

[Article]

# Role of the Process Model in Aligning Mental Models in Global Virtual Teams

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## INTRODUCTION

The use of global virtual teams (GVTs) is becoming quite common due to the rapid globalization of businesses and the advancements of information and communication technology (Klitmøller & Luring, 2013; Mattarelli, Tagliaventi, Carli, & Gupta, 2017; Oertig & Buerger, 2006). It is more relevant today than ever as the threat of COVID-19 keeps spreading across the globe (Ciolfi, Gray, de Carvalho, 2020; Ferreira, Cerejeira, & Portela, 2020).

However, forming and maintaining GVTs remain difficult for organizations because communication and coordination between geographically dispersed members pertaining to sub-teams of GVTs are quite challenging. One of the main reasons behind this difficulty is that frequent face-to-face communications between all members is not feasible, which is still sought-after by many members in teams (Ryssen & Godar, 2000; Stolovitsky, 2012). Others have highlighted additional reasons such as language barriers, cross-cultural issues, and the lack of opportunities for developing interpersonal relationships (Cramton & Hinds, 2014; Hinds, Neeley, & Cramton, 2014). Hence, gaps tend to develop and grow in such teams (Polzer, Crisp, Jarvenpaa, & Kim, 2006).

In the literature on GVTs, language barriers and cross-cultural issues are frequently dis-

cussed as the main causes of misunderstandings and gaps among members of GVTs leading to a hindrance in performance (Klitmøller & Luring, 2013; Tenzer & Pudelko, 2016; Zakaria, 2016). These suggest that it is important for GVTs to have competency in the common language and understand the cultural backgrounds of other members. Others hint at the importance of GVTs to have in place a team mental model (TMM) that would enable them to work cohesively and collectively (Maynard & Gilson, 2014). Several studies on teams and management of product-development projects indicate a positive relationship between a shared TMM and team performance (Cooke, Kiekel, & Helm, 2001; Ellis, 2006; Espinosa, Slaughter, Kraut, & Herbsleb, 2007; Mohammed, Ferzandi, & Hamilton, 2010). Development of TMMs in GVTs, however, seems counterintuitive because of the geographic dispersion of team members. In addition, GVTs are typically formed in knowledge-based environments, where there is a high degree of autonomy. This means, antecedents and processes of TMM development that works in command-and-control teams (Klimoski & Mohammed, 1994) do not hold effective.

In this concept paper, we review the extant literature of TMMs to identify antecedents and their applicability to GVTs, and highlight the limited applicability of the present antecedents of TMMs to GVT environments. We conjecture

that the process model (PM) that reflects the life cycle of a project would play an important role as an antecedent in TMM development. Along this line of thought we provide theoretical propositions and suggest methods for testing these propositions.

## LITERATURE REVIEW

### Global Virtual Teams (GVTs)

Virtual teams refer to work arrangements where team members are geographically dispersed, have limited in-person interactions, and work interdependently through the use of electronic communication media to achieve common goal(s) (Cagiltay, Bichelmeyer, & Akilli, 2015; Dulebohn & Hoch, 2017; Gibson & Gibbs, 2006; Hertel, Geister, & Konradt, 2005). GVTs have other distinctive characters: members are always from different national, cultural, and language backgrounds and the teams typically comprise of multiple organizations in pursuit of a knowledge-seeking endeavor with extreme time constraints (Cagiltay *et al.*, 2015; Gibson, Huang, Kirkman, & Shapiro, 2014; Oertig & Buergi, 2006).

Although the number of studies on GVTs has increased in the recent years, we still know very little about why gaps between sub-teams are opened and how they can be closed in GVTs, especially in interorganizational team environments. Indeed, in their literature review, Gilson *et al.* (2015) pointed out that there is a lack of empirical as well as theoretical studies on sub-team relations in GVTs.

### Team Mental Models and Antecedents

Mental models are defined as the hypothetical representations of reality based on the holder's experiences, which play important roles when the holder recognizes things and makes decisions about how to treat the objects/entities perceived (Craik, 1967; Gentner & Stevens,

1983; Johnson-Laird, 1983). Klimoski and Mohammed (1994) developed the concept of a team mental model (TMM) that is shared within a team. According to them, each member in a team potentially holds his or her own mental model related to the working environment and business processes/practices. Hence, if a well-established TMM can be shared effectively within a team, the team processes and performance will improve.

Research shows that TMMs enable teams to operate seamlessly and make enhanced decisions even in complex, dynamic, and uncertain environments without hindering performance. Therefore, TMMs are antecedents of effective team processes and performance (Klimoski & Mohammed, 1994; Kraiger & Wenzel, 1997; Rentsch & Hall, 1994). Several studies on teams and management of product-development projects clearly indicate a positive relationship between a shared TMM and team performance and cohesiveness (Cooke *et al.*, 2001; Ellis, 2006; Espinosa *et al.*, 2007; Lagerström & Andersson, 2003; Lim & Klein, 2006; Mohammed *et al.*, 2010; Rentsch & Klimoski, 2001).

With regard to antecedents of TMMs, some researchers have suggested similarity of age, gender, educational background, nationality and mother tongue (Fisher, Bell, Dierdorff, & Belohlav, 2012; Rentsch & Klimoski, 2001) in terms of team compositional attributes. Other works proposed turnover of members within a team (Moreland, 2000) and communication media (Hollingshead, 1998) as important antecedents of TMMs. Fisher *et al.* (2012) proposed that team composition in terms of personality facets of cooperation and trust would be positively related to the TMM. They also indicated that implicit coordination of the team processes would mediate the relationship between team-focused TMM similarity and team performance (Fisher *et al.*, 2012).

Extant literature suggested some crucial an-

tecedents of TMMs. However, similarity of compositional attributes, even though are important for convergence of a TMM, can be unrealistic in GVT settings, where members from diverse backgrounds and personal characteristics come together to handle a project. Selection of an appropriate communication medium is of utmost importance for the establishment of a TMM, especially, in virtual teams, because in-person interactions are scarce, if not, absent. Other antecedents such as turnover, trust, and corporation may well prove to be outputs or by-products of a TMM. Hence, there is a lack of understanding about the essential antecedents of TMMs in GVTs, as well as TMMs in general for that matter. In addressing this, we propose the PM as one of the work-specific antecedents of a TMM.

*Proposition 1:* TMM is an essential component for a GVT in order to function effectively and smoothly.

### Process Models

Time is of the essence for virtual teams, which are usually formed between teams from multiple organizations across the globe. Organizations typically have unique business practices, work styles, work/process flows, and interactions that govern how they carry out projects and perform tasks. If these are divergent between members of a GVT, it is extremely difficult for virtual teams to act cohesively, in a limited time period, even if they share a common language, culture, educational background, and an effective communication medium.

The PM is defined as abstract representation of a product development process, focusing on how the major work is done during the project.

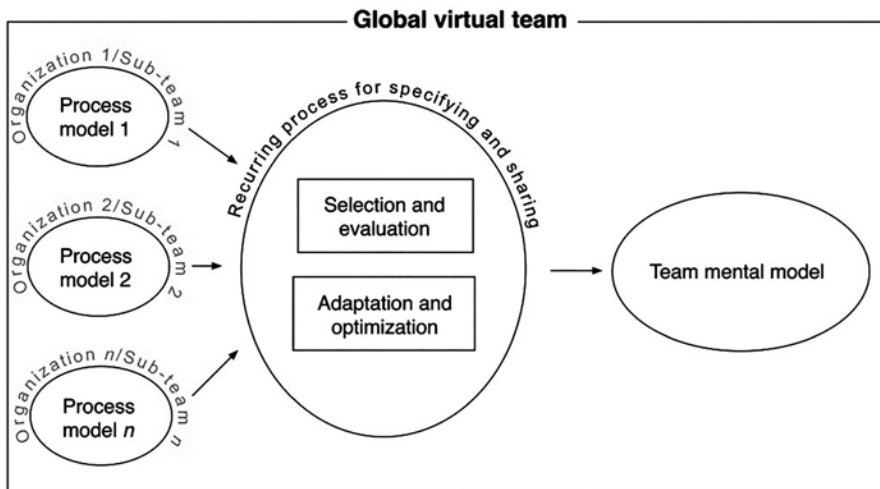
The PMs govern the information/communication flow, resource planning, inputs, outputs, and timing of certain activities during a project (Gnatz, Deubler, Meisinger, & Rausch, 2004; Sommerville, 2010). With respect to software development, an area where GVTs are prevalent with knowledge-seeking initiatives, Sommerville (2010) explains that the software development lifecycle (SDLC) can be divided into the several stages. Software PMs represent the activities of the SDLC and their flow within a project, although not all stages of the SDLC are necessarily employed in all PMs. Different PMs are used in the industry, each having their advantages and disadvantages. Hence, GVTs, especially those formed between different organizations may face difficulties in forming a TMM when sub-teams from different organizations make use of contradicting PMs. This becomes even more difficult because the concept of a PM is something that is abstractly practiced in knowledge-based environments but not explicitly apparent. The propositions of this study are visually summarized in Figure 1.

*Proposition 2:* PM is a crucial antecedent for developing a TMM in a GVT.

*Proposition 3:* The concept of a PM needs to be explicitly specified and shared from the outset in a GVT for a TMM to be formed using the PM as an antecedent.

*Proposition 4:* Explicitly specifying and sharing the concept of a PM will lead to a decrease in the time taken to form a TMM in a GVT.

Figure 1: Hypothesized model for developing a team mental model in global virtual teams. The recurring process for sharing and specifying may be guided by sub-team leaders or through a process of self-organization.



## DISCUSSION

For identifying the process through which the TMM is established and proving that the PM plays a critical role in the development of a TMM in GVTs in knowledge-based environments, we suggest two methods which complement each other. One is a qualitative field study and the other a lab experiment aimed at establishing the causal relationship(s).

### Qualitative Study

As the first method, we propose a qualitative study based on semi-structured open-ended interviews (Kreiner, Hollensbe, & Sheep, 2009), observations, and document analysis. This method enables the investigator to enhance the understanding regarding a matter of interest by asking a series of additional questions based on the answers provided by the informants. It also allows the informants to use their own terminology and experiences to bring up key concepts and issues that they find connected to the main questions, which would bring to surface new

perspectives of the phenomenon for further investigations. The observations and document analysis are aimed at triangulating the data and gaining further perspectives on what aspects to cover in the interviews.

For this study, approximately 10 GVTs from a variety of organizations operating across different industries will be randomly selected, and interviews will be conducted at individual as well as sub-team level. The team compositions, sub-team density, and locations will not be controlled, except for the language of communication (English) and a *main* common communication medium (video conferencing) because of the important roles they play for seamless operation in GVTs (Klitmøller & Lauring, 2013; Tenzer & Pudelko, 2016). A careful initial selection of the organizations and industries will allow the inclusion of GVTs that make use of PMs in their projects and those that do not. This aspect needs to be confirmed by contacting the managers of the virtual members. It is noted that even within the same industry, certain teams use different PMs. Ideally the sample would be equally

divided among these three categories of GVTs with sub-teams that typically make use of similar PMs, GVTs with sub-teams making use of different PMs, and those that do not utilize PMs. In addition, it is intended to select GVTs that have been formed recently, which would enable a time-dependent analysis of the teams based on three studies separated out by time intervals of 3 months. This selection process will enable the elucidation of the time-dependent processes involved in coming up with team-level solutions and work practices in relation to the project, i.e., whether the development of a TMM is facilitated by the PM as the backbone.

The initial study conducted at time  $T1$  will gauge the knowledge of the sub-teams related to the project, resources, team members, and work practices. Semi-structured interviews would include questions such as, 'How long have you been working in this industry, organization, or group?', 'What is the goal of the project?', 'Does your sub-team have the necessary capability to address the goal?', 'Do you think your virtual counterparts are essential for this project?', 'What aspects are your virtual counterparts good at?', 'How would your team go about dividing tasks?', etc.

At time  $T2$ , the second study will collect any updated information on the topics covered in the interview at time  $T1$ , in addition to problems, issues, and workarounds the geographically-distributed members have formed, if any. Questions in the first interview will be modified to obtain updated information, for examples, 'How long have you been working in this project?', 'What is the current progress level of the project?', 'How well do you know your virtual members?', 'Does the virtual members play a significant role in the project?', etc. In addition to these modified questions, the second interview will include questions such as 'Is communication between virtual sub-teams difficult?', 'How often do you communicate with the virtu-

al sub-teams?', 'How well distributed are the tasks among the sub-teams?', 'Do you think there are overlaps in tasks?', 'Do you think you need more information about the virtual sub-teams?', 'Do you think the virtual sub-teams can be used in a better way?', etc.

At time  $T3$ , the third study will collect updated information about the problems, issues, and workarounds together with team-level practices and agreements that have emerged since the second study to overcome the problems faced. Questions in the second interview will be modified to obtain updated information, while new questions such as 'Are the virtual sub-teams functioning well as a team?', 'If so, how long did it take for the virtual sub-teams to work cohesively as a team?', 'Were there any changes to the practices of your sub-team?', 'Did you realign certain tasks?', 'Did you make changes to the frequency of communication between virtual sub-teams?', 'Do you know what outputs are required from your virtual sub-teams?', 'Do you see some flow in the tasks of the project?', 'If so, did you perceive this flow from the beginning?', 'Do you know where the sub-teams fit in the work flow?', etc. These questions will enable the identification of differences between GVTs with sub-teams that make use of similar PMs, those that use different PMs, and those that do not use any PM.

The observations are scheduled in between time  $T1$  and  $T2$ ,  $T2$  and  $T3$ , and after  $T3$ . The frequency, type, and duration of observations will be thought out at a later stage after obtaining detailed information about the projects at time  $T1$ . Document analysis will consist of daily emails, project documents, and outputs produced by each sub-team at major milestones of the project. Document analysis will continue throughout the course of the data collection process.

We aim to follow a grounded-theory approach (Glaser & Strauss, 1967) to identifying what

role the PM played in the formation of team-level understandings, if any, and the processes through which this gets shared within and between subgroups. The main analysis points would align along how the sub-teams view their role within the team, how the sub-team members view the roles of other groups within the teams, the understanding about the fit among different roles, the knowledge about who (or sub-team) fits well for a particular task, the knowledge about communication check points and what outputs to produce, the amount of time it took for them to perceive these aspects at a sub-team level as well as GVT as a whole.

### Lab Experiment

The lab experiment will help understand how the sub-team members operating in a virtual setting develops a TMM and whether the PM is the key antecedent in a TMM (causality). This experiment requires the formation of several GVTs, and several observers who can monitor the within and between sub-team dynamics by being present at each geographically-distributed sub-team's location.

The GVTs formed for this experiment will be divided into two main categories: the treatment teams and control teams. Both categories of teams work on the same task aiming at the same goal. The members of the GVTs will comprise a variety of nationalities (more than three nationalities) but share the same language of communication, English. Five such teams will be formed. In the treatment category, there will be three teams, each using a different PM. This is to confirm that the causality, if any, holds true across different PMs. The set of both treatment and control GVTs will include the same number of members (15 members). Each GVT will have three sub-teams, each comprising 5 members. All sub-teams of GVTs will have the

same distribution of nationalities, genders, and age, similar/comparable language proficiency in English, and similar/comparable working knowledge relating to the assigned task. The team members will be randomly selected from a pool of undergraduate students from several universities, and subsequently assigned to each sub-team to conform to the aforementioned essential characteristics of the sub-teams.

In addition, care will be given to form a sub-team with members who share similar skills or interests to a certain extent (but still maintain a good mix) in a particular aspect of project work, for example, business analysis, design, implementation, or testing. This is to mimic the real-world characteristics of virtual teams, which are formed between sub-teams that do not necessarily carry the same level of expertise in all areas, but are formed to complement each other and work together unitedly in a project. For experimental convenience, the virtual sub-teams of the GVT will be located at different geographically separated locations within a university facility and will have access to ICT infrastructure (video conferencing) to get in contact with the sub-teams depending on their requirements.

Each sub-team will be informed about the task contents, deadline, goals, and the team members, i.e., the other two sub-teams of the GVT. Prior to providing this information, the members of each sub-team will have time to get to know each other in the co-located sub-team. The sub-teams in the treatment teams will be also informed on how to plan the intermediate tasks, a workflow pattern, timing and frequency of communications between sub-teams, outputs to produce prior to these communications, who knows what information, who has what skills, etc., i.e., they will be informed in detail about the concepts of the specific PM assigned to the team and team-critical information that would be essential for establishing a team-level mental

model using the PM. The control team will differ only in the fact that they have no information related to a PM. The three teams will work on solving a specific problem related to computer science, where they will analyze, design, develop, and test a computer program within the allocated time period, for instance, 6 hours.

Each observer will observe a single sub-team and provide feedback to the principal investigator at the end of the day. The observers will be given instructions to monitor activities of each member of the sub-team, sub-team interactions, between sub-team interactions and frequencies, communication problems, misunderstandings, overlaps in task handling, solutions, with whose support and how they found solutions to the issues and problems within the team, etc. The observers of the treatment teams will not be informed about the PMs in order not to bias how they perceive the interactions of the sub-team he/she is assigned.

On the following day of the task, a follow-up interview of each team (all three sub-teams together) will be conducted to get their views and thoughts about the problems they faced, workarounds they devised, and other possible solutions to any problems they faced. The principal investigator will ask two types of questions: general questions regarding how they proceeded with the task and specific questions based on the notes of the observers. The general questions would include, "What did you do first (next) for accomplishing the given task?, What did you understand about your team members' roles?, and "What did you do when you encountered miscommunications or difficulties?, etc. These questions will help the investigator to understand and perceive any differences between the treatment and control groups with regards to how they proceeded with the project, communication styles, task distributions, decision-making, etc. This would, in addition, provide a way to confirm the observations made by

individual observers and link their observations of individual sub-teams to a team-level view. The specific questions, which are based on the observer's notes, will be asked to confirm whether the observer interpreted the context and interactions correctly and also get additional perspectives from the sub-team members about specific topics of interest noted by the observer.

Based on the findings, the investigator would be able discern whether there is a positive relationship between having access to the notion of a PM and the formation of a TMM, leading to a cohesive team successfully completing the task within the given time period. The experiments can also hint on how (the processes) GVTs with sub-teams having the concept of a PM adjust their sub-team practices and inter-group interactions to conform to a team-level standard through time. However, understanding the detailed workings driving this convergence process is one of the main purposes of the qualitative study. If, however, no significant differences are observed among the three types of GVTs, i.e., there is no positive relationship between a PM and a TMM, it would still be interesting to see why and how the GVTs with sub-teams without the notion of a PM self-organizes themselves within a limited time frame to work cohesively as a team.

## CONCLUSION

The extant literature of TMMs suggested crucial antecedents of TMMs, such as similarity of compositional attributes, selection of an appropriate communication medium, turnover, trust, and corporation. However, these antecedents can be unrealistic in GVT settings or may well prove to be outputs or byproducts of a TMM. We proposed the PM as one of the work-specific antecedents of a TMM, which is crucial in guiding the project activities and in

turn aligning the mental models of sub-teams in GVTs in a timely fashion.

In testing our propositions, we suggested two types of studies: a qualitative study and a lab experiment. The qualitative study will help identify the role of the PM in the formation of team-level understandings, and the processes through which this gets shared within and between sub-teams. The lab experiment, on the other hand, will contribute to the in-depth understanding of how the sub-team members in a virtual setting develop a TMM, and whether the PM would ideally guide this process. The analysis of the results of these two studies will surely lead to a deeper understanding of how a TMM is effectively developed in GVTs, especially those that are operated with high degree of autonomy.

The qualitative study requires sample GVTs from a variety of organizations operating across different industries that can cooperate with repeated interviews, longitudinal observations, and provide access to various types of written texts for document analyses. The lab experiment requires participants that can mimic GVTs and may be fulfilled by college students who are planning to work for international enterprises which make use of global virtual teams. The insights generated from the research can provide meaningful suggestions for the companies and organizations to manage their GVTs more effectively and productively.

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