

Analysis of virtual teams.

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Abstract

This paper tracks the increasing interest in virtuality and its effects not only on economic, but also on psycho-social aspects of team performance. It introduces an approach to quantify the degree of virtuality (Do 9 as the unique, but varying characteristic of teams in the virtual. A model of a virtual team (V7) environment is constructed and is tested through a series of working hypotheses derived from the literature. We find that virtuality does not directly influence the economics of effective team performance but, instead, it influences team success through specific mechanisms in regard to a team 's social and psychological efficiency at the individual and the team level. It also shows that "virtuality" encourages several dysfunctional characteristics within a team environment and describes how these can be approached by providing practical implications.

Introduction

'Virtuality' is assumed to have an increasing impact not only on our private, but also our occupational lives. The term is often associated with the rapid development of Information and Communication Technologies (ICTs) over the last years. Collaboration is possible without having to meet partners face to face (f2f). In parallel the supply of bandwidth and advanced conferencing or shared application tools is increasing at decreasing cost. Aichele (2006) states that the development of the information society brings along danger which is as prevalent as it is unexplored. ICT development has to be questioned according to its societal acceptance and effects. It is acknowledged that the gradual workplace virtualization and dispersed collaboration harbours problems (Eichmann and Hermann, 2004). Although virtuality seems to be a salient issue to be taken into account when conducting research on organizational work groups, studies rarely provide clear descriptions of the characteristics of the teams under their investigation (Dube and Pare, 2004). One such attempt by Blanas (2002) has developed a CMM (Capability Maturity Model) that reflects several of the learning and management attributes related to groupware for the cooperation of virtual teams, though in general the views of Dube and Pare prevail.

A review of VT-related managerial, organizational, sociological and psychological literature found that there were heterogeneous approaches to the terms 'virtuality', 'virtual teams' and 'degree of virtuality'. Additionally, classifications vary and few studies provided a quantifiable analysis of the effects of working virtually on the involved individuals and social systems. This constitutes a need for further research because it is known that economic issues

are not the only factors expressing the vital states of organizations and their members. Nieder (1984) states that a 'more healthy' organization distinguishes itself from a 'more ill' one by a better balance between economic effectiveness and social efficiency. Little attention is paid to this aspect, especially in VT related publications, although under-estimation or mismanagement of 'soft' key figures is known to contribute to negative effects at various levels, not only harming project success, but also to dysfunctional organizational cultures (Scholz, 2000a; Turk, 1976). This research study is directed to examining this issue in more detail influenced by an approach first suggested by Turk (1976). It was chosen because recent VT-related literature highlighted the difficulty of direct, interpersonal supervision in VTs (Kirkman et al., 2004; Bell and Kozlowski, 2002). Additionally, the omission of analyzing and measuring behavioural, psycho-social outcomes in regard to performance of VTs is noted (Martins et al., 2004).

Given the lack of knowledge about patterns and measuring mechanisms in forms of virtual collaboration, especially in VT research (Stevenson and Weis McGrath, 2004) and 'little current theory to guide research on the leadership and management of virtual teams' (Bell and Kozlowski, 2002, p. 15), the need for further research constituted the following research question (RQ), which includes several subquestions:

RQ 1: What are the effects of virtuality in organizational teams?

- RQ 1.1: What are the effects of virtuality on economic team effectiveness?
- RQ 1.2: What are the effects of virtuality on psycho-social team efficiency?
- RQ 1.3: How do managers and members involved in differently virtualized teams perceive the applied managerial forces in the virtual?
- RQ 1.4: How is the deployment of VTs perceived and described in practice?

The pursuit of the RQ required the closure of several theoretical prerequisites, denoted as research problems (RPs):

- RP 1: How can VT environments be described and classified?
- RP 2: How can the following factors be quantified?
 - RP 2.1: Degree of Virtuality (DoV)
 - RP 2.2: Managerial forces with an integrative view on direct and indirect managerial influences
 - RP 2.3: Psycho-social/behavioural indicators of efficiency
- RP 3: How can a model of a VT be established that considers the factors from RP 1 and 2 in order to serve as a framework for the research in regard to pursuing the RQ?

In order to answer these questions, we firstly establish a concept of VTs by examining the intersection of the domains of virtuality, team and degree of virtuality (DoV). The next goal is to characterize virtuality and productive team performance at the economic, social and individual level into a framework. Here, productivity is assumed to embrace economic, social and psychological measurements of performance. The importance of social and psychological factors in consideration of productive group output is stressed in Halfhill et al. (2005). By integrating the variables of Orientation (O), Motivation (M) in its intrinsic and extrinsic dimensions as well as Identity/identification (I) into the research framework of this study, the analysis strives for a scalable perspective that acknowledges both

the organization and the team as social systems made up of individuals in the tradition of Turk (1976). The concept offers a pertinent starting point for a quantifiable analysis of VT environments via integrating non-personal indirect and direct managerial leadership forces as part of the social systemic organizational context.

The following sections describe the methodology that includes the resolution of the RPs prior to a further pursuit of the RQ. There follows a description of the research design and the data analysis procedures addressing the RQ. Subsequently, findings of the empirical phases are presented.

Methodology

Addressing the Research Problems

RP 1: 'Virtuality' seems to characterize a state within the process of virtualization that starts when humans model abstract alternatives of real objects. This process is closely connected both to technology and human beings. Technology is both enabler for human beings to realize virtuality as well as means to access and perceive it.

Groups or teams, which are used synonymously in the following, are described as two or more individuals who directly interact interdependently within a certain time frame (Rosenstiel, 1995; Gebert and Rosenstiel, 1981). Group communication towards accomplishing a common purpose is predominantly carried out face to face (f2f) (Guzzo and Dickson, 1996; McGrath, 1984; Alioth, 1980). Given the previously explained foundations, a team would seem to enter the "virtual", when the interaction between its members is digitally represented to a certain extent. The more frequently a co-located situation with synchronous interaction and communication channels is simulated via ICT, the more virtual its members operate. Interaction in our perspective comprises both formal, task-related and informal, interpersonal/social information and communication exchange. It seems reasonable to assume that virtuality occurs in different degrees and constitutes multiple configurations of organizational design in the hybrid workplace somewhere in between traditional and fully virtual environments. While Palmer and Speier (1997) describe VTs as intraorganizational groups, the dominant opinion is that VTs also comprise interorganizational collaborations, e.g. virtual organizations or virtual enterprises (Mowshowitz, 2002; Tjortjis et al., 2002; Travica, 1997; Davidow and Malone, 1992). It is recognized that the term is as a genus itself for different varieties of virtualized groups and that various hybrid forms, between the fully co-located and fully virtualized team, occur in industrial and educational practice (Chudoba et al., 2005; Griffith et al., 2003; Griffith and Neale, 2001; Wong and Burton, 2000). Kirkman and Mathieu (2005, p. 703) state that many teams 'fall between these extremes and occupy middle ranges on a continuum of virtuality'. According to our concepts of the conventional team on the one hand and the fully virtual team on the other, a wide range in the middle is left out. This gap is filled by the conceptual construct 'hybrid' or 'virtualized' team. Hybrid teams are part of a complex spectrum of possibilities between completely virtual and completely traditional. In an effort to at least partially characterize and classify these teams we have integrated several variables applied to distinguish traditional teams (see Fig. 1) and defined the degrees of virtuality

(DoV). It is viewed as important because virtuality is recognized as a potential characteristic of all teams (Martins et al., 2004; Griffith et al., 2003).

RP 2.1: Besides variables that are also used to classify traditional team varieties, the question remains as to how to characterize, quantify and measure the DoV to differentiate teams in the hybrid space. While several contributions associate virtuality and its degree with geographic dispersion (Staples and Cameron, 2005; Walther and Bunz, 2005; Lipnack and Stamps, 2000), critics acknowledge that teams may well be highly virtualized when not operating over huge borders of time and space (Kirkman and Mathieu, 2005). Others discuss virtuality as a composition of different dimensions. Chudoba et al. (2005) introduce three dimensions of virtuality comprising team distribution, workplace mobility and variety of practices. Others share the view that technology mediation is one indicator and dimension characteristically for the DoV. The application and usage of digital ICTs not only enables workers to cooperate synchronously and asynchronously (Pauleen, 2003), it also makes a team virtual to different extents. Bell and Kozlowski (2002) highlight the absence of f2f interaction between team members as the key factor making a team virtual. ICTs enable the digital representation of real, interactive f2f situations in which team members communicate at a certain frequency and exchange different formal, task-related and informal, interpersonal/social contents. In view of Kirkman and Mathieu (2005) virtuality embraces reliance on ICT, informational value and synchronicity. A less virtualized team is characterized by a high frequency of usage of virtual tools, low synchronicity and low informational value. Dube and Pare (2004) underpin the reliance of ICT as a key factor of team virtuality and additionally view both ICT availability and the members' proficiency in ICT as additional characteristics that to different degrees are shared by all VTs. By aggregating the concepts and dropping those dimensions that would not necessarily appear to be characteristic of teams that are virtualized, we propose two dimensions of the DoV. These include a quantitative dimension (To what extent is f2f interaction digitally represented?) and a qualitative dimension (To what extent are formal, task related and informal, person-related contents exchanged?).

The quantitative DoV is approached by generating the weighted mean value of the communication mechanisms. By normalizing this result, a DoV value between 0 and 1 is established. The more synchronous a mechanism is and the more frequently it is used, the higher the weight and the specific quantitative DoV. The qualitative DoV comprises two items, namely frequency of exchange of formal and informal content. Within the social entity 'team' every member is associated with a specific DoV according to the quantity and quality of digitally represented interaction with other team members that is carried out. A VT is not marked with a static DoV per se. Dahme and Raeithel (1997) state that virtuality is an introversive form of reality which is connected to the individual persons acting in an environment in a particular way.

RP 2.2: Turk (1976) integrates both direct (interactional) and indirect (structural) strategies and furthermore enables a systematic access to the explanation of the development of problems in organizational structures. He presumes that the action of a person within the organization as a social system is determined by processes

in the dimensions of orientation (O), motivation (M) and identity/identification (I). In regard to a team context, orientation means to know where to find the resources needed to fulfil one's task. Motivation embraces the intrinsic and extrinsic dimension. Greene and Lepper (1974) describe intrinsic motivation as doing what one wants, while extrinsic motivation refers to doing something to get something (Reiss, 2005, p. 4f.). Identity in the team environment means the identification with the task, the team and the involved organizations. The direct or indirect impact of O, M and I influences an individual's behaviour.

Mismanagement in the areas of O, M and I relates to symptoms of dysfunctional patterns reflected in behaviour and perception of individuals. When dysfunctional states are shared by individuals they threaten all organizational levels and are characterized by pathological cultures. Scholz (2000b, p. 779) describes culture as the implicit awareness of a business, which accrues from the behaviour of the members of the organization and, in return, governs the behaviour of individuals. Thus, dysfunctional cultures are associated with contributing to psychic and social cost to be borne by both individual employees and organizations (Scholz, 2000a; Turk, 1976). Turk characterizes three types of costs: dominance, psychic and social costs. Dominance costs affect the organization and are reflected in increased managerial or technical effort to maintain a certain performance level or loss of yield caused by deficiencies in terms of fluctuation, absenteeism or poor quality of goods and decisions due to information scarcity. Psychic costs are borne by the individual and embrace frustration, fear, feelings of inferiority and higher individual effort or constraint to overcome motivation loss. Social costs refer to those efforts at the expense of an employee in terms of his socio-emotional relations to others. In regard to RP2.2 the perspective following Turk (1976) is applied. It would seem that the approach considering influences on O, M and I, either directly or indirectly, serves an expression of managerial influences for the further pursuit of the RQ in accordance with the recent literature.

RP 2.3: Similar to RP 2.2 the perceptions of O, M and I at the individual and the team level are adopted in order to express the psychological and social performance of a team in the virtual from the perspective of Turk (1976).

RP 3: The framework shown in figure 1 integrates the considerations and variables as described above. It comprises the dimensions attitude, context, management/leadership and performance, each subdivided according to the organizational, team and individual level. 'Context' is reflected by a set of situative variables, which the DoV in its two perspectives forms part of. Further variables have been gleaned from the literature to be able to classify and cluster the different possible appearances of teams in the hybrid. The dimension 'performance' includes measurements of economic effectiveness at the organizational level and indicators of social and psychological efficiency. The view is expanded by the dimension 'attitude' measuring the current, team-related states of orientation (O), motivation (M) and identity/identification (I) as well as enduring states that are acknowledged as influence forces to current attitudinal perceptions. 'Management/Leadership' includes the aggregated indirect or direct levels of support of the dimensions O, M and I.

Research Design

The elements included in the model (Fig. 1) were designed into a questionnaire, which addressed RQ 1.1-1.3. Subsequent to a pre-test, the bilingual online-survey in English and German was conducted from 12/2005 to 06/2006 and delivered 159 responses. The pursuit of RQ 1.4 included additional semi-structured interviews (SSIs) with practitioners that were conducted in 12/2006. Themes included team members perceptions on the virtualized team environment, disadvantages, objectives and the understanding of productive performance. In addition, the perception of effects of virtuality on the workplace and their (self-) management, identified problems, problem-solving strategies and the perception of O, M and I were of interest.

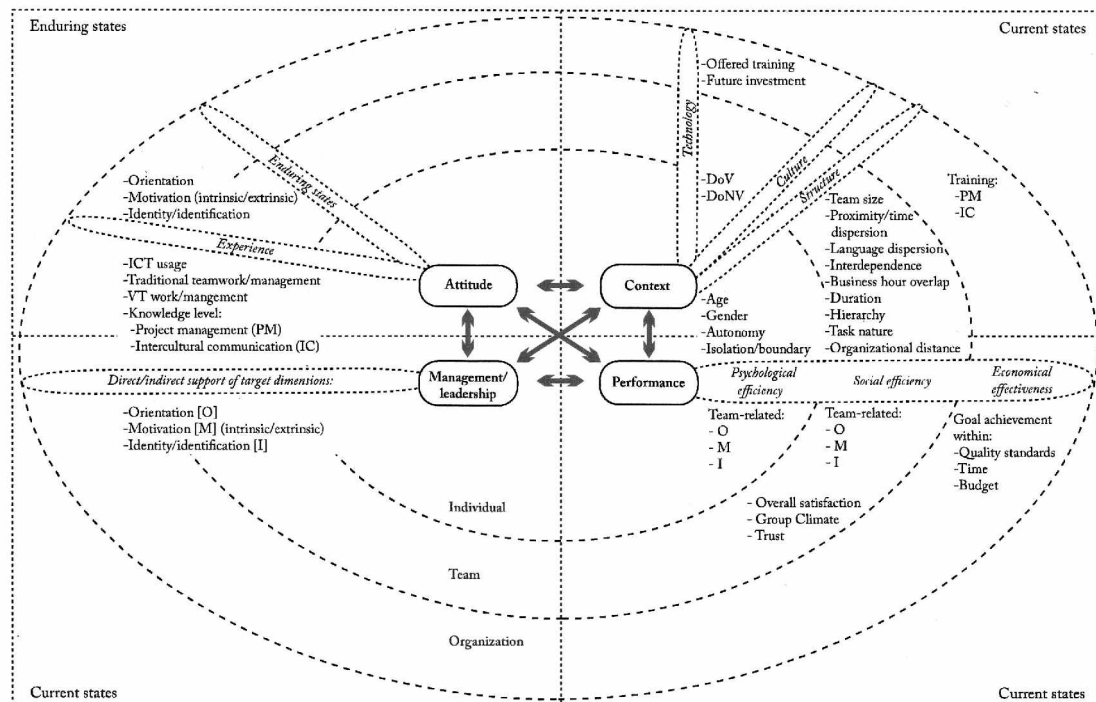


Fig. 1: Model of a Virtual Team (VT)

Analysis of data

The deductive part of the research included the establishment and testing of working hypotheses (see Table 1) based upon theoretical suggestions from the literature on how to support the dimensions of O, M and I. Given the aim of finding out how the suggestions are reflected in the data and the ordinal, metric nature of the scales, hypotheses were tested by calculating construct relations with Spearman's Rho (SR) (Schlittgen, 2000). The reliability of the scales used was assessed with a calculation of Cronbach's Alpha (α). The acceptable reliability of the scales and the support for various developed hypotheses gave confidence for a further inductive pursuit of the RQs based on the developed approach. Therefore, the dataset was both graphically and statistically explored in light of each RQ. The correlation analysis included the calculation of SR.

Deductive Findings**(Validation of the proposed solutions to the Research Problems)**

Table 1 summarizes the test results. Those hypotheses that are significantly supported at a confidence level of 5 per cent ($p < 0.05$) are filled in black. However the strength of significance as measured by the closeness to unity of the correlation coefficients was generally between 0.3 and 0.5. Therefore the deductions from this study must be regarded as indicative rather than definitive. The hypotheses were developed to examine the difference between the views at the individual level (a) and the team level (b) and have been constructed from a distillation of the relevant literature.

Table 1: Overview of significant results (deductive phase)

H	Table key:		Level	SR	SR
	■	■	(a)	Members n=60	Managers n=99
The perception of orientation is positively related to:					
1	The setting of individual goals	(a)	■	■	■
		(b)	■	■	■
2	The setting of team goals is	(a)	■	■	■
		(b)	■	■	■
3	The communication of expectations concerning the team	(a)	■	■	■
		(b)	■	■	■
4	The assignment of tasks and responsibilities	(a)	■	■	■
		(b)	■	■	■
5	Individual role awareness	(a)	■	■	■
		(b)	■	■	■
6	The awareness of team values	(a)	■	■	■
		(b)	■	■	■
7	The awareness of binding norms	(a)	■	■	■
		(b)	■	■	■
The perception of intrinsic motivation is positively related to:					
8	The individual decision freedom	(a)	■	■	■
		(b)	■	■	■
9	The individual freedom of time management	(a)	■	■	■
		(b)	■	■	■
10	The freedom to choose communication channels	(a)	■	■	■
		(b)	■	■	■
Extrinsic motivation is positively related to					
11	The application of reward systems is related to the DoNV				
12	The application of reward systems	(a)	■	■	■
		(b)	■	■	■
Identity/identification is positively related to:					
13	The individual role awareness	(a)	■	■	■
		(b)	■	■	■
14	The decision freedom at the individual or team level	(a)	■	■	■
		(b)	■	■	■
15	The perception of a normative framework	(a)	■	■	■
		(b)	■	■	■

We will now consider these in respect of O, M and I:

Orientation: At the individual level there is support for assuming that the setting of individual goals (H1), team goals (H2), communication of expectations to the team (H3) and the awareness of binding norms (H7) positively relate to the perception of orientation. Additional influences at both the individual and group level are identified in the clear assignment of tasks/responsibilities (H4), individual role awareness (H5) and the awareness of team values (H6).

Motivation: At the individual level, there seems to be a positive relation between the decision freedom at the individual level and the indicated intrinsic motivation (H8) as well as between reward systems and extrinsic motivation (H12). The individual freedom to choose one's communication channels significantly relates to intrinsic motivation at both levels within the member perspective (H10), but is not reflected by managers. Interestingly, no relation to intrinsic motivation was identified for the freedom of time management as expressed in H9. This raised the question if VT managers should be less involved in regulating the usage of tools but therefore be more involved in time-management by setting timely goals, which in return support orientation. This constituted an additional interview theme with the focus to explore how time management and the freedom to choose communication tools is arranged and perceived by the interviewees.

Identity/identification: Individual role awareness (H13) and decision freedom (H14) at the individual level show a significant relation to identification with the team at both levels in the perspective of members. Members also reflect a support for H15 in terms of a positive relation between the perception of a normative framework and the shared group identity.

Overall, the results of the deductive part showed several strong consistencies between theoretical assumptions and their reflection in the data. This gave confidence for further inductive pursuit of the RQ.

Inductive findings (Research Question)

With further interest in perceived effects of virtuality in teams at different levels four subquestions were formulated. RQ 1.1-1.3 were addressed by a questionnaire, while RQ 1.4 was addressed by SSIs. The findings in regard to each subquestion can be summarized as follows:

RQ 1.1-1.3 (based on questionnaire): The respondents of the questionnaire reflect the assumed diversity and pervasiveness of virtuality in business practice as recognized by Martins et al. (2004) and Griffith et al. (2003). In fact, synchronous applications were comparatively lightly used as compared with asynchronous methods such as E-Mail, Internet and Intranet. An overall trend of further investment into ICT is noticeable. Within the group of managers 47 per cent score a high DoV ($x > 0.5$) as opposed to 25 per cent within the group of non-management. The majority of respondents were located in Germany (46.5 per cent), followed by the USA (15.7 per cent) and the UK (10 per cent). 57.2 per cent were large companies with the balance being SMEs. The majority of respondents belong to

non-educational sectors (67.3 per cent) of which 17 per cent are in manufacturing.

RQ 1.1: The DoV in its qualitative and quantitative perspective shows no significant relation to economic effectiveness. On the contrary, highly significant relationships at the one per cent confidence level were identified for attitudes at the individual level. These comprise orientation (SR=0.250), intrinsic motivation (SR=0.289) and identity/identification (SR=0.257). At the team level, orientation (SR=0.258), group climate (SR=0.298) and trust (SR=0.240) reflect positive relations to economic effectiveness. Indirect and direct support of Orientation and Identity/identification also reflect a statistical relation to the economic effectiveness in the manager and member perspective. As a result, the answer to RQ 1.1 can be proposed as follows:

P1: The degree of virtuality is not positively related to economic effectiveness of a team's performance.

Instead, positive relations between the managerial support and perceptions of O, M and I are identified. Thus, social and psychological dimensions are salient prerequisites for achieving economic success in VT environments. O, M and I not only significantly relate to economic effectiveness, but their relation is also noticeably stronger than other factors, that have been recently discussed in the context of VT management as targets of leadership and indicators of non-economic performance, e.g. trust (Jarvenpaa and Leidner, 2000).

RQ 1.2: The DoV positively relates to indicators of social and psychological efficiency as summarized in Table 2, which considers significant results as those scoring values over 0.2.

Table 2: Overview of significant relations between DoV and attitudes (individual and team level)

Performance level	Individual				Team			
Attitude	Orientation	Motivation		Identity/identification	Orientation	Motivation		Identity/identification
		intrinsic	Extrinsic			intrinsic	extrinsic	
DoV	Orientation	intrinsic	Extrinsic	Identity/identification	Orientation	intrinsic	extrinsic	Identity/identification
Quantitative	-	-			-			-
Qualitative	-		-		-			

At first sight it would seem reasonable to assume that the DoV in its qualitative and quantitative dimension positively relate to motivation and identity/identification as indicators for social and psychological efficiency. This though has to be put into perspective with the findings of the subsequent question RQ 1.3.

RQ 1.3: RQ 1.3 aimed at finding out how members and managers in different DoVs perceive the applied managerial forces supporting O, M and I at the individual and the team level. The influence and support of motivation is indicated at a higher level by managers with a higher DoV. This is underpinned by a significant relation between the DoV and the level of perceived motivation support ($SR=0.211$) at the five per cent confidence level. The influence on the remaining attitudes is not indicated differently. No significant, positive relations between the DoV and the level of support of the remaining attitudes are identified. Although positively related to economic effectiveness (see RQ 1.1), there is no increase in the quality of perception or the level of support of orientation with increasing DoVs. With regard to identity/identification the expected trend of a positive relation between the DoV and individual identification with the team is reflected. On that basis, the following propositions can be established referring to the previous question RQ 1.2:

P2: The orientation of virtualized/hybrid teams is independent of the DoV.

P3: Virtual team members are more motivated, the higher the DoV.

P4: Members of VTs identify with the team more strongly, the higher the DoV.

In view of RQ 1.3 we propose:

P5: Managerial support of attitudes is largely independent of the DoV.

In light of the propositions several problems are evident. Besides motivation, managerial support is not increased to meet the needs of the virtual environment towards achieving more social and psychological efficiency as prerequisites for economic success. For practitioners the question arises as to how to overcome the need of creating identity in less virtualized environments and how to create more orientation in the virtual (see section 'Implications for practice').

RQ 1.4 (based on SSIs): The SSIs addressed issues arising from the questionnaire as well as the themes described in the section 'Research Design'. Approximately equal numbers of managers and non-managers enabled a balanced explorative insight into two perspectives of VT practice. The first impressions gained from the interviewees were of low involvement, loss of time and increased effort for coordination. Strong motivation to follow economic objectives with the implementation of VT work is identified. These include the saving of resources in regard to time and the ability to deploy skills and knowledge which are not in-house fast. Similarly, interviewees do not associate social or individual factors with the notion of productivity. One respondent explicitly doubts that work is carried out more effectively by teams just because of the fact that they are operating virtual. This supports P1 derived from the questionnaire in view of RQ 1.1.

The majority of respondents considered the disadvantages of VT work to comprise intrapersonal (less involvement with the team and the task, isolation) and interpersonal aspects (reduced quality of conversation, reduced ability for adequate reaction and judgement) aspects. On the contrary, advantages such as another mention of saving resources, fast reaction to needs by choosing the right people for the job are rather associated with the organization. Remote home workers describe effects

of virtuality on their workplace more positively than respondents sharing an office situation with others. Thus, the comfortable environment without disturbances or stress caused by travelling is mentioned. All respondents describe effects of virtuality on their senior management and their self-management. While only negative aspects such as more time-consuming effort for coordination are noticed at the superior level, remote workers report a positive effect on their self-management. The blurred boundaries between work and family life are not perceived negatively, but positively by offering more flexibility with less (group) pressure.

Respondents describe several problems. Cultural problems include misunderstandings in regard to commitment to meet appointments and adequacy of responding to requests in time. Technical problems include missing voice tracks in videoconferences or total connection breakdowns. Group and process problems comprise intransparency of the availability of others and of progress as well as social loafing and low perceived commitment/seriousness. The consequences that were mentioned include negative aspects at the individual level such as loss of time due to higher effort for coordination in overcoming misunderstandings, frustration and lowered team feeling/identification. Overcoming the problems, especially cultural ones, is described to be nearly if not fully impossible by a majority of the interviewees. Problem solving strategies included traditional methods (milestones, delivery dates, appointment of discussion leaders in conferencing situations, dissemination of protocols).

Lastly, themes aimed at exploring effects and perceptions in regard to the attitudes of O, M and I. Three respondents describe a positive orientation within their team environment that they associate with clarity of roles and goals in alignment with the strategic goal framework of the organization. Two mentions highlighted the importance of achieving orientation in both traditional and virtual settings and view it as a responsibility of oneself. Nevertheless, negative aspects included the availability of others. Remote home workers clearly indicate a positive and higher work motivation in comparison to the remaining respondents who describe their motivation rather neutral and dependent on the task or topic. In regard to identity/identification, three respondents, of which two work from home, indicate positive effects. The virtual environment enables individuals that are restricted to being at home for several reasons to participate in work life. In addition, higher identification with the organization is reported by another respondent working from home. Distance and anonymity were described positively, because one can focus stronger on the task and detach more quickly from negative group situations. Negative mentions include full loss or a lowered team feeling, involvement and identification with the team and the task.

Conclusion

Having provided an approach to investigate 'virtuality' in organizational team environments and its influences on economic, social and psychological performance, several conclusions and implications can be drawn. These are highlighted in the following according to their contributive nature.

Implications for theory

Several prerequisites for examining effects of virtuality on the organizational team output were established prior to the pursuit of the RQ. This included descriptions of the terms virtuality, virtualization and VT. In order to classify virtual teams, the importance of the DoV was highlighted in the context of other approaches and variables. As a basis for empirical analysis the DoV was quantified. Subsequently, the methodological approaches to managing and monitoring psycho-social performance with the dimensions of O, M and I in the sociological systemic tradition of Turk (1976) were highlighted. These findings formed part of establishing and modelling a research framework with regard to RP 3. The framework included classificational variables in the dimensions 'context' and 'attitude', indirect and direct managerial forces in the dimension 'management/leadership' as well as economic, social and psychological team performance measures. The framework was modelled into a questionnaire for an online-survey which was followed by SSIs. The deductive part of the study confirmed many of the hypotheses and constitutes a basis for practical implications on how to enhance O, M and I (see section 'Implications for practice'). The reliability of the scales provided a pertinent basis for the subsequent inductive analysis in regard to effects of virtuality displayed by the RQ.

The findings underpin the assumption that virtuality is not significantly related to economic effectiveness (P1), but relates to indicators of social and psychological efficiency as displayed in the propositions. Positive effects are identified in the dimension of motivation but are associated with an increase in the support of motivation in higher DoVs (P3). Orientation seems to be low in all virtualized teams (P2). Although identity/identification is positively related to the DoV (P4), the general level of virtuality in the sample shows that this effect is not exploited to its full potential.

Overall, the results emphasize the importance of considering both virtuality, social and psychological efficiency in team research and practice. Teams might achieve goals from the organizational point of view, but several significant relations at the team and individual level that influence performance were highlighted in ways that put team success in relation. In particular, virtuality was found to modulate economic success. From the authors' point of view several dysfunctional or negative aspects mentioned in relation to VT work already reflect symptoms of pathologies and non-economic costs. As an example, timely advantages associated with faster project cycles by working virtually are questionable and are not supported by this study. Instead, the existence of dominance cost in VTs is reflected in more efforts and time-consuming activities. The SSI in view of RQ 1.4 reflected psychic costs like isolation and frustration. They also showed that the identified increase in time-consuming activities in VTs contradicts the advantages that are associated with both themselves (Konradt and Hertel, 2002) as well as those with teams in the traditional sense (Rosenstiel, 2000). This provides evidence that there is a need for further studies, since the validity of traditional theory in light of the construct 'virtuality' appears to be limited. This study provided an insight into identifiable facets of virtuality with a thrust to investigate its effects in organizational teams. The assumption that virtuality has different degrees (quantitatively and qualitatively) enabled a quantifiable and systematic approach to characterizing and distinguishing those team

structures assumed to be prevailing in practice. There is a noticeable need for further theoretical and practical knowledge on psychological and social team aspects in order to actively enhance the ability to anticipate to threatening factors at the individual, the team and the organizational level in the context of virtuality. Nevertheless, several indications for practice could be discovered by this study. These are summarized in the following.

Implications for Practice

Although we note a trend towards further investment into advanced ICTs, the domain of low DoVs that is characterized by a high usage of asynchronous tools still seems to be the prevalent level of virtuality in the hybrid teamspace. In our study, virtualization has been associated with problems in the dimensions of orientation and (team) identity/identification. For practitioners the question arises how to solve these problems. Given the complex nature of virtuality and teams, this study in a comparatively new and unexplored field can only be regarded as indicative. Nevertheless, several practical implications are offered. The deductive findings introduced ways to monitor and maintain or enhance social and psychological efficiency with a focus on O, M and I at the individual and the team level. These can be applied by both managers and members, who should be encouraged to demand or push forward clarity in the following dimensions.

Orientation: Orientation can be enhanced for the individual and the team by setting goals at the individual (H1) and the team level (H2). That includes the communication of expectations concerning the team (H3) as well as the assignment of tasks and responsibilities (H4), raising awareness to individual roles (H5) and team values (H6). Managers can therefore play a more active role in the process of the members' time- and self-management. This is pertinent to support orientation as there is no statistical evidence to suppose that the remaining dimensions of motivation and identity/identification are threatened by increased attention to orientation. The responses from team members suggest that an awareness of binding norms is supporting orientation (H7-a).

Motivation: Intrinsic motivation is enhanced by individual decision freedom (H8-a) and individual freedom to choose communication channels (H10-a). Extrinsic motivation is enhanced by the application of reward systems (H12).

Identity/identification: Identity/identification is enhanced by individual role awareness (H13) that also enhances orientation (H5), decision freedom for individual team members (H14) and the creation of a normative framework (H15), which is underpinned by "rules of the game". Respondents expressed that virtual interaction is not a substitute for personal contact. Face-to-face (f2f) meetings, at least in the beginning phase, are advisable. In view of P4, which states that members of VTs identify with the team more strongly, the higher the DoV, one should strive for high DoV environments with more frequent usage of synchronous, advanced tools and more frequent informal and formal content exchange. This should happen within a given set of tools allowing members freedom to choose the most suitable.

Overall, this study reflected that virtuality is a pervasive factor which here has been investigated in the context of teams. Essentially, the approaches and findings of this study do not claim to be exhaustive. It is hoped that a fruitful and helpful basis for further penetration of the subject could be provided.

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