Knowledge Work Productivity in Distributed Teams

Published in Journal of Knowledge Management 2009, 13(6): 533-546.

Petra M. Bosch-Sijtsema, Virpi Ruohomäki & Matti Vartiainen

Dr. Petra M. Bosch-Sijtsema* (corresponding author)

Helsinki University of Technology, BIT / Work Psychology and Leadership

And currently Visiting Scholar Stanford University, Project Based Learning Lab

Stanford, CA-94305 USA

Email: petra@petrabosch.com

Dr. Virpi Ruohomäki

Helsinki University of Technology, BIT / Work Psychology and Leadership

P.O. Box 5500, Espoo, FI-02015 TKK Finland

Email: Virpi.Ruohomaki@tkk.fi

Dr. Matti Vartiainen

Helsinki University of Technology, BIT / Work Psychology and Leadership

P.O. Box 5500, Espoo, FI-02015 TKK Finland

Email: matti.vartiainen@tkk.fi

Knowledge Work Productivity in Distributed Teams

Abstract

Purpose: Knowledge Work (KW) is a well-researched topic. However, KW is difficult to measure and little consensus has been reached on elements that affect knowledge work productivity on a team level. The current theories neglect teams working in distributed geographical areas. The purpose of the paper is to integrate recent literature on knowledge work productivity (KWP) in distributed teams and give an overview of the elements affecting it.

Approach: The paper presents an overview of research performed in the field of knowledge work productivity. The authors integrate theories of different fields of management theory (knowledge management, intellectual capital and learning), and work and organizational psychology. This paper answers three questions: 1) what is knowledge work; 2) what is knowledge work productivity and 3) which elements hinder or enable knowledge work productivity in distributed teams of global technology companies.

Findings: The authors define the crucial elements that either hinder or enable KWP: team tasks, team structure and processes, the physical, virtual and social workspaces as well as organizational context. The paper presents an integrative model of KWP in distributed teams of global technology companies.

Practical implications: Distributed teams are common in global companies. By understanding the elements that affect KWP, companies can stimulate or decrease specific elements in order to improve productivity of their distributed knowledge workers.

Value: This paper integrates theories from different disciplines in order to create an understanding about knowledge work and its productivity for further research.

Keywords: knowledge work, productivity, distributed teams
Paper type: Conceptual paper

1 Challenge of knowledge work productivity in distributed teams

According to Drucker (1991: 69), the greatest challenge of companies is how to raise the productivity of knowledge work. Knowledge work (KW) is defined here as the creation, distribution or application of knowledge by highly skilled (and autonomous) workers using tools and theoretical concepts to produce complex, intangible and tangible results (Antikainen and Lönnqvist, 2005; Davenport, 2002; Drucker, 1995; Harrison et al., 2004; Jones and Chung, 2006; Pepitone, 2002; Pyöriä et al., 2005; Scott, 2005). Several authors have discussed knowledge work productivity (KWP), and the difficulties of improving and measuring productivity (Davenport et al., 2002; Drucker, 1991; 1999; Ramírez and Nembhard, 2004; Antikainen and Lönnqvist, 2005). However, there is no single acknowledged way to measure or improve KWP.

The product of a knowledge worker is typically intangible: knowledge is the addition of meaning, context and relationships to data or information. There is increasing evidence of large differences in knowledge workers' productivity. The reasons for variability can be found in three main factors. First, the KW tasks performed vary from routine to creative. Second, the enabling and disabling contextual factors at work influence the possibilities to realize the work tasks at hand. These contextual elements are organizational and social factors such as culture, strategy, structure, leadership and support from fellow workers, reward and benefit structures, the physical environment of knowledge workers (e.g., Chan et al., 2007) such as office or home where work takes place, and also the virtual environment, i.e., available communication and collaboration technologies. And, third, the quality of individual human resources like skills and competences. Only few studies discuss elements that affect the performance and productivity of knowledge workers collaborating in global contexts. Identifying these elements, is also supposed to be important for improvement, stimulating and influencing the knowledge work. In this paper

the authors focus primarily on the prerequisites of productivity of knowledge workers in distributed teams of global technology companies. Many knowledge workers work often from afar and in multiple workplaces in addition to the main office (e.g., at a customer site, at home, hotels, travelling) (Davenport, 2005) and this makes their working contexts dynamically changing and complex. Distributed teams are defined as groups of geographically dispersed employees with a common goal carrying out interdependent tasks using mostly technology for communication and collaboration (e.g., Bell and Kozlowski, 2002; Jarvenpaa and Leidner, 1998; Majchrzak et al., 2000). These teams are more and more globally distributed.

By integrating literature on KW and productivity in distributed teams from multiple disciplines (e.g., management studies and work and organizational psychology) the paper answers to three main questions:

(1) What is knowledge work? There is still not a shared and concise definition and classification of KW (see Kelloway and Barling, 2000; Pyöriä, 2005).
(2) What is knowledge work productivity (KWP)? How to measure and improve KWP is unclear and many different approaches co-exist.
(3) What are the main enabling and hindering elements for KWP?

This paper is structured as follows. Based on current literature, the paper first conceptualizes KW and its classifications (question 1). Secondly, the authors describe the challenge of analyzing and measuring the productivity of KW (question 2). Then, the paper continues to integrate literature on crucial elements affecting KWP in distributed teams (question 3), and the article is finalized with a conclusion.

2 Knowledge work

Many authors perceive knowledge work (KW) as an important aspect of our current society (Drucker, 1991; Pyöriä, 2005), but no clear and shared definition of KW has been developed (Kelloway and Barling, 2000; Pyöriä, 2005). Different disciplines have discussed KW e.g. intellectual capital and economics, management information systems, i.e., identification and evaluation of technological approaches to KM, management and learning literature (Kelloway and Barling, 2000) as well as sociology (Pyöriä et al., 2005; Pyöriä, 2006;). In these disciplines a number of themes are shared about KW, such as a high level of education and skills and the use of information technology as an integral part of work process have become common to both empirical and theoretical literature (Pyöriä, 2005; 2006).

Knowledge workers are defined primarily by the nature of their work, which is relatively unstructured and organizationally contingent, and which reflects the changing demands of organizations more than occupationally defined norms and practices (Scarbrough, 1999). Authors perceive KW as non-routine, complex and situation-specific (Antikainen and Lönnqvist, 2005; Davenport et al., 1996; Quinn, 2005; Scott, 2005) and opportunistic, non-linear and improvisational (Heerwagen et al., 2004). Knowledge workers often deal with new technologies and their work is autonomous and unpredictable (Pyöriä et al., 2005).

2.1 Classifications of knowledge work

In the literature, KW has been classified in different ways. Some authors define KW as a *function* (Coates, 1968; Kellow and Barling, 2000). Davis (2002) defines *job specific types* of KW. These types are (a) knowledge building and maintenance tasks (learning) and (b) work management tasks (self-management). Others focus more on the *content of the KW task*

(Davenport and Prusak, 1995; Drucker, 1991; 1999; Kelloway and Barling, 2000; Ruggles, 1998; Suchman, 2000) in which several tasks of mainly individual knowledge workers are discussed, like creation, application, packaging of knowledge, and acquisition of existing knowledge (Davenport et al., 1996; Kelloway and Barling, 2000). Although KW is perceived as high-level cognitive work, knowledge workers also perform mundane tasks such as storing and retrieving information, calendaring, telephone calls and emails (Suchman, 2000). Other literature discusses the *level of autonomy* and individual choice (Davenport et al. 2002), the level of *complexity* of the task and *competences* needed as well as tools used to perform tasks (Pyöriä, 2005; 2006).

Another field discusses KW related to *space* (see Davenport et al., 2002; Gjerskvik and Blakstad, 2004; Heerwagen et al., 2004). In this literature, knowledge workers are classified according to status, geography or job role, mobility required for the job, amount of time engaged in team work versus independent work, number of projects undertaken at one time and the amount and type of communication with others that is needed to perform one's job (Davenport et al., 2002). On the one hand knowledge workers need time alone to think and develop ideas, draw their own memory, insight and analytical skills. On the other hand knowledge work involves also conversations and interaction allowing thought embedded in one person's mind to be externalized and become accessible to others through writing, speech or graphic visualization (through group work and social networks) (Heerwagen et al., 2004).

A large amount of research on KW focuses at the individual level (performance) or on the organizational level (intellectual capital, knowledge management, resource-based view). However, KW is usually in practice not an individual task, but is performed in collaboration with others (teams or networks) on complex tasks, which they cannot perform alone (Pyöriä et al., 2005; Scott, 2005).

2.1.1 Mode of working

Another way of classifying KW is to look into the time spent by knowledge workers on specific activities (see e.g., Picard, 1998). Time is spent on e.g., acquiring information, conducting face-to-face and telephone conversations, thinking, travelling and organizing. Since KW comprises so many different tasks that might overlap, the authors prefer to classify KW based on time spend on certain activities by knowledge workers.

Vartiainen et al. (2007b) found that knowledge workers work in solitude, asynchronously with others, virtually online and in face-to-face collaboration with others during their working days. Working in solitude is often "pseudo-private" as it may include focussing on own businesses, virtual asynchronous collaboration with others by e-mails, and simultaneous presence in collaborative net meeting. Thus the nature of KW is blurred at several levels.

In order to understand the prerequisites of KW in distributed teams in global technology companies, it is important that not only the task content of knowledge work is taken into account (e.g., creative, routine task or coordination, management task), but also the kind of modes for performing the work. For distributed teams in global technology firms there are different modes of working:

(a) Time in doing solo work;

(b) Time spend on technology mediated synchronous and asynchronous interaction (phone, video conferencing, teleconferencing, both formal and informal and between two or more persons, mail) and

(c) Time spend on face-to-face interaction (formal and informal and between two or more persons).

2.1.2 Multi-locational workplace

The different modes of working are important from a distributed team perspective, but are also influenced by the workplace, e.g., the office, where KW is performed. Knowledge workers spend a lot of time out of their offices, either travelling, at customer sites, or working at home (Davenport, 2005). The workplace and location define to some extent the mode of working (e.g., remote workers have to travel to meet for face-to-face meetings) and have an impact on productivity. Thus, depending on the task performed, some tasks need to be performed in a place where people can concentrate and work solo. Therefore the authors study distributed teams of knowledge workers on three aspects:

(a) Specific task performed in the team (both individual and collaborative tasks)

(b) Location

(c) In what kind of mode is the work performed.

3 Productivity of knowledge work

In the following section studies on KW productivity measurements are reviewed. Many researchers mention the importance of measuring the productivity of KW (Drucker, 1991; 1999; Cohen, 1998). However, the development of measurements has seemed difficult and no common measurements have been accepted. KW is intangible and hard to measure with traditional productivity measurements. KW seldom has one single correct result or correct way of doing it (Orlikowski, 2002), and it is difficult to quantify (Quinn, 2005). Outcomes of KW are often not comparable, take a long time to develop and value is only manifested when used by customers. Some authors discuss the fact that knowledge worker productivity (KWP) is difficult to quantify (Antikainen and Lönnqvist, 2007), while others focus more on quantitative measurements, such as efficiency, operating efficiency, standard time, professional time utilization, outcome as a

measure, outcome input ratio and cross functional analysis. Nevertheless, there are no universally accepted methods to measure KWP or even generally accepted categories (Ramirez and Nembhard, 2004).

Productivity measures are usually based on the ratio of some input and some output, for example, the relationship of time used in developmental efforts to shortened product design time. Productivity is related to two other concepts: 'efficiency' and 'effectiveness' (see for example, Pritchard and Watson, 1992). Efficiency is a volume measure that is for example the number of produced mobile phones by a team in an hour. Effectiveness measures are ratios of output relative to goal or expectation, e.g., the ratio of satisfied service needs versus identified service needs.

However, for KW there is not necessarily a direct relation between input and output as there are often several intervening variables. The problem is that KW is difficult to observe or measure because of its complexity and intangibility (Drucker, 1991; 1995). It becomes more difficult to measure productivity of knowledge workers whose tasks are not fixed, not routine, have no production standard times and whose tasks can be performed differently among various workers (Ramirez and Nembhard 2004). Furthermore from a review of productivity measurements for KW, Ramirez and Nembhard (2004) found that only few measurements account for quality, while most methods use quantity in assessing KWP. Literature however states that the quality and continuous improvement of the output of knowledge work are very important to KWP (Drucker, 1999). But measuring the outcome quality is a difficult task since it is dependent on what is defined as quality by the organization.

3.1 Team perspective of KWP

Based on the literature on KWP measurements, most measurements focus on individual performance, while they neglect groups, business units, and organizational performance. The productivity of a group is not simply the sum of the performances of the individuals involved. Some authors therefore propose to measure KWP on a group or team level (Rittenhouse, 1992; Sassone, 1992). Sassone (1992) focused on office productivity of business units in order to state conclusions on the total volume of work of different intellectual content and the efficiency of the organization. A change in the productivity of an individual knowledge worker may not affect the productivity of other knowledge workers. The level of productivity measurement is dependent on the goal of the different levels, to represent the contribution that specific level expects to make towards the overall organizational goals. In order to assess the productivity of knowledge workers, the authors perceive the team as the proper level to analyze knowledge work productivity.

From literature it is known that many factors influence both individual and collaborative KW. Some factors are on the organizational level: the organizational context, structure and culture, availability of required resources, management style, compensation, as well as the work environment, work processes, work conditions and information technology (Davenport et al., 2002; Bond et al., 2006; Litschka et al., 2006). While on the team and individual level these aspects are related to nature of tasks, working conditions, social context, cooperation between group members, and to individual commitment, abilities and skills, motivation, and job satisfaction (e.g., Kellow and Barling, 2000; Litschka et al., 2006; Pritchard and Watson, 1992). For example, Bond et al. (2006) found that greater job control (the extent to which people have a

'say' in the way they do their work) led to better performance, less absenteeism and less turnover intention.

In order to be able to measure productivity of knowledge workers, it becomes important to understand the impact of different elements affecting knowledge work and its productivity.

4 Elements affecting knowledge work productivity in distributed teams

Current literature on KWP mainly focuses on measuring quantitative costs and effects on the individual level of a knowledge worker. However, besides quantity, timeliness and costs there are many more aspects that influence the productivity of knowledge workers in distributed teams. In order to find these elements the authors look into work on team effectiveness, distributed team research and workplace productivity literature. Several reviews discuss team effectiveness (e.g., Cohen and Bailey, 1997; Gladstein, 1984; Guzzo and Dickson, 1996, Kozlowski and Ilgen, 2006). Team effectiveness is defined as: 1) performance (quantity or quality), 2) member attitudes (commitment, satisfaction) and 3) behavioural outcomes (absenteeism, turnover) (Cohen and Bailey, 1997; Costa et al., 2001). Most literature on team effectiveness discusses collocated teams and few study distributed teams.

In a number of reviews on distributed teams, performance and effectiveness are touched upon (Martins et al., 2004; Maznevski and Chudoba, 2000; Powell et al., 2004). Maznevski and Chuboda (2000) concluded that effective global virtual team interaction comprises a series of communication incidents, each configured by aspects of the team's structural and process elements. Martins et al. (2004) concluded that task type, time spent working in a group, and the team's social context moderate distributed team performance. According to Powell et al., (2004) research results concerning distributed team performance are mixed. On the one hand, researchers have consistently found that virtual interaction increases the amount of time required

to accomplish tasks, e.g., slower use of technology. On the other hand, there are reports of better work in distributed teams, making more effective decisions, generating unique ideas and solutions.

Based on our literature review on distributed teams, team effectiveness and KW, the authors derived five categories that are suggested to have an influence on the outcome of KW in distributed teams. These categories will be discussed in more detail below (Figure 1):

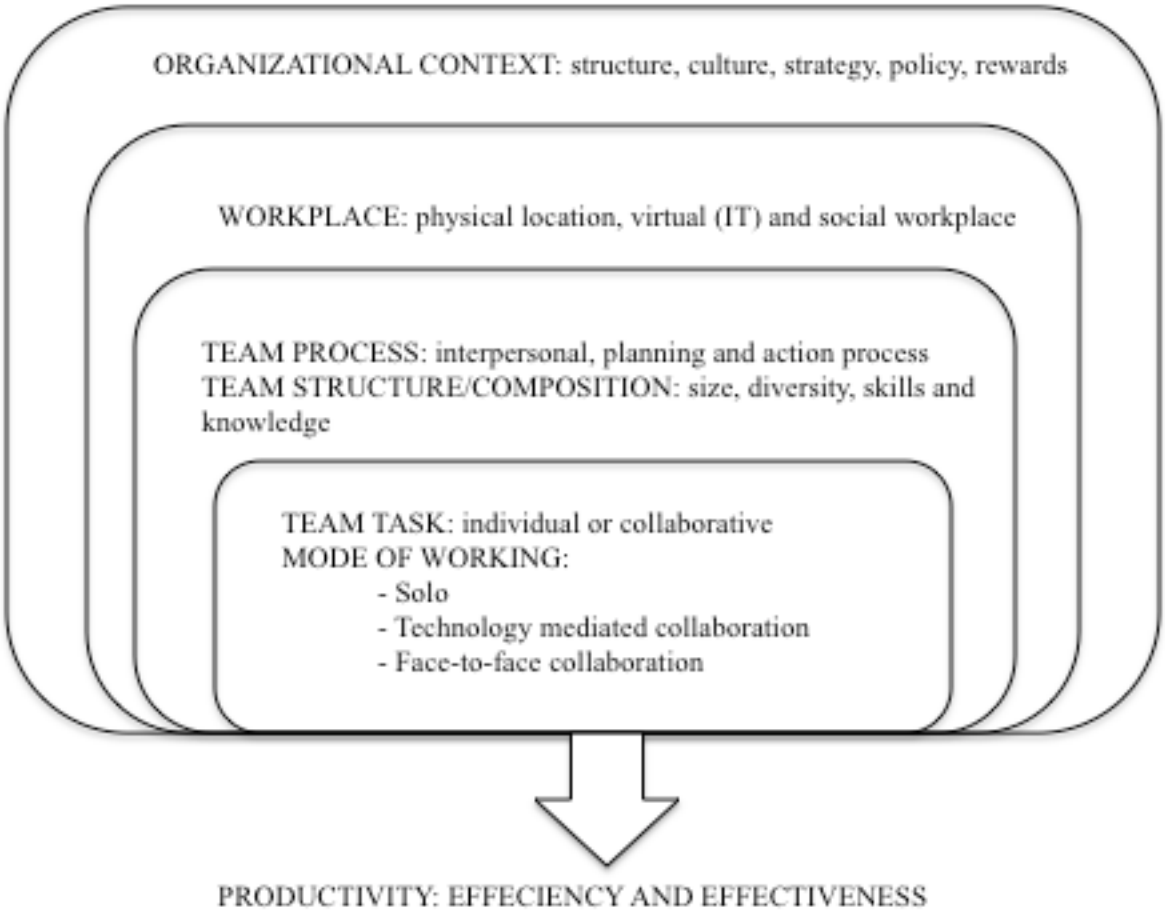

Figure 1: Enabling and hindering elements of knowledge work productivity in distributed teams

(1) task content, i.e. the complexity and interdependency of tasks (Gladstein, 1984; Drucker, 1999) as well as the modes in which a task is performed with other team members or alone are of importance for the outcome of KW;
(2) team structure and composition;
(3) team processes that are related to communication, coordination and planning of tasks, and building trust;
(4) the workplace where work is conducted; and
(5) the organizational context in which KW is performed.

4.1 Work tasks

Koslowski and Ilgen (2006) state that the team task determines two critical issues. Firstly, it sets minimum requirements for the resource pool (knowledge, skills and competencies) needed by team members. Secondly, the team task determines the primary focus of team-member's activities determining the workflow structure and coordination demands that are needed to accomplish task. Maznevski and Chudoba (2000) suggested that dimensions of the team's task and its context shape a global virtual team's most effective use of communications technology. *Task type* has been argued to be critical to the success and speed with which distributed teams make decisions (Martins et al., 2004), i.e., with an ambiguous team task, the time needed to reach a shared goal might be increased. Usually, two aspects of tasks are studied; type or content of task and task interdependence (Hertel et al., 2005). *Task interdependence* describes the degree or requirement of task-driven interaction among group members and is determined when team task is designed. High task interdependence seems to be advantageous particularly at the beginning of distributed teamwork in order to support feelings of connectedness, i.e., increasing communication, cohesion and trust (Hertel et al., 2005).

Besides the types of tasks, it is also important in what kind of modes the tasks are performed, i.e., solo, face-to-face and virtual in order to understand the impact of distributed work settings on outcomes of distributed teams.

4. 2. Team structure and composition

From distributed team review literature (Hertel et al., 2005; Martins et al., 2004; Maznevski and Chudoba, 2000; Powell et al., 2004) the authors know that group effectiveness and performance is affected by group composition and the structure of a group (Cohen and Bailey, 1997; Gladstein, 1984; Guzzo and Dickson, 1996).

4.2.1 Group structure

Group structure focuses on aspects like leadership, shared working values, role and goal clarity and team rewards (Gladstein, 1984). Scott (2005) found that group size and proximity to team members also affects productivity of the group. *Group composition* involves job skills, experience, and heterogeneity of group members, i.e., member personalities, knowledge, skills, and abilities (KSAs) (Martins et al., 2004; Powell et al., 2004).

4.2.2 Composition of teams

For global distributed teams, the group composition crossing different cultures is an important factor that can both stimulate but also hinder the outcomes of the team. The authors reported that technical expertise in a distributed team is positively related to a team's success (Martins et al., 2004). Group composition focuses also on status, gender and national culture aspects and members' personalities (Martins et al., 2004). Maznevski and Chudoba (2000) discussed that a global distributed team's cultural composition may be an influential structural characteristic, and integration processes are likely to be the key to good performance. Cultural

and language differences are evident in global distributed teams, and cultural differences appear to lead to co-ordination difficulties and create obstacles to effective communication (Powell et al., 2004). Hertel et al. (2005) argues that high degrees of virtuality seem to require attributes for telecooperation, such as expertise with new media and groupware technology, self-management skills with certain personality attributes, such as self-sufficiency, interpersonal and intercultural sensitivity, interpersonal trust, and dependability. Whether *diversity* and a related issue of differing *cultural backgrounds* are advantageous or not for distributed teams are still open questions according to Hertel et al. (2005).

Based on the literature discussed above the authors propose that team structure and composition, like size, balanced team diversity, and having the required set of skills and knowledge within the team to perform the tasks are beneficial to KWP in distributed teams.

4. 3. Team processes

Team processes are an important element of team effectiveness (Cohen and Bailey, 1997; Gladstein, 1984; Guzzo and Dickson, 1996). Team processes are the mechanisms with which team members interact with each other, combine their individual resources to meet with the task and contextual demands. Based on classic group literature (e.g., McGrath, 1984; Hackman; 1987), three functions must be fulfilled for a team to be effective: the production function, i.e., ability to perform a task and produce certain products; the well-being function, i.e., a team should be attractive and vital, and the member support function, i.e., working in a group must be rewarding for an individual group member. Team processes regenerate those functions that are needed to keep teamwork going on.

4.3.1 Different team processes

A large amount of research has been performed on team productivity and effectiveness, in which autonomy of knowledge workers, their interdependence, team development, and management issues are important (e.g., Janz et al., 1997). Martins et al. (2004) present a review on distributed team literature and defined team processes as "how" teams achieve their outcomes. Martins et al. (2004) divide distributed team processes into different segments: planning, action and interpersonal processes. *Planning processes* encompass mission analysis, goal setting, strategy formulation, and processes related to focusing the group's efforts. Researchers have found that goal setting is positively associated with cohesion, commitment, collaboration, decision quality, and numbers of alternatives generated in distributed teams. However, developing a shared vision may be more difficult. *Action processes* are dynamics, which occur during the performance of a group's task such as communication, participation, coordination, and monitoring of the group's progress. *Interpersonal processes* include conflict (Hinds and Bailey, 2003; Mortensen and Hinds, 2001), tone of interaction, trust, cohesion, affect, and social integration. In distributed team literature, the three most studied processes are motivation and trust, team identification and cohesion, and satisfaction of the team members (Hertel et al., 2005).

4.3.2 Trust

Trust has been studied extensively, and it is considered as a determining factor in the effectiveness of activities requiring coordination of actions. The named determinants of trust include time, e.g. quick development, communication intensity, and the ability to cope with technical and task uncertainty. From distributed team literature the authors know that trust (Jarvenpaa et al., 1998; Zolin et al., 2004) and *trustworthiness* are important aspects within the

team, which increases cooperation as well as information gathering and communication. Jarvenpaa and Leidner (1998) found that trust, which was critical to the distributed team's ability to manage decision processes, could be built swiftly.

4.3.3 Conflicts

Armstrong and Cole (2002) found that *conflicts* are unaddressed and unidentified longer in distributed teams compared to collocated teams. However, many moderating factors have been found as well such as team members' perception of having a common group identity, technology in use, gender, and style of conflict management. It has also been found that in the distributed context uninhibited behaviour is more common. On the other hand, the amount of informal or non-task communication may be diminished as the media is not always rich enough. Members of highly productive virtual teams communicate more often in informal, social ways than less productive teams.

4.3.4 Cohesion and communication

According to Hertel et al. (2005) team identification and cohesion have been shown to be highly important for the success of distributed teams because they are related to team effectiveness and enhanced motivation, better decisions, more open communication and higher satisfaction. Shared team identity may be strong if members see themselves as a significant part of the team rather than as individuals. Team empowerment is positively related to performance such as process improvements and customer satisfaction (Powell et al., 2004).

Studies analyzed by Powell et al. (2004) showed the virtual environment giving rise to challenges for effective *communication* such as time delays in sending feedback, lack of a common frame of reference for all members, differences in salience and interpretation of written

text, and assurance of participation from remote team members (e.g., Cramton 2001). In addition, nonverbal communication is usually missing. The studies reviewed by Powell et al. (2004) show that conventional teams communicate more effectively than distributed teams, because electronic media is leaner and usually less rich than face-to-face communication. Besides technical challenges, distributed teams face difficulties as they attempt to coordinate across time zones, cultural divides and divergent mental models (Powell et al., 2004). Maznevski and Chudoba (2000) found that effective global distributed team interaction comprises a series of communication incidents, each configured by aspects of the team's structural and process elements.

Based on the literature review above the authors propose that the following three team processes are beneficial to KWP of distributed teams: first, interpersonal processes, like mutual trust, high autonomy, strong team identity, few personal conflicts, and high team cohesion; second, clear planning processes like clear goal setting, clarity of roles and goals, and shared norms within the team; and, third, action processes like coordination of distributed teams, effective team communication, and high and motivated participation.

4. 4. Workplaces

From earlier literature studies it is known that the workplace has an impact on the work that is performed (Chan et al., 2007; Heerwagen et al., 2004). A workplace is a combination of different factors. Becker (2002) perceives the workplace as a complex web of interdependent social and organizational factors that, in combination, influence informal communication, interaction, and learning patterns. Right sizing and redesign of space can lead to a better fit between workspace design and users' tasks; employees' workspace can more effectively support work performance and improve productivity (Vischer, 2005). Joroff (2002) indicates that digital

technologies allow people to change the workplace in a fundamental way. The connectivity enabled by these technologies has opened new opportunities for how, when, and where people work. Those opportunities, when exploited, can help organizations be more effective in their use of human capital.

4.1.1 Workspaces

Knowledge work is often done in multiple places and in a mobile manner. Knowledge work is described as multi-locational (Vartiainen et al. 2007a).

Each workplace can be seen as an integration of imbedded spaces consisting of

(1) a physical space like an office or a customer site where a knowledge worker works;

(2) a virtual space in which people meet and collaborate with help of information and communication technology (e.g., email, video conferencing);

(3) a social space in which people meet formally and informally, e.g., meeting room, coffee room, hall ways;

(4) a mental space which is a personal space of an individual (e.g., feelings, mental maps) and through which an individual perceives and interprets other spaces (Vartiainen et al., 2007a).

The *physical workspace* is known to affect productivity; however, few studies focus on measuring these aspects and empirical evidence is limited (Haynes, 2007; Heerwagen et al., 2004;). From the perspective of workplace design, physical workplaces are typically divided as individual workspaces and collaborative spaces. The *virtual space* and *social space* are discussed in literature as important for knowledge workers who work virtual or distributed (Davenport et al., 2002; Scott, 2005). Some studies show that non-job-related communication contents are

related to productivity and members' satisfaction of global business teams and to their climate (Hertel et al., 2005).

Fruchter (2005) has pointed out the impact of collaboration technology on the degrees of engagement and specific interaction zones in interactive workspaces for distributed teams. The intersection of the design of physical work spaces, i.e., 'bricks', rich electronic content such as video, audio, sketching, CAD, i.e., 'bits', and new ways people behave in communicative events, i.e., 'interaction' are all important in KW. In order to design and develop workplaces for knowledge workers, it is necessary to know in more detail the work activities and work requirements of KW – this is not generally recognized in companies (Vartiainen et. al., 2007a).

Based on the reviewed literature the authors propose that physical, virtual, social and mental spaces, which are aligned with and designed for the KW performed, are beneficial for KWP. Collaborative distributed working environments are combinations of physical, IT-based and social or organizational infrastructures supporting people in their individual and collaborative work.

4. 5. Organizational context

Besides task, team processes and workplace aspects, also the organizational context is of importance to team productivity (Cohen and Bailey, 1997). As Kozlowski and Ilgen (2006) remark teams are embedded in a broader organizational system and task environment that drives the difficulty, complexity, and tempo of the team task. This context can be the organizational structure and resources available in the organization (Gladstein, 1984). Furthermore, organizational strategy, culture and identity contribute to the team and individual's knowledge work. Having a learning strategy or practices and routines to share knowledge across teams/units

also impacts the value and quality of KW. Continuous learning and adaptation of new knowledge are part of knowledge workers' tasks.

4.5.1 Reward systems and technology

Hertel et al. (2005) mention the importance of reward systems and integration of distributed teams in the organizational context. Hertel et al. (2005) suggest team-based rewards to stress the importance of cooperation within distributed teams. In their study, they also found that the use of recognition plans related to the overall team success correlated significantly with the effectiveness of distributed business teams.

The available technology can be seen as an organizational resource provided to global teams. The quality of technology has been found to positively impact on team effectiveness, efficiency, performance, the amount of communication, the relationship among team members, and team commitment and trust (Martins et al., 2004). As the negative side of technology, it has been found that the novelty of the technology may negatively impact team performance, and decision-making may take longer as non-verbal and visual cues decrease in communication (Martins et al., 2004).

Based on the literature the authors propose that an organizational structure, culture and strategy that support sharing and re-using of knowledge are beneficial for KWP. Feeling part of an organization (identity) and having reward systems that support individual, team and business unit knowledge work processes are beneficial for KWP.

5 Conclusion

The productivity of knowledge workers in distributed teams of global companies is hardly studied in current literature. Research has, however, been performed on productivity in teams, on

productivity of knowledge workers (mainly individual level), distributed teams and on knowledge work. In this article the authors combine the findings from these studies and integrate elements that affect the outcomes of distributed knowledge workers in terms of productivity, efficiency and effectiveness in an integrative model (Figure 1). This model integrates the crucial elements of KWP in distributed teams: (1) time spent by knowledge workers in different work modes and on different task; (2) team structure and composition; (3) team processes; (4) physical, virtual and social workspaces; and (5) organizational context.

KWP has been discussed in literature (see e.g., Drucker 1991; 1999) and several authors have mentioned the importance to study KWP in more detail. With help of this review the authors try to shed light on work that has been performed in the field of KWP and integrate recent literature from different disciplines and research areas. By defining elements that enable or hinder KWP, it is possible to find suitable measurements to knowledge work and to influence certain elements in order to support productivity and quality of knowledge work. By understanding the elements that affect KWP, companies can stimulate or decrease specific elements in order to support productivity of their distributed knowledge workers.

However, unclear is to what extent these elements influence KWP. Therefore, for future research the authors will empirically study a number of global distributed teams (in Europe, USA and Asia) of global technology companies.

Generalizability and limitations

This conceptual paper mainly discusses distributed teams of knowledge workers in global technology firms due to empirical research interests of the authors. However, the theoretical framework of enabling and hindering elements of KWP is meant to be more generic and it

possibly fits with other types of organizations who work with distributed teams. As shown above, the important aspects in the framework that affect productivity of knowledge workers are the contextual factors such as the organizational structure, culture, strategy, leadership and the virtual (tools for communication and collaboration) and physical (available premises) environments as well as the content and interdependency of the tasks performed within the distributed teams. These factors are related to each other as well as the team structure and processes needed for the performance.

However, a question can be raised if the framework can be generalized to other types of organizations, for example to global non-profit relief organizations, and to nationally and locally distributed organizations. It is evident that groups and teams vary greatly in their purposes, tasks, working environments, intra-group processes and available external resources needed (Vartiainen, 2007b). All these factors characterizing distributed teams seem to be inter-linked in such a manner that a change in one of them may influence others. Therefore, only rough categories of team types can be presented. Conventional groups and teams differ from distributed, virtual, and mobile teams especially in three characteristics: the geographical distance between their members, the mode of interaction, and physical mobility. Conventional groups and teams are co-located, communicate face-to-face, and work towards a joint goal here and now.

The main types of non-conventional teams are: (1) distributed; (2) virtual, and (3) mobile virtual teams. All of these types can be global groups and teams. Team members working in different locations and their geographical distance from each other make a distributed team. This can be a global team if members or some of them are working in different continents. A team becomes virtual when group members communicate and collaborate with each other from

different locations via electronic media and do not meet each other face to face. Members of a global team or some of them may communicate virtually but not necessarily. It depends on the arrangements of their work, division of tasks, and their interdependence.

Physical mobility of group members adds a new feature to distributed work. Mobile, virtual teams are always distributed, but not all distributed, virtual teams are mobile. Mobility can be a feature of a global team, but their members can also work in fixed places. Virtuality, as in the use of ICT for communication and collaboration, makes a team into a distributed virtual team or mobile virtual team. If a global team collaborates by using ICT, it is a global virtual team. In conclusion, it can be said that global virtual mobile teams are the most complex types of teams to work, lead and manage.

The authors conclude that the factors of global teams in both for-profit and non-profit organizations are similar but highly complex and influence more negatively KWP than in nationally and locally distributed teams. Nevertheless, the conceptual framework can help on the methodological level in understanding the impact of these factors in all kinds of teams, but the impact will be different depending on the firm, its tasks, context and intra-firm processes.

6 References

- Antikainen, R. and Lönnqvist, A. (2005) ”Knowledge Worker Productivity Assessment”, in the *proceedings of the 3rd Conference on Performance Measurement and Management*, Nice, France, September 2005.
- Armstrong, D. J. and Cole, P. (2002), “Managing distances and differences in geographically distributed work groups”, in Hinds, P. J. and Kiesler, S. (Eds.), *Distributed work*, MIT Press, Cambridge MA, 167-186.

- Becker, F. (2002), "Improving organisational performance by exploiting workplace flexibility", *Journal of Facilities Management,* 1, 2, 154-162.
- Bell, B. S. and Kozlowski, S. W. J. (2002), "A typology of virtual teams. Implications for effective leadership", *Group and Organization Management*, 27, 1, 14-49
- Bond, F. W., Flaxman. P. E. and Loivette, W. S. (2006), "*A Business case for the management standards for stress*. Health and Safety Executive Research report 431, University of London HSE Books, London.
- Chan, J. K., S. L. Beckman and Lawrence, P. G. (2007), "Workplace design. A new managerial imperative", *California Management Review*, 49, 2 winter, 6-22.
- Cohen, S. G. and Bailey, D. E. (1997), "What Makes Teams Work: Group Effectiveness Research from the Shop Floor to the Executive Suite Source", *Journal of management*, 23, 3, 239
- Coates, J. (1986), "Three models for white collar productivity improvement", *Industrial Management*, 28, 2, 7-14.
- Costa, A.C., Roe, R.A. and Taillieu, T. (2001), "Trust within teams. The relation with performance effectiveness", *European Journal of Work and Organizational Psychology*, 10, 3, 225-244.
- Cramton, D. C. (2001), "The mutual knowledge problem and its consequences for dispersed collaboration", *Organization Science,* 12, 346-371.
- Davenport T.H. (2005), "*Thinking for Living*", Harvard Business School Press, Boston.
- Davenport, T.H. and Prusak, L. (1995), "*Working knowledge. How organizations manage what they know*", Harvard Business School Press, Harvard.

- Davenport, T. H., Thomas, R. J., and Cantrell, S. (2002), "The mysterious art and science of knowledge worker productivity", *MIT Sloan Management Review*, 44, 23-29.
- Davenport, T. H., Jarvenpaa, S.L. and Beers, M.C. (1996), "Improving knowledge work processes", *Sloan Management Review*, 37, 4, 53-65.
- Davis, G.B. (2002), "Anytime/Anyplace computing and the future of knowledge work", *Communications of the ACM*, 45, 12, 67-73.
- Drucker, P. F. (1991), "The new productivity challenge," *Harvard Business Review*, November – December, 69, 6, 69-79.
- Drucker, P. F. (1999), "Knowledge-worker productivity. The biggest challenge," *California management review*, 41, 2, 79-94.
- Fruchter R. (2005), "Degrees of engagement in interactive workspaces," *International journal of AI and Society*, 19, 8-21.
- Gladstein, D.L. (1984), "Groups in Context: A model of task group effectiveness", *Administrative Science Quarterly*, 29, 499-517.
- Guzzo R.A. and Dickson, MW. (1996), "Teams in organizations: recent research on performance and effectiveness," *Annual review of psychology*, 47, 307-338.
- Hackman, J.R. (1987), "The design of work teams", in Lorsch, J.W. (Ed.), *Handbook of organizational behaviour*, Prentice Hall, Englewood Cliffs, NJ, 315-342.
- Haynes, B. P. (2007), "The impact of the behavioural environment on office productivity", *Journal of Facilities Management,* 5, 3, 158-171
- Harrison, A., Wheeler, P. and Whitehead, C. (2004), "*The distributed Workplace*", Routhledge, London.

- Heerwagen, J. H., Kampschroer, K., Powell, K. M. and Loftness, V. (2004), "Collaborative knowledge work environments", *Building Research & Information,* 32, 6, 510-528.
- Hertel, G., Geister, S. and Konradt, U. (2005), "Managing virtual teams: A review of current empirical research", *Human Resource Management Review*, 15, 69-95.
- Hinds, P. J., and Bailey, D. E. (2003), "Out of sight, out of sync: understanding conflict in distributed teams", *Organization Science*, 14, 615-632.
- Janz, B. D., Colquitt, J. A. and Noe, R. A. (1997), "Knowledge worker team effectiveness: the role of autonomy, interdependence, team development, and contextual support variables", *Personnel Psychology*, 50, 4, 877-902.
- Jarvenpaa, S. L., and Leidner, D. E. (1999), "Communication and trust in global virtual teams", *Organization Science*, 10, 6, 791-815
- Jones, E. C. and Chung, C. A. (2006), "A methodology for measuring engineering knowledge worker productivity", *Engineering Management Journal*, 18, 1, 32-38.
- Joroff, M. (2002), "Workplace mind shifts", *Journal of Corporate Real Estate*, 4, 3, 266 – 274.
- Kelloway, K. E., and Barling, J. (2000), "Knowledge work as organizational behaviour", *International journal of management reviews*, 2, 3, 287-304.
- Kozlowski, S. W. J., and Bell, B. S. (2003), "Work groups and teams in organizations", in Freedheim, D. K., Weiner, I. B., Velicer, W. F., Schinka, J. A., Lerner, R. M. (Eds.), *Handbook of Psychology*, John Wiley and sons, 334-377.
- Kozlowski, S. W. J., and Ilgen, D. R. (2006), "Enhancing the effectiveness of work groups and teams", *Psychological Science in the Public Interest*, 7, 3, 77-124.

- Litschka, M., Markom, A. and Schunder, S. (2006), "Measuring and analyzing intellectual assets: an integrative approach", *Journal of intellectual capital*, 7, 2, 160-173.
- Majchrzak, A., Rice, R. E., Malhotra, A., King, N. and Ba, S. (2000), "Technology Adaptation: The Case of a Computer-Supported Inter-Organizational Virtual Team", *MIS Quarterly,* 24, 4, 569-600.
- Martins, L. L., Gilson, L.L. and Maynard, M.T. (2004),"Virtual teams: What do we know and where do we go from here?", *Journal of Management*, 30, 6, 805-835.
- Maznevski, M. L. and Chudoba, K.M. (2000), "Bridging space over time: global virtual team dynamics and effectiveness", *Organization science*, 11, 5, 473-492.
- McGrath, J. E. (1984), "*Groups: interaction and performance*", Prentice Hall, New Jersey.
- Mortensen, M., and Hinds, P. J. (2001), "Conflict and shared identity in geographically distributed teams", *International Journal of Conflict Management*, 12, 212-238.
- Pepitone, J.S. (2002), "A case for humaneering", *IE Solutions*, 5, 39-44.
- Picard, R.G. (1998), "Measuring and interpreting productivity of journalists", *Newspaper research journal*, 19, 4, 71-80.
- Powell, A., Piccoli, G. and Ives, B. (2004), "Virtual teams: a review of current literature and directions for future research", *The DATABASE for Advances in information systems*, 35, 1, 6-36.
- Pritchard, R. D., and Watson, M. D. (1992), "Understanding and measuring group productivity", Worchel, S., Wood, W. and Simpson, J. A. (Eds.), *Group process and productivity*, Sage, Newbury Park, Ca, 251- 275.
- Pyöriä, P. (2005), "The concept of knowledge work revisited", *Journal of knowledge management,* 9, 3, 116-127.

- Pyöriä, P. (2006), "*Understanding Work in the Age of Information. Finland in Focus*", Doctoral thesis, University of Tampere, Faculty of Social Sciences.
- Pyöriä, P., Melin, H. and Blom, R. (2005), "*Knowledge workers in the information society. Evidence from Finland*", Tampere university press, Tampere.
- Quinn, R. W. (2005), "Flow in knowledge work: high performance experience in the design of national security technology", *Administrative science quarterly*, 50, 610-641
- Ramírez, Y. W. and Nembhard, D. A. (2004), "Measuring Knowledge worker productivity: A taxonomy", *Journal of intellectual capital*, 5, 4, 602-928.
- Rittenhouse, R. G., (1992), "Productivity and the Microcomputer", in Khali, T. and Bayraktar, B. (Eds), *Management of Technology III*, Institute of Industrial Engineers.
- Ruggles, R. (1998), "The State of the Notion: Knowledge Management in Practice", *California Management Review*, 40, 3, 80-89.
- Sassone, P. G. (1996), "Office Productivity: The Impacts of Staffing, Intellectual Specialization and Technology", *Technology Analysis and Strategic Management*, 8, 3, 247 - 269
- Scarbrough, H. (1999), "Knowledge as work: conflicts in the management of knowledge workers", *Technology analysis and strategic management*, 11,1, 5-16.
- Scott P. B. (2005), "Knowledge workers: social, task and semantic network analysis", *Corporate communications: an international journal*, 10, 3, 257-277.
- Vartiainen, M., Hakonen, M., Koivisto, S., Mannonen, P., Nieminen, M. P., Ruohomäki, V., and Vartola, A. (2007a), "*Distributed and mobile work – places, people and technology*", University Press Finland, Helsinki.

- Vartiainen, M. (2007b), "Teams in globalised collaborative working environments and their coping mechanism", in: *Globalisation and new collaborative working environments. Conceptual framework incl review of state-of-the-art in research and practice*, New Global, European Union Report, WP1 deliverable: D1.2, 107-144.
- Vischer. J. C. (2005), "*Space meets status: designing workplace performance*", Routledge, New York.
- Vischer, J. C. (2007), "The concept of workplace performance and its value to managers", *California management review*, 49, 2, 62-79.

Figure 1: Enabling and hindering elements of Knowledge Work Productivity in distributed teams.