

# **Working in Virtual Teams: Exploring the High Road**

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1<sup>st</sup> Biennial European Conference 'ICT, the Knowledge Society and Changes in Work'  
Subtheme Thematic Workshop 2: Virtual teams and virtual organizations

The Hague, 9 & 10 June 2005

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## 1. Introduction

The availability of information networks, internet/e-mail, mobile phones and other personal digital assistants (PDAs) is increasing the ‘virtuality’ of the world of work: work is not longer necessarily connected towards a ‘real’ company consisting of visible buildings and people. Instead, ICT has made it possible for many companies and their employees to work anytime and anywhere. The essential feature of virtual work is the independency of space, time and organisation, enabled by information and communication technology (ICT). Virtual work in the broadest sense refers to all kind of situations where ICT has made it possible to collaborate at a distance.

The virtual workplace differs from the traditional one on seat least two specific characteristics: geographical distance and technology-mediated communication. Therefore, it is interesting to gain knowledge on how employees react towards these circumstances and influence - through their attitudes and behaviour – organisational effectiveness. The virtual work literature assumes challenges as well as threats for individuals and organisations. For example, Lipnack & Stamps (1997) and Hoefling (2001) believe in new possibilities for better (firm) performance through increased productivity, real estate savings, and collection of knowledge’s, while Gassmann and Von Zedtwitz (2003), Jarvenpaa and Leidner (1999) and Shapiro, Furst, Spreitzer and Von Glinow (2002) stress new risks for workers and organisations, such as inefficiencies, collaboration failures, mistrust, increased negative stress, work-life imbalances and technological problems. Therefore, the current challenge of virtual work lies in finding the preconditions under which virtual work contributes to individual as well as organisational well-being.

This paper contributes to this need for knowledge, identifying the conditions under which ‘high road virtual work’ occurs. We do so by focusing on virtual teams, making use of a typology of individual virtual team members in terms of performance and stress, resulting in four categories: (1) *low stress and low performance*, (2) *high stress and low performance*, (3) *low stress and high performance*, and (4) *high stress and high performance*. We call the third category - low stress, high productivity - the high road of virtual teams, and the results of our study show how this category differs on certain preconditions from the other categories.

The following research questions can be formulated:

1. *How does the virtual aspect of virtual teams influence team performance and stress risks?*
2. *Under what conditions do virtual teams have a high performance and low stress risks?*

The paper starts with a description of the research components – virtual teams, work conditions, performance, and stress –, presenting definitions for these constructs. Then we move on to introduce the research method. In section four the research results are presented. In the concluding discussion section the research questions are revisited, and some relevant challenges associated with virtual teamwork are highlighted.

## 2. The research components: virtual teams, work conditions, performance, and stress

In this section we sketch the research framework, presenting definitions for the individual research components and elaborate on relationships between them. We start with the virtual team concept, followed by the specific work conditions different from traditional (team) work settings, and finish with the outcomes stress and performance.

According to Lipnack & Stamps (1997) ‘a virtual team works across space, time, and organisational boundaries with links strengthened by webs of communication technologies’, and we adopt their popular definition. However, this definition only describes the issue of virtuality of these teams. It is striking to notice that many authors writing about virtual teams almost only refer to the virtuality of the team not on the team issue itself (Hoefling, 2001; Lipnack & Stamps, 1997). In other words: virtual teams can be differentiated and these differences may influence work conditions and through these outcomes. Townsend, DeMarie, and Hendrickson (1998) define virtual teams as ‘groups of *geographically and/or organizationally dispersed co-workers* that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task’ (p. 18), a definition very close to Lipnack and Stamps’ (1997) two-dimensional categorisation of virtual teams, presented in figure 1:

<i>Space-time</i>	<i>Organisation</i>	
	same	different
same	co-located	co-located cross-organizational
different	distributed	distributed cross-organizational

Figure 1: Forms of virtual teams (see Lipnack & Stamps, 1997)

In this research we deal with co-located (same space-time and same organisation) and distributed (different space-time and same organisation) virtual teams, two forms of virtual work within organisation. Nevertheless, we acknowledge the importance of the organizational dimension since virtual collaborations between organisations can have extra impact on work conditions, such as different organisational (written) rules and norms, and competition clauses.

Compared to traditional non-virtual teams and non-virtual work in general, virtual teams have some characteristic work conditions. Looking at figure 2, we can conclude that many characteristics are similar between virtual and traditional (work &) teams, but the two differences presented have a major impact on work conditions:

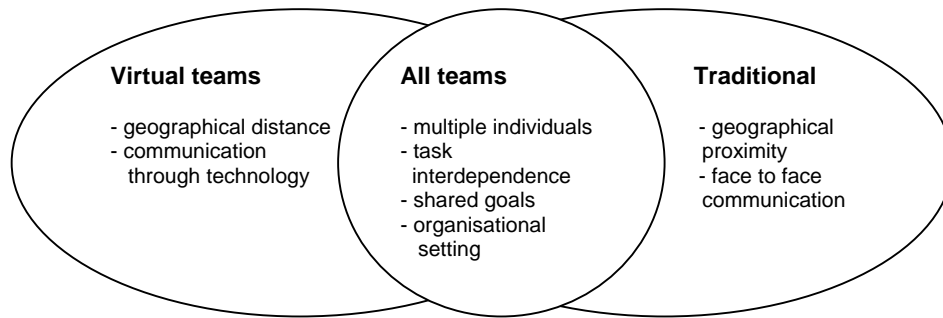


Figure 2: Virtual teams and traditional teams (based on Horvath & Tobin, 2001)

What does it mean if team members are geographically dispersed and the majority of the communication is not face-to-face but mediated by technology? Cascio (1999) and the European Foundation for the Improvement of Living and Working Conditions (1997) state that isolation is the biggest disadvantage of virtual work settings: it is more difficult to get direct support than in traditional, close-by, work settings. Also the contact with supervisors changes: it is less easy to reach them directly (Lipnack & Stamps, 1999; Mohrmann, 1999). The Dutch Ministry of Social Affairs (Ministerie van SZW, 2001) states that the mental pressure can increase through faster and larger information flow, social isolation, and a mismatch between work and private life. Research from Cascio (2000) supports these assumptions partly: the workers are satisfied with working in virtual teams, but at the same time have to cope with negative issues like feelings of being left alone, lack of support by colleagues, lack of visibility within the organization, and problems in work-life balance. As Kelly & Barsade (2001) point out, the introduction of technology is likely to impact the emotional life of the group. They suggest many of the processes underlying the spread of 'affect' through group members are unable to operate in computer-mediated groups. By hampering the occurrence of 'group emotion', effects like psychological detachment, social isolation and lack of commitment could occur. Finally, there is the culture issue. Elron and Vigoda's (2003) story of direct Israeli employees cooperating with indirect Canadian employees, shows not only that cultural differences can influence team behaviour of virtual team members negatively, but that time-space distance may easily lead to confusion or conflict between team members.

These empirical observations lead us to assume that virtuality has a large impact on social interactions within teams. This might have effects on the quality of the team processes, and eventually on the outcomes of virtual teams. Hoegl and Gmuenden (2001) support this line of reasoning since they (a) propose teamwork quality as a comprehensive concept of the quality of the interactions within teams (based on Homans' (1974) concept of interactions as a basic element of human behaviour, apart from 'activities' and 'sentiments'), and (b) three of their six facets of team quality are directly related to social interactions: (1) *communication*, (2) *coordination* (leadership style), and (3) *mutual support* (colleague support). Since communication determines perceived team leader support as well as colleague support, communication is incorporated in both forms of support. Two of the six facets are not necessarily related to social interaction - balance of member contributions and effort - and one of the six can be seen as an outcome of the other

five facets: *cohesion*. Team cohesion or solidarity can be understood as *team commitment*: (1) a binding force - a psychological state or attitude - that (2) gives direction to behaviour (Meyer and Herscovitch, 2001). The intention to stay with the team can be seen as the most important outcome of team commitment. We will not exclusively focus on social interactions, but also on changing task characteristics as a result of enhanced ICT communication since the earlier mentioned report from the Dutch Ministry of Social Affairs also mentions the increased job demands due to faster and larger information flow, and - also supported through empirical research (Benschop, 2000) – enhanced autonomy concerning working time and place. In sum: in this paper we deal with four characteristics of virtual work (team leader support, colleague support, job demands, and autonomy), and one mediating factor between these characteristics and outcomes of virtual work: team commitment.

These four characteristics of virtual teamwork can be seen as *potential stressors*: events, situations, and thoughts, which can arouse negative emotions and through these perceived negative stress (Buunk, 1990). We adopt Kristensen et al. (1998) definition of negative stress or distress: stress is an individual, psycho-physiological, and subjective state, characterized by the combination of high arousal and displeasure. Since we involve task characteristics as well as social interactions in our analysis of stress related to virtual work, we can speak of two explanation models: a work psychology approach and a social-psychological approach. The former emphasises the work system as a potential stressor, the latter the social relationships within the work context (De Jonge, Le Blanc, Schaufeli & Van der Linden, 1998). Since we did not include personal traits as potential stressors, we excluded the individual-psychological or dispositional approach.

*Autonomy* and *job demands* play a central role in work stress research. Karasek's (1979) 'Job Demands-Control Model' (JDC) states that the effects of job stressors are a complex interplay of demands, such as work load, variety, and responsibility for people, and employee autonomy. According to the theory, demands lead to strain only when there is insufficient autonomy; having autonomy reduces the negative effects of demands. Dutch research challenges this assumption. Van Veldhoven (1996) and De Jonge, Schaufeli, and Furda (1995) conclude that high job demands are always unhealthy, regardless the degree of autonomy. Besides, also autonomy should be dosed with moderation. Thus, prudence is called for Holman's (2003) conclusion after a meta-analysis of three work stress studies on call centre employees, a specific group of virtual workers: autonomy has a direct positive relationship with well-being.

Also our second set of variables belongs to the 'treat with caution' vitamins: *social interactions*. We made a difference between colleague, and supervisor support. Communication can be seen as an inevitable condition for the others. The difficulty of virtual work is, that communication is often mediated through ICT, is less personal than direct verbal and non-verbal communication. Therefore, building up personal relationships with team members and supervisors is extra complicated and needs additional effort.

There is some evidence that social support has a buffering effect. As a result of their meta-analysis, Viswesvaran, Sanchez, and Fisher (1999) conclude that social support from supervisors, colleagues, family,

and friends influences stress on three manners: (1) social support reduces stress reactions, such as demotivation, (2) social support relieves the effects of stressors (e.g. work pressure, low autonomy) on stress reactions, and (3) social support reduces the strength of the stressors. De Jonge, Le Blanc, Schaufeli, and Van der Linden (1998) state - after their longitudinal panel-study among nurses – that supervisor social support can have a bipartite effect: (1) enhanced social support provided by the supervisor has a relationship with decreased feelings of emotional exhaustion and depersonalization (two burnout dimensions), and (2) increased job satisfaction. Thus, supervisors are not only co-responsible for employee well-being and through that organisational well-being. However, supervisors as well as colleagues are also potential stressors. In other words: they soften not always the circumstances, but can also cause stress or increase stress through social influence processes, for example: people can adopt physical or psychological problems from others, so-called ‘symptom contamination’ (Buunk & Schaufeli, 1990). Therefore, we may conclude that only healthy social support lightens stress.

Stress also influences performance: non-stressed employees perform better than stressed employees (Varca, 1999). Job performance has been conceptualized as an individual’s overall performance/task proficiency or as performance on specific dimensions, such as the quality and quantity of work (Meyer, Paunonen, Gellatly, Goffin, and Jackson, 1989; Steers, 1977). Team performance originates from individual member contributions. Therefore, and the same counts for distress, the individual level influences the group level. We assume that the work conditions of virtual team members involved in this research influence perceived job performance.

### **3. Methodology**

To be able to answer our research questions, we conducted a survey in a multinational software company, where working in virtual teams is a necessary and common way of work. Before designing the survey, we conducted a number of interviews to gain understanding of the context of the organisation. We also discussed within the research group the norms of high road virtual teams. In other words: under what conditions can a virtual team be labelled as good or bad, from the point of view from the organization as well as the individual? We created a typology in terms of performance and stress, resulting in four categories: (1) *low stress and low performance*, (2) *high stress and low performance*, (3) *low stress and high performance*, and (4) *high stress and high performance*. We call the third category - low stress, high productivity - the High Road of virtual teams, the other three are all within the danger zone, but with different (long-term) outcomes. Low distress is good for the individual (prevents from stress-related disorders such as coronary diseases), the organisation (problems due to fall out from stressed employees), and the society as a whole (costs related to distress). Low productivity is foremost an organizational problem, but we know that some employees can also suffer from it, an additional factor for low wellbeing (Gmelch & Gates, 1998). One could argue that the fourth category - high stress, high performance - is not problematic since these employees seem to function well, however, research supports that long-lasting constant stress will have negative consequences for (at least) the individual (Winnubst & Schabraq, 1995).

This typology made it possible to classify the data, but also enhanced the pressure to ‘fill’ the categories. Therefore, we sent the survey to a large group of employees involved in virtual teams.

The data collection took place in 2004 at a large globally operating software company: SOFTCO. Within this company many employees work - at least part of their time - in virtual teams, and virtual work is becoming the standard type of work for many employees.

We spread the survey through the company’s tool on the corporate intranet. The invitation to take part in the survey was sent out by e-mail to 400 people from Development, Consultancy, Engineering, Sales, and Finance. We limited our sample to these departments because we had company information that within some of these departments many employees take part in virtual teams, whereas in other departments (such as Finance and Engineering) only few people work in virtual teams. We received 154 usable questionnaires, a response rate of 38.5%. The sample group is representative for these departments of SOFTCO.

The sample group consisted of almost 80% male employees, an average age of 40.0 years, 75.8% high-educated employees (university and high applied education), and on average a long tenure of 11.7 years.

#### 4. Results

In this section we present the results of the electronic survey. We distinguish between results regarding characteristics of virtual teamwork at SOFTCO (section 4.1) and the effects on performance (section 4.2) and stress (section 4.3). We conclude this section with some conditions for virtual work with high productivity and low stress (paragraph 4.4).

##### 4.1 Characteristics of virtual teams at SOFTCO

The survey reveals how common virtual work is for employees of SOFTCO. The employees in our sample are very familiar with virtual work. About 25% is working at home for at least half of the time. Furthermore, 13% is working from a third location for at least half of the time. The figures are even higher for working in virtual teams. More than 80% of the employees carry out work in a virtual team at least about a quarter of the time. See table 1 for details.

Table 1. Virtual work at SOFTCO

<b>Work at home: to what extent?</b>	<i>Percent</i>	<i>N</i>
(almost) always	4,5	7
about half the time	20,3	31
about quarter of the time	44,8	69
(almost) never	30,5	47
<b>Work at a third location (not at home, not at the office)</b>	<i>Percent</i>	<i>N</i>
(almost) always	7,3	11
about half the time	6,0	9
about quarter of the time	19,3	29
(almost) never	67,3	101
<b>Virtual team: to what extent?</b>	<i>Percent</i>	<i>N</i>

(almost) always	35,7	55
about half the time	22,1	34
about quarter of the time	23,4	36
(almost) never	18,8	29

The percentage of employees that work in virtual teams for at least half of the time is 57,8%. For the analysis of the effects of virtual teams and the conditions, we make a distinction between two groups: those who are working at least half of the time in virtual teams and those who do not or to a little extent (maximum 25% of their time). In other words, we make the distinction between *heavy virtual team workers* and *light virtual team workers*.

<b>Works in a virtual team at least half the time</b>	<i>Percent</i>	<i>N</i>
no: light virtual team worker	42,2	65
yes: heavy virtual team worker	57,8	89

No big differences exist in the prevalence of heavy and light virtual team workers across the functions and departments. The only noteworthy point is that on average the financial officers are working less in virtual teams compared to those with other functions. As expected, employees working in the Finance and Engineering department work less in virtual teams.

#### *Use of technology: e-mail most used*

We asked which ICT tools the virtual workers use to communicate with project members working from another location of time zone.

Table 2 Use of ICT as communication tools. Significant differences between light and heavy virtual team workers are made bold

<b>Which communication tool?</b>	<i>light virtual team</i>		<i>heavy virtual</i>		<i>Total</i>	<i>N</i>
	<i>workers</i>	<i>N</i>	<i>team workers</i>	<i>N</i>		
E-mail	4,618	34	4,741	81	4,704	115
Instant messaging services	<b>3,485</b>	33	<b>4,179</b>	78	3,973	111
Conference calls	3,667	33	3,841	82	3,791	115
Fixed phone	3,618	34	3,772	79	3,726	113
Cellular phone	3,471	34	3,688	80	3,623	114
Internet	3,030	33	3,550	80	3,398	113
Document sharing	3,121	33	3,203	79	3,179	112
Other groupware applications	<b>2,000</b>	33	<b>2,653</b>	75	2,454	108
File Transfer Protocol (FTP)	1,719	32	1,781	73	1,762	105
Video conferencing	<b>1,188</b>	32	<b>1,467</b>	75	1,383	107
Fax	1,387	31	1,329	76	1,346	107
Web cam	1,063	32	1,213	75	1,168	107

*italic* =  $p < .10$ ; **bold** =  $p < .05$ ; **bold and underlined** =  $p < .01$

(1=always, 2=often, 3=regularly, 4=sometimes, 5=never)

Based on the frequencies, we may conclude that three groups of communication tools exist. Virtual teams most often use e-mail. The second group of communication tools consists of on-line collaboration tools (instant messaging, the internet and document sharing) and the telephone (conference calls, fixed phone



and mobile phone). The third group is only used in exceptional occasions: video conferencing, fax and web cam. The light and heavy virtual team workers do not differ much in the use of these communication tools.

*No more than ten virtual projects in six months*

We asked in how many virtual project teams the respondents were participating during the last six months. The results are presented in table 3. A noteworthy detail is that no one is working in more than ten virtual projects in six months. Not surprisingly, the heavy virtual team workers work in more virtual projects compared to the light virtual team workers.

Table 3 The number of virtual projects

	<i>Light virtual team workers (N=62)</i>	<i>Heavy virtual team workers (N=70)</i>	<i>Total (N=132)</i>
<b>Number of virtual projects during last 6 months</b>	<b>%</b>	<b>%</b>	<b>%</b>
0	30,6	21,4	25,8
1	24,2	12,9	18,2
2 -4	32,3	41,4	37,1
5 - 10	12,9	24,3	18,9
more than 10	0,0	0,0	0,0

**4.2 Effects of virtual teams: performance**

How do virtual team workers report on the effect of their way of work on performance? Based on the survey we use three outcome variables: inefficiency, mistakes due to lack of information and productivity. Our main conclusion is that heavy virtual team workers are more efficient, better informed and more productive compared to the light virtual team members. See table 4.

Table 4 Virtual teams and performance

<b>Inefficiency</b>			
		<i>Unstandardized Coefficients</i>	<i>Standardized Coefficients</i>
		Std. Error	Beta Sig.
Heavy virtual team workers		0,133	-0,083 0,340
Number of virtual projects		0,026	<b>-0,233</b> 0,008
Model Summary	N=151		
	R Square	Adjusted R Square	
	0,069	0,054	
<b>Mistakes through missing information</b>			
		<i>Unstandardized Coefficients</i>	<i>Standardized Coefficients</i>
		Std. Error	Beta Sig.
Heavy virtual team workers		0,184	-0,135 0,129
Number of virtual projects		0,035	-0,066 0,459
Model Summary	N=151		

	R Square	Adjusted R Square
	0,026	0,011
<b>More productivity</b>		
	Unstandardized Coefficients	Standardized Coefficients
	Std. Error	Beta
		Sig.
Heavy virtual team workers	0,187	0,052
Number of virtual projects	0,033	0,129
Dependent Variable: Virtual work leads to more productivity		
Model Summary	N=121	
	R Square	Adjusted R Square
	0,020	-0,002

The results of the survey reveal more interesting findings when we take a closer look into the relationship between working in a virtual team and performance. Table 4 shows the simple models of the relationship. Focussing on the expected relationships summarised above, we only found low beta's, indicating weak associations. One exception is the association between the number of virtual projects and inefficiency: we found a strong and significant negative association for this relationship. What the data seem to indicated, is that the more virtual projects you are in, the more efficient you become. This could be considered an indication of the importance of the learning effect: the more experienced virtual workers are, the more efficient they become.

In table 5, we show the same associations controlled by other variables. Some specific effects emerge. Inefficiency is still significantly negatively associated with the number of virtual projects, but three other variables also explain the differences: job demands, social support and team leader support. The higher the job demands, the more inefficient virtual workers are. The other two variables 'social support (by colleagues)' and 'team leader support' are significantly negatively correlated with inefficiency.

Table 5 Conditions for relation virtual teams – performance

<b>Inefficiency</b>	Standardized Coefficients		
	Std. Error	Beta	Sig.
Heavy virtual team workers	0,156	-0,044	0,634
Number of virtual projects	0,028	<b>-0,208</b>	0,032
Job control (higher = more autonomy)	0,148	-0,166	0,102
Job demands	0,118	<b>0,240</b>	0,019
Social support (colleagues)	0,080	<b>-0,206</b>	0,047
Team leader support	0,129	<b>-0,223</b>	0,025
Sex	0,202	0,017	0,863
Age	0,009	0,005	0,958
Education	0,071	0,104	0,271
N=119			
	R Square	Adjusted R Square	
	0,355	0,284	
<b>Mistakes through missing information</b>	Standardized Coefficients		
	Std. Error	Beta	Sig.

Heavy virtual team workers	0,223	<b>-0,194</b>	0,044
Number of virtual projects	0,040	0,050	0,612
Job control (higher = more autonomy)	0,211	-0,133	0,202
Job demands	0,168	<b>0,229</b>	0,028
Social support (colleagues)	0,114	<b>-0,232</b>	0,029
Team leader support	0,183	-0,164	0,106
Sex	0,288	-0,190	0,060
Age	0,013	-0,060	0,543
Education	0,101	0,049	0,609

N=119

R Square  
0,324

Adjusted R Square  
0,249

More productivity	Standardized Coefficients		
	Std. Error	Beta	Sig.
Heavy virtual team workers	0,191	-0,034	0,748
Number of virtual projects	0,034	0,075	0,486
Job control (higher = more autonomy)	0,181	<b>0,339</b>	0,004
Job demands	0,144	0,050	0,661
Social support (colleagues)	0,098	0,124	0,284
Team leader support	0,157	0,043	0,700
Sex	0,247	-0,047	0,667
Age	0,011	-0,019	0,861
Education	0,086	<b>-0,208</b>	0,052

Dependent Variable: Virtual work leads to more productivity

N=119

Model

R Square  
0,178

Adjusted R Square  
0,086

Concerning the variable of ‘costly mistakes due to lack of information’, we see that the heavy team workers are negatively associated with this variable. This means heavy virtual team workers are succeeding more often in appropriately pulling together all available and relevant knowledge, information and competences. Again, higher job demands are positively associated. In addition, social support also appears to have a positive effect in avoiding costly mistakes due to lack of information.

Job control (task autonomy) appears to have a strong positive association (.339) with virtual work and productivity. This indicates that high autonomy of virtual workers is beneficial for their productivity.

### 4.3 Effect of virtual teams: stress

Table 6 shows that virtual teams do have a negative association with stress. However, the associations are very weak and non-significant. The associations are explained by job control (the more job control, the less stress), job demands (the higher job demands, the more stress) and social support (the more social support, the less stress). This is according to the existing theory on Karasek’s model on stress: a strong positive relationship between stress and the combination of high job demands and low job control.

Table 6 Virtual teams and stress

Stress	Coefficients	
	Unstandardized	Standardized
Model		

	Std. Error	Beta	Sig.
Heavy virtual team workers	0,132	-0,049	0,593
Number of virtual projects	0,024	-0,033	0,727
Job control (higher = more autonomy)	0,125	<b>-0,261</b>	0,011
Job demands	0,099	<b>0,331</b>	0,001
Social support (colleagues)	0,068	-0,178	0,083
Team leader support	0,108	0,009	0,930
Sex	0,170	-0,009	0,927
Age	0,008	-0,136	0,159
Education	0,060	-0,073	0,434

N=119

Model	R Square	Adjusted R Square
	0,364	0,294

One remarkable outcome is that most virtual team workers view virtual work as neutral towards time pressure (the mean is 3.04 on a 5-point scale, with 3 = don't agree, don't disagree). This is surprising, because of our expectation that virtual workers need to collaborate with other team members across time zones. The timeframes are getting longer, longer hours are needed, leading toward more time pressure.

On average, the virtual workers are also rather positive on the work-life balance. They tend to see the work-life balance as a responsibility of the employees, but are rather positive on the effect of virtual work to the work-life balance.

Overall, heavy virtual team workers are more satisfied about working in virtual teams compared to the light virtual team workers. The mean is 3,86 compared to 3,34 (significant:  $p < .01$ ) on a 5-point scale.

#### 4.4 Conditions for virtual teams

In the survey we included several conditions that might enhance the effectiveness of virtual teams. This section is reporting on the conditions making use of a typology of virtual teams in terms of productivity and stress. We combine the outcome variables productivity and stress and categorise the virtual team workers in four categories:

- Low stress and low productivity (N=48);
- High stress and low productivity (N=38);
- Low stress and high productivity (N=36);
- High stress and high productivity (N=10).

As mentioned before, we call the category 'low stress, high productivity' the high road of virtual teams. In the Appendix we explain the construction of the typology.

##### *Virtual teamwork: optimum in number of teams*

The first result is that there seems to be an optimum in the number of teams that employees should be involved in. Table 7 shows that high productivity and low stress mainly occur with virtual workers who participated in 5-10 teams over the last six months. This might suggest that the learning process is of crucial importance for developing into the high road. The more experienced one is in virtual work, the more productive and less stressful it is.

Table 7 Number of virtual projects by stress/productivity typology

<b>Number of virtual projects during last 6 months</b>	low stress, low productivity (N=48)	high stress, low productivity (N=38)	low stress, high productivity (N=36)	high stress, high productivity (N=10)	Total (N=132)
0 projects (% yes)	17,6	24,0	3,4	28,6	19,8
1 project (% yes)	23,5	20,0	10,3	14,3	17,9
2-4 projects (% yes)	44,1	40,0	41,4	28,6	38,7
5-10 projects (% yes)	14,7	16,0	44,8	28,6	23,6
more than 10 projects (% yes)	0,0	0,0	0,0	0,0	0,0

The learning process is according to the majority of virtual workers a self-learning process. The team members learn most of the technical and non-technical skills by themselves. See the table below.

Table 8 Origin of virtual skills by stress/productivity typology

<b>Learned technical skills necessary for working in virtual teams from:</b>	low stress, low productivity (N=48)	high stress, low productivity (N=38)	low stress, high productivity (N=36)	high stress, high productivity (N=10)	Total (N=132)
myself (% yes)	75,0	58,1	77,1	70,0	71,7
my colleagues	16,7	29,0	20,0	20,0	21,6
SOFTCO training	5,6	6,5	2,9	10,0	5,2
<b>Learned the non-technical skills necessary for working in virtual teams from:</b>					
myself	72,2	67,7	82,9	60,0	73,3
my colleagues	19,4	19,4	11,4	30,0	18,1
SOFTCO training	5,6	6,5	2,9	0,0	4,3

### *Communication ability*

The second condition is the ability to make use of communication tools. Since communication is not possible face-to-face in distributed teams, the communication is mediated by technology. We already saw in table 2 the frequency in use of the various communication tools. An important question is: are these communication tools sufficient? The overall answer according to our respondents is: yes. The high-productive virtual teams report most often that they have sufficient communication tools. More over, they make better use of communication tools compared to the low-productive virtual teams.

Table 9 Communication tools satisfaction by stress/productivity typology

<b>Communication tools</b>	low stress, low productivity (N=48)	high stress, low productivity (N=38)	low stress, high productivity (N=36)	high stress, high productivity (N=10)	Total (N=132)
Communication tools sufficient for communication needs	3,69	3,77	4,03	4,11	3,86
Communication tools properly used by colleagues	<b>3,67</b>	<b>2,97</b>	3,89	<u>3,89</u>	3,56

### *Team leader role*

The third condition is the decision-making process in the team and the role of the team leader. The 'high road virtual teams' are most satisfied with their team leaders and about the way the decisions are taken in the team.

Table 10 Team leader and decision making process satisfaction by stress/productivity typology

<b>Team leader and decision-making</b>	low stress, low productivity (N=48)	high stress, low productivity (N=38)	low stress, high productivity (N=36)	high stress, high productivity (N=10)	Total (N=132)
Team leader has right skills to manage a virtual team	3,32	3,00	3,53	2,80	3,27
Satisfied about the way decisions are taken in team	3,50	<b>2,94</b>	<b>3,66</b>	3,00	3,35

*Commitment*

The fourth condition is team bonding and social support by colleagues. Do the respondents in our survey experience a loss in ‘sense of belonging’? The answer is yes. At least the category ‘high stress, low productivity’ reports low on team bonding and social support by colleagues. Again, the high road virtual teams report most positive on team bonding and the possible feeling of isolation.

Table 11 Commitment by stress/productivity typology

<b>Commitment</b>	low stress, low productivity (N=48)	high stress, low productivity (N=38)	low stress, high productivity (N=36)	high stress, high productivity (N=10)	Total (N=132)
Less team bonding in environment where people work at different instead of fixed places	3,44	3,61	2,97	3,20	3,33
Sometimes have the feeling to cope with everything all by myself	<b>3,00</b>	<b>3,77</b>	2,66	3,33	3,14

## 5. Discussion

We started out with two central questions:

1. 'How does the virtual aspect of virtual teams influence the team performance and stress risks?'
2. 'Under what conditions do virtual teams have a high performance and low stress risks?'

In this section we discuss the results of the study regarding these central questions.

### *Virtual teams and the impact on performance and stress*

It is not possible to provide a general answer on the first question because of the dependency of several conditions. We may conclude that virtual teams do have certain positive productivity outcomes, like better operational efficiency, more focused communication, less travel time and more flexibility. Our main conclusion regarding performance is that heavy virtual team workers are slightly more efficient, better informed and more productive compared to the light virtual team workers. We assume only weak positive effects on the performance issue.

The same applies for the impact on stress. We did not find a significant relation between virtual teams and stress. We might suggest that virtual teamwork does not enhance the stress risks. Most respondents observe that virtual work does not lead to stress. The workload itself and customers demands are driving them to work hard, not the virtual aspect of work. However, at the same time, the working day frame is expanding because of working across time zones: 'work never stops'. As a result, employees at SOFTCO work longer days. Also, their commitment to the organisation is under pressure. Employees could start to feel isolated and form new associations, for example with client firms.

Having observed both tentatively formulated effects, we would better shift our attention to the second question: under what conditions do virtual teams perform, both in organisational outcomes and employee outcomes. It seems that effective virtual work is dependent on learning and on management skills. But what exactly are the conditions that make for a high road?

### *Conditions for high road virtual teams*

Our data suggest a certain context in which virtual teams are effective and appropriate. We found that virtual work is not productive when one or more of the following circumstances apply:

- team workers are dealing with highly complex issues (because you need rich communication channels to deal with complicated issues efficiently, e.g. brainstorming, innovative sessions);
- team workers work under high time pressure (because you need direct communication to solve technical and other problems instantaneously);
- team workers are faced with frequent relational misunderstandings or conflicts (because you need direct communication to solve underlying conflicts).

The combination of these three factors (complexity, time pressure, conflict) is not suitable for virtual teamwork. The most obvious way to avoid this situation is to combine both virtual and face-to-face communication in virtual work. This is in line with Gassmann & von Zedtwitz (2003) and Furst et al.

(2004), when they recommend face-to-face team building sessions in the 'forming' stage of a virtual team. As we have seen, the high road to working in virtual contexts is by no means ensured by avoiding the three factors mentioned above or by intuitively knowing when to get together. Based on our findings we can identify a number of conditions of virtual work characterised by high performance and low stress risk.

*Learning process.* Effective virtual work starts with understanding how virtual teamwork is different from 'normal' teamwork. We found that high road virtual team workers were more experienced in virtual teams (they were engaged in more virtual projects compared to the other employees). Working in virtual teams is a skill and should be treated accordingly. Team members have to be self-disciplined and competent in communication. Self-discipline is necessary because virtual team workers must decide more on their own how and when to work. This is also important regarding the work-life balance. The virtual employees have to take care on their private life more than before, because of the possibility of working 7 days and 24 hours. In addition to this, employees can actually learn how to effectively communicate within a virtual team. Knowing when and how to communicate with your team members to get the best results and to avoid conflict and misunderstandings is predominantly a learning issue. Furthermore, certain technical skills are required to effectively participate in virtual teams. Knowing the basics is crucial, and knowing the extra's can be very beneficial to effective teamwork in the virtual context.

*Use of communication technology.* Technology is an important facilitator of virtual teamwork, but it can also be an important impediment. The use of advanced communication and collaboration tools can be very helpful to virtual teams in many ways, but only if these tools are widely and easily available and effectively supported (Andriessen, 2003). Our survey data showed that high road virtual team members are better in using communication technology compared to others.

*Commitment.* Employees in virtual teams work for the company, but are usually not at the office a lot. Our research has shown this can lead to limited social contact with colleagues and limited identification with the company. To avoid employees from having alternative loyalties or leave the company altogether, it is important to establish or improve the 'sense of belonging' among virtual team members. Whether this is done by organising social events, stimulating the use of chat-applications, coaching or other activities largely depends on the specific dynamics and requirements of the team. Our survey results indicate that it is possible to avoid feelings of isolation: the high road virtual team members significantly showed less feelings of isolation. Also Kirkman et al (2004) are pointing to the issue of developing trust within teams by responding to other virtual team members and consequently building commitment and avoiding feelings of isolation.

*Management skills.* Our data showed that the high road virtual teams were most satisfied about decision-making process in their teams and about the support of their team leader. We may elaborate on this: virtual teamwork needs a shift in management style. Both employees and managers stated that managers of virtual



workers should monitor and control virtual team workers based on tasks, objectives and output. And they did so at our case company. It is no longer possible to control on hours and presence (Cascio & Shurygailo, 2003). Managers in virtual teams and team leaders can manage the output of the virtual team, and it sometimes seems that is all they can do. They usually have only a limited oversight on the whereabouts and current activities of all the members of their team. The management of a virtual team is based on trust and clear work arrangements. A manager who is used to always be on top of things is not likely to last long in a virtual environment, where such conduct just isn't feasible. Furthermore, a virtual team manager or leader has a special responsibility in making sure team members don't overstretch themselves working around the clock. Stress risks and an unhealthy work-life balance are more difficult to monitor in a virtual context, but the dangers of work related stress are all the more realistic. Successful (and popular!) managers in virtual teams will probably be managers who succeed in knowing exactly what's going on with their team members, while at the same time unobtrusively respecting the relative autonomy of the individual team members.

Finally, it should be noted that these conditions are derived from a company where work is predominantly project-driven and virtual teams consisting of highly educated employees operate in a knowledge intensive environment. Currently, virtual teamwork is also getting increasing popular in other sectors, such as certain industrial sectors, marketing, retail and certain government agencies. Even though we think companies that are experimenting with virtual teams in these sectors could learn from the evidence presented in this paper, it is uncertain to what extent the conditions for virtual work listed above also apply to these different contexts. Therefore, further research should be done to test our research framework and conclusions. We suggest this research includes a cross-sectional survey in relevant sectors.

## References

- Andriessen, J.H.E. (2003). *Working with Groupware. Understanding and Evaluating Collaboration Technology*, Berlin: Springer.
- Baecker, R.M. (1993), *Readings in groupware and computer-supported cooperative work assisting human collaboration*, San Francisco: Morgan Kaufmann Publishers.
- Benders, J. & Van Hootegeem, G. (1999). 'Teams and their context; moving the team discussion beyond dichotomies', *Journal of Management Studies*, Vol.36, No.5, 609-628.
- Beyerlein, M.M., Johnson, D.A. & Beyerlein, S.T. (eds) (2001). *Virtual Teams. Advances in interdisciplinary studies of work teams*. Vol.8. Amsterdam etc.: JAI Press.
- Byrne, J.A., Brandt, R. & Port, O. (1993). 'The virtual corporation', *Business Week*, February 8, 36-40.
- Cooper, C.L. & Rousseau, D.M. (eds) (1999). *Trends in Organizational Behavior. Volume 6 The Virtual Organization*.
- Cascio, W.F. (2000). 'Managing a virtual workplace'. *The Academy of Management Executive*, Vol.14 No.3, 81-90.
- Cascio, W.F. & Shurygailo, S. (2003). 'E-Leadership and Virtual Teams', *Organizational Dynamics*, Vol.31 No.4, 362-376.
- Davidow, W.H. & Malone, M.S. (1992), *The Virtual Corporation*, New York: Edward Burlingame Books/Harper Business.
- Elron, E. & Vigoda, E (2003). 'Influence an Political Processes in Virtual Teams', in Gibson, C.B. & Cohen, S.G. (eds). *Virtual teams that work; Creating conditions for virtual team effectiveness*, San Francisco: Jossey Bass.
- Furst, S.A., Reeves, M., Rosen, B. & Blackburn, R.S. (2004). "Managing the life cycle of virtual teams", *The Academy of Management Executive*, Vol.18 No.2, 6-20.
- Gassmann, O. & Von Zedtwitz, M. (2003). "Trends and determinants of managing virtual R&D teams", *R&D Management*, Vol.33 No.3, 243-262.
- Gibson, C.B. & Cohen, S.G. (eds) (2003). *Virtual teams that work; Creating conditions for virtual team effectiveness*, San Francisco: Jossey Bass.
- Hoefling, T. (2001). *Working Virtually; Managing People for Successful Virtual Teams and Organizations*. Sterling, Virginia: Stylus Publishing.
- Hoegl, M & H.G. Gemuenden (2001), "Teamwork Quality and the Success of Innovative Projects: A Theoretical Concept and Empirical Evidence", *Organization Science*, Vol.12, No.4, 435-449.
- Homans, G.C. (1974), *Social Behavior : Its Elementary Forms*, Harcourt, Brace, Jovanovich, New York.
- Horvath, L. & Tobin, T.J. (2001). "Twenty-First Century Teamwork: Defining Competencies for Virtual Teams", in Beyerlein, M.M., Johnson, D.A. & Beyerlein, S.T. (eds) (2001). *Virtual Teams. Advances in interdisciplinary studies of work teams*. Vol.8. Amsterdam etc.: JAI Press.
- Jarvenpaa, S. & Leidner, D. (1999). 'Communication and trust in global virtual teams', *Organization Science*, Vol.10 No.6, 791-815.

- Karasek, R.A. & Theorell, T. (1990). *Healthy work: Stress, productivity, and the reconstruction of working life*. New York: Basic Books.
- Kelly, J.R., & Barsade, S.G. (2001). 'Mood and Emotions in Small Groups and Work Teams'. *Organizational Behavior and Human Decision Processes*, Vol.86, No. 1 September, 99-130.
- Kirkman, B.L., Rosen, B., Gibson, C.B., Tesluk, P.E. & McPherson, S.O. (2002). 'Five challenges to virtual team success: Lessons from Sabre, Inc.' *The Academy of Management Executive*, Vol.16 No.3, 67-79.
- Lipnack, J. & Stamps, J. (1997). *Virtual Teams: Reaching Across Space, Time, and Organizations with Technology*. New York: John Wiley & Sons.
- Ministerie van Sociale Zaken en Werkgelegenheid (2001). *Sociaal digitaal: een verkenning van gevolgen en mogelijkheden van ICT voor werk, inkomen en sociale zekerheid*. Den Haag: Ministerie van SZW.
- Mohrman, S.A. (1999). 'The contexts for geographically dispersed teams and networks', in Cooper, C.L. & Rousseau, D.M. (eds) (1999). *Trends in Organizational Behavior. Volume 6 The Virtual Organization*.
- Shapiro, D.L., Furst, S.A., Spreitzer, G.M. & Von Glinow, M.A. (2002). 'Transnational teams in the electronic age: are team identity and high performance at risk?'. *Journal of Organizational Behavior*, Vol.23, 455-467.
- Sundstrom, E., De Meuse, K.P. and Futrell, D. (1990). 'Work Teams. Applications and Effectiveness'. *American Psychologist*, Vol. 45, No.2, 120-133.
- Townsend, A.M., DeMarie, S.M. & Hendrickson, A.R. (1998). 'Virtual teams: Technology and the workplace of the future', *Academy of Management Executive*, Vol.12, No.3, 17-29.
- Yin, R.K. (1984). *Case Study Research: Design and Methods*. London: Sage.

## Appendix A Construction of the typology

The typology is based on two dimensions: 'stress' and 'productivity'.

1. The first dimension refers to stress; we used the items:

- 'On a typical day, how often have you felt depressed about your job?'
- 'On a typical day, how often have you felt stressed by your job?'

These Likert-items are measured on a 5-point scale (1 always; 2 often; 3 regularly; 4 sometimes; 5 never).

The association between both items is  $r=,57$  ( $p<,001$ ). The stress-scale (with these two items) has a mean of 2.14. For the use of the typology we made use of a split at median level: above 2.5 we defined a virtual worker as having 'stress'.

2. The second dimension refers to productivity. This dimension exists of two more or less independent constructs ( $r= -,10$ ).

a. The first construct refers to inefficiencies; we used the items:

- 'I sometimes get the feeling I have to do things all over again';
- 'Compared to other teams and units in this organization, the productivity of our team or unit is high'

We measured this construct by two Likertitems ( $r=,43$ ;  $p<,001$ ) on the following 5-point scale (1. strongly disagree; 2. disagree; 3. don't agree, don't disagree; 4. agree; 5. strongly agree).

b. The second construct has only one item that directly asks about productivity of virtual work:

- 'Virtual work leads to more productivity'.

We defined a virtual worker as productive, if on the first construct the outcome of the respondent is below 3, and on the second construct the outcome is above 3 ('3' means: 'don't agree, don't disagree').

The combination of both the stress dimension and the productivity dimension leads toward the typology with four types of virtual teams.