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METIS : CREATIVITY OF GLOBAL VIRTUAL TEAMS APPLIED TO NEW PRODUCT DEVELOPMENT

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Abstract

This paper explores the process by which Global Virtual Teams (GVTs), namely groups of geographically dispersed and culturally diverse members, carry out most of their activities using information technology. Three case studies have been conducted and will be described here. These studies investigate specifically the creative process stages of GVTs and other factors susceptible to affect team members work whilst designing a creative product. The first case study is composed of university students organized in GVTs and taking part in the main Intercultural Virtual Project. The two other case studies are conducted at Capgemini and Lafarge companies, their aim is to shed light on organizational complexity of GVT within companies involved in R&D. The Intercultural Virtual Project is connected to a broader range of studies conducted to understand better the specificity of our Western Creativity based on Mediterranean Culture, namely Metis. Seven stages within the creation process, namely: preparation, incubation, generation, emanation, selection, finalization, and evaluation. The overall innovation will be described as successive interactions between the Global Virtual teams' conscious and unconscious' creative processes in order to develop a new product. GVTs creativity depends also on emergent states and processes: technology appropriation, group awareness and group memory. Furthermore three managerial levers were identified: contiguity, proximity and reflexivity. These levers include useful procedures in order to enhance the creative process.

Keywords: Creativity, Creative Process, Global Virtual Teams, New Product Development Teams

1 INTRODUCTION

To completely respond to high customer expectations, the organizational structure must adapt to ensure greater flexibility. Companies continually expand across the globe and get plugged into networks to control cost, quality, and deadlines. Project teams are set up to ensure a fast and high-quality response to customer requirements. Connecting from different countries and belonging to different companies, the members communicate, collaborate, and coordinate their efforts, thanks to a variety of information and communication technologies (ICT). Most commonly designated as Global Virtual Teams (GVTs), these "new participants" must demonstrate creativity and innovation. GVTs are most commonly set up for the development of new products (Leenders & al., 2003).

Despite the wide range of existing studies on creativity and increased interest in virtual teams, interdisciplinary research covering both Creativity and Virtual Team remains rare. More work on the subject would prove very useful in a globalized world where innovation is playing a key role (Cao & al., 2004).

Our project is connected to Metis Global Reflective Community and has explored several complementary aspects of a broad research agenda: Creativity, Innovation and Global Virtual Teams, relating to issues such as Innovation Management (Cao & al, 2004), Ergonomy (Pang & al, 2005), Multimedia Document Management (Cao & al ,2004; Cao & al, 2005), Education (Klein, 2004) and the technological needs of NGOs (Klein & al, 2005). This research has been aimed at clarifying how to

organize such an innovative approach, both from the artistic, technological, educational, commercial and research point of view. Some comparative study of aspects of collective creativity in the Western World, China and other cultures has also been carried out (Xu & al, 2005). Finally some technological innovation is carried out with the invention of the Trace composer, a groupware awareness tool enhancing Global Virtual Team cooperative creativity (Metis Reflective Community, 2006).

The purpose of this paper is to understand better the creative process in GVTs and to identify factors that support or inhibit creativity.

2 CREATIVITY APPROACHES FOR GVTs

Creativity is a significant and complex concept. It can be defined as the process by which an individual, or a group, placed in a given situation, works out a new or original product or service adapted to the context as well as the desired outcome of the situation (Lubart 1999, Moscovici 1984). It is performed by 1) a creative participant (individual, group, organization), who by means of 2) the creative process, provides 3) a creative product or service in response to a micro/macro (4) environment.

The wide range of works that have been undertaken on the subject attest to its diversity and wealth. The notion of creativity has aroused the interest of many researchers in various fields (art, sciences, education, management, advertising, etc.). Sternberg and Lubart (1999) suggest a typology of the various approaches used to study creativity: mystical, pragmatic, psychodynamic, psychometric, cognitive, social-personality, and confluence approach.

Studies interested in virtual teams' creativity remain, however, limited in number and scope (Martins & al., 2004). Existing studies on the topic use only two of the seven approaches listed below to investigate virtual teams' creativity: the cognitive approach and the confluence approach.

2.1 The cognitive approach

In the cognitive approach, studying creativity is possible by understanding the creative process and its different stages at the psychological level. Jill Nemiro, based on qualitative research, identified four phases of the creative process: idea generation, development, finalization, and evaluation. These phases are iterative and not mutually exclusive (Nemiro, 2002). A special need or a question marks the beginning of the idea generation stage. An individual or a group of individuals proposes an idea and becomes what is called a 'kicker'. If the rest of the team approves of the idea, the kicker becomes a 'champion'. He develops this idea and becomes its defender. The development stage starts when the kicker's efforts are drafted, presented, and disseminated to the rest of team. During the development stage, team members exchange drafts, designs, or prototypes to develop a product, project, or service that meets the initially proposed need. Information feedback and revisions are carried out up until an applicable result is obtained. Once the ideas are developed towards a workable outcome, the creative product is finalized. The finalization stage consists in completing a final review to be carried out by the team before implementation. The evaluation is the final stage. It takes place after product or service implementation and occurs in certain teams. During this stage, team members evaluate the completed project strengths and weaknesses.

This study enables us to better understand virtual teams' creativity process and its various stages. However, one must search beyond these results. Additional studies are needed to verify their appropriateness for GVTs.

2.2 The confluence approach

In the confluence approach, creativity can only take place when several components are present. We have selected some of the main studies pointing out factors susceptible to enhance or inhibit virtual teams' creativity.

Starting with a case study carried out within the Boeing-Rocketdyne firm, Malhotra and colleagues developed a list of ‘best practices’ (Malhotra and al 2001). Key components for virtual teams’ creativity include setting strategy, using collaborative technologies such as knowledge management technologies, and restructuring work without changing core creative needs. Further studies are needed to confirm the suitability of the results in other contexts and firms.

Kratzer, Leenders and van Engelen have conducted studies based on 44 R&D virtual teams composed from 243 members working in 11 Dutch firms (Kratzer & al., 2004; Leenders & al., 2003). According to these authors, virtual teams members must keep an optimum level of communication that ranges between one and three exchanges per week.

The relatively recent study conducted by Ocker (2005), identifies nine inhibiting factors of creativity: dominance, domain knowledge, external rewards, time pressures, downward norm setting, structured approach, technical problems, lack of shared understanding, and non-stimulating team members. The enhancing factors include stimulating colleagues, a variety of social influences, example setting, a collaborative climate, and team members who make mistakes—or what she calls ‘equivocalities’—which surface, and subsequently decrease. Two major factors limit Ocker’s contribution: 1) the creativity process is not taken into consideration, and 2) the ten experimental virtual teams are composed exclusively of students.

3 RESEARCH METHODOLOGY

3.1 Research design

As stated earlier, more interdisciplinary studies are needed in this field. The shortage of previous studies and the complexity of the phenomenon call for a qualitative and inductive study (Huberman & Miles, 1991). Three case studies have been conducted. The first case study analyzes in-depth the creative process in an experimental situation. The two other case studies are conducted at Capgemini and Lafarge companies. The goal was to explore the impact of the organizational complexity in our research.

3.2 Simulated situation: The IVP project

The study sample is composed of 25 GVTs participating in the *Intercultural Virtual Project (IVP)*⁴¹. The GVT’s study was conducted among one hundred and seventy-two students from twelve universities distributed throughout nine countries. The teamwork consists of the elaboration of a ‘totem’ and a descriptive draft. The ‘totem’ is a complex symbol that is created to represent the team members’ identity. The descriptive draft is a two-page document compiled by each GVT in order to describe its totem and facilitate its comprehension. The project lasted eight weeks. Four weeks were devoted to the elaboration of a totem and its description. Each GVT is composed of students belonging to at least three different universities. Students use a discussion forum to communicate and share ideas and files.

This first study has used quantitative methods (PCA, CFA and hierarchical classification) to pre-extract, from the 25 teams at our disposal, those with either a high or low creativity level (Letaief & al., 2006). To measure creativity of the work turned in by the students, we used the “Creative Product Semantic Scale” (Besemer & O’Quin, 1986; O’Quin & Besemer, 2006; O’Quin, 1989). The fit indexes were relatively acceptable after neutralizing method effects (table 1). The indexes of reliability, convergent validity, and discriminate validity allow us to confirm proper reliability and validity of the used scale (Letaief & al., 2006).

Index	Value
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⁴¹ We have change the project’s real name for confidentiality purposes.

Chi square/ df	2.291
P	0.000
RMSEA	0.073
GFI	0.918
AGFI	0.864
CFI	0.978

Table 1: Fit indexes

Quantitative methods enabled us to choose eight teams with ‘highest’ or ‘lowest’ level of creativity among the twenty-five teams enrolled in IVP session. Then, qualitative methods: grounded theory, synthetic and visualization strategies (Langley, 1999) were used for coding and analyzing collected data. Content analysis was done on all interactions (904 messages) carried out between eight-team members’ (172 members). We were able to collect data from the discussion forums used by team members. We supplemented the data with information available on the project website and the impromptu statements made by some participants. Data coding was completed using LAC'UNE software⁴².

3.3 Real situations: Capgemini and Lafarge companies

The goal of these two studies is to “place” this research in a real context. The data collection was based on fourteen detailed interviews (one hour and half) with members and managers of GVTs involved in Research and Development.

At Lafarge, the interviews focused on two projects. The NF⁴³ Project is a project in progress. It aims to find new features for a new cement. The CMP⁴⁴ Project is a recent project that led to the development of software that can foretell the performance of a concrete from certain elements. Both GVTs responsible for these two projects is composed of four sub-groups located in France and North America.

At Capgemini, the interviews focused on a recent project: the project PROST. This project aims to produce a web solution for a multinational. This solution is intended to be used by 10 000 users spread over fourteen countries. In sum, the production of this web solution has mobilized members from five countries (France, Switzerland, India, United Kingdom and Germany) located in eight sites.

Two analysis are then conducted on the corpus obtained. The first one is quantitative. It intended to confirm the relevance of the collected data within our research. Sphinx Lexica⁴⁵ software was used to do this first analysis.

The second analysis is qualitative. It is a content analysis and aimed to study the creative process and explore the factors disposed to influence GVTs creativity. The data coding was completed with the help of the LAC'UNE software.

⁴² Logiciel d'Aide au Codage Version 1.0 is a coding assistance software that was developed specifically for this study in collaboration with a student from the Grenoble Institute of Technology, France.

⁴³ We have change the project's real name for confidentiality purposes.

⁴⁴ We have change the project's real name for confidentiality purposes.

⁴⁵ <http://www.lesphinx-developpement.fr/>

4 RESULTS

4.1 The creative process

A process can be defined as a set of interdependent activities converging towards a common goal. The creative process is a process by which an individual or a group of individuals create a product (Nemiro 2002). The three case studies have made it possible for us to identify the phases and dynamics of the creative process of GVTs in a collective environment.

4.1.1 Phases of the creative process

The creation process is divided into 7 phases (figure 1). For clarity's sake, we will present these various phases in a linear fashion. In reality, the creative process is in fact more complex than it appears here due to the iterations and overlaps existing between the various phases.

The preparation: This phase marks the beginning of the creation process. During this phase, each member of a GVT gets acquainted with the rest of the team. They share information with each other and then decide to concentrate on the development of their product. This phase generally leads to planning and members' commitment for brainstorming.

The incubation: One of the characteristics of a GVT is the geographical dispersion of team members. Virtual and local sub-groups can be formed within the same GVT. The incubation phase corresponds to the phase where these sub-groups work in a separate and completely invisible way. Ideas coming from sub-groups are gradually exposed to the rest of the team. This development marks the beginning of the generation phase.

The generation: This can be compared with the "generation of ideas" phase described in Nemiro's study (Nemiro, 2001). During the generation phase, the members present their ideas and drafts on the product to be created. A central topic of creation is born progressively, through interaction and exchanges. This is the Emanation Phase.

The emanation: This phase is a very short phase of the creative process within GVTs. During this phase, a code or a central idea emerges to organize and structure the entire set of the members' contributions on a central topic. In the case of the CCIP project, the emanation phase appears with the creation of slogans and metaphors (United Culture, Peace and Friendship, etc). At Lafarge, the emanation phase gives rise to its specifications and at Capgemini, the creation of support documents.

The selection: The emanation phase and the generation phase are two parallel and interrelated phases. The structuring effect of the emanation phase is significant when it takes place at the *beginning* of the generation phase. At the end of the generation phase, the GVTs face the challenge of choosing from several product ideas. This stage of the process is called the selection phase.

The finalization: During this phase and according to the degree of completion of the selected product (or product idea), the team members have to be involved in modifications, revision, and final improvement tasks in order to reach the final product.

The evaluation: Finally, the evaluation phase occurs after the work has been submitted. During this phase, team members evaluate the final product and the contribution of each member. In the evaluation phase, the team members evaluate together the positive and negative points of the project (Nemiro 2002). The objective is to analyze and promote the thought process of the team in the previous work phases. This thought process helps the participants to develop management practices and improve their understanding for collective conception in GVT. The evaluation phase does not solely take place at the end of the project. All along the project, the team members evaluate the work done and contributions made by the other members. The intermediary evaluations may help improve the work procedures and methods of the GVT.

4.1.2 The dynamic of the creative process: confrontation between conscious and unconscious

Following research using the psychodynamic approach to study creativity, our analysis has made it possible to note that the process of creation within a GVT is a succession of interactions between two spheres: the conscious and the subconscious (Sternberg & Lubart, 1999). ICTs play the role of interface, which makes interaction between these two spheres possible (figure 1).

The incubation phase plays a crucial role in the GVT creative process. During this phase, members of the sub-groups—co-located or virtual—act and interact to set up ideas and develop models, which they thereafter will place at the disposal of the team in the shared workspace. These actions and interactions are initially invisible and inaccessible to other GVT members. These actions and interactions are therefore undertaken in **the team’s unconscious** sphere.

By applying psychodynamic theory to the particular context of GVTs, it can be put forth that an act (action or interaction) generally passes through three ‘states’ separated by two kinds of ‘filters’. Initially, an act is carried out in the unconscious team sphere (i.e. on a sub-group scale). A first test for this act is done at the level of the sub-group. The sub-group can validate or refuse the movement of the act from one sphere to another. In the case of rejection, it remains at the unconscious level. If the sub-group accepts to show and share it with the rest of the team, the act is validated and moves on to a higher state.

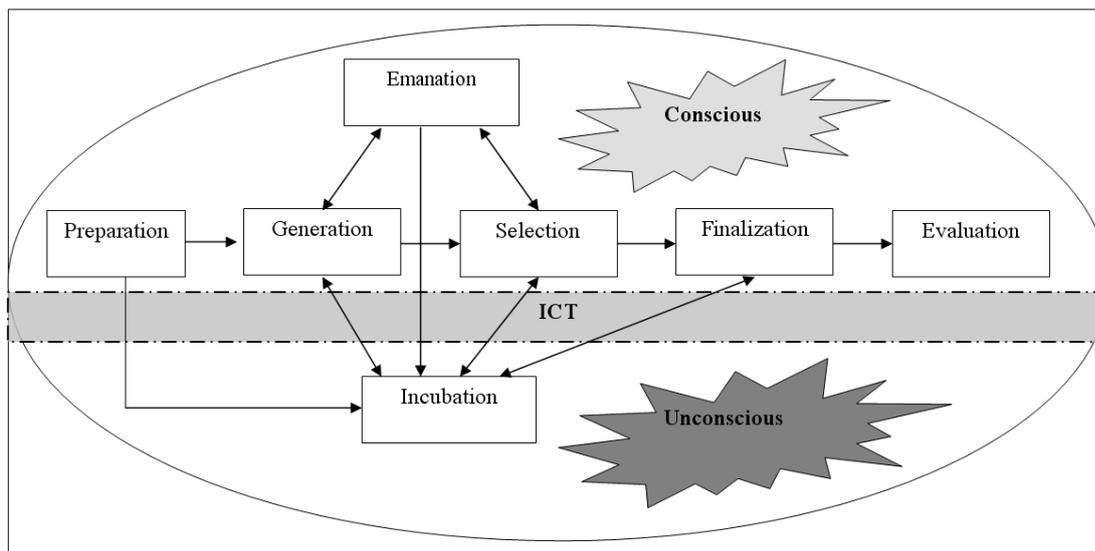


Figure 43. GVT Creative process.

The second level illustrates the **technology used**. Within the framework of this study, team members used discussion forums, msn messenger, Netmeeting, emails, etc. as a shared workplaces. These shared workplaces allow members to interact and take actions that are visible and accessible to all team members.

Before reaching the next level, the act validated on the sub-group level must first make its way through a second filter. Different technologies possess differing capacities for information transmission (Daft & Lengel, 1984). The move from the level of sub-groups to the level of the team directly depends on the technology used. If technology is able to transmit the act, this act moves to the following level. If not, this act is refused and condemned to return on the subconscious team level. Sub-groups which have already validated the act should modify it to make it transmissible by technology. By failing to do so, the sub-group will condemn this act to remaining on the unconscious level. The second filter is thus a technological one.

The third level is the **team’s conscious** that contains all visible and accessible information, actions, and interactions carried out by team members. More commonly named “collective awareness” (Daassi & al.,

2005), these bits of information, actions, and interactions participate to create a common and shared vision of the team's larger context that allows members to implicitly coordinate their activities and behaviors. Once the act crosses the technological filter, it is added to the other acts that are at the conscious level, and takes part in the formation/actualization of the "collective awareness," which contributes to the creation of new acts. Then, the cycle restarts...

4.2 Determining factors for GVTs creativity

A systematic comparison between the different kinds of teams has allowed us to determine three major processes and emergent states that influence GVTs creativity: the appropriation of technology, the group awareness and the group memory. Thus, IMO model (Ilgen & al., 2005) seems to be more appropriate than the common I-P-O model (Martins & al., 2004) to study GVTs and their performance (Curseu, 2006).

4.2.1 The appropriation of technology

The appropriation of technology is the process by which team members choose the manner with which they will use the technology at their disposal (DeSanctis & Poole, 1994). Technologies possess structural properties (structural capacities and spirit) that team members adopt and adapt during their use. Team members may take advantage of technology structural capacities' to facilitate teamwork process and enhance performance (Dennis & Garfield, 2003). The results of this study lead to the same conclusion. In IVP case study, team members mainly use a discussion forum to communicate and collaborate with their remote team-mates. In this study, we identified two major modes of using this technology: "discussion forum mode" and "mail mode". "Discussion forum mode" appears when team members reply to their remote teammates in a structured way by relating their responses and comments to the concerned topic. "Mail mode" appears when team members post their responses and comments without having any specific link (unstructured responses). Results show that creative teams are those that use more frequently the "discussion forum mode". They take advantage of structural capacities of the available technology by structuring their communication and creative processes.

4.2.2 The group awareness

In accordance with Hinds and Weisband (2003), the three case studies indicate that group awareness have positive effect on GVT's creativity. In collaborative situation, group awareness "refers to a common and shared vision of the entire team's context, which allows members to coordinate implicitly their activities and behaviors through communication (Daassi & Favier, 2005). Group awareness is built from sharing information about activities, availability, work process, perspectives and environment (Steinfeld & al., 1999). In the IVP case study, the most creative teams are the first to exchange information to develop group awareness. In companies' cases studies, team members use daily instant messenger, email or phone to keep in touch with each other.

4.2.3 The group memory

Group memory is "the electronic capture of the group's work, which is available for review by the group" (Satzinger & al., 1999). An insufficient use of group memory may be a major source of conflict between team members. It is manifested by the allocation of a good idea and its merits to a person other than its creator. The insufficient use of group memory removes motivation and commitment for members vis-à-vis the team and the project.

To avoid such situation and encourage GVTs members to propose and share ideas, Lafarge Company has established a collaborative tool (discussion forum). It allows members to exchange and develop their ideas. It also plays the role of group memory because it allows to save the footsteps of interactions that took place between members. It guarantees the "idea ownership".

4.3 The managerial levers

The three case studies allow us to identify the creative process phases and the determining factors of creativity. The two case studies carried out in enterprises also made it possible to identify three managerial levers to promote GVTs creativity: the contiguity, the proximity and the reflexivity. These three levers include practices to be in place respectively at the beginning, during and towards the late of the creative process.

4.3.1 *The contiguity*

The contiguity consists of creating overlaps between team members in order to facilitate their communication, their coordination and their collaboration.

Overlapping areas can be physical when members meet face-to-face to work on the project. In both cases, members and managers interviewed EVGs call for a first face-to-face meeting between members. This first face-to-face contact allows members to take ownership of the project and to agree on conditions of the collaboration (Nemiro 2002). It also enables members to build relationships and identify themselves as a member of one team (Fiol and O'Connor 2005).

To improve collaboration, GVTs members must have complementary skills and partially the same knowledge (Tavcar & al., 2005). The geographic dispersion makes difficult to the establishment of communication and creation of shared understanding (Hinds & Weisband, 2003). The overlap of knowledge is to ensure that remote members to have common knowledge in field necessary to the team task. This overlap of knowledge has a positive effect on coordination within the team and fosters virtual team creativity (Malhotra and al. 2001; Ocker 2005).

Overlapping may also exist with regard to roles of team members. When developing IMOI model, authors emphasise the existence of two dominant team mental models in recent researches: shared mental models and transactional memory models (Ilgen & al. 2005). The shared mental models are based on the assumption that more team members have a shard understanding more team will be efficient. Depending on transactional memory models, team has a better performance when there is separation and specialization in the different areas needed to carry out the task. The results obtained in our study are consistent with shard mental models and are coherent with recent studies on virtual teams (Badke-Schaub & al., 2007; Espinosa & Pickering, 2006; Hinds & Weisband, 2003; Tavcar & al., 2005) and theirs creativity (Ocker, 2005).

The alignment of objectives is the fourth and last dimension of the contiguity. GVTs Members have different priorities and different expectations from each other. The alignment of objectives is the process by which team manager incorporate these different priorities and expectations in a uniform set of objectives that meet the project needs (Griffith and Gibson Jr. 2001). From the start of project, the alignment of objectives is needed to ensure commitment and effective participation in the creative process, the project must be a priority for all team members (Beranek & al., 2005; Griffith & Gibson Jr, 2001).

4.3.2 *The proximity*

The proximity is often conceived as linear variable and measured by units distance as meter or miles (Kiesler & al., 2002). In this study, proximity measures the ability of team members to keep in touch despite distance (Armstrong & al., 2002; Kraut & al., 2002). Proximity includes permanent contact between members, responsiveness in communication and visibility of activity.

The team manager must follow the participation and involvement of team members (Malhotra and al. 2007). A permanent contact allows him to understand and overcome some creativity inhibitors (demotivation, difficulties inherent to the technology, etc.). Permanent contact enables team members to share ideas daily instead of waiting for meetings to do it (Majchrzak & al., 2004).

The communication has a crucial role in determining the performance of a virtual team (Horwitz & al. 2006). Mastering the language and ability to synthesize are essential to facilitate communication between virtual team members (Brett & al., 2006; Tavcar & al., 2005). In the case of GVTs, members must be responsive at physical and virtual meetings (Jarvenpaa & Leinder, 1998). They must be “active receivers” and ask for clarification when necessary (Tavcar & al., 2005). The responsiveness reduces the ambiguities and problems of understanding related to the geographic dispersion and cultural heterogeneity of team of members (Horwitz & al., 2006; Ocker, 2005).

Clarification of objectives and the distribution of work among members must be structured and prescribed in a formal manner (Leinonen and al. 2005; Malhotra and al. 2001). The team leader must then secure a permanent monitoring the team activity and results (Lurey & Raisinghani, 2001). The ongoing monitoring and adaptability are crucial for success of new product development by GVTs (Tavcar & al., 2005). The practices used by Lafarge and at Capgemini to ensure visibility are different. The first uses the supervisory committees to present the progress of work. The second uses the “visible points” technique that consists to supervise the work of remote members at the same frequency that co-located members.

4.3.3 *The reflexivity*

In the same company, sharing good ideas and practices between members from different teams promote the emergence of new practices and new work procedures within this teams and increases their performance (Zellmer-Bruhn & Gibson, 2006). The company may reinforce this trend by establishing a formal system for capturing, sharing and dissemination of ideas and practices.

At Lafarge, a first "final project report" is prepared at the end of each project. This report summarizes the achievements during the new product development project (new knowledge, perspectives and research methods, etc.). A second report is intended to capitalize knowledge at the Lafarge Group. It is a generic document entitled “scientific and technical report”. This report presents the knowledge acquired during the project and that can be used in other situations (methodology, measurement techniques and analysis, etc.).

Capgemini has established an internal Rightshore™ portal that gives supports, good practices and contacts for projects in distributed mode. Workshops Rightshore™ are organized between managers notably in France and project managers with significant experience working with Mumbai to discuss their difficulties and good ideas.

5 CONCLUSION

In the contemporary context of global competition, creativity is a major factor for success among contemporary firms. The development of GVTs has triggered the interest of researchers and managers alike who are attempting to understand their dynamics and performances. In spite of a growing number of studies on virtual teams, research on GVT creativity is rare. The purpose of this study was to understand the process and the determinants of GVT creativity.

The results presented here corroborate the scarce studies that exist on GVT creativity. They show that we can divide the creative process into seven iterative phases. Three of them emerged in Nemiro research: selection, finalization, and evaluation (Nemiro, 2001). The generation phase in our study combines Nemiro’s concepts of the idea generation phase and the development phase. In fact, for us, there was no separation between the cognitive and the behavioral generation phases. Team members share ideas and draft them at the same time. Three other specific phases emerged from this study. GVT members are not supposed to know each other before the project’s launching. The preparation phase allows team members to “meet” each other and get acquainted. Another specific phase is the incubation. Geographical and temporal dispersion of members support the formation of subgroups within the same team. In these subgroups, members work either as classic or as virtual teams. The

manifestation of the incubation phase allows us to conceive the creative process as an interaction between the team's conscious and subconscious. The emanation phase is an important phase, as it allows team members to share the same vision of the product. Appropriation of technology, group awareness and group memory are processes and states that emerge during the creative process and influence of GVTs creativity.

It seems obvious that creating a shared vision between team members or promote their awareness may enhance team creativity. But how can we help GVT managers to lead successfully their team? This study suggests that contiguity, proximity and reflexivity are three managerial levers that may help GVT managers to create positive conditions for team creativity.

Despite the opportunity afforded by qualitative study, more research in the field of organizational studies is necessary to measure and control the implementation of the results. In spite of this major limit, this study opens up considerable prospects for future research. The psychodynamic vision of the creativity process in GVTs sheds new light on the existence and the interaction between the conscious and the unconscious during the creative process. It may possible to establish links with work carried out in the Human-Computer Interaction field (HCI). After coordination and leadership, it would be productive to study the impact of the team's "conscious-unconscious" on creativity and creative process.

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