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Creativity techniques to enhance knowledge transfer within global virtual teams in the context of knowledge-intensive enterprises

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Abstract This conceptual paper investigates the common concern among managers that the physical separation of workers within a global virtual team may hinder the transfer of knowledge amongst the team members that is required to carry out their work efficiently, especially in the context of knowledge-intensive enterprises. Workers and work teams in knowledge-intensive enterprises are often involved in creative tasks that are carried out jointly and involve team members with diversified competencies exchanging knowledge related to their projects and assignments to create innovative outcomes. We investigate some popular creativity-enhancing techniques in the perspective of their use as catalysts for knowledge transfer in this context. We assess whether the use of these techniques may alleviate the limitations imposed on global virtual team members by their use of telecommunications and collaborative work tools that might otherwise adversely affect the effectiveness of the knowledge transfer. These techniques are designed to be used individually, by groups or within a virtual community. The physical and temporal separation of the global virtual team members does not hinder the knowledge-intensive dimension of these enterprises when aided by creativity-stimulating techniques. Therefore, we suggest that global virtual teams making use of creativity-enhancing techniques may be more efficient in transferring complex knowledge.

Keywords Global · Virtual teams · Knowledge-intensive enterprises · Knowledge transfer · Creativity

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1 Introduction

The demand for goods and services from knowledge-intensive enterprises (KIEs) is becoming increasingly specialized, and their markets are becoming increasingly fragmented. Consequently, to produce the highly specialized and complex goods or services to meet this diversified demand, organizations require highly specialized and experienced workers, who are becoming increasingly scarce (Bélanger et al. 1994; Grant et al. 1997; Tremblay 2003; Bélanger 2013). Furthermore, the generation of innovative outcomes in response to these highly specialized and complex market needs often requires teams of workers comprising diversified competencies and professional backgrounds to work together toward a common goal. The efficiency of the knowledge exchange between these workers will determine the success of the team. The knowledge transfer needs to be carried out not simply to transfer a body of knowledge from one worker to another, but rather to support and to feed a joint creativity process. The importance of this knowledge exchange is compounded in knowledge-intensive enterprises. KIEs concern ventures "that introduce innovations in the economic systems, and that intensively use knowledge" (Malerba 2010, p. 4), and the characteristics of knowledge intensive activities are the results of interactions between different actors (Malerba 2010). Knowledge intensive activities are "based not only on the use of existing knowledge but also on the integration and coordination of different knowledge assets and the creation of new knowledge" (Hirsch-Kreinsen and Schwinge 2011, p. 3).

In global markets, KIEs need to extend their geographical reach in several remote regions. They may also seek to draw on regionally localized strengths (i.e., comparative advantages) of multiple regional groups that are usually geographically distributed. As KIEs are characterized by qualified employees who form a major part of the work force and mainly engage in "intellectual work" (Alvesson 2000), the pool of potential workers with the required skills is often limited and sometimes even nonexistent in the organization's home region. Searching for local workers only is no longer effective; recruiters need to reach out to workers beyond commutable distances from the KIEs' physical offices. Moreover, highly experienced knowledge workers who are often well established in their communities will often disregard opportunities that involve relocation. For all these reasons, diversified, knowledge-intensive and distributed team members need to work together. Thus, to remain competitive and sustainable, global KIEs have no other choice than to embrace Global virtual teams. Virtual teams refer to geographically and/or organizationally dispersed co-workers working together to perform a task through communication and information technologies (Kankanhalli et al. 2006). Global virtual teams (GVT) refer to globally disperse such co-workers as they typically come from different continents or countries, and rarely or never see each other in person (Kankanhalli et al. 2006). The ability to manage the more challenging GVTs often represents a key success factor for large international projects that involve multiple organizations. Indeed, to take part in such projects, organizations must adopt the practice or pass on the opportunities.

However, despite these strong strategic incentives and the development of a knowledge-intensive dynamic, virtual teams are still at early stages of development in the workforce (Clear and Dickson 2005; Davidson 2013). Nevertheless, as global KIEs play a major role in the new knowledge economy, virtual teaming is slowly gaining recognition as an

organizational model bringing advantages to both an organization and its workers (Pinsonneault and Boisvert 1999).

One objection to virtual teams frequently heard from managers is that employees need to be brought into close physical proximity to be creative, especially in knowledge-intensive settings. This objection is based on the belief that less socialization and less interaction reduce the stimuli and knowledge flow that induce the generation of ideas among the members of virtual teams. In KIEs, knowledge transfer does not occur in a vacuum; it is usually carried out in the pursuit of a production goal. The GVT members exchange knowledge that relates to a problem at hand to find solutions together. In a GVT setting characterized by communications limitations, the knowledge transfer process can be stimulated with creativity-enhancing techniques that are compatible with the characteristics of communications in the virtual team setting (Davidson 2015). This paper therefore focuses on commonly used creativity-enhancing techniques to enhance knowledge transfer; in other words, these techniques represent catalysts for knowledge transfer in GVTs.

Our research objective is to examine knowledge transfer techniques within GVTs, and our research question is "how can creativity-stimulating techniques enhance knowledge transfer within Global Virtual Teams in the context of Knowledge-Intensive Enterprises?"

The article is structured as follows. First, we present the challenges of international knowledge transfer in global virtual teams. Second, we analyze creativity-enhancing techniques as knowledge transfer facilitators. Then, we analyze the implications; and finally, we conclude with the limitations and suggest avenues for future research.

2 Perspectives on knowledge transfer within global virtual teams

Over the past 30 years, a strong emphasis has emerged on the convergence between globalization, virtualization and knowledge (Skyrme 1997). In a globalized context, the success of international knowledge transfer mainly depends on different factors (Kedia and Bhagat 1988). The specific KIE context in which knowledge transfer occurs is better understood by examining the barriers and challenges to such transfer (Keller and Chinta 1990), which we present hereafter. Then, we analyze these dynamics within virtual teams.

2.1 Knowledge transfer in an global context

The competitive advantage of firms mainly depends in their ability to "identify and transfer knowledge and technology between geographically dispersed units" (Miesing et al. 2007, p. 110). Transfer is defined as "a process that nourishes the various needs and stages in the decision-making process of firms" (Landry et al. 2007, p. 575). Transfer, which is an active process which involves interactions between sources and recipients (Battistella et al. 2015), is of great importance (Goh 2002), especially in the case of KIEs (Nunes et al. 2005) and KIBS (Knowledge Intensive Business Services) (Hertog 2000). These types of organization are characterized by tacit and complex knowledge and that is difficult to codify and to transfer (Nunes et al. 2005). Previous studies have attempted to differentiate between technology and knowledge transfer. For instance, Landry et al. (2007) argue that "technology transfer refers to a much more limited set of activities than knowledge transfer. Technology refers to tools for changing the environment, while knowledge embodies theories and principles helping to understand the relationships between causes and effects (Landry et al. 2007, p. 563)".

When taking into consideration the international dimension, most studies distinguish between intra- (Tsai 2001) and inter-knowledge transfer in analyzing the type of governance between firms, such as international acquisition (Bresman et al. 1999), strategic alliances (Simonin 2004), and especially the case of joint-ventures (Inkpen 2008).

Even though international knowledge transfer offers many opportunities, some risks, drawbacks and challenges also exist (Reus et al. 2015). First, previous studies showed that international knowledge transfer is facilitated by communication, visits and meetings (Bresman et al. 1999). In the case of virtual settings, these elements might not be relevant, as participants in knowledge transfer are not expected to conduct visits and meetings on site. Second, some barriers to the transfer of knowledge exist between geographical dispersed actors. In fact, greater distances between actors lead to slower and less effective transfer of knowledge and technology (Battistella et al. 2015). The risks associated with knowledge transfer will increase with geographical and cultural distance (Bresman et al. 1999) as the frequency of contacts, the degree of familiarity, social relationships, reciprocity and feedback activities might by be negatively affected (Battistella et al. 2015). In the context of complex knowledge, most studies have focused on individuals while the analysis of transfer can be applied to other levels such teams (Gerbin and Drnovsek 2015). Working environments can facilitate or hinder collaborative initiatives that can lead to new discoveries through collective reasoning and arguing (Gorman 2002). We hereafter investigate global virtual teams.

2.2 Global virtual teams

Global virtual teams (GVTs) are becoming widely popular thanks to increasing globalization and the advances in communication technologies (Kankanhalli et al. 2006). Additionally, the need to achieve complex organizational tasks that require mobilizing more than individual-based knowledge, the use of telecommunication networks inside and outside the organizations, and the progress made in collaborative tools enhance GVTs' collaborating and decision-making effectiveness (Saunders et al. 2004).

GVTs are an extension of the concept of virtual teams (Kankanhalli et al. 2006); the latter defined as "a group of people who interact through interdependent tasks guided by common purpose" working "across space, time and organizational boundaries with links strengthened by webs of communication technologies." (Lipnack and Stamps 1997, p. 6, 7). GVTs are often temporary teams composed of geographically and/or organizationally dispersed co-workers originating from different countries, that are assembled using ICT to address organizational needs (Powell et al. 2004). Team members, usually accomplishing strategically important and highly complex tasks (Maznevski and Chudoba 2000), seldom see each other while interacting on an ongoing basis via computer-mediated communication technologies (Jarvenpaa et al. 1998).

GVTs offer several benefits to organizations, such as access to expertise and nonstop services to customers, quick responses to global demands and significant savings in terms of travel and communication costs, as well as the flexibility needed to address external changes (Kankanhalli et al. 2006). Nevertheless, GVTs face the challenges of both virtual and global contexts (Jarvenpaa et al. 1998). Although team diversity (in terms of educational background, experience and expertise, and social features, such as race, culture, gender and age) stimulates creativity and facilitates performance, it also reduces cohesion while nurturing conflict (Kankanhalli et al. 2006). Trust building is another issue that usually develops through sustained face-to-face interaction that is removed by the virtual dimensions of the teams (Jarvenpaa et al. 1998). Time can work in favor of GVTs, thanks

to their ability to perform tasks asynchronously, aiding global firms to bridge time zones; pushed to an extreme, it can involve handing off work on a daily basis—a process that is known as the "follow-the-sun" model (Carmel et al. 2010). However, different time zones engender lengthy workdays and coordination burdens (Saunders et al. 2004). The spatial and temporal dispersion of GVTs is another challenge to effective teamwork (Kankanhalli et al. 2006). Although distance may enhance people's productivity in their collaboration, the lack of direct face-to-face contact hampers the reliability and effectiveness of collaboration, especially in regard to new idea generation and management (Gassmann and Von Zedtwitz 2003).

2.3 The challenges of knowledge transfer within global virtual teams for KIEs

Knowledge-intensive processes are inherent to newly emerging problems related to global transformations that cannot be solved using existing knowledge to solve problems (Hirsch-Kreinsen and Schwinge 2011). In addition, the failure of previously well-established firms is sometimes due to their lack of recognition of the global nature of technology and knowledge transfer; the existence of organizational silos represents a common expression of this shortcoming. This has brought many firms to recognize the pitfalls of being locked into a given paradigm, a rigid set of practices or a particular mode of technology transfer that disregards its global nature. To overcome such drawbacks, firms tend to establish initiatives to facilitate knowledge transfer among their workers, especially in the case of GVTs.

A prerequisite for KIEs is their capacity to go beyond existing knowledge, they need to identify, acquire and transfer new knowledge using new bases for such activities (Hirsch-Kreinsen and Schwinge 2011). The issue of international knowledge transfer is paramount in the context of KIEs. The interdisciplinary feature of GVTs, encompassing members with different functional experiences, introduces divergent and diversified perspectives and goals, which boosts creativity but also creates emotional conflicts (Young et al. 2006). However, fear of conflict is one of the most significant potential dysfunctions of a team (Lencioni 2002); fearing conflict stifles the communication of ideas among team members.

Intuitively, one may think that being close to a source of knowledge may represent an advantage over being distant, in regard to receiving, building and transferring knowledge. However, the advantages deriving from close spatial proximity to knowledge sources may also depend on the nature of the knowledge (Sorenson et al. 2006).

Investigating the efficiency of knowledge transfer in the particular case of KIEs, as the knowledge to be created and transferred is potentially of moderate to high complexity within global virtual teams, remains relevant. Indeed, if KIEs strive to improve their effectiveness, they should first understand how international knowledge transfer occurs before identifying how it can be enhanced.

Effective knowledge transfer in GVTs often requires a group of people each of whom holds expertise in a specific aspect of the problem, and all of whom need to work together to find an integrated solution. The process that supports these areas of expertise coming together may not always be planned in advance. Hodgkinson et al. (2009) put forward the concept of 'spreading activation' that mimics the bridging of new connections to respond to the particular needs of a situation. This process involves creative teams reaching out incrementally to the people who hold the expertise as they realize that they need it and as the characteristics of the problem at hand become better understood.

New knowledge needs to be related to the individual's particular goals as she or he participates in the knowledge transfer process. Conversely, not all knowledge needs to be transferred through GVTs.

In KIEs, critical knowledge is mainly tacit, and because it cannot be easily translated into explicit form, knowledge transfer becomes more problematic (Merat and Bo 2013). KIEs can be characterized by complex knowledge, which is knowledge that is broadly applicable but not easily transferable (Novins and Armstrong 1998). Previous studies showed that spatial proximity is not necessary for the transfer of codified and standardized knowledge whereas implicit, non-codified knowledge requires lower spatial distance as personal contacts and verbal and non-verbal communication are of great importance for the partners involved in such transfer (Koschatzky 2002). More specifically, the author explains that implicit knowledge is bound to locations (Koschatzky 2002). In addition, verbal and think-aloud protocols are more efficient tools about tacit problem solving processes (Gorman 2002).

Thus, it is crucial to choose a proper method to transfer knowledge (Lohikoski and Haapasalo 2013). However, few studies have examined the virtual team level of analysis when investigating knowledge transfer in a global setting. Hence, alternative means of knowledge transfer on the international level need to be identified in the context of KIEs.

As mentioned in previous studies, creativity represents a pertinent means in the context of knowledge transfer (Lohikoski and Haapasalo 2013). We aim to contribute to this research stream by analyzing how creativity-enhancing techniques facilitate knowledge transfer within global virtual teams evolving in KIEs.

Having reviewed how knowledge transfer occurs in a global context, we identify how it can be enhanced by relating knowledge transfer to creativity-enhancing techniques.

3 Creativity-enhancing techniques as possible boosters of knowledge transfer within GVTs

Knowledge transfer can occur at different levels within GVTs—from individual to individual, from individuals to groups, between groups, and within and between organizations (Hustad 2004). Some typologies of knowledge transfer in the context of virtual teams focus on the nature of the participants' interactions. According to Soule and Applegate (2005), 'contribution' is unilateral, 'coaching' is bilateral and iterative, and 'collaboration is a multilateral and iterative process of knowledge transfer. The appropriateness of these three types of knowledge transfer is analyzed in the light of creativity-based tools. We aim to analyze creativity-based techniques resulting in increased effectiveness within virtual teams (Lurey and Raisinghani 2000; Davidson 2015) from a knowledge transfer perspective. In a global context, creativity-enhancing techniques are highly important to compensate for the greater physical dispersion of workers in GVTs. Additionally, knowing that typical teamwork involves periods of individual knowledge creation interspersed with group knowledge transfer activities, these creativity-enhancing techniques may be relevant to enhancing/facilitating the knowledge transfer within GVTs in the context of KIEs.

Creativity in modern organizations, such as KIEs, exists on three levels—individual, group, and "eco-system" (Davidson 2015). Each level encompasses many creativity-enhancing techniques. We explore the most popular ones to investigate how these techniques may enhance knowledge transfer in general and within GVTs, in particular.

3.1 Individual-based techniques for knowledge transfer

In the context of KIEs, the ability to emphasize the individual role within GVTs is crucial. Individuals contribute to the virtual team's success in processes related to knowledge creation and transfer. More effective individual creativity as preparation for later group creativity may contribute tremendously to the overall efficiency of knowledge transfer within GVTs. Here we consider two individual creativity techniques, among many others.

3.1.1 Mind mapping techniques

Mind mapping techniques generate visual representations of ideas, concepts and their relationships. The aim is to uncover creative associations between ideas (Buzan and Buzan 2003). GVTs are task-driven with limited opportunities for casual discussions among co-workers and colleagues (Powell et al. 2004). Because visual representations enhance the expressiveness of problem statements, they are helpful tools to uncover the issues and patterns underlying these statements. Individuals within GVTs use mind mapping to disseminate their proper "visuals" while allowing their colleagues to build on their initial visions and ideas. Hence, doing so supports the contribution type of knowledge transfer (Soule and Applegate 2005). The visual representations may also allow GVTs to streamline the communication among their members, specifically in the context of KIEs, where the knowledge to be transferred is often tacit and more complex by nature. In such a case, iterative processes are more appropriate. Hence, knowledge transfer processes are more efficient in the settings that relate to coaching or collaboration.

3.1.2 Transformations of the problem space techniques

Transformations of the problem space techniques can be viewed as variations of the 'brain-writing' technique (Silverstein et al. 2009). They first involve substituting a principal concept in the written statement of one's problem, then finding solutions to that modified problem statement, and, finally, attempting to transpose the solutions found to the original problem. These techniques relate to the Heuristic Ideation Technique (HIT) matrix that focuses on identifying commonalities between two unrelated products and mapping them on an x–y matrix. When there is a match, the user can derive a novel idea for the problem at hand from these commonalities (Silverstein et al. 2009). The technique is also based on the 'convergence' principle that exploits the stimulating effect of problem constraints because constraints foster creativity (Ashford et al. 1979).

A set of tools allows the user to carry out a functional analysis of the problem, to differentiate the problem from its causes, to identify the problem components and to isolate them from environmental constraints. This technique emphasizes individual cognitive processes and is multilateral and inclusive rather than unilateral. Consequently, these techniques are more appropriate in 'contribution' knowledge transfer settings.

3.2 Group creativity techniques

Contrary to Lovelace (1986) who stressed the need for scientists to be removed from any distractions to be fully creative, several researchers (Warr and O'Neil 2005; Kop and Carroll 2011) suggest that social (vs. individual) creativity is more efficient, which in turn might facilitate the transfer of knowledge. For instance, social creativity allows for

immediate feedback, which impacts the extent to which knowledge is transferred to the virtual recipient who is located in a different country/environment.

3.2.1 Stochastic stimulus

The aim of this technique is to induce associations between (1) ideas to be developed and (2) a word or a concept picked at random (Hooge and David 2014). Used within the global virtual team, the reactions of the team members will feed a process of 'conceptual association.' The key to this technique is in inducing metaphors in the participants' minds to discover similarities between seemingly unrelated concepts. The purpose of the metaphors is to encourage the participants to apply new frames of reference. Such techniques are even more pertinent in the case of global virtual teams as each participant possesses diverse reference frames.

This technique can easily be carried out in iterative-based knowledge transfer processes. In fact, when a particular line of reasoning comes to a halt, the group may be re-stimulated by selecting a new 'conceptual-association' that launches a new wave of creativity, as suggested by Hooge and David (2014). Consequently, this technique is more appropriate in iterative processes such as 'coaching' and 'collaboration' knowledge transfer settings.

3.2.2 Brainstorming

As suggested by Osborn (1988), this technique is designed to separate the ideation process into two distinct phases (1) the participants are invited to dream up ideas freely, and (2) these ideas are evaluated. However, the lag in the switchover from speaker to speaker on conference calls is a drawback with which global virtual team members will need to contend. It may adversely affect the effectiveness of this technique. Still, this operational constraint can become an opportunity, particularly when the role of each member within the team is well defined. More specifically, previous works have emphasized the role of the leader (Pauleen 2003). His/her mission consists in coordinating the ideation processes and the inherent knowledge sharing among participants in the most efficient way.

Consequently, the brainstorming technique as a creative tool is relevant for all three types of knowledge transfer techniques, and its effectiveness is mediated by the role of the leader as coordinator among members of the GVTs.

3.3 Eco-system creativity techniques

In a globalized setting, knowledge transfer is becoming so complex and specialized expertise is so scarce that organizations must reach out beyond their traditional borders to address and resolve inherent challenges; creativity also has become a more open and inclusive activity.

The eco-system approach to creativity involves knowledge transfer activities within and between organizations. This is especially true for KIEs, which are characterized by complex knowledge and highly skilled workers. KIEs participate in sharing their resource people who in turn can usefully contribute to effective knowledge transfer. Such processes can be applied both internally and externally within the organization's industry. For instance, such partnerships can involve alliances with suppliers in the value chain or temporary projects with organizations in complementary lines of business.

In an era of social networking, KIEs may also reach out to a virtual community by engaging customers or members of the market at large. This extension of the KIE's boundary establishes an eco-system of complex relationships that they may tap to enhance their own creative capabilities. We examine some of these techniques and their potential influence on knowledge transfer techniques in virtual teams.

3.3.1 Innovation funnel

The purpose of the innovation funnel is to foster as many ideas as possible and gradually reduce them to focus on the best ones. This approach lessens the traditional lines of authority and top-down decision-making and helps to bring down the artificial barriers within and across organizations. Hence, creativity may become a more inclusive activity fostering greater commitment from all members of the virtual team. Empowerment of the team members is a key objective because knowledge is tacit, codified and/or complex in KIEs, which makes its transfer even more challenging and reliant on the individual workers' good will in sharing their knowledge. Such techniques encourage all participants in the process.

Consequently, as an innovation funnel represents a 'democratization' process, without differentiation between insider and outsider members; this technique is more appropriate for multilateral processes of knowledge transfer ('collaboration').

3.3.2 Crowd-sourcing

As Sveiby and Riesling (1986) explain, KIEs also "sell knowledge," which implies that we need to consider the customers and the market in general in the process of idea generation, knowledge creation, and more importantly effective knowledge transfer. Hence, creativity-based techniques can greatly contribute in such processes.

Market needs evolve quickly and are increasingly difficult to grasp; investing large financial resources in the development of new products or services represents major risks that firms strive to mitigate by reaching out to their customers or to the market at large for input or feedback. Creativity is carried out by a virtual community (Füller et al. 2006) through open innovation (Chesbrough 2003; Enkel et al. 2009) and/or co-creation processes. Sharing a common value or a commitment to a common cause may also be a strong motivator for the members of the virtual community to volunteer their time, their energies and their imagination. For example, open-source software involves a community of independent software developers working together on a common body of computer code. Version control software is the coordination tool that allows for the integration of the individual modules of work into a common and coherent body of software code. The contributors and the community at large benefit from the combined outcome.

Consequently, virtual communities as components of virtual teams are found to be more appropriate for multilateral and iterative processes of knowledge transfer ('collaboration').

4 Implications

The creativity-enhancing techniques available at the individual, group or eco-system levels that we reviewed involve approaches, such as controlled interactions, conceptual associations, transformations of the problem space, improved collecting and access to ideas and

reaching out beyond one's inner group. Overall, these techniques represent creativity enhancers and serve as knowledge transfer facilitators as it is addressed in this article.

We now analyze the validity of each technique in regard to its influence on knowledge transfer, especially based on the interaction between participants, as suggested by Soule and Applegate (2005).

First, even though GVTs are more than just an aggregation of individuals, the diversity and wide distribution of these individuals offers a unique setting for knowledge transfer. Consequently, individual-based creativity tools are crucial to the GVTs.

Visual representations and problem statement transformations represent pertinent means to transfer knowledge between the members of GVTs, especially because they allow the GVTs to engage in cognitive processes and to streamline the communication. Finally, the individual-based creativity techniques lead to a variety of knowledge transfer processes, whether unilateral, bilateral or multilateral. Hence, if they are not properly applied they might not lead to the intended result. This is even more essential in the KIE setting, in which it is necessary to transfer complex and tacit knowledge.

Second, group-level techniques may easily be carried out among the members of a GVT using available telecommunication and collaborative work tools. Group-level techniques seek to control the interactions of a group by delaying judgment or by making use of written rather than verbal expression even when people would be sitting in the same room. This is designed to avoid the shortcomings of human interactions and the negative effects of the creativity-based techniques on the knowledge transfer. Overall, group-level techniques are more appropriate in iterative settings. However, one question remains: In a context of controlled interactions, can limited means of communications associated with limited richness of content be as efficient as other means to transfer knowledge? The role of the leader in GVTs is crucial at the level of social creativity and in all three types of knowledge-transfer settings (unilateral, bilateral and multilateral).

Third, eco-system creativity represents an expansion of the virtual team paradigm to the scale of a virtual community voluntarily participating in a knowledge transfer activity. The eco-system techniques imply that the KIEs possess enough leverage with their brand, with their reputation or with their involvement in subjects of community interest to entice members of their eco-system at large who have a vested interest in the subject for which an inventive solution is being sought to voluntarily participate in the knowledge-transfer process. Social-networking skills may make workers more adept in a virtual team setting and certainly would be an obvious key success factor for managing the transfer of knowledge within a community. Overall, eco-system creativity techniques promote collaboration in a virtual community because they are multilateral and iterative. Such techniques foster knowledge transfer among members of GVTs and contribute to effective project management and co-creation processes in KIEs.

Closer examination of the knowledge transfer techniques outlined in the previous section of this paper suggests that collaborative work tools and technologies used by virtual team members may actually reduce, or avoid altogether, the pitfalls of interpersonal interactions that otherwise may need to be managed and restricted in the physically co-located office setting. Hence, we suggest that the use of these techniques among virtual team members may in fact facilitate knowledge transfer. In particular, we have described how virtual team members can be connected with their colleagues very much like a social network exchanging and sharing information at a far greater rate or speed and to a greater extent than that at which their colleagues at the physical office would be able to. Furthermore, by embracing partnerships, alliances, open innovation and crowd-sourcing, knowledge transfer practices are breaking out of the traditional borders of an organization.

These are new skills that KIEs need to acquire to be successful in the future; embracing GVTs goes a long way toward that goal. Finally, team members can take advantage of the diversity of creativity-based techniques and the variety of advantages they provide for knowledge transfer. Thus, we suggest that global virtual teams applying these techniques will improve their effectiveness, especially in the context of KIEs.

5 Conclusion

Virtual teams represent a developing practice, especially in a globalized context and in KIEs. Davidson (2013) suggested that there is a competitive advantage to be derived by firms that adopt virtual teams early and make it a core competency; this applies even more to KIEs. However, manager buy-in remains slow. The commonly held belief that a GVT setting is not conducive to effective knowledge transfer is a misconception that this paper has strived to address. We suggest that the advantages of team members being physically co-located to transfer knowledge are not as significant as generally believed. Furthermore, worker co-location possesses drawbacks that, in fact, hinder the workers' effectiveness at transferring knowledge.

Therefore, we focus on GVTs. In fact, little is known about virtual teams as a level of analysis (Bell and Kozlowski 2002). First, we draw on prior academic works that examined factors impacting the effectiveness of virtual teams (Ebrahim et al. 2009). We build on Kratzer et al. (2005), and we bridge the gap between creativity and knowledge transfer in a virtual setting. We focus on creativity-enhancing techniques as catalysts for knowledge transfer. Second, we also contribute to previous articles that both presented the opportunities and the risks inherent to virtual teams (Bergiel et al. 2008). The capacity for virtual teams to use creativity-based techniques is important for knowledge transfer effectiveness because these teams are dispersed and diverse (Soule and Applegate 2005) and tackle complex issues as they evolve in the context of KIEs (Nunes et al. 2005) in the global context (Kankanhalli et al. 2006).

The complexity of knowledge transfer is significantly increased when taking into consideration the global scene and the context of the KIEs. Therefore, we bring together distinct knowledge transfer practices at the virtual team level of analysis (Soule and Applegate 2005) and combine them with creativity techniques to improve the knowledge transfer process in KIEs. We examine individual, group and eco-system creativity techniques to analyze knowledge transfer within GVTs. It appears that individual-level techniques require concentration, while several group-level methods involve controlling and even restricting on-the-spot interactions between participants. GVTs provide an excellent setting for these requirements. Eco-system techniques involve wide internal, and sometimes external, consultations that can only be managed with powerful network, Internet-based tools and social-networking connectivity—tools and techniques that are inherently virtual. To keep up with global challenges and the knowledge-based economy, KIEs will need to embrace globally distributed remote teamwork and become proficient at managing virtual teams and virtual communities.

This article aims to examine knowledge transfer within global virtual teams in the context of knowledge intensive firms. International knowledge transfer in the context of KIEs represents a pertinent field of inquiry in different disciplines. Therefore, future studies might investigate the above-mentioned processes in new settings, such as entrepreneurship (Audretsch and Caiazza Forthcoming), or in social networks as

innovation enabler (Palacios-Marqués et al. 2015). In addition, the concept of KIEs requires further investigation. Hence, comparative studies in different industries (e.g., low tech vs. high, established vs. traditional) might provide valid insights. Finally, while this article is conceptual, it might be pertinent to conduct an empirical analysis to test the efficiency of the techniques presented in the current article. All these elements represent avenues for future research.

References

Alvesson, M. (2000). Social identity and the problem of loyalty in knowledge-intensive companies. *Journal of Management Studies, 37*(8), 1101–1122.

Ashford, N. A., Heaton, G. R., Jr., & Priest, W. (1979). Environmental, health, and safety regulation and technological innovation. In C. T. Hill & J. M. Utterback (Eds.), *Echnological innovation for a dynamic economy* (pp. 161–221). New York: Pergamon Press.

Audretsch, D., & Caiazza, R. (Forthcoming). Technology transfer and entrepreneurship: cross-national analysis. *Journal of Technology Transfer*. doi:10.1007/s10961-015-9441-8.

Battistella, C., De Toni, A. F., & Pillon, R. (2015). Inter-organisational technology/knowledge transfer: A framework from critical literature review. *The Journal of Technology Transfer*. doi:10.1007/s10961-015-9418-7.

Bélanger, P. R. (2013). Notes du séminaire 9: "L'expression de la demande" ("The expression of demand"). EFA 7930—Politiques et ingénierie générale de la formation formelle et non formelle des adultes (Policies and general engineering of formal and informal adult learning). UQAM. Département d'éducation et formations spécialisées. Faculté de l'Éducation.

Bélanger, P. R., Grant, M., & Lévesque, B. (1994). *La modernisation sociale des entreprises (The social modernization of firms)*. Montréal: Presses de l'Université de Montréal.

Bell, B. S., & Kozlowski, S. W. (2002). A typology of virtual teams implications for effective leadership. *Group and Organization Management, 27*(1), 14–49.

Bergiel, J. B., Bergiel, E. B., & Balsmeier, P. W. (2008). Nature of virtual teams: A summary of their advantages and disadvantages. *Management Research News, 31*(2), 99–110.

Bresman, H., Birkinshaw, J., & Nobel, R. (1999). Knowledge transfer in international acquisitions. *Journal of International Business Studies, 30*(3), 439–462.

Buzan, B., & Buzan, T. (2003). *The mind map book: Radiant thinking—Major evolution in human thought (Mind Set)*. London: BBC Active.

Carmel, E., Espinosa, J. A., & Dubinsky, Y. (2010). "Follow the Sun" workflow in Global Software Development. *Journal of Management Information Systems, 27*(1), 17–38.

Chesbrough, H. W. (2003). The era of open innovation. MIT sloan management review. . *Spring, 44*, 35–41.

Clear, F., & Dickson, K. (2005). Teleworking practices in small and medium-sized firms: Management style and worker autonomy. *New Technology, Work and Employment, 20*(3), 218–229.

Davidson, P. L. (2013). Why do many firms still miss the competitive advantage of virtual teams? In Proceedings of the PICMET'13 conference: technology management in the it-driven services (pp. 1697–1708). San Jose, 28th July–1st Aug.

Davidson, P. L. (2015). Can creativity thrive within virtual teams? Novadex Ratings White Paper No. 101, April, Montreal, QC.

Ebrahim, N. A., Ahmed, S., & Taha, Z. (2009). Virtual teams: A literature review. *Australian Journal of Basic and Applied Sciences, 3*(3), 2653–2669.

Enkel, E., Gassmann, O., & Chesbrough, H. (2009). Open R&D and open innovation: Exploring the phenomenon. *R&D Management, 39*(4), 311–316.

Füller, J., Bartl, M., Ernst, H., & Mühlbacher, H. (2006). Community based innovation: How to integrate members of virtual communities into new product development. *Electronic Commerce Research, 6*(1), 57–73.

Gassmann, O., & Von Zedtwitz, M. (2003). Trends and determinants of managing virtual R&D teams. *R&D Management, 33*(3), 243–262.

Gerbin, A., & Drnovsek, M. (2015). Determinants and public policy implications of academic-industry knowledge transfer in life sciences: A review and a conceptual framework. *The Journal of Technology Transfer,*. doi:10.1007/s10961-015-9457-0.

Goh, S. C. (2002). Managing effective knowledge transfer: An integrative framework and some practice implications. *Journal of Knowledge Management, 6*(1), 23–30.
Gorman, M. E. (2002). Types of knowledge and their roles in technology transfer. *The Journal of Technology Transfer, 27*(3), 219–231.
Grant, M., Bélanger, P. R., & Lévesque, B. (1997). Aperçu des principales transformations des rapports de travail dans les entreprises: le cas québécois. In M. Grant, P. R. Bélanger, & B. Lévesque (Eds.), *Nouvelles formes d'organisation du travail: études de cas et analyses comparatives. (New Organizational Forms of Work)*. Paris: L'Harmattan.
Hertog, P. D. (2000). Knowledge-intensive business services as co-producers of innovation. *International Journal of Innovation Management, 4*(4), 491–528.
Hirsch-Kreinsen, H., & Schwinge, I. (2011). Knowledge-intensive entrepreneurship in low-tech sectors. In DRUID conference, Copenhagen Business School, Denmark, 15–17 June 2011.
Hodgkinson, G. P., Sadler-Smith, E., Burke, L. A., Claxton, G., & Sparrow, P. R. (2009). Intuition in organizations: Implications for strategic management. *Long Range Planning, 42*(3), 277–297.
Hooge, S., & David, A. (2014). What makes an efficient theme for a creativity session? In Proceedings of the XXIst international product development management conference (IPDMC), 15–17 June Limerick, Ireland.
Hustad, E. (2004). Knowledge networking in global organizations: the transfer of knowledge. In Proceedings of the 2004 SIGMIS conference on Computer personnel research: Careers, culture, and ethics in a networked environment (pp. 55–64). ACM (April).
Inkpen, A. C. (2008). Knowledge transfer and international joint ventures: The case of NUMMI and general motors. *Strategic Management Journal, 29*(4), 447–453.
Jarvenpaa, S. L., Knoll, K., & Leidner, D. E. (1998). Is anybody out there? Antecedents of trust in global virtual teams. *Journal of Management Information Systems, 14*(4), 29–64.
Kankanhalli, A., Tan, B. C., & Wei, K. K. (2006). Conflict and performance in global virtual teams. *Journal of Management Information Systems, 23*(3), 237–274.
Kedia, B. L., & Bhagat, R. S. (1988). Cultural constraints on transfer of technology across nations: Implications for research in international and comparative management. *Academy of Management Review, 13*(4), 559–571.
Keller, R., & Chinta, R. (1990). International technology transfer: Strategies for success. *The Academy of Management Executive, 4*(2), 33–43.
Kop, R., & Carroll, F. (2011). Cloud computing: Learning from a Massive Open Online Course on how to enhance creativity in learning. *European Journal of Open, Distance and E-Learning*. http://www.eurodl.org/?p=special&sp=articles&article=457. Accessed 30 July 2016.
Koschatzky, K. (2002). Networking and knowledge transfer between research and industry in transition countries: Empirical evidence from the Slovenian innovation system. *The Journal of Technology Transfer, 27*(1), 27–38.
Kratzer, J., Leenders, R. T. A., & Van Engelen, J. M. (2005). Keeping virtual R&D teams creative. *Research Technology Management, 48*(2), 13–16.
Landry, R., Amara, N., & Ouimet, M. (2007). Determinants of knowledge transfer: Evidence from Canadian university researchers in natural sciences and engineering. *The Journal of Technology Transfer, 32*(6), 561–592.
Lencioni, P. (2002). *The five dysfunctions of a team: A Leadership fable*. San Francisco, CA: Jossey-Bass, A Wiley Company.
Lipnack, J., & Stamps, J. (1997). *Virtual teams: Reaching across space, time, and organizations with technology*. New York: Jeffrey Stamps.
Lohikoski, P., & Haapasalo, H. (2013). Virtual competencies and knowledge transfer in global NPD: A case study. *International Journal of Management, Knowledge and Learning, 2*(2), 185–207.
Lovelace, R. F. (1986). Stimulating creativity through managerial intervention. *R&D Management, 16*(2), 161–174.
Lurey, S. L., & Raisinghani, M. S. (2000). An empirical study of best practices in virtual teams. *Information & Management, 38*(8), 523–544.
Malerba, F. (Ed.). (2010). *Knowledge intensive entrepreneurship and innovation systems: Evidence from Europe*. London: Routledge.
Maznevski, M. L., & Chudoba, K. M. (2000). Bridging space over time: Global virtual team dynamics and effectiveness. *Organization Science, 11*(5), 473–492.
Merat, A., & Bo, D. (2013). Strategic analysis of knowledge firms: The links between knowledge management and leadership. *Journal of Knowledge Management, 17*(1), 3–15.

Miesing, P., Kriger, M. P., & Slough, N. (2007). Towards a model of effective knowledge transfer within transnationals: The case of Chinese foreign invested enterprises. *The Journal of Technology Transfer, 32*(1–2), 109–122.

Novins, P., & Armstrong, R. (1998). Choosing your spots for knowledge management. *Perspectives on Business Innovation, 1*, 45–54.

Nunes, M. B., Ananasingh, F., Eaglestone, B., & Wakefield, R. (2005). Managers' perceptions of the value of knowledge management in small and medium sized knowledge-intensive enterprise (SMEs). *Journal of Knowledge Management Practice*. http://www.tlainc.com/articl104.htm. Accessed 30 July 2016.

Osborn, A. F. (1988). *L'imagination constructive (constructive imagination). Créativité*. Paris: Bordas.

Palacios-Marqués, D., Merigó, J. M., & Soto-Acosta, P. (2015). Online social networks as an enabler of innovation in organizations. *Management Decision, 53*(9), 1906–1920.

Pauleen, D. J. (2003). An inductively derived model of leader-initiated relationship building with virtual team members. *Journal of Management Information Systems, 20*(3), 227–256.

Pinsonneault, A., & Boisvert, M. (1999). The impacts of telecommuting on organizations and individuals: A review of literature. Cahier du GReSI, no. 99-09, Nov.

Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: A review of current literature and direction for future research. *The Database for Advances in Information Systems, 35*(1), 6–36.

Reus, T. H., Lamont, B. T., & Ellis, K. M. (2015). A darker side of knowledge transfer following international acquisitions. *Strategic Management Journal*. doi:10.1002/smj.2373.

Saunders, C., Van Slyke, C., & Vogel, D. R. (2004). My time or yours? Managing time visions in global virtual teams. *The Academy of Management Executive, 18*(1), 19–37.

Silverstein, D., Samuel, P., & Decarlo, N. (2009). *The innovator's toolkit: 50 + Techniques for predictable and sustainable organic growth*. Hoboken, NJ: Wiley.

Simonin, B. L. (2004). An empirical investigation of the process of knowledge transfer in international strategic alliances. *Journal of International Business Studies, 35*(5), 407–427.

Skyrme, D. J. (1997). The globalisation and virtualisation of knowledge. *Gyosei Journal, 1*(3), 71–86.

Sorenson, O., Rivkin, J. W., & Fleming, L. (2006). Complexity, networks and knowledge flow. *Research Policy, 35*(7), 994–1017.

Soule, D. L., & Applegate, L. M. (2005). Beyond knowledge transfer: A typology of knowledge sharing behavior in virtual teams. In Proceedings of the European conference on organizational knowledge, learning and capabilities.

Sveiby, K. E., & Riesling, A. (1986). *Kunskapföretaget—Seklets Viktigaste Ledarutmaning?*. Malmö: Liber AB.

Tremblay, D. -G. (2003). New management forms for the knowledge economy? HRM in the context of teamwork and participation. Publication of the Teluq, Research Directorate, Research note no. 2003-14A.

Tsai, W. (2001). Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal, 44*(5), 996–1004.

Warr, A., & O'Neil, E. (2005). Understanding design as a social creative process. In Proceedings—5th creativity and cognition conference (pp. 118–127). London, 12–15 Apr.

Young, K., Sauer, S. J., & Mannix, E. A. (2006). Synergy in interdiscplinary teams. ACM meeting paper.