, by developing cluster and network mechanisms and linking them to innovation obstacle and accelerators, a theoretical base is furnish future research how these external situations impact innovation pursuits and outcomes. In addition, the conceptual model explains how cluster principally reinforce the accelerators of innovation and network defeating the innovation obstacle and together how they fulfilling each other in intensification the possibility of innovation. Third, the concepts of network energy and cluster energy, this study is extended and furnish a perspective on networks and clusters and emphasize the significance of temporary considerations in investigating their effects. Finally, basic conceptualization of network direction furnishes perception why and how firms gain from their network resources and lays for future conceptual research.

CONCEPTUAL BACKGROUND

Arikan (2009) suggested that creativity of cluster firms and their collective knowledge are important for innovation opportunities make by cluster resources. However, the understanding of implicit in mechanisms through which cluster determines firm innovation is extremely limited. Similarly, previous research regarding network tradition has shown that a firm's cooperative relationships with other firm's contribute to innovation (Ahuja, 2000; Powell *et al.*, 1996). A firm's link network size, as an indicator of resource of the network, has been shown to impact its innovation output positively (Ahuja, 2000). Recent research explore into some types of resources and demonstrates that variety and quality of a firm's link network resources improve the firm's ability to generate innovations (Srivastava and Gnyawali, 2011). While growing literature has founded that a firm's network is a major source

of external resources, this will come to know how the characteristics of the firm's network determine its ability to defeat different innovation obstacle. In addition, although firms networking behaviors are determined by both competition and cooperation motives (Madhavan *et al.*, 2004), Further it will be known how these motives might manifest in the firms network configurations and impact their innovation outcomes. In addition, network and cluster research have developed different path, recent research suggests that network and cluster could play supplementary (Zaheer and George, 2004) or even replacing roles (Whittington *et al.*, 2009). Emphasizing the supplementary roles, Zaheer and George (2004) located that cluster is not enough for effective knowledge sourcing, firms need to have access to link network to perform resource flows. In contrast, Whittington *et al.* (2009) found that a firm's positions in the global network and the local network have partial replacement effect on the firm's innovation output. Further, regarding supplementary roles, McCann and Folta (2011) assumed that the effects of a cluster on innovation increases with increasing link experience. These evolvment in the literature suggest encouraging roles of a firm's network and cluster situations on innovation and emphasize the significance of explaining the underlying mechanisms through which the effects would occur. The present dependent construct is technological innovation, i.e., innovation generated through technological way (Utterback, 1971). Technological innovations are qualified as incremental or discovery, both types of innovations for survival and growth of firms are important. Incremental innovations include low degree of new knowledge and relatively minor improvements in current technologies or products (Phelps, 2010). Innovations that are named discovery (Srivastava and Gnyawali, 2011) work as the base for succeeding technological evolvment (Ahuja and Lampert, 2001). Therefore, networks and clusters which impact firm innovation are important for innovation (Dougherty and Hardy, 1996). Mohr (1969) stated that innovations directly related to the motivation to innovate, inversely related to the obstacles of the innovation and directly related to the availability of resources for defeating the obstacles. The suggested technological innovations by a firm is as: The firm should be well-known with related technological trends in order to see productive innovation opportunities. As well as the firm should realize to occupy the innovation. The ability to innovate, which is based on resource talent, is related only when the firm is aware of important technological trends and is motivated to occupy in innovation. Innovation obstacle, accelerators, succeeding conversation of network and cluster effects recognition is based on this core point.

Innovation obstacle: Firms often struggle or even fail in their innovation attempt due to some obstacles (Mohr, 1969). According to the survey of the innovation literature, the import obstacle are: Resource restriction (Mone *et al.*, 1998), ambiguity (Abernathy and Utterback, 1978) and organizational inflexibility (Ahuja and Lampert, 2001). Resource restriction

show that the firm does not have the resources ambiguity shows that the firm does not know what to do and inflexibility shows that the firm may not be able to do it because of resistance from its internal systems and procedure and managers disposition.

Resource restriction: Resource restriction refers to the lack of the inputs (such as technology) needed for following innovations. Resources are needed to search for ideas, conduct experiments, follow multiple projects, develop and test paradigms and launch new products. Often firm's struggle in innovation due to resource (Galia and Legros, 2004). The resource restriction become a bigger obstacle in case of research projects which is following discovery innovations (Srivastava and Gnyawali, 2011). While firms could attempt to develop resources internally, factors such as path dependency, causal ambiguity, develop resources internally (Cohen and Levinthal, 1990). Sometimes it may not be economically beneficial to develop resources internally when the central firm requires them for a limited goal. Changing environmental situations justify different types of resources thus make a gap between the current organizational resources and the resource requirements in order to generate innovations (Grant and Baden-Fuller, 2004).

Ambiguity: Innovation entails, assessing the technological trends in the external environment, knowing which technology or product has the most potential, to learn through trials and errors. Each of these, however, involves high degree of ambiguity (Dickson and Weaver, 1997). Rapidly changing technologies, multiple technology options and technological intersection and differences make it very difficult for a single organization to deal with these situations, distinguish an encouraging innovation path and give valuable resources for a particular innovation path (McGrath, 1997). Ambiguity makes it difficult for managers to exactly estimate the current situation and future changes (Dickson and Weaver, 1997) and to distinguish the desirable dimensions of the product, technological attributes and to predict the demand pattern (McGrath, 1997).

Organizational inflexibility: Organizational inflexibility is difficult to change mental models of the dominant alliance (Hambrick and Mason, 1984). Because mental models' decision makers determine how they perceive opportunities and act on them (Hambrick and Mason, 1984), managers with difficulty to change mental models may not be able to observe and value new and technological trends. Even they may not be willing to attempt out new things (Ahuja and Lampert, 2001). Founded organizational systems and procedure that translate into practiced routines (Nelson and Winter, 1982) serve as another major source of inflexibility (Leonard-Barton, 1992). Even though routines help to ensure coordination, reliability and efficiency (Becker, 2004), the same routines become ingrained in daily practices and oppose the changes that are necessary for innovation. Innovations are also to disturb the organizational truce (Kaplan and Henderson, 2005). Many profitable innovation projects may be rejected if they do not fit with current organizational routines. While encouraging

innovation requires incentive system and culture that reward experimentation and change, people fear and oppose, changes in the power structure and reallocation of organizational resources (Kaplan and Henderson, 2005). Even disabling effects would occur when multiple innovation obstacle exist simultaneously and reinforce each other. Organizational inflexibility further intensifies ambiguity (Mone *et al.*, 1998), it is difficult to get the important mass to agree on projects and commit resources to them. Thus, each of the innovation obstacle is important on its own, these obstacle, in combination, make it extremely difficult for a firm to follow innovations relying on its internal resources.

Innovation accelerators: While obstacle restrains the possibility of innovation and therefore need to be minimized, accelerators increase the possibility and therefore need to be encouraged. Research suggests that central enabler's of innovation are consciousness of technological trends and opportunities and motivation to innovate (Dosi, 1997).

Consciousness: Consciousness refers to a firm's pointing out a new technological and appearing market that results from the initiatives tackled by challenger's and other related firms (Chen *et al.*, 2007; Chen, 1996). According to the nature of new technologies developed by challenger's and other firms, central firm impact realize better needs for innovation and take actions to do so. Increased consciousness would make the firm forceful (Chen, 1996) in initiating and introduction innovation projects and speed up an existing project, that may not be allow competitive to the market situations. Consciousness also helps in making more informed resource commitments. Pointing out a new idea or finding out a new opportunity may stimulate innovation attempt and help the firm in using its resources and capacities for generation of innovation more effectively for that goal.

Motivation: Motivation refers to firm's readiness to occupying examination and to accumulate resources for innovation. Motivation determines firm's search and the amount of attempt a firm dedicate to search for knowledge and new resources. A firm's motivation for innovation could come from challenger's to be innovative and availability of resources for innovation (Schumpeter, 1934). Firms with strong motivation make cooperative attempt to identify innovation opportunities, dedicate resources for innovation projects and occupy methodically in innovation tasks and as a result increase the possibility of successful innovations.

Role of cluster and network mechanisms: A cluster is define as collection of firms operating in related industries (Arikan, 2009) that are next to each other geographically. Therefore, it assume that lack of inter-firm formal cooperative relationships within the cluster. A firm's network is define as the comprising of the central firm and firm's (alter) with whom the central firm has formalized cooperative relationships. This is also referred to as a central network (Everett and Borgatti, 2005). Formal modes of cooperation furnish organized ways of knowledge flow among firms in a network. Competition and cooperation are shown at the core of both clusters and

networks. However, these mechanisms function at different levels and have different effects in networks and clusters. Porter (1990, 1998, 2000) clearly suggested that the competition among-located firms is the essential for the benefits from a cluster but the literature ignored this core essential while investigating the benefits of clusters. Arrow (1962) and Romer (1986), showed that co-located firms generate knowledge externalities due to firm's operating in related industries. Their claim led to the development of knowledge (Tallman *et al.*, 2004), which suggested that unofficial knowledge overflows in clusters make the co-located firms confidential to the overflow. The findings related to geographic localization of knowledge overflows (Jaffe *et al.*, 1993) and significance of geographic closeness in sharing of tacit knowledge (Polyani, 1966) strengthened the significance of knowledge. Saxenian (1994) emphasized the significance of unofficial communities and social interactions in such communities. She showed that unofficial social interactions in such communities serve as a backbone for knowledge overflow. While competition occurs at the firm level, unofficial interactions and exchanges occur at the individual level. Accordingly, two important concepts, are selected, competitive intensity and social interaction intensity, getting the core mechanisms regarding a cluster's benefits. According to Burt (1992), the advantages of network arose from the lack of relationships among some of the existence of structural holes. Lack of relationships makes structural holes,

which leads to partners competing with each other for obtain to network resources or to counter others advantages (Madhavan *et al.*, 2004). In contrast, Coleman (1988) showed that the advantages of network arising from trust and shared norms in cooperative relationships. This perspective emphasizes the significance of relational exchanges and working together for the common goals (Madhavan *et al.*, 2004). According to these perspectives, The firm's are differ in their network directions and therefore, two contrary approaches are seen about network configurations driven by competitive or collaborative disposition. The cooperative agreements which Firm's enter, driven by a competitive perspective would set up their networks differently than firms that observe their network from a more collaborative perspective to build mutual relationships. Accordingly, such network directions conceived as acquisition direction. Because the focus is on resources and their roles, A network recognize is an important construct that is resource talent of the central firm's network and show that network directions have differential effects on the range to which firms realize and furnished by their network resources.

MATERIALS AND METHODS

Conceptual model and propositions: The conceptual model to the research gaps and background discussed in the previous section (Fig. 1). Effects of clusters are suggest to lie

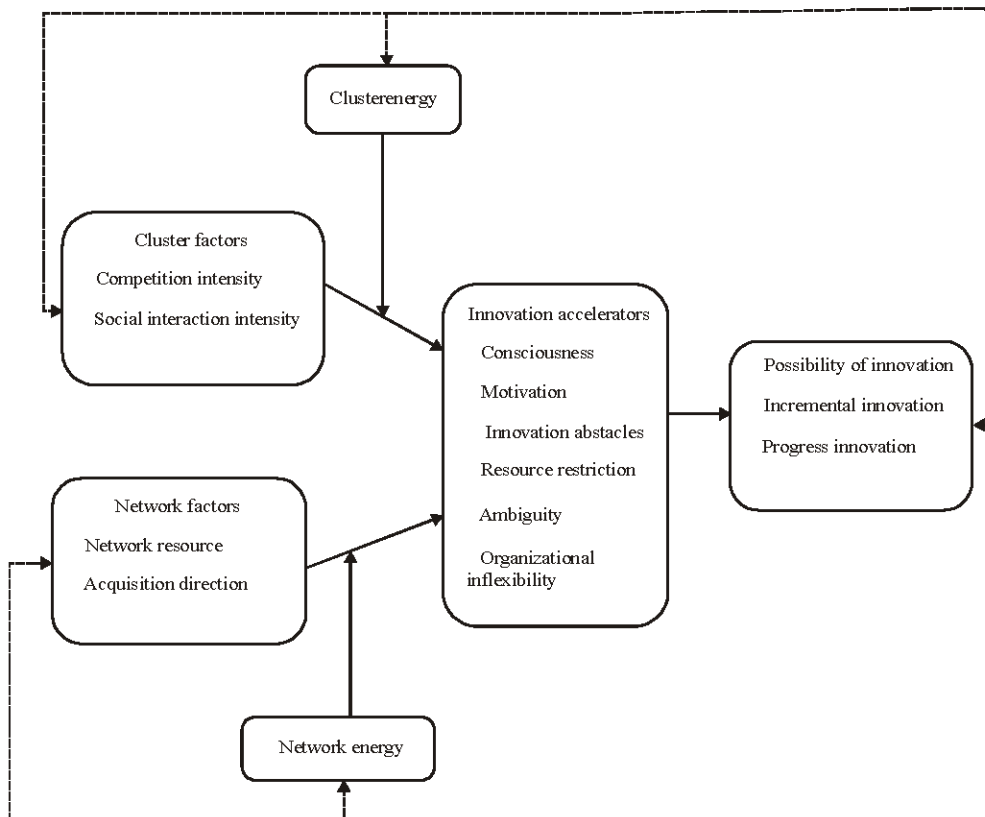


Fig. 1: A conceptual model of network and cluster effect on innovation (Gnyawali and Srivastava, 2013)

terms of influencing consciousness and motivation principally, the accelerators of innovation and in reducing the ambiguity obstacle. Particularly, a competition is showed in a cluster contributes to increase in firm's consciousness of new technological evolvement within the cluster and increases their motivation to occupy in innovation. In addition, social interaction in a cluster decrease the ambiguity obstacle by providing a wide range of ideas and knowledge from the communities of experts located in the cluster. It also suggest that cluster energy leads to more effective of benefits of competition and social interaction within the cluster. Due to the lack of structural mechanisms for resource flows between firm's, resource benefits in a cluster are indirect. As formalized mechanisms for resource flows exist in the network and the network stem mainly effects from resources in the network. However, the range and benefits depend on the firm's network direction, i.e., how the firm studies the network and as a result mobilizes resources controlled in it. Differences in the firm's network directions are fundamental to the differential effects of networks on firm's innovation outcomes.

Cluster competition: Cluster competition refers to the range that firms located in a cluster occupy in similar products and markets and thus are competitor to each other. Previous literature has identified the role of competition on firm innovativeness (Geroski, 1990). Co-location of challenger's increases competition (Cattani *et al.*, 2003) in the input and output factor markets. Survival and growth of these firm's depended on their ability to offer higher-ranking of products and possibly at lower prices. As a result, innovation becomes the base for firm survival and growth (Porter, 2000). It suggest that competitive intensity in a central firm's cluster improves the firm's innovation outcomes principally by increasing the firm's consciousness of new evolvement, motivation to occupy in innovation projects. Due to geographic of the firms which is next to each other, the behavior challenger's becomes much more visible (Pouder and St. John, 1996) and therefore much stronger threats arises from competitors. Additionally, the closeness of geographic makes it easier for a central firm to monitor its co-located challenger's actions more frequently and more closely (Porter, 2000). As the firm is tracks those challenger's with greater intensity, it becomes even more aware of the new technological tasks of those challenger's (Pouder and St. John, 1996). High consciousness of these technological evolvement encourages the firm to search for related technological evolvement in somewhere else. Similarly, other co-located firms' behavior is also determined by the central firm's behavior. As the co-located firms improve their innovation attempt, the total volume of knowledge available is also increases. However, the knowledge overflow in all segmented cluster form (Caniels and Romijn, 2005). It is due to the lack of formal firm-to-firm structural mechanisms for resource exchange and sharing, which the overflow of segmentation is not accompanied by flow of organizational resources. Therefore it is absorb knowledge in the form of ideas and

information. Moreover, segmentation could initiate the cluster firms to many new technological initiatives in the cluster which in turn contribute to intensification of both the consciousness of innovation opportunities and the motivation to innovate. Moreover, consciousness of technological evolvement and opportunities furnishes new ideas for innovation, high perceived threats from challenger's furnish strong motivation to occupy in innovation projects and available opportunities to unofficially learn from co-located challenger's and their innovation initiatives furnish valuable perception in the innovation process. All these would improve the quality of the central firm's innovation projects and the intensity of its innovation occupation and succeeding improve its innovation outcomes. It therefore suggest that:

- **Hypotheses 1:** The competitive intensity within a firm's cluster, the innovation by the firm principally through (a) Increased consciousness of technological evolvement and (b) Increased motivation to innovate

Cluster social interaction intensity: Social interaction intensity refers to the employees of a firm that unofficially interact with employees of other cluster firms and occupying unofficial knowledge sharing (Arikan, 2009). Two ways of social interaction in a cluster are (a) Unofficial information exchanges through occasional, training programs and other unofficial settings and (b) Mobility of employees within the cluster. Social interaction intensity is believed as one of the most effective mechanisms for knowledge sharing and transfer (Noorderhaven and Harzing, 2009). Such social interactions play an important role in the flow of information and knowledge within the cluster (Lissoni, 2001; Saxenian, 1994). Similarly, the closeness of geographic firms spreads information about new job opportunities and increases the chances of employees changing employers within the cluster. Employees are believed as 'knowledge-carriers' and when they move they often carry and the level of knowledge embedded in them (Almeida and Kogut, 1999). Because employees more often move to firms within a cluster than to firms outside a cluster (Breschi and Lissoni, 2009), such knowledge is principally approachable to cluster firms. Therefore technological changes and new technological pursuits would help the employees shape and rectify their innovation ideas and thereby decrease ambiguity in some important ways. First, high social interaction helps to develop a cluster of specific knowledge (Tallman *et al.*, 2004) within a cluster. Such interactions also help to rectify the cluster of specific knowledge and build succeeding innovations on such knowledge with confidence. Technological ambiguity decrease when cluster of specific technological knowledge serves as a core platform for succeeding knowledge generation and innovation. Second, opportunities to interact with each other in unofficial settings (Cattani *et al.*, 2003) regarding technological trends and market situations (Lissoni, 2001; Saxenian, 1994) the market "buzz" as well as new product development initiatives of some firm's within the cluster

(Dahl and Pedersen, 2004) would help employees exchange information. As well as may shares information regarding current innovation initiatives in their teams, divisions, or companies. More information sharing about their innovation initiatives helps to rectify ideas and projects and decreases ambiguity related with their own projects. Finally, high social interaction among cluster firm's may also allow the flow of market feedback on innovation projects, help distinguish of innovation path and may help resources in pursuit of that path. Unofficial feedbacks from a variety of sources about the technology and markets serve as a base to drop some initiatives. The more information a central firm about the new product development initiatives of other firms, new technological evolvement in the industry and market response to the innovation attempt, it could channel resources for the viable projects and put forth planned attempt on the projects. The co-located challenger's become more motivated to absorb knowledge from the firm and the closeness of firm geographic improves the co-located challenger's ability to do so. Thus, social interaction intensity increases the chances of knowledge leakage and co-located challenger's may make more systematic attempt to absorb the knowledge. Because of the highly segmented nature of the interactions and overflows, the damage would be extremely low, therefore knowledge overflows through unofficial interactions occur very quickly. In addition, employee mobility may bear knowledge possessed by individuals but not the firm-level knowledge (Lissoni, 2001). Thus, in spite of possible overflow, firm's are keep their knowledge private and use cluster knowledge in order to reconfirm and rectify their own knowledge. The positive benefits of decreased innovation ambiguity and increased innovation capacity are therefore overbalance downsides. Therefore it suggest that:

- **Hypotheses 2:** The social interaction intensity within a firm's cluster, the possibility of innovation by the firms through decreased ambiguity

Cluster social interaction intensity and competitive intensity together play supplementary roles for innovation related benefits from geographic clusters. For substantial benefits from clusters both are important. Competitive intensity improves the consciousness and motivation to innovate and knowledge, helps creating commitments on innovation projects and social interaction intensity furnishes the base for the flow of information, ideas. However, due to cross-fertilization, mobility of employees, the cluster could become homogenized. This will now turn to the significance of cluster energy for the social interaction intensity and effectiveness of competitiveness intensity.

Cluster energy: Cluster energy refers to a cluster inspire with new knowledge resources. Increasing cluster energy shows helpful situations for innovation within the cluster (Arikan, 2009). New knowledge resources could occur: (a) Location of new firms within the cluster, (b) Inflow of new employees

from outside the cluster and (c) Improvement of the knowledge of existing cluster firms. If from outside new firms and employees do not move to the cluster or if existing firms do not regenerate themselves, the cluster becomes more homogenized (Pouder and St. John, 1996), lacks fresh ideas and therefore firms within the cluster face greater risks of spatial short sightedness (Maskell and Malmberg, 2007). Moreover, due to crowding of firm's, cluster energy could decline. When crowding occurs, new firms and employees from outside the cluster would loses its magnet power (Porter, 1990). Due to the lack of new firms in the cluster limited their inflows, new firms are well springs of new knowledge, new ideas and new resources (Geroski, 1990). As a result, crowding would adversely impact the resource situations within the cluster. Pouder and St. John (1996) stated that crowding is occur during the ripe stage of a cluster's life cycle. It showed that social interaction intensity and competitive intensity are not very effective when cluster energy is low. One of the core responsibility of competitive intensity comes from the power of competitive actions (Chen, 1996) that challenger's can change the competitive equilibrium. On the bases of new ideas to the cluster, innovative actions which are based on older ideas become increasingly less capable of troubling the competitive equilibrium. As a result, the power of the innovative actions guaranteed by challenger's goes down and the competitive intensity loses its bite, therefore its power to coerce firms to improve their innovation attempt to goes down (Gnyawali and Srivastava, 2013). While social interaction still contributes to knowledge overflow, that overflow contains few new ideas or fresh approaches. Due to continued circulation of existing ideas, the overflow does not contribute to generation of new ideas. As a result, the cluster as an entity becomes free of new ideas and also accepting to outside ideas. Thus, lack of cluster energy joined with social interaction intensity intensify the problem as older ideas that contribute to support of existing opinion get recirculated at a rapid rate:

- **Hypotheses 3:** The energy of a firms' cluster, the effects of cluster competitive intensity and cluster social interaction intensity on the possibility of innovation by the firm

As discussed it, cluster benefits are increased disclosure to opportunities, increased motivation to occupy in innovation and decreased ambiguity through unofficial learning from cluster members. Effects of network are showed which lie in access and use of partners' resources, which are useful in reducing the resource restriction and organizational inflexibility obstacle. Therefore, resource of a network becomes an important factor for a firm to extract innovation related benefits from the network.

Network resource: Network resource refers to the variety of resource talents of a central firm's link partners. The number of partners and their resource talents, would be the central

firm's network resource. Previous literature emphasizes the significance of network resources (Phelps, 2010; Srivastava and Gnyawali, 2011) and show that when network resource is high, the firm's possibility of innovation increases by lowering both the resource obstacle and the organizational inflexibility obstacle. High network resource helps the central firm in directing the resource obstacle in some ways. First, the resources availability encourages the firm to occupy more experimentation and lies at the core of the innovation process (Thomke, 2003) and claims significant amount of resources. More available resources, encouraging firm's experimentation projects into the development stage and take more of the projects which is already in the development stage closer to their commercial launch. As a result, less projects will meet their untimely death due to the scarcity of resources. Second, having more partners and access to resources of those partners also shows that the firm delights higher status (Wasserman and Faust, 1994), which increases its visibility and reputation as a partner. As a result, the firm can attract more resource rich partners (Gulati, 1999). With new partners and new resources, it could follow more resource intensive innovation projects and follow them with greater energy. Finally, firms of higher status have the power of endorsement (Stuart, 2000), which is bring opportunities (Pfeffer and Salancik, 1978). Variety of resources could be performed by having many partners that dominate unique resources or a few partners with different resource profiles. When the partners and their resources are different, the firm can search broadly and access different types of resources and capacities owned by the partners. Variety of resources furnishes the firm a broader horizon, wider range of options for examination of ideas and increased ability to perform re-combinatory search (Fleming, 2001). The availability of heterogeneous resources thus not only outfits the firm to follow different substitutions and combinations but also furnishes it with the means to realize those ideas and reject less profitable projects. Taken together, partners that are grant with a larger volume and variety of resources help the central firm to decrease resource restriction, an important obstacle that cripples firms' innovation tries:

- **Hypotheses 4a:** The network resource of a firm is the possibility of innovation by the firm principally through the reduction of resource restriction

Network resource through access to volume and variety of resources helps the central firm in coping with the organizational inflexibility obstacle (Leonard-Barton, 1992). Two inflexibility sources are important in this context: Cognition of decision makers' and organization's systems and procedure (Tripsas and Gavetti, 2000). Two important options for defeating this obstacle could be reducing that obstacle. Reduction of cognitive obstacle is important for managers to occupy in pursuit solutions. Once cognitive obstacle is decreased managers can now attempt to or bypass the obstacle arising from internal systems and procedure. Access to

partners and different resources furnishes the managers with disclosure that would help them to decrease their cognitive obstacle. Srivastava and Gnyawali (2011) stated that "Disclosure to partners" the wide of different technologies of the firm's perspective and increases its ability to see profitable opportunities that may arise at the confluence of multiple technologies". Increased disclosure would widen the managers observes and therefore make them less nearsighted and more motivated to search for solutions more broadly (Sampson, 2007). The wide search for solutions makes the managers to accept different ways of doing things and different approaches to problem solving (Tripsas and Gavetti, 2000). Access to different resources of partners could also be useful in defeating obstacle arising from the inflexible systems and procedure. Instead of attempting to change internal systems and procedure for pursuits, managers could choose for avoid them. Formal partnerships between firms with different resources allow them to make solutions while avoid the internal obstacle. Similarly, the central firm could use partners systems and procedure to follow innovation projects or together make new systems and procedure instead of attempting to change internal ones. Both scenarios would lead to decreased role of internal inflexibility in pursuit of innovations:

- **Hypotheses 4b:** The network resource of a firm, is the possibility of innovation by the firm principally through the defeating of organizational inflexibility

The network resource makes enables situations for the firm to improve its innovation generation capacities by permitting it to access and obtain network resources. But the firm benefits from the resource would depend upon how the firm observes and mobilizes the network resources. As mentioned earlier, by central ideas and putting them in the context of resources and innovation, the firm's generally adopt acquisition directions which in turn leads to differences in the ways in which that mobilize their network resources for innovation. Table 1 clarifying summary of these directions. Although these two directions are not mutually exclusive, firms may exhibit elements of both directions.

Acquisition direction: Table 1, shows some situations of a firm's network which describe acquisition direction. An acquisition directed network disorganized in such a way that the central firm can access resources of a large number of partners. Similarly, in such a network, the central firm is to be more powerful than the partners so that it can more easily obtain resources from the partners. In addition, in a network, due to the existence of knowledge transfer routines which helps regular and systematic flow of resources from the partners, the presence of inter-organizational mechanisms for knowledge sharing (Dyer and Singh, 1998) is essential. By mobilizing its network resources through the ties, the central firm is able to fertilize its resource bases' firm with the acquisition direction increases its resource base and use such resources for its innovation needs. Increased resource strength would be used by the firm to follow innovations on its own

Table 1: Acquisition network direction

Acquisition direction
Managers observe of network and its role on innovation
Network and ties observe to get specific resources and other support to allow the central firm to pursue its own innovation priorities
Networks structural situation
Location of innovation is internal efforts
Large but sparse network
Many partners with mostly mutual ties
High structural independence
High centrality of central firm
Networks relational situation
Central firm more powerful than others
Ties with fixed purpose and low multiplicity
Limited trust between partners
Inter-organizational mechanisms
Combining of volume of resources
Formal, of an agreement exchanges (can be one-way)
Informal intelligence gathering
Nature of resources involved
Mostly explicit knowledge and tangible resources
Volume of resources is important
Primary innovation obstacle addressed
Lack of mass of resources
Resolution of market ambiguity
Innovation results
Limited of progress innovations

than working with others in shared pursuits. Because open exchanges and interactions are improbably take place with the partners, the firm is may get explicit knowledge and general resources extremely than tacit knowledge and complex resources. Further, the firm's innovation and innovation pursuits are may be limited to what it already knows best. Acquisition direction implies a purpose ful of competitive with the goal of out-learning the partner (Hamel, 1991) and taking imbalance advantage of information (Burt, 1992). Such a competitive behavior would make its partners quite suspicious and they may not share their best resources. Taken together, while these resource situations and partnering behavior would contribute to the firm's ability to guarantee innovative projects but such projects is may be improved well understood and familiar than toward extremely unfamiliar, risky and resource-intensive. Therefore, acquisition direction is to increase a small amount of the firm's capability to generate discovery innovations that require combination and combining of multiple resources, undertaking of major risky projects and investment of a large amount of resources. According to this it suggest that:

- **Hypotheses 5:** A firm with an acquisition direction of its network is may be effective in generating more incremental innovations than discovery innovations

Network energy: Network energy shows the range of networks inspire with new resources, knowledge especially resources. A firm's network energy can increase through the increase in a new members (Rosenkopf and Padula, 2008) and/or increase in resource energy of the partners. By forming partnerships with new members and dissolving some of the old partnerships, firms can increase partner energy (Koka *et al.*,

2006). According to the existing partners and intensification the resource they could increase resource energy. Therefore, when their ability to develop new resources and capacities considerably declines then firms become rusted (Srivastava, 2007). A good indicator of "rusted" firm's could be declining innovation output of firms over time. When the existing members in the network are dynamic and continually improve their resource bases, then resource energy could increase. Firms with vital network would bring in new resources from outside and develop more inside. Over a long period of time, when it is linked with the same set of firms and those firms are also losing steam and becoming rusted then a central firm's network loses energy. Inactivating ties with such rusted firms could free valuable firm resources which could be more productively utilized in establishing new ties with more innovative and dynamic firms (Gnyawali and Srivastava, 2013). This shows that network energy has differential moderating impact depending on whether a firm has acquisition direction of its network. In order to illuminate contrary moderating impacts of network energy two situations are consider: When resource energy and partner energy is high and when resource energy is high but the partner energy is relatively low. In the first case, the network energy will have a positive impact on the effectiveness of acquisition direction in intensification the possibility of generating discovery innovations. Thus, though the resource energy will have a positive effect as there are new resources to tap into, the unstable network mars the central firm's ability to fully influence the benefits of resource energy. Therefore, this situation is almost tailor-made for acquisition direction network firm. The firm's network has a high degree of churning that furnishes the central firm the much needed flexibility (Obstfeld, 2005). While the structural situations are more positive for the acquisition direction firm, the high resource energy of network members also allows the central firm to tap into new and rich resources of those members. Thus, the central firm is able to access new and rich resources with greater frequency and greater ease permitting it to as combine them with its internal resources, a result the firm improves its ability to generate high impact innovations. In the second case, the central firm is linked with the same set of partners for a long period of time and those partners are very actively occupied in improving their resource bases. It shows that in this case network energy negatively moderates the effects of acquisition direction. Acquisition direction firm succeed on flexibility and structural advantages which arise from the lack of certain types of relationships (Burt, 1992) than from the presence of relationships. For a long time being linked with the same set of partners, commitments and expectations of relationships that essentially decrease the flexibility of the central firm (Gargiulo and Benassi, 2000). Further, maintaining multiple structural holes by the central firm in its network and becomes difficult as unlinked partners in the network find more opportunities and have great motivation to get linked in order to counter the appropriation

power of the central firm (Madhavan *et al.*, 2004). Thus, low partner energy makes adverse situations for the acquisition direction firm and cripples the firm's ability to influence network resources:

- **Hypothesis 6a:** When both partner energy and resource energy are high, network energy positively moderates the effectiveness of acquisition direction on the possibility of innovations as stated in hypothesis 5
- **Hypothesis 6b:** When partner energy is low and resource energy is high, network energy negatively moderates the effect of acquisition direction on the possibility of innovations as stated in hypothesis 5

RESULTS AND DISCUSSION

As the boundary gap between a firm and its surrounding environment is more (Chesbrough, 2003), conceptual model developed to improve the role of external factors on firm technological innovation, explaining how two important external factors cluster and network determine the possibility of technological innovations. Firm's should improve their ability to generate innovations (Powell *et al.*, 1996). It also described situations in which a firm could generate discovery innovations by using cluster and network benefits. The innovation obstacle and accelerators which described to examine the underlying issues that firms need to address in their innovation attempt and channel their cluster and network resources accordingly.

The basic emphasize on three contributions to the literature. First, recognition of innovation obstacle and accelerators and explicit theoretical link with the network and cluster situations furnishes that how a firm's cluster and network play important and often supplementary roles in intensification the possibility of innovation. Conceptual framework suggest the comprehension with clusters and networks and at the same time explicates their limitations. When primary benefits compared with the secondary benefits of the other, they could play partially replacing roles (Whittington *et al.*, 2009) and as well as their primary benefits clusters and networks play supplementary roles (Zaheer and George, 2004). If a firm deploys its network for informational goal, a primary benefit of a cluster, such an use of a network for such secondary benefits will be an ineffective and extremely improper use of the firm's resources given the costs of creating and managing a network. Additionally, for the separating the network and cluster mechanisms and for parsimony of conceptual model, it was assumed the lack of formal inter-organizational ties for a central firm within its cluster, if the constraint is released in increasing intersection between the firm's network and cluster leads to increased benefits from both initially. A cluster increases consciousness of the environment and of opportunities, improves motivation to occupy in innovation and furnishes unofficial knowledge inflows and the formalized network ties help the firm mobilize organizational resources from within the cluster. However, as

network energy and cluster energy tend to scatter over time, high intersection between a firm's cluster and network would enlarge the contrary effects of scattering energy. In this situation, the central firm would not only lose its explicit and tacit knowledge but would also face the risk of its partners being in better positions to take advantage of the knowledge leakage. Primary and secondary benefits of networks and clusters would believed to help address some of the evident contradictions in the literature regarding their effects (Whittington *et al.*, 2009). Second, the concepts of network and cluster energy that we improved here furnish a useful conceptual to examine the network and cluster dynamics (Rosenkopf and Padula, 2008). For instance, the level of cluster energy is exogenous to a firm, when cluster energy starts declining, a firm principally relying on its cluster for external resources might face a difficult choice. However, a firm that relies on both cluster and network for external resources might benefit more by using an exchanging strategy: rely more on the cluster when cluster energy is high and shifts toward the network when cluster energy is low. Similarly, firms that rely to greater range on the network also need to actively manage the level of their network energy. Additionally, they need to configure their network by explicitly taking into account the risks of knowledge leakage. The role of competition mechanism within the cluster suggests that when the cluster firms compete both in the input factor market and output factor market, the formal ties with direct co-located challenger's will be less effective. So within a cluster formal network ties with downstream network partners and upstream network partners where the partners may compete in the input factor market or the output factor market, not in both, will be more effective. Third, conceptualization of acquisition direction furnishes a unique approach to networks and their effects on firms. It showed that a firm is to generate discovery innovations when it follows its network for resources because combining expertise with partners allows resource recombination's (Fleming, 2001) and pursuit of risky projects to generate discovery innovation. A firm with an acquisition direction of its network is less and to be observed by others as an original cooperator and therefore may be trusted for commitments of highly valuable resources. However, resource acquisition direction could be helpful in protecting a firm's core knowledge assets. The conversation of network direction also has important implications and its effective relationships for partner selection. Similarly, in clusters, when competitive intensity and social interaction intensity both are high, a firm may find itself at a competitive risk. The central firm's high stock of technological knowledge makes it an attractive target for other co-located challenger's. Therefore, high competition intensity and the firm's knowledge base increase the co-located challenger's motivation to obtain the knowledge from the central firm and high social interaction intensity may furnish them with the means to do so.

According to conceptual model, this particularly focused on cluster and network factors and assumed firm-level factors

as constant. Future research could examine the depending effect on cluster and network effects on firm characteristics, including firms' internal resources capacities. Clarifying questions such as: What kinds of firms benefit more from cluster resources and versus from network resources? Are cluster and network resources supplementary for some type of firms and substitutes for other types? This study furnishes a strong base for empirical research in some ways. While it would be difficult empirically to tackle the entire conceptual model in one study, a good starting point would be to examine whether and to what range cluster and network situations do therefore to address the obstacle and accelerators identified in this study. Discussing on obstacle and accelerators, future research could methodically develop specific enablers and obstacle especially in pursuit of discovery innovations. Such an investigation would be empirically examined whether and to what range the cluster and network situations fulfilling each other in directing the obstacle and accelerators for some kinds of innovations. Another intriguing research path would be to develop indicators of the acquisition direction and empirically examine their effects. Table 1 clarifying indicator of these directions along some dimensions, which future researchers could fine-tune along the technological, relational and structural dimensions of network direction.

This model helps managers to develop of how networks and clusters contribute in unique ways to defeat key innovation obstacle and act as accelerators of innovation. It also suggest that a firm's network is a resource which needs to be managed like any other important resource at the disposition of a firm. Managers need to make sure that the network develop and maintains energy so that the network does not become a financial obligation. As previous research suggests, firms need to effectively organize their network to improve innovation (Dhanaraj and Parkhe, 2006). This study clearly suggests that the design and management of the firm's network must be a key strategic consideration of managers to ensure that the network continues to furnish innovation opportunities and resources and decreased underlying innovation obstacle. According to a cluster strategy, managers need to look for clusters with high competitive intensity and energy in making their cluster entry decision and take advantage of social interaction in order to benefit from their presence in the cluster. Finally, a focus on cluster alone may strip the firm from unique and rare resources and specific mechanisms for resource flows, whereas a focus on network alone may make the firm miss important information on technological trends and major innovation opportunities. In conclusion with the purposeful to develop the role of cluster and network situations on firm innovation, this study started off with the recognition of important obstacle and accelerators for innovation and then interpreted how the obstacle and accelerators could be impacted by some cluster and network mechanisms. According to the competitive and collaborative outlook of cluster and network and interpretation of how these views manifest differently in a cluster and in a network have furnished differential roles of clusters and networks on innovation. According to our conceptual model future research need to

examine how a firm's cluster and network exceptionally serve as supplementary forces in reducing the obstacle and in intensification the accelerators and impact the firm's possibility of generating innovations.

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