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# A COMPARATIVE ANALYSIS OF COLLECTIVE AWARENESS BUILDING IN VIRTUAL TEAMS

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## Abstract

Collective awareness becomes an important construct in the virtual context. It allows facing problems derived from uncertainty and ambiguity of electronic relationships and virtual environment. Considered as a dynamic concept, collective awareness develops with time and accumulated information exchanged between team members. However, virtual teams have different configurations resulting from different characteristics such as long/short lifespan, homogeneity/heterogeneity of team members, etc. This implies that processes of collective awareness building are different from one configuration to another. The purpose of this paper is to analyze how changing virtuality levels influence the dynamic of collective awareness. After theoretical analysis of both concept of virtuality and collective awareness, the paper present the steps and the results of a qualitative case study. This study compares two types of virtual teams (pure and hybrid) and explain differences found in collective awareness building mechanisms. Results of our study show that in team having short life span and whose members work together for the first time, it is difficult to build collective awareness. However teams having enough time to accomplish work, to exchange social and work related information, and to build personal relationships, can succeed to build a shared understanding of the actions of the others and visibility of their actions.

*Key words: collective awareness, virtuality, pure virtual teams, hybrid virtual teams.*

# **1 INTRODUCTION**

Virtual teams is a growing research field that interests many researchers in Information Systems. Several topics are studied to better apprehend the concept of virtual teams and to analyse factors influencing their dynamics and performance (Avolio et al., 2001; Hardin et al., 2006; Jarvenpaa et al., 1998 ; Kanawattanachai and Yoo, 2002; Montoya-Weiss et al., 2001; Zigurs, 2003).

One of these factors is collective awareness which is identified as a solution to solve problems of uncertainty and ambiguity of virtual context (Hinds and Weisband, 2003). Indeed, Collective awareness is referred to more broadly as a shared mental model of the team. A team mental model refers to a collective understanding or mental representation of knowledge that is shared by team members (Klimoski and Mohammed, 1994). These organized knowledge structures allow individuals to interact with their environment. The mutual knowledge consists not only of the information itself but also the awareness that the other knows it.

In addition, two types of awareness are identified: activity and social awareness. The former is the knowledge about the project-related activities of other team members. The latter refers to the knowledge about the team members, and especially about their social situation. The development of these two dimensions needs time to allow team members to know each other with information exchanges and interactions.

However, some recent studies discovered that processes and functioning of virtual teams change according to their characteristics, which are mostly related to their degree of reliance on Information and Communication technologies (ICT) and to the distance between their members. These characteristics define the concept of virtuality which determine different types of virtual teams (Chudoba et al., 2005; Kirkman and Mathieu, 2005). Consequently, collective awareness building mechanisms are expected to be different from one type to other.

The purpose of this paper is to analyse how virtuality level influences collective awareness in the team. We aim at identifying the way collective awareness and its determinants change over time when virtual team members use more or less ICT, when the distance between them is more or less important, when they know each other or not, etc.

To reach this purpose, we will organise the paper into two main parts. On the one hand, a theoretical analysis of both concepts of virtuality and collective awareness will be presented in the following section. The dimensions and determinants of each concept will be discussed and the dynamic of collective awareness will be examined. In addition, this analysis will establish the links between them that will be formulated into research propositions.

On the other hand, we will present the comparative qualitative study that we conducted to test our propositions. The third section will present the teams observed and the qualitative method adopted to collect data. In the fourth section, results of our study will be presented and discussed according to the type of virtual the team observed.

The conclusion will summarise our findings, present their theoretical and managerial implications, and indicate the limits and the possible extensions of this work.

## **2 EXPLORING VIRTUALITY EFFECTS ON COLLECTIVE AWARENESS DYNAMIC**

### **2.1 A multidimensional approach to evaluate team virtuality**

Virtual teams are defined as group of skilled individuals a) separated in space and time, b) using extensively information and communication technologies, c) to accomplish a task limited in time (Jarvenpaa et al., 1998; Lipnack and Stamps, 1997; Townsend et al., 1998). These characteristics distinguish virtual teams from traditional teams and announce what makes them virtual. However,

they don't allow identifying different types of virtual teams. They, instead, assume implicitly that there exists a unique possible configuration of virtual teams. More recently, typologies were developed to clarify the concept and to examine the variability of virtual teams characteristics' impact on their design (Bell and Kozlowski, 2002; Casio and Shurygailo, 2003; Jarvenpaa et al., 1998).

The proposed typologies are based on two fundamental elements. The first is the identification of key characteristics of virtual teams. The second is about assuming that they vary in a continuum. For example, geographical dispersion has many degrees from low to high leading to co-located or separated team members (Bell and Kozlowski, 2002). The result of different combinations of such changing characteristics is the existence of multiple types of virtual teams.

We present here three typologies that we consider to our analysis. In the first one, Bell and Kozlowski (2002) establish four criteria to define different types of virtual teams: lifespan, time-distribution, team's organizational, functional and cultural frame and role of the members. They also introduce the complexity of the task as a moderator variable of the nature of the team as it influences and shapes all the other criteria (Bell and Kozlowski, 2002: p.30).

In the second typology, Dubé and Paré (2002) identify the characteristics, which are common to any virtual team, and those that can help determine different types of virtual teams. In the latter category, the authors introduce more criteria than the authors of the first typology: size, geographical scattering, duration of the task, shared anterior experience, role of the members, nature of their relations, interdependence of activities and cultural diversity (p.14).

Both typologies admit that the team's nature vary in a continuum determined by the variability of their characteristics. A team can then be defined by any combination of identified properties. Two extreme cases are the archetype of the virtual team (short lifespan, members' geographical scattering and intensive ICT use) and relatively permanent virtual teams (stable framework, unique role of the members, and real-time communication).

In the third typology of Jarvenpaa et al., (1998), the authors take into consideration three variable to identify a type of a virtual team: communication mode (face-to-face, computer-mediated or mixed), lifespan (long or temporary team), and cultural diversity (homogeneous or heterogeneous team).

Taking up the previous typologies we may put forward another one that results from their confrontation. We decided to keep the following characteristics: geographical distribution, lifespan, interdependence and previous shared work experience. Among these characteristics, we tried to put together those, which are common in the two previous typologies. In addition, our choice was guided by the role played by each of these variables in determining the design of the virtual team and by their impact on the nature and development of trust (Jarvenpaa and Leidner, 199; Kanawattanachai and Yoo, 2002; Meyerson et al, 1996).

Like Bell and Kozlowski (2002), we admit that the forms of virtual teams vary in a continuum and that they can consist of any combination of these criteria. We can, then, deduce the existence of several types of virtual teams with two extreme configurations at the two opposite poles and one intermediary configuration in between. In other words, there are three types representing virtual teams at the crossroad of the identified characteristics:

- First we find *pure virtual teams* whose members are geographically dispersed, do not know one another and never meet face to face. In this type of team, there is a strong interdependence and a short lifespan. Given these characteristics, it is this type of team, which puts actual management models into question and calls for innovation of management practices.
- Secondly, we find *traditional virtual teams* whose characteristics are comparable to those of traditional teams. Members of such a team are dispersed but have already worked together in the past, have a long time period to achieve the task they were entrusted with and rely heavily on ICT. Usual management practices are still valid and organizational mechanisms see their usual development modes unchanged.

- Thirdly, mixed or hybrid virtual teams share the characteristics of the two previous categories. In such a configuration, members can combine two modes of communication (face-to-face or ICT-based), they can share previous work experiences and have a moderate deadline for the achievement of their task. Some research show, that, in practice, it is the latter type that prevails most of the time.

The existence of several types of virtual teams has repercussions on the analyses related to the way they work and on the organizational processes that are developed. Indeed, a prevailing feature in virtual teams' literature is the idea that they only form one type diverging from traditional teams. As a result it impoverishes these analyses and distorts the generalization of the results. Though, to admit the existence of several types of virtual teams and the variability of their characteristics leads to accept that their functioning and their organizational mechanisms can differ according to their characteristics. This observation affects, among other things, collective awareness and its building mechanisms. The following paragraph will explain this idea and formulate our research propositions.

## 2.2 Collective awareness building in virtual teams

Collective awareness has been defined in numerous ways, although many definitions don't share a common foundation. Schmidt (2002) argues that awareness is "*being used in increasingly contradictory ways...In fact, it is hardly a concept any longer*". Dourish and Bellotti (1992) define collective awareness as "*an understanding of the activity of others which provides a context for your own activity*" (p. 107). Other definitions are formulated to enrich the previous one. In these researches, the authors pointed out many aspects that contribute to understand collective awareness such as coordination (Beaudouin-Lafon and Karsenty, 1992: p.171), presence and workspace sharing (Tollmar and Sundblad, 1995: p. 181) and informal communication (Smith, 1996: p. 59). Based on these studies, Daassi and Favier (2005) propose a working definition of collective awareness that takes into account members' behaviours and their context: "*collective awareness refers to a common and shared vision of a whole team's context which allows members to coordinate implicitly their activities and behaviours through communications*" (Daassi and Favier, 2005: p. 2).

In addition to several definitions given to collective awareness, some authors tried to better apprehend the concept by identifying its elements or types (Gutwin et al., 1996; Steinfield et al., 1999; Tollmar et al., 1996). Some of the presented types of awareness means the same requirements and can be coupled (Daassi et al, 2005). Prinz (1999) distinguish task-oriented or activity awareness from social awareness. The former refers to awareness information focused on activities performed to achieve a specific shared task (Steinfield et al., 1999). It consists, for example, of knowing what actions others do at any given moment. The later includes information about the presence and activities of people outside the context of their work, their habits and level of interest (Gutwin et al., 1996; Tollmar et al., 1996). This typology is broadly in line with Bales's (1950) Interaction Processes Analysis findings, where he distinguishes task-oriented from socio-emotional processes.

In virtual context, collective awareness is as important as in face-to-face environment. Yet, it is facing more challenging issues caused by physical separation, electronic communications, and asynchronous work. Virtual team members have to engage in shared understanding building over time while using computer-based communications. Establishing a climate of collective awareness in virtual teams needs time. According to time, interaction, and performance theory of McGrath (1991), with time, participants interact, exchange information about each other, and accumulate knowledge about their team's behaviours, work styles, schedules, and habits. Frequent interactions and immediate feedback are necessary conditions to share information and to take position in the team (Weisband, 2002).

The dynamic nature of collective awareness can be also drawn from its dimensions evolutions. Both activity- and social awareness increase over time with information exchange and accumulation. However the relative importance of each dimension is different from the other. Activity awareness is expected to be more important at the beginning of the project than social awareness. As virtual team members don't know each other and don't have prior shared work experience, their communications and information exchange are expected to be professional and task-oriented (Hiltz et al, 1986). Social

interactions, personal information exchange, habits, and cultural values come after and growth over time.

In this regard, we think that characteristics of virtual teams explained above have considerable effect on collective awareness development. In pure virtual teams whose members do not know each other before, who interact mostly via ICT, and who have short period of time to accomplish their task, in this kind of team, collective awareness is expected to take longer time to be build. Its development mechanisms are complicated as members lack of a shared knowledge of each other and face problems of time to interact and to exchange personal and work-related information.

However, in traditional and hybrid virtual tams, collective awareness building is expected to be less complicated as team members know each other, combine different mode of communication with different richness degrees, and have enough time to build social and personal relationships and to exchange work related information.

Propositions resulting from this development can be formulated as follows:

*Proposition 1: In pure virtual teams, collective awareness building is difficult and hindered by lack of time, shared prior work experience and computer-mediated communication.*

*Proposition 2: In traditional and hybrid virtual teams, collective awareness building is expected to be enhanced by combined communication mode, and prior shared work experience.*

### 3 RESEARCH DESIGN AND METHODS

We adopted a qualitative methodology based on two case studies to test our research propositions. Data was collected through team observation and in-depth interviews with their members. Our empirical study consisted of the observation of two virtual teams to compare their characteristics and the effects of varying virtuality levels on collective awareness building mechanisms.

The first team is composed of members working in the same organization. They know each other as they worked together in the past for different project. The organization is Hewlett-Packard which is an international firm in the high-tech sector. Six members were interviewed in this team.

The second team is composed of members working together for the first time. Members have different skills and belong to different organization. They work for a scientific project called COUCOU aiming at developing new product and new results in the telecommunications field. The project rassemble different actors from France Telecom R&D, STMicroelectronics, CEA-LETI, the MSH-Alpes, and from CLIPS-IMAG. Six members of this team were also interviewed. So the total numbers of interviews conducted is 12. The following table presents the characteristics of the interviewed members.

Case study		Gender	Function
<b>Hewlett-Packard Team (HP)</b>		Male	Project leader
		Male	Engineer
		Male	Engineer
		Female	Manager
		Male	Project leader
		Male	Manager
	France Télécom R&D	Male	Engineer
	MSH Alpes		Research

<b>Team project COUCOU</b>		Female	engineer
	Multi-Com	Female	Engineer
	MSH Alpes	Male	Engineer
	CLIPS- IMAG	Male	Researcher
	Multi-Com	Female	Project leader

*Table 1. Main characteristics of the sample*

Applying the criteria explained above to evaluate the virtuality level of a team, we can identify to which type each team belongs. On the one hand, the first team can be qualified as a hybrid virtual team as it has members communicating in face-to-face and through ICT. They also have worked together in the past and have a shared organizational culture. However, they have diversified skills and then constitute a heterogeneous team in this regard.

On the other hand, the second team can be considered as a pure virtual team. The project has a limited lifespan, its members work together for the first time, have diversified skills, use only ICT to exchange information, and have different organizational cultures.

For the two teams, data was collected through centered interviews using an interview guide composed of three themes: collective awareness, its antecedents, and its dynamic. All interviews were conducted during a total period of six months and every interview lasted almost one hour. They were realized in face-to-face, were registered and transcribed to facilitate qualitative analysis. We conducted content analysis following coding scheme developed from the literature review and results of similar empirical studies.

## **4 RESULTS AND DISCUSSION**

The results of our study are related to collective awareness, its nature, its existence and its importance in the team. They also concern the dynamic of collective awareness and evolution of its dimensions. For clarity sake, we will present our finding for each case study.

### **4.1 Case study HP**

The results of this qualitative study illustrate the need for the virtual teams for a collective awareness. All interviewed members expressed problems of uncertainties requiring a better visibility and a common comprehension. Considered as a sign of a need for collective awareness, uncertainty seems to be the main factor threatening functioning of virtual teams. The collective awareness thus makes it possible to face this kind of threat.

One of the members interviewed confirmed: *“There are the problems of uncertainty. There is no visibility and it often happens that it is discovered that the situation on papers does not correspond to the situation on the ground”*. He also noted: *“In this electronic communication problems are related to understanding. There is no common vision of the things and we take time to share a common vision: what it is your rate/rhythm of work? How you work during the day, the week, the month, and how to set up a common environment there”*.

The proximity between uncertainty and need for collective awareness was often analysed in the literature (Weisband, 2002; Hinds and Weisband, 2003; Daassi and Favier, 2004).

Although collective awareness is necessary for the good functioning of virtual teams, it is not easy to build it. Members interviewed agree on the difficulty of creating a collective awareness without having the opportunity to meet face-to-face. As one team member interviewed explains, collective awareness in a virtual environment is very fragile: *“One realizes that common comprehension originates in the meetings. On the other hand, for people who never saw themselves, this understanding is more volatile and one cannot evaluate it: do people in Asia have same understanding*

*that me. It is then difficult to create a shared understanding if I did not see these people*". We can conclude from this interviews that the virtuality of exchanges creates problems in building a collective awareness within a virtual team.

Concerning the evolution of collective awareness, all team members interviewed confirm the dynamic nature of the concept and the importance of the time for its development. For example one interviewee noted that: *"Its is not easy to build it [collective awareness] and it needs time and knowledge of each other. Another interviewee also noted that "Permanent collaboration makes it possible to improve the collective awareness but once established it makes it possible to know people who work or who does not work or less than others"*.

To summarize our findings generated by the first case study, we can say that building collective awareness is a dynamic process. It requires permanence and stability of information exchanges which intensify over time. As the members of a virtual team advance in their project, they exchange information in an increasingly frequent way. These interactions enable them to keep up to date with the activities with the ones and others and their socio-emotional climate.

## **4.2 Case study COUCOU**

The interviews conducted with COUCOU members show that building collective awareness is translated into terms of actions. Indeed, it requires the participation of all the members of the team. The latter must be implicated in the exchange of information needed for task accomplishment of their colleagues. One interviewee explained this idea as follows: *"Collective awareness gathers the ideas and diffuses them but I think that it is necessary already that everyone takes part. It is a concept of division, solidarity, and agreement to exchange"*.

In addition, COUCOU team members consider that the establishment of a mutual trust within their team and team cohesion supports and facilitates information exchanges and sharing which constitute dimensions of collective awareness.

Concerning the dynamic nature of collective awareness, members of COUCOU project believe that the existence of a priori enhances the progressive development of collective awareness. The talks carried out confirm the empirical existence of this dynamics as the extracts attest it below: *"The more people know each other, the more one knows with whom one deals and the more one is aware of the other. It is not something which one has or which one does not have! That is done gradually and that requires time"*.

The dynamic nature of the collective awareness is also confirmed in the case of COUCOU. It gradually evaluate with the evolution of interpersonal relationships between the different participants in the project.

To summarize our findings, we note that the establishment of collective awareness is crucial for the two situations of virtuality. Indeed, the collective awareness allows reducing the uncertainty which accompanies virtuality with its different degrees. However, virtuality degrees have considerable effects on the creation of the collective awareness. Indeed, the latter seems more difficult to establish and to more fragile in the pure virtual teams (Case HP) compared to the context of the hybrid virtual teams (Case COUCOU). In addition, the collective awareness within the two types of virtual teams gradually builds with the accomplishment of the task. More precisely, the permanence of collaboration supports and enhances a mutual knowledge articulated around relationship and work related awareness. For these reasons we can consider that our findings confirm the propositions and that collective awareness nature and building mechanisms change with changing virtuality level.

## **5 CONCLUSION**

In this paper we tried to analyze the effects of different virtuality levels on the development of collective awareness in virtual teams. Virtuality was studied through different configurations of virtual



teams that can be grouped into three categories: pure, traditional and hybrid virtual teams. Results of our empirical study confirm that mechanisms used to build and maintain collective awareness are different from one type to another according to the characteristics of the team. In addition, time and shared work and social knowledge seem to be two important factors for collective awareness. Thus we conclude that collective awareness management is more difficult in pure virtual teams than in hybrid ones. However, we cannot conclude what are mechanisms employed in traditional virtual teams as we did not observe this kind of team.

It is, then, important to extend this study by examining other possible configurations of virtual teams resulting from other characteristics and to identify in what direction collective awareness develops. In addition, it would be interesting to investigate factors depending on virtual team configuration and contributing to collective awareness management such as leadership, trust, group cohesion, etc.,

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