

Degree of Virtuality, Well-being and Performance in Dispersed Teams and Projects

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Abstract

In this explorative study, the degree of virtuality is defined by the six requirement features showing the contextual complexity of dispersed teams and projects. The features of contextual complexity are: location (same vs. geographically dispersed), mobility (fixed vs. mobile), time (synchronous vs. asynchronous), temporariness (permanent vs. temporary), diversity of actors (same vs. different), and the mode of interaction (face-to-face vs. electrically mediated). In addition to contextual features, task complexity is supposed to influence the internal processes of individual and collective subjects and their functional outcomes. The data consists 230 responses from fifteen teams and projects, which were sub-divided into 'Finnish', 'Nordic' and 'Global' groups. The three groups were compared in order to find differences in requirements, internal processes and outcome variables. The results show that the groups differ in virtuality, however, not consistently. The dispersed working complicates working. There are only few differences in internal processes and outcomes.

1. Definition of the research target and its context

Statistical data on employees in Europe shows the increased prevalence of new types of work and organisations. Most of the available data concerns the use of information and communication technologies (ICT) as tools in work (eWork¹). eWork has been sub-divided into three types: home-based telework, mobile work, and self-employed work in SOHOs (small office – home office, SOHO). In three years, 1999-2002, the number of eworkers has grown annually around 30 percents. In addition, distributed or virtual teams and projects inside companies and company networks are increasing rapidly due to customer-orientation, globalisation, and outsourcing using technologies as enablers. The number of distributed work units and their use spread in companies and other organizations are not, however, well-known.

The increase of eWork is an indication of emerging new organisations, whose effects on job demands and content, group processes, and on individual well-being and performance are only weakly known. It is assumed that new technologies, especially mobile technologies and services will be implemented more in the future creating pressures to develop and possibilities to work flexibly in different places and over time. Is this development a nuisance or a blessing for employees is a dilemma and a question of choices and decisions between alternatives. Information technology should, of course, be an instrument or medium through which new forms of organizations are enabled, but not determined. In contrast, it is the forms and requirements of the task and of the social interaction of the employees collaborating that should shape the actual work process and determine the performance and quality of the

¹ EWork: "Work practices making use of information and communication technologies to increase efficiency, flexibility (in time and place) and the sustainability of resource use." See. [Collaboration@Work](http://europa.eu.int/information_society/topics/ework/information/) The 2003 report on new working environments and practices. http://europa.eu.int/information_society/topics/ework/information/

business they are designed for. Consequently, ICT technologies should meet work-oriented social requirements in order to be a support rather than a hindrance for work.

Teams and projects in dispersed work context can be considered activity systems in their environment striving for their task-related goals. An activity system consists of a subject, tools and an object. Subjects as actors are social and cultural entities like individuals, pairs, groups, organizations and networks. They use both concrete and mental tools to work on their objects in their respective environment, which can be characterized by their complexity. Objects of work are manifested as assignments, tasks and goals related to them. In principle, three intertwined factors influence on the functionality, performance and the outcome of activity systems: (a) the complexity of individual and collective tasks, (b) the complexity of context or space, and (c) internal processes of individual or collective subjects.

Complexity of tasks. The content of assignments varies from routine to problem-solving and creative tasks (Andriessen 2003). Bell and Kozlowski (2002) claim that task complexity has critical implications for the structure and processes of virtual teams. In front of Figure 1, the task is demanding and carried out in a dispersed context, which is described by the extreme edge of the hexagon. In the far-end, the task is in its simplest form, i.e. work is routine-like and takes place locally and face-to-face. For example, in a global company, the collaboration in new product design teams between sites is more difficult than the collaboration of production lines in the same firm, not to speak about face-to-face collaboration in the same assembly line.

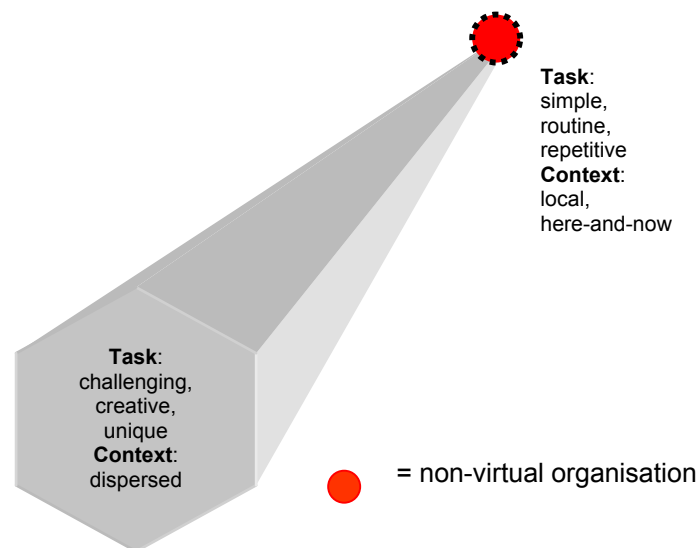


Figure 1. The combination of the degrees of task and context complexities creates the requirements for dispersed working.

Complexity of context. Tasks are always executed in some space. Space can be characterized as a context or an environment or a scene where actions take place. Roughly speaking, the context can be seen both physical and psychological or ‘objective’ and ‘subjective’. Each individual exists in a psychological field of forces that determines and limits his or her behavior. Lewin (1972) called this psychological field the ‘life space’. It is a highly subjective ‘space’ dealing with the world as the individual sees it. ‘Life space’ is, however, imbedded in the objective elements of physical and social field. The physical and social conditions limit the variety of possible life spaces and create the boundary conditions of the psychological field. ‘Subjective’ and ‘objective’ elements are not strictly divided, but the context is blended and layered as analyzed in the concept *ba* (Nonaka, Toyama & Konno 2000). *Ba* refers to a shared context in which knowledge is shared, created and utilized by those who interact there. *Ba* does not just mean physical space, but a specific time and space.

Nonaka et al. refer to Heidegger's concept of 'locality' that simultaneously includes space and time. *Ba* unifies the physical space such as an office space, the virtual space such as e-mail, and the mental space such as common experiences, ideas and ideals shared by people with common goals. Today's working life, the contexts of individuals and groups are combinations of physical, social, cultural and virtual working environments.

In this study, the complexity of context or space is described by the following six dimensions (Figure 2):

- (a) *Location*: actors are working in a same location face-to-face or geographically dispersed in different places.
- (b) *Mobility*: actors may be physically mobile and change their workplaces or they stay in a fixed place working mainly in one location.
- (c) *Time*: actors work either synchronously or asynchronously in different time zones or sequentially in a same time zone. In addition,
- (d) *Temporariness*: the collaboration of actors and their social structure may be permanent or temporary.
- (e) *Diversity*: the background of actors, i.e. their culture, education, sex, nationality, religion, language, etc, is similar or different.
- (f) *Mode of interaction*: communication and collaboration take place directly face-to-face or mediated via different media and technological systems.

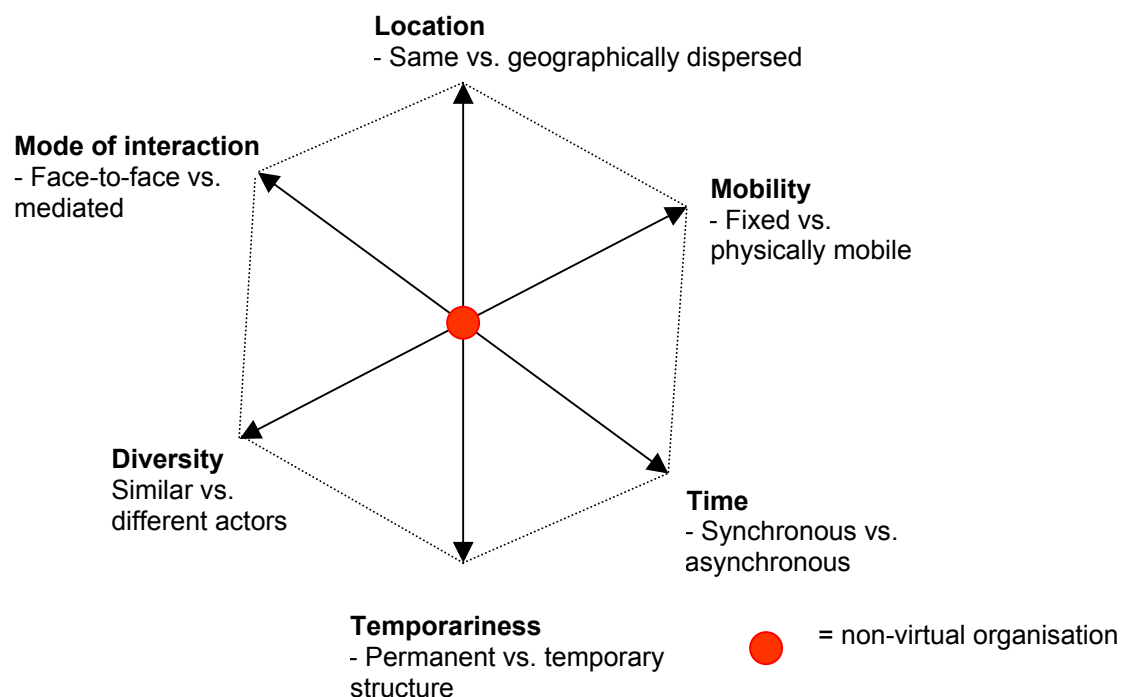


Figure 2. The context features of work systems defining the degree of virtuality.

The variables of location and time characterize the physical space, the variables of interaction indicate the virtual space, and the variables of diversity show the relations between people as the basis of mental space. In this study, the degree of virtuality is defined by these six dimensions and is always seen as their combinations. In the other end of the continuums (= spot in the center, Figure 2), there are traditional co-located work groups such as assembly workers around a production line, and in the other end, there are global, virtual teams and projects such as marketing teams and new product design teams, whose members are constantly moving and may never meet each other face-to-face. Dispersed teams and projects are defined as groups of people who work interdependently with shared purpose

across space and time using technology to communicate and collaborate (Lipnack and Stamps 2000). As our data represent different degrees of virtuality, we use the term ‘dispersed workgroup’ of each of our case groups.

In practice, teams and project are only seldom fully virtual in our meaning. Organization’s virtuality is a matter of degree (DeSanctis, Staudenmayer & Wong 1999). In a non-virtual organization, employees similar to their cultural and national background work in a same room, at the same time, and communicate face-to-face. In fully virtual organizations, employees work geographically dispersed, often asynchronously and are linked with each other by using various communication technologies. Thus the virtual organization challenges the traditional working here and now, and communicating face-to-face. In order to overcome temporal, spatial and organizational disablers, ICT is utilized both as means of communication and as a collective memory to collect, store, and utilize knowledge.

Internal processes of individual and collective subjects. The characteristics, features and actions of individual and collective subjects modify the influence of task and context complexities to activity systems’ performance and outcomes. On the individual level, actors may be seen as an open system existing and capable of existing only through processes of exchange with the environment. Rice (1969) described individuals as multi-task systems capable of multiple activities (Figure 3). The activities become bounded and controlled task systems when they are directed to the performance of a specific task and fulfilling of some specific purpose. Different goals and tasks (T) in different sites (S) require the individual to take different attitudes (A) and roles (R). Roles and attitudes needed in sites S_2 and S_3 overlap to the extent that they use some, but not all, of the capabilities of the individual. In contrast, tasks in the site one (S_1) require quite different capabilities. As can be concluded, the increasing degree of virtuality, e.g. the number of locations a group members uses and how often (s)he changes them, creates pressures for individuals’ mental and physical self-regulation, e.g. for re-orientation. In principle, the more virtual a group or a project is, the more flexibility is needed.

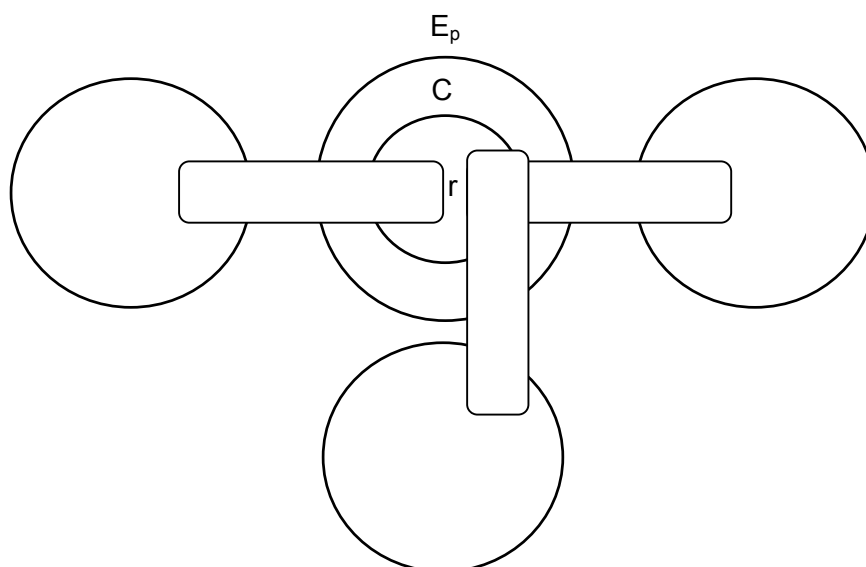


Figure 3. Individuals as acting subjects in dispersed work (E_p = external environment of individual, S_1 - S_3 = dispersed sites, C = cognitive functions, r = internal world of individual, T_1 - T_3 = different tasks, R_1 - R_3 = roles, A_1 - A_2 = attitudes) (Modified from Rice 1969).

On the group level, getting to know each others’ individual characteristics and ‘life space’ in dispersed teams is more difficult than in co-located groups. Clarity of common goals and tasks, others’ roles and accountability, etc. may be vague. As well knowledge about the practices of communication and information sharing and availability of technologies for

communication and collaboration may differ. All this may influence on intra-group processes like co-operation and collaboration, trust, and cohesion. Knowledge sharing and mutual learning are supposed to become more complicated when the task and context complexities increase. In spite of all these challenges, groups and projects should fulfill three functions to be effective (McGrath 1991): production function, member-support function, and well-being function. *Production function* implies that team performance meets or exceeds the performance standard set by clients. *Member-support function* requires that working in a team results in satisfaction, learning, etc. of individual group members. *Well-being function* is related to the degree to which the attractiveness and vitality of a team is strengthened.

Starting from these general points, this study aims at answering to the following questions: (1) how much each of the contextual features defining virtuality in dispersed teams and projects complicate teamwork, (2) what are the perceived effects of working in virtual settings compared to co-located work, and (3) how do ‘Finnish’, ‘Nordic’ and ‘Global’ dispersed teams and projects differ from each other in their contextual features, internal processes, and outcomes.

2. Data and methods

2.1 Dispersed groups and projects

The data was collected from eight companies all having their headquarters in Finland and from their fifteen teams and projects dispersed either in Finland (= ‘Finnish groups’), in the Nordic countries (= ‘Nordic groups’) or globally (‘Global groups’). These three groups were compared to each other supposing that they not only differ in their degree of virtuality but also in their internal processes and outcomes. Table 1 provides background information on the three research target groups. Teams and projects were of different sizes.

Table 1. Background information of the ‘Finnish’, ‘Nordic’ and ‘Global’ dispersed teams and projects and their members (n = 15, n_{members} = 230).

Background information	Finnish groups (n=125)	Nordic groups (n=22)	Global groups (n=83)
Age (years)	47.0	43.8	33.4
Females (%)	19.8	52.4	30.0
Supervisory position (%)	30.0	9.5	34.2
Locations (n)	5-6/group	2-4/group	2-8/group
Nationalities (n)	1	4	20
Team tenure (months)	9.9	15.3	12.9
Company tenure (years)	16.4	9.8	3.6
Travel days/year (n)	22.2	13.0	19.2
Location due to team task (n)	3.7	2.2	2.7
Former experience in dispersed teams (1 = not at all, 4 = a lot)	2.6	1.7	2.3

‘Finnish groups’ (n=125) consist of two projects: Three of the companies formed a two-year joint kraft mill process design project involving several sub-contractors and consultants, altogether over two hundred people. Although the project is large, its sub-units were supposed to work as dispersed collaborative teams aiming at their designing targets. Therefore, their responses are treated as group member answers. The second project came from a company providing expert services for design and construction of roads. The average age in the Finnish groups is a little bit higher than in other two groups. As well there are also less female employees. All members are Finnish and have worked on an average almost seventeen years in their firms. Members are physically rather mobile traveling a lot between several locations in the southern part of Finland.

'Nordic groups' (n=22) consist of four permanent teams: All four teams come from the same company providing information technology and software services for business customers all over Scandinavia. Employees work in several locations in Sweden, Norway and Denmark in addition to Finland. There are more female employees in this group than in others, and they are traveling less than 'Finnish' and 'Global' groups..

'Global groups' (n=83) consists of nine mostly project-type of teams in three companies operating worldwide. One of them is a small start-up company providing data capture software to its global customers and it operates in Helsinki, Stockholm, London, Brussels and Boston. The second global electronic company operates in twelve locations in three continents. Data was collected from six of its dispersed teams. The third company is designing and producing telecommunication equipment and services globally. Data was collected from two of its global teams. In global groups, the employees are younger than in other two groups, and they have also been working shorter time in their companies. Team members are dispersed in many locations and travel a lot; some project although rather small are distributed over eight locations all over world. There are 20 nationalities represented in this global group.

2.2 Data collection

First, a context analysis was made in each company by collecting documents and by interviewing company management. Second, a target team or a project in each company was selected for detailed analysis. Executives, team leaders, and team members were interviewed. Third, a web-based Virtual Team Questionnaire (VTQ) was administered electronically to the members ($n_{\text{delivered}}=371$, $n_{\text{returned}}=230$, response rate 62%) of all virtual teams and projects, which were accessible in each company. An email was sent to each member of a team informing about the www-address where the form was available for filling. The period of one to two weeks to answer the questions online was given. Two email reminders (?) were sent to all potential questionnaire respondents. The questionnaire required approximately 20-30 minutes to complete. Responses were given anonymously. The results of this study are based mainly on the questionnaire data. The descriptive statistics for all the studied variables are presented in Table 2.

The first two research questions were studied with two sets of items, which were specifically formulated to assess (a) "How much each of the six context features complicates teamwork?" (six items, scale: 1 = 'Not at all', 3 = 'Somewhat', 5 = 'Very much') and (b) "How does working in a virtual setting affect compared to co-located work?" (11 items, scale: -2 = "Is much more difficult", 0 = "No difference", +2 = "Is a lot easier"). The averages of the three test groups were compared with each other.

The third research question was studied by categorizing first the groups and projects into 'Finnish', 'Nordic' and 'Global' groups. Background variables (Table 1), task complexity variable and virtuality index served as controls showing and describing the differences in virtuality of the three groups. This qualitative variable also served as the primary independent variable.

Virtuality index was constructed from five dichotomous items asking for five dimensions of context. The items were "This team's members work in different locations" (location), "My job in this team requires me to travel" (mobility), "Team members work in different time zones" (time), "My team is working temporarily together" (temporariness), "Team members' cultural backgrounds are different" (diversity). Each item was scaled so that 0 = no and 1 = yes. Asking the use of mediated communication (mode of interaction) with similar logic would have been unnecessary since (a) using mostly ICT mediated communication was a sampling criterion and (b) we know from other questions that all the respondents use at least e-mail and phone quite a lot. The five items were summed to form an index (0 = not virtual, 5 = very virtual). The five sub-dimensions are also reported separately because we wanted to study their individual impacts.

The relationship of the three qualitatively different groups to the aspects of job demands (information load), leadership quality, internal individual and group processes, and well-being and performance outcomes were studied with the following variables (Table 2):

- *Task complexity*, e.g. “My work in this team requires complex decisions”, consists five items (three items from Lindström et al. 2000 and two self-made items)
- *Information load*, e.g. “There is always more information available to utilize in this team than I absorb” (all items from Toppinen and Kalimo 1995)
- *Leadership quality*, e.g. “I am satisfied with the overall quality of the leadership in this team” (two items from Hackman and Oldham 1980, four items from Lindström et al., three self-made items)
- *Goal clarity*, e.g. “My present goals in my team are completely clear to me” (one from Hertel, Orlikowski and Konradt 2001, one self-made item)
- *Effort*, e.g. “I try very hard to do my job in this team” (two items from IMI, see also Deci, Ryan and Koesner 1999)
- *Interest*, e.g. “I enjoy very much doing my work in this team” (two items from IMI, see also Deci, Ryan and Koesner 1999)
- *Trust*, e.g. “In my team, some people succeed by stepping on other people” (all items from Costa 2000, adapted from Cummings and Bromiley 1996)
- *Identification*, e.g. “When someone criticizes our team, it feels like a personal insult” (all items from Mael and Ashforth 1992)
- *Performance*, e.g. “Our team achieves better results than required” (all items from Costa 2000, orig. Roe et al. 1997)
- *Effectiveness*, e.g. “We are very effective in using the skills of different team members” (all items from Järvenpää and Leidner 1997, orig. from Conolly, Jessup and Valacich 1990)
- *Stress*, e.g. “Working in this team causes a lot of stress to me” (self-made items)
- *Satisfaction*, e.g. “Generally speaking, I am very satisfied with this job in my team” (one item from Lindström et al. 2000, one item from Hackman and Oldham 1980, two items from Costa 2000)

Table 2. Descriptive data for the studied indexes and variables.

Variable	N	Mean	SD	α
Task complexity* (five items)	229	3.59	0.61	.79
Degree of Virtuality (sum index)	227	3.17	1.33	-
Location (one item)	229	0.86	0.35	-
Mobility (one item)	228	0.64	0.48	-
Time (one item)	230	0.43	0.50	-
Temporariness (one item)	230	0.64	0.48	-
Diversity (one item)	230	0.59	0.49	-
Information load* (three items)	229	3.16	0.87	.67
Leadership quality* (nine items)	203	3.35	0.77	.90
Effort* (two items)	228	4.58	0.56	.59
Interest* (two items)	228	3.90	0.84	.76
Trust* (five items)	227	3.87	0.82	.82
Identification* (five items)	230	3.68	0.73	.74
F-t-F communication (two items) ¹	212	3.26	1.09	-
Electrical communication ²	64	2.25	0.54	-
Electrical collaboration ³	47	2.03	0.77	-
Performance outcomes				
Performance* (four items)	160	3.32	0.68	.79
Effectiveness* (three items)	213	3.30	0.78	.73
Well-being outcomes				
Stress* (three items)	230	2.41	1.02	.86
Satisfaction* (four items)	230	3.69	0.68	.72

* 1 = strongly disagree, 5 = strongly agree

¹ Index of two items, 1 = never, 3 = monthly, 5 = daily

² Index of ten items: the frequency of use, 1 = never, 3 = monthly, 5 = daily

³ Index of eight items the frequency of use, 1 = never, 3 = monthly, 5 = daily

2.3 Analysis of data

Questionnaire answers were analyzed quantitatively by using SPSS statistical program. The means of the three groups on various indexes, items and sum variables were compared by variance analysis (ANOVA). Because the study uses an exploratory design and is descriptive, there were not exact directional hypotheses. Pairwise two-tailed t-tests were used to determine statistical significances of variable means between the three groups.

3. Results

3.1 General outcomes of dispersed working

As shown in Figure 4, geographical dispersion is the most influential feature of the virtual context. Physical mobility is closely related to locations and seems to complicate teamwork as well. Asynchronous working time also complicates teamwork to some degree. Projects as temporary social structures, diversity of actors, and using electronic communication tools complicate teamwork only little.

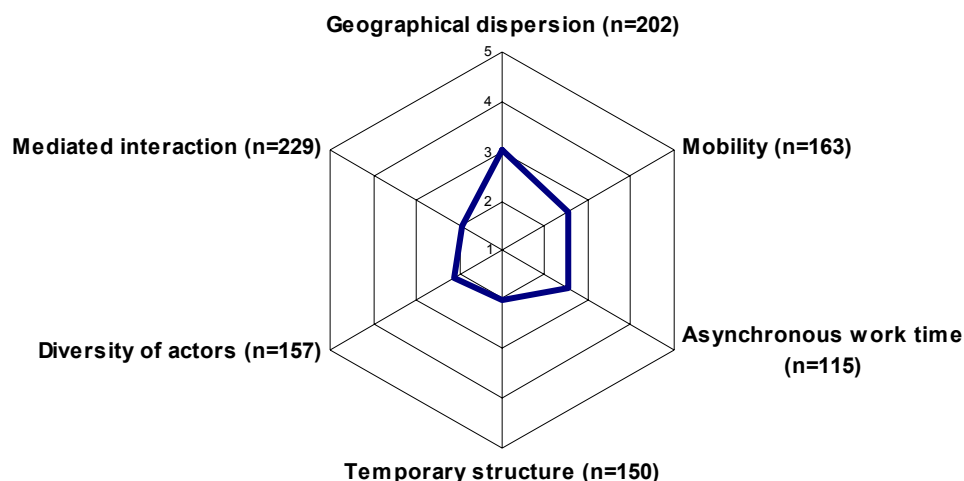


Figure 4. "How much each of the six context features complicates teamwork?" (1 = 'Not at all', 3 = 'Somewhat', 5 = 'Very much') (n= 230).

When the three groups were compared, it was shown that global dispersed working was perceived more complex than local one. The 'Global' group experienced that working in different locations, in different time zones and temporarily together complicate teamwork more than 'Finnish' groups (geographical dispersion: mean = 3.35 vs 2.84, $t = 3.39$, $p < .001$, asynchronous work time: mean = 2.94 vs 1.71, $t = 4.69$, $p < .001$, temporary structure: mean = 2.32 vs 1.84, $t = 2.96$, $p < .004$) and 'Nordic' groups (asynchronous work time: mean = 2.94 vs 1.54, $t = 4.05$, $p < .001$). There were no significant differences between 'Finnish' and 'Nordic' groups. Other differences between groups were not significant.

Almost all of the dispersed employees perceived their work in virtual settings as more difficult compared to co-located work (Figure 5). Especially creating we-spirit and leading

the team were considered more difficult. When the three groups were compared, it was shown that ‘Global’ groups regarded communication and sharing information in dispersed settings as more complicated than ‘Finnish’ groups (mean = -0.63 vs -0.39, $t = 2.19$, $p < .03$). Other differences between groups were not significant.

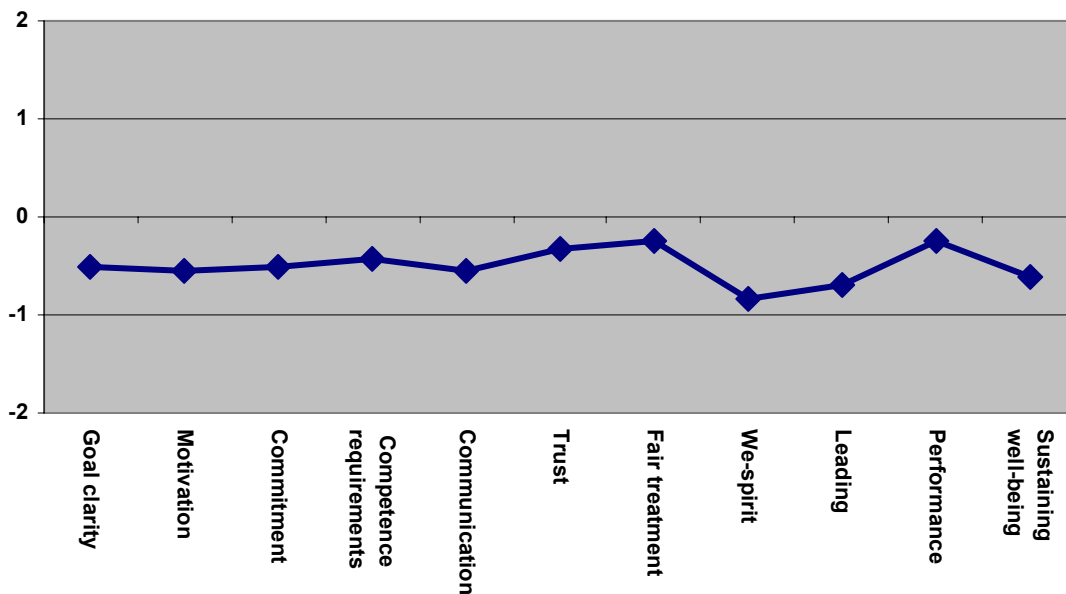


Figure 5. “How does working in a virtual setting affect compared to co-located work?” (-2 = “Is much more difficult”, 0 = “No difference”, +2 = “Is a lot easier” (n=230).

3.2 Degree of virtuality and its outcomes

Next, the differences of nationally and internationally dispersed teams and projects in contextual features, internal processes, and outcomes are shown (Table 3).

Task and context complexity

All groups perceived their tasks as complex, and there were no differences in information load, which was perceived as moderate. There was, however, an almost significant difference between ‘Global’ groups and others in the perceived task complexity, showing possible difference in task assignment. As could be concluded from background information (Table 1), there are differences in contextual complexity measured by the degree of virtuality index and virtuality features. The virtuality index shows that ‘Global’ groups differ from both ‘Finnish’ ($t = 9.45$, $p < .001$) and ‘Nordic’ ($t = 6.11$, $p < .001$) groups. ‘Nordic’ groups worked in a more local manner than ‘Finnish’ ($t = 3.16$, $p < .002$) and ‘Global’ ($t = 4.32$, $p < .001$) groups. There were no differences in mobility. ‘Global’ groups worked more asynchronously than ‘Finnish’ ($t = 19.36$, $p < .001$) and ‘Nordic’ ($t = 5.67$, $p < .001$) groups, and ‘Nordic’ more asynchronously than ‘Finnish’ groups ($t = 4.42$, $p < .001$). ‘Nordic’ groups were more permanent of their structures than ‘Finnish’ ($t = 6.87$, $p < .001$) and ‘Global’ groups ($t = 4.92$, $p < .001$). The perceived diversity of groups as well varied according to more objective indicators: diversity in ‘Global’ groups was wider than in ‘Finnish’ ($t = 11.09$, $p < .001$) and ‘Nordic’ ($t = 2.72$, $p < .007$) groups, and also between ‘Global’ and ‘Nordic’ groups ($t = 4.48$, $p < .001$). The quality of leadership was perceived as rather good in all the studied teams and projects.

Internal processes

All the group members were well aware of their assignments and respective goals. They were all highly internally motivated enjoying their work, and also ready to try hard for their team. Willingness to effort was high in all groups but highest among ‘Finnish’ groups, which differed from ‘Nordic’ groups ($t = 4.22, p < .001$). Relationship between team and project members can be characterized as trustful, and identification with the team was high. ‘Finnish’ group members met face-to-face more frequently than ‘Nordic’ ($t = 4.26, p < .001$) and ‘Global’ ($t = 6.20, p < .001$) group members, but there were no differences in the frequencies of using communication and collaboration tools.

Performance and well-being outcomes

All the groups and projects considered their performance rather good, and also effective in using skills of different team members, generating ideas and coordinating their tasks. There were moderate feelings of stress, least in ‘Nordic’ groups, which differed both from ‘Finnish’ ($t = 3.19, p < .002$) and ‘Global’ ($t = 2.49, p < .014$) groups. Job satisfaction and satisfaction with team members’ contribution and intra-group relationships were good.

Table 3. Comparison of ‘Finnish’, ‘Nordic’ and ‘Global’ teams and projects. Significant differences between groups are shown by bold and italics.

Variable	‘Finnish’ (n=125)		‘Nordic’ (n=22)		‘Global’ (n=83)		ANOVA	All (n=230)
	Mean	SD	Mean	SD	Mean	SD	Sig.	Mean
Task complexity	3.53	0.58	3.43	0.67	3.71	0.64	.050	3.59
Degree of Virtuality	2.69	3.53	2.36	1.73	4.10	0.99	.001	3.17
Location	0.86	0.35	0.59	0.50	0.93	0.26	.001	0.86
Mobility	0.63	0.49	0.59	0.50	0.67	0.47	.732	0.64
Time	0.10	0.58	0.45	0.51	0.92	0.28	.001	0.43
Temporariness	0.75	0.43	0.09	0.29	0.63	0.49	.001	0.64
Diversity	0.34	0.47	0.64	0.49	0.95	0.22	.001	0.59
Information load	3.19	0.72	2.74	1.00	3.23	1.02	.055	3.16
Leadership quality	3.31	0.73	3.38	0.83	3.41	0.82	.709	3.35
Internal processes of individual and collective subjects								
Goal clarity	4.08	0.80	4.10	0.75	3.87	0.98	.236	4.00
Effort	4.74	0.38	4.30	0.75	4.41	0.65	.001	4.58
Interest	3.98	0.79	3.86	0.76	3.78	0.93	.248	3.90
Trust	3.81	0.78	3.98	0.75	3.93	0.91	.482	3.87
Identification	3.63	0.59	3.52	0.76	3.80	0.89	.144	3.68
F-t-F communication	3.67	0.93	2.76	0.68	2.73	1.15	.001	3.26
Electrical communication	2.37	0.44	1.95	0.68	2.24	0.57	.172	2.25
Electrical collaboration	2.04	0.74	1.58	0.52	2.08	0.82	.580	2.03
Performance outcomes								
Performance	3.37	0.66	3.19	0.63	3.28	0.73	.550	3.32
Effectiveness	3.29	0.75	3.17	0.76	3.34	0.84	.681	3.30
Well-being outcomes								
Stress	2.51	0.97	1.80	0.87	2.43	1.09	.011	2.41
Satisfaction	3.71	0.69	3.72	0.57	3.64	0.70	.739	3.69

4. Discussion

4.1 Degree of virtuality matters

It seems that the distance between team and project members (location) and moving between locations (mobility) are the most complicating contextual features in virtual working. This was shown when all the dispersed team and project members evaluated the complicating effect of each feature. Almost all of the dispersed employees perceived their work in virtual settings as more difficult compared to co-located work. There was only one difference

between 'Finnish', 'Nordic' and 'Global' groups: globally working employees considered communication and sharing information more difficult than 'Finnish' groups whose members also met other project members more often face-to-face than members of other groups. There were no differences in the use frequency of communication and collaboration tools. We may conclude that the quality of the tools is not good enough to support working from big distances, when their deficiencies cannot be replaced by meeting personally each other. And, naturally it is easier to move in one country from location to location than to move globally.

It was implicitly assumed that the virtuality increases from 'Finnish' to 'Nordic' to 'Global' groups. This was not consistently realised. The 'Global' groups were different from others, whereas the 'Nordic' groups were less virtual than 'Finnish' groups in some contextual features. Both the 'objective' data on, for example, average number of locations, number of nationalities, and travel days in groups, and the virtuality index measured by the 'subjective' responses are quite consistent in this respect. It is supposed that increasing virtuality is shown as distinct differences in the features of contextual complexity and task complexity and related to differences in internal processes of individual and collective subjects, as well as in well-being and performance outcomes. There were, however, only few differences in intra-group processes and individual features between the groups, and almost none in outcomes. The only difference in outcomes was found in stress: Nordic teams felt less distressed than the Finnish and global teams. At the same time, their degree of virtuality, task complexity and information load means were the lowest and the leadership quality mean was the highest. This might indicate that high degree of virtuality, high task complexity and high information load raise the felt stress. Leadership quality has been found to buffer distress in traditional work (e.g. Seltzer, Numeroff and Bass, 1989), and it also seems to have the similar effect in our data.

4.2 Measuring degree of virtuality

The degree of virtuality as contextual features were measured both as 'subjective' evaluations and 'objective' indicators. They supported to some extent each other, albeit there are several deficiencies on both measures. The subjective measures were dichotomous "yes" and "no". More steps should be added to the scale. It would be also important to measure virtuality in a quantitative manner. For example:

- Location: in how many different locations team members are working, how far the locations are from each other
- Physical mobility: how many locations each member is visiting/week or month, how far the locations are from each other, how often locations are changed
- Time: in how many time zones team members are working, how many of the members are working simultaneously on the work object,
- Temporariness: how long the team or project is working together, how many simultaneous project each member has
- Diversity: are the members different from their backgrounds: culture, education, sex, nationality, religion, and language
- Mode of interaction: how many different tools for communication and collaboration are used, how often tools are used

Both quantitative and qualitative data is needed in the analysis and modeling of virtual organizations. The features and functions of each virtual company should be analysed, modeled and evaluated by collecting documents, observing and interviewing personnel, and making questionnaires. Case studies and their analysis provide the deepest knowledge but have the well-known problems of how to generalize. Action research is also needed. By action research we mean that results of the study are provided for the company development. The research approach will be very much qualitative, utilizing ethnographic method to

investigate the social processes, actions and meanings involved in creating and sustaining the virtual organizations.

The collection of data is a challenge. There are not much experiences of using such traditional methods as network and communication analyses, information flow and network analyses. New methodologies are just emerging. In addition, the collection of empirical data is complicated and costly, because of dispersed, often global working.

The analysis of concepts, empirical studies and practical experiences on virtual organizations shows that the research target is still a dizzy and transforming entity. More serious and extensive research is needed. From research viewpoint, virtual organisations provide possibilities to study evolving organisations and to test the former findings of organisational research. New, evolving forms of virtual organizations in the edge of known and unknown create an exceptional possibility to study new organizational forms and their human outcomes in their developmental process. For organizational scientists, they provide a kind of 'laboratory' to test various hypotheses based on the classical models, concepts and empirical findings. The content of research certainly covers all the topics of traditional organizational studies.

What kind of research strategy should be selected to study virtual organizations? On conceptual level, literal reviews are needed to define the key concepts, types and levels of virtual organizations. As there are still few empirical studies, their number must be increased in order to find critical factors, recommendations and guidelines, how to arrange the daily life in these new organizational forms. Action research is needed to develop new leadership and management practices.

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