Learning virtual project work

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Abstract. There are a variety of challenges in organizing productive virtual collaboration projects. Problems of commitment and co-ordination are all common. Organized use of collaboration technologies with appropriate organization and management of activities can help avoid these obstacles. We have developed and tested a model that is intended to support learning of project management and virtual teamwork. It can be applied for introducing collaboration models and practices to global firms, or as we have done, to collaboration between university seminars. The model includes a multi-layered organization structure according to which virtual or semi-virtual teams are built. Facilitation of the exercise is supported with students operating in two layers: coordination and reflection layers. The model has evolved and we report experiences from tests with two seminars during 2003. The first seminar was arranged between courses at three universities, and two universities was participating the second one. We describe the basic constructs of the model, our experiences and preliminary results of studies.

1 Introduction

Virtual and especially semi-virtual communication, collaboration, and learning have become an essential part of organizational life. Unpredictable and dramatic factors such as September 11th and the recent sars epidemic have boosted the need for distant collaboration. Global organizations, subcontractor networks, distributed teams, and many other areas of production and services meet the challenge.

While it is customary to discuss virtualness mainly as an entity of its own [6, 8, 15, 16], the de facto challenge of present organizations is how to best manage the mix of their virtual and other activities. Virtual collaboration can become expensive in terms of human resources and time needed for communication and coordination. The adoption of new tools may introduce unpredicted organizational friction due to insufficient understanding of roles and networked performance. A strong organizational culture can even prevent novel interaction through the network [18], and the lack of shared contextual experiences between members can cause inefficient communication and motivation [13].

We can distinguish between two learning strategies in utilizing information and communication technology (ICT). In the open, self-organizing, approach individuals and organizational units are supported in their activities by offering access to databases, links, services and applications through numerous channels [12]. In doing

so organizations and individuals are trusted to be capable of using new tools and materials for their benefit. The focus is in finding and developing optimal tools and environments. The open strategy is not uncommon to most business organizations, perhaps because of the richness of technologies and business processes that exist.

In the closed or integrated approach, certain application environments or working models are provided to support projects (e.g. http://www.knowledgeforum.com). Typically, a software framework, application, or model of individual or organizational work is applied to provide the structure and function for the work. The selected collaboration model and groupware are often used to support work processes.

In practice, there is a need to apply a mixed strategy. Reasons for this include fast changing technology, a risk of incompatibility in adopting new tools, and an ongoing change that concerns both information technology and organizational structure and processes. Whatever the particular situation is, organizations must rely on virtual or semi-virtual processes that are built according to an explicit or implicit model of collaboration. Such models are not abundant and, hence, people in organizations must continuously learn new ways of virtual collaboration and project work.

In this paper we present a model for learning project management and virtual teamwork. We believe that a mixed strategy with a planned co-ordination and reflection is beneficial especially in cases where the members of the virtual or distributed team do not share a common organizational history or apply a predefined process model. This is typical e.g. for new distributed teams, collaboration networks consisting of variable organizational cultures, and for new members of organizations.

The model is called Virtual Project Model (VPM) and it aims to constitute a structure for a "learning by doing" exercise. VPM contains layers of co-ordination and reflection. Tasks are partly emergent and self-organized as in open model. The exercise reported in this paper was arranged twice as a part of higher education courses: the first exercise between three Finnish Universities (Spring 2003) and the second one (Fall 2003) between two Universities involved also in the earlier exercise. The coordination layer details differed between exercises. Based on our experiences we believe participants can become committed if they are guaranteed a well-defined structure of collaboration and a certain amount of power and responsibility.

The paper is organized as follows. Section 2 describes the basic concepts of the VPM. We use coordination theories to discuss how co-ordination is arranged. Section 3 goes through two seminars in which the VPM has been applied and tested. We also discuss our experiences and show preliminary results of studies done during the exercises. Section 4 presents concluding remarks and future work.

2 Virtual Project Model

Originally, the development of Virtual Project Model (VPM) had the goal to support reflection of distributed collaboration experiences. When consulting distributed projects at Nokia [10], we built an approach to increase management's knowledge of various individual, team, and community related aspects. We concluded that teaching these aspects and practices require an organized interplay between individuals sharing a common task. In order to develop and test VPM we arranged a joint exercise between University seminars. It is based on the following principles:

1. Learning by doing,
2. Individual commitment,
3. A model of collaboration, and
4. Technology independence.

Firstly, the purpose of VPM exercise has been to give students possibility to learn and enhance their skills in the areas of project management and teamwork, especially in a distributed environment. It is necessary to give students means to conceptualize and experiment [11, 14]. Before starting the exercise we provided relevant practices and tips [4, 6], process models [7] and frameworks [8, 10].

Secondly, project groups and also university seminars that do not share organizational or other contextual motivation for collaboration may suffer from the lack of commitment and isolation of member activities. In order to achieve a better motivational basis for collaboration the exercise takes place as interplay between teams, participants have a responsibility to act and interact, and a sufficient feedback is guaranteed. A time window is reserved for teams to build their team identities, e.g. imaginary company, logos, and virtual places (see [7]).

Thirdly, VPM is based on a model of collaboration: it embodies structures enabling communication, co-ordination and reflective feedback. Goals are given on a coarse level but details are left emergent. Communication and co-ordination processes are discussed in Sections 2.1 and 2.2, and reflection processes in Section 2.3.

Finally, the exercise is carried out with the help of various ICT tools including phone, e-mail, videoconferences, discussion areas, and shared repositories. Technology is not the main focus on the exercise. Instead, people choose among the tools they have. Our goal is to make VPM work for virtual teams. However, teams in our exercises are semi-virtual, that is, only some participant worked virtually.

2.1 Teams and responsibilities in VPM

We applied a multi-layered structure in which various parties are dependent on each other. The parties are: Facilitators (Lecturers and Assistants), Co-ordination team (Students), Sub-contracting teams (Students), and Research team (Students). Figure 1 shows the responsibilities and dependencies of each team.

Cross et al. [2] presented two important viewpoints in their discussion of myths in networks. Firstly, when a network grows large no single actor knows what takes place in the network. Secondly, when one key actor is becoming a bottleneck her tasks need to be delegated. Several emergent situations that require quick reaction may occur. Because of that we have arranged communication between facilitators and virtual teams through the co-ordination team that is more aware of the whole process and situation.
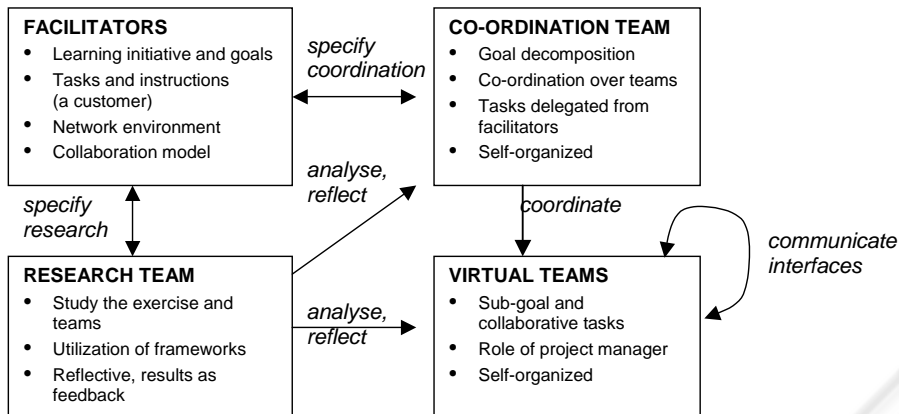
Fig. 1. Teams and responsibilities in VPM

Each virtual team has its own goal, e.g., a sub-goal of the main goal given to co-ordination team. The VPM collaboration between virtual teams can be planned in advance (e.g., joint tasks) or during the process by co-ordination team. It may also occur emergently as a need arises.

Facilitators and the research team have a close relationship and aim at making sense of work processes and team behavior in the exercise and to develop means for data analysis. Research team studies what takes place in the exercise and how people experience the work. It analyses each team and gives the results as feedback to them.
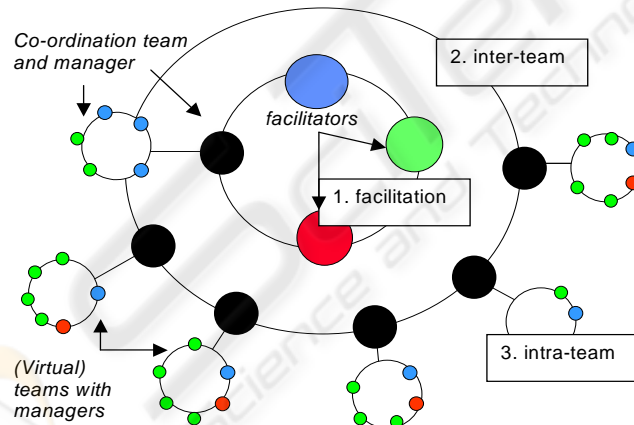

Fig. 2. Communication paths in VPM

Figure 2 shows the main communication layers and participants in each layer. Communication in the first layer, that is facilitation, takes place between facilitators and the manager of the co-ordination team. The second layer tackles inter-team communication and takes between co-ordination team (nominated members) and virtual projects (managers). The third layer is inter-team communication that takes place among team members. All communication can be made transparent using a team discussion forum.

We claim that without such a structure the roles of each party remain unclear and can even harm the progress of the exercise. We believe that leaving the appropriate co-ordination and decision-making responsibility for each layer has a facilitatory effect on the team commitment.

2.2   Co-ordination processes and mechanisms

We use the co-ordination theory by Malone and Crowston [9] and the concept of "co-ordination mechanism" by Schmidt and Simone [17] to discuss how co-ordination in VPM is planned.

Malone and Crowston define co-ordination as "management of dependencies between activities". This includes an assumption that if there is no interdependence there is nothing to co-ordinate. It is clear that actors performing interdependent activities may have conflicting interests. The goal in VPM has been to delegate tasks and responsibilities to students. The dependencies of VPM can be pre-defined by facilitators, left as a responsibility of the co-ordination team, or to take place emergently between teams. Teams themselves decide practices for their intra-team level collaboration, which often leads to an agreement by discussion (see e.g. [19]).

Malone and Crowston [9] identified four following dependencies:

Task/subtask relationships. When a set of activities are all subtasks for achieving an overall goal they need to be integrated either through top-down goal decomposition or through bottom-up goal identification. In VPM each team has its own predefined goal. Facilitators and co-ordination team discuss the goal decomposition. The main responsibility of task accomplishment is given to the co-ordination team. The clarification of sub-goals requires also negotiation and agreement between co-ordination team and virtual teams. At any milestone, co-ordination team reviews the deliverables of each virtual team and checks dependencies (e.g. conflicts in interfaces).

Relationships between producers and consumers. This dependency occurs when one activity produces something that is used by another activity. It requires the sequencing and transfer of products, and ensuring their accessibility from the perspective of the receiving activities. This dependency is an essential part of VPM. The learning stresses negotiation skills for arriving at an agreement between teams. The number of interfaces between teams determines the degree of difficulty.

Simultaneity constraints. Activities need to occur at the same time. This type of dependency requires synchronizing of activities. In VPM the synchronization of activities is arranged using a set of milestones. The synchronization need is due to producer-customer dependencies discussed above.

Management of shared resources. Whenever multiple activities share a limited resource (e.g. person, deliverable, or tools) a resource allocation process is needed to manage the interdependencies among these activities. VPM focuses on a fluent communication instead of creating bottleneck roles (communication layers). Most tools and data are available for all (all the time) videoconferencing time as an exception.

A certain coordination mechanism can be embedded in dependencies between teams or as a part of team co-working. Schmidt and Simone [17] define co-ordination mechanism as a construct of a coordinative protocol (an integrated set of procedures

and conventions such as a review, a contract negotiation or a follow-up) and a related coordination artifact in which the protocol is objectified (minutes of a meeting, a contract and a status report as examples). Coordination mechanism reduces the complexity of the dependency and the space of possibilities. Because students learn to use their own conceptualizations, VPM protocols embody weak stipulations [see 15].

2.3 Reflection processes

A special emphasis on reflection processes is included into VPM. A research team has been formed in order to augment the traditional feedback given by facilitators and self-reflection of students. A central part of the research is the utilization of 4Q framework which provides a holistic view to study distributed work [10]. Bartlett and Ghoshal [1], for example, have recently noted the importance of human and intellectual capital and people as key strategic resource of building competitive advance. This has also been our focus of interest and it has been studied from four viewpoints:

Personal work focuses on issues around personal tasks of an individual in a distributed environment. This area covers the following issues: competencies, mental frameworks, motivation, stress, personal ambitions, individuality, working style, beliefs, and values. **Work with people** focuses on general social interactions that, firstly, take place between persons not having a close or formal relationship, and, secondly, are often affected by organizational culture, traditions, values, and experiences. For example, various communities belong to this category. Personal goals, needs and earlier experiences are often driving forces for collaboration. **Project/teamwork** focuses on how people are involved with production as a member of projects and teams. Here, project goals are controlled and schedules are often tight. In this area personal values and capabilities are considered against project rules, processes, schedules, managerial styles and the values of closest teammates. The fourth viewpoint focuses on the **work with data and information**. It addresses capabilities of a person to use and utilize data and information [5][1] including qualities, means, and tools.

3 Applying the virtual project model in two seminars

This section presents two seminars applying VPM model. We describe the arrangements and main differences of the seminars, show the evolution of the co-ordination layer, and present our experiences and results of analyses.

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[1] We prefer to use data and information instead of knowledge. Any of the four areas may be present in knowledge creation processes.

3.1 "Coaching model" (Spring 2003)

Virtual Project Model was first applied as a joint exercise between three different seminars and units: Organizational Psychology (University of Helsinki), IS Project Management (Helsinki School of Economics), and Knowledge Management (Tampere Technical University). Altogether there were 49 students participating the exercise with largest representation from economics. The participants had extensively variable backgrounds ranging from second year students to those having a several year experience in work life.

We had a leading facilitator from each university (with assistant facilitators), a coaching team (7 persons), eight virtual teams and one local "reference" team (4-6 persons per team), and a research team (3 persons). Facilitators delegated the following responsibilities to the coaching team: collecting a project management literature database, providing coaching services and consultancy for teams, and steering the progress and preventing problematic situations of teams.

All virtual teams and local teams were given the same goal of designing *a competence information system* (CIS) that will be implemented in a fictional organization. The process was divided into three sequential tasks:

1. Team identification and project planning (2 weeks)
2. Definition of system requirements and use scenarios (4 weeks)
3. System design and deployment planning (5 weeks)

The following tools were used: learning environment called Optima [3] as a shared repository and a bulletin board, IP based videoconferencing tools in milestones, and e-mail and phone for team communication.

A special topic of interest was the virtual start up of teams. We started each period by giving instructions virtually through the Optima. The first task included a virtual kick-off and team building. We composed teams, nominated the first project managers and published the information via Optima. Teams were encouraged to use available tools for their collaboration instead of meeting face-to-face. The first two milestones were arranged as a multi-point videoconference, status checks and internal reviews of deliverables (project plan, requirements specification) as tasks. In the last session all teams presented their final report of CIS design.

3.2 "Subcontracting model" Fall 2003

The second exercise was arranged together with two seminars from the previous case "Organizational Psychology" and "IS Project Management". Altogether there were 36 students, 70 % of them from economics. The following teams were set up: a co-ordination team (8 persons), five subcontractor teams (4-6 persons in each) and a research team (5 persons). Next we consider changes and their motivation to the earlier exercise covering team responsibilities and goal decomposition, kick-off, and tools used.

The main goal for the exercise was still to design a CIS. But now the coaching dependency was replaced by co-ordination dependency. The responsibilities of the co-ordination team were as follows: to be an intermediary between facilitators and sub-contractors (as in Figure 1), to guide sub-contractors work, and to follow-up teams' progress. Co-ordination team created the imaginary organization and stated

requirements for CIS. They reviewed project plans of subcontractors, signed contracts with them, steered the progress and accepted design reports. All subcontractors had a sub-goal to design a part of the CIS (system architecture, database design, user interface, and two system modules). The responsibility of use scenarios (a part of task 2 in earlier case) was given to the subcontractor designing general UI.

The kick-off was now organized differently. First, all students had the possibility to select which team to join. Facilitators held a meeting with the co-ordination team in which the responsibilities were discussed. After the meeting the exercise proceed mainly as interplay between coordinators and subcontractors. Only minor questions were asked from facilitators.

Optima was used as a shared repository, a discussion forum and a messaging tool as in previous case. Now also Optima discussion lists were taken into use for inter-team communication, for the negotiation and the acceptance processes. In addition, teams used e-mail and phone for inter-team communication. Videoconferencing sessions were not arranged.

3.3 Discussion of co-ordination and reflection processes

In the first exercise ("coaching model") the main focus was to study and learn virtual work and virtual start-up. We expected a need for coaching services but started with a simple arrangement without dependencies between teams, all teams designing CIS. In this exercise the role of the coaching team remained unclear due to minimal demand for coaching. We believe two reasons affected to the lack of this demand. Firstly, joined tasks were not planned to occur between teams. Secondly, the process was divided into three tasks, and teams expected feedback and instructions to continue from facilitators. Teams reported that without planned milestones their interest was in their own responsibility and not in to design the whole CIS.

Table 1. Coordination in exercises: coordination dependencies, mechanisms (M) and artifacts (A)

Dependency	"Coaching model"	"Subcontracting model"
Task-subtask relationships	Intra-team coordination (M) Project plan (A)	Goal decomposition by co-ordination team (M), Statement of work (A) Intra-team coordination (M), Project plan (A)
Producer-consumer relationships	Project phases (M) Project plan (A) The team is both a producer and consumer.	Requirements and design made by different teams (M), Contract and project plan (A) Dependency management between co-ordination and subcontracting teams (M)
Simultaneity constraints	Milestone presentations at intra-team level (A) No simultaneity constraints between teams.	Flexibility in schedules by co-ordination team (M), Progress report to coordination team (A)
Shared resources	"Coaching" aid (M)	Interfaces between teams (M) Requirements documentation and FAQ (A) Discussion list per dependency (A)

The coaching dependency was not totally unrealized. Coaching team used their role in two cases. Firstly, one of the teams did not start during the virtual kick-off and this required the re-allocation of students. As a result two projects joined together. Another case was a team conflict. Team members of diverse background had different opinions of quality of deliverables. Based on the experiences we concluded to have more emphasis on co-ordination in the "subcontracting" exercise. Table 1 summarizes how co-ordination is arranged in two exercises.

The research team used the 4Q framework for creating a questionnaire of 50 questions that monitored collaboration. We used 5 point Likert -scales, where the anchors for the scales are: 1 = very low and 5 = very high. For the "coaching model", the study was done three times (4th week, 7th week, 10th week). The subjects were instructed to use their earlier responses as a reference in order to guarantee within-subject reliability. All 49 participants responded to the first survey, 47 to the second, and 42 to the last one. Research team made an analysis for all teams and presented the main findings of each teams. For the "subcontracting exercise" the test was accomplished only at the end of the exercise (last week, 24 responses out of 33) and a special feedback session was arranged.

We first summarize some findings of the coaching model with 8 virtual teams and two local teams (including co-ordination team). After the virtual kick-off we encouraged teams to proceed virtually but meeting face-to-face was not totally forbidden. As we noted the virtual start-up was problematic for some teams. Another disturbing factor was team members belonging to the same class and seeing each other e.g. during courses. Thus, in addition to making a comparison between "virtual" and local teams we compared persons working virtually with those working in a mixed mode.

The overall profile of work in the exercises can be characterized by the following data. 60% of time on average was spent working alone with assigned tasks. Participants in local teams reported lower share for working alone. Presumably, they could contribute to the tasks also during their meetings. It also seems that the amount of face-to-face meetings was not essential for successful collaboration due to slight differences between "virtual" and local teams. Semi-virtual teams met once in three weeks and local ones once in two weeks. Probably the crucial factor was that teams met or there was a possibility to meet when necessary.

One quarter of participants worked virtually, the rest met once per week or rarely as discussed above. Virtual ones felt that they got less information from project and other teams, and also were less satisfied with received feedback when compared against others. However, they felt easier to share their work with others' and also to use others' work. Furthermore, they felt better able to fit project goals and schedule to their own ones.
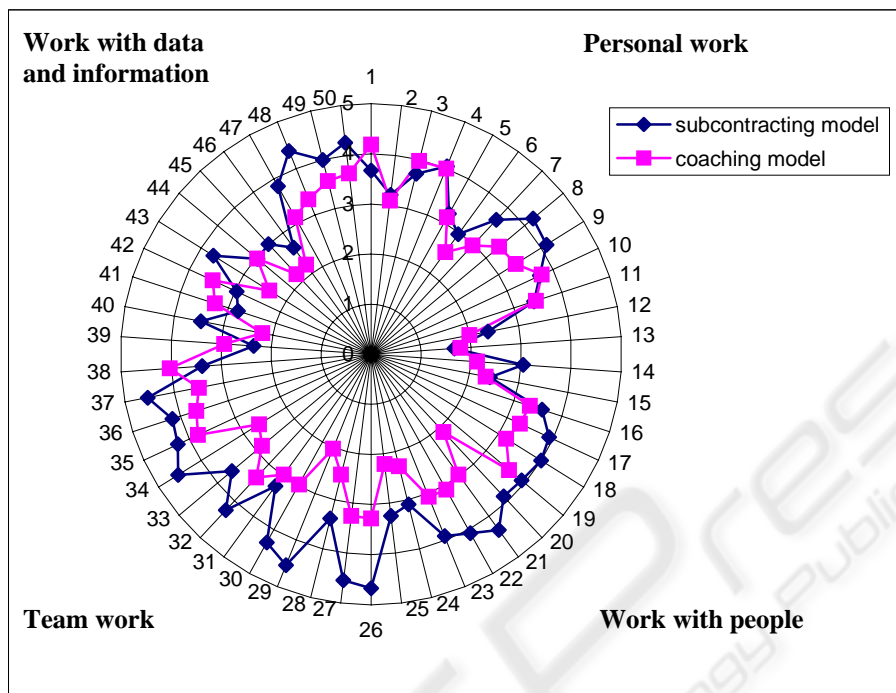
Fig.3. Questionnaire results visualized as 4Q radar: means of two exercises.

The analysis of the subcontracting exercise is still ongoing and no final conclusions of differences between two exercises have been done. However, as we expected from the subcontracting model, the students were committed to the subcontracting course (they gave the average score of 4.04 on a 5 point Likert scale in the 4Q test on this issue). They also experienced the new arrangements (Section 3.2) as helpful. When comparing means of respondents (Figure 3) we may assume to affect teamwork by changing co-ordination. Differences in the area of "work with people" can be interpreted as increased inter-team coordination in subcontracting exercise.

4   Conclusions

In organizing virtual collaboration and learning initiatives, there is no ready-made knowledge of all factors (organizational, team-related, or individual ones) that come to play in different contexts. We argue that this knowledge is partly tacit and we consider useful to incorporate one type of research and/or monitoring function to gather relevant knowledge and experiences from virtual work. This is especially important in the early phases of projects. Often when projects are terminated the obtained experiences are soon lost and there is a fast disruption of any shared knowledge concerning the issues. The Virtual Project Model demonstrates a way to

study and to understand these problems. Our experiences from two seminars are quite positive and the research data and other feedback that we received was very constructive for developing the model further.

This study does not give answers to the questions of the best way to build co-ordination or reflection. Based on our experiences we can say that if the pedagogical aspects are not planned or are a free aspect of the tasks they will not be realized. We see the layers of co-ordination and reflection as a way to support these pedagogical aspects. The whole exercise is built on the action towards the goal and on interaction. Thus, the role of an individual student needs to be well defined and clear enough in the network of teams and layers.

As a next step in VPM we do statistical analyses of the data collected from two seminars, study the capabilities of students to work in each exercise and analyze differences between seminars. As we have developed a more coherent co-ordination layer after the first attempt, our own goals are to improve learning practices for the seminar. Secondly, based on the experiences we are ready for testing the exercise as a multi-cultural and organizational exercise.

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102

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