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A Transactive Memory Systems Perspective on Virtual Team Creativity

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Abstract

Regulating the creativity of virtual teams (VTs) has turned up to be a major concern for many companies. Furthermore, organizations with geographically distributed teams, are struggling to keep up satisfactory VT relations to enhance creativity initiatives. This research analyses how firms can manage the relationship between transactive memory systems (TMS) components (specialization, coordination and credibility) with VT creativity. We examined the collected data from 231 professionals employing structural equation modeling to assess the model fit and partial least squares to evaluate the robustness of our results. Our investigations found different results. The first conclusion shows that TMS components have a positive impact on VT creativity. Second, our study gives a confirmation of the combined intra and inter-TMS components' effect on VT creativity.

Keywords: Virtual team creativity, Transactive memory systems, specialization, credibility, coordination

Introduction

Many firms host virtual communities in which members interact to create knowledge on new products and services (Mahr et al. 2012). Virtual team (VT) initiatives, in which teams are geographically dispersed and communicate via modern computer-driven technologies, has attracted increasing attention from researchers and professionals (Hertel et al. 2005; Leenders et al. 2003; Piccoli and Ives 2003; Fuller, Hardin and Davison, 2006). The growing need to examine how to balance and optimize VT is particularly important given the exposure experienced by companies when their employees encounter globalization and decentralization pressures to monitor VT performance and creativity (Ayoko et al. 2012; Gilson et al., 2015).

For instance, companies during the last ten years, have increasingly emphasized VT creativity initiatives to increase their research and development (R&D) performance. This consequently has conducted big firms (like IBM, General Electric and SAP) to implement an organizational structure that can accomplish increasingly complex activities by clustering their competencies into geographically dispersed centers of excellence (Eppinger et al. 2006). Furthermore, large companies such as General Electric have established steering committees to oversee global R&D efforts. The members of those committee's members are assigned to different locations, facilitating the development of an informal network across companies' main R&D sites worldwide (Siebdrat et al. 2009). In each of these dispersed competence centers, VTs are composed of different pools of expertise with increased heterogeneity and diversity (Eppinger et al. 2006). VTs are exposed to heterogeneous sources of work experience, feedback and networking opportunities, all of which build trust over time (Jarvenpaa et al. 1999). These illustrations clarify why organizations need to have a better control on VT creativity. Yet, the previous studies did not focus on the needed tools and strategies to help organizations balance VT creativity.

Some studies suggest that the future success of business depends on the extent to which VTs can stimulate creativity (Martins et al. 2004; Thatcher and Brown 2010). VTs consist of dispersed expertise, skills and knowledge (Zakaria, Amelinckx, & Wilemon, 2004) that can positively enhance coordination and collaboration (Zakaria et al., 2004; Qureshi & Zigurs, 2001). Ultimately, this team composition may lead to recognition of both who has expertise and where that expertise is located (Maynard et al., 2012); over time, the team composition may also build trust among VT members over time (Jarvenpaa & Leidner 1999; Jarvenpaa et al. 2004), developing the ability to coordinate their knowledge (Srivastava et al., 2006). However, for a team's behaviors to enhance VT creativity, the organization must strategically develop and align the behavioral capabilities of the team's dispersed competences and knowledge capabilities. When firms use VTs to explore and exploit their creativity performance, greater strategic and operational benefits emerge that can efficiently improve team behaviors (Malhotra and Majchrzak 2014; Stewart and Gosain 2006).

Limited research has been conducted on team behavior systems such as transactive memory systems (TMS), whose benefits are associated not only with combining communication between individuals but also with increasing VT creativity performance. The evidence of these benefits has prompted organizations to switch from information processing to TMS (Wegner, 1986).

Even if previous studies present inconsistent results between cognitive decision making and creativity (Dayana et al. 2011). This study builds on TMS to examine how team cognition can not only help firms develop greater VT creativity (Gilson et al., 2015) but also directly and indirectly impact VT performance by performing tasks successfully (Kanawattanachai and Yoo 2007; Lewis 2004). TMS is driven by the central concept that the system is built on the distinction between internal and external memory encoding. A VT learns something new and catalogs it in memory for future retrieval and use (Nevo et al. 2005). TMS uses the role of information technology to explain VT behaviors (Majchrzak, Rice, Malhotra, King, & Ba, 2000; Malhotra & Majchrzak 2014; Stewart & Gosain 2006) by offering VT members the possibility to encode, store, and retrieve information (Griffith et al. 2001; Hollingshead 2001; Wegner 1986). TMS considers the members of a team as a processing system in which the location of expertise both enhances knowledge coordination and builds trust among members over time (Heavey & Simsek, 2015; Lewis et al., 2005). We build on TMS to hypothesize the effects of specialization, coordination and credibility on VT creativity. We also assess the reciprocal relationship between TMS components and VT creativity.

Our study seeks to answer the question of how to enhance VT creativity through the use of the components of TMS. The current research on VT performance suggests that although most studies seek to identify the factors that can enhance VTs' performance (Hoch & Kozlowski, 2014; Lin et al., 2012; Turel & Zhang, 2010), more research is needed to address the question of how to actually enhance VT creativity (Gilson et al., 2015).

The structure of the paper is organized as follows. First, we define TMS and present a literature review on VT and VT creativity. Second, we detail our research model and the corresponding hypotheses. Third, we present the methodology that we have used with the main results. Fourth, we provide a discussion of results that we complete with limitations and future directions research.

Theoretical Background

TMS, which is often associated with Wegner's (1986, 1987) work, is an empirically supported theoretical paradigm known as a specialized division of cognitive labor; it is referred to as a shared system that individuals in groups and organizations develop to collectively encode, store, and retrieve information and knowledge from different domains (Lewis, 2003). This shared system is built on the distinction between internal and external memory encoding, storing and retrieval through various transactions between individuals. The effective knowledge of an individual in a group consists of internal knowledge (held in the mind of the individual) and external knowledge (which the individual can effectively access using the directory) (Jackson et al. 2008). Individuals can not only encode knowledge internally (learning something new and cataloging it in memory for future retrieval and use) but also encode knowledge externally in directories (or in other people's memory labeled according to the subject and location of the knowledge) (Nevo et al. 2005). These directories indicate the existence, location and form of retrieval required to access the knowledge of others in the group. Directory maintenance is necessary both for the updating, information allocation, and retrieval coordination involved in the creation and maintenance of TMS (Wegner 1995) and for the ongoing upgrading of the mental maps held by people in a group (Jackson et al. 2008).

TMS directories and processes need certain forms of information systems (e.g., intranets, search engines, standardized concepts and vocabularies), which can be used to enhance TMS functioning by accessing knowledge anywhere in the organization, without the need to always access that knowledge through sub-groups (Anand et al. 1998). Knowledge management systems can also be used to improve the functioning of group TMS (Alavi et al. 2002). Nevo et al. (2012) stated that information technology can be useful in supporting organization-wide TMS; in addition, they earlier proposed a conceptual model upon which to base the design of an information system for supporting an organizational TMS (Nevo et al. 2005). This research trend is consistent with Peltokorpi (2004), who stated that computer-mediated communications will facilitate the ongoing and effective communications of VTs, which are a key development of TMS. TMS development has also been studied in experimental and field studies within dyads and small groups; these studies have shown that performance improvement can occur in a variety of tasks such as consulting, product assembly, and software development (Faraj & Sproul 2000; Hollingshead 1998; Liang, Moreland & Argote 1995). Keel (2007) also proposed that technology can support TMS development through VTs. VTs are a key interest of TMS studies in the virtual environment (Griffith et al. 2003; Moreland et al. 2010). Therefore, because VTs are characterized by physical distance between team members, technology-mediated interactions, diversity among team members, and limited collaborative history (Alavi and Tiwana 2002), both interpersonal and technological approaches may be used to improve the functioning of organizational TMS (Jackson et al. 2008). Griffith et al. (2003) also suggest that proper technological support can alleviate these challenges, leading to the development of TMS in VTs by identifying key challenges such as the need for shared experiences, common language, nonverbal cues, and group members' familiarity. Furthermore, Lewis (2004) found a positive correlation between the strength of TMS and knowledge-worker team performance. These studies show that TMS leads to improved group performance (store and recall knowledge, use, match problems, and coordinate activities) through better problem-solving mechanisms (Nevo et al. 2012).

Other studies highlight TMS support to teams in an effort to find the means to reduce performance complications in virtual settings (Hollingshead 2000; Liang et al. 1995; Moreland 1999; Moreland and Myaskovsky 2000). To overcome these challenges of the shared system comprising the TMS, although team members performing collective tasks virtually, they need to use mutual reliance and coordinated access to encode, store, retrieve, and communicate differentiated (but complementary) knowledge (Lewis & Herndon, 2011). One of the means by which TMS contributes to VT development is by minimizing the balance between common knowledge and specialized knowledge to maximize VT performance (Kanawattanachai and Yoo 2007). Argote et al. (2003) contend that TMS facilitates knowledge management activities domains such as creativity, knowledge retention and knowledge transfer. In this context, teams with well-developed TMS are found to be more creative than their counterparts with less developed TMS (Gino, Argote, Miron-Spektor & Todorova 2010). Indeed, TMS facilitates creative self-efficacy in several ways through its main functions such as mutual learning, knowledge exchange observations and coordination behaviors (Liao, Jimmieson, O'Brien, & Restubog 2012; Michinov & Michinov 2009).

However, for a team's behaviors to enhance VT creativity, an organization must strategically develop and align behavioral capabilities for its dispersed competences and knowledge capabilities. TMS is driven by the central concept that a team's members divide cognitive labor, and each of the behavioral dimensions of TMS work to increase the positive impact on VT creativity. This finding explains the increased impact of TMS behavioral dimensions on VT creativity. Specifically, we build on the TMS components that are crucial to understand how TMS increases specialization, credibility and coordination, enhancing VT creativity.

Model

A TMS is formed when geographically distributed individuals outside the boundaries of an organization form teams and distribute their work via the Internet; work toward a common objective; and use transactive memory to retrieve knowledge from themselves, access knowledge from others, and use this combined knowledge to work toward common goals (Ebrahim et al. 2009). When formed, a TMS is composed of the transactive structure, which is an organized store of knowledge, and transactive processes, which allow the assignment of shared labels to pieces of individuals' expertise (encoding), thus storing knowledge with the appropriate team member (storage) and accessing task-relevant knowledge from team members based on their areas of expertise (retrieval of knowledge) (Lewis and Herndon 2011; Ren and Argote 2011; Rulke and Rau 2000).

The development of TMS is associated with three dimensions of group behaviors (Lewis 2003; Kanawattanachai and Yoo 2007): a) specialization, in which different team members are specialized in different areas of expertise—namely, it is the awareness of knowledge specialization among team members that leverages other members' knowledge when performing joint tasks (Moreland & Myaskovsky 2000; Namho et al. 2015); b) credibility, in which team members evaluate the expected gains from knowledge exchange (Jensen et al. 2015). Team members can show a high degree of trust of other team members' knowledge and ability and reliability to implement the task on their behalf (Akgun et al. 2005; Zhong et al. 2012); and c) coordination, which represents the team's ability to develop overlapping mental representations to understand a task requirement, efficiently matching that requirement with specialized expertise (Lewis 2003).

Therefore, a well-developed TMS indicates that individuals find others' expertise to be credible, have a shared understanding of who in the collective knows what, and efficiently coordinate their work and achieve better performance (Austin 2003; Lewis 2004; Lewis 2005; Faraj & Sproull, 2000). To enable a VT's creativity, it is necessary to combine TMS knowledge from different individuals to build collective knowledge and create new knowledge. VT creativity is supported by both IT, which positively influences knowledge creation (Sabherwal and Sabherwal 2005), and TMS, which provides mechanisms that allow team interactions, dialog, coordination, documentation, experimentation, and learning by doing (Nonaka 1994) (see Figure 1)

Taken together, the three TMS dimensions of specialization, credibility and coordination are the key behavioral abilities that are often found in VTs with highly developed TMS. In this paper, we argue that not all dimensions have the same immediate impact on VT creativity. Specifically, similar to Kanawattanachai et al. (2007), we posit that the impact of expertise location and cognition-based trust on VT creativity will be mediated by task-knowledge coordination. Knowledge coordination refers to a team's ability to effectively coordinate tasks and knowledge among team members (Liang et al. 1995; Wegner, 1986). Several studies have shown that specialization has a positive impact on the emergence of a TMS, particularly with respect to member awareness of expertise location (e.g., Akgun et al. 2005). Other research has shown that the awareness of expertise location positively influenced management team performance (Rau 2005). Therefore, a high degree of expertise location is a necessary condition for effective task-knowledge coordination (Kanawattanachai et al.; 2007).

We hypothesize the following:

H1a: Specialization is positively associated with knowledge coordination.

Trust is found to be an important consequence of involvement in virtual communities (Hsu et al. 2011). In addition, trust can not only facilitate the transmission of information between team members but also support their coordination (McEvily et al. 2003). Trust can also provide an important foundation for positive social interactions and cooperative effort (Doh and Acs 2010). Consequently, when team members have high trust in each other's capabilities, they are more likely to work together cooperatively and conscientiously (Huemer et al. 1998) to facilitate knowledge coordination (Weick and Roberts 1993). We hypothesize the following:

H1b: Credibility is positively associated with knowledge coordination.

According to past studies, TMS is effective in predicting VT performance (Kanawattanachai and Yoo 2007; Lewis 2004). However, there is a gap in the literature regarding how to incorporate creativity (Offermann et al. 2010), and a limited number and scope of studies focus on VT creativity (Martins & al. 2004). Creativity occurs not by individuals in isolation but through interaction (Csikszentmihalyi 1996), which can lead to more and better ideas (West 1990). To foster creativity and improve a collaborative climate, VT members must maintain an optimum level of communication and an optimum quality of communication content (Leenders et al. 2003; Ocker 2005; Ocker et al. 2008). Team communication permits the combination, confrontation and integration of the VT member's knowledge to create new knowledge and insights. Thus, VT creativity occurs when TMS enhances team knowledge capabilities by building a shared understanding to integrate into diverse knowledge bases and create new knowledge (Schulze and Hoegl 2006; Sabherwal and Sabherwal 2005).

This finding is possible when TMS specialization enhances the awareness of the knowledge location by facilitating access to the appropriate knowledge with the appropriate person when confronted with problems (Littlepage, Robison, & Reddington 1997). In fact, expertise is required for people to innovators to be creative (Boha et al. 2014). The ability for a VT to identify expertise location, facilitating access to diverse knowledge from various domains, ultimately increases the ability to promote creativity by coordinating and integrating different sources of knowledge (Tiwana and Mclean 2005). Consequently, TMS specialization reinforces VT creativity by allowing access to team members' location knowledge.

H2a: Specialization is positively associated with VT creativity.

On the issue of TMS coordination, implicit and explicit streams of research have highlighted the cognitive mechanisms necessary for TMS to provide a team with the ability to share a common understanding of a situation (Hsu et al. 2012; Liang et al. 1995; Nevo and Wand 2005; Oshri et al. 2008;). On the one hand, this cognitive approach promotes knowledge exchange, which is associated with the capacity to combine and exchange knowledge resources to innovate and be more creative (Kogut and Zander 1992). On the other hand, this approach also expands the social connections in the VT to promote innovation and team creativity (Baer 2010; Paruchuri 2010; Rodan and Galunic 2004). Consequently, TMS coordination contributes to VT creativity by efficiently managing its knowledge resources to enable creative team behavior. TMS coordination can enhance team creativity by integrating and coordinating team knowledge to generate different ideas for solving problems (Hackman 1987; Harrison and Rouse 2013, Alavi and Tiwana 2002; Lewis et al. 2005; Rico et al. 2008). Indeed, team creativity embraces the ability to coordinate and integrate various information and knowledge from team members (Chen 2006) to find new solutions (Tiwana and Mclean 2005).

H2b: Coordination is positively associated with VT creativity.

Trust increases creativity (Battstroma et al 2012) and plays a key role in fostering the willingness to take the risks that are often required to innovate (Dirks and Ferrin 2001; Knack and Keefer 1997; Mayer et al. 1995) . Sarker et al. (2005) found that team members have more willingness to share, integrate, and coordinate knowledge from other team members when they trust one another. TMS credibility is an important component that creates a feeling of trust and belonging between team members that affect team creativity (Andriopoulos 2001; Woodman et al. 1993). Therefore, trust within VTs is important for team performance that involves acquiring and manipulating various knowledge (Weick and Roberts 1993) and supporting creativity (Barczak et al. 2010; Whitener et al. 1998). Consequently, TMS credibility enhances VT creativity by creating a trust context in which teams can be more creative.

H2c: Credibility is positively associated with VT creativity.

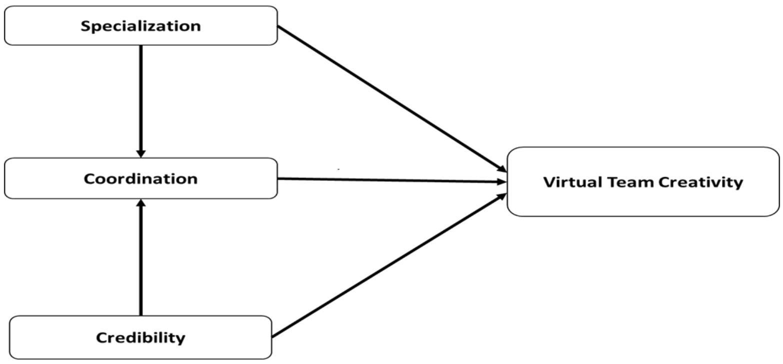

Fig. 1: Research model

Methodology

This study focuses on how TMS facilitates VT creativity. Therefore, we needed to analyze the creative behavior of VT members. Thus, we have decided to collect survey data to test VT behavior and assess empirically the research question that try to answer the larger situation of VT behavior and how TMS impacts creativity.

Sample and Data Collection

We have first performed a survey pre-test with 29 master's students from a French business school between October and November 2014. A validity and reliability assessment were realized. From the results, we have been able to enhance the readability and accuracy of the survey instrument. Then we have sent a preliminary email to 651 French managers who had graduated from an executive French business school program in 2014. The respondent's emails were taken from lifetime alumni emails provided by the business school, the titles and names were retrieved from LinkedIn accounts and the business school's alumni office. During spring of 2015, the preliminary email invited respondents with VT experience to participate to our online survey.

Two weeks later, the link to participate to our online survey was sent. We opened the survey for a duration of 14 days and two solicitations were sent. Respondents to our online survey needed less than 10 min to complete it. After discarding the responses with missing values, 231 responses were collected. The response rate was of 35%, which can be considered as good because only managers with VT experience responded. Our Sample shows that it is composed of diverse groups of various sizes, industries and positions.

After data collection, we applied the maximum likelihood estimation to replace the missing data (Allison 2000). In addition, before the measures were subjected to a purification process to assess validity and reliability (Anderson and Gerbing 1984; Fornell and Larcker 1981), we first addressed the missing data replacement. We then decided to assess our dataset by comparing early and late respondents in the sample. This approach assumes that non-respondents tend to be similar to late respondents (Kwaku Atuahene-Gima 1995; Kanuk & Berenson 1975; Oppenheim 1966). Because there are no significant differences between the two groups, we concluded that nonresponse bias was not a concern.

After these two pre-analyses, the discriminant validity of the measures was examined in the two-step approach recommended by Anderson and Gerbing (1988). First, an exploratory factor analysis was conducted to assess the underlying factor structure of the items that measured each construct. The exploratory factor analysis was conducted, including 20 measured items of 4 variables, using a principal component with a promax rotation and an eigenvalue of 1 as the cutoff point. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.861, and the Bartlett test of sphericity was significant at p <.001 and χ^2 (190) = 2822, 118, indicating the suitability of these data for factor analytic procedures. A single factor was extracted for each multiple-item scale in this analysis.

Measures

The measures were adapted from the prior research. We measured our constructs on a seven-point Likert scale, ranging from 1, which indicated "total disagreement", to 7, which indicated "complete agreement". The measures of VT creativity were operationalized because teams perceive their creative ability as adapted from Rego et al. (2007). The measures of TMS were adapted from Lewis (2003). We considered the roles of three distinct dimensions: specialization, credibility and coordination. The development procedure acted in accordance with the prior literature on scale development procedures, including conceptual definition, measurement development, and refinement through pilot testing. The first step in establishing factorial validity is to determine which constructs are formative and which are reflective (Diamantopoulos and Winklhofer 2001). Previous methodologists have suggested examining how the constructs were formed and validated in the literature and modeling constructs accordingly (Petter et al. 2007). In accordance with these guidelines, we note that all the measures adapted for this study have been previously modeled and measured as reflective, first-order constructs (Choi et al. 2010). The measures developed for this study were similarly theorized and intended as reflective measures (Appendix A). We thus act in accordance with the prior literature and validate the measures using the guidelines established for reflective construct measurement. Appendix A contains items, factor loadings, composite reliability, Cronbach's alpha, and average variance extracted (AVE) scores.

Data Validity and Common Method Bias

To evaluate our variables reliability and validity based on existing TMS and creativity literature, we applied an exploratory factor analysis (EFA) to test the scale development. Then we performed a confirmatory factor analysis (CFA) to assess the model goodness of fit (Hurley et al. 1998; Schniederjans et al. 2016) to test the items loads of on non-hypothesized factors collected using a survey (Kelloway 1995). For the EFA, the collected data is normally distributed, we have retained the maximum likelihood promax method (Cudeck et al. 1994; Fabrigar et al. 1999). Whereas for the CFA, to evaluate the goodness of fit, we used AMOS 21.0. Concerning the fit indices, we need to explain our choice (Shah et al. 2006). In our case, we relied on the ones that are not influenced by the sample size (Sharma et al. 2005). The results present a satisfactory fit ($\chi 2/df=2.40$, comparative fit index (CFI)=0.92, Tucker-Lewis index (TLI)=0.92, root mean square error of approximation (RMSEA) = 0.078). The convergent validity results are displayed in Appendix A. The outputs show, that the Cronbach's alpha value for each variable were over the recommended threshold of 0.7 (Nunally 1978). The composite reliability scores exceeded 0.85, indicating satisfactory internal consistency reliability (Fornell and Larcker 1981; Nunnally and Bernstein 1994). All the AVE scores of the constructs exceeded the 0.50 threshold (Fornell et al. 1981; Hair et al. 2010) and their corresponding AVE square roots are supporting a satisfactory requirement for discriminant validity as their values were exceeding the correlation coefficients. Finally, we have tested for common method bias in the measurement model to verify that no shared variance among the constructs exist. We have initially reduced this likelihood by randomizing the order of survey items (Straub et al. 2004). The results on table 1 show that none of the correlations were greater then 0.90, which indicate no common method bias (Pavlou et al. 2007). Then, we run the Harman's single-factor test (Podsakoff et al. 1986) which showed that the explained variance of the largest factor was 35% which is under the threshold of 50%. Thus, we can conclude that there is no common method bias which may threaten the validity of our results.

Table 1. Correlations of the constructs

Variables	F1	F2	F3	F4
Virtual Team Creativity (F1)	**0.770**			
Credibility (F2)	**0.356****	**0.817**		
Specialization (F3)	**0.301****	**0.369****	**0.732**	
Coordination (F4)	**0.415****	**0.396****	**0.269****	**0.734**

** p <0.01 two tailed. Diagonals show the square root of AVEs.

Data analysis

After presenting the validity and reliability of the constructs, we moved to the analysis of the full model using the structural equation modeling (SEM) method, which hypotheses were estimated using maximum likelihood. In addition, we have performed a partial least squares (PLS) analysis to guarantee the robustness of our results (Peng and Lai, 2012).

Our research used AMOS 21.0 to test the SEM full model and SmartPLS (Ringle et al. 2005) to test the robustness check. We first tested the effects of specialization and credibility on coordination (H1a-H1b) and the effects of specialization, coordination and credibility on VT creativity (i.e., H2, H3, and H4).

Structural Model

The fitting of the structural model to the data produced using SEM, has produced some acceptable indications of fit (Chi-sq = 416,13, *df Model* = 190, $p < 0.01$, Chi-sq/*df* = 2.52, CFI = 0.92, TLI = 0.91, RMSEA = 0.078) (Hair et al. 2010). The hypothesized relationships shown in the theoretical model in Fig. 1 were tested using SEM. Concerning the robustness checks, they have been assessed using PLS algorithm and bootstrapping. The tested hypotheses, their corresponding path estimates and significance levels are summarized in Fig. 2.

As Fig. 2 shows, specialization is positively associated with coordination ($\beta=0.19$, $p<0.05$). Credibility is also positively associated with coordination ($\beta=0.45$, $p<0.01$). consequently, H1a and H1b are supported. There is also a positive association between specialization, coordination and credibility with VT creativity respectively ($\beta=0.25$, $p<0.01$), ($\beta=0.35$, $p<0.01$), ($\beta=0.12$, $p<0.1$). Therefore, H2, H3 and H4 are supported.

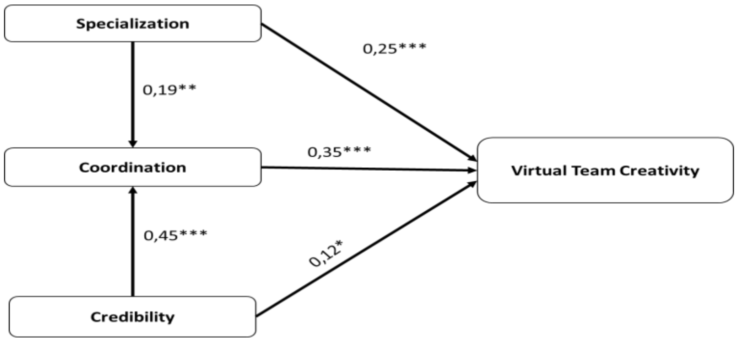

Fig. 2: Results of the structural equation model. *p<0.1, **p<0.05, ***p<0.01

Conclusion

For global and decentralized R&D organizations, discovering and implementing new tools and strategies are crucial to enhance their VT creativity performance. Further, the geographically dispersion of VTs makes it very difficult to leverage the different strategic priorities to increase VT creativity. Thus, the objective of this study was to propose tools (TMS and its components) and strategies that could enhance VT creativity to balance it. We establish that TMS impacts positively VT creativity, but we also found a positive association among the TMS components. These results, play a part into VT behavior (Malhotra and Majchrzak 2014), TMS and VT's (Kanawattanachai and Yoo 2007) theory contributions. These results also support empiracallly by addressing the question of how to reach VT creativity (Gilson et al., 2015). Although, our research presents a first introduction to VT creativity concept, it is critical to comprehend that various other variables can influence VT creativity and TMS, and thus there are different ways to manage team creative behavior. These findings usually occur within geographically dispersed firms that use VTs to be more performant and creative (Siebdrat et al. 2009). Forthcoming studies may include other influencing factors to efficiently regulate VT creativity and better explain VT and creativity. These other factors such as knowledge sharing (Chen et al. 2013), learning orientation, (Alexander and Knippenberg 2014) and communication in teams (Staples and Webster 2008) can enable this understanding. Furthermore, we need also to report that using survey data could be considered as a limitation as the analysis are based on individual perceptions. That why we recommend that other studies can include different methods of analysis then the one used in our study (case studies, interviews and controlled experiments) and should incorporate both antecedents and outcomes.

This conclusion also proposes a practical guidance to decentralized organizations that have or are in the process of implementing VTs. VT managers may not consider that putting in place a TMS will consequently lead to improve VT creativity. Rather, VT managers should focus on the adequate methods that will monitor the necessary balance between TMS components to influence positively VT creativity. Even if few studies focused on the relationships between TMS components and VT creativity (Malhotra and Majchrzak 2014; Gilson et al., 2015), our empirical study try to provide more evidence based on VT members' perceptions on how TMS components - specialization, coordination and credibility- are positively associated with VT creativity. Our study proposes for VT managers the managerial support to find the right balance between TMS components to improve VT creativity.

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Appendix A: Constructs, measurement items & descriptive statistics

		Mean	Standard Deviation	Factor Loading	T-value
Q1	**Virtual Team Creativity (α= 0,877; CR= 0,879; AVE= 0,593)**				
Cre1	My team members suggest new ways to achieve goals or objectives.	**4,31**	**1,558**	**0,70²**	
Cre2	My team members come up with new and practical ideas to improve performance.	**4,30**	**1,466**	**0,81**	**11,10**
Cre3	My team members promote and champion ideas to others.	**4,41**	**1,561**	**0,85**	**11,55**
Cre4	My team members exhibit creativity when given the opportunity to.	**4,48**	**1,487**	**0,73**	**10,19**
Crea5	My team members have new and innovative ideas.	**4,40**	**1,428**	**0,76**	**10,48**
Q2	**Specialization (α= 0,863; CR= 0,870; AVE= 0,576)**				
TMSa1	Each team member has specialized knowledge of some aspects of our project.	**4,35**	**1,636**	**0,78**	**8,92**
TMSa2	I have knowledge about an aspect of the project that no other team member has.	**4,19**	**1,411**	**0,88**	**9,52**
TMSa3	Different team members are responsible for expertise in different areas.	**4,46**	**1,513**	**0,81**	**9,08**
TMSa4	The Specialized knowledge of several different team members was needed to complete the project deliverables	**4,38**	**1,503**	**0,70**	**8,34**
TMSa5	I Know which team members have expertise in specific areas	**4,11**	**1,607**	**0,58²**	
Q3	**Coordination (α= 0,854; CR= 0,852; AVE= 0,536)**				
TMSc1	Our Team Worked together in a well-coordinated fashion	**4,49**	**1,611**	**0,77**	**11,89**
TMSc2	Our team had very few misunderstandings about what to do.	**4,19**	**1,699**	**0,69**	**10,43**
TMSc3	Our team did not need to backtrack and start over a lot.	**4,32**	**1,696**	**0,70**	**11,89**
TMSc4	We accomplished the task smoothly and efficiently.	**4,48**	**1,673**	**0,80²**	
TMSc5	There was much confusion about how we would accomplish the task.	**4,25**	**1,806**	**0,70**	**10,72**
Q4	**Credibility (α= 0,905; CR= 0,908; AVE= 0,668)**				
TMSb1	I was comfortable accepting procedural suggestions from other team members.	**5,09**	**1,456**	**0,67**	**9,30**
TMSb2	I trusted that other members' knowledge about the project was credible.	**5,25**	**1,281**	**0,84**	**11,42**
TMSb3	I was confident relying on the information that other team members brought to the discussion.	**5,19**	**1,353**	**0,67²**	
TMSb4	When other team members gave information, I wanted to double-check it for myself.	**5,15**	**1,276**	**0,94**	**12,43**
TMSb5	I did not have much faith in other member' expertise.	**5,14**	**1,153**	**0,93**	**12,37**