Available online at www.sciencedirect.com
SCIENCE DIRECT
Technovation 26 (2006) 42–49
technovation
www.elsevier.com/locate/technovation

Managing creative team performance in virtual environments: an empirical study in 44 R&D teams

Jan Kratzer*, Roger Th.A.J. Leenders, Jo M.L. Van Engelen

Faculty of Management and Organization, University of Groningen, P.O. Box 800, Groningen, 9700 AV, The Netherlands

Abstract

Creative performance in R&D is of vital importance to organizations. Because R&D usually is organized in teams, the management of creative performance inherently refers to the team level creative performance. Over the last decades, R&D teams have become increasingly virtual. In this article we argued that the level of a team's 'virtuality' can be described by three factors: the proximity of team members, the communication modes used, and the manner in which the team task is coordinated. An exploratory empirical study in 44 R&D teams reveals that the creative performance is affected by each of these factors. The results of the study indicate that the more variable R&D teams are in the manner in which they employ these three factors, the higher is their creative performance. Virtuality of R&D teams is neither generally positive or negative for their creative performance: the creative outcome is a function of how virtuality in these teams is managed.

Keywords: Virtuality; Creative performance; R&D teams; Task structure; Communicational mode; Physical proximity

1. Introduction

Research and development (R&D) is the core activity and starting point for innovation. Every organization, regardless of size, profit motive, or industry experiences regular pressurizes to renew, expand, or modify its product or service offerings. In R&D, creativity is of pre-eminent importance. Many R&D projects start with only a vague idea; creativity then is indispensable to fill in the blanks. The market success of a company's R&D effort is strongly related to the uniqueness of the product, both in terms of product functions and technical aspects. The design and development of a unique product requires creativity. And, the more innovative a new product, the less it is possible to rely on set procedures and routines and creative solutions need to be devised. As a result, creative performance is an important determinant of R&D success.

R&D activity is typically executed in a project-management-like approach, and the organizational nucleus is the team (Griffin, 1997; Van Engelen et al., 2001). Nowadays, the management of R&D inherently means the management of teams. The traditional view of R&D teams is one in which R&D team members work together, are located closely to each other, communicate with each other frequently, face-to-face, and together solve the design tasks at hand, coordinating their task together through input from all team members. While such R&D teams resemble closely the proverbial teams described above, research in R&D shows that such teams have become rare. Changes in the business environment have had a strong effect on the way in which R&D is conducted. The knowledge required for the development of most new products has become increasingly specialized and detailed. R&D projects increasingly require in-depth mastery of specialized knowledge areas. Compared to only a few decades ago, even moderate variations to existing products require much more in-depth knowledge and expertise. The specialized skills and talents required for the development of new products often reside (and develop) locally in pockets of excellence around the company or even around the world. Firms therefore, have no choice but to disperse their new product units to access such dispersed knowledge and skills. As a result, there is a general movement towards more 'virtual' R&D teams (e.g. Andres, 2002; Boutellier et al., 1998). Virtual teams consist of individuals collaborating in the execution of a project while

* Corresponding author. Tel.: +31-50-3636543; fax: +31-50-3632330.
E-mail addresses: j.kratzer@bdk.rug.nl (J. Kratzer), r.t.a.j.leenders@bdk.rug.nl (R.T.A.J. Leenders), vanengelen@compaqnet.nl (J.M.L. Van Engelen).

0166-4972/$ - see front matter © 2004 Elsevier Ltd. All rights reserved.
doi:10.1016/j.technovation.2004.07.016

geographically and often even temporally distributed, possibly anywhere within (and beyond) their parent organization. Virtual teams work across boundaries of time and space by utilizing modem computer-driven technologies. The use of virtual teams is perhaps most evident in the area of R&D (Boutellier et al., 1998).

Since creative performance is a vital ingredient for the success of most R&D efforts, this study explores ways how the creative performance of (virtual) R&D teams is affected by their virtual nature. We do this as follows. First, we discuss what 'virtual' means. As we will argue, an R&D team is not either virtual or not; rather, virtuality is a matter of degree. As a result, we consider virtuality to be a continuum, running from fully traditional to fully virtual. Next, we will describe three factors that capture how virtual a team is. We then derive three hypotheses connecting each virtuality factor to its effect on R&D team creativity. We subsequently test these hypotheses, using social network analysis methodology. We end this article with conclusions that can be drawn from our study.

2. Virtuality as continuum

R&D teams rely on both formal and informal communication, across physical, temporal, and status boundaries. The ability of R&D teams to realize their creative goals, depends on how well information is acquired, interpreted, synthesized, evaluated, and understood. Given the increasingly specialized and localized nature of the expertise involved in R&D, aspects of virtuality occur in most R&D teams. Still, even in R&D, few pure virtual forms exist today (Dutton, 1999). For most R&D teams, being virtual is a matter of degree. At one extreme, a team is virtual to the extent that its members are fully geographically and temporally dispersed and communication is maintained solely through electronic means. But this structure will rarely. arise in R&D, environments: even in large-scale projects, such as in the development of a new airplane or a satellite, with specialists scattered and consulted across the world, chunks of the work are done by individuals, located in the same building or on the same complex. Also, representatives (or sometimes, all members) of dispersed teams often travel around the world a great deal and meet face-to-face. While virtuality in R&D has increased and will likely continue to increase, the entirely virtual R&D team still remains scarce.

The other extreme, the traditional, fully co-located face-to-face R&D team in which all specialists live under the same physical roof and all communication occurs face-to-face is also increasingly unlikely. In reality, most R&D teams employ specialists (and customers) from various parts of the world or from other buildings and communicate through electronic means—at least to some extent.

So, it may not be practical to draw a distinction between traditional face-to-face teams and virtual teams.

Table 1
Fully traditional teams versus fully virtual teams

Fully traditional team	Fully virtual team
Team members all co-located	Team members all in different locations
Team members communicate face-to-face (i.e. synchronous and personal)	Team members communicate through asynchronous and a personal means
Team members coordinate the team task together, in mutual adjustment	The team task is so highly structured that coordination by team members is rarely necessary

The literature on virtuality suggests that at least three factors capture the extent to which a team is virtual (Leenders et al., 2002). The first factor is the physical proximity of the team members. In the proverbial non-virtual teams, members work next to each other; in proverbial virtual teams, members all work in different locations. The second factor is the modality used by team members to communicate with each other. A fully non-virtual team relies entirely on face-to-face communication; a fully virtual team, on the other hand, only uses electronic communication. Finally, the third factor refers to the manner in which the team task is structured and, consequently, coordinated. Team task coordination defines the nature of the interactions that ensue in order for the NPD team to complete its product development task. In a team that is completely non-virtual, the team task is coordinated by the members of the team together through mutual adjustment; in wholly virtual teams tasks are specified in more detail and do not require (or even invite) high levels of joint coordination and adjustment. In entirely virtual teams, such intensive coordination among the team members themselves is often simply impossible and almost always highly inefficient. Table 1 summarizes the distinctions between the two extreme forms. Of course, the three factors of virtuality do interact. For example, if all team members are situated in different locations, only relying on face-to-face communication is highly impractical and unlikely to occur.

While these three factors describe the extent to which a team is virtual, literature suggests that they also affect the creative performance of R&D teams (e.g. Kratzer, 2001). This leads to the observation that the management of virtuality and the management of the creative performance are highly related. In other words, by managing the virtuality of R&D teams one increases or decreases the creative achievement of R&D teams.

3. The three factors of virtuality and the creative performance of R&D teams

3.1. Team member proximity

The most fundamental effect of proximity is that potential collaborators have the opportunity to make contact