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ECOLOGICAL APPROACH TO VIRTUAL TEAM EFFECTIVENESS

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Abstract

This paper attempts to address the need for more research on virtual team effectiveness, and outlines an ecological framework. Prior empirical studies on virtual team effectiveness have used frameworks of traditional team effectiveness and mainly followed Hackman's normative model (input-process-output). We propose an ecological approach for virtual team effectiveness that accounts for team boundaries management, technology use, and external environment, which were previously either non-existent or contextual. The ecological framework suggests that three components reciprocally interact with effectiveness: external environment, internal environment, and boundaries management. The significance of the proposed framework is the holistic perspective that takes into account the complexity of the external and internal environment of the team.

Introduction

As a result of globalization and advances in information telecommunication, a new organization form emerged – the virtual organization (Davidow and Malone 1992). This organization is structured around virtual teams (VT), which are “group[s] of people who work interdependently with a shared purpose across space, time, and organization boundaries using technology” (Lipnack and Stamps 2000, p. 18). The need for more theoretical and empirical research on virtual team effectiveness (VTE) (e.g. DeSanctis and Poole 1997; Furst, Blackburn and Rosen 1999) attracted several empirical studies (e.g. Anderson 2000; Barret 2000; Piccoli 2000; Lurey and Raisinghani 2001). These studies on VTE (Barret 2000; Piccoli 2000) were conducted mostly under the systems approach using Hackman's normative model (input-process-output) for traditional team effectiveness (Hackman and Oldham 1980).

Previous studies of VTE emerged from the body of knowledge on traditional team effectiveness frameworks (Hackman and Oldham 1980; Shea and Guzzo 1987; Pearce and Ravlin 1987; Sundstrom, DeMuese and Futrell 1990; Cohen and Bailey 1997), and from theoretical perspectives on the interplay between IT and organizations, (Orlikowski 1992; DeSanctis and Poole 1994; Kling, McKim, Fortuna, and King in press). We capture the complexity of work groups and IT under a framework that manifests environmental aspects (social, cultural, organizational, and technological) and propose an ecological approach. This theoretical framework is delineated from synthesizing, adopting, and modifying theories from other fields and levels of analysis. Specifically, we are influenced by several ecological theories, such as ecological psychology at the individual level (Barker 1968; Bronfenbrenner 1979; Wicker 1979) and the group level (Sundstrom et al. 1990), and theories on IT and organizations, such as social action framework (Ngwenyama, and Lyytinen 1997).

The main reasons for the selection of an ecological framework for VTE were because it stresses the critical role of the environment through a reciprocal interdependency between internal processes and external environment. Second, the ecological perspective is a dynamic approach, which supports an understanding of processes and changes, emphasizing the importance of team development (founding and disbanding) as a component of team effectiveness. Since, one of the three key characteristics of VTs is a temporary context (Wong and Burton 2000), this aspect is important as VTs form and disband as organizational goals change (Jarvenpaa and Leidner 1999). Third, team effectiveness under this approach is a process and not an end state (Sundstrom et al. 1990). Researchers suggested assessing VTE not only by the team outcomes, but also by the team processes (Blackburn, Furst and Rosen in press). Furthermore, it was previously suggested that internal and external environments influence VTE (Lurey and Raisinghani 2001), and that an ecological approach helps us understand VTs (Baba, Gluesing, Harris, and Ratner 2002).

Before we will outline the ecological framework components, several assumptions should be stressed (Wicker 1979):

1. A VT organism cannot be considered to exist or act in isolation. Every VT organism is linked with other organisms in a complex network of relationships.
2. All VT organisms are affected by forces inside themselves, such as leadership, team norms, technology use, and process losses (e.g. conflict management), as well as by external forces of other organisms, such as competitors, customers, and task technology.
3. VT adapt and act in a way that would achieve harmonious working relationships with their environment, distinguishing between features that are appropriate for their needs and those that are not.

The proposed ecological framework consists of three components critical to VTE: external environment, internal environment, and boundaries. Compared to Hackman's normative model (Hackman and Oldham 1980), our framework is more holistic and emphasizes continuing dynamic process, disregarding chronological sequence. The components are reciprocal and interdependent among themselves and with VTE (Figure 1).

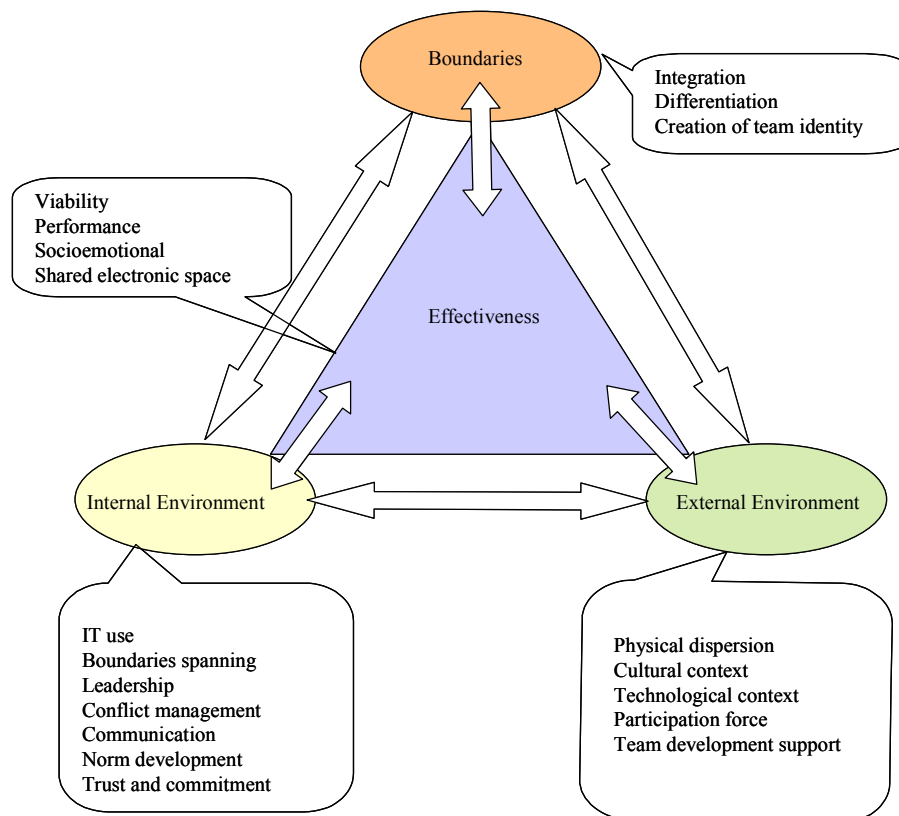


Figure 1. Ecological Framework for Virtual Team Effectiveness

External Environment

The external environment is a critical component for VTE. Following Bronfenbrenner (1979), we claim that VT behavior is embedded in a setting that could be categorized into four levels: microsystem, mesosystem, exosystem, macrosystem. The **microsystem** is the immediate setting in which the team experiences its own activities, roles, and interdependency, given a specific setting (e.g., the VT physical and digital space, and their shared working time). The **mesosystem** refers to the relationships between two or more of the settings in which the team participates. It is a system of microsystems, the network of teams and organizations. The **exosystem** refers to one or more settings without active participants (for example, the task

environment of the VT's parent organizations). The **macrosystem** refers to the general environment – the legal, political, social and cultural environments. Among the four levels we will further elaborate on the components of this level that is critical for team effectiveness (Hackman and Oldham 1980; Pearce and Ravlin 1987; Shea and Guzzo 1987; Sundstrom et al. 1990).

1. **Physical and temporal dispersion** (Barker 1968) is the physical and temporal setting of the VT. Space is a critical component of identity and boundary maintenance (Sundstrom et al. 1990). The VT's physical space is used only for temporary collocation (e.g., during face-to-face meetings) or not used at all for teams who never meet. Furthermore, VT development and life cycle are temporal (Vickery, Clark and Carlson 1999), and members share work time within the permanent shared electronic space.
2. **Cultural context** (Shea and Guzzo 1987; Sundstrom et al. 1990) are the cultures surrounding the team: professional, organizational, and national (Schein 1992; Hofstede 1991). For example, the culture would affect team norm development, communication, and performance evaluation (Furst et al. 1999).
3. **Technological context** is work technology (Hackman and Oldham 1980, Shea and Guzzo 1987; Sundstrom et al., 1990) and telecommunication infrastructure. The infrastructure should be taken into consideration in terms of team effectiveness, because the only way to conduct their shared task would highly depend on the accessible infrastructure, configuration and legislation.
4. **Participation forces** (Barker 1968) are the environmental factors that motivate team members to be part of the VT. The rationale for participation in a VT could be to volunteer (e.g., open source community) or to work under a specific organizational reward system (Hackman and Oldham 1980; Pearce and Ravlin 1987; Shea and Guzzo 1987; Sundstrom et al. 1990).
5. **Autonomy and control system** is the degree of autonomy a VT uses to conduct its task (Shea and Guzzo 1987; Pearce and Ravlin 1987; Sundstrom et al. 1990). For example, high team autonomy means that the team could make decisions in regard to members' roles, without approval from senior managers. Furthermore, the control system manifested through the level of reporting mechanism is critical to VTE (Piccoli 2000).
6. **Team development support** is the training and consultation the organization provides to support teamwork (Hackman and Oldham 1980; Pearce and Ravlin 1987; Sundstrom et al., 1990) and performance evaluation (Sundstrom et al. 1990). Montoya-Weiss, Massey, and Song (2001) found that several of the conflict management approaches were moderated by a coordination mechanism that the facilitators provide to the VTs, and Pauleen and Yoong (2001) investigate the issue of VT facilitators and stress the importance of team building training.

Boundaries Management

The second component of the ecological framework is boundaries management. The ecological approach emphasizes the issue of creating and maintaining boundaries (Sundstrom et al. 1990). Group boundaries (physical and psychological) determine who is in the group (Alderfer 1977). A VT is defined as a team by the boundaries that are formed and maintained over time. These boundaries become critical components of VT viability. Experimental studies of traditional and VTs do not stress this aspect (Sundstrom et al. 1990), because the team boundaries are pre-defined, thus integration is not relevant, whereas studies on real VTs in an organizational setting suggest that boundaries creation and maintenance are critical (Pawar and Sharifi 1997; Robey, Khoo and Powers 2000; May and Carter 2001; Sole and Edmondson 2001). Boundaries management on one hand differentiates the team from its environment, so that it will have its unique identity, but integrates the team with its environment to avoid isolation, on the other hand. Therefore, three components of boundaries management will be further described: differentiation, integration (Sundstrom et al. 1990), and creation of team identity.

1. **Differentiation** refers to the specialization, interdependence, and autonomy of the team. VTE depends on the ability of the team to differentiate its members from others (Sundstrom et al. 1990). However, in VT, the physical limitations make this process more complex, and the boundaries more permeable. Thus, differentiation of the team would be supported by the shared electronic space of team members, and would mainly rely on task and team resources differentiation.
2. **Integration** refers to the ties of the VT with its immediate environment of the organization, and of other teams. Integration in traditional teams and some VTs refers to the team relationships with suppliers, customers, and peers (Sundstrom et al.

1990). It is considerably easier to integrate a VT with external environment, because in many cases representatives of supplier and customers are parts of the team.

3. **Creation of team identity** is crucial to the performance of VTs. The physical territories reinforce group boundaries and identities (Sundstrom et al. 1990). In order to overcome the lack of physical territories, which was attributed to the deindividuation process of computer-mediated groups (Lea and Spears 1991), VT members rely on shared electronic space for the creation of team identity. This electronic shared space is devoted only to the members of the team and enables them to share experience.

Internal Environment

The third component in the proposed ecological framework is the internal environment. Within the internal environment, the following factors for team effectiveness have been discussed in the literature as process or contextual variables: team composition and design (Hackman and Oldham 1980; Pearce and Ravlin 1987), communication (Jarvenpaa and Leidner 1999; Pearce and Ravlin 1987), team development (Sundstrom et al. 1990), conflict management (Montoya-Weiss et al. 2001), leadership (Lurey and Raisinghani 2001), norms (Sundstrom et al. 1990), commitment (Hackman and Oldham 1980; Pearce and Ravlin 1987), and trust (Jarvenpaa and Leidner 1999). We suggest two additional components that influence VTE: technology use (Ngwenyama, and Lyytinen 1997; Lengel and Daft 1988), and boundary spanning (Wenger 1998). Unlike other authors (Sundstrom et al. 1990), we propose to differentiate task technology and information and communication technology (ICT) and consider technology use not only as a contextual factor, but also as an internal factor, specifically by using a social action framework (Ngwenyama, and Lyytinen 1997).

1. **Technology use** - although this ecological framework could be applicable to traditional teams in general, the technology use as a component of the internal environment in the framework is significantly more relevant to VTE. The technology that the VT uses to accomplish its tasks should support team's social actions. The focus of the social action framework for analyzing groupware (Ngwenyama and Lyytinen 1997) is the use of IT for communication and creation/use of knowledge among VT members. They suggest the following four social action categories in groupware: instrumental, communicative, discursive, and strategic. Instrumental action focuses on end products by controlling, manipulating, and transforming physical artifacts, such as generating new documents to a shared database. Communicative action supports creating and maintaining shared understanding among members and is facilitated by computer-mediated communication (CMC). Discursive action specifies and evaluates goals and objectives as well as achieving a consensus on shared values and norms, for example, through the use of a voting system or anonymous contributions. Strategic action influences the group behavior to achieve common goals, such as access restrictions to the shared space. During the process of work, each of these social actions uses technology, appropriating different functions of groupware.
2. **Boundaries spanning** is another internal component critical to VTE. We suggest that not only the external boundaries management, in the traditional sense, but also the internal boundary spanning should be discussed as part of the VTE ecological framework. Heterogeneous VTs incorporate boundary spanning. Individuals from different organizations, nations, and professions traditionally have boundaries that differentiate each group from others. Furthermore, Watson-Manheim, Crowston, and Chudoba (2002) defined virtual work as work that spans discontinuities of temporal work location, geographic work location, group membership, organizational affiliation, and cultural background. Therefore, in VTs, these discontinuities or internal process of boundary spanning is much more critical than in traditional teams. Several types of boundary spanning are embedded in heterogeneous VT (Lipnack and Stamps 2000), not all are embedded in all VTs. The first occurs in geographical dispersion, where team members do not share the same physical space. The second occurs based on cross-functional membership of professionals using several languages, practices, and cultures. The third is of various organizational affiliation manifesting inter-organizational relationships, organizational cultures, and power issues among parent organizations. The fourth is based on international diversity of languages, cultures, and religions. The fifth is time zones of team members who are working in different parts of the globe. The boundary spanning process occurs either through a broker or boundary object (Wenger 1998). Brokers are team members who introduce new knowledge and practices into the VT while boundary objects are artifacts within a VT shared electronic space (e.g., documents).

Effectiveness

Although examination of team performance (e.g., effectiveness and efficiency) is evident in some studies of VTs, researchers have not yet reached consensus on how virtual setting impacts team effectiveness (DeSanctis and Poole 1997; Furst et al. 1999). Furst et al. (1999) suggest that the lack of research on VTE is partially a result of the newness of VTs and partially a result of the

underlying assumption that the existing knowledge of collocated team effectiveness is applicable in the virtual environment. In order to address this knowledge gap, they proposed a research agenda on VTE based on Hackman's normative model (Furst et al. 1999).

Effectiveness has been the focus of several frameworks for traditional teams as well as VTs. Effectiveness could refer to **task performance** and examine whether the team has accomplished its assigned tasks (Shea and Guzzo 1987). Another approach embraces **socio-emotional** consequences of group action, such as member satisfaction and attraction to the group as elements of effectiveness, (Hackman 1987). Many researchers agree that effectiveness includes more than performance (Hackman 1987; Pearce and Ravlin 1987; Sundstrom et al. 1990). For example, Pearce and Ravlin (1987) suggest that team effectiveness refers to employee satisfaction, absenteeism, turnover, safety, and innovation, while Sundstrom et al. (1990) suggested that team **viability** is another important aspect. In addition to task achievement and socio-emotional consequences, team viability as an outcome measure was proposed as a third component (Hackman 1987; Hackman and Oldham 1983; Sundstrom et al. 1990). Team viability is critical component of VT, not only as an outcome of the VT, but also as a process. Viability is a critical component of team collaborative work throughout the time that the team engages in shared tasks. Team viability is manifested during the shared working period, when team members conduct their shared tasks, overcome conflicts, and other constraints, and support the creation of shared team history. Beyond these three effectiveness measures (satisfaction, performance, viability), an effective virtual team creates and maintains a **shared electronic space** during team life-cycle. This shared electronic space, could be preserved for future use by the organization and other teams (Furst et al. 1999).

Conclusions

In this paper, we proposed an ecological framework to understand VTE. This framework consists of three components: external environment, internal environment, and boundaries. We proposed reciprocal interdependency among the three components and VTE, by stressing the effects of components on VTE, and vice versa, the effects of VTE on the three components. The significance of the proposed framework is threefold. First, we internalized technology, which is traditionally a contextual variable in team effectiveness models, and stressed its roles and impacts as a part of internal environment on VTE. Second, boundary management as well as boundary spanning effects was explained in relation to VTE, whereas most traditional frameworks tend to ignore this aspect. Third, we expanded on the factors of the external environment of VT as they relate to VTE; specifically we delineated the factors of the microsystem. Evidently, further empirical study to validate this framework is yet to be done. While we did not include examples from our experiences due to the space limitation, the proposed framework is developed based on our own studies as well as the literature on VTs. We do hope that this framework would inform other researchers' studies to consider environmental aspects and not only examine this phenomenon under closed systems perspectives when studying VTE.

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