Building a Better National Innovation System through Effective Knowledge Sharing: A Case of Croatia

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Abstract: In this article we discuss how knowledge sharing that takes place between scientists working on complex Science and Technology projects is related to the knowledge sharing that takes place among actors of the innovation system. Governments' role in constructing and managing National Innovation Systems and the role of effective knowledge sharing on S&T projects are emphasized. Leadership, support and clear vision by the government are essential for framework establishment and policy design facilitating effective interaction among research institutes, universities and firms which would enables knowledge sharing both on macro level, between innovation system actors, and on micro level, between scientists working on projects. Generating relevant knowledge flows, would help countries like Croatia, which are lagging behind in the innovation race, to establish knowledge based economies, consequently resulting in higher competitiveness and market success. Only through effective knowledge sharing both on micro and macro level can the optimal result be reached.

Key words: Knowledge Sharing, National System of Innovation, Project Teams

1. Introduction

It is a commonly adopted perspective among researchers that in today's world the ability to innovate is a major factor of competitiveness, which is seen as a driver of the long – term economic development. Organizational, industrial, regional and national level innovation is considered essential for job creation, development and sustainable wealth generation. (Goran et al., 2009). Economic conditions and prosperity of a nation depend on the industries' and organizations' capacity to innovate continuously, as well as on research institutions and universities to come up with worthy scientific results. Additionally, the capability to innovate is considered a primary source of any organization's sustained competitive advantage (Lengnick-Hall, 1992; Porter, 1990). Taking into consideration that overwhelming majority of innovations come from companies (Paul, 2005), comprehending the innovativeness of industries and organizations is therefore of vital importance to any nations' government, particularly for the reason that the increased international competition puts additional pressure on countries' organizations to be competitive.

Competitiveness doesn't depend solely on the existence of production factors and skilled labor force; it can be achieved through a well-planned and accurately designed policy which stimulates innovations. A government is the one that establishes satisfactory conditions and encourages innovation through its policy

measures, which provide a foundation for other actors to become innovation conscious and innovation oriented. This strategic direction for achieving global competitiveness and economic prosperity is seen as a path for many countries not rich in natural resources. This is especially a valid argument because of the fact that countries which mainly export sophisticated goods are the ones increasing the size of their wealth while countries exporting minerals and other raw materials are even getting poorer (data, green report). However, attaining conditions which would fuel the innovation process is not an easy task. This requires development of policies that support innovation appropriately, encompassing deep understanding of critical aspects of the innovation process, such as various innovation activities, interaction among innovation actors and creating relevant linkages and knowledge flows. (OECD, Oslo report). One of the most significant processes which influences work-environment creativity (Schepers and van den Berg, 2007) team performance, cohesion, knowledge integration, decision satisfaction (Mesmer-Magnus et al., 2009) and innovation is knowledge sharing. Employees contribute to the knowledge base, innovativeness, competitiveness (Jackson et al., 2006) and success of their organization and projects (Adenfelt, 2010) by sharing their knowledge. Through creation of policies that facilitate effective interaction among actors of an innovation system and relevant knowledge flows, transition countries will be able to establish knowledge based economies, consequently resulting in higher competitiveness and market success. Only through effective knowledge sharing between various institutions within innovation systems can the optimal result be reached.

Furthermore, the precondition is that individuals within these institutions share their knowledge freely and openly without the fear of losing unique value. Still not all countries have been able to recognize promptly the significance of the innovation strategy and knowledge sharing as a way of achieving competitiveness and in turn economic growth. In the 1980s when the majority of the developed countries were constructing their National Innovation Systems and focusing on the integration of science, industrial and technology policies, Croatian government had hardly been planning or implementing such programs (Svarc, 2005). However, in recent years Croatia has initiated its transformation towards a knowledge based society through the development of the Croatian national innovation system (Mohamad, 2006). In doing so, Croatian government has recognized Science and Technology projects with other countries as being noteworthy in the development of NIS and has provided declarative and some financial support. Nevertheless, it still struggles to consolidate its S&T policy and keeps failing to utilize and analyze projects in order to learn valuable lessons necessary for future advancement.

This paper aims at investigating the role of Science and technology projects and more particularly knowledge sharing between scientists in project teams in the development of Croatian National Innovation System. In the first section we will explore the concept of National System of Innovation and discuss its significance in fostering innovations. Subsequent section investigates Science and Technology projects which play an important role in building a national innovation system. Next, we explore knowledge sharing and posit that knowledge diffusion and contribution is a crucial activity and a basic requirement for the S&T project teams to function well. As a final point, we discuss how knowledge sharing on a micro-level i.e. on projects between scientists, can be translated into a wider context of NIS and how adopting an individual level perspective on knowledge sharing and innovation can contribute to the macro -level innovation actors' interaction effectiveness, and consequently NIS. We also provide background information on Croatian competitiveness, innovation ability and government support to the projects we aim to investigate. Our research provides an insight into the development of the National systems of Innovation in a transition country and sheds light on the role of knowledge sharing as an activity vital for innovation.

2. The role of national innovation system

The concept of National systems of innovation has been introduced by the works of Freeman, Lundvall and Nelson in the mid-1980s (Freeman 1987/1988; Nelson 1988; Lundvall, 1988). Since then NIS has been a subject of many researchers and policy makers therefore giving the concept a significant role in the process

of nurturing innovations. **NIS** represents a framework for analyzing national science and technology policy. In addition, different societal institutions interact within the system, and by exchanging knowledge, funds and human resources generate, transfer and utilize innovations in the market (Deok, 2006). These innovation actors include organizations and institutions directly related to searching, generation, diffusion, and appropriation of technological innovations, such as R&D departments, universities, and research institutes (Building a national innovation system through regional innovation systems S Chung). They also include government, financial institutions, market and other actors.

“Special emphasis is put on the role of policy-makers to assist in defining mismatches among actors within the system and find appropriate solutions to improve networking among them” (Report of 1997, OECD). Cooperation and interactive learning between major actors within the institutional setting is essential for generating innovations and strengthening national competitiveness. Through a systematic approach, leadership and good governance cooperation between key institutions is enabled, which is extremely significant for innovating effectively (Umid et al., 2012). This kind of approach to constructing an effective **NIS** of a country requires a set of political, economic, social, organizational, institutional and other policy measures to be implemented by the government; that facilitate interaction and exchange between different actors of the innovation system eventually leading to the increase in their overall innovative performance (Fig. 2)

Fig. 2-1 Conceptual Model: National Innovation System

Attainment of the innovation advantages is an outcome of a highly functional **NIS** where free flow of knowledge, money and human resources is established between the main actors of the system. In today's global competition it is extremely difficult for a single actor to create and utilize innovations effectively due to the risks involved and resources required. Firms that share knowledge with their innovation system have higher innovative performance than the firms which do not share knowledge (Spencer, 2003). Forming clusters with other firms, cooperating closely with research institutes and universities, creating research and development zones helps organizations enhance their knowledge base, ultimately driving innovation. On the other hand, interacting only with their national innovation system earns lower innovative performance than interacting with the global innovation system (Spencer, 2003). Firms' knowledge-sharing strategies in the global innovation system: empirical evidence from the flat panel display industry.

Industrial units, public research institutes, universities and government institutions should cooperate closely both on global and local levels, engaging in networking often forming clusters in order to enhance their innovative capabilities (OECD, 1999). Universities and research institutes are a significant actor as they are the ones coming up with the breakthrough discoveries in the field of science and technology. In addition, when cooperating closely with firms they can bring these innovations to the market, thus increasing industrial competitiveness and consequently improve national competitiveness.

This type of intense and effective interaction is often generated on projects in which multiple institutions cooperate, and which very often are of international character. In this manner best scientists and researchers from around the world are joined together to solve complex problems and generate knowledge valuable for innovating.

Industry, universities and research institutes are the ones actually generating innovations by conducting R&D activities while the government manages the institutional setting, promoting the S&T culture, coordinating the actors and creating different policy measures in order to facilitate innovation creation.

3. The nature of science and technology projects

One of the key roles of the government is to provide a setting for institutions to interact effectively and contribute to the National Innovation System. The work on the international S&T projects between various institutions is usually done by non-traditional working entities created to respond to recent knowledge challenges. Generating a perfect knowledge-sharing environment in these types of conditions might pose a difficult task. Frequently, diverse virtual teams are created to work on projects and respond effectively to the knowledge challenges their organizations face. Advantages to forming such teams may include reduction in travel and cost, recruitment of geographically dispersed talented employees, building diverse teams with specific knowledge and ties of team members, promoting employment in different areas, reduction in discrimination and promoting proactive employment practices for disadvantaged individuals and groups (Bergiel et al., 2008). On the other hand, working environments that do not align with some employees' psychological traits, lack of face-to-face interaction, difficulties in establishing team identity, cultural and temporal differences, complex technological applications and operational environment unfit for company's organizational culture are all challenges that need to be met in order to enable effective knowledge sharing (Gibson and Gibbs, 2006). Therefore "virtuality" itself can be both a threat and an opportunity for promoting effective knowledge sharing between individuals. For the significant S&T projects governments sometimes provide funding in order to increase the mobility of scientists and ensure there is sufficient face-to-face contact needed for effective knowledge exchange.

Knowledge sharing that occurs between team members working on S&T projects encompasses both sharing of explicit knowledge such as information, data, product samples, materials, equipment and instruments; as well as tacit knowledge embedded in people and facilitated through the exchange of team members and other technical experts of global teams. By gaining access to expertise, ideas and information which are not available locally to project team members, they will benefit greatly by enhancing their knowledge base which in turn will drive innovation. Through face-to face communication, electronic networks and other information technology it will be possible to exchange knowledge essential to the success of the project. When it comes to distributed research and development process (Ahuja et al., 2000) and teams whose members are geographically spread; knowledge flows are enabled by properly utilized electronic networks and other computer mediated communication tools. Managing virtuality is an important factor in ensuring knowledge sharing, creative performance and project success (Kratzer et al., 2006). Teams are not only traditional or virtual as literature tends to categorize them, but all teams are to some extent virtual (Martins et al., 2004). For that reason organizations and project managers should be flexible in managing the proximity of team members, the manner in which team tasks are coordinated and the communication modes used because the more flexible teams are in managing these factors the higher the creative performance is (Kratzer et al., 2006). Even between industries differences exist on how teams should be managed. In industries that possess a synthetic or symbolic knowledge-base-knowledge exchange in geographical closeness is highly significant because the interpretation of the knowledge has a tendency to vary between places, unlike in those industries with analytical knowledge base where knowledge is codified, more abstract and universal (Martin et al., 2013).

As a result, the creative outcome is dependent on how these "virtuality" factors are managed. In order for the optimal knowledge sharing level to occur between project team members, not only the aspects of "virtuality" need to be properly managed but also other principles of knowledge management should be applied.

4. Promoting knowledge sharing on projects

In the international circles “Knowledge management” has established itself as an effective way to create, transfer and utilize knowledge within organizations and on projects. Knowledge management awareness and practices are a prerequisite for innovation as they foster knowledge sharing conditions which drive individual, team and organizational level knowledge exchange. Therefore, knowledge sharing on multiple levels should occur in order to build an effective National Innovation system. In the core of Science and Technology projects is individual level knowledge sharing, and it is essential for the successful completion of projects

Effective individual knowledge sharing is attained through proper management of knowledge sharing factors. Examining which factors influence knowledge sharing of scientists is particularly interesting as the whole concept of scientific research is based on openness and cooperation. Knowledge is freely shared between scientists cooperating on projects and because S&T projects require solving complex problems it is done effectively through joint knowledge intensive activities. For that reason the behavior of scientists can potentially serve as a benchmark for knowledge sharing behavior in organizations. Individual (Kamdar et al., 2004; Canbera and Canbera, 2006; Chen et al., 2009), team (Phillips et al., 2003; Cummings, 2004) and organizational context factors (McDermott, 2001) are all connected and influence knowledge sharing behavior between individuals. When it comes to S&T project work, scientists cannot be separated from the organizational culture of their institution, a wider context of NIS and government's financial support. As institutional climate and organizational culture are important elements for creating an environment conducive to facilitating knowledge sharing of individuals (Chen and Cheng, 2012; Al-Alawi et al., 2007) more emphasis should be put on generating favorable knowledge sharing conditions through better regulatory work and effective policy making. Individuals tend to share knowledge in organizations which promote learning (Taylor and Wright 2004; Hsu, 2006), innovation (Bock et al., 2005), trust (Kankankhalli et al., 2005; Chiu et al., 2006; Liao 2006) and cooperation (Wang, 2004).

In addition to the culture, it can be assumed that fairness, leadership and top management support on scientific projects have relationship with knowledge sharing. Empowering leadership positively influences efficacy, and leads to knowledge sharing and an improved team performance (Srivastava et al., 2005). By treating employees fairly a leader can influence a cognitive state which promotes positive behaviors, such as organization citizenship behavior of team members which can result in supervisory and organizationally relevant outcomes (Rupp and Cropanzano, 2002; Schepers and van den Berg, 2007). Conversely, as knowledge sharing on S&T projects is not an organization citizenship behavior, but a fundamental condition for successfully completing a project, fairness might not be highly significant for scientists contributing and sharing knowledge connected to the project theme. Nevertheless, unfair treatment might lead scientists not to share knowledge they have outside of the project scope, resentment and future complications at work.

Due to the nature of the S&T projects higher level of cooperation is expected as scientists have teamed up in order to complement their skills, taking into consideration that S&T projects consist out of highly interdependent tasks which require a wide range of skills in order to respond to the scientific challenges at hand. In relation to that, we can also posit that influence of social capital is significant among scientists. Trust, reciprocity norm, social interaction and networks, shared vision shared language and identification impact quality and quantity of knowledge sharing (Chiu et al., 2006; Wu et al., 2006; Kane et al., 2005; Nahapiet and Ghosha, 1998) and can impact knowledge sharing on S&T projects as scientists are often guided by shared goals and vision of contributing to science and solving complex problems. Furthermore, social interaction might not be highly significant for knowledge sharing, bearing in mind that scientists of different nationalities do a lot of work being on different physical locations and interact mostly through CMC. Knowledge sharing success factors belonging to organizational and team contexts and their relationship to the individual context are fundamental for affecting the cognitive dimension of scientists resulting in knowledge sharing. Willingness, eagerness and generally a positive attitude towards knowledge sharing is expected due to the nature of their work and high knowledge self-efficacy and controllability. Knowledge

self-efficacy affects personal and community outcome expectations, and in sequence those personal outcome expectations impact knowledge sharing (Hsu et al., 2007).

As far as their personality is concerned, woman scientists are more dominant, confident, intelligent, and adventurous than women in the general population. At the same time they are less sociable, group-dependent, and sensitive (Bachtold and Werner, 1972). Even between physicists, biologists and social scientists differences in personality and interests exist. Nevertheless, they are all fully committed to their goal and are characterized by "driving absorption in their work" (Roe, 1952).

In addition, there is a significant relationship between personality traits and knowledge sharing within teams (Matzler et al., 2008). For instance, agreeableness, conscientiousness, (Matzler et al., 2008) learning orientation (Antecedents of knowledge sharing – Examining the influence of learning and performance orientation) openness of individuals to experience (Canbera and Canbera, 2006; Matzler et al., 2008), emotional intelligence (Chen et al., 2009) and exchange ideology (Lin, 2007) positively influence knowledge whereas performance orientation has a negative impact on knowledge sharing. Because individuals are inclined to have a certain attitude and exhibit a specific behavior we conclude that different aspects of personality under a positive influence of team and organization context factors are more likely to result in knowledge sharing behavior.

Consequently, when all the necessary requirements for individual level knowledge sharing to occur are met, knowledge is shared freely and openly between scientists, leading to a better team performance and successful project completion.

5. Implications of Knowledge sharing for croatian national system of innovation

In the 1990s a huge number of developed countries adopted innovation policy as the core policy for their strategic development and future economic growth. Governments' efforts to create measures which would enable the integration of S&T within the wider social and institutional context positioned NIS as one of the major tools of bringing national economies one step closer to the knowledge-based economies. Then again, not all countries immediately recognized the importance of being innovative and establishing a highly functional NIS. The transition countries, such as Croatia, which are lagging behind should therefore focus on the development of an effective innovation system as it is one of the critical factors for catching up. (Jan et al., 2007). Furthermore, a concept of knowledge management, one of the key activities for fostering innovations yet needs to be recognized in Croatia as a mean of achieving competitive advantage and therefore has been scarcely implemented by Croatian institutions and organizations so far (Clanak, 2011; Vidovic, 2008).

In order to build an effective NIS understanding both "micro- behaviour in the core and "the wider setting" within which the core operates" is crucial (Lundvall, 2007). Micro- behaviour such as knowledge sharing between scientists can be applied to a macro-context, in which knowledge sharing between various actors of the innovation system also happens. As among the scientists working on projects where management support, fairness and leadership are significant factors for promoting knowledge sharing, interaction between research institutions, universities and industry is also shaped by leadership, while support of the government is fundamental. As a part of the strategy to make innovation one of the priorities for Croatian government, the Ministry of Science, Education and Sports of Croatia has created necessary conditions for direct cooperation of institutions in the domain of education, science and technology. By establishing cooperation with a number of countries and foreign partners bilateral and multilateral projects of Croatian institutions with other foreign institutions were enabled. These agreements have been designed to promote scientific and technological cooperation between research institutions, universities, units and companies of the countries involved. In the core of the co-operation are only those projects which had already secured funding at the national level. Therefore, they were evaluated as significant in their respective fields of research, as

well deemed as significant for the growth of the national knowledge base, and consequently innovations. From that perspective, they play an important role within the NIS of Croatia.

In project teams leadership and management support are organizational context factor of great significance and together with the organizational culture they sets the tone for cooperation between scientists, in the same way as the institutional setting formed by the government sets the tone for cooperation between research institutes, universities and firms. As scientists do not work in a vacuum, but are affected by the organizational culture of their institution, government's support and wider context of NIS, it is sometimes difficult for them to perform their job. In Croatian media it has often been reported of scandals within research institutions, universities and lack of financing of the scientific sector, all which can potentially lead to negative climate in the field of science and research (Jan et al., 2007). Some of it is also due to the poor leadership from the side of the government, which every few years declaratively introduces science and innovation as a crucial pillar for development, but lacks execution. Recently, based on the decision of the Ministry of Science and Education funding was cut for research projects for the last three months of the year 2013. Lack of vision and strategy is also prevalent. It was back in 2010. when Croatia last had a Science and Technology policy and just recently the government commenced a project of developing national innovation policy, something that developed countries have had for years.

Furthermore, investments in research and development sector in Croatia amounted to approximately 0.8 percent of GDP in 2012, while the developed countries such as Finland allocated about 3 percent of GDP for innovation. According to the OECD an increase of only 0.1 per cent of investments in innovation results in improved competitiveness of products and services can be a long-term increase of overall GDP of 1.2 to 1.5 per cent in 5-10 years.

This absence of vision and support of top government officials transposes to the middle level personnel which lacks motivation to develop initiatives for utilizing scientists whose education they financed. Whether it is on a strategic or bureaucratic employee level the Ministry of Education and Science lacks there is lack of support and leadership.

When it comes to constructing policy and giving support government should be cautious as the implemented policy should suit the personality of the institution in question. As psychometric characteristics of scientists are not only different from characteristics of general population, but they also differ between themselves it is only natural to assume that certain specialized institutions, such as research institutes and universities tend to develop their own "personality". Both institutions and government should be conscious about the nature of the institutions and in joint effort aim to develop a stronger social capital between various actors of the innovation system, which will enable effective cooperation between them. As a part of this government cooperation should encompass regular exchange of information on the key strategies and the latest plans for the development of science and technology by all sides.

By cooperating closely with the industry sector, research institutions and universities can commercialize their findings, resulting in innovations valuable for the development of National Innovation System. In turn, this will build competencies of scientists and institutions driving them to share more knowledge. These lessons on effective knowledge sharing from S&T projects can be transferred to organizations, government and other institutions within the NIS.

A National Innovation System based on openness, cooperation, knowledge sharing between and within all the actors can lead to a more competitive national economy.

6. Future plans

The main goal of the future research is to deepen the understanding of knowledge sharing and its role in building an effective innovation system. This can be done by determining critical success factors influencing knowledge sharing on projects of diverse and dynamic nature and by building a model that will effectively lead to individual level knowledge sharing on projects.

The sample should include knowledge-intensive projects aimed to solve complex problems through innovative solutions in the field of science and technology for which knowledge sharing is highly relevant. Past studies have focused mainly on knowledge sharing within organizations and virtual communities and not between project team members. In the first stage of data collection semi-structured interviews can be conducted with project managers of the sample projects to discuss factors influencing knowledge sharing as well as the extent to which knowledge sharing occurs in the studied environment. After content analysis has been conducted a refined model of knowledge sharing built on extensive literature review and findings from semi-structured interviews with project managers should be developed and empirically tested. By doing so limitation of previous studies to include all relevant factors influencing knowledge sharing and the existing relationship between them would be addressed.

Furthermore, future studies should evaluate the current state of knowledge management practice applied in joint research projects between Croatia and other countries and at the same time determine the factors facilitating effective knowledge sharing behavior. The lessons learned would provide empirical evidence upon which effective knowledge sharing initiatives can be developed. This is a prerequisite to the development of an effective National Innovation System as the research institutions and universities are a major actor in the innovation system.

Existing research has suggested the strong need to empirically test and synthesize theories from different disciplines to examine the complex phenomenon of knowledge sharing among virtual Science and Technology and RD project team members in cross-cultural settings because they can all make contributions to understanding people's knowledge sharing patterns.

For that reason future research should be grounded on existing social, psychology and organizational theories which can be applied to analyze knowledge sharing on the individual level. Relevant factors belonging to the organizational, team and individual contexts should be explored and how their relationship leads to optimal knowledge sharing behavior. Additionally, the investigation of specific conditions regarding the "virtuality" of the projects and national cultures would deepen the understanding of knowledge sharing which occurs in the dynamic working environment encompassing many complex elements.

7. Conclusion

Although managing S&T projects may be difficult due to special project characteristics, they serve as a worthy example of interaction and effective work as scientific research is based on the principles of openness and knowledge sharing. Creating successful project teams requires providing necessary knowledge sharing conditions to support team work. Therefore it is of large importance to develop a knowledge sharing framework and knowledge management practice that can lead to optimal usage of existing knowledge as well as to creation of new knowledge essential to the effective functioning of the entire National Innovation System and the execution of the Innovation strategy.

Given that national economic performance is closely related to the country's effectiveness to create an environment that is favorable for generating innovations in organizations and that such environment is strongly dependent on the extent to which knowledge is being shared among relevant actors of the innovation system (Miller and Shamsie, 1996) it is crucial that an environment which encompasses multiple level factors critical for the success of knowledge sharing is created. One of the main functions of Knowledge management activities undertaken by institutions is to generate particularistic knowledge sharing initiatives which would empower and motivate employees to share their knowledge, consequently having a positive effect on project outcomes or the success of an organization. Creation and implementation of policies and knowledge management initiatives that facilitate effective interaction among and within relevant institutions of the innovation system will lead to higher innovation levels and more competitive national economy. Therefore, by establishing a knowledge sharing framework that can be utilized in future bilateral cooperation in various fields, including academy, science and business, an opportunity to share knowledge and innovate would result in one step closer to an effective National Innovation System and a knowledge based economy of a country.

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