

NETWORK APPROACH TO THE MANAGEMENT OF INNOVATION SYSTEMS

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Abstract

Purpose – the purpose of this paper is to analyze the context of the public governance changes with an emphasis on networks and to identify the key features of how these changes influence the transformations of the innovation system management.

Design/methodology/approach – analysis of scientific literature.

Findings – the paper reveals that the combination of high level of collaboration actions and intense level of knowledge flow is considered as a central point of competitiveness in the network system.

Research limitations/implications – The paper analyses the environment of the public governance changes and its influence to the innovation system management with an emphasis on the unique features of knowledge networks.

Practical implications – the article describes a holistic view on network approach to public governance, based on two contrasting perspectives on networks: network as *logic of organizing* and network as *analytic perspective*. The synthesis of both perspectives is used to analyze the transformations of innovation system.

Originality/Value – The study integrates the network governance and knowledge-based collaboration streams of reasoning to give a unique contribution towards the understanding of the fundamental network factors that are essential to the contemporary knowledge-based management of innovation systems.

Keywords: innovation management, inter-organizational networks, network governance, knowledge networks, knowledge transfer.

Research type: conceptual paper, literature review.

Introduction

If we accept that knowledge is the key driver in today’s economy and a fundamental condition for economic growth it means that constant knowledge-seeking, knowledge absorption, knowledge creation and knowledge transfer are the most important sources to obtaining long-term competitive advantage.

Last two decades of the XX century were marked by significant structural transformations influenced by the emergence and diffusion of information and communication technology. The world was connected into a global, informational and networked social structure called *network society* (Castells, 2005).

Networks and networking have been recognized as key factors in strengthening the innovation capacity of a country and responding to the challenges of increased international competitiveness (Rampersad, 2008). According to Badaracco (1991) the central domain in the age of the constantly proliferating knowledge “*is a social network that absorbs, creates, transforms, buys, sells, and communicates knowledge. Its stronghold is the knowledge embedded in a dense web of social, economic, contractual, and administrative relationships*”. This stream of reasoning has directed the research of innovative modes of governance and knowledge management towards the creation of new forms of intersectoral collaboration, various types of partnerships, networks and networking techniques. (Raipa, 2011; Domarkas, 2011).

This article provides a holistic view on the management of innovation networks suggesting the combination of knowledge management and networking as background for the successful development and management of innovation networks in order to be competitive in the world system.

The **purpose** is to analyze the context of the public governance changes with an emphasis on networks and to identify the key features of how these changes influence the transformations of the innovation system management. The **object** of the paper is the transformations of public governance and their influence on innovation management. **Key tasks**: (1) to analyze the network approach to public governance; (2) to explore the changes of the scientific society influenced by the network governance, (3) the change of the essence of the architecture of the innovation networks and (4) Change of the essence of social relations between actors.

Network approach to public governance

Prior to any study on networks, the definition of what is meant by the term network is necessary because despite the growing amount of literature on *network* and *networking* but no unified definition is formed.

In order to describe a holistic view on network approach in the context of the organization and management literature Powell and Smith-Derr (1994) suggested two contrasting perspectives on networks – networks as *logic of organizing* and networks as *analytic perspective* (Saz-Carranza, A. 2007).

The *logic of organizing* approach refers to the main conflicting images of governance modes (Williamson, 1975): markets, hierarchies and networks as the means of governing the relationships between the different organizations (Lowndes and Skelcher - 1998).

Network as *an analytic perspective* emphasizes the relational aspects of actors, and uses the term as a metaphor for conceptualizing and understanding social reality (Dowding 1995). This use of the term focused mostly on embeddedness of the actors in a network and various forms of social relations.

The synergy of the two perspectives describes a holistic understanding on the network approach to public governance.

The *logic of organizing* perspective refers to the evolution of the modes of governance and the contrast between networks and the traditional forms of markets and hierarchies (Powell 1990). These forms may be roughly characterized by *governance through competition, direct governance, and governance through cooperation*. (Hewitt 2000)

Early research on network governance focused on defining the network model as a separate paradigm: the third mode of governance. In recent years, however, large amount of literature conceptualized networks as a hybrid form of organization that merges two extremities: hierarchy and networks (Thorelli 1986; Siebert 1991; Sydow 1992) because it contains characteristics of both forms (Tamyko Ysa, Ferran Curtó & Marc Esteve). In the scientific literature most authors refer to this hybrid model as governance, *holistic governance*, or *occasionally network governance*,

Agranoff (2007) proposed a term of *collaborarchy*. Klijn (2008) argues that both concepts refer to the same thing. Walker, O’Toole and Meier (2007) define network as “*a pattern of interdependence among social actors in which at least a portion of the links are framed in terms of something other than superior - subordinate relations. Parts of this network may include hierarchical arrays, but at least some portions of the pattern are linked in another fashion*”. (Walker et. al. 2007)

Pure cooperation is not the background of network as a mode of organization. The unique idea of the network governance lies in the synergy of the principles of hierarchy and market. Therefore network approach is compared to social constructionism in the sense that each case/project/situation is regarded as unique therefore it requires relevant unique treatment (Hjelt et al., 2008). Network governance combines vertical/horizontal coordination; control-command/competition/collaboration etc. According to van Dijk (2006) mutual trust and the reputation of participants are the cornerstones of the progress and internal accounting of networks.

In recent years, high attention is brought to the *analytic approach* to the networks in order to understand how the networks operate and how the knowledge is absorbed, created and shared among the actors of the network. In large amount of scientific literature this approach refers to the social network theory that focuses on social relations between actors.

Broadly speaking, a network can be loosely defined as a set of actors connected by ties, where *two or more agents, at least in part autonomous, which are interdependent and give rise to an exchange relationship, according to certain modalities and forms*”. (Understanding Supply Chains, 2004)

Transferred to management studies, a network of organisations can be understood as a set of “*formal and informal relationships that shape collaborative actions*” (Atkinson & Coleman, 1992; Dredge, 2006b) among all the actors of public, private, non-government sectors: individuals, groups, organizations, collectives of organizations, sectors as well as regions, countries etc. According to D. Carson, A. Gilmore and S. Rocks (2004), a network is a form of partnership and collaboration. It unites the individuals, groups and organizations that have common goals and empowers them to exchange resources, information and knowledge in order to improve the efficiency of their activities. Networks

have been analysed from different approaches and various theoretical perspectives in organization studies (Nohria, 1992; Oliver and Ebers, 1998). Researchers tend to distinguish two levels of analysis: the structural properties and the processes involved in developing and sustaining networking relations also known as networking (Alter and Hage, 1993). Networking is a fundamental component that connects the dimensions of a network and covers a variety of collaborative actions in order to exchange/transfer knowledge and information. Networking is defined as a process by which two or more organizations and/or individuals collaborate to achieve common goals (Waring 1997). Vilkas and Bučaitė (2008) proposed that networking should be defined as “purposeful action to shape network”.

In order to structurize the network concept, four network dimensions can be distinguished: node, link, network as the entity and networking as the dynamic component. The classification of the basic components of the network, points out the following four constituent dimensions of characteristics of structural and social-relational features of the network components:

Table 1. Network dimensions and components

Level	Components	Dimensions	Characteristics	Key research elements
Structural	Actors / Nodes	Architecture	Who is connected to who;	Centrality, position, types of actors, number of clusters
	Links/ties	Interdependency	How they are connected;	Directed/indirected Formal/informal; strong/ weak ties, strength; weight; directions (vertical/horizontal);
	Network	Embeddedness	Set of nodes and ties;	Size, density, distance, bridges, Redundancy (structural holes)
Social	Networking	Process of interaction	What is exchanged and how;	Exchange of goods (work flow networks); exchange of information, knowledge and ideas (communication networks); affect or linking (friendship networks).

Source: Adaptation based on various sources.

Structural qualities of the networks can be used as important tool for the explanation of the performance and outcomes of the network, because they reveal relational and social information of the process of interaction of the network. The analysis of these elements provide important information such as how actors are or are not connected, who are the effective central key players, who create/absorb/share the highest levels of knowledge and information etc. These different measures allow us to make value insights and assumptions about the way that information and knowledge flows are organized in a network.

Centrality is one of the most important concepts in social network analysis. It is an index related to the potential importance of a node and is directly related to the process of networking.

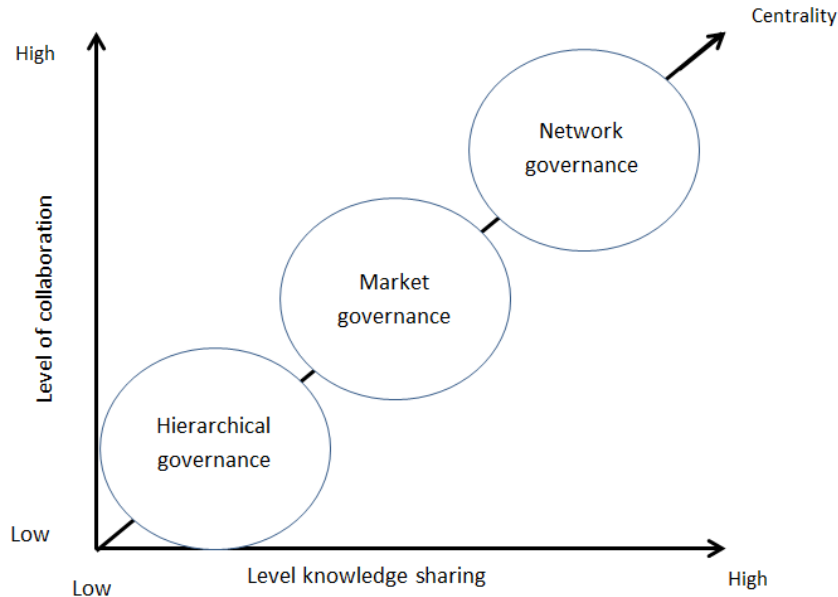


Figure 1. Relationship between the level of interaction, level of knowledge flow and centrality

Network centrality can be considered as the index of an important structural source of power of the organization (Ibarra, 1993). Central position can only be held by controlling the highest level of information and knowledge flows. Some nodes have greater “influence” over others compared to the rest, or are more easily accessible to other, or act as a go-between in most node-to-node communications. This dynamic creates a hierarchy of networks in networks. Figure 1 illustrates a model of centrality conditions based on the analysis of the two-folded network conception. Central position should be understood as a highest level of competition where knowledge is the basic advantage. A high level of knowledge-based interactions is the key condition and the key of competitive advantage in a contemporary networked economy.

On the ground of the analysis of the two folded concept of *network*, three flows of changes are distinguished as for further analysis of the networks implications to innovation systems:

- Change of the essence of scientific society.
- Change of the essence architecture of the innovation system.
- Change of the essence of social relations between actors.

Change of the essence of scientific society

The essence of the changing scientific society was explained by distinguishing two contrasting modes of knowledge production. Gibbons et al (1994) argue that global changes of societies transformed the process of knowledge creation and led to the emergence of a new form of knowledge production, *Mode 2* alongside *Mode 1*. *Mode 1* represents traditional university research performed, established and governed by closed academic community with strong hierarchies and isolated disciplines. According to Viliūnas (2006), *Mode 1* represents the generation of knowledge within a disciplinary, primarily cognitive, context where problems are set and solved by the, largely academic, interests of a specific community.

Here *Mode 2* is seen not as a contrast to *Mode 1* but rather as the globalization-influenced evolution of the same paradigm. There are five fundamental principles that reveal the nature of knowledge creation in contemporary knowledge-driven network society: (1) knowledge is produced in the context of application; (2) transdisciplinarity; (3) heterogeneity and organizational diversity; (4) quality control and (5) social accountability and reflexivity (Nowotny et al. 2001). Scientific questions rise from the practical needs and the value of knowledge is estimated by its applicability impact on economy (Viliūnas, 2006). Innovation becomes a general incentive to encourage the creativity of the society, transparency, trust, changes in management that create added-value and long term advantage (Mosta, 2009). In *Mode 2* science is applied, technologies are transferred and knowledge is managed. The key drivers of *Mode 2* paradigm are not only the generation of new knowledge, but also configuration of existing knowledge, knowledge transfer and application. Contrary to *Mode 1* where the function of knowledge creation was attributed exclusively to researchers of the universities/institutes, *Mode 2* promotes heterogeneity and focuses on the mutual integration of private and public research. This led to the emergence of new transdisciplinary fields of research (biotechnology, information technology etc.).

Change of the essence of the architecture of the innovation networks

In the context of National systems of Innovation, Etzkowitz & Leydesdorff (1995 ir 2000) explained the emerged institutional arrangements of university-industry-government relations by introducing a *Triple Helix* model. The authors distinguish three stages of intersectoral collaboration evolution.

First two stages, the so-called “etatistic” model and the “laissez faire” model of university–industry–government relations can be compared with the hierarchic mode of governance in the sense of the vertical control and the strong influence of the government in shaping research and industry sectors. There was a weak or no connection between the sectors. All strategic initiatives came from the government as well as the decisions on the finance, policy etc. (Etzkowitz, H., Leydesdorff, L., 2000). With the emergence of market ideas in the public governance, and later – the network governance - the transitional

“laissez-faire” stage of university–industry–government relations evolved into the Triple Helix stage that promotes interdependent connections between university–industry–government by blurring boundaries between disciplines, research fields and functions as well as by introducing new forms of dynamic collaboration and communication initiatives such as joint projects, interorganisational institutions, Complex research and innovation programmes, centres of excellence etc., in order to promote innovation development in all sectors on all levels (Kiškienė, 2010).

Aside of the original functions each sector acquires the qualities and characteristics of the other two. The state becomes a collaborator, “enabler” (Etzkowitz, Leydesdorff, 2000; Etzkowitz, 2002). A special attention is paid to the changing role of universities and public research institutions. In addition to education and research functions they are attributed by a so-called Third Mission (Kiškienė, 2010). This view highlights knowledge transfer responsibilities and activities (Martinelli, Meyer & Tunzelmann 2007; Bramwell & Wolfe 2008) and focuses on the external outcomes of entrepreneurship such as new venture creation and commercialization of research findings. (Kiškienė, 2010). This function requires cardinal re-thinking of the strategies in order to compete for external research funding and emphasizes business-like efficiency (e.g. Liesner 2006). Industry sector becomes an important actor in shaping public governance, national economies.

Change of the essence of social relations between actors

The free flow of knowledge and information is a key characteristic for innovation networks, where interactions typically occur between the nodes in the networks. According to Powell, Koput, and Smith-Doerr (1996), *sources of innovation do not reside exclusively inside firms; instead, they are commonly found in the interstices between firms, universities, research laboratories, suppliers and customers.*

According to Granovetter (1985), *all economic processes are socially embedded*, consequently innovation is considered to be as the outcome of interaction among firms as well as between these and local institutions. Various types of relationships exist among the actors of a network ranging from highly informal, flexible and trust-based relations to more formalised and stable arrangements, such as partnerships. However, beneath every formal network (research co-operations, joint ventures, etc.) *lies a sea of there are various informal networks* that give it life and sustainability.

Regarding the ties among universities, incubators and industry, Rothschild and Darr (2005) observe that *informal networks play a central role in the development of emergent technology and* are more important than formal connections. These informal relations can be considered as networks inside the networks in the networked society. Blau and Scott (1962) observed that the influence of the informal relations must be taken into account and evaluated in order to describe a holistic view on processes within the formal organization. Martins (2009) emphasizes that social networks are the key to transforming the *individual resources into organizational resources*. Breschi and Lissoni (2004) and Singh (2005) observed, that the researchers that work together on the same invention or project form social networks that correlates with the variance in citation

patterns within and across regions (Cartoni, D., Gardim, N., Caballero, S., Silveira, M. A. 2013). In this perspective, different authors (Vasconcelos & Campos, 2010; Tomaél, Alcará & Di Chiara, 2005) argue that informal social networks promote innovative activity by maintaining channels and information and knowledge flow in which the connection between actors is developed by fostering trust, reliability and respect. According to Schmidt (2007), observed that the literature on informal R&D collaboration and the channels of information and knowledge flows are very closely related. Meyer-Krahmer and Schmoch (1998) highlight the importance of *informal contacts and collaborative research* as channels of communication between firms and public institutions.

It is fair to state that successful informal collaboration is the key to successful formal collaboration. Therefore it is important to develop both forms especially when innovations are concerned. Here formal relations are being created in a way that they would also encourage the development of informal relations.

However despite of the importance of social relations, little research has been done in exploring the relationship between formal and informal collaboration, the processes of the development of informal relations as well as the collaboration mechanisms for facilitating networking and their influence on innovation clearly needs to be investigated further.

Conclusions

The two-folded concept of a network is based on organizational and analytical perspectives. The contemporary networked society is considered as a hybrid mode that contains the features and means of hierarchy governance and market governance and it is considered as a network of networks where the capability of networking in order to absorb, create, share and transfer knowledge is becomes the most important competitive advantage.

Central position in this system of networks depends on the actors' capability to intensively interact in the network by combining the maintenance of high level collaborative actions and the capability to effectively control knowledge flows.

The changing environment of public governance changes the essence of the scientific society. Knowledge creation becomes an interactive process of the information management and it goes together with knowledge transfer and collaborative actions because in the contemporary knowledge-driven networked society science is applied, technologies are transferred and knowledge is managed.

The change of the essence of the scientific society implicates the insitutional transformations: changing roles, functions and relationships between university, industry and state. From the highly vertical construction governed by state actors this relation becomes an interdependent network of public-private-non-government organizations that interact through the various forms of formal and informal collaborations.

Informal collaboration becomes a field of interest regarding the management of innovations. Informal collaboration has been recognized as an important factor of

innovation process and one of conditions of successful formal collaboration. Formal relations are being created in a way that they would also encourage the development of informal relations. Despite this fact, the relationship between formal and informal collaboration, the development of informal networking relationships, the collaboration techniques for enabling networking and their influence on innovation clearly requires further research.

Recommendations

As it was argued in this paper, formal and informal forms of collaboration and the relationship between these forms are clearly an important topic for further research on networks and network centrality and should be taken into account when analyzing competitive advantages of the organization.

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