IMPACTS OF TEAM VIRTUALITY ON PERFORMANCE: A QUALITATIVE STUDY

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Abstract

Recent studies on virtual teams reveal that team virtuality varies in a continuum and may take different levels. Different levels of virtuality have considerable impacts on team processes and management as they imply several characteristics concerning communication dynamics and interaction styles, which change when shifting from one level to another. The purpose of this paper is to assess how the variability of team virtuality influences team performance. A multidimensional approach to evaluate virtuality was elaborated to identify changing performance variables at each level. The performance variables retained with relevance to the context study are: output quality, team members’ satisfaction, and team processes. A qualitative study was conducted on 6 virtual teams composed of 4 students involved in on-line master degrees at a French university. The results show that performance measures are differently influenced by virtuality level. Although output quality seems not to be related to team virtuality, effective team processes and members’ satisfaction are associated with low virtuality levels. Ineffective processes were found in high virtuality teams, however positive dynamics and team spirit characterise low virtuality teams.

Key words: team virtuality, virtuality dimensions, virtuality antecedents, virtual team performance, team processes, members’ satisfaction.

1 INTRODUCTION

Virtual teams are considered as a revolutionary mode of organizing work. They are composed of geographically scattered individuals who work together via Information and Communication Technologies (ICT) to accomplish an organizational task (Bell and Kozlowski, 2002; Lipnack and Stamps, 1997; Townsend et al. 1998). They allow firms who use them not only to reduce the financial costs of organizing regular face-to-face meetings for all remote team members but also to reach the required competences wherever they are located. Given the widespread use of virtual teams in organizational settings, an important growth of research on the topic may be noted in managerial literature. Many studies were interested in dynamics and processes of virtual teams such as trust, leadership, communication, coordination mechanisms and performance (Anderson et al., 2007; Avolio and Kahai, 2001; Järvenpää et al., 1998; Maznevski and Chudoba, 2000). Another stream of research was dedicated to defining virtual teams and identifying their different and possible configurations (Bell and Kozlowski, 2002; Cascio and Shurygailo, 2003; Dubé and Paré, 2002). The results of these researches led to the classification of virtual teams into different types.

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according to their characteristics and resulting in different virtuality levels. This has considerable implications on team functioning and requires the adaptation of management practices to team virtuality level. Indeed, different levels of virtuality are generated by notable differences in communication tools and processes. They also result in varied interaction styles and dynamics. High virtuality teams have not the same interaction frequency than low virtuality teams. As virtual teams functioning is completely based on ICT use, then coordination mechanisms and task performance will be impacted by ICT issues and consequently by team virtuality level. However, little is known about how virtuality influences team dynamics and processes and in particular their performance. Although several performance determinants were investigated such as conflict resolution, cultural diversity, team cohesion, … (Lurey and Raisinghani, 2001; Maznevski and Chudoba, 2000; Paul et al., 2004) no study was interested in team virtuality. Studying virtuality impacts on team performance may allow achieving two objectives. On the one hand, it helps understanding of virtuality determinants and factors influencing its changing level. On the other hand, it may lead to discovering new links between virtuality and performance and thus, formulate relevant management practices of team performance management. Our study tries to reach these purposes and is interested in assessing the effects of virtuality level on team performance. The paper will be organized as follows. The second section presents the conceptual framework, which exposes a multidimensional approach to evaluate team virtuality and the measures adopted to evaluate team performance. The third section is dedicated to the presentation of the methodology used for the empirical study. We conducted a qualitative study based on the observation of virtual teams and the elaboration of in-depth interviews with their members. In the fourth section, we present and discuss the results of the empirical investigation. We conclude with the implications for theory and management and on limits and possible future extensions to enhance our results.

2 **CONCEPTUAL FRAMEWORK**

Although many studies have been interested in defining virtual teams and delimitating their main characteristics, little attention has been given to the concept of virtuality and its assessment methods. In a recent study by Kirkman and Mathieu (2005), team virtuality is apprehended through three dimensions: intensity of ICT use, informational value of these tools and synchronicity. We note that all these dimensions focalize on ICT, which raises the question of whether distance or ICT use is prevalent in the definition of virtual teams (Cascio, 2000; Chudoba et al., 2005; Larsen and McInerney, 2002). We think that virtuality derives from ICT use rather than distance. Indeed, we can find members who work in the same town or even in the same building but prefer communicating via e-mails (or other ICT) for the workflow needs and thus develop virtual relationships (Kirkman and Mathieu, 2005). That’s why we consider that virtuality is not automatically related to distance. However, distance is an important factor influencing communication needs and ICT use, as we will see in the paragraph dealing with virtuality antecedents.

Evaluating virtuality is an important step to a better understanding of how virtual teams work and what management practices they need. Indeed, different virtual team configurations resulting from varying virtuality levels generate specific processes and outcomes (Zaccaro and Bader, 2003). For example, virtual team members who have a short time to perform their work will develop coordination mechanisms that differ from those developed by teams that have a longer lifespan (Montoya-Weiss et al. 2001). Team performance is likewise influenced. Team results and processes and team members’ satisfaction depend on the tools used to communicate and coordinate work, on the distance between them, on cultural, organizational and professional diversity and on other features that can be used to evaluate team virtuality. These elements will be developed in the following section in order to draw a multidimensional approach of team virtuality. We will then explain the measures used in our empirical study to assess team performance. Propositions concerning the effects of team virtuality on performance will be formulated.

2.1 A multidimensional approach to evaluate team virtuality

Virtual team is considered as a recent concept introduced to managerial literature (Information systems, corporate strategy, human resource management, etc.). To understand this concept and to
better apprehend its facets, typologies were developed (Bell and Kozlowski, 2002; Cascio and Shurygailo, 2003; Dubé and Paré, 2002; Järvenpää and Leidner, 1999). All of these typologies suppose that virtual teams vary in a continuum with two extreme cases. On the one hand, pure virtual teams are characterised by a short lifespan, an extensive use of ICT to communicate and accomplish work tasks and by geographical distance between team members. On the other hand, traditional virtual teams have less permeable boundaries, a more stable lifespan, mixed communication modes (face-to-face and computer mediated communication) and less cultural diversity between members. These typologies suffer from the lack of integrative vision as they do not provide a global approach allowing different virtual team types to be identified. They describe the two extreme cases but tell nothing about the characteristics of other possible configurations. This is why an integrative approach is required (Chudoba et al. 2005). This idea of a virtuality model that identifies dimensions and antecedents of virtuality is developed in Kirkman and Mathieu (2005). Applying this model could make the evaluation of team virtuality and the identification of appropriate management practices possible. We will use this model in our research but we will introduce two modifications. First, we shall extend the list of virtuality antecedents to add those considered relevant to virtual team literature but not integrated by the authors. Second, we will modify a proposition of this model concerning the effect of one dimension of virtuality on its level.

The dimensions of virtuality developed by the model are: intensity of use of ICT, informational value and synchronicity. The determinants affecting these dimensions and leading to different virtuality levels are: distance, number of boundaries crossed, team size, past shared work experience, members’ ICT skills, ICT availability, task complexity, team lifespan and life cycle.

2.1.1 Virtuality dimensions

Assuming that one of the key characteristics of virtual teams is their reliance on ICT, we shall build our model on this feature with the idea that virtuality levels change according to the extent of ICT use, the informational value of these ICT and the synchronicity of exchanges between members. First, the extent of reliance on ICT is generated by impossible or difficult face-to-face meetings. It traduces the use of a large panel of ICT including e-mails, videoconferencing, groupwares, decision support systems, etc. Thus, the extent of use of ICT is concerned with the frequency of use of communication tools and the combined proportions of electronic versus face-to-face communication. A higher proportion of face-to-face meetings characterises traditional virtual teams, whereas an extensive use of virtual tools characterises pure virtual teams (Bell and Kozlowski, 2002; Dubé and Paré, 2002; Jawadi et al., 2007). Although these two types exist in reality, dominant virtual teams combine both modes of communication in different proportions (Poltrock and Engelbeck, 1999). According to Kirkman and Mathieu (2005), the higher the use of ICT by virtual team members, the higher the virtuality of the team is. It means that team virtuality increases as face-to-face communication between team members decreases. In formulating this hypothesis, the authors clearly compare face-to-face to ICT communication and deal with the contribution of each mode to creating a shared work experience and a social context facilitating task execution and performance achievement. We do not agree with the authors concerning this assumption. We think that it may be true when comparing ICT to face-to-face communication. However, when virtual teams only or extensively use ICT (which is the case of most virtual teams), we think that their intensive use contributes to reducing their virtuality. In this case virtual team members will multiply and diversify the tools they use to build a shared context and will set accepted working norms and behavioural rules that will guide team functioning.

These efforts aim at creating a rich work situation designed to replicate the parameters of face-to-face situation. The extent of reliance on ICT is not about comparing face-to-face to electronic communication but rather about the frequency and intensity of interactions through either means. Frequent and regular communications facilitate information exchanges, help establishing shared work and behavioural norms, and enhance team performance. In this regard, virtuality is also related to social and human issues in addition to technological and communicational issues. Given these developments, we assume that an extensive use of ICT contributes to reducing virtuality level.
Second, informational value related to the virtual tools used is identified as an important dimension of virtuality. It refers to the ability of ICT to deliver information that enhances team effectiveness (Kirkman and Mathieu, 2005). The informational value of communication tools is derived from the media richness theory (Daft and Lengel, 1986; Daft et al., 1987) but is much broader. It is related to the extent to which information exchanged through ICT is relevant to work tasks and whether it helps to execute them effectively. Information value expresses how suitable the virtual tools used are to the work to be accomplished even if they are considered as lean media. For example, e-mailing, considered as lean media (Majchrzak et al., 2004), may be more suitable to analytic tasks than videoconferencing that is higher in information richness. This means that the relevance of virtual tools to task accomplishment is not related to their characteristics and ability to deliver an important amount of rich information. Instead, it is related to their consistent use by team members in order to adapt to the work situation and to find some help in reaching the fixed performance objectives (Majchrzak et al., 2000). Informational value is negatively related to team virtuality; which means that virtuality decreases when ICT informational value increase.

The third dimension of virtuality concerns the synchronicity of exchanges, which refers to the time lags that may exist in communications. Exchanges are qualified as synchronous if they occur in real time and as asynchronous if they imply time lags. It depends on the media used and has several impacts on communication processes. However, results concerning the effects of synchronicity are divergent (Bordia, 1997; Benbunan-Fich et al. 2002). Some studies comparing face-to-face to computer-mediated-communication (CMC) found that the first mode generates more effective processes than CMC. Other studies reveal that CMC provide features (such as anonymity) that favour negative behaviours. Concerning team virtuality, we believe that asynchronous exchanges create higher virtuality as they eliminate immediate feedback and thus foster distance between team members.

2.1.2 Virtuality antecedents

To evaluate team virtuality levels, one must consider the effects of virtuality antecedents on its dimensions. These antecedents may be regrouped into three categories: contextual features, compatibility between task, members and technologies, and temporal dynamics (Kirkman and Mathieu, 2005).

The first category encompasses distance, team size, and past-shared experience (Bell and Kozlowski, 2002; Dubé and Paré, 2002). Distance can be evaluated through the number of geographical, organizational and professional boundaries crossed by the team. It generates cultural diversity considered as an important challenge for virtual team managers. It also implies temporal distribution, which may hinder interaction and communication processes as it results in asynchronous exchanges. Team size increases team virtuality when the number of participants increases. Indeed, large teams face serious difficulties related to travel costs and their availability to organize face-to-face meetings including all team members. That’s why members will rely more on ICT to communicate and coordinate work. However, the effect of this factor can be moderated by the proportion of collocated team members who will privilege richer media such as the face-to-face mode and reduce their use of virtual tools. The last contextual feature that influences team virtuality is prior shared work experience. Team members who are working together for the first time will increase their use of ICT to gather information about work and also information allowing them to form perceptions and evaluate behaviours. Accordingly, virtual relationships are built between members and team virtuality is increased (Aubert and Kelsey, 2003).

The second category of virtuality determinants includes the compatibility between task characteristics, individual skills and technology (Kirkman and Mathieu, 2005). It refers to the compatibility that may exist between the complexity of the work tasks, the technology available to accomplish them, and the ability of the members to use these technologies. High complexity tasks generate high interdependence between team members, which requires adapted communication tools (Avolio et al., 2001; Majchrzak et al., 2000). The ICT used must then provide quick feedback and fluid workflow facilitating collaboration and work coordination (Montoya-Weiss et al., 2001). On the other hand, perceptions of the ability to use ICT are derived from perceived computer self-efficacy (Bandura, 1982). People
forming positive perceptions of their ability to use ICT will have a favourable attitude toward these technologies. Thus, ICT use increases as perceptions of ability to use ICT increase. Thus, virtuality increases as task complexity, availability of virtual tools and skills developed by team members to use them increase, which in turn increases intensity of ICT use.

The third antecedent influencing team virtuality is temporal dynamics, which includes team lifespan and team life cycle. The first determines the time available to execute the work and it distinguishes traditional virtual teams from pure virtual teams. The latter indicates different stages of virtual team life that define different needs of interaction and communication. According to the forming, storming, norming, performing, and adjourning model of Tuckman and Jensen (1977), needs for communication in virtual teams are more important during the three first steps (Zaccaro and Bader, 2003). Members will increase and diversify their use of ICT to gather sufficient information about work and other team members, which in turn decreases team virtuality (Bélanger et al., 2002; Hertel et al., 2005).

2.2 Virtual teams performance

Team performance can be evaluated through different measures regarding either the team or the individual level (Hardin et al., 2006). In this study, we are interested in both levels when evaluating team processes, output quality, and team members’ satisfaction. This paragraph explains each measure and identifies how it changes with team virtuality.

Team processes encompass decision-making, relationship building, leadership, activities planning, problems and conflict resolution, and consensus level (Kayworth and Leidner, 2001-2001). To achieve team performance, team processes have to be set. Team members have to establish rules, which will guide their actions and behaviours and help them to facilitate work accomplishment effectively. High performance is reached through high quality decision making processes, trusty and cooperative relationships, dynamic and positive leadership, effective coordination mechanisms for planning and executing tasks, collaborative management conflicts, and high consensus between members (Järvenpää et al., 1998; Lurey et Raisinghani, 2001; Paul et al., 2004).

Fluid and effective team processes are based on frequent and high quality interaction between team members. Indeed, establishing effective management mechanisms (coordination, conflict resolution, decision making, etc.) may be reached through high levels of consensus, which are based on ideas exchanges, frequent communication, and regular feedback (Maznevski and Chudoba, 2000; Montoya-Weiss et al., 2001). This can be achieved regardless of communication modes. It means that face-to-face or CMC generate the same team dynamics and processes if they have the same frequency and deliver the same information quality. Expressed differently, this means that what most matters is not the communication mode used but the intensity of communication and the relevance of the information exchanged to work execution. This leads to an extensive use of ICT and a high informational value associated to these tools and decreases team virtuality. Hence, we believe that:

**Proposition 1:** Low team virtuality level leads to effective team processes.

The second performance measure included in our framework concerns output quality. This variable results from effective team processes. High quality work output results from the respect of the established schedule, deadlines and fixed objectives and is also derived from clear goals and task distribution. It is influenced by a greater implication and participation from team members and by the contributions of each one to the collective final work and also by effective coordination mechanisms. We think that low virtuality positively influences work quality. If members use appropriate ICT to accomplish work activities (even extensively) and if these tools have a high informational value leading to work improvement, even with asynchronous tools, the results are expected to be satisfying and to correspond to fixed quality criteria. That’s why we think that:

**Proposition 2:** High output quality is related to low team virtuality levels.

Members’ satisfaction is assessed through their satisfaction with the output quality and team processes. It also can be seen through relationship building mechanisms and through the implication and participation to work achievement. For example, problems and conflictual climates may generate distrust between team members and degrade their relations. This also influences the participation to
work achievement that inhibits the members’ implications and interest in the team. Output quality also affects team members’ satisfaction. When work is perceived as having high quality and as being coherent with the requirements, team members will have greater satisfaction with their work and with their teams and greater motivation to continue to work together. They will appreciate collaboration and will be able to work with the same members in the future. However, if team members are disappointed with the results of their work, this will damage their relationship and will not encourage them to renew collaboration in the same team.

Concerning the possible effects of virtuality on team members’ satisfaction, we think that intensive use of ICT, high informational value and exchange synchronicity are related to a high degree of member satisfaction. What makes a difference in the members’ satisfaction is the setting of norms and rules of regular communication, consistent feedback, mutual work adjustment and the respect of these norms and rules by all members. This may ensure a high quality work output and process losses can be reduced through communication, exchanges of relevant information and regular feedback decreasing the virtuality level. These developments lead to the following proposition:

**Proposition 3:** Members’ satisfaction is associated to low team virtuality levels.

Our conceptual framework can be represented by the following figure:

![Conceptual Framework](image)

### 3 METHOD

We observed 6 virtual teams over a period of 5 months: 3 months for intensive observation and collection followed by 2 months of in-depth interviews with team members. Data was collected from different sources: communications logs, interviews, e-mails exchanged, observation and a questionnaire. Qualitative and quantitative methods were adopted to analyse this data.

3.1 **Sample**

The virtual teams we observed were composed of four graduate students attending on-line courses at a French university to obtain a master’s degree. This kind of studies is especially dedicated to people who want to have a high degree but who cannot attend ordinary classes because they have professional obligations. Therefore, all the team members in our study were professionals and worked besides studying. These courses are also accessible to any individual whatever his localization. That’s why some of the teams studied were global and included members out of France. This implies that face-to-face meetings were impossible or difficult to hold (because of professional occupation and physical separation) and that team members had to rely on ICT to communicate and accomplish work. Another characteristic of these studies is that most courses are teamwork based. Students have to be organized into teams to do their homework.

We decided to intervene in the “Strategy and Organization” course which is supervised by one of the co-authors of this paper. In this course, students have to do a collective case study that is evaluated and which makes up for 50% of the global course mark.

As all courses in this degree are on-line, students have access to an advanced technological web-based platform containing communication tools (forums, chat rooms, e-mails), collaborative tools to
understand lessons, etc. Through this WebCT, students may attend their lessons, interact with each other and with their teachers, ask questions about their lessons, and accomplish work tasks. The teams observed were constituted through calls for participation posted on the forum to form a new team or to join two or three members who knew each other and who needed a third or fourth member to constitute the team.

3.2 Data collection

We collected data from two main sources: observation and interviews. Team observation allow as to collect 379 e-mails exchanged between team members. We used these e-mails, messages posted on the forum and communications logs. We used this data to assess team virtuality as the combination of three dimensions explained above (extent of use of ICT, informational value, and synchronicity of interactions). We also used the information from this source to assess some determinants of team virtuality such as perceived task complexity by team members, team lifespan and life cycle and team members’ virtual skills.

The second source used to collect data is the interviews that were conducted after task completion. Eleven participants answered our requests for interviews, which were registered, and transcripted to facilitate analysis. The information gathered from interviews provided assessments of performance variables. Participants were asked questions about their teams’ processes (leadership, coordination mechanisms, tasks scheduling, relationship building), and if they were satisfied with the virtual work in their teams concerning output quality and team dynamics. They were also used to evaluate technology use by team members, the styles of conflict management developed in the teams and the virtual skills of team members.

The teams’ observation and questionnaires provided additional information about the team virtuality level and also performance measures. In addition to demographic characteristics (age, gender, and professional profile) questionnaires asked participants about their localisations during task accomplishment, about the tools they used to coordinate work, their use intensity and their perceptions of group dynamics and processes. To measure performance, we also used the grades obtained from the professor’s evaluation of the final work.

3.3 Analysis

All data was coded and analysed after task completion. Different measures were used for team virtuality and performance. On one hand, team virtuality was assessed through its dimensions. We used data collected both from e-mails and interviews coded to evaluate the members' extent of use of ICT, the informational value of virtual tools used, and exchanges synchronicity. More specifically, we calculated the number of messages exchanged, the number of electronic tools used versus the number of face-to-face meetings. In addition we organized messages according to their relevance for task effectiveness to evaluate their informational value. For this purpose messages were coded into task oriented or personal oriented messages. We also evaluated the lags between communication initiations and answers to assess the team members' reactivity and exchanges synchronicity.

On the other hand, performance was measured through two methods. First, output quality was measured through the mark obtained from the supervisor's evaluation, which expresses a conformity degree to task requirements. Team processes and members' satisfaction were assessed through members' perceptions collected from interviews and observation. We pay a particular attention to problems that appeared and to their resolution modes and their effects on the teams' climate and relationships. We also consider interaction styles adopted by participants to assess their participation and their reactivity to teamwork.

4 RESULTS AND DISCUSSION

To better understand how virtuality affects team performance, we may use the evaluation of virtuality dimensions and the influence of virtuality antecedents. Applying this method, we divide our sample into high level virtuality teams and low level virtuality teams and find 2 high virtuality teams and 4 low virtuality teams, as described in the following table.
Teams | Distance | Team size | Past shared work experience | Communication tools used and their frequency use | Virtuality level
--- | --- | --- | --- | --- | ---
**Team A** | Global (Russia, France, South Africa, Netherlands) | 4 then 3 | Low | e-mail: 80 chat rooms: often skype: often | Low
**Team B** | Local (Different towns in France) | 4 then 2 | Low | e-mail: 18 phone call: rarely skype: rarely | High
**Team C** | Global (Ghana and different towns in France) | 4 | Low | e-mail: 52 chat rooms: often skype: often face-to-face: 1 | Low
**Team D** | Global (Estonia and different towns in France) | 4 | High | e-mail: 48 skype: often collaborative tool: Google Writely | Low
**Team E** | Local (Different towns in France) | 4 | High | e-mail: 91 skype: often face-to-face: 2 chat rooms: often | Low
**Team F** | Global (Cambodia and different towns in France) | 4 | Low | e-mail: 90 phone call: rarely | High

Table 1. **Virtuality evaluation**

Then, we assess performance variables of these two categories and try to find links between virtuality levels and performance levels. The following table describes the measures used to evaluate performance.

<table>
<thead>
<tr>
<th>Teams</th>
<th>Output quality (mark obtained)</th>
<th>Member satisfaction</th>
<th>Team processes</th>
<th>Performance level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Team A</strong></td>
<td>13/20</td>
<td>High</td>
<td>Effective</td>
<td>High</td>
</tr>
<tr>
<td><strong>Team B</strong></td>
<td>12.5/20</td>
<td>Low</td>
<td>Ineffective</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Team C</strong></td>
<td>13/20</td>
<td>High</td>
<td>Effective</td>
<td>High</td>
</tr>
<tr>
<td><strong>Team D</strong></td>
<td>16/20</td>
<td>High</td>
<td>Effective</td>
<td>High</td>
</tr>
<tr>
<td><strong>Team E</strong></td>
<td>15/20</td>
<td>High</td>
<td>Effective</td>
<td>High</td>
</tr>
<tr>
<td><strong>Team F</strong></td>
<td>14/20</td>
<td>Low</td>
<td>Ineffective</td>
<td>Low</td>
</tr>
</tbody>
</table>

Table 2. **Performance evaluation**

4.1 Performance in high virtuality teams

Teams B and F have a high virtuality level. The media used by these teams were limited to e-mails with occasional conference calls (team F) and chat discussions (team B). Although team F exchanged 90 mails, this was not enough to classify it as a low virtuality team for several reasons. F team members did not diversify communication tools. They relied only on e-mails. Although e-mailing can
be considered as an appropriate means for this task, is has poorer content than chat or real time conference calls. It also implies a time lag between initiations and answers and this is precisely what happened to team F. Members of this team had highly asynchronous exchanges as they did not give immediate answers to a question or to a remark formulated by another member. This lag sometimes reached one week. In addition, this team had a member located outside France, which increased the diversity of the team and the difference in temporal distribution. For both teams, virtuality was accentuated by professional and geographical distance between members. They were also working together for the first time. So, they did not have enough information to form perceptions about the behaviours and work habits of each other. Their interactions were also work focused.

Globally, we consider teams B and F as high virtuality level teams because they only—though not frequently—relied on e-mails with high exchange synchronicity, important geographical and professional distance and without any prior shared work experience. What were the effects on the performance of these teams?

Although all teams had a good mark and respected deadlines for work accomplishment, high virtuality teams were less effective on team processes and members’ satisfaction than low virtuality teams. This can be seen through the members’ participation in the elaboration of case studies, in team leadership, and in conflict management. Team B and F had passive members who did not participate actively in the work done and who rarely sent e-mails or answered other members’ initiations. These passive members relied on the active ones to do their share of the work and gave different excuses such as being in different time zones or having professional work surcharge to justify their behaviours. These attitudes generated two types of consequences. On the one hand, team B, which had begun the task with 4 members, finished it with two members only. The two passive members left the team without informing other members. They did not answer to the different raises of the team leader and they did not reply to her request for explanations either. As a result, the relationships between the leaders and these members degraded and a negative climate was established.

On the other hand, team F experienced serious conflicts, which have not been well managed. Problems had been ignored for a long period and as a result, team members ended up sending each other angry messages and behaving hatefully. Although these problems occurred right from the beginning of the project, team members continued to work together because they were worried about the results of their work evaluation. Relations grew colder and colder, characterized by an atmosphere of distrust, and exchanges were limited to the tasks and their execution.

Another important team process concerns leadership. These two teams experienced different types of leadership. Team B had an active leader with no follower (because of inactive members). She tried to make suggestions about task repartition and activity scheduling so as to organize work but her e-mails remained unanswered. Team F had a negative and destructive leader who contributed to the degradation of relationships, and as a result of his demotivating comments on the contribution of each member and of his destructive style of conflict management, distrust escalated. He was even perceived as the source of the problems in the team1.

Concerning the satisfaction with the project experience, interviews revealed that they were satisfied with the quality of the work done but not with their relations with some members or with some members’ behaviours. Members interviewed believed that they would not be willing to work with the same persons in the future. To some extent, this was due to the presence of passive members and to the negative leadership they had experienced.

4.2 Performance in low virtuality teams

Team A, C, D and E are considered as having a low virtuality level for several reasons. They exchanged an important number of e-mails (a total of 271 e-mails). In addition to e-mails, chat rooms and conference calls, each team had an additional communication tool. Team A relied extensively on Skype and phone calls. Members of team D used a collaborative tool to communicate and to

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1 Members of this team reported that their leader creates problems with his destructive style and inappropriate remarks. We do not include verbatim as there are in French language and we are not sure to conserve their real meanings when translating them.
accomplish work (Google Writely). They also relied heavily on Skype. Team E and C held face-to-face meetings. Although most of the work was done through e-mails, other means were also used. Thus, low virtuality teams combined several means of communication with different level of richness (from face-to-face to e-mail). This contributed to increasing the amount of information exchanged, either in relation to work or to behaviours, work habits and their value for task effectiveness. It also helped team members avoid the disadvantages of the effects of asynchronous exchanges by ensuring frequent and quick feedback. Geographical distance differed from one team to another. Except team E that was composed of one member located in France, all the other teams (A, C, and D) were global and included at least one member located abroad. Distance was reduced through the combination of rich and lean media and thanks to frequent and regular interactions.

Unlike the members of team A who had been working together for the first time, the members of teams C, D and E benefited from a past shared work experience. Members of these teams collaborated in other courses. Thus, they already knew each other and had a clear idea of their competences, behaviours and work habits.

We note that the low virtuality of these teams may be associated with a high performance. Indeed, all these teams got a good evaluation mark; they had developed effective processes and reached a high degree of satisfaction among their members. The good marks obtained give an idea about the overall output quality, logically resulting from the respect of the objectives and evaluation norms. This level was reached through an early repartition of tasks and through the clarification of the role assigned to each member. The members of these teams also elaborated a task progression planning and respected the deadlines.

This also led to an active participation of all team members who actively took part to work execution. Regular and frequent call conferences were held with the participation of all members and members who could not attend provided a notification of absence in due time. In this case, attending members prepared a summary of the situation to inform the absentees on the evolution of the work.

A dynamic and positive leadership characterized the low virtuality teams. In team A, leadership was emergent. One member played the following roles and functions: task distribution, work coordination and coherence, work control and motivation of other members. In team D, the leadership was shared between all members. As they worked together in other courses, leaders emerged according to their field of expertise. So, leaders changed from one course to another. For team C and E, leaders were designed and perceived as positive, skilful, motivating, and dynamic. They played all the leadership roles by coordinating and clarifying the tasks’ goals and requirements.

All low virtuality team members were satisfied with this experience of virtual work and would be glad and willing to collaborate together in the future. They perceived their experience as enriching and have learnt a lot from it. We note that there was only one member of team E who was not satisfied with his leader. He estimated that she was not clear enough and that she did not facilitate his work. This result may be explained through the fact that this member wanted to be the leader, although other members did not choose him.

None of these teams ever experienced any kind of problems or conflicts. The members had established trusty and cooperative relationships based on frequent discussions, respecting each member’s obligations and execution of the requisite work. This climate was favourable to a high performance level and helped team members build effective dynamics and work relations.

These results give more insights to our propositions. Proposition 1 and 3 are confirmed. On the one hand, low virtuality teams build effective processes and reach high member satisfaction through frequent communication, quick feedback and the diversification of communication tools. On the other hand, high virtuality teams failed to attain effective processes that would have helped them reach a high members’ satisfaction and effective dynamics. Nevertheless, proposition 2 cannot be validated with regards to our data. Output quality is not positively influenced by virtuality level as all the teams studied (whether high or low virtuality ones) obtained a good mark. Yet, these results have to be comforted by other studies, as we are not able to confirm the nature of the relation between output quality and team virtuality from the data that we collected.
5 CONCLUSION

In this paper, we tried to analyse the effects of team virtuality on performance variables. We elaborated a theoretical approach to evaluate team virtuality by selecting precise performance variables serving our interests. Virtuality may be evaluated through the extent of use of ICT, its informational value, and through the synchronicity of exchanges. Performance was apprehended through outcomes variables, team processes and members’ satisfaction. We tested our propositions on 6 virtual teams of graduate students involved in on-line master degrees in a French university. Our results show that although output quality cannot be associated with virtuality level, other performance measures depend on team virtuality. Low virtuality teams developed effective processes (leadership, work scheduling and coordination, members’ participation) and had their members satisfied either with their results or with the team dynamics. However, high virtuality is associated with lower members’ satisfaction and ineffective team processes. The members of these teams experienced inactive participants, conflictual climate, and degraded relationships (Järvenpää et al., 1998; Majchzrak et al. 2004; Ortiz de Guinea et al., 2005).

5.1 Theoretical and managerial implications

Our study has theoretical and managerial implications. On the theoretical side, we were interested in defining and identifying dimensions and antecedents of team virtuality. We adopted a multidimensional approach developed by Kirkman and Mathieu (2005). With regard to this definition, virtuality levels are derived from ICT use. In addition, we think that virtuality is also related the ability of team members to overcome spatial constraints by building a shared social context and accepted norms through technology use. Accordingly, we think that intensive and regular communications, either face-to-face or mediated, contribute to decrease team virtuality.

We also conducted the first study on virtuality and performance links. We discovered a new variable, which can shape team performance. Combinations of virtuality antecedents generate different levels of virtuality, which differently influence team performance. Consistent with our definition of virtuality, we find that low virtuality is associated with high performance whereas high virtuality generates ineffective results and processes. In this respect, our study constitutes a first step and need to be confirmed in other contexts.

On the managerial side, our results put an emphasis on ICT importance in virtual teams. Virtual team managers have to pay a particular attention to ICT issues. As high performance teams have a low virtuality levels, managers have to ensure ICT availability and facilitate their access to team members. They also have to check their effective use by team members. Besides, as frequent interactions, reduces team virtuality, virtual team managers have to establish communication routines that favour regular meetings, consistent and immediate feedback, and constructive interaction style. Team members must accept and respect team norms and values.

Our study reveals the importance of e-leaders role in performance management. E-leaders have to be well trained to be able to cope with a virtual environment. They have to develop virtual skills allowing them to lead positively, dynamically and in motivating way (Kayworth and Leidner, 2000-2001; Zaccaro and Bader, 2003).

5.2 Limits and future extensions

Some limits related to this study should be noted. On the methodological side, we conducted a qualitative study with only 6 virtual teams. This method may be suitable for the exploratory study that we conducted. However, for future extensions, a quantitative approach may help confirm our results. A survey on a larger sample of virtual teams members may be appropriated to evaluate impacts of team virtuality on performance.

In addition, some variables not included in our study may very well be significant performance variables. For example, cultural diversity may considerably influence performance outcomes but this was not analysed because of its irrelevance to our context. Indeed, although some teams were global, their members shared the French culture and its values. In different contexts, cultural diversity may have to be taken into account to evaluate team performance (Järvenpää and Leidner, 1999).
addition, as our propositions were tested in an educational context, the results may differ in a professional context. That’s why a validation in a professional context is required to generalize our results.

References


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